Czech University of Life Sciences Prague

Faculty of Economics and Management

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DIPLOMA THESIS

Labor as a Factor of Production –A Case Study of the Czech Republic

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Labor as a Factor of Production – A Case Study of the Czech Republic

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Objectives of thesis

The aim of the diploma thesis is to analyze the factors connected with labor as a factor of production and their impact on economy , specifically economy of the Czech Republic. The first objective is to conduct an analysis, in order to evaluate the situation and trends, connected to the aspects of labor, specifically, human capital, in the Czech Republic. The second objective is to determined the direction and size of the impact, which quantity of human capital, expressed through education, has on the economic growth in the Czech Republic.

Methodology

The theoretical part is focused on literature review. Firstly, all the necessary information is gathered. Secondly, thorough selection and discussion of gathered theoretical and descriptive material is conducted and a detailed comparison of theories, in terms of their applicability is carried out. In the practical part, econometric linear regression model is used to carried out the analysis of relationships among selected variables related to the topic.

The proposed extent of the thesis

60 – 80 pages

Keywords

labor, human capital, economic growth, employment, wages, education, demographic changes, Czech Republic

Recommended information sources

BARON, Angela. and ARMSTRONG, Michael. Human capital management: achieving added value through people. Philadelphia: Kogan Page, 2008. ISBN 9780749453848

CAROLEO, F. E. and DESTEFANIS, Sergio. The European labour market: regional dimensions. New York, NY: Physica-Verlag Heidelberg, 2006. ISBN 3790816795

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Statutory Declaration

I, the undersigned, hereby declare that the thesis "Labor as a Factor of Production – A Case Study of the Czech Republic" is a result of my personal work and only sources I used are listed in the references.

In Prague, March 28, 2017

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Alžběta Kolorosová

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Labor as a Factor of Production – A Case Study of the Czech Republic

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Práce jako Výrobní Faktor – Případová Studie České Republiky

Summary

The goal of this diploma thesis is to analyze aspects connected to subset of labor, precisely human capital, such as educational and demographic changes, as well as, to analyze the impact of human capital on economic growth. The thesis is divided into two parts. Firstly, in the theoretical part, all relevant and necessary terms connected to labor and human capital, such as supply and demand, wages, or unemployment, are explained and clarified. Secondly, in the analytical part, descriptive analysis of aspects of education and health, influenced by demographic changes, as main components of human capital, is conducted using quantitative and qualitative research, based on necessary data mining. Thirdly, also in the analytical part, econometric analysis is conducted to determine and quantify the impact of human capital on economic growth in the Czech Republic. For example, the analysis shows, that in the period from 1995 until 2008, the number of university students increased by 136% and the public investments per student increased by 37%, which implies positive influence on the quantity and quality of human capital.

Souhrn

Cílem této diplomové práce je analyzovat aspekty spojené s podskupinou práce, konkrétně s lidských kapitálem, jako například změny ve vzdělání či demografické změny. Cílem je také analyzovat vliv lidského kapitálu na ekonomický růst. Práce je rozdělena do dvou částí. V první, teoretické části, jsou vysvětleny a popsány všechny podstatné a nezbytné termíny, spjaté s prací a lidským kapitálem, jako je například nabídka, poptávka, mzda či nezaměstnanost. V druhé, analytické části, je provedena deskriptivní analýza aspektů vzdělání a zdraví, které je ovlivněné demografickými změnami, za použití kvantitativního a kvalitativního výzkumu na základě nezbytné metody data mining. Dále, také v analytické části, je použita ekonometrická analýza, s cílem určit a kvantifikovat vliv lidského kapitálu na ekonomický růst v České republice. Analýza například ukazuje, že mezi lety 1995 až 2008, se počet vysokoškolských studentů zvýšil o 136% a veřejné investice na jednoho studenta se zvýšily o 37%, z čehož vyplívá pozitivní vliv na množství a kvalitu lidského kapitálu.

Key words: labor, human capital, economic growth, employment, wages, education, demographic changes, Czech Republic

Klíčová slova: práce, lidský kapitál, ekonomický růst, zaměstnanost, mzdy, vzdělání, demografické změny, Česká republika

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List of Abbreviations

CZK	Czech Koruna
etc.	et cetera, and so on
EU	European Union
EUR	Euro
GDP	Gross Domestic Product
IEA	The International Association for the Evaluation of Education
ISCED	International Standard Classification for Education
LRM	Linear Regression Model
MFC	Marginal Fixed Costs
MIL	Million
MP	Marginal Product
MR	Marginal Revenue
MRP	Marginal Revenue Product
NIQUES	National System of Inspectional Assessment of Educational System
NUTS	Nomenclature of Units for Territorial Statistics
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squares
PISA	Programme for International Student Assessment
PPP	Purchasing Power Parity
TIMSS	Trends in International Mathematics and Science Study
TFP	Total Factor Productivity
THSD	Thousand
UNESCO	United Nations Educational, Scientific and Cultural Organization
USD	United States dollar

1. Introduction

It is inevitable, that the term labor and the labor sphere play a key role in everyday lives of most people. Providing labor for corresponding reward, is an activity, by which people spend most of their lives. Because labor directly contributes to the development of economy, it is important to closely examine all its attributes and directly related terms, such as wages, employment, productivity or supply and demand of the factor of production.

In the last century, world economy has undergone massive changes. Globalization and gradual transition from industrialized society into knowledge-based, has given rise to the importance of the term human capital. With technological progress and rise of automatization of production, the necessity of corresponding skills and knowledge has become crucial. Human capital has become principal component of labor, as a factor of production.

Human capital, being the major part of labor, is generally described as a factor of production. In more detail, human capital is closely linked to terms like education, training and development or competitiveness. And it is human capital, which in today's world, is one of the main drivers behind economic success of any economy. Therefore, a crucial way for a country, to be successful, is to analyze the importance and all aspects of human capital in their economy. It is necessary to identify and monitor forces linked to human capital in order to estimate their exact impact on economy.

When it comes to measuring of influence of human capital on economic growth, this sphere had been for quite a long time often ignored, most probably because of the disputes over its quantification. Even though such circumstance occurred, it does not mean, that such measurements and studies should be neglected.

2. Thesis Objectives and Methodology

2.1. Objectives

The first goal of the thesis is to analyze aspects, which influence a subset of labor, precisely human capital, in the Czech Republic. The aim is to evaluate aspects of education and health, influenced by demographic changes, as the two main components determining the state of human capital in the country. The second goal is to analyze the impact of human capital on economic growth in the Czech Republic. The aim is also to analyze the size and direction of the relationship between the two variables.

2.2. Methodology

Initially, in the theoretical part, all relevant data are collected and subsequently explained to clarify all necessary terms connected to the selected topic. Discussion of gathered theoretical and descriptive material is conducted. Detailed comparison of theories in terms of their applicability and connecting of own research with broader theoretical background and assumptions based on literature takes place. Methods of synthesis, abstraction and induction are used in the Literature review.

First section of the analytical part, which consists of descriptive analysis, numerical data are collected and subsequently evaluated by comparative methods, in order to explain particular phenomena. In the second section of the analytical part, econometric analysis is conducted, using one-equation linear regression model based on time-series data. Data used in the analytical part are collected mostly from the Czech Statistical Office, but also from Ministry of Labor and Social Affairs. The quantitative data for descriptive analysis ranges as far as from 1950 until 2015. The quantitative data used in econometric analysis is from 1993 until 2015. For visualization of the results, graphs and figures are created and explained. Any extraordinary and noteworthy outcome is pointed out. For evaluation and analysis of the data Microsoft Excel and software for econometric analysis Gretl are used.

3. Literature Review

3.1. Labor

3.1.1. Definition of Labor

Labor in general is the physical, mental or a combination of the two works or efforts, which is undertaken to receive income. Bear in mind that the word income plays a crucial role here. If a person puts work into something, but does not get any income in exchange, it is not considered labor, from the economics point of view, of course. Basically, any effort that is not undertaken for obtaining income, or simply done for pleasure or from a good will, cannot be categorized as labor. A perfect example is a person, who is a teacher by profession. He or she gets an income from doing his or her job, thus considered as labor. But imagine a situation, where he or she has to teach his or her own child. Even though there is definitely effort put into this, there is no source of income for doing so, therefore it cannot be counted as labor (Freeman and Gottschalk, 2000).

Ancient definition by Alfred Marshall (1890) describes labor as “any exertion of mind or body undergone partly or wholly with a view to some good, other than the pleasure derived directly from the work“.

According to Holman (2016) labor is “a purposeful human activity which ensures production and transforms inputs into outputs”. It is important to mention that not every person is able to or willing to produce the labor activity. Some are unable due to illness or other limitations. While others simply do not employ it, because they do not have the necessary need to obtain income from the activity.

Another perception of the term labor is by Vlček (2016), who perceives labor as “goal-directed economic activity of a person”. People provide labor with a very clearly set aim and that is to obtain resources to satisfy their unlimited want and needs (Vlček, 2016).

3.1.2. Specific Features of Labor

First, and the most important attribute of labor is the fact, that unlike the other three factors or production, land, capital and entrepreneurship, labor is human. And it is particularly for this reason, that labor is abundant with peculiarities, typical only for this factor of production. According to Mussida and Pastore (2015), the features can be divided based on the following characteristics.

Immobility of Labor

Although immobility might be a little excessive term, because labor in not completely immobile as compared to another factor of production – land. On the other hand, it cannot be moved as easily as capital for example. It is not possible to move labor from one place to another just like that, because as it was already stated, labor is human, and a laborer might not be willing to leave the native or familiar place (Mussida and Pastore, 2015).

Perishability of Labor

Labor is much more perishable than other commodities. When a work is lost, it is lost for good. It is not possible to store labor for later, therefore when a laborer is not working for one day, the labor that he or she could have produced, cannot be compensated for or retrieved later (Mussida and Pastore, 2015).

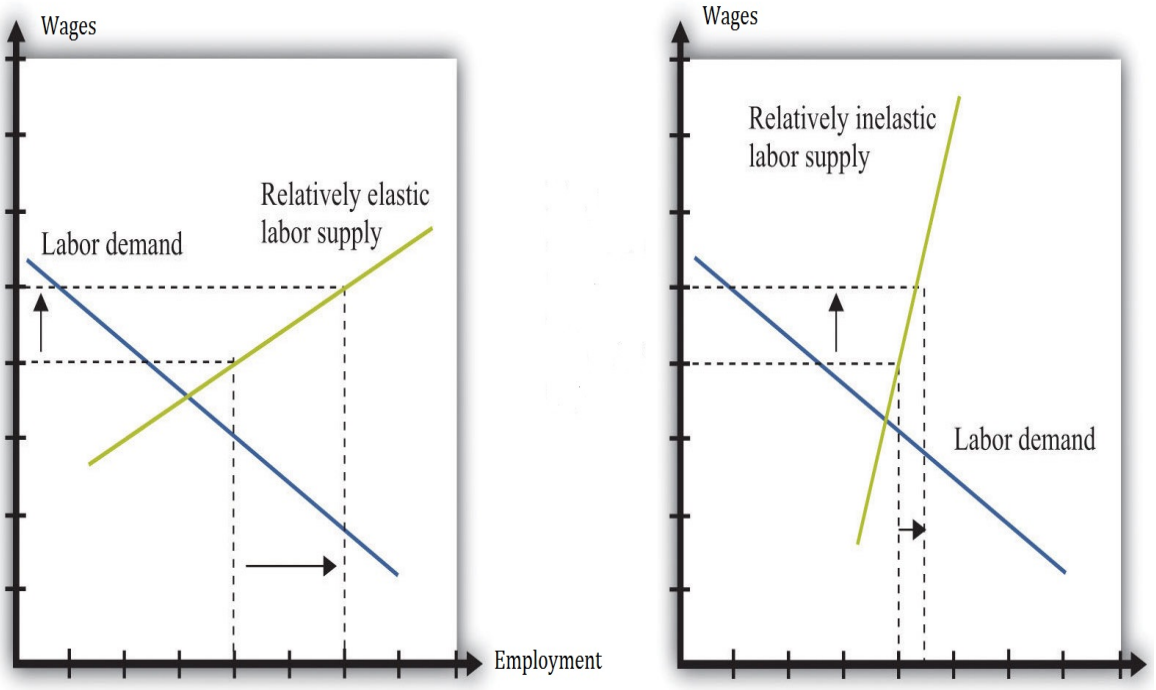
Supply Elasticity of Labor

To be more precise, inelasticity of labor and in a short run horizon only. Supply of labor can be described as greatly inelastic, at a point in time and the reason is very simple. If a country is facing scarcity of labor, it is impossible to be solved immediately. Supply of labor is independent of the demand and cannot be adjusted momentarily. Labor cannot just be made, whenever it is order, like goods. It takes a long time to obtain new supply of labor, because labor is formed by population and population cannot be increased or decreased rapidly. The issue of short term labor supply can of course be partially solved by

importing labor from other countries, but that also has its limits (Mussida and Pastore, 2015).

On a more specific note, it is possible to distinguish elasticity and inelasticity of labor supply, also according to different criteria and that is the requirement of skills in the labor market. In this case elasticity describes the extent to which labor supply reacts to changes in wage level (Briggs, 2012).

Figure 1: Elasticity of Labor Supply



Source: Briggs, 2012

The Figure 1 above depicts the elasticity of labor supply. It shows that in a job, which requires lower amount of skill (on the left side), the labor supply is elastic, because labor is available at generally constant wage rate. On the other hand, high skilled jobs tend to have more inelastic labor supply, because they required more specialization and training, as shown in the graph on the right side. The labor supply curve is of course upward sloping. From the figure above, it is also possible to see, that as wages rise, other workers enter the market, attractive by the level of incentives (Briggs, 2012).

Labor Is Not a Machine

Human beings is what makes up labor. People are not designed to work nonstop for days, weeks, years, like machines. After certain time, they need to take a break and 'recharge'. A laborer has specific needs, likings and feelings that need to be satisfied, to work efficiently (Mussida and Pastore, 2015).

Active Factor of Production

Labor is labeled as an active factor of production, because it can create the production process. Land and capital are passive factors of production, because without labor these factors are incapable of starting the production process on their own (Mussida and Pastore, 2015).

Labor Inseparability

It is not possible to separate labor from a laborer. It is necessary to clarify that in this context, labor means the performed work and laborer is the person, who performs it. In other words, the person needs to be present at delivery of the work. As an example, it can be used a doctor, who needs to perform a surgery on a patient. The doctor needs to be present in the hospital to do so. He or she cannot do this task from home (Mussida and Pastore, 2015).

Efficiency of Labor

Every laborer can bring different level of labor, therefore is compensated for the labor on different levels as well. Efficiency of labor can be improved through education, training and development (Mussida and Pastore, 2015).

3.1.3. Labor Productivity

By the term labor productivity, it is understood the amount of production produced by one worker in one unit of time, so how much production is produced with certain level of employed labor. In this case labor is measured by either the time period, which is needed to produced that amount, or a number of workers employed in the production process. Increase in productivity can be described as decrease of labor, which is needed to produce one unit of production or in other words, increase in the amount of production, while the labor used for the production remains constant. Labor productivity can be granted to the following factors (Urban, 2011).

Quality of Labor Force

The quality is defined by knowledge, education, qualification, which are key to the production process. Different levels in quality of labor force bring about different levels of productivity (Urban, 2011).

Quantity and Quality of Capital Equipment

In this case, it is crucial to keep up with the technological innovation to prevent decreasing marginal production, as improvement of quality of capital is the fastest way to increase labor productivity (Urban, 2011).

Overall Economic Conditions

It is important to analyze in what phase of economic cycle the company is. In economic decline, companies reduce volume of production and try to lower the costs (Urban, 2011).

Quality of Resources

Productivity of a firm is also highly dependent on the quality and availability of natural resources in a particular country (Urban, 2011).

Quality of Institutional and Legal Framework

It is important that these frameworks are well identified and lawfully followed. For the development, things like protection of private ownership and investments are crucial (Urban, 2011).

Labor Specialization and Division

One of the oldest and most efficient ways to reach higher labor productivity is specialization and division of labor (Urban, 2011).

3.1.4. Labor Specialization and Labor Division

Today's standards of living are much higher, compared to the previous century and it is safe to say that its due to economies of scale, made possible by mass production, which was enabled by specialization. As Samuelson and Nordhaus (2008) state "specialization occurs when people focus their effort on a specific, typically narrow set of tasks; which then makes it possible for each person and each area to make use of all specific differences in skills and resources, as efficiently as possible". Adam Smith perfectly described increase in productivity due to labor division on an example of pin production. He stated that one worker could, in the best-case scenario, make a dozen of imperfect pins. However, if a small group of workers would be divided according to small separate tasks, each of them does small repeated actions, which makes it possible to produce thousands of perfect pins a day. Of course, specialization brings about the risk of excessive specialization, which can slow down the productivity. Extreme specialization means that a person does one thing and one thing only. This can lead to deceleration of personality development and decreasing satisfaction from ones' work. Therefore, nowadays many organizations employ more flexibility and work rotation to keep their workers actively participated in the production process. This however is not the only negative side that specialization might give rise to. It is inevitable, that if one person is responsible for only one task in the production process, he or she is never able to produce the good from the start to the end. This creates mutual dependency of workers. This means that even though each worker is technically only responsible for the part of their task, all in all, they are all responsible for

the whole production altogether, because there will not be one without the other (Samuelson and Nordhaus, 2008).

3.2. Labor Market

Labor is defined as targeted economic activity of a person, according to the economic theory. It is essential to assume that the labor activity is the only source of income for a person or persons. In labor market, the supply of labor is represented, opposite to classical goods market, by people (or households), and the demanders constitute of companies (or firms) (Urban, 2011).

There are certain particularities connected to the labor market. Labor market is asymmetric. That's is due to the fact, that entities on the supply side are endowed with less choice flexibility, than the entities on the demand side; in this case firms. This is caused by the nature of the exchanged commodity, which is labor. People provide labor to satisfy their unlimited wants and needs and when doing so, they are influenced by the substitution and income effects. Second specificity of labor market is closely linked to the theory of human capital. Motivation of people to provide labor is not only the vision of income, but it also has a social dimension. Certain level of work activity gives people the option to further developed their potential and bring them satisfaction from doing so. It also provides them with a social status. From Vlček (2016) point of view "all these aspects of working activity of a person are densely expressed by the term human capital" (Vlček, 2016).

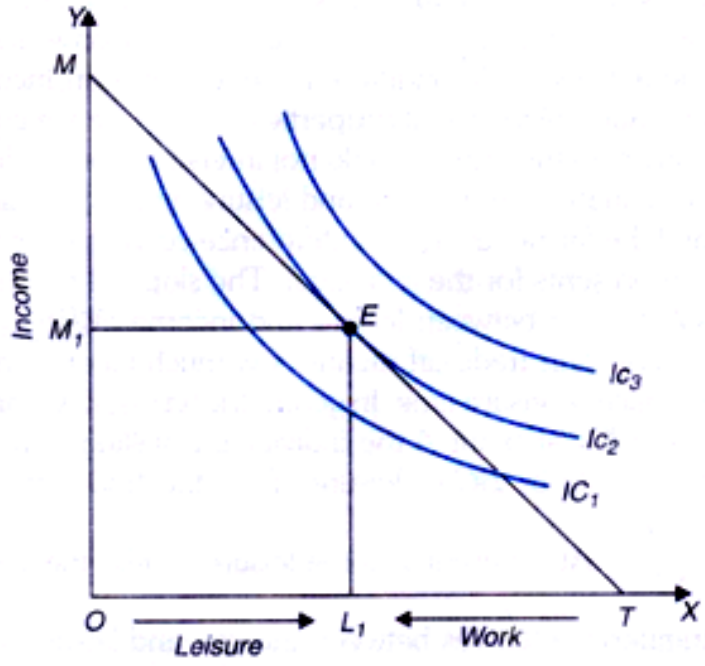
3.2.1. Supply of Labor

As it was already stated before, labor market is characterized by its asymmetry, mainly because of the nature of the exchanged factor of production – labor, which has a completely different attribute than any other commodity. The difference is, that the entrance of a certain good to the market is regulated by its marketability, but in case of labor, it is determined differently (Keen 2011).

The determining factors of labor supply are to a certain level independent of the carriers of the labor force. These are factors such as socio-economic situation or demographic

development. This causes that supply of labor on the labor market is relatively stable and widely inelastic, unlike supply of other commodities. The reason for this abnormality is clearly defined by the motive of a person, or a carrier of labor force into the market, which is completely different than the reason why any other goods enter any other markets. People perform labor to gain resources to satisfy their needs. As those needs are urgent and unpostponable and in market system can only be accommodated by gaining the resources, it is inevitable for a person to enter the labor market and create the wage relationship. The amount of work that a person decides to supply on the labor market is influenced by his or her decision on dividing his or her disposable time. Persons' disposable time consists or two segments, work (work hours) and relaxation (free time). Given that the reward for working is defined by wages, which are then used to purchase goods and gain utility, it is vital for a person to decide how much of the reward one requires, to satisfy the needs. The decision between the amount of two options, which can be described as 'wage' and 'free time' is the standard problem of utility maximization defined by options of work activity and inactivity (Vlček, 2016).

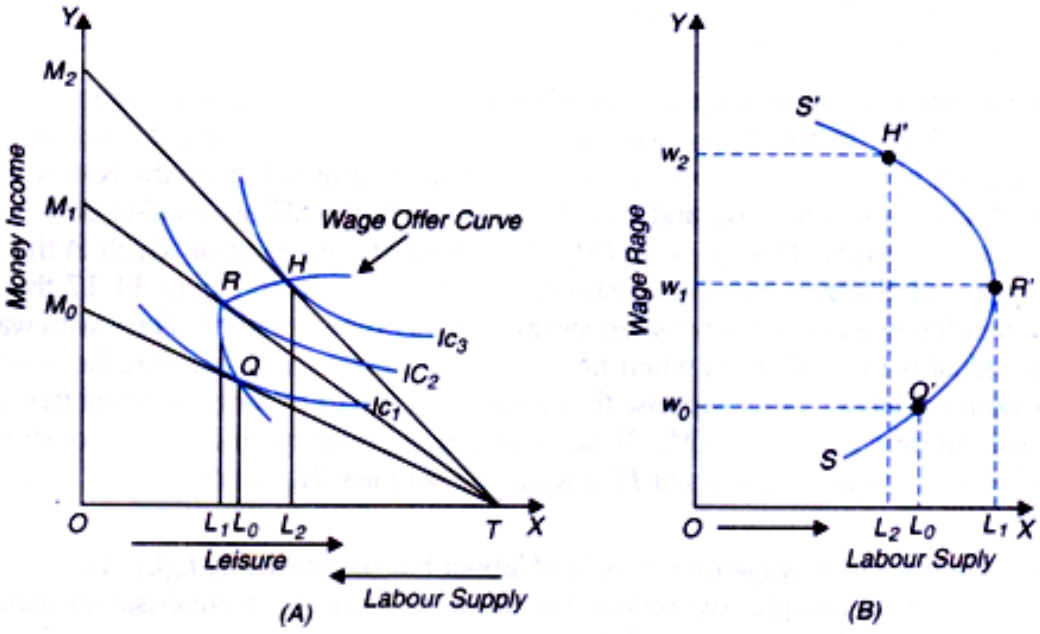
Figure 2: Wage and Free Time Equilibrium Optimization



Source: Singh, 2005

The decision making, where people compare the utility of goods consumption, which is possible only by gaining wages and utility gained from free time, is described by indifference analysis in Figure 2. Equilibrium of decision between wage and free time is illustrated in the figure above. A laborer can in this case decide between two goods, free time and income (wage). Both goods bring the laborer utility and the preferences are shown by the indifference curves IC 1-3. The indifference curves show all different possible combinations of free time and wage, which bring the laborer the same level of utility. The equilibrium occurs, in a point, where the indifference curve is tangent to the wage curve, which means that the utility of the laborer is maximized, because the last unit of free time brings the laborer same marginal utility as the last unit of work (Singh, 2005).

Figure 3: Income and Substitution Effects of Changes in Wage Levels



Source: Singh, 2005

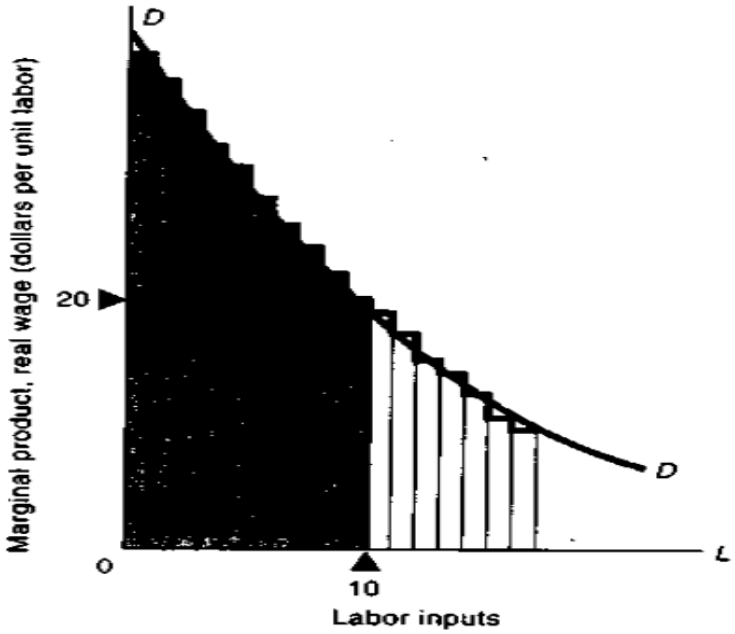
From the previous example and differences based on changes in wage level, it is possible the derive the labor supply curve. The left graph in Figure 3 above shows the labor, that a laborer is willing to offer. On level of wage M_0, the laborer is willing to offer combination Q, with level of L_0 of free time and labor time. In contrast, for level of M_1, the laborer would choose combination R, which equals less free time and more labor time L_1. The

graph on the right side shows the relationship between wage level and labor hours, that the laborer is willing to supply. It is obvious that the curve is backward-bending. The reason for this abnormality is, that with higher wage level, the laborer can purchase more goods and service to satisfy the needs, but the laborer can obtain higher wage only at the expense of free time. This is often labeled as substitution effect of changes in wage level. However, another effect plays a crucial role in the determination. Because wage is also the income of the laborer, increase in wages increases his or her real income and enables him or her to purchase more goods and services. However, for the utilization of these goods and services, the laborer must have free time. Therefore, the laborer tends to exchange the labor time for more free time. This is called the income effect of changes in wage level. The income effect causes higher demand for free time, thus lowers labor supply. Because both effects take place at the same time and are contradicting each other, the overall impact always depends on the intensity and prevalence of each, which is what determines the individual shape of labor supply. Generally, it is possible to say that from a certain wage level, the prevailing effect is substitution, because a laborer wants more free time. The laborer tends to supply more labor, at lower wage levels, as he or she need more income to purchase the goods or services, which is why the prevailing effect is substitution (Singh, 2005).

3.2.2. Demand for Labor

Determination of labor demand can be expressed like any demand for any other factor of production, by marginal revenue product. MRP_L, marginal value of product, is the market value of one additional unit of production/output. It can be expressed as product of multiplication of marginal product of labor and a price for which the product is sold ($MPR_L = MP_L \times P$). This occurs of course in perfect competition. In imperfect competition, the MRP_L is defined by the product of marginal product of labor and marginal revenue ($MRP_L = MP_L \times MR$) (Keen, 2011).

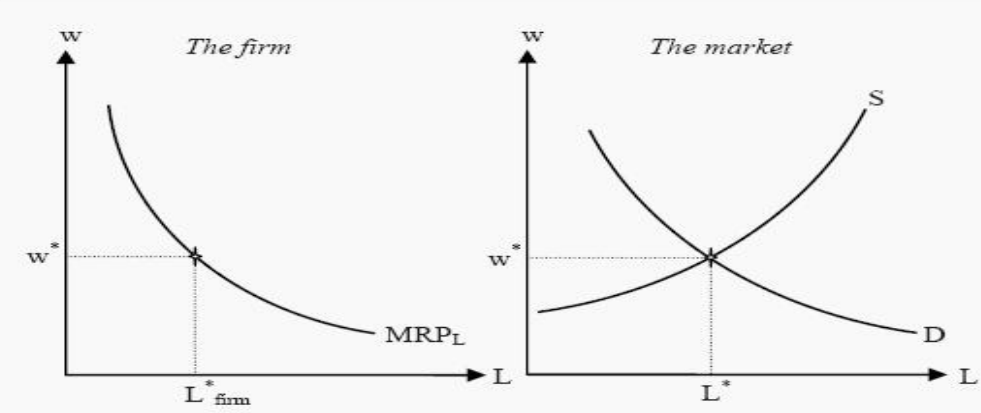
Figure 4: Marginal Revenue Product and Demand Curve



Source: Samuelson and Nordhaus, 2008

Figure 4 illustrates that a firm will demand additional units of labor, when MRP_L is higher than or up until the point when marginal revenue product of labor equals to the costs of labor. The colored stripes describe marginal products of each additional unit of labor. The figure also shows that a wage rate set in the market is 20 (USD for example), when the units of used labor are equal to 10, at this point, the wage rate also equals to the marginal product of the last additional unit – the tenth unit (Samuelson and Nordhaus, 2008).

Figure 5: Demand for Labor and Market Equilibrium



Source: Heckeman, 2007

Based on the description of Figure 4, it is possible to derived that it is the reason why, and as also depicted in Figure 5, the demand curve equals the MRP_L curve. The point, where the MRP_L intersects the labor supply, is the labor market equilibrium (Heckeman, 2007).

Other Determinants of Labor Demand

Demand for labor is not only influenced by the marginal revenue product of labor, but also other important factors. Among these influences, it is possible to distinguish how much of each factor of production a firm uses, how much of advanced capital a firm has at its disposal or the quality of the technology, which is used in the production process. The less advanced technology the firm uses, the higher the demand for labor should be. On the other hand, if it uses highly advanced technology, the demand for labor is more likely to be minimized. However, the small amount of labor that is demanded must have the potential of high level of specialization or qualification (Hamermesh, 1993).

Vlček (2016) brings up an interesting note on the labor demand matter by explaining that "because demand for labor is derived from demand, meaning that it is dependent on demand for the outcomes of the labor (goods, services), the price of the factor of production will also be influenced by the price of those goods and services, and not the other way around".

3.3. Wages

Wage is the price of labor. It is a certain amount of income, that a laborer/employee receives from the employer, adequate to the level of labor he or she supplied. The wage level is determined in the labor market and depends on the present situation of supply and demand for labor. Wages can be assessed on two levels – macroeconomic and microeconomic. In the case on macroeconomic scope, it is worth mentioning the wage policy of each country, which establishes a set of basic rules for creating and distributing compensations. These rules concern subjects such as minimal wage rate or regulation of the influence of wages on inflation. The general aim of the policy is to deal with wages in relation to the overall economic situation and development in the country. When it comes to the sector of companies and non-company entities, the rules are less general. Wage are

usually established based on a complex of wage sets. These set clearly define rules and conditions, which the laborer must fulfill to obtain the desired and agreed level of compensation (Flatau, 2002).

3.3.1. Nominal and Real Wages

Generally, wages are distinguished as nominal and real wages. Nominal wage is the amount that the laborer gets for provided labor. It is the amount that is specified in his or hers contract, beforehand. Real wage is a little more specific and meaningful expression of nominal wage. Real wage expresses the purchase power of nominal wage, meaning the amount of goods and services the laborer can actually purchase, with the given nominal wage. The real wage is influence by the level of nominal wage and the price level of those goods and services, but also by the level of tax burden in an individual country. That is why, in the process of comparison of level of wages among countries, it is necessary to use so called index of real wages. The real wage formula is defined by OECD (2002) as "nominal wages index corrected for changes in purchasing power measured by the consumer price index (100*nominal wage index/consumer price index)". Another important term, which is needed to clarify, is gross wage. Gross wage is the amount, before deduction of the tax burden, social and health insurance and other liabilities differencing in each country. After subtracting these obligations, we get a level of wage, which is labeled as net wage (OECD, 2002).

3.3.2. Other Forms of Wages

The form of wages differs from the type of wages in one specific aspect. The form of wages has as its most important goal to motivate the laborer to superior performance and results, based on which the level of wage is distributed. According to the level of contribution to the overall performance of the entity, the laborer is awarded the high-performance wage (OECD, 2002).

The way and scope, which makes up the aggregate compensation of the laborer, in relation to his or her performance, behavior and overall efficiency, is called the wage form and can be divided into two categories (Vlček, 2016).

Basic Wage Form

This category can be further subcategorized into two forms – time and task. Time wage form is historically speaking the oldest category, from which the task form later developed. Time wage is usually used in professions, which require real deal of experience or thoroughness or profession where a person simply does not have influence over the work pace, thus doing it faster would not increase efficiency what so ever. In time wage form, as the name suggests, workers are paid for time worked. With this said, there comes an obvious deficiency of motivation, because there is basically no way for the laborer to earn more money, by for example working faster or more efficiently. In the second basic wage form – time wage form, the laborer is compensated according to the completion of a given task, for example specific number of manufactured products. This type of form has a very high motivational potential, as the person can earn more wage with increasing productivity, however it can also have a negative impact on the laborer. Increasing the number of finished tasks can put the laborer in a great deal of time pressure and stress, as it is the only way the laborer can earn more money (Vlček, 2016).

Complement Wage Form

This category is labeled as dependent, because the laborer always gets basic and specified compensation, and thus is well-off, even if he or she does not get the complement wage. This form includes incentives such as bonuses, commissions, share on profit or premiums. This way can provide the worker with high motivation not only for a superior performance in their own day to day tasks, but also the overall performance of the company, as the reward is sometimes the share of profits from the overall earnings of the company (Vlček, 2016).

3.3.3. Differences in Wages Among Groups of Workers

Gaps and irregularities in terms of wages occur anywhere in the world. It is a fact that people doing different types of work get also rewarded differently. Manual worker, who puts together compartments on the assembly line, gets compensated very differently than for example a lawyer or a doctor. However, the wage inequality is not only a problem of

different sectors, but also countries. A doctor in one country gets compensated to a lesser extent than his colleague from a different country. In general, it is possible to say that wage differences occur everywhere among different individuals, sectors, regions and countries (Samuelson and Nordhaus, 2008).

These wage level differences among individuals and sectors can be linked to several factors, more precisely according to Vlček (2016) they are attributed to the following five factors.

Compensating Wage Differential

However technical or complicated this term might sound, it is concerned with nothing else than money. The attractiveness of individual jobs of course differs. This means, that if a certain job is unattractive compared to other possible jobs, the compensation for that job must be sufficient or adequate, otherwise it tends to be uninteresting. The level of the compensation is decided in the labor market, as people themselves decide how high the level must be, for them to be willing to take the job, thus supply the labor (Reed and Hubard, 1992).

Qualitative Differences among Individuals

Even though, most qualities are, more or less, inborn qualities, such as physical or mental abilities, some are possible to modify and improve through education, training and development. This is where the term human capital comes in the picture again. Investment into human capital, understood as a complex of useful knowledge and skills, brings about the biggest difference in quality of labor, as it positively influences productivity. In direct relation to wages, part of high level of wages can be linked to benefits of higher education (Garen, 1988).

Special Natural Talent

This factor explains how differently are compensated people, who are born endowed with some quality or talent, which the society regards as exceptional and appreciates it. It can be all kinds of categories or individuals such as famous singers or athletes (Garen, 1988).

Segmentation of the Labor Market

First it is necessary to define the labor market as a market made up from smaller partial markets, which are represented by non-competing workers. There are different work compensations in each of these partial markets, which are derived from the current situation in the sector or profession. The differences among individual profession have always existed and will continue to exist. The segmentation of the market can be divided into two categories; profession and regional segmentation and is caused by two major reasons. First is profession immobility. This means that there does not exist profession replaceability. A doctor cannot do the work of a lawyer and vice versa. There is however the possibility of one way substitution. This means that a ditch digger cannot do the work of a doctor, but a doctor can replace a ditch digger. This phenomenon is called 'asymmetric replaceabilty'. However, in the case of profession, in long term horizon, people can undergo a requalification or change professions, which is why the labor market is referred to as segmented in the short term. Second reason for market segmentation is regional immobility. This occurs when people, for whom the demand for their qualification decreases, are unwilling to move or relocate to a place, where the demand is still relatively high. There can be multiple reason for such unwillingness, such as family and friends in the current place of work, or cost connected with relocation (Reich et all, 1973).

Discrimination at the Labor Market

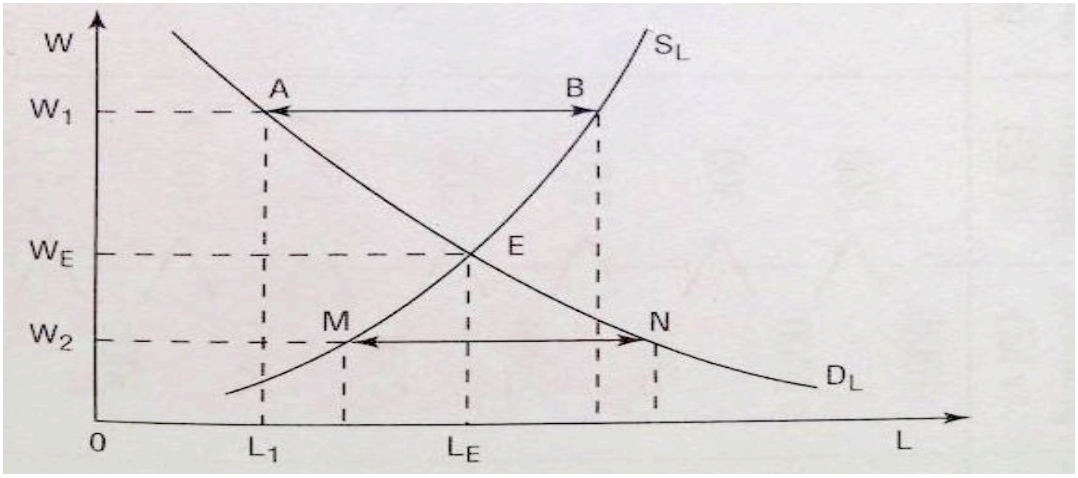
Discrimination at the labor market can be further subcategorized according to gender, age, race or religious beliefs *etc*. These issues can be solved through various legal norms and laws, however still occur in majority of countries. In many countries, women still get compensated far less than men. Some studies have also shown, that while men's wages generally increase with age, women in their thirties get paid on average the same amount as women much older than them (Pager et al, 2000).

3.3.4. Wages in Perfect Competition

Wages differ throughout different sectors, countries, genders or positions and that is why it is very difficult to establish unified or integrated level of average wages (Reed and Hubard, 1992).

However difficult the determination of average wage might be, it is relatively easy to identify the overall level of wages and it is safe to say that basically all wages in all sectors or professions are on a much higher level than they were a hundred years ago. In conditions of perfect competition, every entity in the market is merely a price taker. It is assumed that the price of labor is determined by supply and demand only and that it is impossible for individual companies to deviate from the equilibrium price. Another assumption is, that the labor, which is being traded in the market is strictly homogenous, excluding the possibility of difference in quality of labor and qualification of labor force. How wage levels differ in perfectly competitive markets is shown in Figure 6 (Samuelson and Nordhaus, 2008).

Figure 6: Wages in Perfectly Competitive Market



Source: Samuelson and Nordhaus , 2008

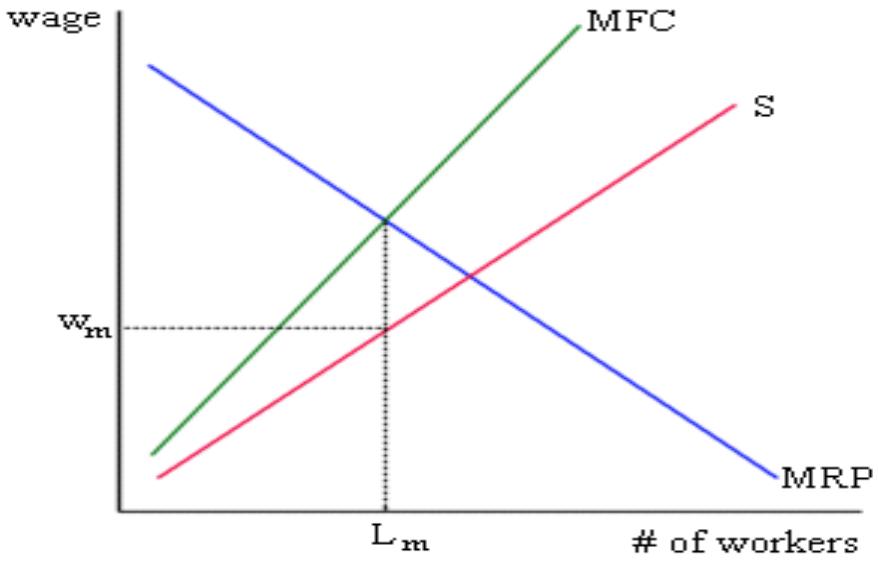
Figure 6 depicts the wage level and changes in perfect competition. It shows the equilibrium for a given level of L_e, there is level of W_e. However, if the wage level increases to W_1, the number of employed labor significantly decreases, while the interest to work increases, which causes labor surplus (from point A to B). On the other hand, if the wage level decrease to W_2, the demand for labor is higher than supply (from point M to N). In perfect competition, the market mechanism works as follows, if supply of labor increases the wage level tends to decrease and vice versa, respecting ceteris paribus. Equilibrium in a perfectly competitive labor market occurs, when real wage rate equals marginal revenue product of labor. In perfectly competitive market, each firm can demand unlimited number of employees without it having impact on the price level. However, if all firms decided to buy more labor, it would unequivocally change the wage level (Samuelson and Nordhaus, 2008).

3.3.5. Wages in Imperfect Competition

From a theoretical point of view it makes sense to analyze changes and conditions in perfectly competitive markets, when it comes to practical sense, analysis in conditions of imperfect competition is much more useful. This is because labor market is never homogenous. Due to segmentation of the labor market, there exist numerous partial labor markets, divided according to regions, sectors and professions. Monopsony can be used as a perfect example for demonstrating wage changes in imperfect competition. As an example, can be used a firm, which represent the only employer in one town. Assumption,

that labor is the only variable factor of production and the firm's sales occur in perfectly competitive market. This scenario brings about the fact that the firm is the only buyer (of labor) in the market and crosses with the labor supply curve, thus is the price maker (of wages) and if it wants to employ more labor, it must make wages more attractive – higher. With every other laborer, the firm wants to employ, it must give higher and higher wage and at the same time, it must increase the wages of the already employed laborers. That is the reason why marginal costs of labor are higher than average costs of labor and as shown in the Figure 7. Therefore, the curve of marginal fixed costs of labor is above the labor supply curve, which equals to the average costs of labor. The optimization criterion is to maximize profit. The firm therefore focuses on comparison of marginal revenue product with marginal costs of labor, which would change with employing one additional unit of labor. The firm will employ more labor only if each additional laborer will produce amount that is higher than the costs that the company must pay with employing that one additional laborer ($MRP_L > MFC_L$) (Cahuc and Zylberberg, 2004).

Figure 7: Monopsony Labor Market



Source: Cahuc and Zylberberg, 2004

Figure 7 illustrates that the firm will employ labor L_m, which is determined by the MRP of labor curve, which equals the demand, and the curve of MFC of labor. The supply curve in the graph assigns the wage level W_m, which would be paid if employing the given level of L_m (Cahuc and Zylberberg, 2004).

3.4. Unemployment

Low unemployment is one of the targets of economic policies, and one of the key indicators of economic performance. If a country has high unemployment, it is not using all its resources efficiently, thus not operating at its highest potential. First it is necessary to specify what is meant by the term unemployment. The labor force of any country is made up by specific group of people, who can provide labor and produce goods and services. The labor force does not include children, retirees or disabled persons. The labor force is made up of employed and unemployed persons. The unemployed part consists of people, who do not have jobs, but are looking for it at the moment. Unemployment can be easily quantified by calculating the unemployment rate, which is the ratio of number unemployed divided by number labor force and multiplied by one hundred. It would be the best to have the rate zero, however due to specific types of unemployment the rate is never zero. There exists so-called natural rate of unemployment, usually set to 4-5% (Lidderdale, 2003).

3.4.1. Population Ageing and Migration

Ageing of population and migration are two terms, which are very closely linked to unemployment. One as a cause and the other one as a possible solution for certain countries. United Nations (2001) defines population ageing as “an inevitable outcome of the demographic transition. Primarily, because of declines in fertility and, secondly, mortality declines. The age structure of a population becomes older, with a growing number and proportion of elderly persons”. The increasing trend in population ageing can give rise to major economic difficulties, as the number of people in productive age, who can work declines, and as well the number of future possible labor force declines, as fertility rate decreases. Studies have shown that with the continuous decrease in fertility rate and no immigration, the population of most European countries could decline by as much as 20% in the near future. The age of immigration is generally lower than the age of the host country, which is why it has the potential to make the country relatively ‘younger’, and thus expand the labor force (United Nations, 2001).

3.5. Theory of Human Capital

3.5.1. Human Capital

Most people, when hearing the term capital, imagine a bank account or ownership of issued stock or bonds. The term is much broader than that, it also represents some other assets, such as firms, businesses, real estate properties or consultancy services. The reason, why these assets fall into the category of capital is, that in long term they yield profits and produce other beneficial outputs. The still increasing technological progress in last decades causes the deepening of work division and specialization. Increasing use of technology during the production process brings about the necessity of work distribution into smaller and simple work tasks. Specialization enables workers to work more efficiently, as it improves their dexterity, and increases productivity, while decreasing the production costs. However important the relationship between productivity of a worker and their set of innate skills and quality of physical capital used during production might be, productivity is also a function of human capital. Possession of human capital and the choice to use it, increases person's ability to perform activities, which in return yield certain level of economic value. The level and quality of human capital at the same time influences the level of that economic value, as investment into human capital increases the productivity of a person. When talking about the term human capital, the name stands for different spectrum of concepts than regular capital. It represents educations, more specifically language course or courses of moral integrity *etc*. Participating in such activities improves people's health and increases income. Expenses spend on such activities can be counted as investments into capital. More specifically investment into human capital, because unlike in case of regular tangible capital, education, new skills or recognition, cannot be separated from a person (Kameníček, 2012).

3.5.2. Investment into Human Capital

In the theory of human capital, it is assumed that people make decisions about improvement and development of their education, experience and other knowledge, based on basic cost and revenue analysis. A rationally thinking person will invest into his or her further expansion of human capital, if the benefits from doing so will exceed the investment costs. Costs of human capital development can represent time, that is spend on

the development. Whereas in the case of revenue, it can contain increase in the wage level or improvement in the quality of job attractiveness or and other non-monetary qualities (Baron and Armstrong, 2012).

A factor, which has the biggest impact on the quality of human capital, is most likely investment into education. In case of education, the investor can be the person him or herself, or it can be a firm investing into their employee and looking for possible profit from doing so. Based on this division, according to Vlček (2012), it is possible to distinguish between two types of human capital.

General Human Capital

The word 'general' is pretty much self-explanatory in this case. Development of human capital promotes productivity and skill attractiveness of a worker for any type of employment in general. Of course, by any type of employment is meant, an occupation in a specific profession in any firm in that sector. As an example, it is possible to use a worker, who is qualified to operate a specific machine. Although, one type of machine, this skillset can be used in any firm, meaning that the worker has the ability and potential to work in many firms, not just one (Hartog, 2009).

Specific Human Capital

Specific human capital falls into the category of a purpose build capital, as it is invested in solely for the reason of improvement and development of qualities and skills, which can be useful only for one specific firm. If it would be compared with previous example of a machinery, in this case, it would be a worker, who can operate a machine, that is rare and characteristic only for one specific firm. If a comparison of differences in a scope of investment into these two types of human capital would be done, it would be possible to see obvious distinction. Development of general human capital, is financed by firms only on rarest of occasions, because it increases the price of that labor force, as it promotes skills, which can be useful also in competing firms. On the other hand, investment into specific human capital, is something that is done by firms on daily basis, mainly because it

increases productivity and possibly brings profit only to that one firm. Au contraire, employees have no desire into investing into this type of human capital themselves, because they are very much aware, that it does not improve a type of human capital, which they would be able to use in different engagement, thus it does not increase their attractiveness to other potential firms. (Hartog, 2009).

3.5.3. Human Capital and Economic Growth

Some economics say, that the relationship between human capital and economic growth is something that cannot be questioned. The consequent influence is inevitable. Very much like investment into single worker's human capital produces individual economic and other types of growth, the investment into human capital impacts economic growth. Not only the accumulation of existing human capital, but also development of new human capital is important, as it represents the source of new innovations and technological improvement, crucial for sustainable economic growth. Human capital, jointly with physical skills/abilities form what is known as labor, one type of factor of production. The direction and size of influence of human capital on economic growth, is something, which differs on national levels (Mincer, 2007).

Scientific progress and technological development have enormous impact on the size of economic growth as they both increase productivity. However, it is necessary to consider another important factor, while analyzing impact on economic growth. The ever-accelerating informational and communicational progress and globalization of economic activities have caused an increase in demand for education, because without education and proper training in the new emerging specific areas, the participation in such activities is nearly impossible (Hartog, 2009).

3.5.4. Education and Training

Education and training are considered as the most influential components of investment into human capital. Some studies in the United States shown that the income of high school and university graduates after second world war has significantly increased. Studies from early 1990's suggests that since 1980's the level of income of university graduates had been increasing so much, that they reached their all-time high in the past 50 years and

at the same time the differences in income between high school graduates and non-graduates had deepened as well. Interesting finding came in the 1980', where the studies discovered, that even though the level of tuition had escalated, the number of people attending universities had increased as well. This perfectly demonstrates the direct proportion between the extent of investment into human capital and development of costs and return from education (Kameníček, 2012).

3.5.5. Human Capital and Family

In searching for understanding of the theory of human capital, it is important not to leave out the inevitable influence of family environment. It is possible to assume, that generally there are initial insignificant difference among the natural talents of children, as they are born with relatively the same amount and are prone to learn the same pace. These initial negligible difference, can however deepen over the years of schooling and it is the proper family environment, which has a significant influence over it. Children, who are led and encouraged to discovering and improving their skill set, habits and proficiencies, do not only perform and learn better than their peers, but also tend to perceive the world as more interesting and remarkable as their further object of observation. Same goes for the market. At the labor market, demanders – firm base their decisions, whether to buy or not on proportion of the qualities and price of the demanded entity – laborer. That is why it is very unlikely that the demander will show interest in a laborer that has poor skills, poor manners, non- existing elementary work habits or can hardly read. All these qualities are labeled as aspects of human capital and influences mainly by the family environment. Parents have without a doubt, the biggest impact on children's habits, beliefs, standards, goals. For example, even on permanence in an employment, as it is deeply embedded in the guidance to carry out and sustain any activity since early child age. The initial persistence and diligence of parents can surpass into adulthood (Kameníček, 2012).

3.5.6. Differences among Ethnic Groups

Variations in investments into human capital, which rise from differences, because of distribution according to ethnicity, are very closely related to the phenomenon of family and human capital. In the Czech Republic, it is possible to generally say, that from a historical point of view, the number of communities of different ethnics is so negligible,

that if this subject wanted to be analyzed in detail, there would probably be insufficient amount of significant data for this matter. For this reason, it is better to use as an example, in a country, which would provide more significant sample, United States. The aim of the study was not to study the phenomenon or to suggest possible consequences *etc.*, but simply to describe the given phenomenon. The results of the study showed immense differences among ethnic groups in the USA, particularly the differences according to size of families and their investments in to children's education. The core finding was, that ethnics, which tend to form smaller families, invest into education and development of their children significantly more money, whereas ethnics with higher number of children per family spend considerably less money per children on their education. Children of Chinese, Japanese or Jewish descents, who usually have smaller families, are provided with better and higher education. On the other hand, children from ethnic groups, which on average usually have bigger families, such as Mexicans, Porto Ricans or African Americans, tend to suffer from insufficient level of education. Generally, children from smaller families, which at the same time receive higher level of investments in to development of their human capital, proceed on the scale of employment and level of income much faster and higher, than children from ethnic groups with bigger families. Needless to say, that it of course does not necessarily apply to all ethnic groups, especially if we take into consideration religion. For example, in case of Mormons, this phenomenon of lower investment into children education in relation to bigger size of the family does not apply at all (Becker, 1994).

4. Analytical Part

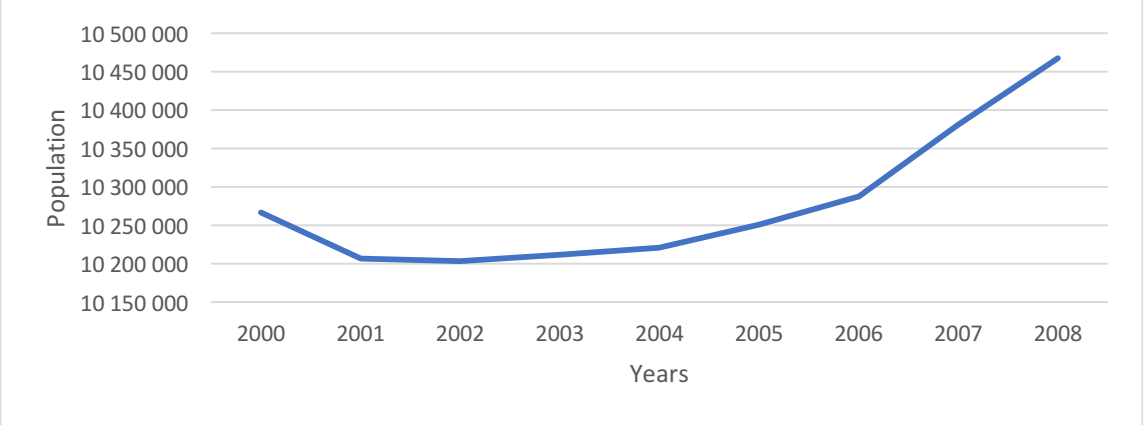
4.1. Analysis of Factors Influencing Human Capital in the Czech Republic

The general consent, that human capital has a particular influence on economic growth and development, is acknowledged by most economics. However, the methods and factors used to quantify the influence of human capital on economic growth differ. There are various definitions of human capital itself, as well as opinions about, which components make up human capital as a whole. In this case, it is important to focus on those components, which can be used as certain types of indicators or ratings of economic progress and growth. Two factors, which are generally credited as the most influential are education and health. Each of these factors can be then further subcategorized into more detailed segments and analyzed thoroughly.

4.1.1. Analysis of Labor Force in the Czech Republic

As it was already previously stated, many times over, human capital is the human part of labor. It is directly united with humans and frankly, inseparable. Without labor, there would be no human capital. This is the reason why, when analyzing changes and pattern linked with human capital, it is also necessary to study the development of labor as a whole and its major component - labor force.

Figure 8: Population Development in the Czech Republic: year 2000 - 2008



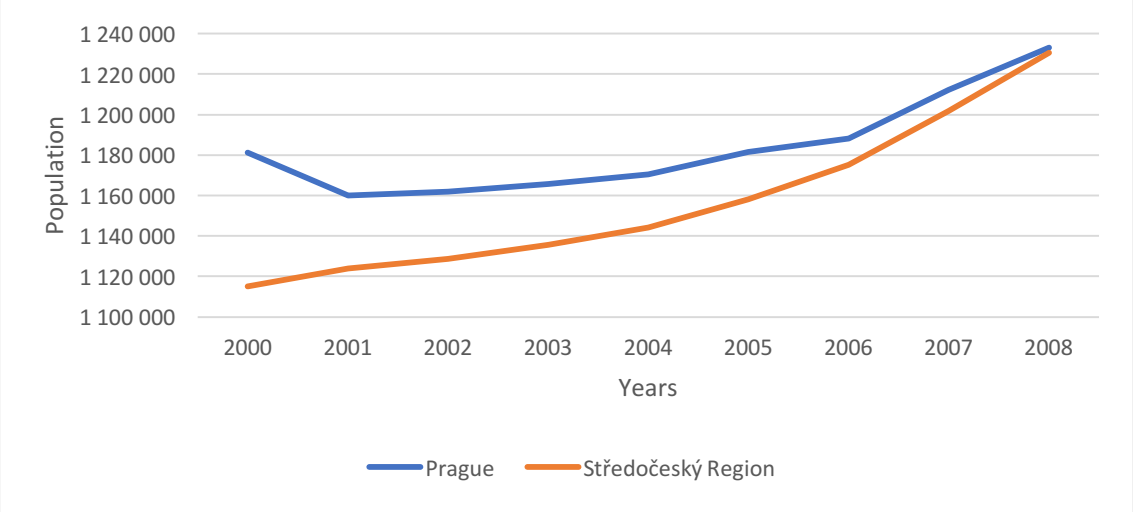
Source: Czech Statistical Office, own processing of data

Figure 8 illustrates how the number of all inhabitants changed in the nine-year period, since the 2000 until 2008. While at the very beginning of the 21st century, it is possible to see a significant drop, the numbers are slowly increasing from year 2002. In the four -year period from 2004 until 2008, the number of inhabitant increased by almost 2.5%. It is necessary to mention that foreigners living in the Czech Republic have been considered in this development since 2001.

Development of Population in Regions Based on Level of Labor Market Attractiveness - Prague and Středočeský Region

The highest standards of living, highest average wages and highest volume of the markets make Prague the most attractive from a labor point of view. Prague is also the region or area with the lowest unemployment rate in the Czech Republic, which benefits from countless number of foreign investment and makes up almost one fourth of the entire country's GDP. Středočeský Region benefits mostly from its unique position, surrounding Prague all the way around and represents major logistics and storehouses hub. It also holds major potential in the form of city of Mladá Boleslav, which's connection to Auto Škoda represents immense potential of foreign investments and market expansion in the automotive industry.

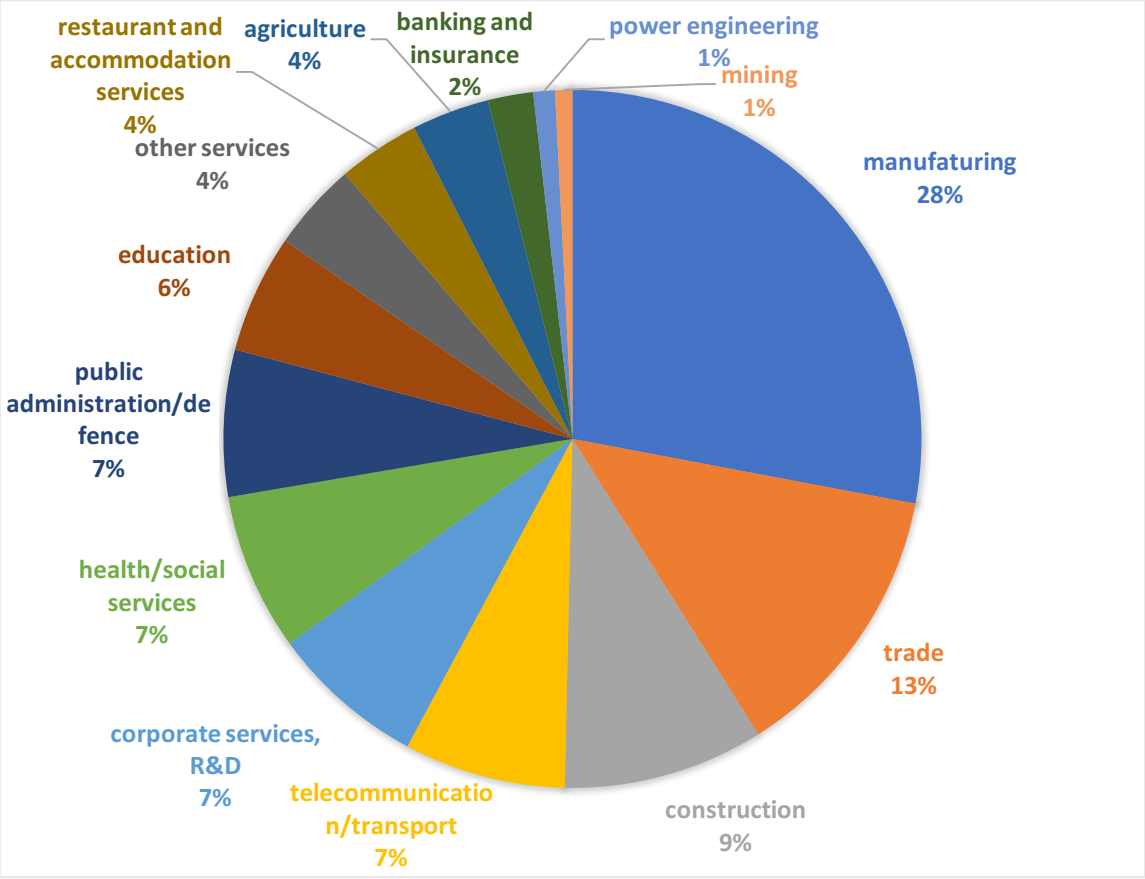
Figure 9: Population Development in Prague and Středočeský Region: year 2000 – 2008



Source: Czech Statistical Office, own processing of data

From Figure 9 it is possible to see, that the development of population in the capital city of Prague had very similar curvature as the whole Czech Republic as seen in Figure 8. Slight drop at the beginning of the century and then constant increase until 2008. Středočeský Region shows a constant increase in the whole nine-year period. Since 2000 the population of the region increased by more than 100 thousand inhabitants, which is more than 10% and reached almost the same number as Prague. Prague registered 4.4% increase in the nine years by 52 085 inhabitants. Relatively lower costs of living and real estate, yet very convenient proximity to the capital labor market can be one of the reasons, why Středočeský Region had noticed significantly higher growth than Prague. The rapid increase in inhabitants in the region can promote investments of foreigners, not only the industry, but also real estate and services.

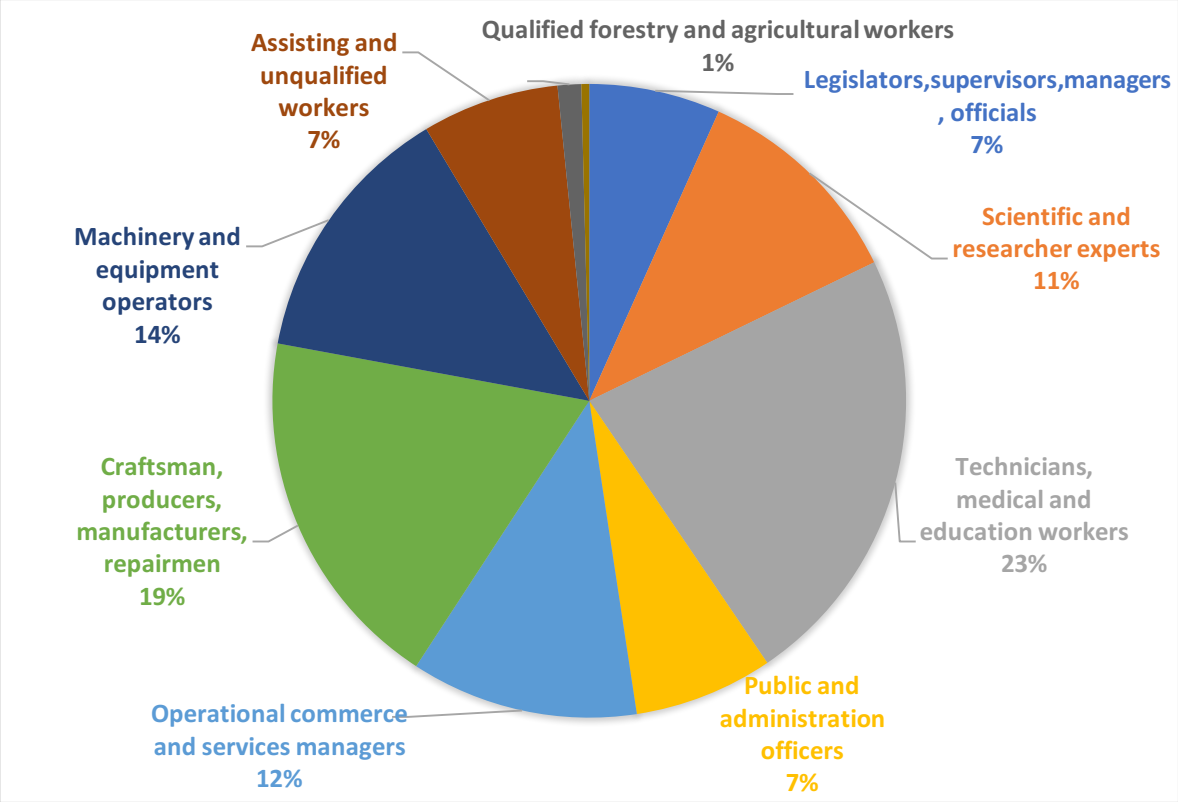
Figure 10: Distribution of Employed Persons According to Economic Sectors: year 2008



Source: Czech Statistical Office, own processing of data

Figure 10 depicts the share of employed population in different economic sectors. The highest share is represented by the manufacturing , followed by trade and construction. On the other hand, relatively insignificant share of employed people is in power engineering and mining sector, with only 1%. It is worth noting, that the agricultural sector provides only 4% share of employed population, which is relatively small percentage.

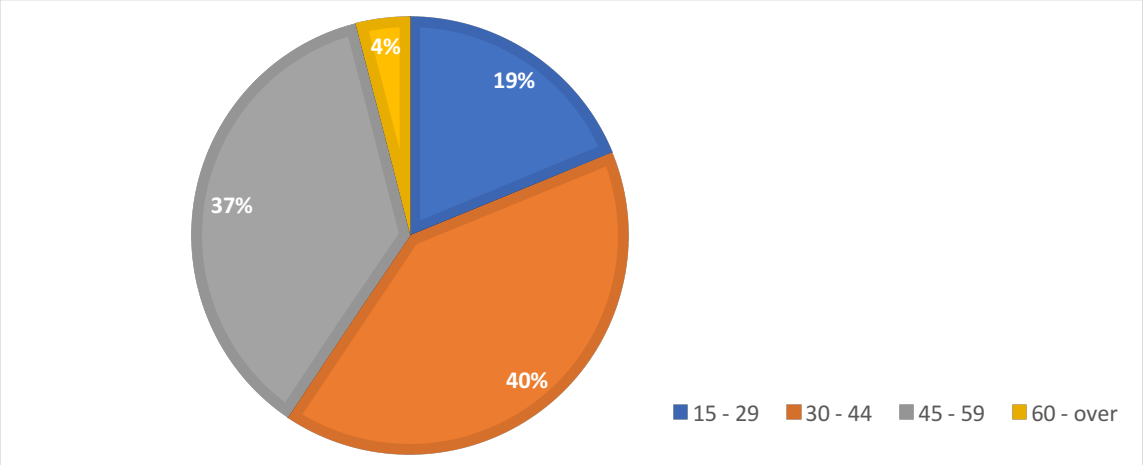
Figure 11: Distribution of Employed Persons According to Job Title Classification: year 2008



Source: Czech Statistical Office, own processing of data

Figure 11 demonstrates the percentage share of employed persons, distributed accordingly to their job titles. The broadest category is represented by technicians and medical and education workers, with 23%. Relatively similar share between 14 and 19%, is represented by various equipment operators, craftsman, manufacturers or operations managers with 12%. Very much like in the distribution of person according to economic sectors, the share of employed persons with a job titled related to forestry and agriculture, represents one of the smallest groups among all workers, with only 1%. Even smaller share is represented by members of army, which represent only 0.4%.

Figure 12: Distribution of Employed Persons According to Age: year 2008



Source: Czech Statistical Office, own processing of data

From Figure 12, it is possible to notice, that majority of the employed people is made up by persons in the age group of 30 to 44 years old. Almost the same share, with 37% is represented by people of 45 to 49 years of age. A smaller share is represented by 15- 29 years old. This is not surprising, as a lot of people between the ages 15 to 24 are still students, thus cannot fully participate in employment.

Figure 13: Development of Unemployment Rate: year 2010 - 2015

Source: Czech Statistical Office, own processing of data

Figure 13 illustrates the development of unemployment rate in the Czech Republic, which has a slightly decreasing trend. The overall average in the 6-year period of 6.5%, indicates, that the Czech economy is in a very good state, when it comes to unemployment comparison. In 2015, when the rate dropped to 5%, equating the natural rate of unemployment, the country was the leader in Europe's lowest unemployment rate.

4.1.2. Analysis of Education

4.1.2.1. Classification of Education in the Czech Republic

Number of years and degree of difficulty of each level of education differs in each country. In most countries, the classification is very similar, in some countries it is possible to notice vast differences. This is due to the fact, that each country sets the rules and conditions for different levels of education for its citizens. The basic classification of education in the Czech Republic is defined in the table below.

Table 1: Classification of Education in the Czech Republic

Classification	Type of Education	Description	Number of Years
A	Unfinished basic/No education	-	-
B	Basic education	Obligatory by law	9
H	Apprenticeship	Finished with apprenticeship certificate	2
J	Professional education	Finished with apprenticeship certificate with recognition of higher education	2-3
L	(Full length) Professional education	Finished with high school diploma – 'maturita'	4
M	High School education	Finished with high school diploma – 'maturita'	4
N	Higher Professional education	Required 'maturita'. Finished with title DiS. (non-academic title)	2-3

R	University Bachelor education	Requires ‘maturita’. Finished with title Bc.	3
T	University Masters education	Requires Bc.. Finished with Mgr. /Ing.	2
V	University PhD. education	Requires Mgr./Ing. Finished with doctorate degree PhD.	3-4

Source: Czech Statistical Office, own processing of data

Table 1 segments each level of education. Basic level of education, which is entitled to last 9 years, is mandatory by law in the Czech Republic. Even though accounting for different number of years, the levels are consecutive and it is necessary to successfully finish one before being able to enter following one. For attending high school, it is necessary to finish basic education. For university, it is required to earn so-called maturita certificate, which is a diploma certifying the education completion. However, it is possible to finish professional education with only apprenticeship certificate, which gives the person the recognition to perform certain specialized professional work, such as joiner or electrician. The highest level of education in the Czech Republic can be achieved by finished university with a doctoral degree in a field of expertise.

Classification of Education in the Czech Republic According to International Standards

For comparison and assessment in the international education sphere, it is necessary to distinguish education, according to international standards. Most commonly used is **ISCED** (International Standard Classification of Education). It is classification by UNESCO developed in 1976 and belonging to social and economic categorization of United Nations. The most recent revitalization of the ISCED standards was done in year 2011 and the classification of Czech educational levels according to ISCED is compared in the table below.

Table 2: Czech Education Levels Comparison to ISCED Classification

Czech Classification	ISCED Classification
No education	ISCED 0
Unfinished basic education	ISCED 1
Basic education	ISCED 2
Apprenticeship - certificate	ISCED 3C
Professional Education – with 'maturita'	ISCED 3A
High School Education – with 'maturita'	ISCED 3A
Post-high school Education	ISCED 4
Higher Professional Education	ISCED 5B
Bachelor Studies	ISCED 5A
Master Studies	ISCED 5A
Doctoral Studies	ISCED 6

Source: Czech Statistical Office, own processing of data

Each ISCED category, illustrated in the Table 2 above, is distributed according to two basic criteria; level of education, but also fields or subject of study. The highest level of education recognized by the ISCED standards is doctoral degree, as in the Czech Republic.

Certain levels of Czech educational system fall into same numerical categorization of ISCED. However, in each of the category, the ISCED ranking system also distinguishes sub-categories. So even though there are only 6 ISCED categories by number, differentiation by letters expands these basic categories into many more.

4.1.2.2. Development of Population According to Attained Educational Level in the Czech Republic

Table 3: Population Development According to Attained Educational Level: Year 1950 - 2011

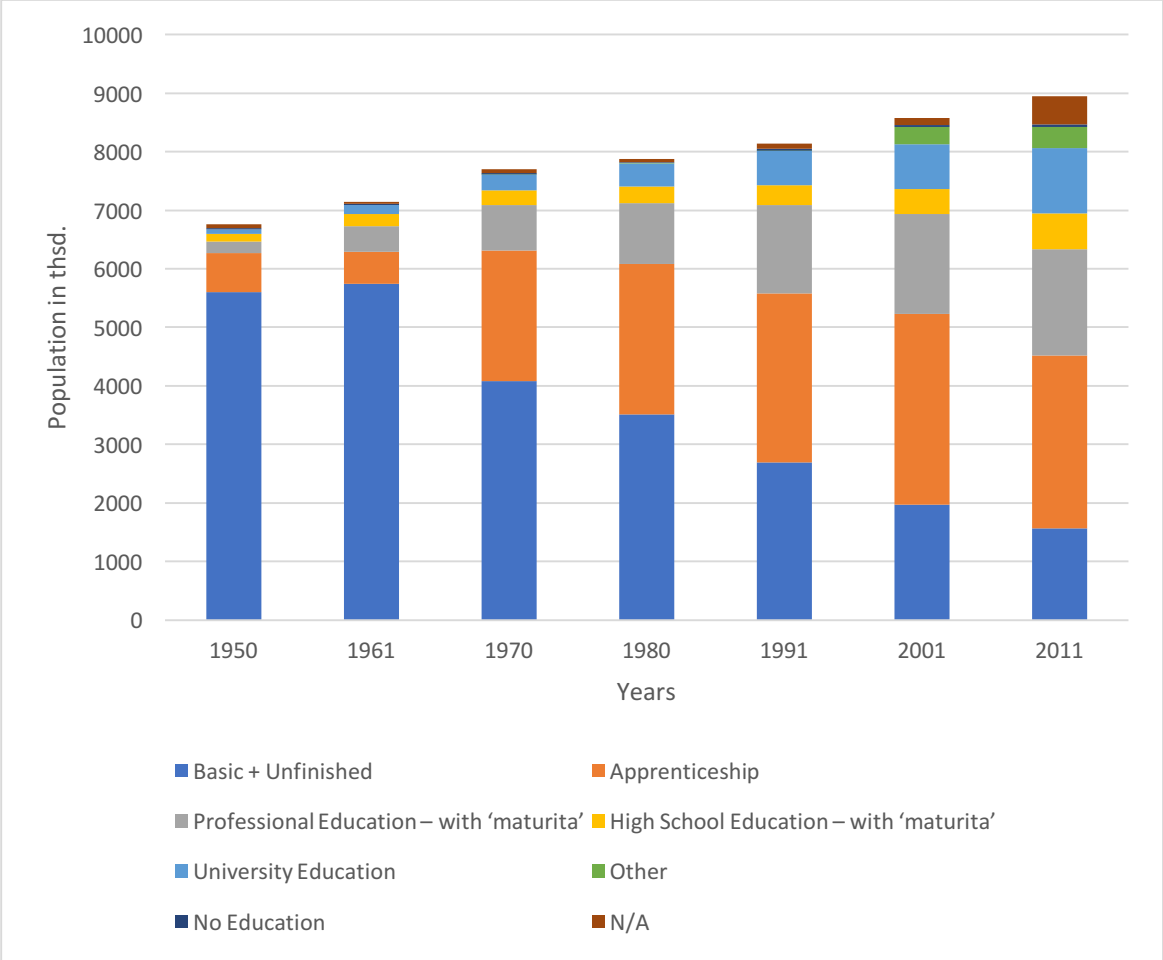
Number of Inhabitants Above 15 Years Old (in Thsd.)							
Year	1950	1961	1970	1980	1991	2001	2011
Total	6757	7143	7701	7879	8138	8575	8947
Basic + Unfinished	5606	5743	4086	3511	2696	1975	1571
Apprenticeship	660	546	2225	2566	2878	3255	2952
Professional Education – with 'maturita'	194	437	774	1047	1515	1703	1814
High School Education – with 'maturita'	141	205	260	278	342	431	610
University Education	70	156	263	393	582	762	1114
Other	-	-	10	11	9	296	365
No education	22	24	22	20	28	38	42
N/A	63	29	60	50	85	113	476

Source: Czech Statistical Office, own processing of data

In comparison and assessment of population share and distribution, according to the achieved level of education, it is important to take into account the overall development of population. In Table 3, the number of population of each and different level of education is composed of population, which is 15 years old and higher. It would not make sense to consider children below 15 years old, as most of them have not finished their basic education at that point. Interesting outtake from the table suggests, that with overall

constant increase of population in the sixty-year period, number of population in each level of attained education increased as well, except for one. The number of population, which has only basic or no education at all had decreased by 4 million inhabitants. With focus on university education, immense growth was recorded. While in 1950, only around 70 thousand inhabitants above 15 years old achieve some level of university education, 60 years later, it more than 1 million.

Figure 14: Population Development According to Attained Educational Level: Year 1950 - 2011



Source: Czech Statistical Office, own processing of data

Figure 14 illustrates the proportion of the data from Table 3. It is possible to see, how the proportion of population above 15 years old, according to achieved level of education changed during the years. While in 1950, the majority of population constituted of people with highest attained level of education in the form of basic or no education at all, over the

years the share had significantly declined. The share of graduates with apprenticeship certificate had increased enormously, and very reasonably, as nowadays the demand for this type of labor is still unsatisfied and very much desired. With the focus on the most current year 2011, one third of the population above 15 years old constituted of people with apprenticeship. Compared to the 33%, very close was population with education finished with maturita certificate with 27%, from which professional education made up majority of 20% and regular high school education the rest of 7%. University graduates made up for 12% of the population, from which almost 10% were able to finish with a master's degree. Very positive was the figure of people with no education, which in 2011 was only negligible 0.3%. The still relatively high proportion of basic education to university education can be contributed to increasing average living age, as people above 65 make up most of the population with only basic education and lower fertility rate cause the inability to proportionally increase the share of higher education graduate.

4.1.2.3. Share of Economically Active Population According to Attained Level of Education – Comparison to EU27

For comparison on a more international level, it is necessary to consider and asses the share of population according to their educational achievements also in other countries.
As of year 2017, the European Union has 28 members, however the data from year 2010 only contains information about 27 members, excluding Croatia, which joined the EU in the year 2013. Table 4 contains percentage shares of economically active population of selected countries. Among economically active population are considered persons between 15 to 64 years of age. The comparison is done for four closest neighboring countries; Austria, Germany, Slovakia and Poland, and also several other ones, which in some way stand out from the EU27 averages.

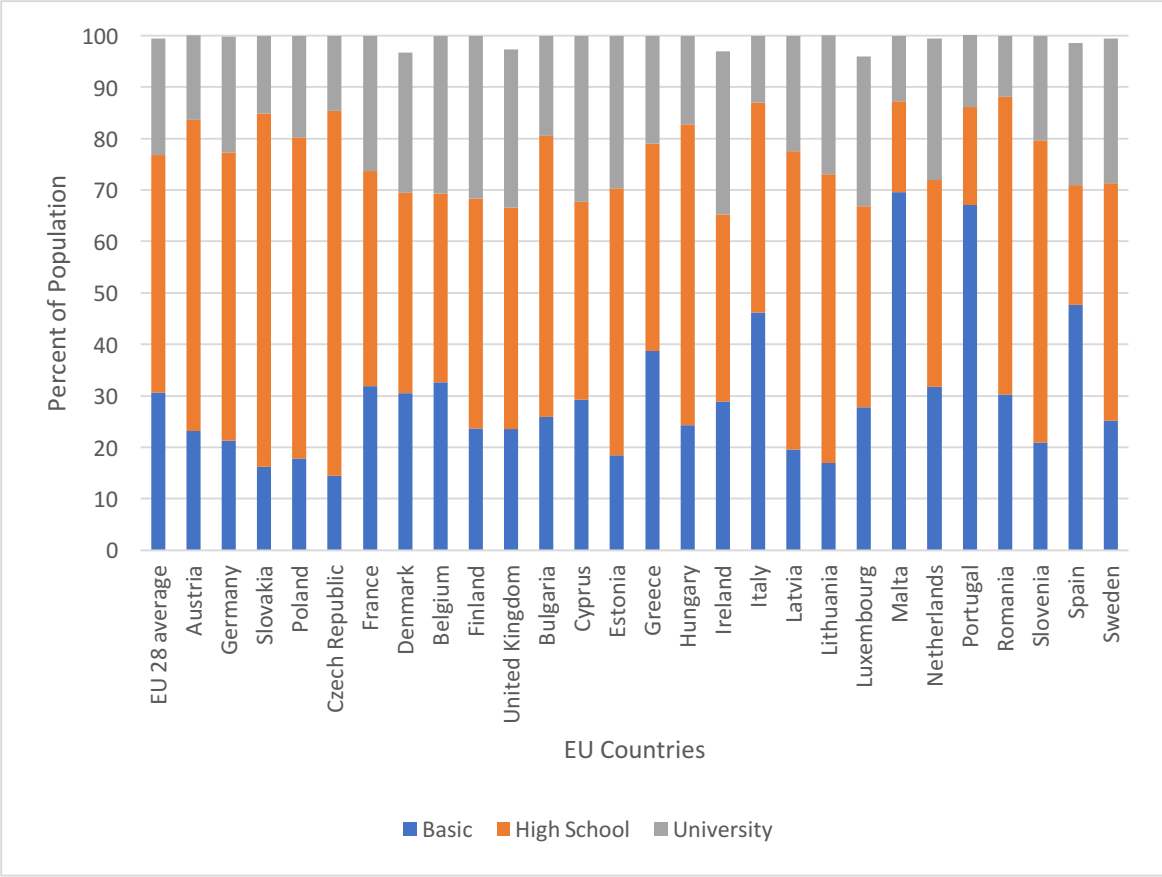
Table 4: Percentage Share of Economically Active Population According to Attained Level of Education – Comparison of EU27: year 2010

Country	Basic	High School	University
EU27 average	30.6	46.2	22.6
Austria	23.1	60.6	16.4
Germany	21.3	56	22.5
Slovakia	16.2	68.7	15.1
Poland	17.8	62.4	19.8
Czech Republic	14.4	71	14.5
France	31.9	41.8	26.3
Denmark	30.5	39	27.2
Belgium	32.6	36.7	30.7
Finland	23.6	44.8	31.6
United Kingdom	23.5	43.1	30.7

Source: Eurostat, own processing of data

As shown in Table 4 the Czech Republic stands out from the crowd in share of economically active population, which achieved high school level of education. With 71% share, it is almost 25% above the EU27 average in this category and in the first place from all the 27 countries. Still above average of 46%, but the four neighboring countries lag behind the Czech Republic, when it comes to this category. Shares in the other category of university education might seem pitiful for the Czech Republic. Share of university graduates is lower by 8% compared to EU27 average. However, it is necessary to mention certain limitations to this category, and that is that the economically active population is from 15 years of age, and at this point, it is impossible for students to have had earned university education, thus leave possibility for future achievements until higher age. Half the percentage share of EU27 average, in the 'only' basic education category, and symbolizes another victory. With the lowest percentage of 14.4% from the 27 states, the Czech Republic achieved another primacy. Opposed to the category of university education, where the higher the percentage the better, in this category the lowest percentage is positive as well.

Figure 15: Percentage Share of Economically Active Population According to Attained Level of Education – Comparison of EU27: year 2010



Source: Eurostat, own processing of data

Figure 15 depicts the percentage share of population's educational level. It is possible to see than among the EU27 countries exit vast differences and it is difficult to somehow categorize them. However, it is possible to see certain patterns. In southern countries of the EU, the share of population with basic education is very high compared to the Czech Republic and the EU average. For example 70% of economically active population in Malta reached only basic education. Similarly, high share with 50% can be notices in the case of Spain, or Italy with 46%. Czech Republic in this scenario falls in a group with Baltic states and Poland and Slovakia. In this group, countries, together with the Czech Republic generally share lower than EU27 30.6% average proportion of basic education and higher than the EU17 46.2% average proportion of high school education. However, these countries also share a pattern of lower than the EU27 average proportion of 22.6% of university level graduates.

4.1.2.4. Wages According to Attained Educational Level in the Czech Republic

Much as the quality of human capital has an impact on the productivity, efficiency and overall quality of a person in a certain job, it is also very differently compensated for. Wages differ and deviate from average, based on the achieved level of education, which positively contributes to the development of individual's human capital. It is also important to distinguish changes among categories of wages and salaries. Some people tend to use these two terms interchangeably. Wages and salaries can be categorized according to hourly pay or fixed rate etc. For the following comparison, wages are described as a pay in the private sector; e.g. firms. Salaries are described as a pay, which are paid to public sector employees. How much wages and salaries vary due to certain levels of education in the Czech Republic is illustrated in the tables and figures in the following pages.

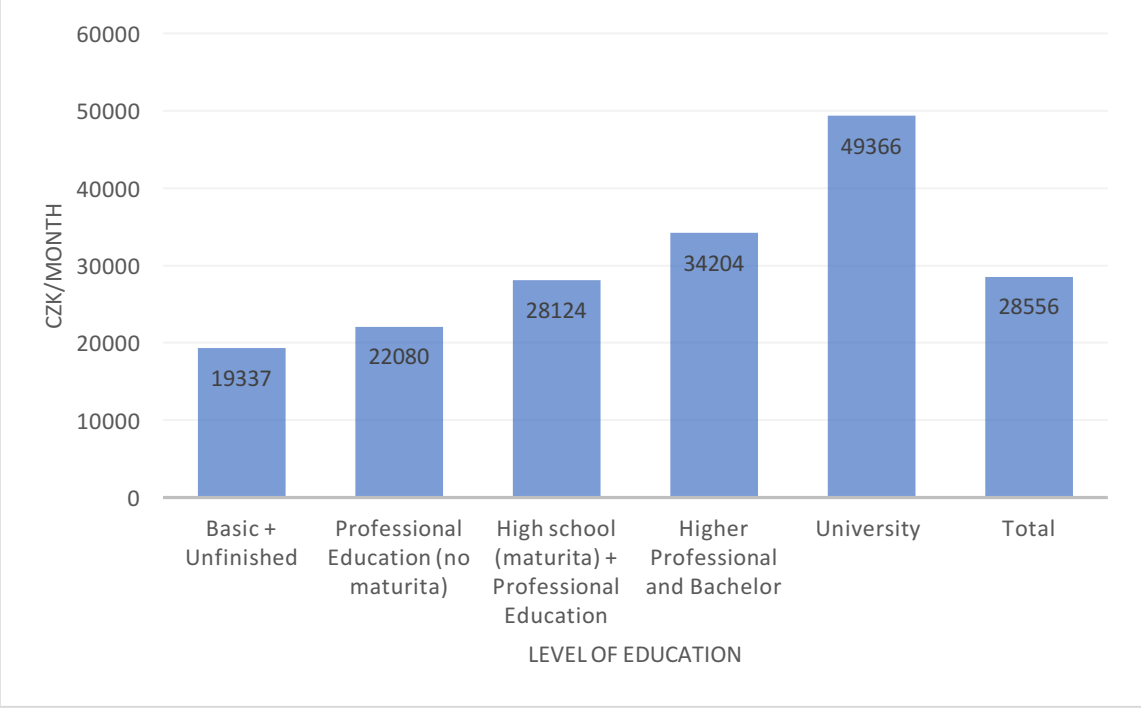
Table 5: Gross Monthly Wages According to Attained Education – Wages: year 2016

Values	Emplo-yees	Median	D1	Q1	Q3	D9	Mean
Units	Thsd. Person	CZK/ Month	CZK/ Month	CZK/ Month	CZK/ Month	CZK/ Month	CZK/ Month
Basic + Unfinished	176.9	18014	10995	13459	23301	28903	19337
Professional Education (no maturita)	1110.2	20694	11772	15333	26734	33595	22080
High school (maturita) + Professional Education	1055.1	24441	13190	18204	33049	44662	28124
Higher Professional and Bachelor	112.6	27903	16198	20916	38369	55470	34204
University	426.2	36662	17579	25409	56334	88615	49366
N/A	68,8	20938	11554	14782	28323	40571	25257
Total	2949.7	23409	12258	17008	32089	45782	28556

Source: Ministry of Labor and Social Affairs, own processing of data

Table 5 lists the amounts of wages, in CZK per one month and person, which generally private sector employees receive for providing labor. The table also list total number of employees in 5 categories distributed according to corresponding level of achieved education. Median and mean values are listed and as visible from the table, are increasing with each higher level of attained education. Median represents the middle value of consecutively order values, mean is calculated as weighted average of values. Column with first decile D1, contains values, under which lies the bottom 10% of the lowest observed values from each category. Column with first quartile Q1 works on the same principle, however the border is moved to 25%. Columns with decile D9 and quartile Q3 provide the top measurements. Q3 contains amounts, above which lies the 25% of the highest observed values and D9 the amounts, above which lies the 10% of the highest observed values.

Figure 16: Average Gross Monthly Wages According to Attained Education – Wages: year 2016



Source: Ministry of Labor and Social Affairs, own processing of data

Figure 16 illustrates how wages differed according to achieved levels of education among population in the Czech Republic in 2016. It is apparent that with each highest level of education, people on average received highest compensation for providing their labor. University graduates received the highest amount of wages on average, as they represent

the group possessing the highest level of education possible to achieve in the Czech Republic. University graduates received on average almost 50 thousand CZK, which is 2.5 times more than only basic education graduates and 1.7 times more or by 73% more than the average of all groups together. University graduates represent the third largest group, but still with more than 400 thousand employees they make up only for total of 14.5%. The largest two groups are professional and high school education graduates with 38% and 36%. The closest average wage group to total average wage, is again high school education group with only 2% difference. Higher professional education and bachelor graduates receive higher than total average wage, but still receive by 30% less than masters' and doctoral degree graduates.

Table 6: Gross Monthly Wages According to Attained Education – Salaries: year 2016

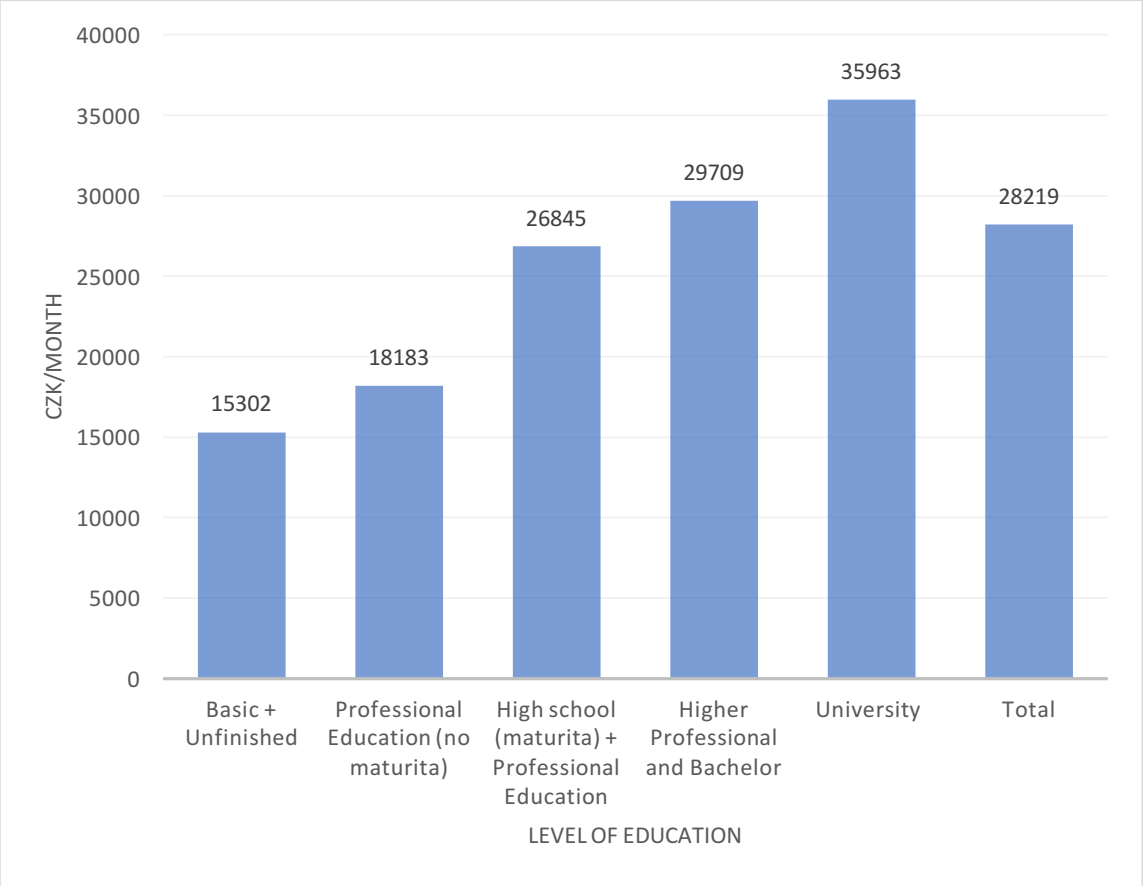
Values	Emplo-yees	Median	D1	Q1	Q3	D9	Mean
Units	Thsd. Persons	CZK/ Month	CZK/ Month	CZK/ Month	CZK/ Month	CZK/ Month	CZK/ Month
Basic + Unfinished	20.9	13886	10434	11823	17880	21918	15302
Professional Education (no maturita)	90.1	17240	11926	13722	21560	25602	18183
High school (maturita) + Professional Education	243	26034	17868	22004	31193	36472	26845
Higher Professional and Bachelor	65	28394	20234	23361	34736	41105	29709
University	186.5	30857	23771	26771	40358	53185	35963
N/A	18.7	24649	17070	21278	29349	37145	26451
Total	624.2	26478	15369	21246	32485	41060	28219

Source: Ministry of Labor and Social Affairs, own processing of data

Table 6 lists the amounts of salaries, in CZK per one month and person, which generally state and public sector employees receive for providing labor. The distribution of the 5

categories based on achived level of education is the same, as in the case of wages comparison, and so is the methodology for calculation of median, mean, first and ninth decile and first and third quartile values in the table.

Figure 17: Average Gross Monthly Wages According to Attained Education – Salaries: year 2016



Source: Ministry of Labor and Social Affairs, own processing of data

Figure 17 shows how average salaries vary between categories of achieved education in the Czech Republic in 2016. The trends are the same as in the previous case of average wages based on levels of education. With each higher level of education, comes higher level of compensation for provided labor and university graduates, having the highest possible education level, receive the highest compensation on average. Even though the trend is the same as in the case of wages, the percentage difference and deviations between each category in case of salaries differ. For example, university graduates receive on average, salaries higher than total average salaries only by 22%. In case of wages it was

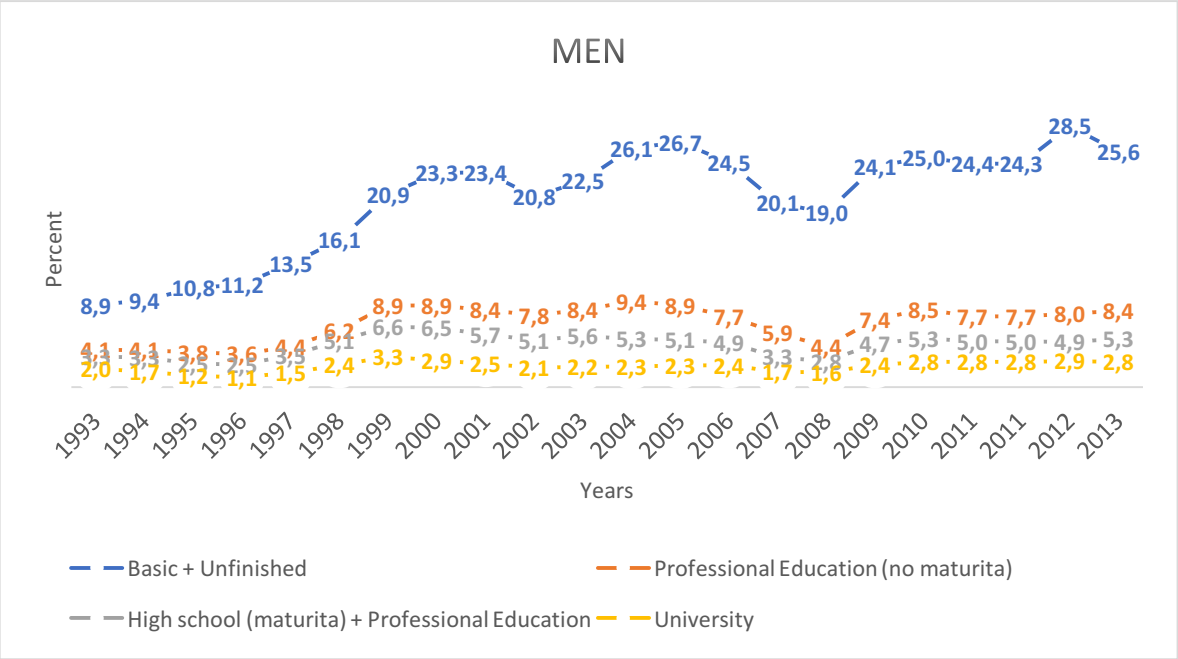
more than 70%. It necessary to mention, that university graduates, in this case also represent the second largest group of employees, with 30% share of all employees. Higher professional and bachelor education graduates get compensated above the total salaries average, but only by 5%. Wider gap can also be seen between professional education and high school education with 33% difference on average. In comparison of wages and salaries, the levels in each category, are higher in the case of wages. The differences are 30% among basic education graduates or employees with no education, 18% among professional education graduate employees, 5% among high school education group, 14% among higher professional and bachelor graduates and 27% among higher university degree achievers. Nonetheless the total mean value difference between wages and salaries is only little bit over 1%, with 337 CZK per month.

4.1.2.5. Specific Unemployment Rate According to Attained Level of Education in the Czech Republic

Firstly, it is crucial to clarify what is meant by specific unemployment rate. Unlike regular unemployment rate, which determined the percentage of work force without a job, specific rate focuses on a particular grouping. In this case level of education, so the specific rate determines the share of the particular group on the overall work force without a job.

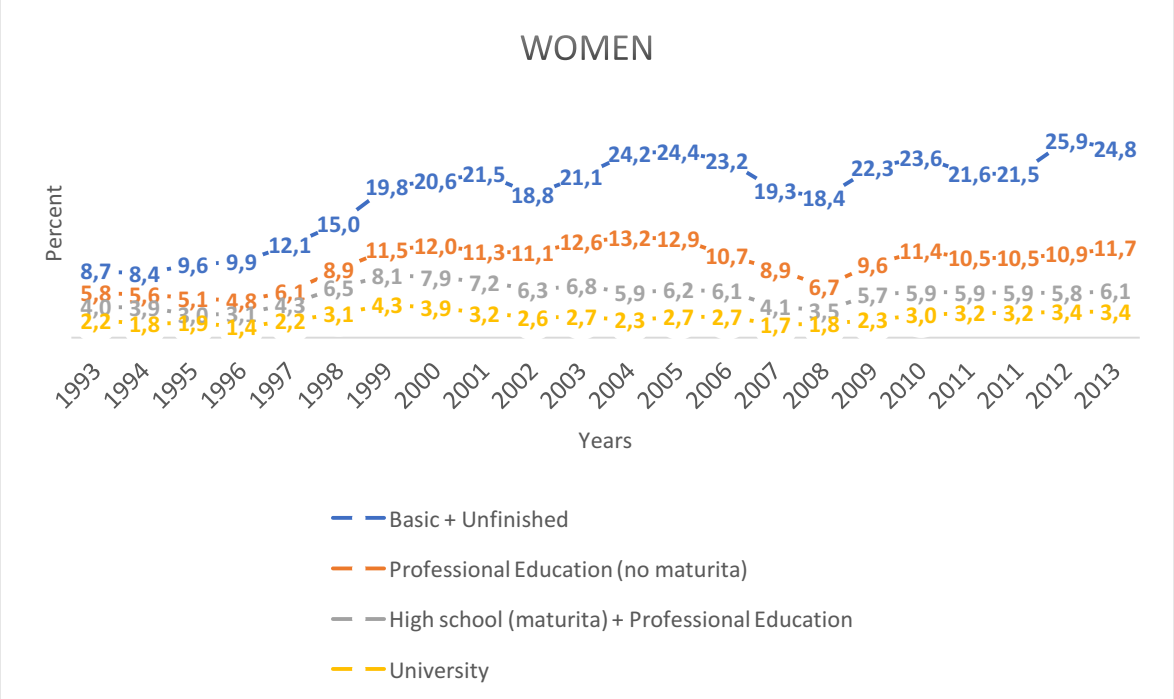
The Figures 18 and 19 illustrate, not only particular differences among achieved levels of education and specific unemployment rate, which can be noticed in the Nomenclature of Units for Territorial Statistics classification; NUTS 1 – Czech Republic, but also differences in these two categories according to gender. The categorization of educational level is according to the ISCED system.

Figure 18: Development of Unemployment Rate According to Categorization of Education by ISCED - Men: year 1993 – 2013



Source: Czech Statistical Office, own processing of data

Figure 19: Development of Unemployment Rate According to Categorization of Education by ISCED - Women: year 1993 - 2013



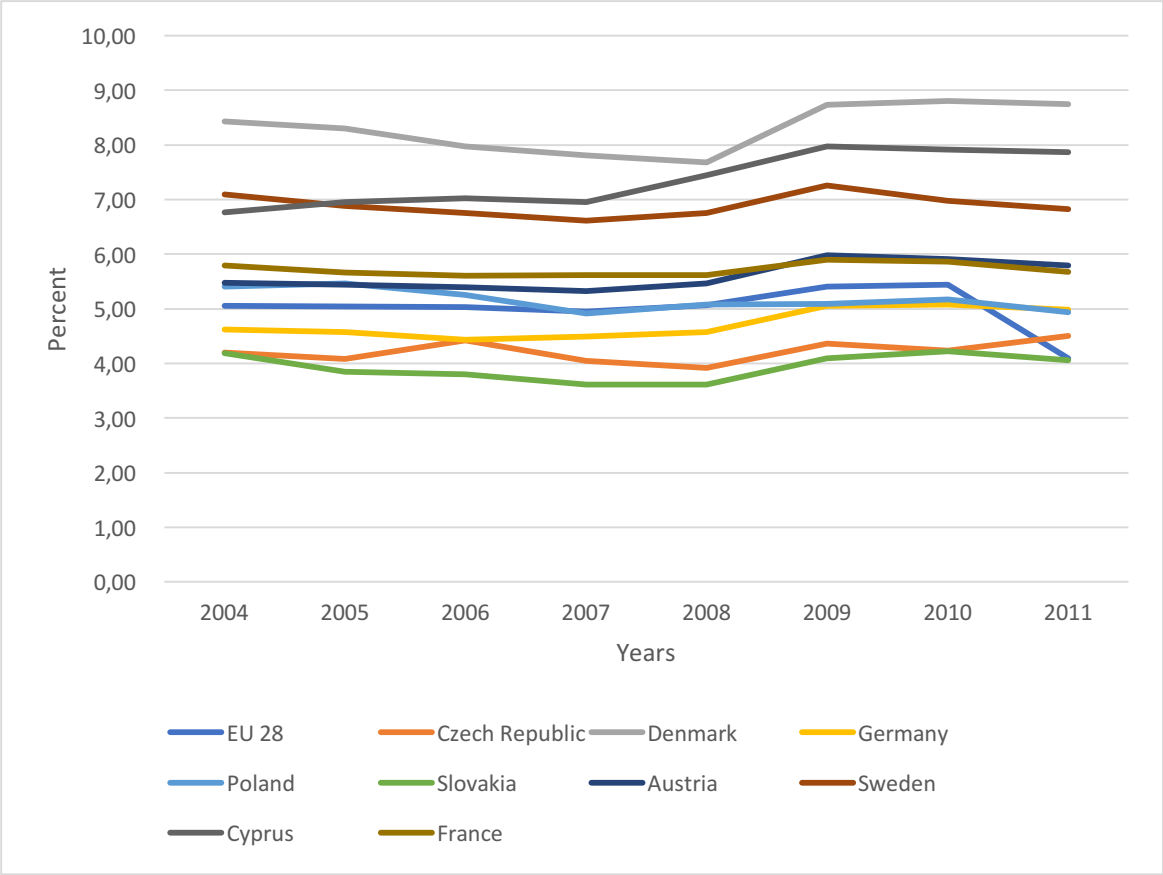
Source: Czech Statistical Office, own processing of data

The Figures 18 and 19 show a positive correlation between levels of education and unemployment rate. As it can be seen, the category with the highest rate of unemployment is the category with lowest level of achieved education according to the ISCED system. The lowest share among unemployed workforce had had since 1993 university graduates. The proportions did not change during the 20-year period and never deviated in case of women above 4.3%, which was the highest share in all period in 1999. In the case of men university graduates, the share never reached higher share than 3.3%. The average share over the whole period was 2.7% among female university graduates and 2.3% among male. The development was very similar among men and women over the period as the specific unemployment, being part of overall unemployment, is subjected to multiple forces, which have impact above gender differences. The only difference is that over the whole period, in three of the categories, the specific unemployment rate was generally higher in case of women. The only category, where the share of women was overall lower than in men, was basic education specific unemployment rate. In the case of women, the rate over the 20-year period was 18.8%, among men the rate was 20.4%.

4.1.2.6. Public Expenditures on Education in the Czech Republic

Investments into the education sector are especially important for improvement of quality and quantity of human capital in any economy. Expenditures in this particular sector improve the quality of education and may promote economic growth. As size of each country differs, so does the education sector and its needs of investments, which is why it might be tricky to compare the expenditures on international level. One of suitable methods is comparison of education expenditures as a percentage share of country's GDP.

Figure 20: Development of Public Expenditures on Education as a Share of GDP: year 2004 - 2011

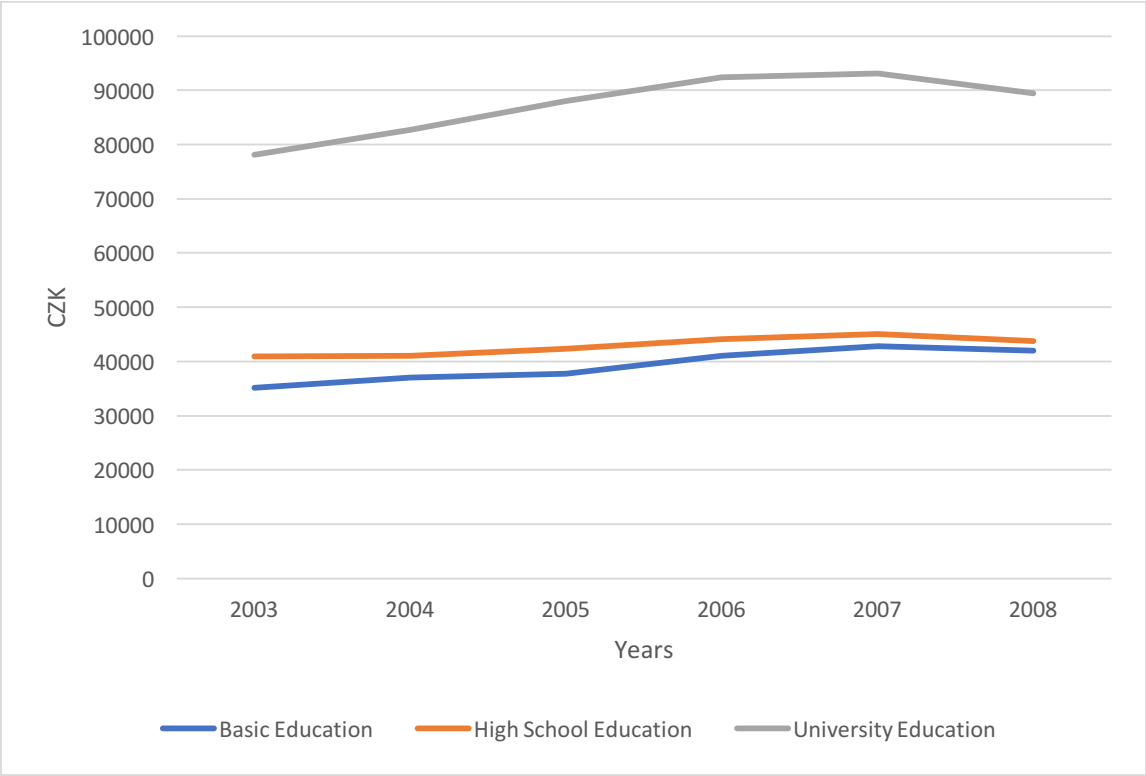


Source: Czech Statistical Office, own processing of data

From Figure 20 is visible, that the Czech Republic in terms of public expenditure into the education sector, in comparison to EU28, is generally below the average. During the 8-year period from 2004 until 2011, the expenditures as a percentage of the Czech GDP did not exceed the level of 4.5%. The investment level in the Czech Republic has been constantly increasing and decrease over the period, however not more than 0.5% share of GDP every year. The changes were so insignificant, that the overall change during the period was only 0.31% increase. The overall EU28 average was around 5.1% and all the neighboring countries, excepts for Austria and Poland is some years, stayed below that average as well. It is interesting to notice, how different countries help their education sector. Northern countries, such as Demark or Sweden, tend to invest relatively higher share of GDP into this sector. On average Denmark invests more than 8% of their GDP and Sweden around 7% of their GDP into the sector, which is around 1.5 more than the Czech Republic. However interesting to realize the difference in expenditures approaches

towards the education sector each country takes, it is important to take into account, that the public expenditures do not have to be the only source of investment for this sector. Private sector investment can have significant impact as well, of course it also depends whether the education sector is more in the hands of private or public execution.

Figure 21: Development of Public Expenditures per Student According to Level of Education: year 2003 - 2008

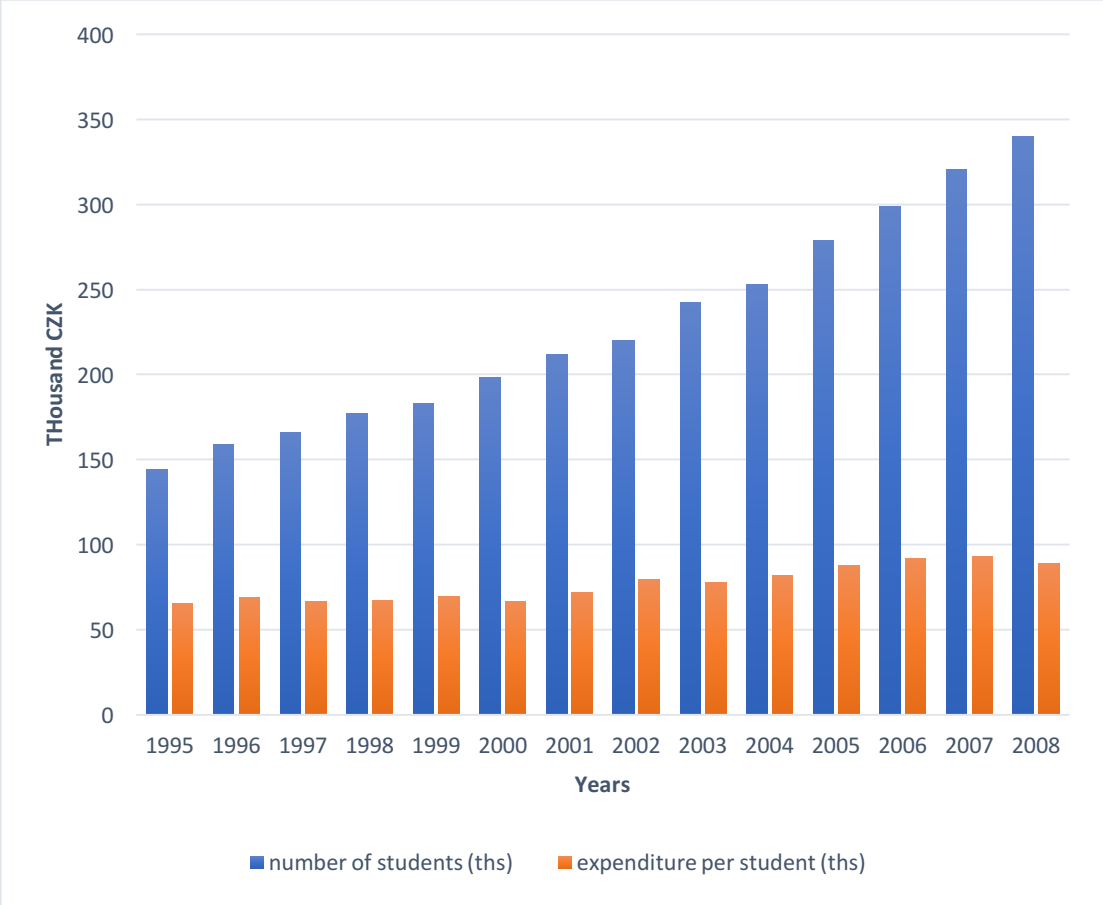


Source: Czech Statistical Office, own processing of data

Figure 21 depicts how did the level of expenditures change in selected period from 2003 until 2008 per one students and what are the difference among three levels of education. The amount of expenditure change proportional with each and higher level of education. However, the amount spend on a basic education student and a high school student is not very different. In 2007 the difference was only 2.5%. The average amount spend on a basic education student was around 39 thousand CZK and had increased in the period by around 6%. The expenditures are the lowest, because a basic education student usually does not need any specialized equipment, which could increase the cost per of student.

Per high school student expenditures are, as was already mentioned, very similar to basic education, with an average of 42 thousand CZK. This similar level of per student expenditure make sense in the case of general high school studies. On the other hand, if it is a student of certain apprenticeship, it would be expected, that the expenditures would be much higher, due to the need for specialized equipment. The expenditures are of course the highest per university student. The reason is, that at this point, the education is so specialized, the student needs very specific equipment and needs a lot of it. This of course differs with the field of subject of study. For example, medical students might require higher level of expenditure, as they need laboratories, specialized surgical tools and other equipment, whereas students of economy might manage with only board and a pen.

Figure 22: Comparison of Development of Number of Students and Public Expenditures per Student – University Education: year 1995 - 2008



Source: Czech Statistical Office, own processing of data

Figure 22 illustrates how expenditures per university student changed compared to the total number of students since 1995 until 2008 in the Czech Republic. The number of students increased in the 14-year period more than twice. The number of students since 1995, when it was around 144 thousand, increased by 136% to 340 thousand students in 2008. The expenditures per student reported an increase as well, from initial 65 thousand CZK to 89 thousand CZK per student in 2008, which is around 37%. Both, the constantly increasing number of university students, as well as the constantly increasing investments per student, could positively impact economic development, as the number of student contributes to quantity of human capital and the expenditures could contribute to the quality of human capital.

4.1.2.7. Comparison of Selected International Testing Systems

Quality of education is an integral part formulating quality of human capital. It very useful to start measuring the quality of education since early age, meaning since earliest level of education. Throughout the whole European Union, each state has different framework and guidelines for unitedly testing all their students. Unfortunately, Czech Republic, like Wales and Greece, is one of the countries in the EU, which does not have any nationwide testing system.

The closest the Czech Republic had come to nationwide testing of student was, when in 2011 project NIQUES started. NIQUES was a shortcut of national system of inspectional assessment of educational system in the Czech Republic powered by the Czech School Inspectorate. It was terminated in 2015, leaving Czech Republic to be one of few countries worldwide, that does not have countrywide testing system. Czech Republic however participates in several multinational studies, aimed at evaluation of results of education. The types and description of international studies is listed in Table 7.

Table 7: Selected International Testing Systems for Students

Test Type	Organized by	Targeted test group - school grade	Year	Scope of testing
TIMSS	IEA	4.,8. basic school, 3. high school	1995, 2007, 2011	Mathematics + Natural sciences
PIRLS	IEA	3., 4., 8. basic school	1995, 2001, 2011	Reader's literacy
PISA	OECD	15-year-old	2003, 2006, 2009, 2012	Mathematical, Reading, Natural Sciences Literacy
CIVED ICCS	IEA	8. basic school, 3. high school	1999, 2009	Civics
ICILS	IEA	8. basic school	2013	Computer and Informational Literacy

Source: Czech School Inspectorate, own processing of data

Table 7 above lists several multinational testing systems, which are applied worldwide. Each of them differ in couple of criteria. Each test is organized at different level and grade of education and is done only once, or can be repeated in a higher grade. Each of the systems also focuses on a different specialization and fields of study and is conducted every couple of years, not every year. The two most well-known tests are TIMSS (Trends in International Mathematics and Science Study), organized by the IEA (International Association for the Evaluation of Educational Achievements), and PISA (Program for International Student Assessment), organized by the OECD.

Table 8: Czech Republic– Basic Education Students in TIMSS Testing: year 1995, 2007, 2011

Year	1995	2007	2011
Place in Mathematics			
4th grade	6.	24.	22.
8th grade	6.	12.	DNA*

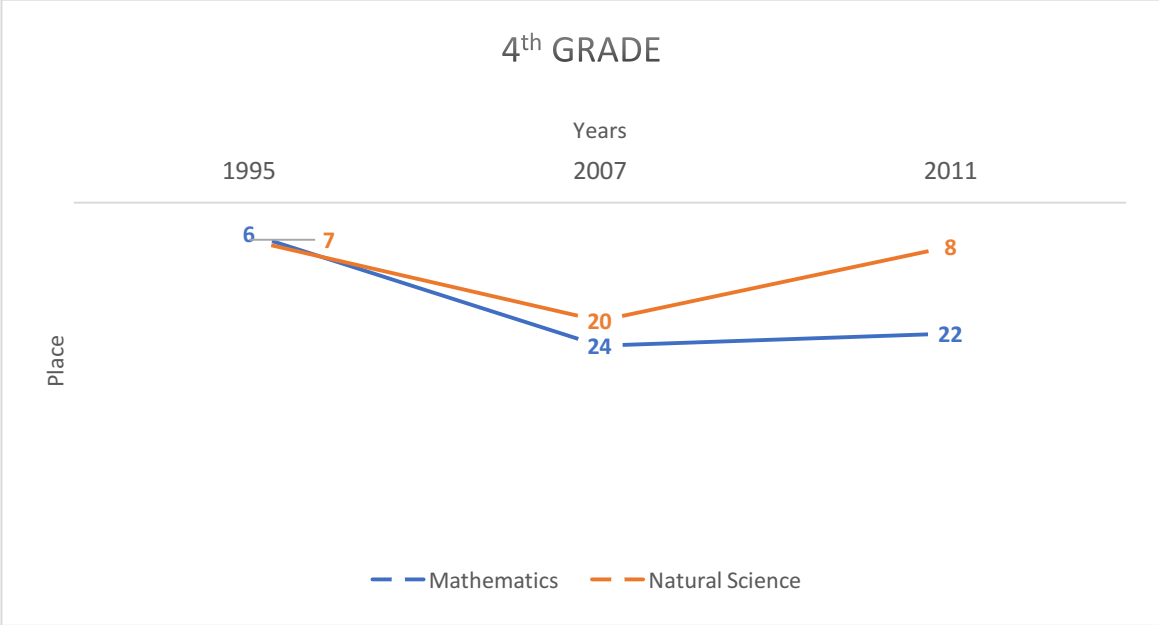
Place in Science			
4th grade	7.	20.	8.
8h grade	2.	7.	DNA*
Number of participating countries: 4th grade	25	36	52
Number of participating countries: 8th grade	41	49	45

Source: Czech School Inspectorate, own processing of data

*Did Not Attend

Table 8 lists the placings of students in 4th and 8th grade of basic education in the Czech Republic in the international testing TIMSS. The place according to grade, subject of testing and also year, differ very significantly in each testing years. The number of participating countries in the 4th grade TIMSS more than doubled since 1995 until 2011, on the other hand number of countries in the 8th grade TIMSS change only by several countries.

Figure 23: Czech Republic – Basic Education Students in TIMSS Testing – 4th Grade: years 1995, 2007, 2011

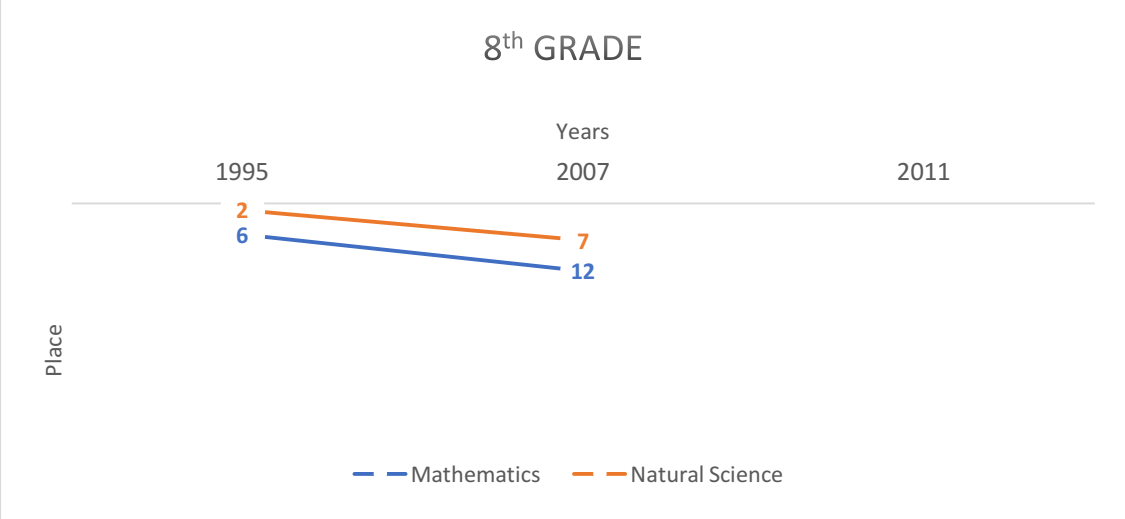


Source: Czech School Inspectorate, own processing of data

Figure 23 depicts placing of 4th grade students in the TIMSS worldwide testing in the field of mathematics and natural sciences. The results in both fields yielded very similar

rankings in year 1995 and 2007, but in year 2011, there was a difference of 14 positions. The best results achieved in both fields were in 1995, where the 4th grader received 6. and 7. place from total of 25 participating countries. In comparison in 2011, they received 8. place in natural sciences, but the achievement is much more valuable since the number of participating countries more than double to the total od 52. The worst results were in both fields in 2007, where the students score only 20. and 24. place from total of 36 participating countries.

Figure 24: Czech Republic – Basic Education Students in TIMSS Testing – 8th Grade: years 1995, 2007, 2011



Source: Czech School Inspectorate, own processing of data

The Figure 28 above illustrates the development of placing of 8th grade students in the Czech Republic in TIMSS testing systems. On major deficiency is, that in the year 2011, the Czech Republic 8th grader did not participate neither fields of the testing, so it is only possible to compare the development between year 1995 and 2007. The best and at the same time very impressive results was achieved in 2008, where the Czech 8th grader scored 2nd place in Natural sciences from all of the 41 participating countries, which was a lot more than in the 4th grader category. A decrease was recorded between the two years in both mathematics and natural sciences, however from the overall 49 participating countries in 2011, 7th and 12th place is also relatively high achievement.

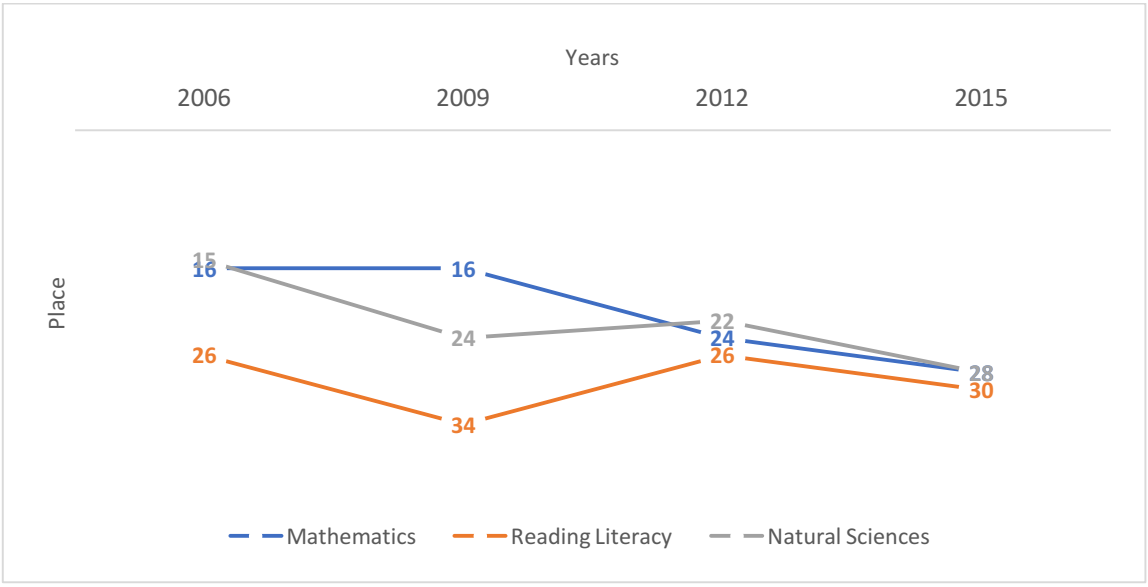
Table 9: Czech Republic in PISA Testing: years 2006, 2009, 2012, 2015

Year	2006	2009	2012	2015
Mathematics	16.	16.	24.	28.
Reading Literacy	26.	34.	26.	30.
Natural Sciences	15.	24.	22.	28.
Number of Participating countries	57	75	65	72

Source: Czech School Inspectorate, own processing of data

The Table 9 above lists the placing of the Czech Republic in the international PISA testing system. PISA, like TIMSS test students all around the world in mathematics and natural sciences. On top of that, it also tests reading literacy. The testing is not done according to the grade, nor repeated. It is a one-time testing of 15 years old students. Organized by the OECD and well-known The testing system benefits interest, as the number of participating countries increases almost every year.

Figure 25: Comparison of Ranking of the Czech Republic in PISA Test Scores: year 2006, 2009, 2012, 2015



Source: Czech School Inspectorate, own processing of data

Figure 25 depicts the development of placing of the Czech Republic's 15-year-old students in the international PISA testing system. The best achievement that the students reached

was in 2006, when they scored 15th and 16th place in natural sciences and mathematics from total of 56 participating countries. In the following year, they achieved the same result in mathematics, however in the other fields of study, they recorded the deepest drop to 24th and 34th place in natural sciences and reading literacy. The 34th place in reading literacy in 2009 is also the worst result in the history or Czech Republic's participation in PISA. Given that the number of participating countries increased since 2006 until 2015 by around 26%, the results of 86% decline in natural sciences, 75% in mathematics and 15% decline in reading literacy, which was already always in constant mal-performance, is disproportionally insufficient. The testing results on international level are very important and can yield many benefits. The comparison of earlier age education can detect certain deficiencies or also exceptionalities among countries, which might influence the potential of human capital and can be either improved or prevented in the future or in case of extraordinariness used for the country's benefit in competitiveness in terms of human capital and its potential.

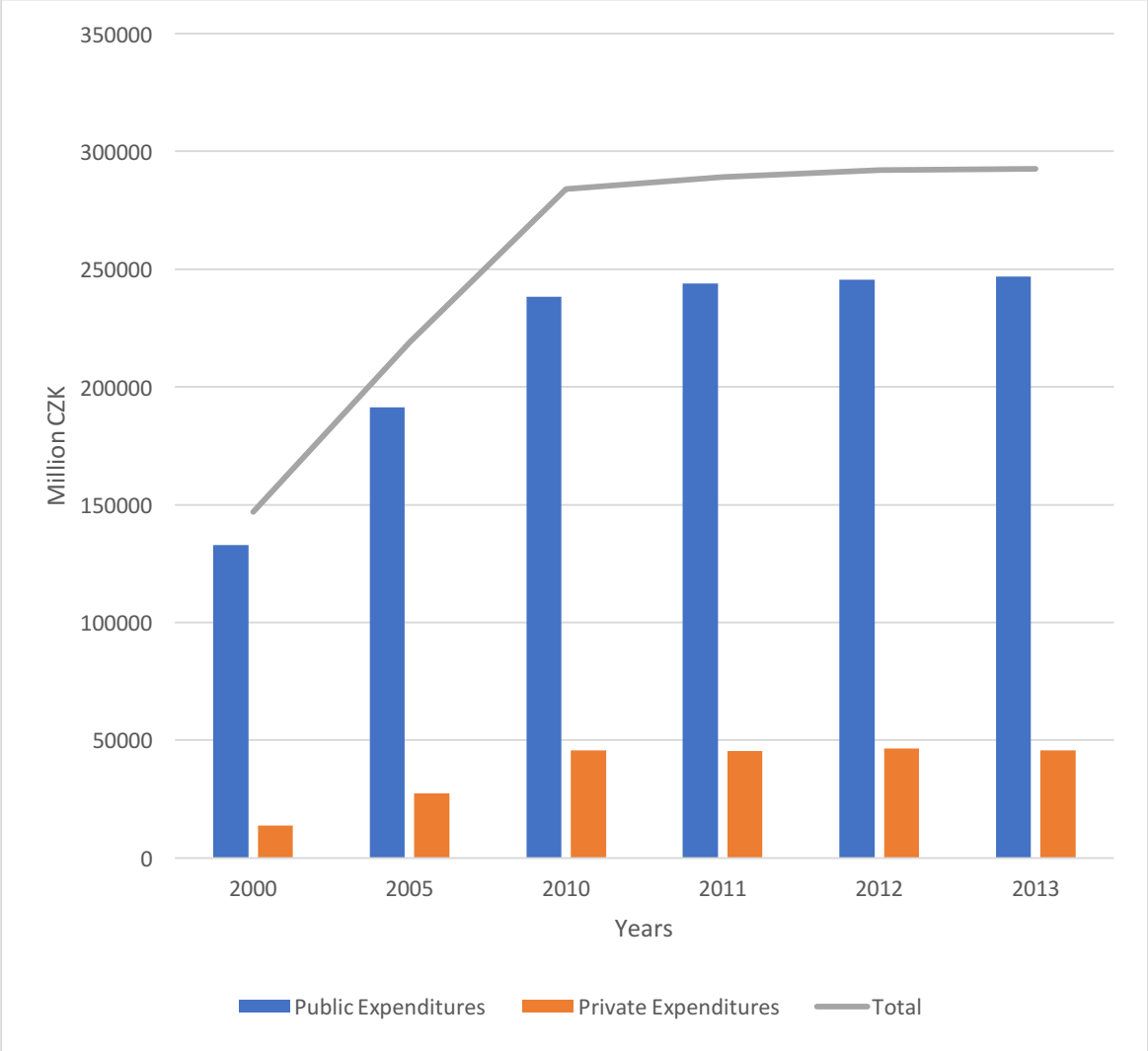
4.1.3. Health

Health has an evident impact on the quality of life and determines its length. Health is an integral part of any individuals' life, and that is why health also influences the quality and quantity of human capital and economy as a whole. Health of individuals is primarily linked with sustainability of economy and is express by several different factors.

4.1.3.1. Investment into Health Sector in the Czech Republic

Expenditures towards the health sector are important aspect, which need to be monitored. Increase in the investments, from both public and private sectors, has the highest potential for improvement of health care, thus improving the health of the population and quality of life, which directly affects the quality and quantity of human capital.

Figure 26: Development of Expenditures into the Health Sector: year 2000- 2013



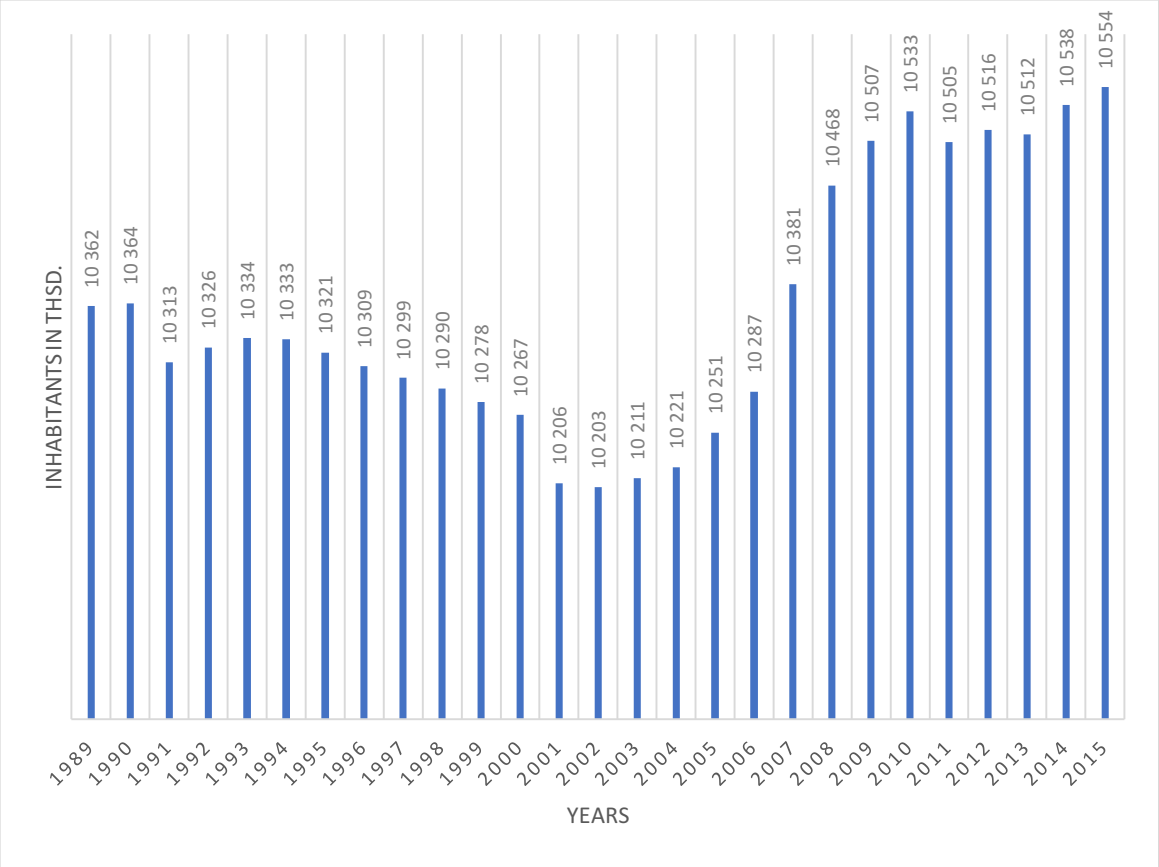
Source: Czech Statistical Office, own processing of data

Figure 26 presents the development of expenditures towards the health sector. It is interesting to see how much it changed in 10-year period from 2000 to 2010 and how little increase could be recorded since 2010 to 2013. In the past few years the investment towards the health sectors remained very stable, when it comes to both public and private expenditures. The public sector generally represents the major investment source with around 85% of total expenditures. The private sector covers the remaining 15%.

4.1.3.2. Demographic Changes in the Czech Republic

Most of the factors, which influence the health state of population, fall into a category of so-called demographic changes. One of major problems of today's world, when it comes to sustainability of economies, is demographic transition. The age structure of population changes, thus so does the health and productivity of human capital, which can deeply affect the whole economy.

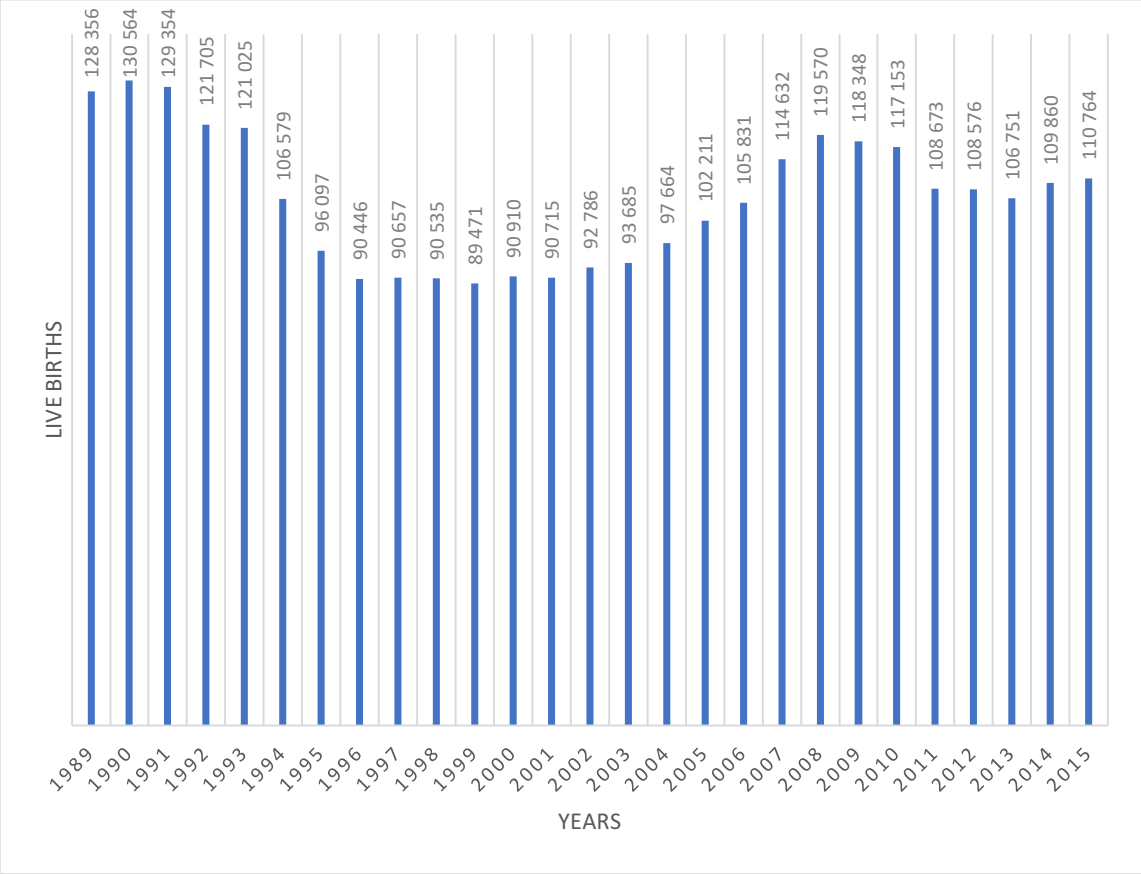
Figure 27: Development of Number of Inhabitants: year 1989 - 2015



Source: Czech Statistical Office, own processing of data

The Figure 27 above demonstrates how did the number of inhabitants, during the 26 year period from 1989 until 2015, change. Overall increase since 1989 was around 2% total. In the beginning of the 21st century, it is visible, that number decreased and since then up until 2006 recorder negligible yearly growth of only around 0,1%. The increase in number of inhabitant is an important component in quantity of human capital and quantity of labor force in general, which can have crucial impact on economic development.

Figure 28: Development of Number of Live Births: year 1989 - 2015

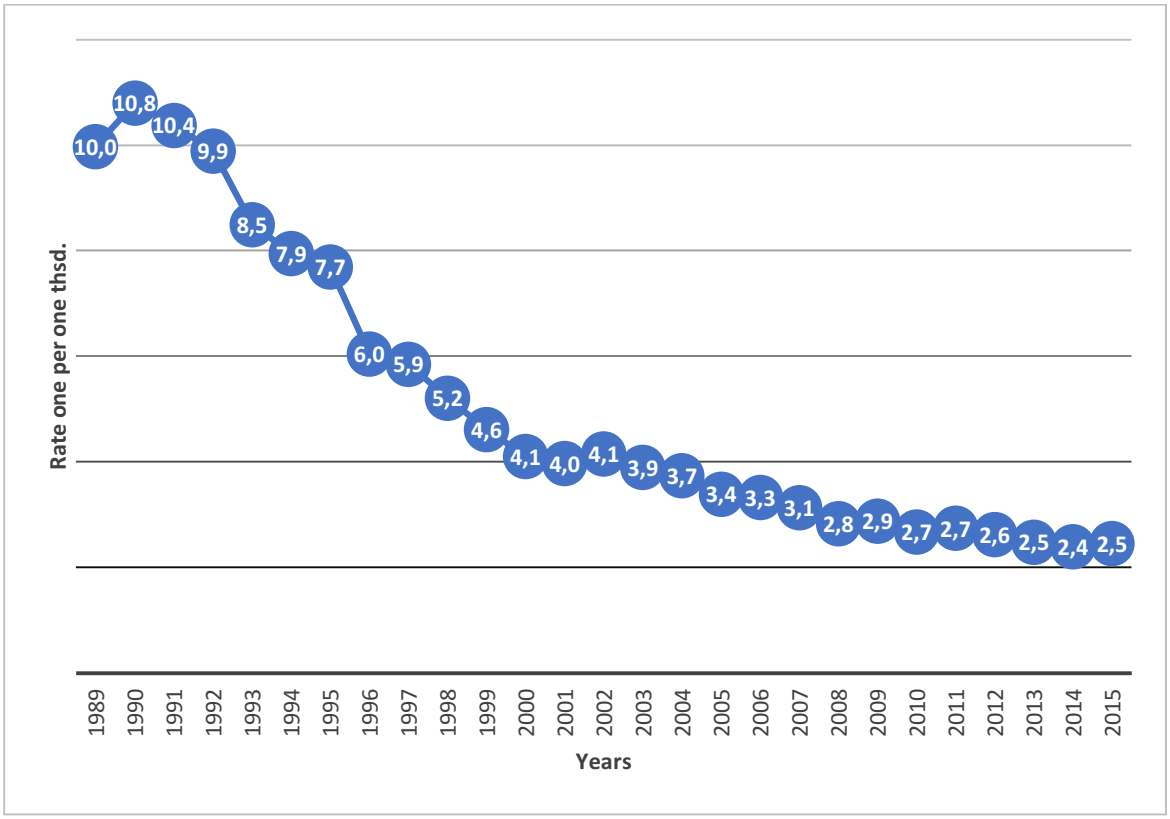


Source: Czech Statistical Office, own processing of data

From Figure 28 above is clearly visible that the Czech Republic recorded very significant decrease in fertility rate in the second half of the 1990's, as the number of live births declined by around 30% compared to the base year 1989. In the very beginning of the 21st century the number started to increase again, but registered a slight decreasing trend after 2009, which could be connected to social and economic reasons of uncertainty of inhabitant due to world economic crisis. The fertility rate in the Czech Republic between years 2000 and 2007 increased from 1.14 to 1.44 child per one women. With this increase rises another interesting trend, which is increased age of pregnant mothers. This can be explained by the sudden interest in motherhood, of women born in 1970's, which was a very fertile decade in the Czech Republic, who postponed having children until higher age due to various social and economic reasons.

From an international point of view, even though the fertility rate improved in the given period, Czech Republic is still lacking behind the EU28 fertility rate average by around 0.2 child per woman at the moment and 0.25 children per on woman, on the long term overall average.

Figure 29: Development of Infant Death Rate: year 1989 - 2015

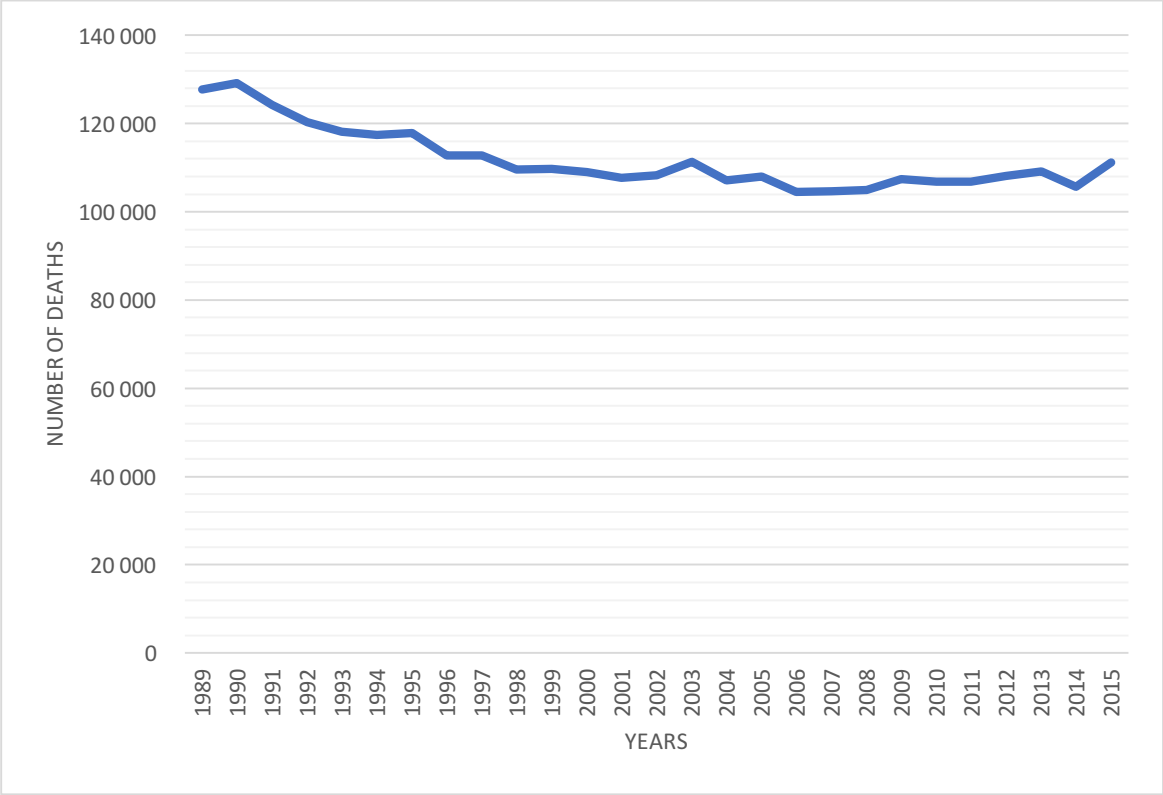


Source: Czech Statistical Office, own processing of data

The Figure 29 above shows the development on infant death rate in the Czech Republic between 1989 and 2015. The analysis and development of infant death rate is especially important to observe, if the population and overall fertility rate is in decline. The rate is measured as a quotient. This means that if the rate is 1, there is one death of an infant younger than 1 year old per 1000 infants born in the country. From the figure 29 it is obvious that there is a very positive development in the selected period. The rate has declined by astonishing 75% in the given period and as the trend suggests, it will most likely continue to decline in the future. In 2014 the infant death rate was the lowest in the Czech history. The Czech Republic has generally high level of prenatal and postnatal care,

which puts it among countries with the lowest number of infant deaths in the EU, but also in the world. The apparent reason for the decline is also the astounding progress in the medical field, as well as generally in the research and development, over the given period.

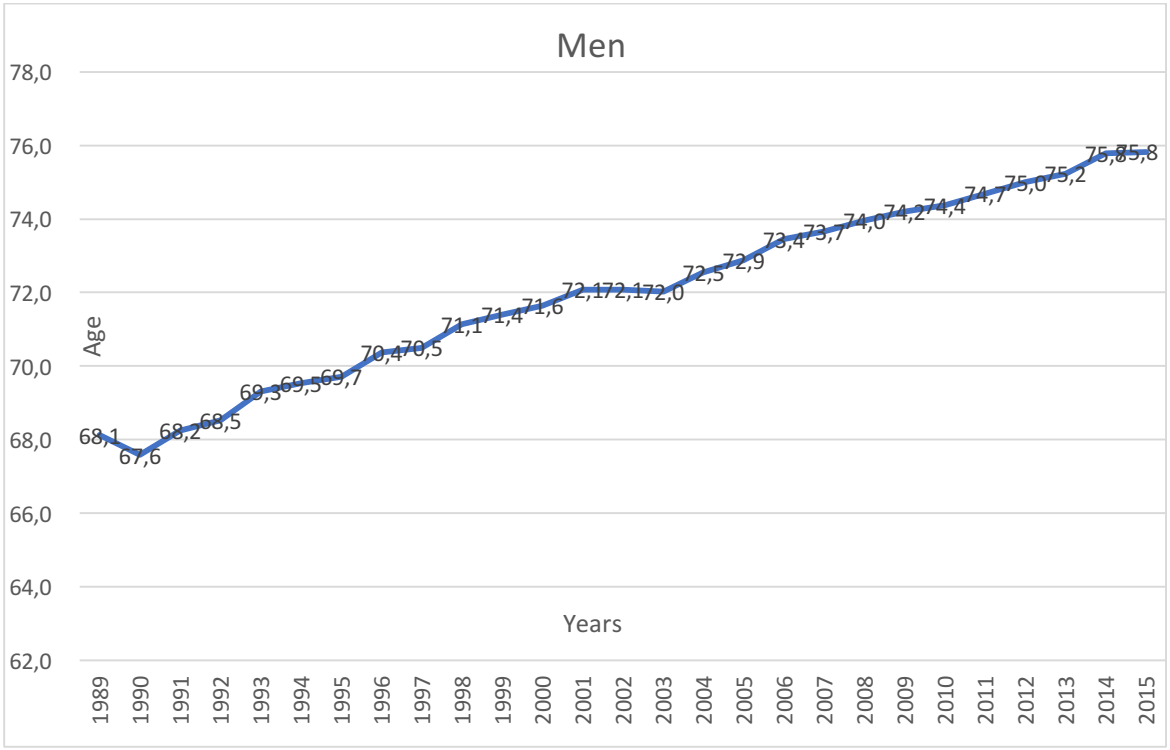
Figure 30: Development of Number of Deaths: year 1989 -2015



Source: Czech Statistical Office, own processing of data

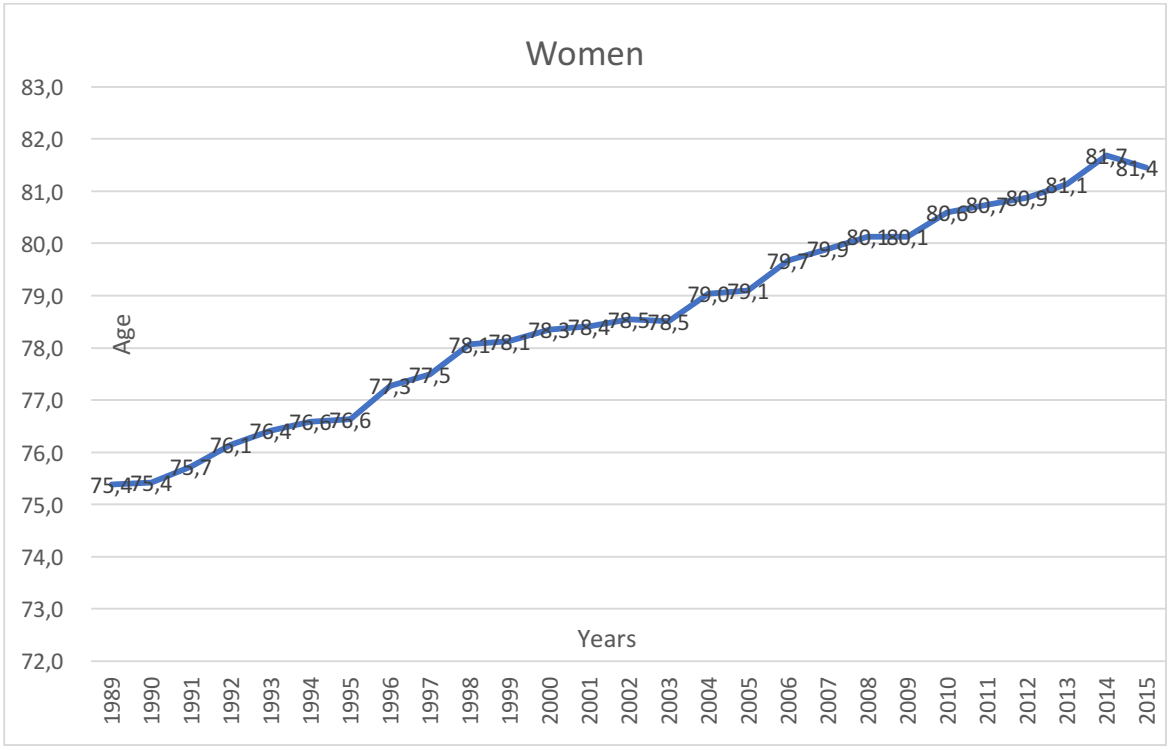
Figure 30 outlines the development in number of deaths in the Czech Republic in period from 1989 until 2015. It is noticeable to record an overall constant decline over the period, with certain exceptions in some years. The reason for the decline, is again progress in quality of provided health care and in medical science, research and development. With the decreasing death rate also comes a negative trend and that is higher share of population above 65-year-old due to ageing of population. For the overall development of death is usually used gross death rate, which calculates number of death per 1000 inhabitant of middle quantity. This rate is in the Czech Republic around 10.5 on average, which is a little bit higher than the overall average of the EU28, but it is constantly declining in the long-term horizon. This indicator has one imperfection, which is that it does not take into account the specifics of given population connected with age.

Figure 31: Development of Life Expectancy at Birth – Men: year 1989 - 2015



Source: Czech Statistical Office, own processing of data

Figure 32: Development of Life Expectancy at Birth – Women: year 1989 - 2015



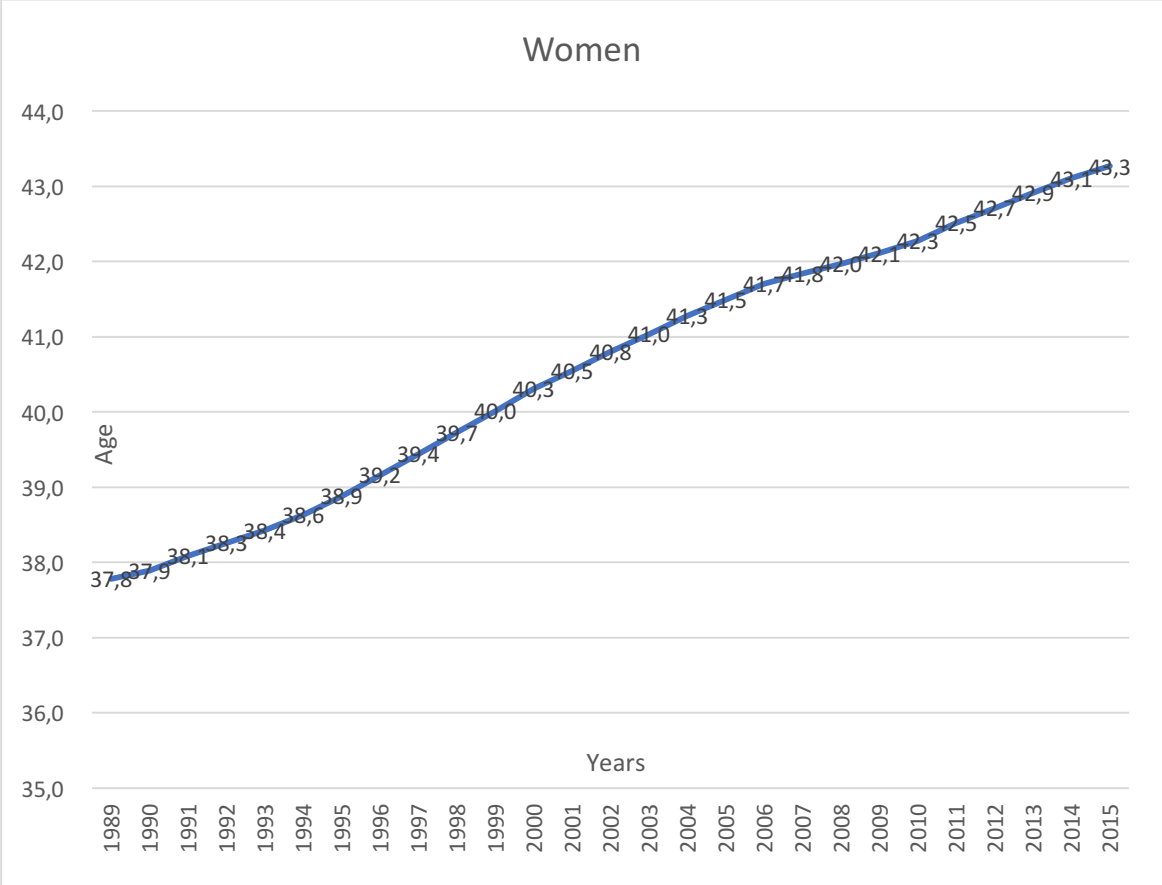
Source: Czech Statistical Office, own processing of data

The two Figures 31 and 32 show the development of life expectancy at birth of both men and women. The two figures differ mainly only in the expected living age, which on average is higher by 5 – 6 years for women than men, which is a trend generally prevailing all over the world for many years. The overall trend of increasing years of life can be seen in both men and women. This trend is currently prevailing in EU, as well as in the world. The yearly increment of expected living of almost one whole year can be seen in couple of years during the selected period in the Czech Republic, in both men and women, and contributed to the overall increase of living age expectancy of all inhabitants.

Figure 33: Development of Average Living Age – Men: year 1989 - 2015

Source: Czech Statistical Office, own processing of data

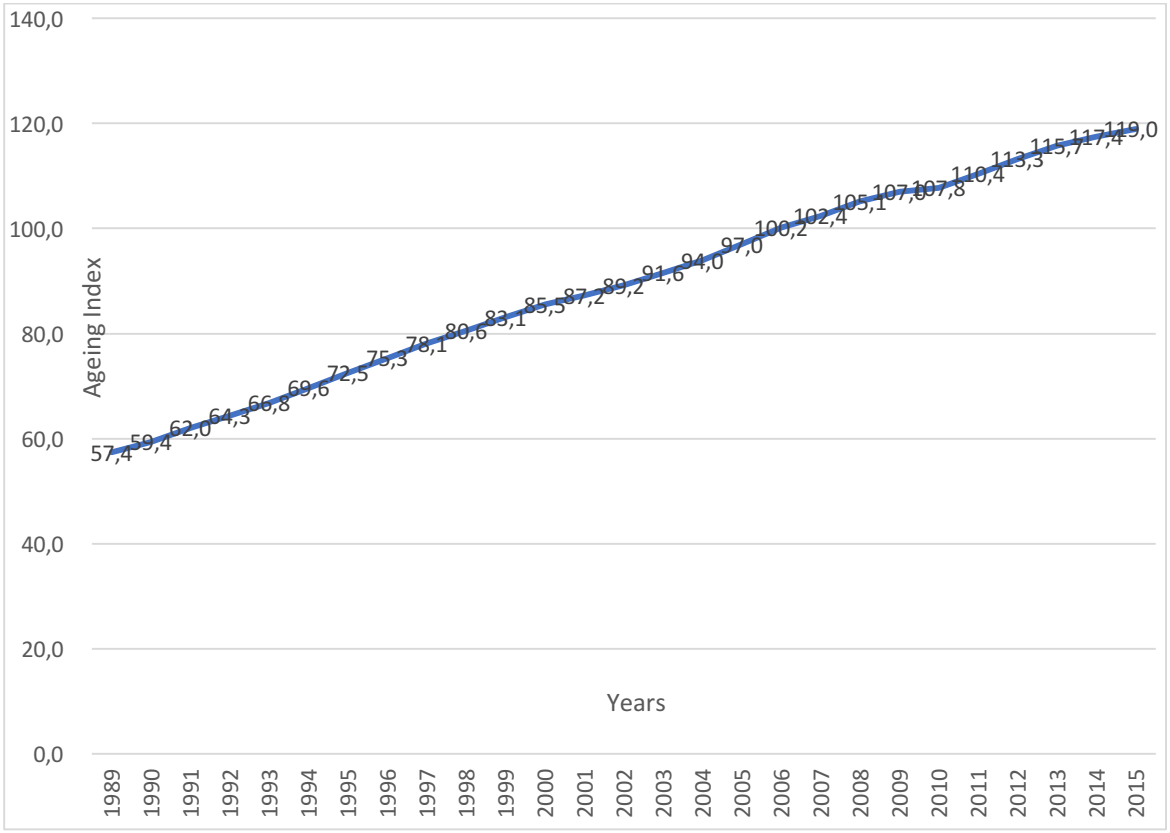
Figure 34: Development of Average Living Age – Women: year 1989 - 2015



Source: Czech Statistical Office, own processing of data

Figures 33 and 34 characterize the development of average living age in the Czech Republic during the period 1989 to 2015 in men and women. It is again possible to detect increasing trend in both men and women. While the average living age of men increased by 6 years from 34.4 to 40.4 years old, in women the increase was slightly smaller by 5.5. The average living age is generally higher, than in men by around 3 years, but so is the life expectancy for women at birth. The constantly increasing trend in average living age is one of the components, which form demographic transition and ageing of population. Although at the moment, the average living age still falls into the category of productive age or economically active age, the productivity might be decreasing with each year. If the average living age would continue to rise at this or even higher pace, it is possible that it will soon shift in the category of post productive age and cause major difficulties for the economic state and development of Czech Republic.

Figure 35: Development of Ageing Index: year 1989 – 2015



Source: Czech Statistical Office, own processing of data

Figure 35 shows the development of index of ageing in the Czech Republic in period 1989 to 2015. The ageing index is a very crucial measure of demographic development of a country. It measures the ratio of number of population above 60 and more years of age per 100 of children of 14 years and younger and is a very meaningful indicator of population ageing. It is especially meaningful in case of Czech Republic, where as it is visible from the figure, the ageing index had in the given period more than doubled. This means that, while in 1989 the number of inhabitant above 60 years old per 100 of children below 14 years old, was only around 57, in 2015 the number was 119. This shows that in 2015, the number of people above 60 years old was significantly higher, than the base number of 100 to which is it being compared to. The increasing ageing index was due to two reasons. One reason is the increasing number of living population above 60 years old, which however recorded only around 2% increase. The main reason is long-term decrease in fertility rate. This could mean the possibility of further burden in the future as the population ages more rapidly.

Share of Economically Active Population in the Czech Republic

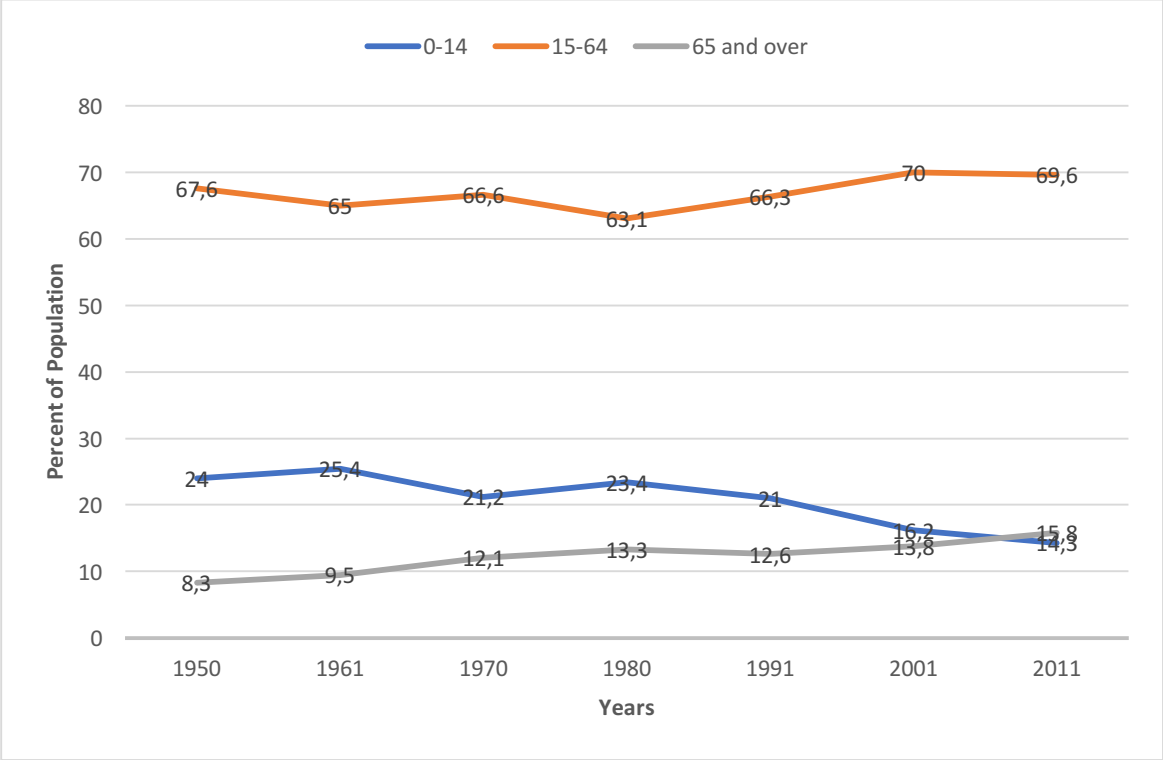
Table 10: Percentage Share of Economic Population: year 1950 - 2011

	1950	1961	1970	1980	1991	2001	2011
Total Inhabitants	100	100	100	100	100	100	100
Age 0-14	24	25.4	21.2	23.4	21	16.2	14.3
Age 15-64	67.6	65	66.6	63.1	66.3	70	69.6
Age 65 and over	8.3	9.5	12.1	13.3	12.6	13.8	15.8

Source: Czech Statistical Office, own processing of data

The Table 10 above lists the distribution of population into three major groups, from level of contribution to economic development. The first category, children up to 14 years old, is described as pre-productive age, as it does not provide or seek employment, but will in the future. Another category is 65 year olds and over, marked as post-productive population, which generally did provide employment in the past, but does not seek it anymore. Both these categories are marked as non-productive population. The last category is between the age of 15 and 64, which is an economically active and productive population, which either provides employment or is actively seeking it. Being the broadest group, when considering age, the economically productive population makes up the majority of population and is especially important for economic development and contributions in the Czech Republic.

Figure 36: Development of Share of Economic Population: year 1950 - 2011



Source: Czech Statistical Office, own processing of data

The Figure 36 above illustrates how did the share of each population group change in the 60-year period. Share of the economically productive category did not record any radical changes and generally stayed between the line of 65% to 70% of the population of Czech Republic. On the other hand, the two other categories underwent massive shifts. From 1950's until 1980's the share of pre-productive and post-productive group stayed somewhat the same, around average of 23% and 10%. After 1980's the share of pre-productive population started to decrease significantly and share of post-productive group increased even more. This negative trend resulted in a major shift in share of the two groups in 2011, when the share of post-productive age with 15.8% outgrew the share of pre-productive age with 14.3%.

Immigration and Population Development in the Czech Republic

Population ageing, decrease in fertility and overall decline in population can have very negative impact on a given economy. The obvious solution, is to try increase the fertility, by encouraging its inhabitant with certain benefits. However, the success does not have to be evident and immediate. Immigration is one of possible solution for the negative situation, as it can be relatively rapid and efficient.

Dependency Ratio

The dependency ratio is a measure, typically a proportion, of people, who are in labor force and who are not in labor force (dependent on them). It characterizes the level and share of economic burden of the labor force, which comes with higher share of those, who are not in the productive age group.

Table 11: Dependency Ratio in %: year 1950 – 2060 prediction

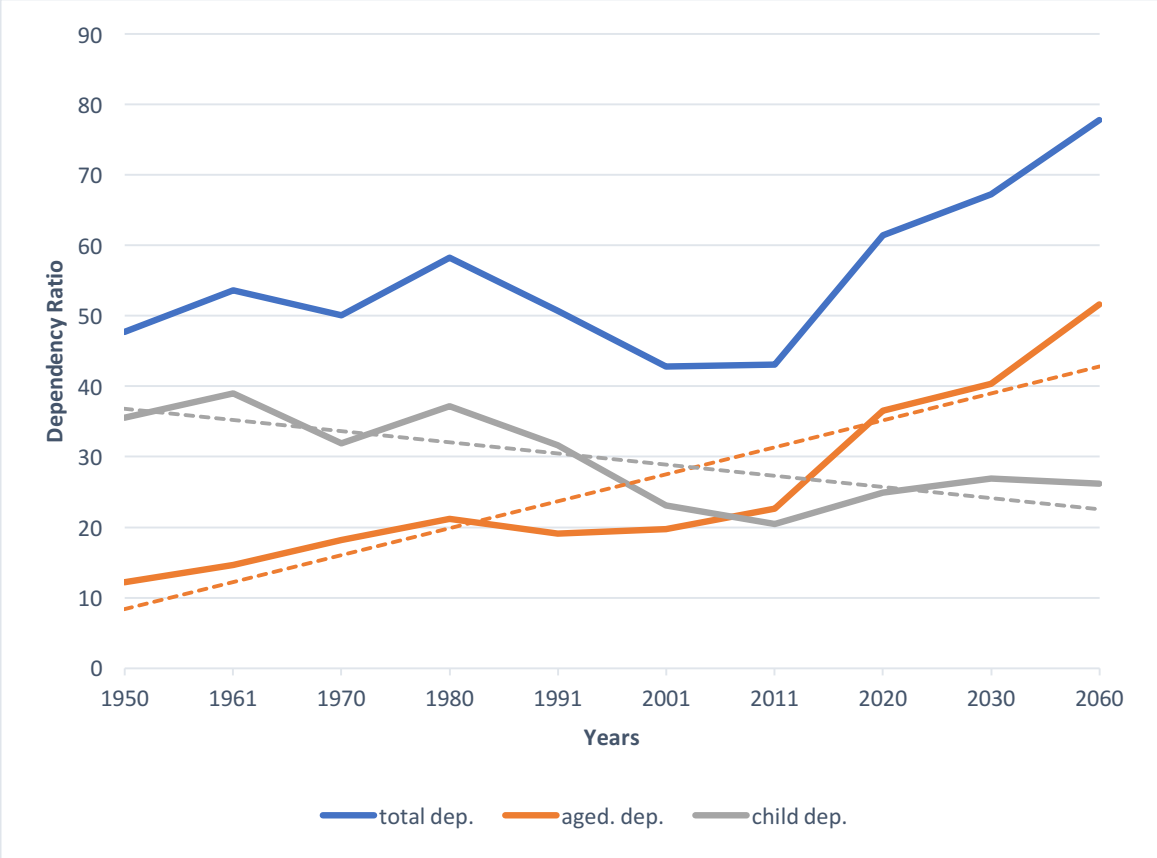
	1950	1961	1970	1980	1991	2001	2011	2020	2030	2060
Total dependency	47.76	53.67	50.09	58.3	50.72	42.8	43.12	61.45	67.27	77.78
Aged. dependency	12.21	14.65	18.22	21.15	19.05	19.7	22.63	36.52	40.4	51.59
Child dependency	35.54	39.02	31.87	37.15	31.67	23.11	20.49	24.93	26.87	26.19

Source: Czech Statistical Office, own processing of data

The Table 11 above shows the distribution of the dependency ratios in the Czech Republic, together with prediction for 3 periods. The total dependency ratio measures the total burden, which people in productive age group (25-64), must bear from the total share of non- productive population (people of age 0-25 and 64-older). It is possible to see, that while the total dependency did not increase, or even lowered in some years, from 1950 to 2011, in the future it is expected to increase enormously. The prediction is, that in 2060, total of 78% of non-productive population will be dependent on the only 30% of those,

who will be in productive age. Aged dependency ratio measure the share of those in post-productive age and productive age. Table 11 suggests, that year 2020 the share of those in prost productive age will be more than 36%, which is a 24% increase since the base year of 1950. Child dependency ratio is the only indicator, which is decreasing. This might seem like a good thing, but in fact can cause major difficulties. The fact that the share of pre-productive population is decreasing means, that there are less children born, which means that there might not be sufficient number of people in the productive age in the future.

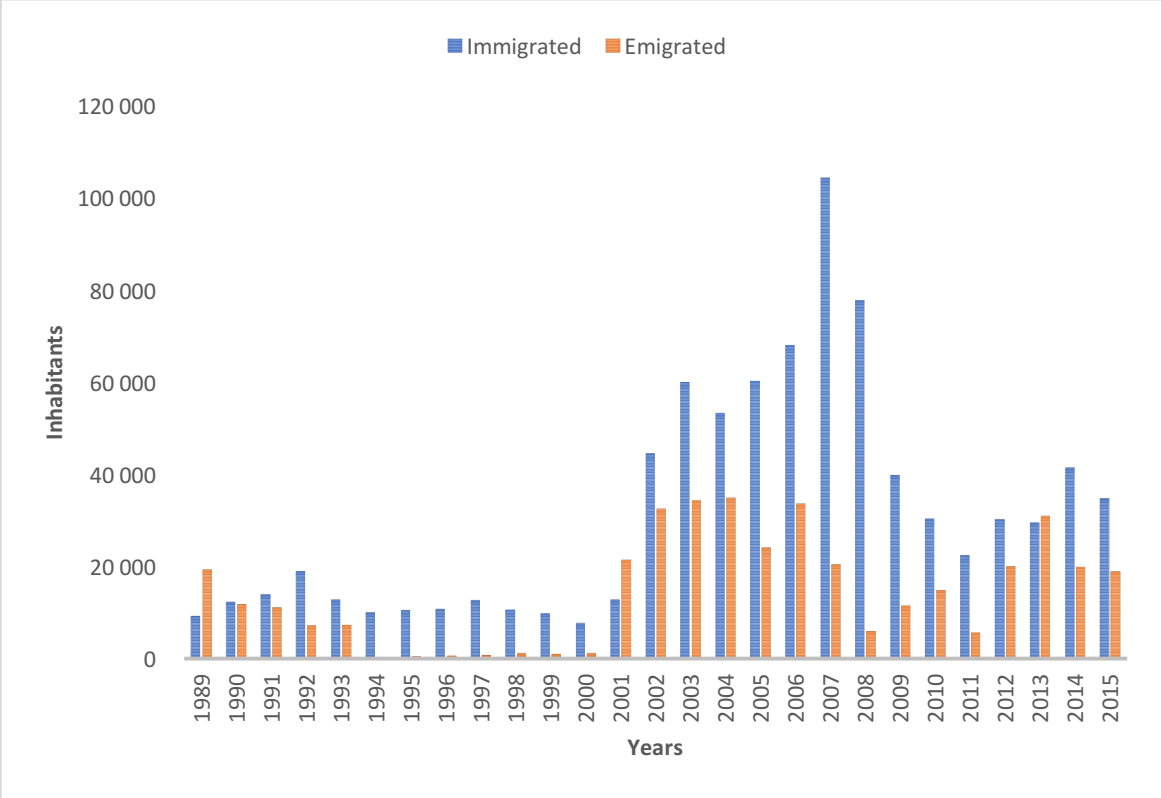
Figure 37: Dependency Ratio Development in %: years 1950 – 2060 prediction



Source: Czech Statistical Office, own processing of data

The Figure 37 above illustrates the changing trend between age dependency and child dependency in the Czech Republic, as was previously discussed in the text. Interesting outtake from this figure is, the proportion of the child and aged dependency ratio. While for the period of 1950 to 2000, the share of children dependency was higher than aged dependency, since 2004 the trend is reversed.

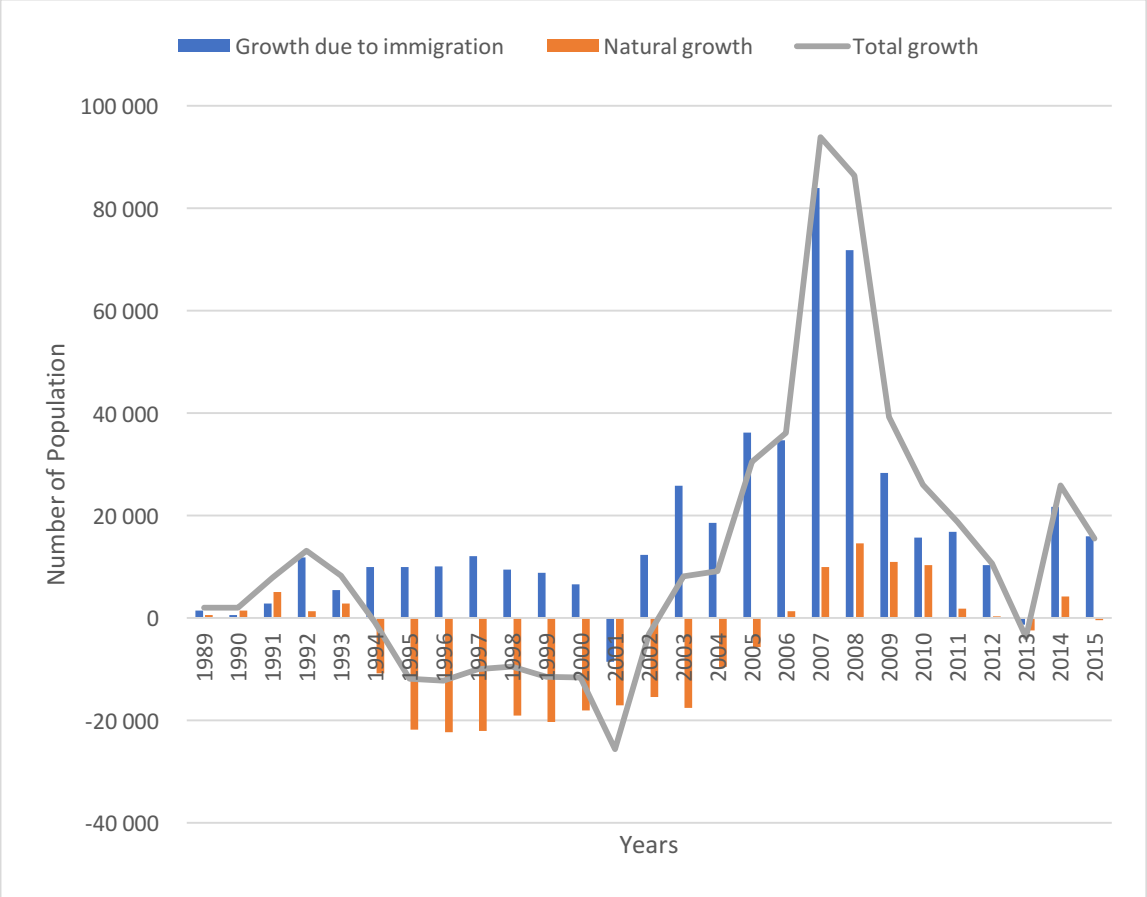
Figure 38: Development of Immigration and Emigration: year 1989 - 2015



Source: Czech Statistical Office, own processing of data

The Figure 38 above depicts the development and population, which immigrated to or emigrated from the Czech Republic from 1989 until 2015. The increases or decreases are generally proportional with certain exceptions. Throughout the 1990's the number of people, who immigrated into the Czech Republic was around 11 thousand a year. The number of people, who emigrated was much smaller and insignificant, especially in the second half of 1990's. In the very beginning of the 21st century there was an immigration boom until 2008. In the year 2007 the yearly immigration increment was an astonishing 104 thousand people. After that the numbers started to decline, but picked up again 2014, when the increment was around 40 thousand people. Over the 26 years period the total number of people, who immigrated was more than twice as much than the people who left the Czech Republic, with 852 thousand compared to 391 thousand.

Figure 39: Development of Population Growth: year 1989 - 2015



Source: Czech Statistical Office, own processing of data

Figure 39 shows development and share of growth of population due to immigration and natural growth as components of the total yearly growth of population from 1989 to 2015. It is possible to observe negative trend in natural growth of population. While growth due to immigration stayed, except for year 2001 positive throughout the whole 26-year period, natural growth switched to natural decline in population from 1994 until 2005. Even though, the growth of population due to immigration was positive from 1994, the negative numbers in natural growth, were so radical, that the total growth of population was negative as well, up until 2002. The total growth due to immigration was over the years more than 470 thousand people, however the natural growth rate was mainly negative during the period and the overall contribution was a 137 thousand decline. This caused the total average growth rate over the period to be even smaller, than the total average immigration growth, with 333 thousand people in total.

4.1.4. Outcome of the Analysis of Factors Influencing Human Capital

Education

The number of inhabitants in the Czech Republic has been constantly increasing over the past 60 years. Similar trend is also visible in the development of achieved education among the population. The analysis suggests that the number of graduates of each level of education increased significantly, particularly in the category of university graduates. Czech Republic dominates the share of high school education graduates in the EU, with 71% share, which is almost 25% above the EU average. The opposite result, however with the same message, is achieved also in basic category education. Czech Republic, with 14%, has the lowest share of only basic education graduates in the whole EU. On the other hand, the share of university education graduates is 8% lower than the overall EU average. The analysis suggests, that there are vast differences among wages according to achieved level of education. While people with university education get compensated around 40 thsd. CZK/month on average, basic education graduates received only almost half for providing their labor. Even though, the categories of high school and university education are closely linked, there are almost 10 tshd. CZK/month differences in wages and salaries between these two groups. When it comes to specific unemployment rate, differences among men and women are very low. However, there are enormous difference among categories of achieved level of education. Persons, with attained basic level of education generally make up to 25% of unemployed, while university graduates share only 2-3%. Considering investments towards the educational sector, Czech Republic generally lacks behind the EU average. The country's expenditures on education represent around 4.5% share of its GDP and during the past decade, the level of investment increased by only 1% on average. The average expenditures per student did not change significantly, but it is possible to see wide differences among expenditures per student according to educational level. While the average amounts for basic and high school education was around 40 thsd. CZK/student, the expenditure towards the university sector was twice as high. Interesting outtake is also the fact, that with the increasing number of university students, over the past years, the per student expenditures, increased by 37%. Focusing more on quality of human capital in terms of education, the comparison of Czech Republic's student in the TIMSS and PISA international tests can be evaluated. In 1995, the Czech 4^{th} and 8^{th} grader placed

6th and 7th in the TIMSS testing systems, since then they have not been able to repeated this excellent result. Since then, they achieved results only around 20th place. This can be influenced by increasing competition, with increasing number of participating countries, but it cannot be contributed only to this factor. In the PISA testing score, the Czech 15 years old students had registered decreasing trend since 2005. While in 2005 they were in the 15th place, ten years later they achieved only 25th place among the participating countries.

Health and Demographic Changes

The health sector recorder big increase in investment from both public and private sector in the period from 2000 to 2010. However, since 2010, barely any changes were recorded between expenditures. Given that the Czech Republic has universal health care, the majority of the investments come from the public sector. While the number of population increased in the selected period, there were certain demographic changes in the structure and share of population. Czech Republic recorded changes in number of live births, which at the end shifted the fertility rate downwards. On the other hand, the death rate decreased significantly as well, which can be contributed mainly to improvements in the fields of medicine and research. Life expectancies at birth increased since 1989 by 7 years for men and 6 years for women, which can also be linked to better health care and R&D. Average living age also changes in both cases. For men, the average living age shifted from 34 years in 1989, to 40 years in 2015. For women, the change was little bigger from 37 years in 1989 to 43 years in 2015. The ageing index jumped from 57 to 119 of population above 60 and more years of age per 100 of children of 14 years and younger, which directly influenced the dependency ratio. The dependency ratio of productive versus non-productive population increase by 5% in 5 years. The distribution of economically active population documented certain changes, implying the ageing on the population as well. In the period from 1950 to 2011, the share of group between 15 – 64 years of age, even increased slightly from 67 to 69%. On the other hand, the share of group of 0-15 years of age decreased in the given period by 20% to total of only 14%, which goes in accordance with the decreasing fertility rate based on number of live births. The share of population of 65 years old and above, increased in the selected period by almost twice as much to 16%.

This conforms with the decreasing death rate and increasing life expectancy among both men and women in the past years.

Among factors, which influence demographic changes and general growth to decline of population belong immigration and emigration of inhabitants. The results suggest, that the ageing of population and decrease of fertility rate in the Czech Republic, could be solved particularly by immigration. While in period from 1989 to 2015, there was a negative trend in natural growth of population and even in some years, natural decline in population occurred instead of growth. The total growth of population due to immigration was almost 500 thsd. inhabitants in the selected period and positive every year. Over the 26- year period, the total number of people who immigrated, was more than twice as much than the people who left the Czech Republic.

4.2. Econometric Analysis of Human Capital and Economic Growth in the Czech Republic

4.2.1. One-Equation Linear Regression Econometric Model

The primary focus of the analysis is to find evidence of impact of human capital on economic growth in the Czech Republic. As assumed, that human capital is not the only thing, which influences economic growth, other variables, which can have impact on it as well, were added to the model and expressed. The annual data necessary for the analysis, were collected from official source of Czech Statistical Office and range from year 1993 until 2015. The data set is provided in the appendices. The model is constructed as simple one-equation econometric model. It includes one endogenous (explained) variable and three exogenous (explanatory) variable, which influence it.

4.2.2. Description of Variables and Type of Dependency

Economic growth, which represents the depended variable, is characterized by GDP per capita in Purchasing Power Parity. The PPP approach was chosen, because it better describes the real differences in income per capita. The PPP takes into account domestic level of prices and inflation, opposite to the nominal approach, which works with international market exchange rates, which might have distorting effect on the actual differences. The influential factors in the form of independent (explanatory) variables are; physical capital in the form of available work forces in productive age (15 – 64 years old), technological progress, characterized by total factor productivity, and of course human capital, which is quantified using average number of years of schooling of population above 25 years of age in the Czech Republic. The total factor productivity is a measure used to describe growth in output, responding to changes in traditional inputs, in the form of factors of production, such as labor or capital. The method for calculating the TFP is to divide output by weighted average of inputs. The weight given to each input are 0.7 for labor and 0.3 for capital. Some economists argue, that TFP is not necessarily the ideal way how to quantify technological progress. On the other hand, many argue, that the increase in productivity is best described as increase in output, with the same amount of inputs and that is possible and successfully achieved with improvements in technology. It is relatively hard to describe the qualitative aspects of human capital, as there are no national

level testing models of education in the Czech Republic, which would be able to capture the differences in quality of human capital. It is, however, possible to quantify it by the average number of years of schooling among the population.

Table 12: Assumed Variables Dependency Based on Economic Theory

Variables	Influence	Type of Dependency
Available work force (15-64 years old) and GDP per Capita PPP	Increase in amount of available work force will cause growth in GDP per Capita	Direct
Total Factor Productivity and GDP per Capital PPP	Increase in Total Factor Productivity will increase GDP per Capita	Direct
Average years of schooling and GDP per Capita PPP	Increase in the average number of years of schooling will lead to increase in GDP per Capita	Direct

Source: Own processing of data

4.2.3. Model Formulation

Economic Model and Assumed Relationship

$$y_{1t} = f(x_{1t}, x_{2t}, x_{3t,} x_{4t})$$

GDP per capita in PPP is dependent on available work force, total factor productivity and average years of schooling in the Czech Republic. In other words economic growth in the Czech Republic is influenced by physical capital, technological progress and quantity of human capital.

Econometric Model

$$y_{1t} = \gamma_1 x_{1t} + \gamma_2 x_{2t} + \gamma_3 x_{3t} + \gamma_4 x_{4t} + u_{1t}$$

Linear relationship is used to model the relationship between the variables. It is necessary to include the stochastic error term, which includes any possible errors connected with measurement and specifications of the functional form of the model, as well as factors, which might have certain influence on the dependent variable, but were not included among the independent variables in the model.

Variables Declaration

Table 13: Variables Declaration

	Variable	Type	Units
y_{1t}	GDP per Capita PPP	Endogenous	Thousand EUR
x_{1t}	Unit vector ≡ 1	Exogenous	-
x_{2t}	Available Work Force (15-64)	Exogenous	Million people
x_{3t}	Total Factor Productivity	Exogenous	Index
x_{4t}	Average Years of Schooling	Exogenous	Years
u_{1t}	Error Term	Stochastic	-

Source: Own processing of data

Determination and Elimination of Multicollinearity in the Model

Detection of multicollinearity is a crucial assessment of strong dependency among explanatory variables. Occurrence of multicollinearity in the model is a negative feature and needs to be eliminated. It is measured by the Coefficient of Correlation R, which has an interval of <-1, 1>. If the value of R exceeds (0.8), there is a problem of multicollinearity in the model. However, the border value can be moved to (0.9), especially in the case in macroeconomic models. The coefficients of correlation are recorded in the Correlation Matrix.

Table 14: Correlation Matrix

y_{1t}	x_{2t}	x_{3t}	x_{4t}	
1.0000	0.5249	0.9841	0.9354	y_{1t}
	1.0000	0.5779	0.2477	x_{2t}
		1.0000	0.8815	x_{3t}
			1.0000	x_{4t}

Source: Own processing of data

There are two outcomes from the correlation matrix, which need to be analyzed. The correlation coefficient higher than 0.8, is detected in the relationships between x_{3t} and y_{1t}, and x_{4t} and y_{1t}. This however does not suggest multicollinearity, because the strong dependency is between explanatory and explained variables, which is not a negative feature. Correlation coefficient with value of 0.8815, among x_{4t} and x_{3t}, suggests multicollinearity between these two variables. It is possible to modify the original time series into first differences or exclude the variable from the model to solve the multicollinearity. However, by doing so, one of the major influencing factors would be eliminated from the model. The solution, which is done in this case is, that the border value of R, critical to distinguish multicollinearity, is moved to 0.9, as it is a macroeconomic model and the model can be proceeded for parameter estimation using Ordinary Least Square Method.

4.2.4. Estimation of Parameters

Parameters are estimated using Ordinary Least Square method, which works on the principal of minimizing sum of squared differences between the real and theoretical values of y_{1t} in a linear regression model. Statistical software Gretl is used for the estimation.

Table 15: OLS Model for Parameters Estimation Outcome

	Coefficient	Std. Error	t-ratio	p-value	SS
Const.	−54.8183	8.29312	−6.6101	<0.0001	***
x2t	3.10961	1.00914	3.0814	0.0061	***
x3t	22.136	2.67138	8.2864	<0.0001	***
x4t	3.21652	0.428265	7.5106	<0.0001	***

Mean dependent var.	**17.17024**	**S.D. dependent var.**	**4.179800**
Sum squared resid.	2.777355	S.E. of regression	0.382330
R-squared	0.992774	Adjusted R-squared	0.991633
F(3, 19)	870.1317	P-value(F)	1.64e-20
Log-likelihood	−8.324641	Akaike criterion	24.64928
Schwarz criterion	29.19126	Hannan-Quinn	25.79158
rho	0.442112	Durbin-Watson	1.099865

Source: Own processing of data

Estimated parameters

Table 16: Values of Estimated Parameters

Constant (Parameter of x_{1t})	**−54.8183**
Parameter of x_{2t}	**3.10961**
Parameter of x_{3t}	**22.136**
Parameter of x_{4t}	**3.21652**

Source: Own processing of data

Estimated Equation

$$\hat{y}_{1t} = -54.8 + 3.11*x_{2t} + 22.1*x_{3t} + 3.22*x_{4t} + u_1t$$

4.2.5. Interpretation and Economic Verification of the Estimated Parameters

The interpretation and following economic verification of the estimated parameters are steps, which are necessary to be done in testing, whether the model is consistent with economic theory.

Parameter	Value
γ_1	−54.8183

The parameter of x_{1t}, respectively the constant, characterizes the value of GDP per capita in PPP, if all other variables are 0. While this hold from mathematical point of view, the actual interpretation would suggest, that the GDP per Capita in PPP is negative 54.8283 thousand EUR. This of course does not make sense and explanation for the negative value of the constant is, that the other variables are never equal to 0, thus making the assumption with all variables held equal to 0 is impossible. Constant cannot be interpreted under such assumption, as the data point might be outside the range of the observed data.

Parameter	Value
γ_2	3.10961

The parameter of x_{2t} suggests that if the number of available work force would increase by 1 unit, the GDP per Capita would increase by 3209.61 EUR. This evidence complies with economic theory, as well as the assumed dependency of the variables.

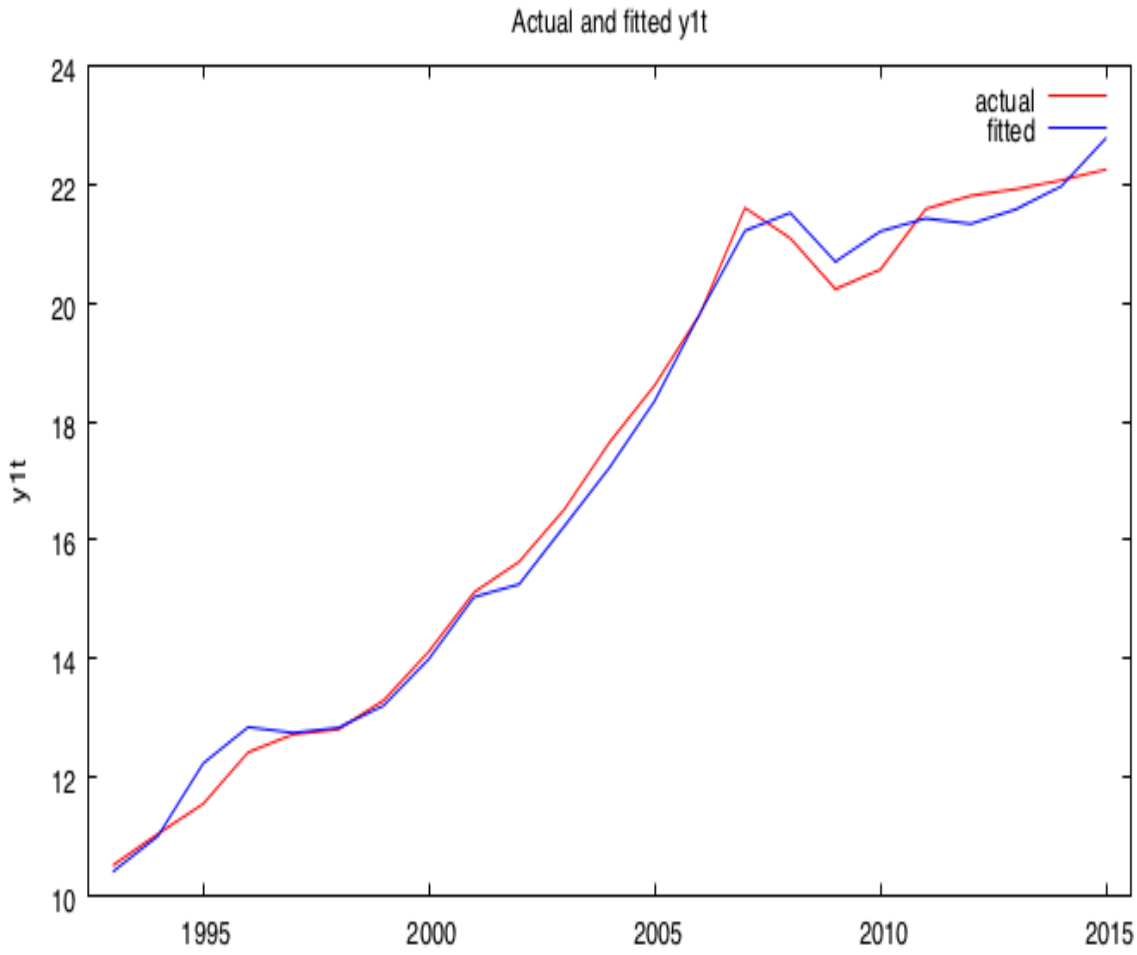
Parameter	Value
γ_3	22.136

The parameter of x_3t demonstrates, that if the Total Factor Productivity increases by 1 unit, the GDP per Capita, grows by 22 163 EUR. It is fundamental to understand that, while this change might seem extreme, it is due to the fact, that the TFP usually change by only around 0.03 of its units. The direction of the change satisfies the economic theory and assumptions about the dependency of variables.

Parameter	Value
γ_4	3.21652

The key and most crucial is the interpretation and verification of the parameter of the variable describing changes in the quantity of human capital. The parameter of x_4t shows, that with an increase by one unit of average years of schooling, which means one year, the GDP per Capita in PPP would increase by 3216.52 EUR. This fact also complies with economic theory and assumed relationship among variables.

Figure 40: Actual and Fitted y_{1t} Against Time



Source: Own processing of data

The Figure 40 above illustrates the actual values of GDP per capita in PPP (red line) and the fitted values of GDP per capital in PPP (blue line), which are generated by the estimated equation. The lines suggest that, while there are certain errors in the values throughout the period, as a whole, the values determined by the estimated equation are very accurate. However, the significance of the parameters of the equation, as well as the whole model, need to be statistically tested.

4.2.6. Statistical Verification

Statistical verification is an unavoidable step in the verification of the linear model. It checks, if the parameters are statistically significant and measures the goodness of fit of the whole model.

Testing of Significance of Parameters

Table 17: Testing of Significance of Parameters Outcome

	Coefficient	Std. Error	t-ratio	SS
constant	−54.8183	8.29312	−6.6101	***
x_{2t}	3.10961	1.00914	3.0814	***
x_{3t}	22.136	2.67138	8.2864	***
x_{4t}	3.21652	0.428265	7.5106	***

Source: Own processing of data

Determining of level of significance using statistical software Gretl is fairly simple. The last column of the table above shows the statistical significance of each parameter. The number of stars determined the significance at each level of significance α. No star means statistically insignificant parameter. One stars means statistically significant at level α of 10%, two stars at level α of 5%, three stars at level α of 1%. In practice, testing the significance of each individual parameters can be done by number of different ways. One way, is to calculate the t-value of each parameters and individually compare it with critical table value according to degrees of freedom and level of significance α. Another way is to compared the p-value, which describes the probability, at which the null hypothesis holds, with the chosen level of significance α and based on the criteria, determine the significance of each parameter.

Statistical Significance of Parameter γ_1

Hypotheses

H_0: $\gamma = 0$ Parameter is not statistically significant
H_A: $\gamma \neq 0$ Parameter is statistically significant

Table 18: Statistical Significance of Parameter γ_1

Variable	Parameter	Level of significance α	p-value	Significant/Insignificant
x_{1t}	γ_1	0.01	2.52e-06	Statistically Significant

Source: Own processing of data

In case of parameter γ_1, the p-value is smaller than <0.0001, which is many times smaller than the level of significance α. The null hypothesis is rejected; the alternative hypothesis is confirmed and the parameter is then statistically significant.

Statistical Significance of Parameter γ_2

Hypotheses

H_0: $\gamma = 0$ Parameter is not statistically significant
H_A: $\gamma \neq 0$ Parameter is statistically significant

Table 19: Statistical Significance of Parameter γ_2

Variable	Parameter	Level of significance α	p-value	Significant/Insignificant
x_{2t}	γ_2	0.01	0.0061	Statistically Significant

Source: Own processing of data

The p-value 0.0061 < 0.01, this means that the null hypothesis is rejected, thus the parameter is statistically significant.

Statistical Significance of Parameter γ_3

Hypotheses

H_0: $\gamma = 0$ Parameter is not statistically significant
H_A: $\gamma \neq 0$ Parameter is statistically significant

Table 20: Statistical Significance of Parameter γ_3

Variable	Parameter	Level of significance α	p-value	Significant/Insignificant
x_{3t}	γ_3	0.01	9.90e-08	Statistically Significant

Source: Own processing of data

The p-value of parameter γ_3 is smaller than level of significance set to 1%, which means the parameter is statistically significant, as the null hypothesis is rejected.

Statistical Significance of Parameter γ_4

Hypotheses

H_0: $\gamma = 0$ Parameter is not statistically significant
H_A: $\gamma \neq 0$ Parameter is statistically significant

Table 21: Statistical Significance of Parameter γ_4

Variable	Parameter	Level of significance α	p-value	Significant/Insignificant
x_{4t}	γ_4	0.01	4.22e-07	Statistically Significant

Source: Own processing of data

The level of significance α, is like in all previous case smaller than p-value of the parameter γ_4, and it causes the rejection of the null hypothesis, making the parameter statistically significant.

Testing of Significance of Confidence Intervals of Parameters

Table 22: Confidence Interval of parameters: 1-α, α=5%

VARIABLE	COEFFICIENT	95% CONFIDENCE INTERVAL	
Const.	-54.8183	-72.1760	-37.4606
x2t	3.10961	0.997454	5.22176
x3t	22.1360	16.5447	27.7273
x4t	3.21652	2.32015	4.11289

Source: Own processing of data

The condition of determining the statistical significance of parameters is, that if the confidence interval, of the tested parameter, does not contain 0 value, the parameters is then said to be statistically significant. In case of all four parameters, the 95% confidence intervals do not contain 0. The fact that the values of the interval of the parameter γ_1 are negative does not have any impact on the significance criteria.

Table 23: Confidence interval of parameters: 1-α, α=1%

VARIABLE	COEFFICIENT	99% CONFIDENCE INTERVAL	
Const.	-54.8183	-78.5444	-31.0922
x2t	3.10961	0.222525	5.99669
x3t	22.1360	14.4934	29.7786
x4t	3.21652	1.99128	4.44176

Source: Own processing of data

If the confidence interval is changed to stricter criteria of 99%, it is possible to see from the table above, that all the parameters remain statistically significant at this level, as none of the four intervals contains 0. The confidence interval with α=1% suggests, that 99% of observation lies within this interval.

Testing of Significance of the Model

Unlike the testing of each individual parameters by t-test or p-value, the goodness of fit, measures the significance of the whole model. It is represented by the coefficient of determination R^2, which describes the tightness of dependence. The value of R^2 can be in the interval <0,1> and is also possible to be interpreted in percent.

Table 24: Goodness of fit R^2

Mean dependent var.	17.17024		S.D. dependent var.	4.179800
Sum squared resid.	2.777355		S.E. of regression	0.382330
R-squared	0.992774		Adjusted R-squared	0.991633

Source: Own processing of data

The R-squared of 0.99 suggests that 99% of variation in the dependent variable is explained by the independent (explanatory) variables and the functional form of the model, which represents the relationship between the variables. The other 1% variation is explained by other factors, not included in the model. Adjusted R-squared, has a slightly lower value than R-squared, but still above 99%. The fact that adjusted R-squared is lower is perfectly normal, because it describes the dependency with adding another explanatory variable, thus adding more degrees of freedom.

4.2.7. Econometric Verification

Econometric verification is another step, which needs to be done in the econometric analysis in order to confirm, that the assumptions about the linear regression model estimates hold.

Table 25: Assumption of the LRM Estimates

Zero mean	$E(u_t) = 0$	Not tested
Covariance	$(x_{1t}, u_{1t}) = 0$	Not tested
Linearly independent columns of non-random matrix X	h (X) = k	Not tested

Normal distribution of u_t	$u_t (0, \rho^2)$	Tested (Jarque-Bera)
Constant variance - Homoscedasticity	$u_t = \rho^2 < \infty$	Tested (White + Breusch-Pagan)
No Autocorrelation	$(u_t, u_{t-1}) = 0$	Tested (Durbin-Watson + Breusch-Godfrey)

Source: Own processing of data

Autocorrelation

Autocorrelation is used to test for mutual dependence of residuals. It tests, if there is dependency between u_t and u_{t-1} and if the assumption; covariance $(u_t, u_{t-1}) = 0$.
Autocorrelation of first order is tested by Durbin-Watson and Breusch-Godfrey Tests.

1. Durbin –Watson Test for Autocorrelation of First Order

Test Statistic:

$$d = \frac{\sum_{t=2}^{n} (u_t - u_{t-1})^2}{\sum_{t=1}^{n} u_t^2}$$

$d \in [0, 4]$

Conditions:

- if d approaches 0, ρ is close to 1
- if d = 2, ρ = 0
- if d approaches 4, ρ is close to -1

Hypothesis:

$H_0 : \rho = 0$ No autocorrelation

$H_1 : \rho > 0$ Positive autocorrelation

$H_2 : \rho < 0$ Negative autocorrelation

Value:

Durbin-Watson statistic = 1.09987

Decision:

According to the value of DB statistic, it is between 0 and 2, which means there can be positive or no autocorrelation, or the test can be inconclusive, depending on the upper and lower limits.

5% critical values for Durbin-Watson statistic, n = 23, k = 3:

- $d_L = 1.0778$
- $d_U = 1.6597$

$1.0778 < 1.09987 < 1.6597$

The DB test statistic is in between the critical values of $d_{,lower,\alpha}$ and $d_{,upper,\alpha,}$ which means it is impossible to say anything about autocorrelation, because the value of the test, is in the inconclusive section. It is necessary to test the autocorrelation by different test.

2. Breusch-Godfrey Test for Autocorrelation of First Order

Hypothesis:

H_0: No autocorrelation of first order (the time series is fixed)

H_A: Autocorrelation of first order

Values:

Breusch-Godfrey test for first-order autocorrelation

OLS, using observations 1993-2015 (T = 23)

LMF = 4.084492 with p-value = P(F(1,18) > 4.08449) = 0.0584

Decision:

P-value = 0.0584 > level of significance $\alpha = 0.05$

The null hypothesis cannot be rejected; this means there is no autocorrelation of first order in the model.

Heteroscedasticity

Heteroscedasticity occurs, when the variance is not constant, meaning that it depends on the parameters. If the variance in the covariance matrix are heterogeneous, there is heteroscedasticity present in the model. It is necessary to test to confirm the assumption about the LRM estimates, that the variance is constant and homogeneous.

1. White's Test for Heteroscedasticity

Hypothesis:

H_0: there is homoscedasticity in the model

H_A: there is heteroscedasticity in the model

Values:

White's test for heteroscedasticity

OLS, using observations 1993-2015 (T = 23)

Dependent variable: uhat^2

with p-value = P(Chi-square(9) > 11.027580) = 0.273823

Decision:

The p-value = 0.273823 > level of significance α= 0.05. The null hypothesis holds. There is no heteroscedasticity in the model.

2. Breush-Pagan Test for Heteroscedasticity

Hypothesis:

H_0: the residual variance depends on one explanatory variable

H_A: the residual variance depends on more than one explanatory variable

Values:

Breusch-Pagan test for heteroscedasticity

OLS, using observations 1993-2015 (T = 23)

with p-value = P(Chi-square(3) > 1.099176) = 0.777273

Decision:

Level of significance α= 0.05 < p-value= 0.777273. This means that the null hypothesis cannot be rejected and there is no heteroscedasticity in the model, because the residual variance depends on more than one explanatory variable.

Normality

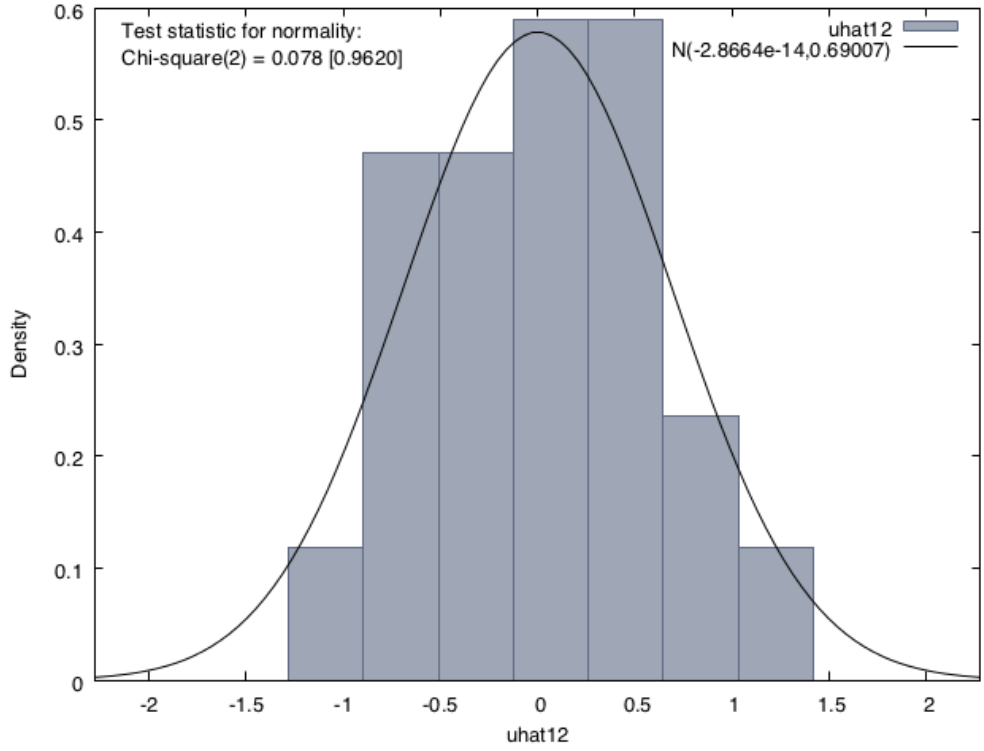
Normality is tested to see, if there is normal distribution of the error term. The assumption that the error term is normally independently distributed needs to be confirmed.

Hypothesis:

H_0: normal distribution of u_t in the model.

H_A: no normal distribution of u_t in the model.

Figure 41: Normal Distribution of u_t



Source: Own processing of data

Figure 41 illustrates, that the distribution of the residual resembles the bell-shaped curve for normal distribution, however still needs to be tested.

Values:

Test for null hypothesis of normal distribution:
Chi-square(2) = 0.078 with p-value 0.96198

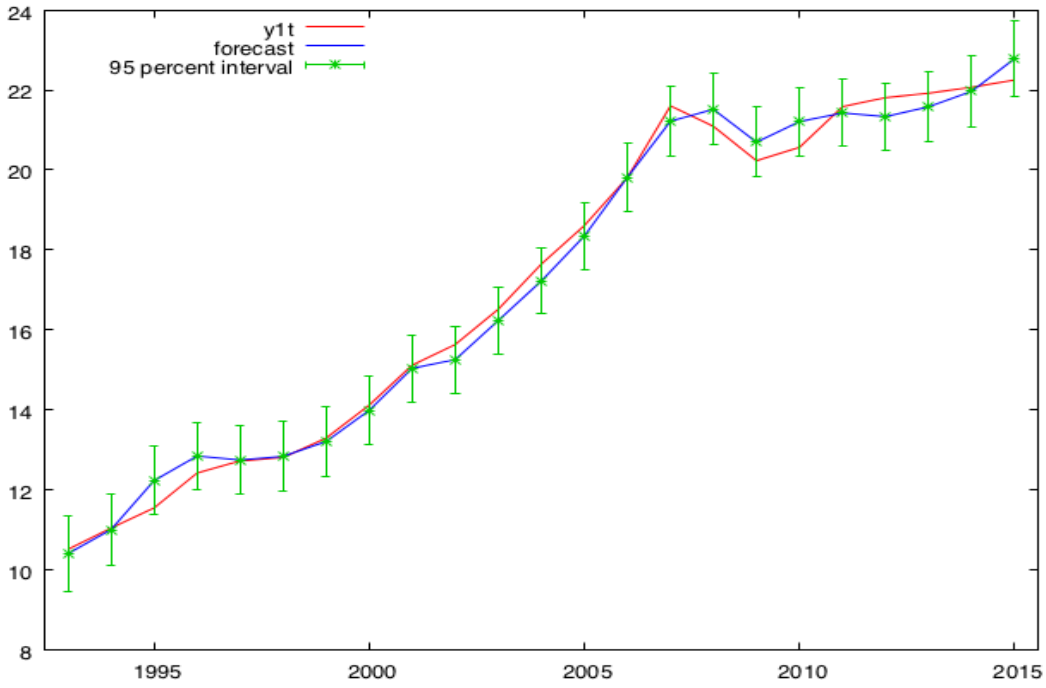
Decision:

P- value =0.96198 > level of significance α= 0.05. The null hypothesis cannot be rejected. There is normal distribution of u_t in the model.

Ex-post Forecast

The ex-post forecast compares forecasted values with actual values in the past and is done for the purpose of testing, whether the model is suitable for ex-ante (future) prognosis.

Figure 42: Ex-post Forecast



Source: Own processing of data

Figure 42 compares the actual values and forecasted values of ex-post forecast. It shows that the forecasted values fall within the 95% confidence interval, which suggests that the model is of a good quality and can be used for ex-ante prognosis.

4.2.8. Results of the Model

The model was focused on quantifying the influence of amount of physical capital, technological progress and human capital on economic growth. With the use of Ordinary Least Square method for parameter estimation, the following results were obtained from the estimated model. Physical capital, which was express by number of available work force (15 – 64 years of age), has positive influence on economic growth. This means, that if the number of available work force increases, GDP per capita in PPP, which expresses economic growth, increases as well. There also exists positive relationship between technological progress and economic growth. The model suggests, that if total factor productivity increases, the GDP per capita in PPP grows as well. The last relationship of interest, and perhaps the most important, is between human capital and economic growth. Results obtained by the model, where human capital was quantified by average years of schooling, suggest that there is a positive relationship between the two variables. With an increase in average years of schooling, there is an increase in GDP per Capita in PPP, thus increase in economic growth. Parameters of each variable and the model as a whole had to be verified, in order to confirm its suitability for modelling of such relationships. Economic verification confirmed, that the size and direction of parameters was in accordance with economic theory. Testing of statistical significant of each parameter proved that all the estimated parameters were significant. Testing for goodness of fit by R^2 supports, that 99% of the variation in the dependent variable, is explained by the influencing variables and the functional form of the relationship. Econometric verification verified, that there is no autocorrelation of residuals in the model. The variance does not depend on the parameter, thus there is also no heteroscedasticity in the model and the residuals are normally independently distributed.

4.2.9. Implication of the Model for Human Capital and Economic Growth

The results of the model for human capital and its impact on economic growth are the main objectives of the analysis. As it was already previously stated, the economic verification confirmed the accordance with economic theory. The testing of significance of the parameter of the variable average years of schooling, which expresses the quantity of human capital, confirmed the statistical validity of the parameter. And the econometric

verification supported the validity of the model as well. The parameter estimated by the model shows positive relationship between the quantity of human capital and economic growth. And as for the size, the parameter estimated by the model has a value of positive 3.21652. This means that with an increase in average years of schooling by one unit and all the other variables held constant, GDP per Capita in PPP would increase by 3216.52 EUR. The results of the model support the assumptions and dependency of the analyzed relationship. There is a direct positive relationship between the quantity of human capital and economic growth in the Czech Republic. An increase in quantity of human capital, expressed by average years of schooling, leads to an increase in economic growth, expressed by GDP per Capita in PPP, in the Czech Republic.

5. Conclusion

As it was clearly explained and clarified, in the literature review, human capital impacts economic growth in general. The main components, which influence human capital are education and health, more precisely the demographic changes linked to it. Based on these assumption, it was necessary to conduct analysis of these aspects of human capital, in order to examine and evaluate their state in the Czech Republic and determined the influence of human capital on economic growth in the Czech Republic. The analysis of educational aspects discovered positive trends in increasing number of students, as well as increasing share of people with attained university education. For example, it suggests that the number of graduates of each level of education increased significantly, particularly in the category of university graduates, which increased by 136% since 1995. Czech Republic dominates the share of high school education graduates in the EU, with 71% share, which is almost 25% above the EU average. Comparing investments into the educational sector, Czech Republic generally lacks behind the EU average. The country's expenditures on education represent only around 4.5% share of its GDP. The analysis also found, that there are vast differences among wages according to achieved level of education. While people with university education get compensated around 40 thousand CZK/month on average, basic education graduates received only almost half for providing their labor.

Focusing more on the health and demographic changes aspect of the analysis, there have been some significant shifts, suggesting ageing of the population. For example, the life expectancy age increased for both men and women since 1989 by 6 years, as well as the average living age, which increased by 6 years as well, for both men and women. At the same time, Czech Republic still lacks behind the EU fertility rate average by 0.2 child per women, which causes inevitable changes in the structure of population. The share of group of 0-15 years of age decreased in the given period by 20% to total of only 14%, while the share of population 65 years old and above, increased in the selected period by almost twice as much to 16%.

The conducted econometric analysis confirmed the assumptions about the impact of quantity of human capital on economic growth and all the other relevant variables, included in the model, in the Czech Republic. There was found direct positive relationship

between human capital and economic growth. Based on the parameter of human capital, an increase in quantity of human capital, expressed by average years of schooling, would lead to an increase by 3216.52 EUR in economic growth, expressed by GDP per Capita in PPP, in the Czech Republic. The analysis also confirmed that all of the other variables, physical capital and technological progress have direct positive impact on economic growth. This means, that with an increase in technological progress or physical capital, there would be an increase in economic growth. The conducted verification of the linear regression model confirmed, that the parameters are in accordance with economic theory and all of them are statistically significant. The goodness of fit R^2 with value 0.99, suggests that 99% of variability in GDP per capita in PPP, can be explained by the variable included in the model, among influencing variables. The econometric verification confirmed, that there is no autocorrelation of residuals, no heteroscedasticity and the residuals are normally independently distributed.

The crucial outcome, that comes from the connection of the descriptive and econometric analysis suggests following. It was found that the amount of physical capital does have impact on economic growth, which can be a problem in the future, because if the ageing of the population continues at given pace, Czech Republic will face certain economic difficulties due to scarcity of labor force. However, it was also discovered that the quantity of human capital, expressed by average number of years of schooling also positively impacts economic growth. Based on the detection, that the number of students with the highest level of achieved education has increased significantly, the possible negative influences of ageing population could be reduced or eliminated by concentrating more on the educational sector. It is up to the relevant authorities of the Czech Republic to develop and implement such solutions, which would contribute to maintaining sustainable economic growth and assure its efficiency.

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7. Appendices

7.1. Data Set for Estimation of Linear Regression Model

Year	y_{1t}	x_{1t}	x_{2t}	x_{3t}	x_{4t}
1993	10,5135745	1	6,981337	0,74531	8,4
1994	11,0456745	1	7,028905	0,75113	8,5
1995	11,5498580	1	7,055805	0,77365	8,7
1996	12,4223811	1	7,07821	0,78966	8,76
1997	12,7249352	1	7,102231	0,77315	8,82
1998	12,8092971	1	7,126712	0,76205	8,9
1999	13,2972304	1	7,152815	0,76791	8,95
2000	14,1206730	1	7,179109	0,79226	9
2001	15,1184365	1	7,170017	0,82635	9,1
2002	15,6346374	1	7,195541	0,82962	9,12
2003	16,5174438	1	7,233788	0,85833	9,19
2004	17,6466204	1	7,259001	0,89072	9,25
2005	18,6071997	1	7,293357	0,92931	9,3
2006	19,8069402	1	7,325238	0,98109	9,37
2007	21,5998154	1	7,391373	1,01609	9,5
2008	21,0882774	1	7,431383	1,01971	9,53
2009	20,2296870	1	7,41356	0,97477	9,6
2010	20,5635780	1	7,378802	0,9884	9,7
2011	21,5814086	1	7,262768	1	9,8
2012	21,8054721	1	7,188211	0,99183	9,9
2013	21,9187535	1	7,10942	0,98492	10,1
2014	22,0655875	1	7,056824	0,99519	10,2
2015	22,2486544	1	6,997715	0,99687	10,5

Source: Czech Statistical Office, own processing of data