2010-2011

The Competitiveness of the Czech Republic

– Quality of human resources

National Observatory of Employment and Training - National Training Fund

ANALYSIS

Research Centre
for Competitiveness
of Czech Economy

NATIONAL OBSERVATORY
NTF CZECH REPUBLIC

The Competitiveness of the Czech Republic 2010 – 2011 Analysis

Part – Quality of Human Resources

CONTENT

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The publication has been supported by the research grant of the Ministry of Education, Youth and Sport No. 1M0524.

Introduction

The publication **THE QUALITY OF HUMAN RESOURCES** consists of three chapters. Their themes have been chosen in relation to both current developments in the labour market and changes in requirements on availability and quality of occupational groups. All the chapters not only pay attention to selected problem areas in the CR, but they also define position of the CR in European context. The first chapter focuses on selected aspects of the impact of economic crisis on the labour market. In particular, it analyses shifts in employment and unemployment in terms of relevant structural aspects. The literacy level of fifteen-year-olds is assessed in the first part of the second chapter. This chapter, at the same time, comes up with an analysis of tertiary education including employability of HEIs' graduates and quality of higher education. The third part of the second chapter deals with both educational structure and educational mobility. The third chapter provides information on employment in one of the most demanding sectors as to skills – research and development. It assesses the employment structure in relation to basic aspects, including inter-regional variability. Moreover, attention is paid to the inflow of graduates of Master and Doctoral study programmes and developments in the specific segment of the labour market – the R&D segment.

The chapter ***Selected Aspects of the Impact of Economic Crisis on the Labour Markets in the CR and EU*** (Martin Bakule, Věra Czesaná) is divided in two subchapters, while the core of the text consists in the second one. The first subchapter gives an overview of strategies adopted by the employers to adapt to the ongoing market changes, addressing in particular the impact of the economic downturn and slump on the fundamental labour market indicators, i.e. labour productivity, labour intensity, economic activity of the population and the number of job vacancies. The latter subchapter examines the employment's response to the recession identifying, at the same time, the decisive factors determining the time-lag of this reaction and their different level of activity in individual Member States. At the EU level, it analyses development of unemployment over the period 2008-2010, while identifying the sectors facing the most pronounced slumps in unemployment. Due to the lack of data on European developments, the impact of crisis on occupational structure of employment is analysed only for the CR. Attention is paid also to changes in the duration of unemployment, to its structure in terms of gender, age and education. Furthermore, the correlation between the unemployment rate in the pre-crisis period and its change due to the crisis is studied on regional level in the CR.

The chapter ***Human Resources for Skills-Intensive Occupations*** (Zdeňka Matoušková, Zdeňka Šímová, Marta Salavová) consists of three subchapters. The first one deals with the results achieved by fifteen-year-olds in the international literacy survey. Achieved literacy levels in reading, mathematics and science are assessed in terms of development trends, proportions of individual levels of literacy and proportions of the best achieving pupils in all types of literacy. Attention is also paid to gender differences, ICT impact on reading literacy, the link between the school results and achieved literacy level, as well as to the influence of socio-economic environment on pupils' performance and degree of selectivity of the educational system. The second subchapter focuses on tertiary education, whose role is to prepare individuals for the performance of skills-intensive occupations. It evaluates developments in the number of students in both segments of tertiary education, i.e. tertiary professional schools and higher education institutions, using also the indicators of gross and net participation rate and entry rate into tertiary education. Also the gender aspect is taken into account in relation to individual fields of study. The inflow of the workforce with tertiary qualifications depends not only on the number of students admitted, but also on the rate of success in graduation. The rate of success of Czech students is compared to the rates achieved by the students in other EU countries. Attention is paid as well to the changes in the field structure of HEIs' graduates and their employability in the labour market. Eventually, based on available indicators, the second subchapter evaluates the quality of higher education. The third subchapter draws on trends in educational structure and educational mobility. Developments in educational structure are assessed on the basis of changes in proportions of population with particular level of education. Examined is also the correlation between development of educational attainment and development of jobs requiring tertiary qualifications. The following part of this subchapter concerns educational mobility within the both - secondary as well as tertiary education.

The chapter ***Human Resources in Research and Development*** (Hana Žáčková, Věra Havlíčková, Jiří Braňka) is divided into three subchapters. The first one focuses on comparison of employment within the sector of research and development (R&D) in the CR and EU. In addition to assessing the share of R&D employment in the total employment, this subchapter also examines the principal structures of R&D employment. Attention is focused only on one method of measuring R&D results – the method using the number of high-tech patents per 1,000 employees engaged in R&D. The second subchapter is devoted exclusively to the distribution of R&D among individual regions across the CR. It maps and evaluates not only the differences in overall R&D employment in individual regions, but also the employment in terms of sectors and fields of science, occupational and educational structure. It also assesses participation of women in R&D in individual regions. The third subchapter deals with preparation of human resources for R&D, it closely examines developments in numbers of graduates of Master and Doctoral study programmes in total as well as broken down by fields of study. On the basis of data from the Labour Force Sample Survey, it examines whether the new graduates of Doctoral study programmes actually get employed in those sectors of the economy, in which the R&D activities are most represented. Data on numbers of unemployed graduates of higher education institutions and information on job vacancies in R&D allow for evaluating the situation in this specific segment of the labour market.

1. Selected aspects of the impact of economic crisis on the labour markets in the CR and EU

In the autumn of 2008, a majority of European Union (EU) countries were affected by the most serious post-war economic recession impacting strongly on the national labour markets.

The decline in economic activity of the EU as a whole began in the second quarter of 2008, when the quarterly growth in gross domestic product (GDP) dropped into negative values. In the following quarter, the EU economy entered in technical recession (decline in GDP for two consecutive quarters). Despite strong interdependence of national economies, different depth and timing of the decline in economic activity can be identified among individual EU countries. On one hand, there was recorded a strong decline in Germany, Italy and the United Kingdom (all showing a year-on-year decline of about 6-7%), slightly milder in France and Spain (a year-on-year decline of 3.9% and 4.4% respectively) and, on the other hand, positive values of year-on-year GDP growth were recorded in Poland. Most of the larger EU countries showed a negative quarterly GDP growth in the third quarter of 2008, however, the main decline was recorded in the fourth quarter of the same year and the first quarter of 2009. A slight recovery took place in all countries, with the exception of Spain, only in the course of 2009.

From the sectoral perspective, the decline in EU economic activity was rather differentiated. While a significant decrease was recorded in manufacturing (NACE C, D, E) and construction (NACE F), a decline in volume of services within the sectors of whole sale and retail trade, transportation, accommodation and food service activities (NACE C, D, E) was much smaller. The largest drop suffered manufacturing (a difference of -19.6% between the last quarter of 2007 and the second quarter of 2009) and industrial production as such (-18%). Construction also showed a significant decline of 12.9% (by the first quarter of 2010). The decline in construction was milder as well as slower; nevertheless, it took longer. It lasted nine quarters. In contrast, the activity decline in the sectors of whole sale and retail trade, transportation, accommodation and food service activities was much less pronounced (a difference of 7% between the last quarter of 2007 and the second quarter of 2009). While the sectors of manufacturing and services recovered relatively quickly and since the second quarter of 2009 have been growing again, construction in 2010 stagnated around the bottom values of its decline.

The Czech Republic recorded a GDP decline in the fourth quarter of 2008, and in the subsequent quarter entered into recession. After a decade of continuous growth, its GDP showed a year-on-year decrease of 4.1% representing the deepest slump in its modern history. A decline in foreign demand affected to a varying degree all sectors of open economy, particularly the export-oriented manufacturing industries. However, the recession did not last long, and thanks to the improving situation of the main trading partners, a slight growth was restored already in the third quarter of 2009. [1]

The above stated outline of economic activity development, viewed from sectoral and territorial perspective, indicates the seriousness of changes, to which the member countries' labour markets needed to adapt. Impacts on labour market differed in forms and severity, which can be explained not only by the factors related to the structure of individual economies but also, generally speaking, by factors of labour markets regulation. The present study provides a comparative perspective on selected aspects of the economic crisis' impacts on the labour markets in the Czech Republic and other EU countries. The first part deals with mechanisms of labour market adjustment and the types of reactions to the decline in economic activity; the second part focuses closely on changes in employment and unemployment.

1.1 Mechanisms of adjustment and reaction of the labour markets

Decline in economic activity affects the operation of the labour market. It is particularly reflected by the decrease in demand for labour, which derives from demand for production of companies that sold on the markets of goods and services. Companies (employers) are trying to adapt working capacity cost to the volume of production available for sale by means of various mechanisms. Mechanisms of adjustment – the flexibility of the labour market can be distinguished based on strategies the companies use to adapt to market changes.[2]

External numerical flexibility refers to the adjustment of the labour intake from the external labour market or the number of existing workers. The adaptation can be achieved by employing workers on temporary work or fixed-term contracts or through relaxed Employment Protection Legislation or in other words through relaxed hiring and firing regulations, where employers can hire and fire permanent employees according to the needs of the company. This flexibility is, therefore, reflected in employment and vacancies.

Internal numerical flexibility, sometimes known as working time flexibility or temporal flexibility, includes adjustments of working hours or schedules of workers already employed in the firm. This includes part-time, flexible working hours, shifts, working time accounts, parental and maternal leave or even overtime. This flexibility is, therefore, reflected in the hours worked.

Functional or organizational flexibility expresses the extent to which employees can be transferred to different activities and tasks within the firm. This type of flexibility, therefore, has to do with overall management and organization of operation, employees' development activities (training) or outsourcing.

Financial and wage flexibility expresses the extent, to which the wage levels are not decided collectively, and where differences can exist between the workers' wages. This can be achieved by creating the environment where wages and other employment cost reflect the supply and demand of labour. This flexibility, therefore, relates to rate-for-the-job systems, or assessment based pay system, or individual performance wages.

The overall reaction of employers to the economic cycle and changes in demand for production is in practice affected by varying extent of use of all these mechanisms. Mix of these strategies can be, to a significant level, influenced by targeted state interventions.

[1] For details, e.g. in EC (2009)

[2] Atkinson, J. and Meager, N.(1986)

Box 1 – Decomposition of economic growth into labour market growth indicators

For better understanding of relation between indicators of economic activity and labour market development, the economic growth can be decomposed using the following equations of growth into the demographic indicators and labour market indicators:[3]

1. Economic growth, which is usually approximated as an increase in gross domestic product (GDP), can be decomposed into increase in productivity per employed person, increase in share of employed persons in productive age (15-64 years) population (employment rate), increase in share of productive age population in total population and population growth.

$$g(GDP) = g\left(\frac{GDP}{employment}\right) + g\left(\frac{employment}{productive\ age\ population}\right) + g\left(\frac{productive\ age\ population}{population}\right) + g\left(population\right)$$

2. In more detail, the GDP growth can be decomposed into growth in productivity per hour worked (GDP per hour worked), increase in hours worked per employed person, increase in share of employed persons in productive age (15-64 years) population (employment rate), increase in share of productive age population in total population and population growth.

$$g(GDP) = g\left(\frac{GDP}{hours\ worked}\right) + g\left(\frac{hours\ worked}{employment}\right) + g\left(\frac{employment}{active\ age\ population}\right) + g\left(\frac{productive\ age\ population}{population}\right) + g\left(population\right)$$

In the short-term perspective of changes running within the time scope of several year quarters, the influence of the last two demographic terms of the equation is negligible.

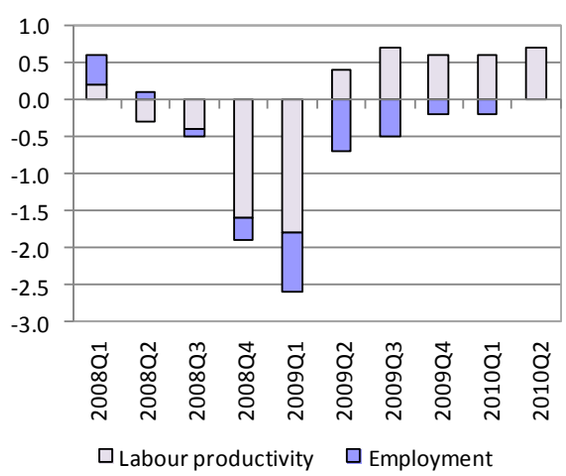
Available data indicate that labour markets in EU countries responded to the economic recession not only through changes in employment (reduction of employment and growth of unemployment, or economic inactivity in certain groups) and changes in volume of vacancies. They reacted also through reduction of working hours (number of hours worked); and also other measures cutting employment costs of the companies were taken such as freezing or reducing salaries, paid or unpaid holidays, changing the employment contracts, etc. Employers' decisions, concerning the mix of responses to the market changes, were in a number of countries importantly influenced also by the short-term measures of the labour market policies. These policies aimed at preservation of jobs and attempted to reduce and slow down the impact of the crisis on employment (see Box 1).

Labour productivity

Already the beginning of the crisis showed that the downturn in economic activity shall be within the EU labour markets reflected by the decline in labour productivity, (i.e. productivity per employed person), rather than decline in employment. Labour productivity dropped into negative values in the second quarter of 2008, when employment was still showing a quarter-on-quarter growth. The turning point in the development of labour productivity occurred in the second quarter of 2009, when a significant decline in employment was recorded. The average decline in labour productivity represented more than two thirds of GDP decline in the EU economy, while the remaining third related to the decline in employment. Thus, milder impact on employment was achieved at the expense of labour productivity, which can be attributed mainly to the fact that the employers opted for adjustment through mechanisms of internal numerical flexibility rather than those of external numerical flexibility.

From the territorial point of view, significant differences can be identified among individual EU countries. In all member states, except for Estonia, Ireland, Latvia, Portugal and Spain, the decline in production affected labour productivity rather than employment. In Austria, Czech Republic, the Netherlands, Italy, Slovenia and Slovakia, almost all changes (over 70% of the decline in GDP between the second quarter of 2008 and the second quarter of 2009) accounted for the decline in labour productivity with minimal changes in employment (see Figure 1).

Figure 1: Development of labour productivity and employment in the EU (%)



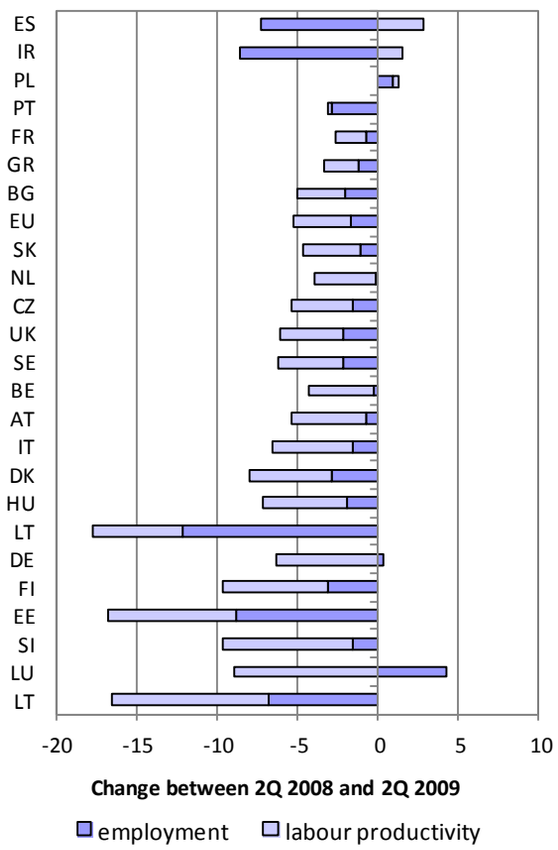
Note: Data are seasonally adjusted. Source: Eurostat (2011d), own calculation.

In Germany and Luxemburg, the downturn was in full absorbed by labour productivity and employment recorded no decline or even showed a year-on-year growth. On the other hand, we can find also countries, such as e.g. Ireland and Spain, where the response of employment to the decline in

[3] Daly, K. (2004), p. 19.

economic activity was exceptionally strong and in relevant countries led to an increase in labour productivity. Poland represents an exceptional case, where the growth in GDP was reflected in the growing labour productivity as well as employment in the stated period (see Figure 2).

Figure 2: Changes in labour productivity and employment in EU countries (%)



Note: Data for Cyprus, Malta and Romania not available. Source: Eurostat (2011d), own calculation.

In the Czech Republic, the number of employed persons showed in the second quarter of 2009 a year-on-year decrease of 1.5 % and labour productivity dropped by 3.9%. Therefore, decline in employment contributed to the total reduction in economic activity by less than one third (27.8%) and most of the decline can be attributed to a decrease in labour productivity (72.2%).[4]

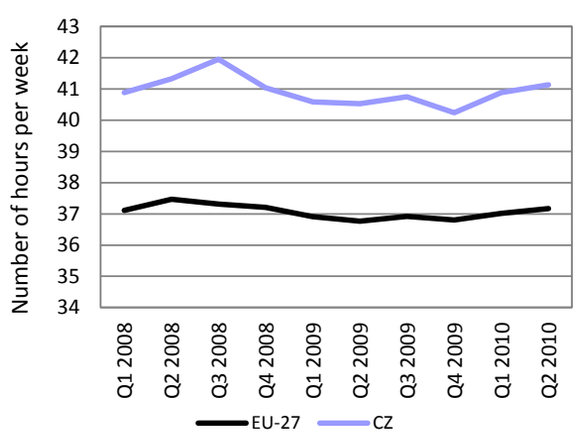
Labour intensity

In the context of labour productivity per employed person, it is also interesting to look at labour intensity measured by number of hours worked per employed person. Available data suggest that, during the recent recession, the reduction of working hours represented one of the key mechanisms of adjustment used by the firms in response to the decline in demand for production. Preference of this adjustment mechanism was determined by two main factors. In the first place, it was the choice of the firms themselves, which in the deepening economic recession were reluctant to start laying off their staff, particularly the staff working full time, with longer working experience and higher qualifications. The reasons for this behaviour can be both internal and external. Among internal ones would belong the effort to retain key employees, in whose training or hiring in the labour market the firm invested considerable effort. The existence of complex and costly firing procedures due to legislative restrictions and agreements with the unions can be named as an external reason. The employers, therefore, preferred alternative methods of adaptation by means of mechanisms of internal numerical flexibility or organizational flexibility.

Support of private sector, by means of short-term measures of labour market policies, was another factor influencing in many countries the firms' choice of adjustment mechanisms following the decrease in demand for production. These measures were mainly aimed at working hours' reduction and strengthening the functional flexibility of employees through training. These programmes were in some countries further enhanced and in others introduced for the first time. [5] The Czech Republic carried out the projects "Training is a chance" and "Get into training". State interventions, aimed at reductions in working hours, helped to preserve jobs, reduce the initial impact of the recession and prevent sharp increase in unemployment. However, on the other hand, it is evident that this practice might become one of the factors slowing down the employment growth (and decrease in unemployment) during the phase of the incipient economic recovery. For the employers, it is easier and in terms of costs often more convenient to extend working hours of the existing employees rather than hiring new ones.

Within employment, the changed economic situation was not reflected only by the development of the total number of workers. Labour intensity can be followed also in the development of the average working hours of employees in main job. To assess the development, we can apply either the category of hours usually worked, which is particularly determined by the legislative conditions applying to the individual countries, types of jobs and industries. However, the average of hours actually worked during the given period is even more apt (see Figure 3).

Figure 3: Number of hours actually worked in main job in the EU and CR



Note: Seasonally adjusted and modified to the same number of working days. Source: Eurostat (2011d), own calculation.

The Czech Republic belongs among the EU countries with the highest average of hours actually worked in main job. The impact of the economic crisis on the labour intensity was also more pronounced than in most EU countries. While the EU saw a decrease by 1.8% in the number of hours actually

[4] Compare to CZSO (2009a).

[5] For details see RILSA (2009).

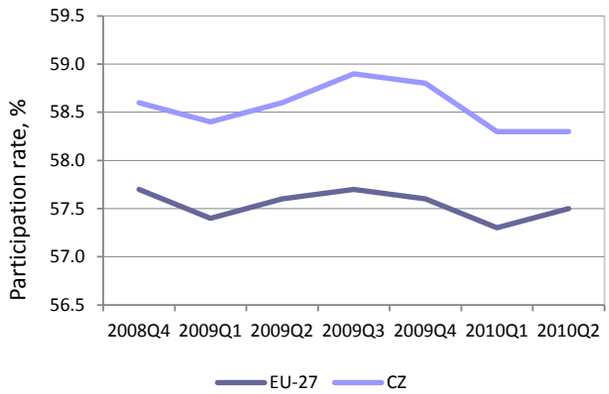
worked in main job between the second quarter of 2008 and the last quarter of 2009, in case of the CR the decrease represented 2.6%. The development varied significantly in individual industries. The largest decrease was recorded in the primary sector, where the result was possibly determined not only by the economic situation but also by harsh winter. The secondary sector also suffered a considerable decline due mainly to the most crisis-affected industries of manufacturing and construction. Thus, the relatively least affected was the tertiary sector.[6]

In order to adjust to the economic situation, the employers used, in addition to internal numerical flexibility, also external numerical flexibility. In other words, despite the reduction of labour intensity, the crisis eventually affected also employees, who began to shift mainly to unemployment (and only marginally into economic inactivity – see below). From the perspective of the EU as a whole, we can observe that during the second quarter of 2008 disappeared the employment growth and the employment rate (seasonally adjusted) reached its peak. This shift can serve as a point of reference when comparing the subsequent developments in the labour market. Established negative trend was further confirmed in the second half of 2008 after the financial crisis considerably deepened in the course of September and October. Employment ceased decreasing in the second quarter of 2010, a year after the economic recovery, when the employment rate did not show any quarter-on-quarter shift for the first time in almost two years, and the unemployment rate stabilized (the impacts on employment and unemployment are analyzed in more detail in the following chapter).

Economic activity of the population

The available data show that the negative impacts of the crisis on the labour force lead almost exclusively to the shift of the affected workers to unemployment and not to their massive leave from the labour market into economic inactivity (although there are several exceptions on the national level and vulnerable groups' level – young people up to 24) [7]. At the EU level, a limited impact of the crisis on the overall labour supply is indicated by the development of the average rate of economic activity of the population, in other words participation rate. Participation rate - i.e. proportion of the total of economically active population in the population over 15 - remained virtually unchanged since the beginning of the crisis. It oscillated closely around 57.5% (it increased from 57.4% to 57.5% over the period from the last quarter of 2008 to the second quarter of 2010). In the CR, where the economic activity rate has long remained above the EU average, this value fluctuated between 58.3% and 58.6%, whereas on the long-term it indicates a downward trend [8] (see Figure 4). Trends in the economic activity rate, which are determined by the overall demographic development and socio-economic conditions for the involvement of labour force into economic activity (development in the structure of specific economic activity rates by age), however, vary considerably across individual countries.

Figure 4: Economic activity rate of the population in the EU and CR (%)



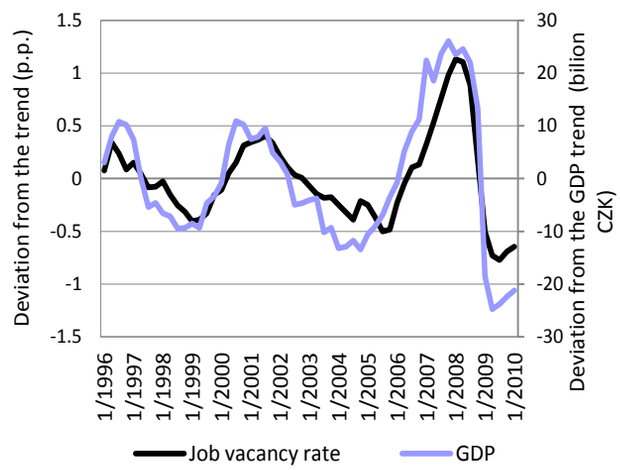
Source: Eurostat (2011c), own calculation.

Job vacancies

Employer adjustments to the economic situation through external numerical flexibility related also to unmet demand for labour, i.e. job vacancies.

Unmet demand for labour, described usually through the number of job vacancies or the vacancy rate (the proportion of vacancies in the sum of the number of vacancies and the number of employees), responds rather directly to the economic cycle. As soon as signs of economic trouble appear, the employers reduce the recruitment process in order to avoid increased labour costs in economically difficult times.

Figure 5: Cycle of vacancy rate and GDP in the CR (p. p., billion CZK)



Note: Data are seasonally adjusted. The trend is extrapolated by the average of the Hodrick-Prescott and the band-pass filters. Source: NTF-NOET (2010a), own calculation.

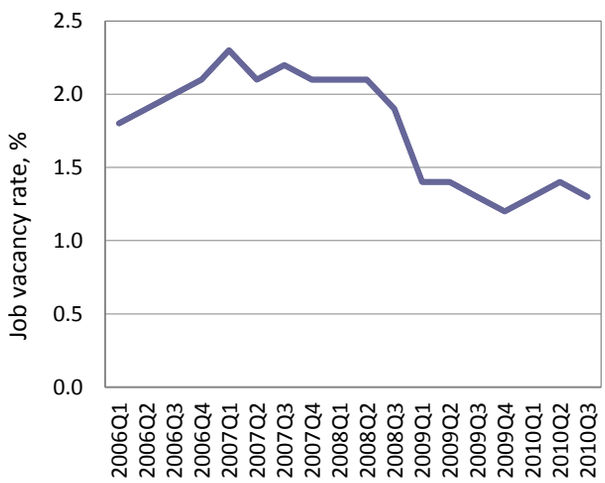
Immediacy of such a response can be illustrated by data for the CR on job vacancies registered by the labour offices, which closely copied the economic cycle. Analysis of cyclical components, from the first quarter of 1996 to the first quarter of 2010, determined the correlation ratio 0.926 for the concurrence of GDP and number of job vacancies and the correlation ratio 0.931 for the concurrence of GDP and vacancy

[6] For details see CZSO (2009b).
[7] For details see EC (2010), p 57.
[8] CZSO (2011b).

rate. It is an excellent pro-cyclical indicator able to predict particularly accurately the onset of recession [9] (see Figure 5).

On the European level, the demand for labour responded to the decrease in economic activity and dropped sharply already in the course of 2008. Vacancy rate within the EU commenced its continuous decline in the second quarter of 2008 (decreased from 2.2% in the first quarter to 1.2% in the last quarter of 2009). In total, it recorded a year-on-year decrease of 0.9 percentage points (about 40%) in that period, even though these developments are covering significant differences in individual EU countries in scale of the decline in demand. Thanks to the improved situation in Germany, the vacancy rate began to grow again in the first quarter of 2010, when it slightly increased to 1.3% and it continued growing also in the subsequent quarter, when it reached 1.4%. Although the recent developments indicate a relative increase in demand for labour, the values for 2010 and 2011 range still below the level recorded at the beginning of 2008 (see Figure 6).

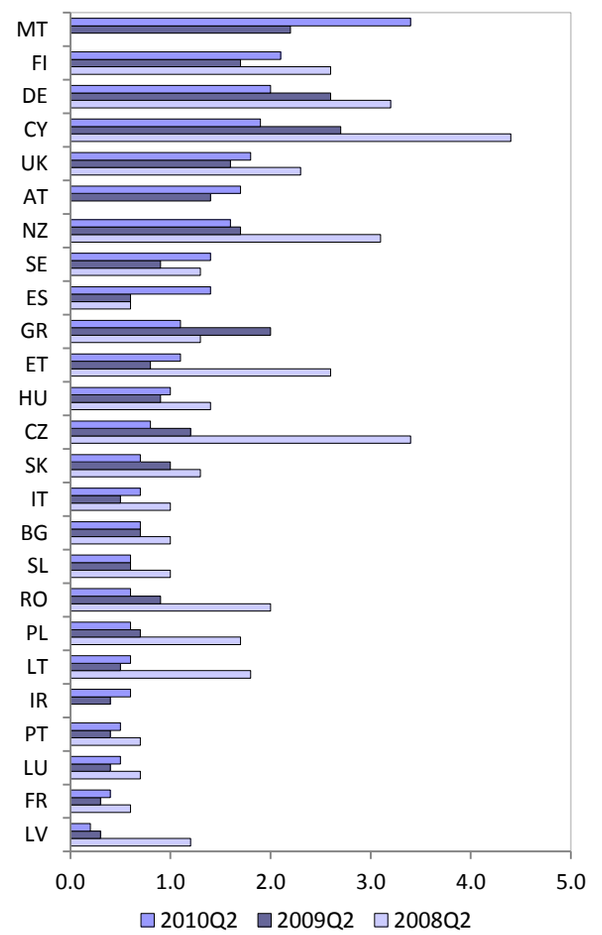
Figure 6: Development of vacancy rate in the EU (%)



Note: Data on job vacancy rate for the period of 2006-2008 according to NACE rev. 1.1. Q3 2009 data for Germany include data on subsidized jobs' supply. Source: Eurostat (2011b), own calculation.

Territorial perspective indicates that, in the large EU Member States, the vacancy rate in the second quarter of 2010 remained at the level recorded in spring 2008.[10] Vacancy rate decline compared to the second quarter of 2008 was most pronounced in Poland (1.1 percentage points, representing 2/3) in parallel with a slowdown in employment growth, in 2008, and its slight decrease in 2009. When compared to spring 2008, the values of vacancy rates saw larger than an average decline in France (by 0.2 percentage points), Germany (by 0.7 p. p.), Italy (by 0.3 p.p.) and the UK (by 0.5 p. p.). In contrast, in Spain the vacancy rate increased substantially in 2010 compared to levels in previous years. While, in Italy and France, the slump represented a relative decline by approximately one-third compared to the second quarter of 2008, Germany and the United Kingdom recorded lesser decline (about one fifth). In the second quarter of 2010, the rate reached 0.6 - 0.7% in Italy and Poland and only 0.4% in France, which thus saw the second lowest rate within the EU. However, relatively high figures were recorded in Germany (2.5%, the second highest rate in the EU) and the United Kingdom (1.9%). Despite the crisis and increased unemployment, they reflected persistent lack of (skilled) labour force and conservation of sufficient supply of jobs. Official sources in Germany and the United Kingdom confirm that, despite the fact that, at the beginning of 2010, the number of registered job vacancies was significantly lower than before the crisis, the total number of vacancies remains relatively high. With the exception of Sweden, all the other member states for which data are available recorded in spring 2010 vacancy rate significantly lower than in spring 2008, however, it is possible to see multiple improvements. The sharpest drop (about 1.5 percentage points and more) was recorded in the Czech Republic, Estonia, the Netherlands and Romania. Significant decline was also seen in Latvia and Lithuania. In addition to Germany and the United Kingdom, the demand for labour remained in the second quarter of 2010 rather strong also in Austria, Finland, Malta and the Netherlands (all with rates higher than 1.5%) despite the sharp decline when compared to the beginning of 2008. Weakest demand (less than 0.5%), in addition to France, was recorded also in Latvia, Luxemburg and Portugal (see Figure 7).

Figure 7: Development of job vacancy rate in the EU (%)



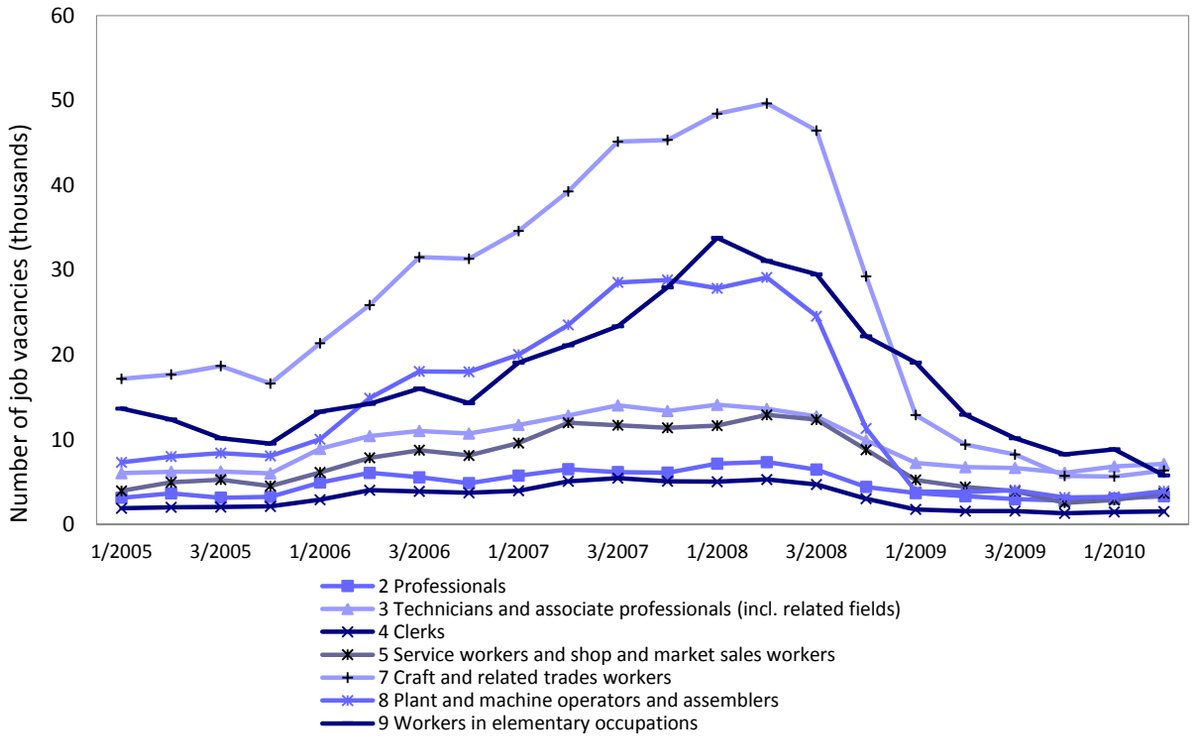
Note: Data for all the countries relate to NACE Rev.2 B-S categories, except for IT, which relate to NACE Rev.2 B-N. FR, MT and IT relate to the job vacancies in companies with more than 10 employees. Source: Eurostat (2011b), own calculation.

Data on job vacancies at the European level do not allow for deeper examination of occupational or sectoral variability.

[9] For further details see the study by NTF-NOET (2010).

[10] It needs to be noted that data on job vacancy rates within the EU are not comparable as individual countries use different methods of data collection. For further details see Eurostat (2011f).

Figure 8: Development of job vacancies in the CR by ISCO occupational categories (in thousands of jobs)



Note: ISCO 0, 1 and 6 have been omitted due to their low dynamics. Source: CZSO (2011d).

However, it is evident that the decline in unmet demand – job vacancies was not, from the occupational or sectoral perspective, uniform. This can be illustrated by the example of the Czech Republic.

In the Czech Republic, the occupational structure of the job vacancies registered by the labour offices saw dynamic changes in the course of the crisis. In total, number of job vacancies recorded a drop of up to 80%, between the second quarter of 2008 – when it reached its peak – and the last quarter of 2009 – when the job vacancies supply began to recover, representing a reduction by 121 thousand jobs in the labour offices' supply.

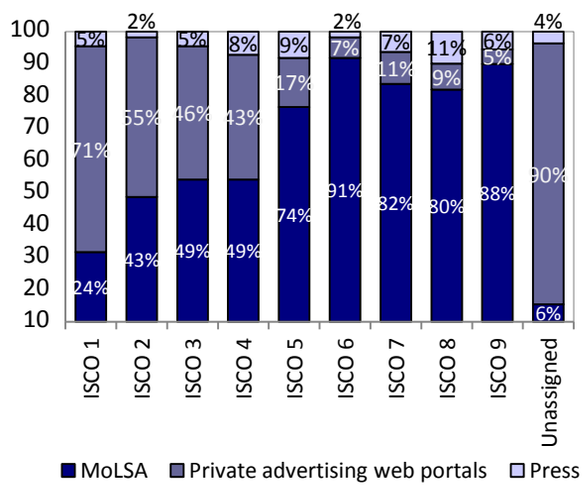
Dynamics of decline in individual occupational categories of ISCO (national variant of ISCO-88) varied significantly. Within the studied period, the largest absolute decline was recorded in ISCO 7 (Craft and related trades workers, -44 thousand jobs), ISCO 8 (Plant and machine operators and assemblers, -23 thousand jobs) and ISCO 9 (Workers in elementary occupations, -23 thousand jobs) (see Figure 8).

In absolute numbers, the lowest decline in job vacancies was recorded in ISCO 1 (Legislators, senior officers and managers, -0.9 thousand jobs), ISCO 6 (Skilled agricultural and forestry workers, incl. related fields, -1 thousand jobs) and ISCO 4 (Clerks, -4 thousand jobs), not taking into account specific category ISCO 0 (Members of the armed forces). The largest relative decline was recorded in ISCO 8 (-89%), ISCO 7 (-88%), ISCO 6 (-82%), ISCO 5 (-80%), ISCO 4 (-75%) and ISCO 9 (-73%). In relative numbers, the least affected were ISCO 1 (-54%) and ISCO 3 (-55%).

The above analysis indicates that the most affected by the decline in (unmet) demand of labour were particularly the less-skilled occupations (ISCO 8 and 9) and occupational groups demanded in industries most hit by the recession (Manufacturing and construction, ISCO 7).

However, these findings are distorted by the fact, that the data proceed exclusively from the labour offices database (MoLSA), where only some of the employers register/advertise their job vacancies (despite registration is required by law). Employers, of course, use also other channels to advertise their vacancies (press, web portals, professional / social networks, etc.), which may not have the same structure of offered job vacancies. Survey, carried out by NTF-NOET in mid 2010, proves that the supply on open private advertising media, after removing duplicate advertisements, displays a different occupational structure than the MoLSA database.

Figure 9: Distribution of open job vacancies supply among individual media by main ISCO classes (% of advertisements)



Source: NTF-NOET (2010b).

Labour offices' supply of job vacancies best represents occupational groups of ISCO 6 – 9. On the contrary, classes 1-4 are advertised mainly through private media (web portals and press), which indicates that the dynamics of the developments within the segment of ISCO 1 – 4 remains rather hidden due to the absence of regular examination of overall supply of job vacancies on private advertising media (see Figure 9).

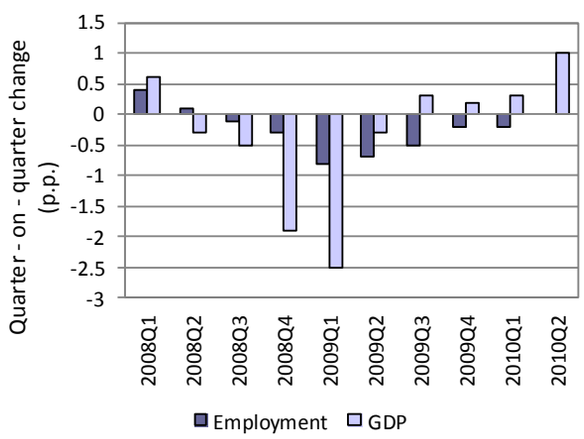
1.2 Employment and unemployment

The following chapter examines in further detail impacts of economic crisis on employment.

Response of employment to the change in economic activity

Employment responded to the recession with the usual delay. As indicated in the previous chapter, severity and complexity of the corporate decision to reduce the labour force determines reaction time of the labour market to the deterioration of the economic environment. Such a decision represents one of the strategic moves with long-term consequences. Furthermore, the delay was caused e.g. also by the legislative reasons among which rank the conditions of hiring and firing employees, collective agreements and relationship with unions at all. Companies are trying to minimize costs associated mainly with the dismissal and re-recruitment of qualified workers. Therefore, they seek alternative ways to adjust to the economic situation. Last but not least, impacts on employment are also affected by state interventions aimed at mitigating social consequences of the crisis and promoting other methods of adjustments than the reduction in the number of workers. In sum, these factors both delay and mitigate the impact of economic downturn on employment and unemployment.

Figure 10: Quarter-on-quarter changes in GDP and employment in the EU (%)



Source: Eurostat (2011c, d), own calculation.

The decline in employment in most EU countries was significantly smaller than the decline in economic activity during the crisis (see Figure 10). In the EU as a whole, the decline in economic performance between the peak and the bottom (i.e. between the first quarter of 2008 and the second quarter of 2009) represented 5.3%; while the decline in employment between the peak and the bottom (i.e. between the second quarter of 2008 and the first quarter of 2010) represented only 2.7%. Elasticity of employment to GDP (sensitivity of employment to changes in GDP) thus represented 0.5. In comparison with the U.S.A., the reaction is much milder (elasticity of employment to GDP was 1.4), reflecting the economic downturn of 4.7% and the decline in employment by 6.0%.

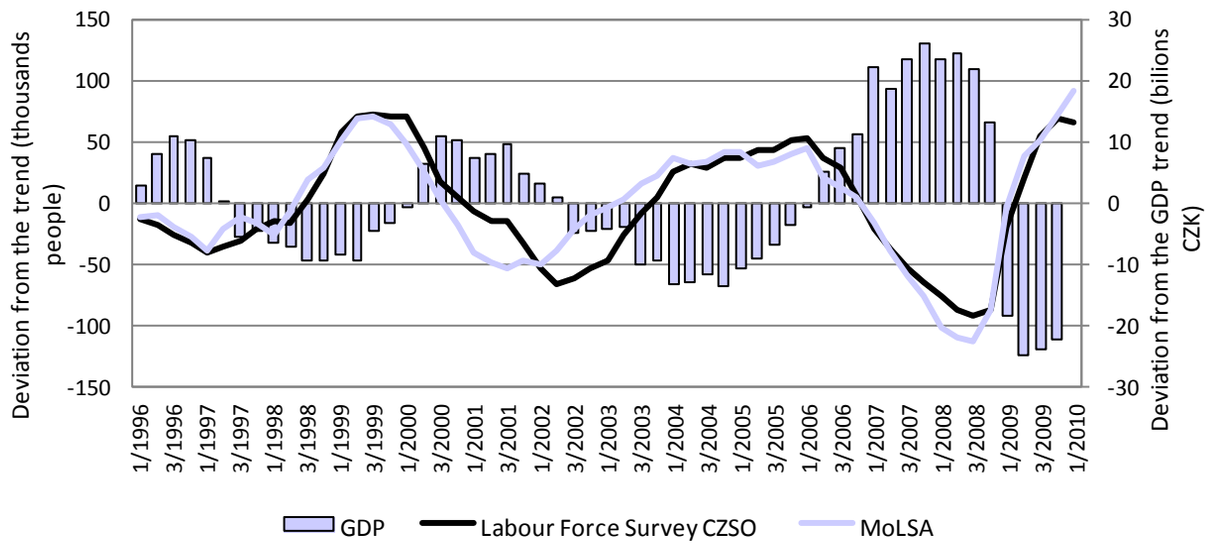
However, the decline in employment in response to a reduction in economic activity was in some EU countries more pronounced. Values of elasticity of employment to GDP show relatively strong response of employment to the economic downturn in the Baltic States, Denmark, Ireland, Portugal and particularly in Spain (values exceeding 0.5, elasticity in Portugal exceeding 1 and reaching almost 2 in Spain). Contrariwise, in many other EU countries, the impact of recession on labour market was partly inhibited by means of reduction in labour productivity. Values significantly under the average were recorded in Austria, Belgium, Italy, the Netherlands, UK and especially in Germany, where the overall decline in production of approximately 6.6% led to a drop in employment of only 0.3%. [11]

There are several reasons for varying response of employment across the EU countries. One of the key factors is the importance of construction - one of the sectors most affected by the recession – for the national economy and its share in employment (high share e.g. in Ireland or Spain). In this context, the differences between individual countries are reflected in the varying values of productivity in industries most affected by the recession. E.g., manufacturing industry in Germany was seriously affected by the declining exports; nevertheless, high productivity in this sector led to a rather small decline in employment, in proportion to GDP. While, in Spain, a large decline in the industry of construction with rather low productivity caused a massive drop in employment in proportion to GDP. Another reason is the widespread use of the mechanisms of internal numerical flexibility in countries like Austria, Belgium or Germany in contrast to the absence or limited application of these measures in the Baltic States, Ireland or Spain. A prominent role is also played by the structural characteristics such as the proportion of fixed-term contracts, which are relatively easy for employers to terminate. Countries with a high proportion of fixed-term contracts, such as Spain, are then relatively more susceptible to changes in employment due to economic shocks.

At the EU level, it is evident that the response of employment to the downturn in economic activity was delayed. In the second quarter of 2008, when the quarter-on-quarter drop in GDP was recorded, employment kept growing, while, in the third quarter of 2009, when the economy started to recover, employment was still showing decline. The delay of the employment behind the economic activity, caused by the above mentioned factors, is different in each country. The example of the Czech Republic illustrates that the decline in employment (and unemployment growth) occurred at a slower pace than the decline in the national economy performance. Given that the total economic activity of the population during the crisis remained literally unchanged, i.e. there were no withdrawals from the labour market (see previous chapter), and almost all the numerical shifts in employment translated into unemployment (see Figure 11).

[11] EC (2010), p 27.

Figure 11: Unemployment cycle according to MoLSA, Labour Force Survey CZSO and GDP in the CR (p. p., billions CZK)



Note: Data are seasonally adjusted. The trend was extrapolated by the average of the Hodrick-Prescott and the band-pass filters. Source: NTF-NOET (2010a), own calculation.

In the Czech Republic, shifts in unemployment show an average delay of two quarters behind the economic cycle, measured either by the number of persons registered at labour offices (MoLSA) or by CZSO Labour Force Survey. Shifts in unemployment are of counter-cyclic nature, in other words, they inversely copy cyclical changes in economic activity. Analysis of cyclical components, in the period from the first quarter of 1996 to the first quarter of 2010, concluded that the correlation coefficient between the number of the registered unemployed and GDP is -0.890 and the correlation coefficient between the number of the unemployed according to the Labour Force Survey and GDP is -0.817 for the delay of two quarters between unemployment and GDP.

Territorial development of employment within the EU

At the EU level, in the second quarter of 2008, employment growth disappeared, and employment rate (seasonally adjusted) reached its peak, while the unemployment rate started to rise from its low values recorded in the previous quarter. This shift serves as a reference point for the comparison of subsequent developments in the labour market. Established negative trend was further confirmed in the second half of 2008 (quarter-on-quarter drop of 0.1% and 0.3% in the third and the fourth quarters respectively) due to the significant deepening of the financial crisis. However, drop in employment became most dramatic in the first three quarters of 2009, when the quarterly rates of employment growth recorded values -0.8%, -0.7% and -0.5% before slowing down (-0.2%) in the last quarter of 2009 and the first quarter of 2010. Decline in EU employment ceased in the second quarter of 2010, a year after the onset of economic recovery, when the employment rate remained unchanged between two quarters for the first time in almost two years, and unemployment rate got stable. In the period between the second quarter of 2008 and the second quarter of 2010, the number of employed decreased by 2.5% representing a drop by 5.6 million people.

From the territorial perspective, the impact of the crisis on employment in EU Member States was rather uneven, which derives from different levels of economic downturn, determined by the different structures of national economies, and reflects the varying political responses to the crisis. Spain recorded the most dramatic decline from the large member states. It was mainly due to drop in labour demand in manufacturing and construction. Although the economic downturn in Italy and United Kingdom was more pronounced, deterioration in the labour market was not as severe as in Spain, where the decline in employment was much bigger than the decline in economic activity. In addition to these countries, rather dramatic decline in employment was also recorded, by the second quarter of 2010, in the Baltic States (Estonia, -15%, Latvia, -19%, and Lithuania, -13% compared to levels in the second quarter of 2008), and Ireland (-12%), where the sharp decline in economic activity led to a relatively long period of sharp decline in employment.

By contrast, in Germany, the economic recession impact on the labour market was successfully attenuated through measures of internal numerical flexibility because a large proportion of companies made use of regulation measures, such as temporary suspension of production or adjustments and reductions in working hours, rather than reducing the number of workers. As a result of these measures, Germany experienced during 2008-2010 only two quarters with particularly limited decline in employment (-0.1% and -0.3% in the second and third quarters of 2009 respectively). Despite the general trend of decline in employment, some member states (Belgium, Luxemburg, Germany and Poland), in the second quarter of 2010, regained employment levels from mid 2008 or they even recorded significant growth (see Table 1).

Also in the CR, as the economy weakened, employment was declining, and it is evident that these shifts were not due to modernization, investments or labour productivity growth. For the first time, the number of employed recorded a quarter-on-quarter decline in the first quarter of 2009 and it continued decreasing in the two subsequent quarters. A deep decline was observed in the first quarter of 2010, when the economy was already growing.

Table 1: Development of employment in the EU countries (quarter-on-quarter changes in number of employed, %)

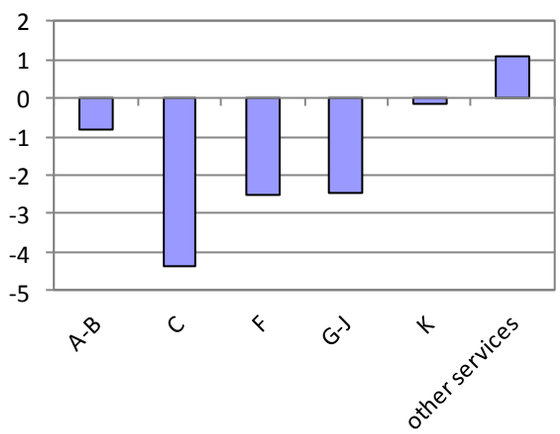
	2008Q1	2008Q2	2008Q3	2008Q4	2009Q1	2009Q2	2009Q3	2009Q4	2010Q1	2010Q2
BE	0.5	0.4	0.4	0	-0.4	-0.3	-0.3	0	0.3	0.3
BG	1.6	0.2	0.4	-0.2	-0.8	-1.4	-1.7	-1.8	-2	:
CZ	0.1	0	0.5	0.3	-0.7	-1	-0.4	0.2	-0.9	0.1
DK	1.3	-0.1	0.5	-0.1	-1.4	-1.5	-1.4	-1.3	0.1	0.4
DE	0.6	0.2	0.2	0.1	-0.1	-0.2	0	0	0	0.2
EE	0.5	-0.6	0	-0.3	-5.1	-4.9	-1.2	-1.4	-0.8	-1.3
IE	-0.2	-0.9	-1.4	-1.6	-3.9	-1.7	-1.8	-1.1	-0.8	:
EL	-0.3	-0.1	0.1	0.1	-0.6	-0.2	-0.5	-0.8	-0.3	-0.9
ES	0.3	-0.5	-1.1	-1.8	-2.8	-1.5	-1.4	-0.7	-0.1	-0.2
FR	0.2	0.1	-0.1	-0.3	-0.5	-0.4	-0.3	-0.1	0	0.1
IT	-0.2	-0.1	-0.1	-0.1	-0.8	-0.4	-0.6	-0.2	0.3	-0.2
LV	-0.2	0.1	-1.3	-4	-3.6	-5	-4.6	-2	-1.8	1.3
LT	-0.3	-0.4	-0.1	-1.4	-3.4	-1.3	-1.6	-2.6	-2.1	-0.4
LU	1.3	1.1	1	0.5	-0.2	0	0.1	0.3	0.3	:
HU	0.1	-0.7	0.5	-0.8	-1.1	-0.9	-1.1	0.3	-0.4	0.6
NL	0.4	0.4	0.1	-0.1	-0.3	-0.9	-0.6	0.1	-0.3	:
AT	0.5	0.6	0.2	0	-1.1	-0.2	0.1	0.2	0.2	0.2
PL	2	0.1	0.4	0.5	0	-0.2	-0.1	-0.1	-0.3	1.1
PT	0.3	0.2	-0.6	-0.1	-1.3	-0.8	-0.9	0.1	-0.1	-0.6
SI	0.8	0.7	0.3	0	-0.7	-0.9	-0.8	-0.8	-0.5	-0.3
SK	0.2	1	1.4	-0.7	-2.3	0	-0.7	-0.3	-0.9	-0.3
FI	0.4	0.7	-0.6	0.2	-1.2	-1.4	-1	-0.5	0.6	0.4
UK	0.4	0.1	-0.4	-0.2	-0.5	-0.9	-0.1	0	-0.2	0.7
EU-27	0.4	0.1	-0.1	-0.3	-0.8	-0.7	-0.5	-0.2	-0.2	0

Note: Data for CY, MT, RO and SE not available. Source: Eurostat (2011c).

Sectoral development of employment within the EU

Decline in EU employment, between the second quarter of 2008 and the second quarter of 2010, was due to the reduction in economic activity in almost all industries. In absolute numbers, the greatest decline was recorded in the industrial sector, where 4.8 million people lost their jobs. In the sector of services, it was only 0.2 million people and in the sector of agriculture 0.6 million people.

Figure 12: Sectoral changes in employment in the EU between Q2 2008 and Q2 2010 (NACE Rev. 2, million persons)



Note: Agriculture, forestry and fishing; Mining and quarrying (A-B); Manufacturing (C), Construction (F); Wholesale and retail trade; Transportation and storage; Accommodation and food service activities; Information and communication (G-F), Financial and insurance activities (K); Professional, scientific and technical activities; Administrative and support service activities; Public administration and defence, compulsory social security; Education; Human health and social work activities; Arts, entertainment and recreation, etc. (Other services), data are not seasonally adjusted. Source: Eurostat (2011c).

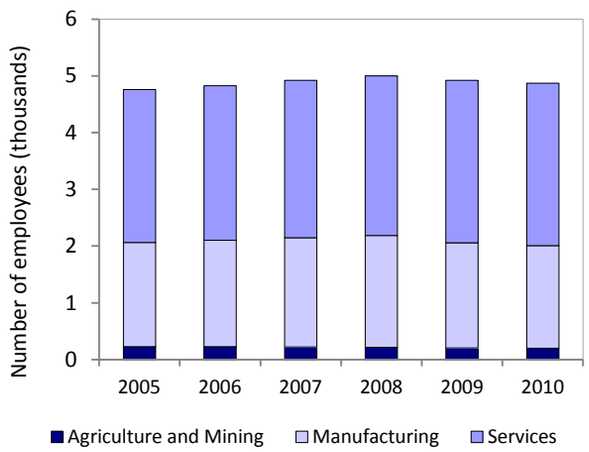
A closer look shows that the most affected industries were manufacturing and construction, both in absolute (-4.4 million and -2.5 million respectively) as well as relative (-11.6 and -13.8% respectively) numbers. Severely affected were also the industries of wholesale and retail trade, transportation and storage, accommodation and food service activities and information and communication. This result is attributable to drop in economic activity in these industries, caused by the behaviour of consumers and investors, who were postponing larger spending, as well as to the impact of the collapse in real estate prices in the sector of construction.

All three sectors saw between the first quarter of 2008 and the first quarter of 2009 increasing contraction of employment. From the second half of 2009, all affected industries, with the exception of manufacturing and construction, recorded improvement. Thus, the decline in employment did not expand to other sectors of the economy but instead a slight overall recovery took over. Other services, including particularly public administration, education, human health and social work, maintained a positive growth during the crisis period. However, with regard to the existing budget deficit in many countries, reduction in jobs can be expected in public administration as a result of austerity measures (see Figure 12).

Regarding the situation in the Czech Republic, between 2008 and 2010, employment decreased in total by 2.3%; thus, 117.6 thousand workers moved mainly into unemployment. Males represented more than 55% of this number. From the sectoral perspective, the most significant decline in employment was in that period recorded in industries where the employment dropped most, in manufacturing (-142.6 thousand workers, 10% drop) and construction (-15.9 thousand workers, 3% drop). Decline in services sector was milder, influenced mostly by wholesale and retail trade (-25.4, 4% drop) and administrative

and support service activities (-15 thousand workers, 12% drop). On the other hand, it is possible to find sectors of services that in the given period recorded employment growth, such as information and communication services (19.2 thousand workers, 16% growth) and human health and social work activities (18.7 thousand workers, 6% growth) (see Figure 13).

Figure 13: Sectoral changes in employment in the CR between 2008 and 2010 (in thousands of workers)

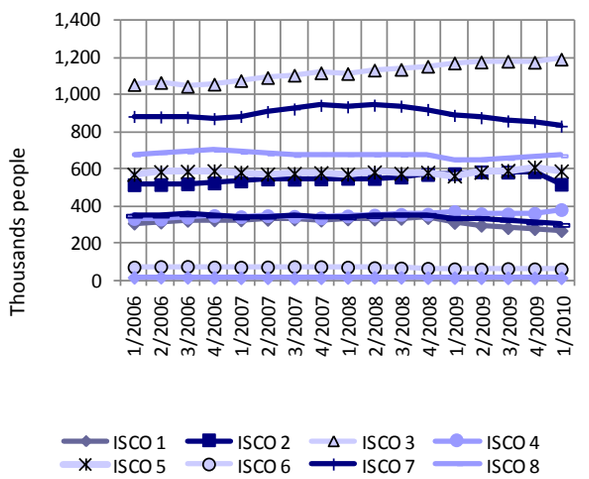


Note: Agriculture and Mining (NACE Rev.2 A and B), Manufacturing (NACE Rev. 2 C-F) and Services (NACE Rev.2 G-T). Source: Eurostat (2011c), own calculation.

Development of occupational structure of employment in the CR

Due to the lack of comparable data, it is difficult to analyze changes in occupational structure at the European level. Impact of the crisis on employment in terms of occupational structure might be well illustrated by the example of the Czech Republic (see Figure 14).

Figure 14: Changes in the occupational structure of employment in the CR between Q1 2006 and Q1 2010 (in thousands of workers)



Note: ISCO 1 – Legislators, senior officials and managers, ISCO 2 – Professionals, ISCO 3 – Technicians and associate professionals (incl. related fields), ISCO 4 – Clerks, ISCO 5 – Service workers and shop and market sales workers, ISCO 6 – Skilled agricultural and fishery workers, ISCO 7 – Craft and related trades workers, ISCO 8 – Plant and machine operators and assemblers, ISCO 9 – Elementary occupations, ISCO 0 – Armed forces. Source: CZSO (2011d), own calculation.

Occupational structure of employment saw changes in the course of the crisis. Analysis of the decline, between the last quarter of 2008 and the first quarter of 2010, does not allow for concluding that in general the crisis affected less-skilled occupations. Although the drop, in number of the employed, was largest within the occupational group of craft and related trades workers (ISCO 7, -89 thousand workers, 10% drop), thus representing the largest contribution to the total decline by 204 thousand workers in that period; legislators, senior officers and managers (ISCO 1, -70 thousand workers, 21% drop) represented the second most affected occupational group. Closer examination of the data indicates that such a development can by partly explained by the fact, that the decline in ISCO 1 involved mainly the occupations from the most affected sectors of the economy (particularly manufacturing and whole sale and retail trade).

Other severely affected occupational groups are elementary occupations (ISCO 9, -54 thousand workers, 15% drop) and surprisingly also professionals (ISCO 2, -53 thousand persons, 9% drop). This decline can be partly explained by changes related to budget reduction of the Academy of Sciences of the Czech Republic. By contrast, employment growth in the stated period was recorded in the occupational group of technicians and associate professionals (ISCO 3, 38.4 thousand workers, 3% growth) and in clerks (ISCO 4, 24.9 thousand workers, 7% growth).

In terms of timing, a few differences are worth pointing out. In the last quarter of 2008, the impact of recession was reflected in ISCO 9 and 1 by the onset of the downward trend, while in ISCO 4, 5 and 8 showed only a slight decline. In ISCO 7, the employment showed stagnation and subsequent decline even earlier, already in the first half of 2008. ISCO 2 and 5 saw a decline in the first quarter of 2010, while ISCO 3 did not record any significant changes during the recession and maintained its growing trend throughout the whole period.

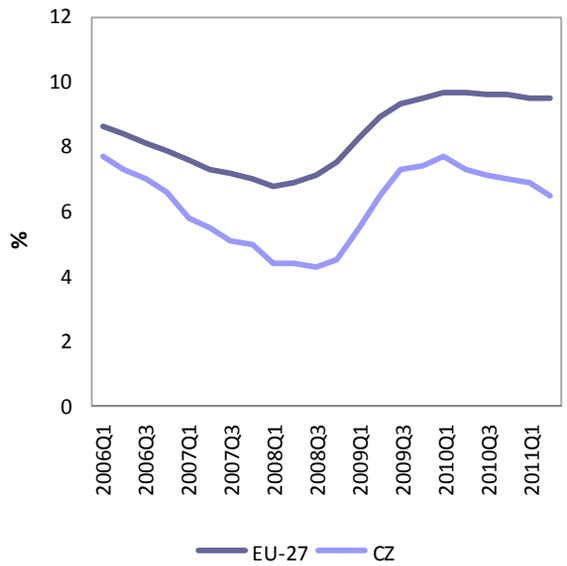
Described differences can be explained by the fact that the occupations represented in the industries primarily affected by the crisis were hit first, and only subsequently the consequences transferred to the occupational groups in other industries. Certain role was played also by other factors, such as qualifications, education level, working experience.

Territorial development of unemployment in the EU

Given that the rate of economic activity of the population remained virtually unchanged, the cushioned and delayed impact of recession was reflected in the shift of labour force from employment to unemployment.

The average unemployment rate in the EU began to grow from the lowest values in the first quarter of 2008 until reaching its peak in the first and second quarter of 2010. The increase represented 2.9 percentage points. The unemployment rate, in the CR, went through a similar development, only the increase between the third quarter of 2008 and the first quarter of 2010 was steeper (3.4 p. p.) and in the course of 2010 and 2011, an improvement can be observed against the average development in the EU (see Figure 15).

Figure 15: Development of the unemployment rate in the EU and the CR between Q1 2006 and Q2 2011 (%)



Note: Data are seasonally adjusted. Source: Eurostat (2011c), own calculation.

Similar differences in timing and extent of unemployment growth can be observed across all EU countries (see Figure 16). While Ireland, Italy and Spain saw unemployment growth already in the first half of 2007, Bulgaria, Germany and Slovakia enjoyed low unemployment until the last quarter of 2008. Although, during the last two years, unemployment rate increased in all Member States at some point, the extent of the increase in individual countries varies considerably. The increase in unemployment was rather steep in some countries; (unemployment rate more than doubled against the previous lowest values in Denmark and Spain; it tripled in Ireland and grew almost four times in the Baltic States); while, in other countries such as Austria, Belgium, Luxemburg, Malta, the Netherlands and particularly Germany, it remained rather limited.

In most Member States, the increase in unemployment was, in the first year of rising EU unemployment rate (i.e. from March 2008 to March 2009), higher than in the following year (from March 2009 to March 2010). Ireland and Spain (drop of about 6-8 percentage points in the first year and approx. 2 percentage points in the second year) and, to some extent, also Latvia, Lithuania and Estonia belong among the most affected countries by increasing unemployment rate in both years. Fast increase in unemployment affected also France, Italy, Malta, Sweden and United Kingdom; while, in Austria, Germany and Luxemburg, the unemployment rate began to decrease in the course of the second year. By contrast, as a consequence of delayed onset, more intensive unemployment affected in the second year Bulgaria, Cyprus, Greece, the Netherlands, Poland, Slovenia, Slovakia and Romania (see Figure 17).

When sorting the EU countries according to level of the unemployment rate before the crisis (third quarter of 2008) and the subsequent increase in the following two years, we get four groups of countries: [12]

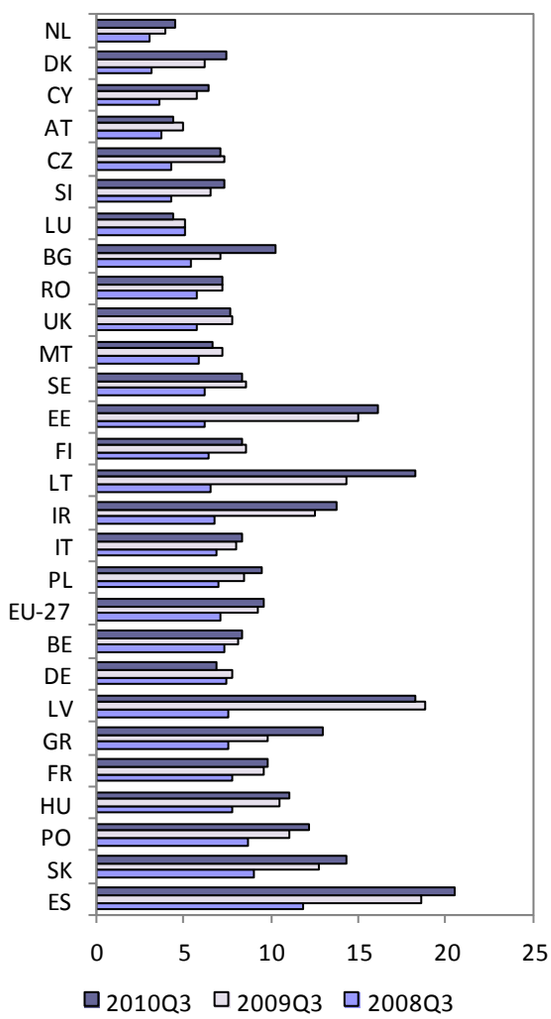
a) Countries with high unemployment rate and its high growth. This group includes Spain, Latvia, Estonia, Ireland, Greece, Slovakia and Hungary,

b) Countries with low unemployment rate and its high growth. Lithuania, Denmark, Bulgaria, Slovenia, Sweden, Czech Republic, the Netherlands, and Cyprus,

c) Countries with high unemployment rate and its low increase. Poland, France, Belgium, Portugal, Italy and Germany (where the unemployment rate even decreased),

d) Countries with low unemployment rate and its high growth. Malta, United Kingdom, Romania, Finland, Austria and Luxemburg (where the unemployment rate even decreased).

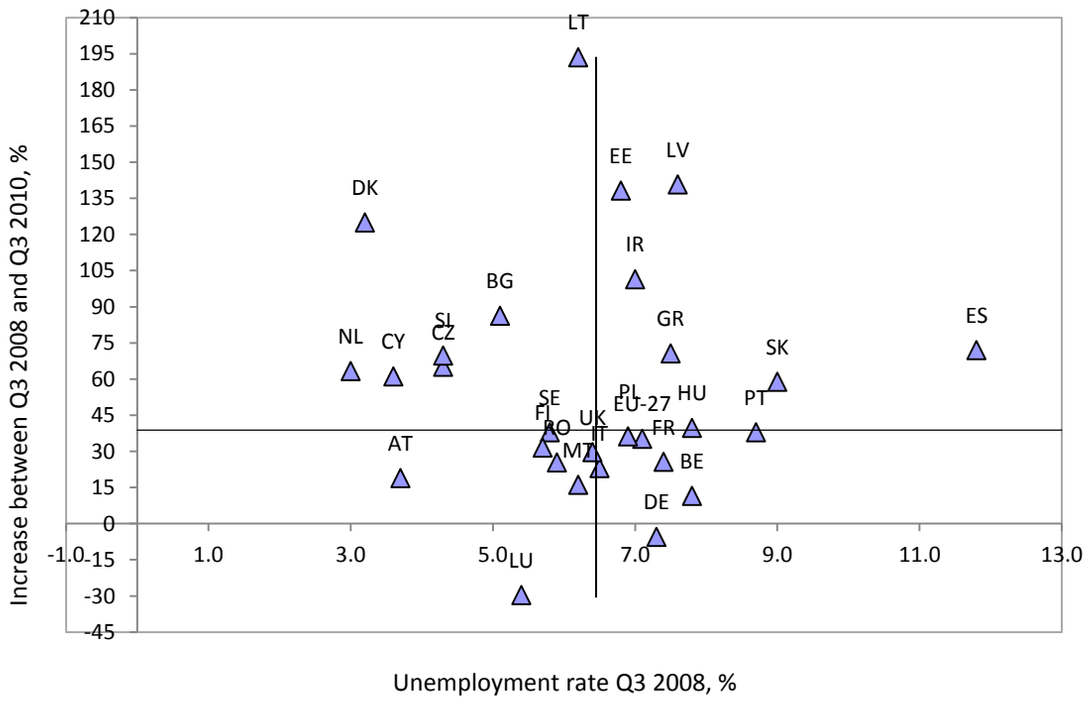
Figure 16: Development of the unemployment rate in the EU countries (%)



Source: Eurostat (2011c), own calculation.

[12] There is no evident statistical dependence between the pre-crisis levels of unemployment rate and its increase over the following two years at the level of individual EU countries.

Figure 17: Shift in the unemployment rate between Q3 2008 and Q3 2010 (%



Note: The median is the sorting criterion on both scales. Source: Eurostat (2011c), own calculation.

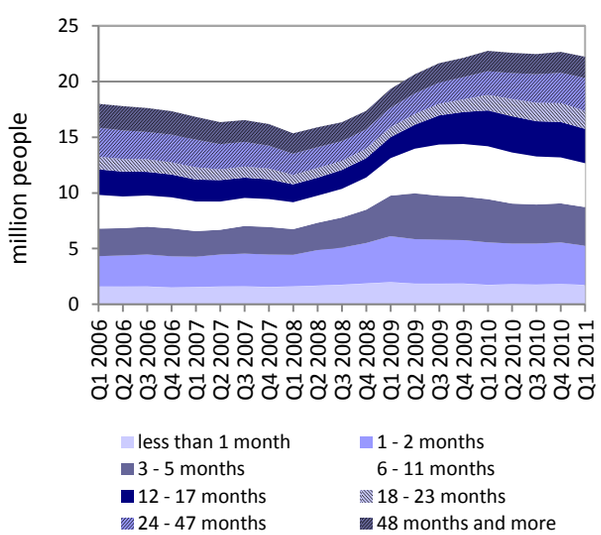
In terms of labour market balance, the most problematic countries appear to be those that have been already dealing with higher unemployment before and at present are significantly affected by the current crisis, e.g. Spain. To what extent the rise in unemployment will affect the future unemployment, however, depends on the labour market structural characteristics and the length of the downturn in economic activity. In some of the affected industries, the jobs may disappear permanently thus causing an increase in structural unemployment, which always has longer-term consequences. Moreover, for a part of the unemployed, the long-term restriction in economic activity may worsen the prospects of regaining a job, particularly affected might be the groups with lower applicability in the labour market (young people up to 24, see below).

The economic recovery, contrariwise, may lead to relatively fast employment growth in cases when the increase in the number of unemployed was partly caused by numerical flexibility factors (temporary contracts) and the economic downturn did not last long.

Development of the time structure of unemployment in the EU

Impacts of the economic crisis on labour markets in the EU caused also changes in the time structure of unemployment. With the growth of total unemployment, in the initial period, i.e. during 2009, increases also the number and share of the short-term unemployed, mainly within the categories of the unemployed for 1-2 months, 3-5 months and 6-11 months. The share of short-term unemployed increased up to 21% in the last quarter of 2009 representing an increase of 6 p. p. compared to the lowest level in the first quarter of 2008. In the moment when unemployment (the number of unemployed) reaches its peak, in the first quarter of 2010, the share of the short-term unemployed already decreases. A part of the unemployed is gradually shifting back into employment. Faster shift is inhibited by the factors that have contributed to the slow-down of the unemployment growth (employers are now reluctant to recruit new workers and prefer to extend reduced working hours). A larger proportion of the unemployed, however, moves into categories of longer duration unemployment. Thus, when the number of the unemployed remains stagnant, the share of the long-term unemployed (over 12 months) increases.

Figure 18: Development of time structure of unemployment in the EU (million of persons)

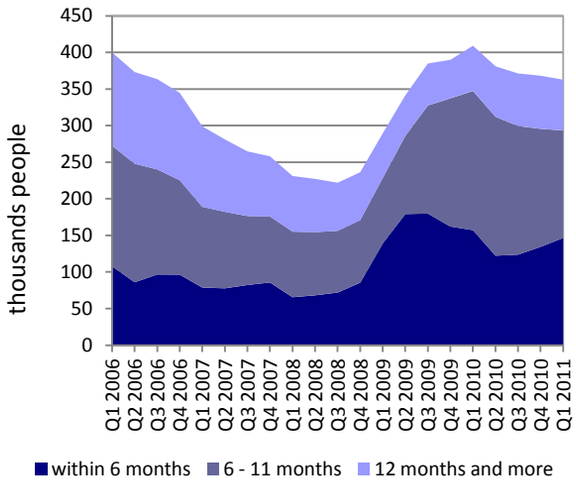


Source: Eurostat (2011c), own calculation. Data are seasonally adjusted.

Persistence of this situation brings risk of a permanent increase in long-term unemployment due to a phenomenon called hysteresis. The longer the cyclic fluctuation, the more

likely it is that a part of the long-term unemployed looses their work habits, skills and motivation to seek for a job. Thus, the cyclic fluctuation may transform into a structural issue.

Figure 19: Development of time structure of unemployment in the CR (in thousands of persons)



Note: Data are seasonally adjusted. Source: Eurostat (2011c), own calculation.

Development of time structure of unemployment in individual EU countries, however, also shows differences. When comparing the situation in the EU as a whole and the specific case of the Czech Republic, we can immediately see several differences (Figures 18, 19). The total number of unemployed, as noted earlier, has been slightly declining since the first quarter of 2010. A closer analysis shows that the decline has been caused by the gradual withdrawal from unemployment in the cohort of persons who contributed to the unemployment growth in the first half of 2009. The growth and subsequent decline are first reflected in the number of unemployed up to 6 months and only later in the group of unemployed for 6-11 months. The number of long-term (over 12 month) unemployed increased only slightly during 2010 and then it began to drop. An interesting development has been recorded in the group of the unemployed up to 6 months. Their number after reaching its maximum values, in the third quarter of 2009, began to decline; however, in the second quarter of 2010, the situation reversed again and since then, the number of the short-term unemployed has kept growing. This proves that the situation has not stabilized in the Czech labour market yet, and the employers keep releasing redundant workers.

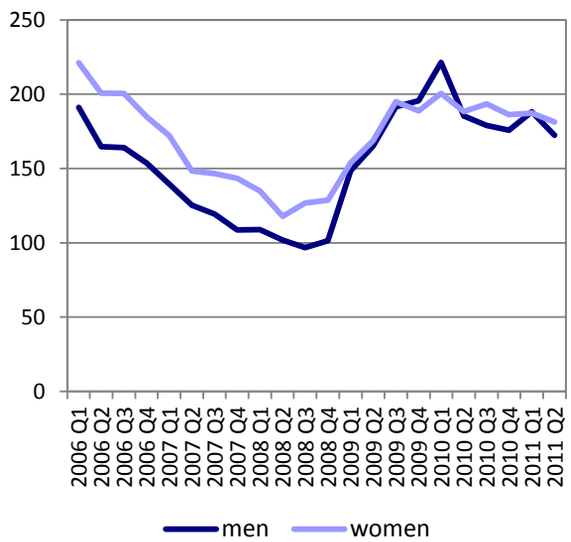
Development of unemployment by gender, age and education level

As illustrated by the above analysis, the impact of recession did not affect all occupational groups equally. Differences can be found not only by sectors or occupations but also by gender, age, education level or region.

Looking at the change in unemployment between the third quarter of 2008 and the third quarter of 2010 by gender in the EU, we can see that higher increase was recorded in the group of men (almost 43%) while women saw only 28.9%. Women are in general considered being more vulnerable in terms of unemployment risk; however, greater impact of the recession on male unemployment has its explanation in the employment structure of the crisis-affected sectors. The crisis affected most the industries with a higher proportion of male employment. For instance, in the third quarter of 2008, the proportion of men in total employment in manufacturing represented 70% and in construction even 91% in the EU.

Also in the Czech Republic, the impact of crisis caused certain anomaly in the composition of the unemployed by gender. Persistently higher proportion of women was between the third quarter of 2009 and the second quarter of 2010 replaced by the higher proportion of men. Temporary increase in the proportion of men can be also explained by sectoral impact on employment in industries (see Figure 20).

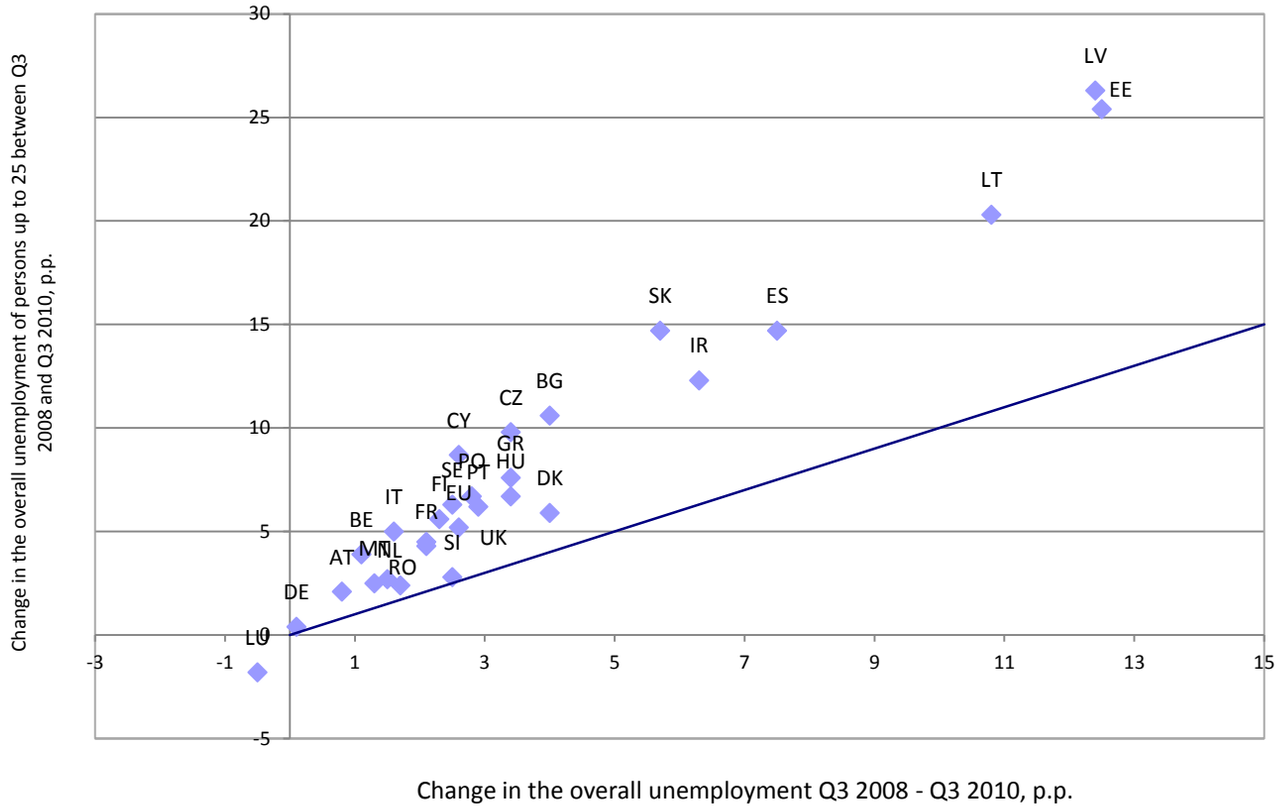
Figure 20: Development of unemployment by gender in the CR (in thousands of persons)



Source: Eurostat (2011c), own calculation.

Impacts of the crisis differed also by age groups affected. Due to the crisis, the difficulties of groups vulnerable to employment risk became even more serious, mainly those of young people up to 25 who seek their first employment, lack working experience and highly often have unstable jobs. The young unemployed up to 25 within the EU showed before the crisis (the third quarter of 2008) unemployment rate of 15.7%, which was 9.7 percentage points more than the labour force aged 25 – 49 and 12.1 percentage points more than the labour force aged 50 – 64. These differences got even bigger due to the crisis; as the highest increase in unemployment, (between the third quarter of 2008 and the third quarter 2010), was recorded in the group of young people up to 25. This increase accounted for 4.8 percentage points, while, the age groups 25-49 and 50-64 recorded an increase of 2.6 p.p. and 2.8 p.p., respectively. Thus, in 2010, the unemployment of persons up to 25 exceeded the 20% threshold (see Figure 21).

Figure 21: Change in the overall unemployment rate and unemployment rate of persons up to 25 between Q3 2008 and Q3 2010 (%)



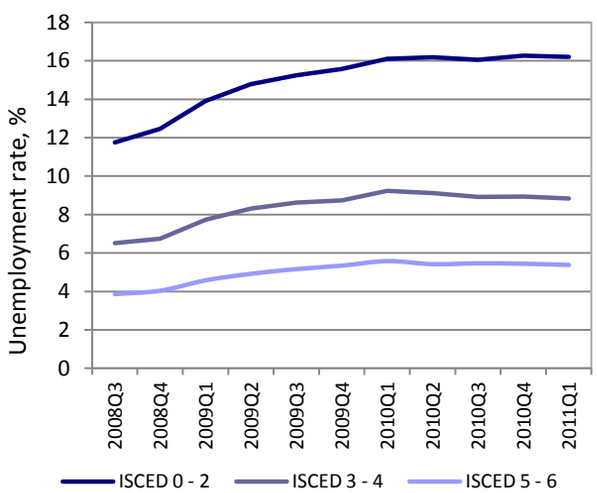
Note: The blue line defines the border where the change in the overall unemployment rate equals the changes in the unemployment rate of persons up to 25. Source: Eurostat (2011c), own calculation.

Higher growth in the unemployment rate of people up to 25 compared to the general unemployment rate was recorded, except for Luxemburg, in all EU countries. Higher increase in youth unemployment can be observed in countries that were affected by the crisis earlier (Spain, Ireland and the Baltic States). In terms of timing, it is worth noticing that the growth of youth unemployment reached its peak in the first half of 2010, while, in other age groups, the growth continued. The decline in employment of young people occurred in all occupational groups due mainly to the above-average proportion of temporary jobs (fixed-term contracts) and the above-average concentration of young people in industries sensitive to economic cycles.

In the Czech Republic, the unemployment rate of young people up to 25 increased even more than it did on average in EU countries, it increased by 8.1 percentage points thus reaching the value of 18.4%. The gap between the unemployment rates of young and older labour force is at present larger than the EU average.

It is not surprising, that the unemployment rates and the impact of crisis on these rates vary also depending on education level (see Figure 22). Similarly, as in terms of age groups, also in terms of educational attainment, we can identify the greatest aggravation of employment in the most affected group, i.e. in persons with at most primary education. In the long term, the unemployment rate in this group is almost twice as high as in the group of people with at most secondary education and three times higher than the unemployment rate in the group of people with tertiary education. In EU average terms, during the period from the third quarter of 2008 to the third quarter of 2010, the highest dynamics of increase in the unemployment rate were recorded in the group of people with primary education, by 4.4 p. p., while the unemployment rate, in the group of people with secondary education, grew only by 2.7 p. p. and those with tertiary education by 1.7 p. p.

Figure 22: Development of the unemployment rate by education level in the EU (%)



Source: Eurostat (2011c), own calculation.

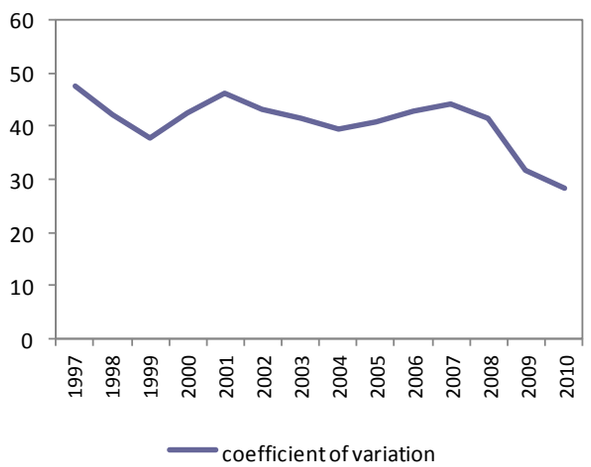
Again, it is possible to observe relatively large differences between individual EU countries. As noted earlier, in the case of the Czech Republic, the overall increase in unemployment was steeper, which was, however, reflected only

in faster growth of specific unemployment rates in groups of people with primary and secondary education (increase by 7.7 and 3.8 p. p. respectively); while, the increase recorded by people with tertiary education was below European average (1.6 p. p.) in given period. Thus, education acts as a protection against unemployment, although not absolutely. The crisis affected also the skills-intensive occupations, and it is evident that this situation is due to several factors that are co-decisive in terms of employability and job retention (in addition to those already mentioned, e.g. length of work practice, quality of skills and further education).

Development of regional imbalances in the CR

The effects of the crisis on labour markets also have a regional aspect. It can be assumed that the impact on individual regions will vary depending on varying concentration of affected sectors. The question is: how will these impacts affect the overall imbalances between the regional labour markets. Impact of the recession on regional imbalances can be illustrated by the example of the Czech Republic. Uneven distribution of especially long-term unemployment among regions is on one side due to the spatial irregularity of the structure of the economy, and thus concentration of insufficiently competitive industries in certain regions and on the other side to the influx of new investments in the regions that are attractive in terms of infrastructure. Also, the demand for labour is unevenly distributed in terms of territory, and as the labour force mobility is low, the imbalances on the labour market are irregular too.

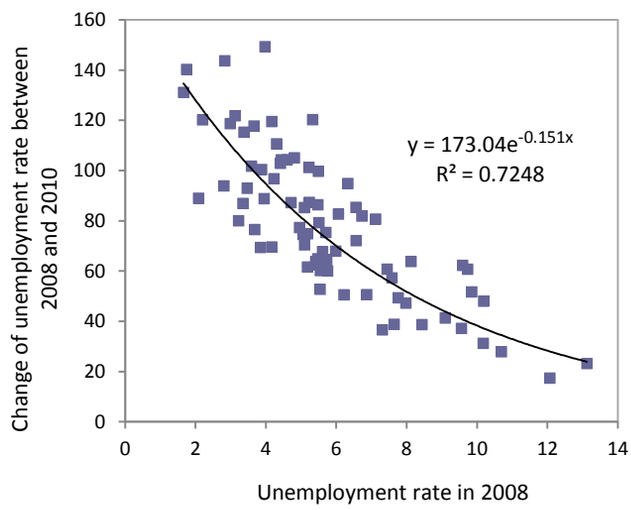
Figure 23: Development of variability in district unemployment rates in the CR (%)



Source: MoLSA (2011c), own calculation.

Variability of annual average unemployment rates in the CR districts (measured by the coefficient of variation) fluctuated between 40 – 45% from the end of the 90s to the beginning of the crisis, showing no trend. Onset of the crisis represented a rather significant change. Despite the uneven impact of the crisis on individual sectors of the economy, regional disparities began to diminish importantly. In 2009, the value of the variation coefficient decreased to 32% and in the subsequent year even to 28% (see Figure 23). This situation has its explanation.

Figure 24: Change of unemployment rates by districts in the CR (%)



Source: MoLSA (2011c), own calculation.

Although unemployment increased in all regions, there were large variations in the level. Its role played not only the sectoral structure of unemployment but also initial conditions on the specific regional labour market. In relative terms, the least deterioration was experienced by those regions that had been affected by unemployment and structural problems already before the crisis. It can be proved, that there is an indirect correlation between the initial level of unemployment and the change occurring between 2008 and 2010.

In regions affected by structural unemployment, the potential increase in unemployment was lower, but its long-term social consequences might be more serious than in the structurally less affected regions, where the economic recovery is more likely to cause subsequent reduction in unemployment (see Figure 24).

2. Human Resources for Skills Intensive Occupations

The demands of the economy concerning the educational attainment of the population are growing. Consequently, there is an increasing importance attached to all levels and forms of education. This chapter is divided into three subchapters. The first subchapter is devoted to the quality of basic education expressed in terms of the outcomes fifteen-year-old pupils achieved in international studies of various types of literacy. The changes in the level of reading, mathematical and scientific literacy between 2000 and 2009 are assessed, and attention is also paid to gender differences and the impact of selected factors on the scores. The second subchapter is concerned with the overall development of various fields of study as well as with the employability of higher education graduates and the quality of higher education. The third subchapter focuses on issues related to the educational structure of the population aged 25-64, on comparing the increase in the size of the population with tertiary qualifications and the increase in the number of skills intensive occupations, and the intergenerational shift in educational attainment.

2.1 Basic competencies of the young population

For human resources to be well prepared for skills intensive jobs it is necessary to be equipped with a good standard of basic competencies. These competencies make it possible for an individual to participate actively in society and working life, and form a basis for lifelong learning.

OECD experts[1] document that, over the long term, there is a correlation between educational outcomes as measured in the PISA study and the pace of GDP growth. Their models point to large opportunities for economic growth that may be materialised if the basi c skills of the entire population improve. This means that enhanced quality of educational outcomes could considerably boost economic performance. Of course, these are only models that must be interpreted with a high degree of uncertainty, as there is a number of other factors and situations that play their part in this context. Nevertheless, reforms that will result in improved learning outcomes may bring major economic benefits in the future.

With regard to the above, this subchapter is concerned with the competencies of fifteen-year-olds in reading, mathematical and scientific literacy as ascertained by means of the PISA international studies. The position of the Czech Republic and the way it changed from 2000 until 2009 is compared with other OECD countries.

Box 1 – The PISA international study

PISA (Programme for International Student Assessment) is a project of the Organisation for Economic Cooperation and Development (OECD). Its aim is to examine how fifteen-year-old pupils are prepared for life – i.e. what basis they have for lifelong learning. PISA focuses on identifying pupils' competencies in reading, mathematics and science. These basic competencies – called literacies in the PISA survey – are acquired primarily in the course of initial education. This means that the results of the research show, above all, the quality of initial education systems.

The PISA study explores the knowledge and skills that form a basis for the life of an individual in modern society. The countries that took part in the survey in 2009 account for nearly 90% of the global economy. In 2009 the fourth round of PISA was implemented. In 2000, 2003 and 2006 the main focus was on reading, mathematical and scientific literacy respectively. In 2009 attention was paid, again, to reading literacy – this time with a particular focus on digital texts. It is therefore possible to see the development of the pupils' outcomes over time.

Figure 1 illustrates a very alarming finding – the results of Czech fifteen-year-old pupils deteriorated significantly from 2000 until 2009 in all the areas under review. In reading literacy their scores are far below the OECD average. In mathematical and scientific literacy the results in recent years have shown a steep decline towards the OECD average.

Box 2 – Definition of types of literacy of fifteen-year-old pupils

Reading literacy is understanding, using and reflecting on written texts, in order to achieve one's goals, to develop one's knowledge and potential and to participate in society.

Mathematical literacy is an individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgements and to use and engage with mathematics in ways that meet the needs of that individual's life as a constructive, concerned and reflective citizen**.**

Scientific literacy is the capacity to use scientific knowledge, to identify questions and to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity.

2.1.1 Trends in the development of reading literacy

The results in the area of reading literacy seem to be the most important in terms of the future success in an individual's life and work. This is also confirmed by longitudinal research carried out, for example, in Canada[2]. The research points to a robust link between the reading literacy scores in PISA 2000 and the highest level of education attained in the future and success in the labour market.

The emphasis placed on reading literacy in PISA 2000 and then again in PISA 2009 makes it possible to compare the outcomes of pupils in this period. We present data from selected OECD countries that have participated in all studies since 2000.

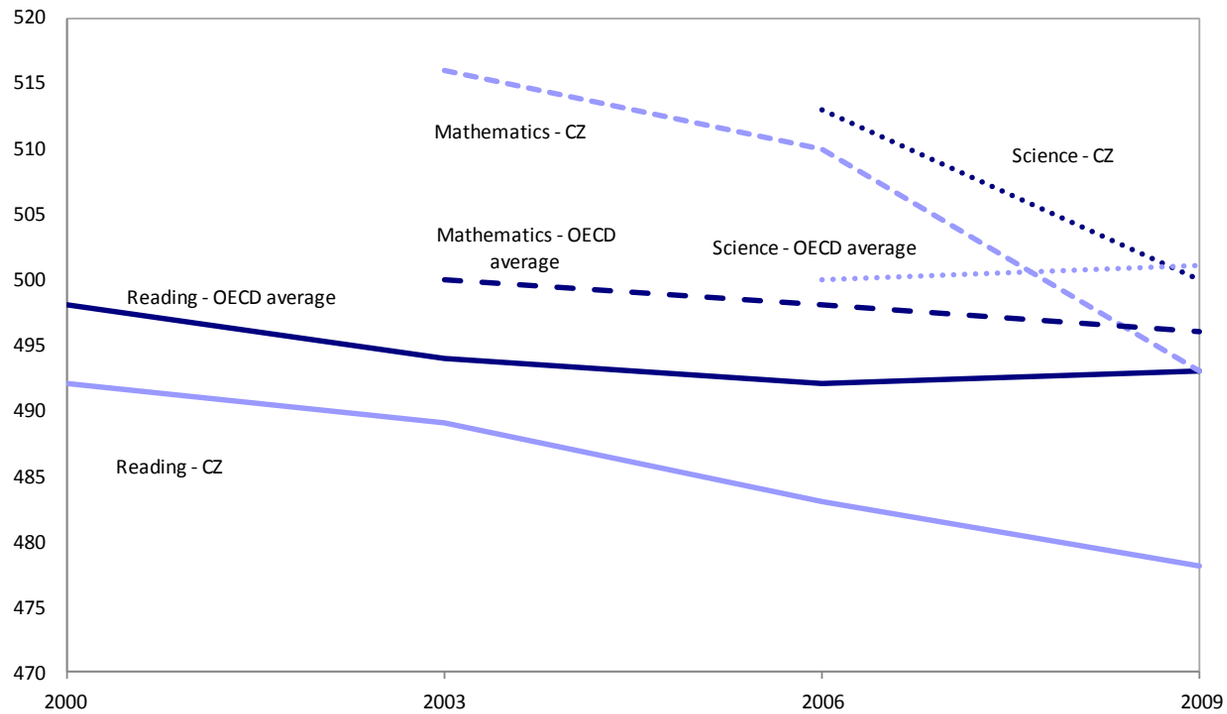
The development of average level of reading literacy in fifteen-year-old population

Table 1 shows that while the OECD average displays minor changes, some countries got either much higher or much lower scores in this period. The CR is one of the countries where the results deteriorated significantly – by 13 points. Among selected countries a steeper decline occurred only in Sweden and in Ireland. However, while students in these countries still have average scores within the OECD, the results of pupils in the CR dropped far below this average.

[1] **OECD** (2010f).

[2] **OECD** (2010b).

Figure 1: PISA scores development – comparison of the CR and the OECD average (points)



Note: Overall scores in mathematical literacy in 2000 and scientific literacy in 2000 and 2003 are not statistically comparable with those achieved in the following years. Therefore they are not presented. Source: OECD (2000, 2003, 2006, 2009a).

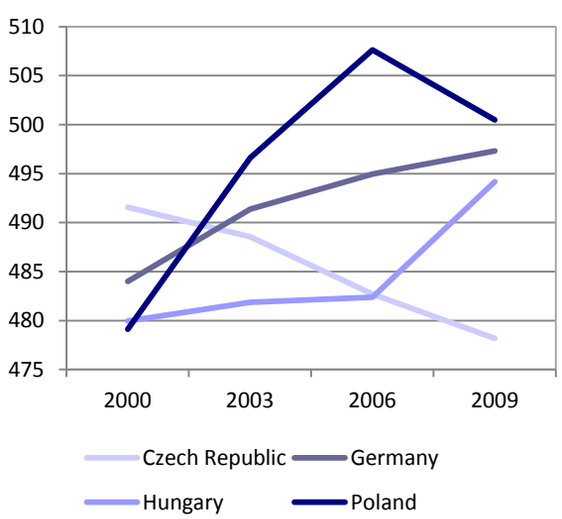
Table 1: The development of average level of reading literacy

	PISA 2000	PISA 2003	PISA 2006	PISA 2009	Change between 2000 and 2009
	Average score	Average score	Average score	Average score	Score dif. *
Poland	479	497	508	500	**21**
Portugal	470	478	472	489	**19**
Korea	525	534	556	539	**15**
Hungary	480	482	482	494	**14**
Germany	484	491	495	497	**13**
OECD-26	496	m	m	496	1
Belgium	507	507	501	506	-1
Italy	487	476	469	486	-1
Denmark	497	492	494	495	-2
Japan	522	498	498	520	-2
USA	504	495	m	500	-5
France	505	496	488	496	-9
Finland	546	543	547	536	-11
Spain	493	481	461	481	-12
CR	492	489	483	478	**-13**
Sweden	516	514	507	497	**-19**
Ireland	527	515	517	496	**-31**

Note: OECD-26 – the average outcome of 26 OECD countries that participated in the PISA study. * – the difference is calculated from the original non-rounded values; therefore it might not equal exactly the difference calculated from the rounded values presented in the table. Source: OECD (2010d).

Other Central European countries – Poland, Germany and Hungary – that in 2000 scored below the OECD average and worse than the CR, achieved much better results. In 2009 they produced average OECD scores – i.e. far higher than the CR. Poland achieved the largest positive change – by 21 points (see Figure 2).

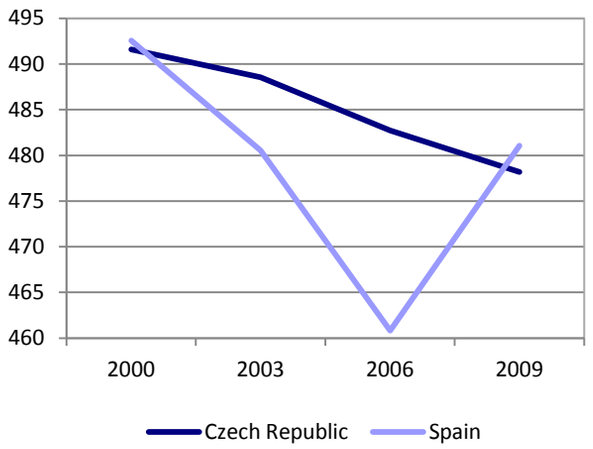
Figure 2: The development of average level of reading literacy (points)



Source: OECD (2010d).

The CR currently shows reading literacy scores that are similar to those achieved by Spain. However, the two countries differ in terms of the development from 2000 until 2009 (see Figure 3). While in the CR the average results gradually worsened in the course of the entire period, Spain saw a major decline between 2003 and 2006. However, in the most recent three-year period there was a positive change, but the results are still lower than those scored in 2000.

Figure 3: The development of average level of reading literacy



Source: OECD (2010d).

The results presented above and the ways they develop are not directly correlated with educational spending. While between 2000 and 2007 the expenditure on education in the OECD increased by an average of 25%, the results did not improve in a corresponding manner. Nor did countries with a significant increase in the level of financial resources flowing into education saw an impact of this move in terms of better outcomes. This means that other major factors play a role in this context, such as the characteristics of education systems or the students' social and cultural backgrounds. These aspects are dealt with in parts 2.1.8 and 2.1.9.

Further detailed analyses are going to show the development of reading literacy scores for various groups of students. Students are divided into six so-called proficiency levels depending on how many points they attained in the test. Pupils at Level 1 of proficiency reach the lowest scores and master the least difficult skills. Level 6 corresponds to the highest scores. Table 2 displays the proportions of students in those OECD countries that achieved the relevant proficiency levels in 2009.

Table 2: Levels of proficiency

	1b	1a	2	3	4	5	6
Minimum number of points	262	335	407	480	553	626	698
OECD share of population (%)	98.9	94.3	81.2	57.2	28.3	7.6	0.8

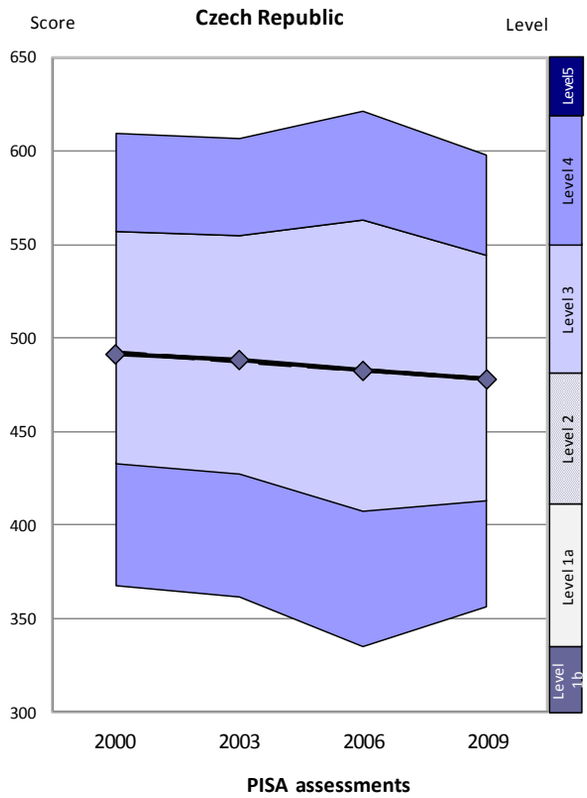
Source: OECD (2010e).

Figure 4 illustrates the distribution of the Czech population of fifteen-year-olds according to the proficiency levels. It is clear from the data that the major trend of an increasing proportion of students at the lowest proficiency level was halted in the CR. However, there is also a declining proportion of students at the higher levels of proficiency. The highest level, Level 6, is not attained by students in the Czech Republic.

The lowest levels of reading literacy of fifteen-year-olds

Level 2 of reading literacy is considered to be the baseline level that makes it possible for students to use reading for further learning and it is the basis from which an individual may effectively influence his/her life. Table 3 shows the scores (percentages) of students who fail to attain this principal level. These students are very much at risk. As a rule, they do not complete secondary education and face difficulties in the labour market.

Figure 4: The proportions of students at various levels of reading literacy



Source: OECD (2010d).

Table 3: The proportion of students at the lowest levels of reading literacy

	Under level 2 (score less than 407), 2000	Under level 2 (score less than 407), 2009	Under level 2 (score less than 407), change 2000-2009
	%	%	p.p. difference*
Ireland	11.0	17.2	**6.2**
CR	17.5	23.1	**5.6**
Sweden	12.6	17.4	**4.9**
France	15.2	19.8	**4.6**
Japan	10.1	13.6	3.5
Spain	16.3	19.6	**3.3**
Italy	18.9	21.0	2.1
Finland	7.0	8.1	1.2
Korea	5.8	5.8	0.0
USA	17.9	17.6	-0.3
Belgium	19.0	17.7	-1.2
OECD-26	19.3	18.1	**-1.2**
Denmark	17.9	15.2	**-2.7**
Germany	22.6	18.5	**-4.2**
Hungary	22.7	17.6	**-5.1**
Poland	23.2	15.0	**-8.2**
Portugal	26.3	17.6	**-8.6**

Note: OECD-26 – the average outcome of 26 OECD countries that participated in the PISA study. * – the difference is calculated from the original non-rounded values, therefore it might not equal exactly the difference calculated from the rounded values presented in the table. Source: OECD (2010d).

The OECD average for this indicator does not change much either. The differences among the countries are more robust. The CR ranks among the countries with the highest proportion of these students in Europe. Nearly a quarter of fifteen-year-olds fail to reach this baseline level of reading literacy. Between 2000 and 2009 the development was unfavourable and this proportion increased by 5.6 p.p. Ireland, Sweden, France and Spain saw a similar change. In these countries the proportion of low-performing students in this respect still hovers around the OECD average, whereas in the CR the proportion of these students is far higher than the average. Other Central European countries – Poland, Germany and Hungary, and also Portugal managed to reduce significantly the proportion of low-performers in the given period. While in 2000 they lagged behind the OECD average as well as the scores achieved by the CR, in 2009 they displayed much better results than the CR. Portugal and Poland saw the largest shift towards positive figures of all OECD countries, as they managed to decreased the proportion of low-achievers in reading by 8.6 p.p. and 8.2 p.p. respectively.

Figure 5: The proportion of students at the lowest levels of reading literacy (in %)

Source: OECD (2010d).

The highest level of reading literacy of fifteen-year-olds

Students who achieve the highest levels of proficiency in reading (Level 5 and 6) can work with a text that is unfamiliar to them both in terms of form and content. In this text they are able to find the relevant information, understand the details of the text and to judge which piece of information is important for a given task. They can critically assess the text, develop hypotheses, etc. Students who attain this level may be considered as the human resources for skills intensive occupations in the future. This is why the proportion of these students is a good indicator of the future competitiveness of the given country. Table 4 shows the percentages of students who achieve these levels.

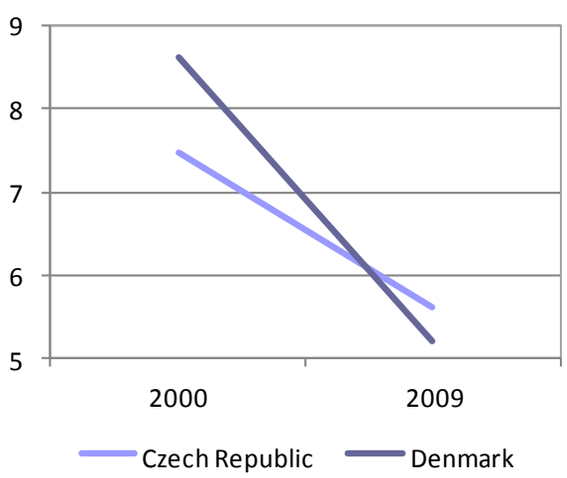
The OECD average for this indicator does not change much either, but the differences between individual countries are starker. Finland maintains its largest proportion of students who reach the highest levels of proficiency in reading, although it saw a major decline between 2000 and 2009. Asian countries display a major improvement in this respect. Japan and Korea in particular scored among the countries with the highest proportion of students with the best results in reading literacy. Several countries that ranked well above the OECD average in 2000 witnessed a significant decline – in Ireland the drop was the largest (by 7.3 p.p.) followed by Sweden and the USA. The CR is among the countries (similarly to Denmark) where the proportion of the best performers was below the OECD average already in 2000 and it further dropped to 5%.

Table 4: The proportions of students at the highest levels of reading literacy

	Level 5 and higher (score more than 626), 2000	Level 5 and higher (score more than 626), 2009	Level 5 and higher (score more than 626), change 2000-2009
	%	%	p.p. difference*
Korea	5.7	12.9	**7.2**
Japan	9.9	13.4	**3.6**
Poland	5.9	7.2	1.3
France	8.5	9.6	1.1
Hungary	5.1	6.1	1.0
Portugal	4.2	4.8	0.6
Italy	5.3	5.8	0.5
Belgium	12.0	11.2	-0.8
OECD-26	9.0	8.2	**-0.8**
Spain	4.2	3.3	-0.9
Germany	8.8	7.6	-1.2
CR	7.0	5.1	**-1.9**
Sweden	11.2	9.0	**-2.2**
USA	12.2	9.9	-2.4
Denmark	8.1	4.7	**-3.4**
Finland	18.5	14.5	**-4.0**
Ireland	14.2	7.0	**-7.3**

Note: OECD-26 – the average outcome of 26 OECD countries that participated in the PISA study. * – the difference is calculated from the original non-rounded values, therefore it might not equal exactly the difference calculated from the rounded values presented in the table. Source: OECD (2010d).

Figure 6: The proportions of students at the highest levels of reading literacy (in %)



Source: OECD (2010d).

Performance on subscales

In addition to the overall scores in reading literacy it is possible to assess the achievement of pupils in solving various types of tasks. For this purpose performance subscales were developed for three categories of tasks requiring various aspects of reading literacy (see Box 3).

Box 3 – The PISA study distinguishes three types of skills:

Finding and collecting information ("Access and retrieve" subscale): searching for specific information in a text or its integration.

Processing information ("Integrate and interpret" subscale): includes identification of the main idea or interpretation of the meaning of the text.

Evaluation of the text ("Reflect and evaluate" subscale): requires identification of the connection between information in the text and the reader's own knowledge of the world or information from another source, and assessment of the content or the form of the text.

Both continuous and non-continuous text (e.g. graphs, diagrams, forms, etc.) is used for examining reading skills.

Table 5 shows the differences in pupils' scores on the overall scale and on the subscales of reading literacy in 2009. An ideal outcome might consist of comparable results on all three subscales. However, in most countries the scores on the individual subscales vary. Poland, for example, reports quite well-balanced scores. The CR is among the countries that fall far behind on the subscale concerned with text evaluation (similarly to Slovakia, Slovenia, Bulgaria and Russia). This reveals that Czech students are not used to critically assess what they read. As distinct from this, students in the USA or the UK have far better scores on this subscale as compared to finding and processing information.

Table 5: Reading literacy scores on subscales in 2009

		Difference between the result on the overall scale and on the subscale		
	Average results (points)	Finding and collecting information	Processing information	Evaluation of the text
Czech Rep.	478	1	9	-16
Poland	500	0	2	-3
USA	500	-8	-5	12
OECD average	493	2	0	1

Source: OECD (2010e).

It is clear from the above that the results of fifteen-year-old pupils in reading literacy in the CR are not very good. What is particularly alarming is the downward trend. What is also alarming is the very low proportion of students who achieve the highest scores. This points to the **limited potential of human resources for skills intensive occupations,** because these very students are probably the future successful graduates of universities and experts with high qualifications.

2.1.2 Trends in the development of mathematical literacy

The changes in the mathematical literacy scores in the PISA study can be traced since 2003. In general, they are smaller than those in reading literacy. This is also influenced by the shorter period of time for which the results can be compared. The OECD average did not virtually change during those years.

The development of average mathematical literacy of fifteen-year-olds

As Table 6 shows, the Czech Republic is the country with the steepest decline in the scores – by 24 points. This has placed Czech pupils below the OECD average, while in 2003 they were still above this average. A major deterioration occurred in other European countries as well (Ireland, Sweden, France and Denmark). However, the scores of Belgian and Dutch students remain above the average despite a major drop. Portugal and Italy displayed a significant improvement, but the scores of the pupils of these two countries still remain below the average.

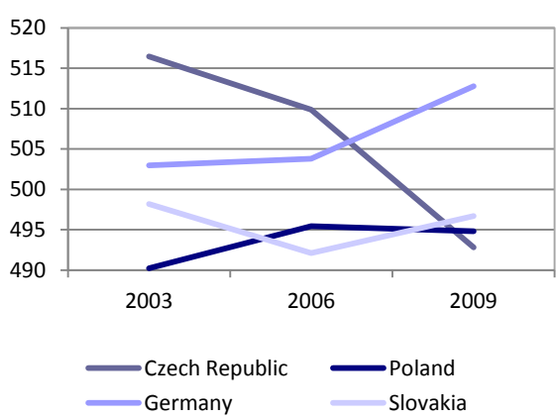
Table 6: The development of average level of mathematical literacy

	PISA 2003	PISA 2006	PISA 2009	Change between 2003 and 2009
	Average score	Average score	Average score	Score dif.*
Portugal	466	466	487	**21**
Italy	466	462	483	**17**
Germany	503	504	513	**10**
Poland	490	495	495	5
USA	483	474	487	5
Korea	542	547	546	4
Hungary	490	491	490	0
OECD-28	500	497	499	0
Slovakia	498	492	497	-2
Spain	485	480	483	-2
Finland	544	548	541	-4
Japan	534	523	529	-5
Denmark	514	513	503	**-11**
Netherlands	538	531	526	**-12**
Belgium	529	520	515	**-14**
France	511	496	497	**-14**
Sweden	509	502	494	**-15**
Ireland	503	501	487	**-16**
Czech Rep.	516	510	493	**-24**

Note: OECD-26 – the average outcome of 26 OECD countries that participated in the PISA study. * – the difference is calculated from the original non-rounded values, therefore it might not equal exactly the difference calculated from the rounded values presented in the table. Source: OECD (2010d).

Figure 7 illustrates the comparisons of the scores of pupils in Central European countries, our neighbours.

Figure 7: The development of average level of mathematical literacy (points)



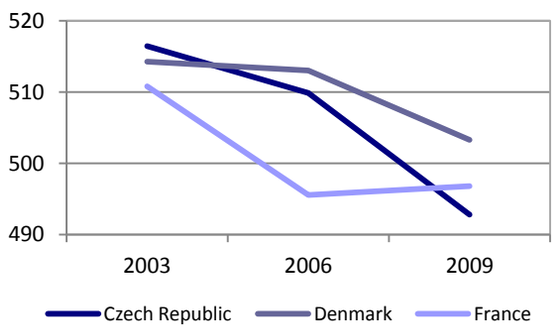
Source: OECD (2010d).

While the results of Slovakia and Poland hover slightly below the OECD average and did not change significantly in the period concerned, the scores of Czech pupils fell below the level of these countries. Contrary to this, Germany continues scoring above average results and between 2006 and 2009 it improved by 10 points. Other countries reported a

similar decline as did the Czech Republic, although not as significant.

As Figure 8 reveals, the results of Denmark and France, which were comparable with the CR in 2003, worsened by 11 and 14 points respectively. France witnessed a radical decline between 2003 and 2006 which it managed to halt in the most recent three-year period. Denmark also saw a major deterioration, although not so steep as the Czech Republic, and its scores are still above the OECD average.

Figure 8: The development of average level of mathematical literacy (points)



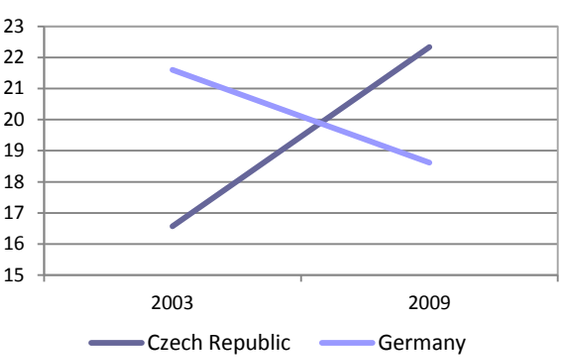
Source: OECD (2010d).

The lowest levels of mathematical literacy of fifteen-year-olds

As with reading literacy, Level 2 is considered to be the baseline level that allows an individual to participate in the current society. Students at this level can apply basic mathematical algorithms and solve simple mathematical tasks in a familiar context. Table 7 shows the percentages of students who fail to perform to this baseline level and will therefore face problems in further education.

The Czech Republic ranks among the countries that, similarly to France and Ireland, showed an increase in the percentage of students performing to the lowest level of proficiency in mathematics. While in 2003 the CR had a proportion of these students that was lower than the OECD average, in 2009 the percentage increased and exceeded this average. As opposed to this, Portugal and Italy, that had nearly one third of these pupils, improved significantly from 2003, although they still score below the OECD average. Germany is one Central European country that managed to improve and get above the OECD average. Figure 9 illustrates a development that is the reverse of that in the CR.

Figure 9: The proportion of students at the lowest levels of mathematical literacy (in %)



Source: OECD (2010d).

Table 7: The proportion of students at the lowest levels of mathematical literacy

	Under level 2 (score less than 420), 2003	Under level 2 (score less than 420), 2009	Under level 2 (score less than 420), change 2003-2009
	%	%	p.p. difference*
France	16.6	22.5	**5.9**
Czech Rep.	16.6	22.3	**5.8**
Ireland	16.8	20.8	**4.0**
Sweden	17.3	21.1	**3.8**
Belgium	16.5	19.1	**2.6**
Netherlands	10.9	13.4	2.5
Denmark	15.4	17.1	1.6
Finland	6.8	7.8	1.1
Slovakia	19.9	21.0	1.1
Spain	23.0	23.7	0.8
Hungary	23.0	22.3	-0.7
Japan	13.3	12.5	-0.8
OECD-28	21.6	20.8	**-0.9**
Korea	9.5	8.1	-1.4
Poland	22.0	20.5	-1.6
USA	25.7	23.4	-2.3
Germany	21.6	18.6	-3.0
Portugal	30.1	23.7	**-6.4**
Italy	31.9	24.9	**-7.0**

Note: OECD-28 – the average outcome of 28 OECD countries that participated in the PISA study, *– the difference is calculated from the original non-rounded values, therefore it might not equal exactly the difference calculated from the rounded values presented in the table. Source: OECD (2010d).

The highest levels of mathematical literacy of fifteen-year-olds

Levels 5 and 6 in the tests of mathematical literacy are reached by students who are able to solve complex mathematical tasks requiring highly developed mathematical thinking and reasoning. Table 8 illustrates the percentages of students who achieve these top levels.

In addition to the CR, Belgium and the Netherlands are countries that saw the steepest decline in the proportion of these best performing students. While the proportion of the Belgian and Dutch high-achievers remains above the OECD average despite the major decline, the CR is among the countries that, similarly to Denmark and Sweden, showed a decrease in this proportion that brought them to rank below the OECD average. Portugal is perhaps the only country that reports positive development for this indicator, but its scores are far below the OECD average. This means that most countries fail to increase the proportions of these students. Moreover, many countries that had a high percentage of those at the top proficiency levels in 2003 show a change for the worse.

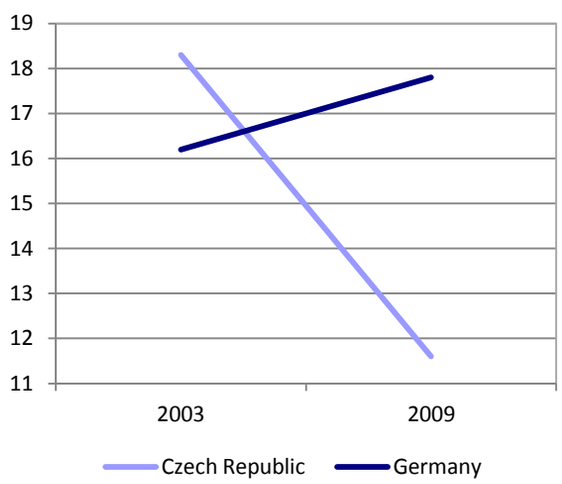
Figure 10 shows, again, the comparison of the CR with Germany that did report a slightly positive development after all. The overall improvement in Germany is primarily due to the reduced number of students with the lowest scores, while there is also a slight increase in the proportion of the top-performers.

Table 8: The proportion of students at the highest levels of mathematical literacy

	Level 5 and higher (score more than 607, 2003	Level 5 and higher (score more than 607, 2009	Level 5 and higher (score more than 607, change 2003-2009
	%	%	p.p. difference*
Portugal	5.4	9.6	**4.3**
Italy	7.0	9.0	**1.9**
Germany	16.2	17.8	1.6
Korea	24.8	25.6	0.8
Poland	10.1	10.4	0.3
Spain	7.9	8.0	0.1
Slovakia	12.7	12.7	0.0
USA	10.1	9.9	-0.2
Hungary	10.7	10.1	-0.6
OECD-28	14.7	13.4	**-1.2**
France	15.1	13.7	-1.4
Finland	23.4	21.7	-1.7
Japan	24.3	20.9	-3.4
Denmark	15.9	11.6	**-4.4**
Sweden	15.8	11.4	**-4.4**
Ireland	11.4	6.7	**-4.7**
Netherlands	25.5	19.9	**-5.6**
Belgium	26.4	20.4	**-6.1**
Czech Rep.	18.3	11.6	**-6.6**

Note: OECD-28 – the average outcome of 28 OECD countries that participated in the PISA study. *– the difference is calculated from the original non-rounded values, therefore it might not equal exactly the difference calculated from the rounded values presented in the table. Source: OECD (2010d).

Figure 10: The proportion of students at the highest levels of mathematical literacy (in %)



Source: OECD (2010d).

2.1.3 Trends in the development of scientific literacy

The trends in scientific literacy scores may be traced in the PISA study from 2006. It may be expected that due to the shorter period allowing for comparisons, among other things, the changes are smaller as compared to those in reading and mathematical literacy. The average of OECD countries virtually did not change over those years.

The development of average level of scientific literacy of fifteen-year-olds

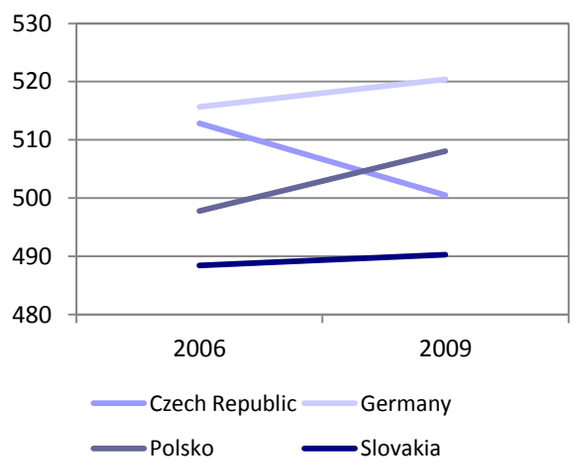
As Table 9 illustrates, the CR is again among the countries with the most extensive decline in the scores – by 12 points. This placed Czech students at the OECD average, while in 2006 they were still above this level. The countries that saw deterioration of the results included, for example, Finland which, however, retains its position among the best-scoring countries.

Table 9: The development of average level of scientific literacy

	PISA 2006	PISA 2009	Change between 2006 and 2009
	Average score	Average score	Score dif.*
Portugal	474	493	**19**
Korea	522	538	**16**
Italy	475	489	**13**
USA	489	502	**13**
Poland	498	508	**10**
Japan	531	539	8
Germany	516	520	5
Denmark	496	499	3
France	495	498	3
OECD-33	498	501	3
Slovakia	488	490	2
Ireland	508	508	0
Spain	488	488	0
Hungary	504	503	-1
United Kingdom	515	514	-1
Netherlands	525	522	-3
Belgium	510	507	-4
Slovenia	519	512	**-7**
Sweden	503	495	-8
Finland	563	554	**-9**
Czech Rep.	513	500	**-12**

Note: OECD-33 – the average outcome of 33 OECD countries that participated in the PISA study, *– the difference is calculated from the original non-rounded values, therefore it might not equal exactly the difference calculated from the rounded values presented in the table. Source: OECD (2010d).

Figure 11: The development of average level of scientific literacy (points)



Source: OECD (2010d).

A major improvement in this area occurred both in countries with traditionally excellent scores such as Korea, and in countries that used to rank below the OECD average. Students from the USA and Poland exceeded the OECD average. Italian and Portuguese pupils remain below the OECD average despite a considerable improvement in their results. Figure 11 shows a comparison of the outcomes of pupils in Central European countries, our neighbours. Unlike these countries, the CR displays a negative development – i.e. worsening of the results.

The lowest levels of scientific literacy of fifteen-year-olds

As with reading and mathematical literacy, Level 2 is viewed as a baseline level that is a precondition for an individual's participation in today's society. Students at this level have scientific knowledge that allows them to explain the external world and infer conclusions based on simple examination. Table 10 shows the percentages of students who fail to reach this basic level and therefore will face difficulties related to their full participation in the life in our society where science and technology play an important role in everyday situations.

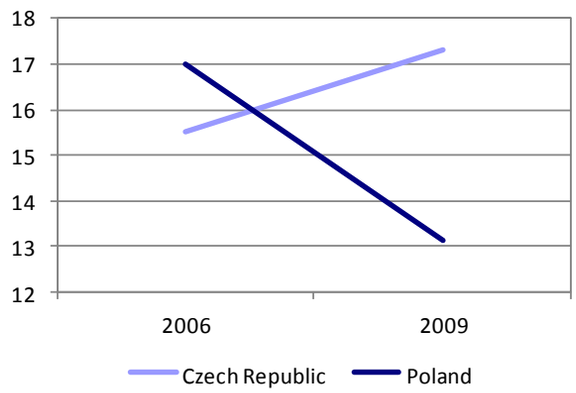
Table 10: The proportion of students at the lowest levels of scientific literacy

	Under level 2 (score less than 410), 2006	Under level 2 (score less than 410), 2009	Under level 2 (score less than 410), change 2006-2009
	%	%	p.p.difference*
Sweden	16.4	19.1	2.8
Finland	4.1	6.0	1.9
Czech Republic	15.5	17.3	1.8
Belgium	17.0	18.0	1.0
Slovenia	13.9	14.8	0.9
Netherlands	13.0	13.2	0.2
Ireland	15.5	15.2	-0.3
Germany	15.4	14.8	-0.6
Hungary	15.0	14.1	-0.9
Slovakia	20.2	19.3	-0.9
Japan	12.0	10.7	-1.4
Spain	19.6	18.2	-1.4
United Kingdom	16.7	15.0	-1.7
Denmark	18.4	16.6	-1.9
France	21.2	19.3	-1.9
OECD-33	19.9	17.9	-2.1
Poland	17.0	13.1	-3.8
Italy	25.3	20.6	-4.6
Korea	11.2	6.3	-4.9
USA	24.4	18.1	-6.3
Portugal	24.5	16.5	-8.0

Note: OECD-33 – the average outcome of 33 OECD countries that participated in the PISA study, *– the difference is calculated from the original non-rounded values, therefore it might not equal exactly the difference calculated from the rounded values presented in the table. Source: OECD (2010d).

In the CR there was a slight increase in the proportion of students performing to the lowest proficiency levels in science (as in Sweden, for example). This places us at the average of OECD countries. A major improvement occurred both in countries that show below average scores such as Italy, Portugal and USA, and in countries with results above the average such as Poland (and also excellent countries such as Korea). The different developments in Poland and in the CR are illustrated in Figure 12.

Figure 12: The proportion of students at the lowest levels of scientific literacy (in %)



Source: OECD (2010d).

The highest levels of scientific literacy of fifteen-year-olds

Proficiency levels 5 and 6 in the test of scientific literacy are achieved by the best performing students who are able to apply scientific knowledge and skills in resolving complex scientific questions of the real world. Table 11 shows the percentages of students who reach these top levels.

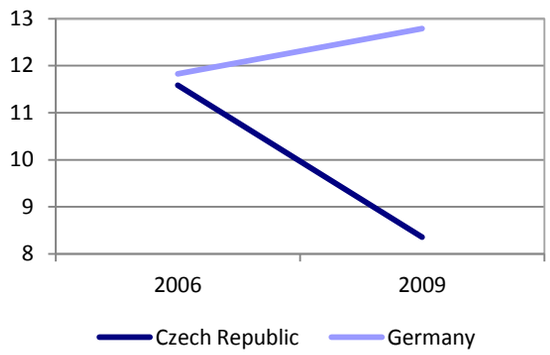
Table 11: The proportion of students at the highest levels of scientific literacy

	Level 5 and higher (score more than 633, 2006	Level 5 and higher (score more than 633, 2009	Level 5 and higher (score more than 633, change 2006-2009
	%	%	p.p. difference*
Japan	15.1	16.9	1.9
Korea	10.3	11.6	1.3
Italy	4.6	5.8	**1.2**
Germany	11.8	12.8	1.0
Portugal	3.1	4.2	1.0
Poland	6.8	7.5	0.8
Slovakia	5.8	6.2	0.5
Sweden	7.9	8.1	0.2
France	8.0	8.1	0.1
USA	9.1	9.2	0.1
Belgium	10.1	10.1	0.0
Denmark	6.8	6.7	-0.1
OECD average -33	8.8	8.5	**-0.3**
Netherlands	13.1	12.7	-0.4
Ireland	9.4	8.7	-0.7
Spain	4.9	4.0	-0.9
Hungary	6.9	5.4	-1.5
Finland	20.9	18.7	-2.2
United Kingdom	13.7	11.4	**-2.4**
Slovenia	12.9	9.9	**-3.0**
Czech Republic	11.6	8.4	**-3.2**

Note: OECD-33 – the average outcome of 33 OECD countries that participated in the PISA study, *– the difference is calculated from the original non-rounded values, therefore it might not equal exactly the difference calculated from the rounded values presented in the table. Source: OECD (2010d).

Of all the countries under review the Czech Republic experienced the steepest decline that placed it at the average of OECD countries. Slovenia displays a similar development. A positive development could only be seen in Italy that, however, is far below the OECD average for this indicator. This means that the majority of countries achieve no major success in increasing this proportion.

Figure 13: The proportion of students at the highest levels of scientific literacy (in %)



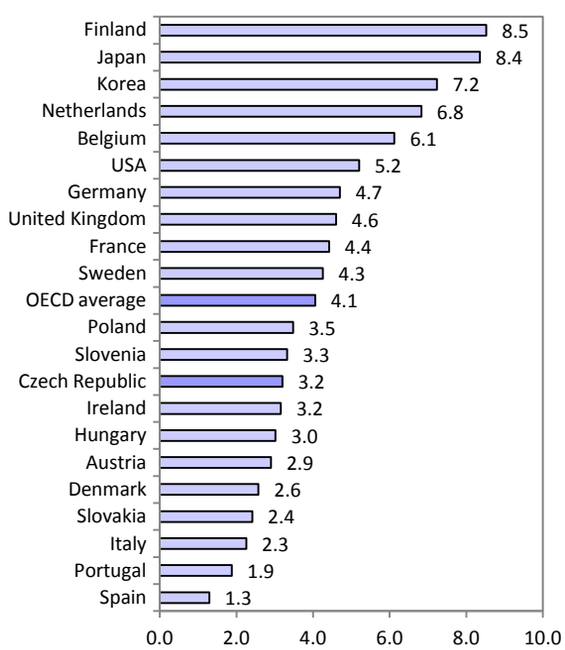
Source: OECD (2010d).

Figure 13 presents very similar percentages of pupils at the highest levels of scientific literacy in the CR and in Germany in 2006. Contrary to the CR, Germany managed to enhance the proportion slightly in 2006-2009.

2.1.4 Best-performing students

The growing demands for highly qualified workforce result in a competition of talent on a global scale. Highly developed knowledge and skills are a prerequisite for the development of new technologies and innovation. Therefore, if we pay attention to best-achievers in reading, mathematics and science in various countries, we may predict the future pool of talent and think how to support them.

Figure 14: The proportion of students who achieve the best scores in all three literacy domains (in %)



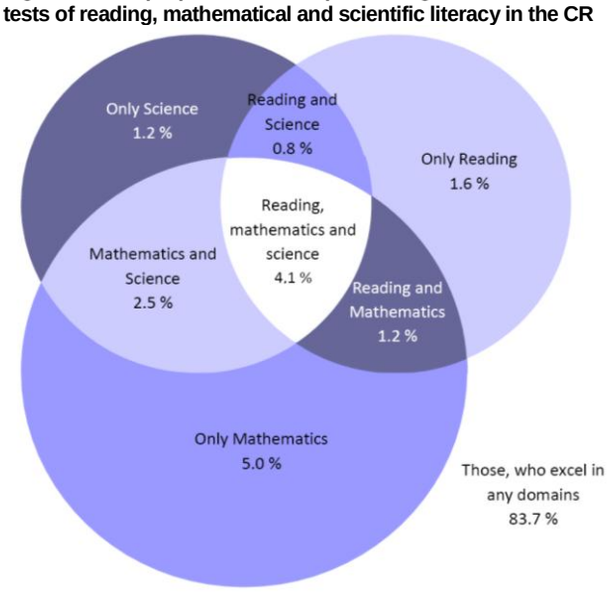
Source: OECD (2010e).

These students will lead competitive economies based on knowledge, and their number is important for each country. An average 8% of pupils in OECD countries achieve Level 5 and 6 in reading. In mathematics it is 13% and in science these levels are reached by 9% of pupils on average. While 16% of students score excellent results only in one domain, a mere 4% of students get excellent scores in all three domains.

Figure 14 below shows the proportions of students who excel in all areas in selected OECD countries. Finland has the largest proportion of these students, followed by Japan and Korea. The Netherlands and Belgium are other European countries that score well above the average. The Czech Republic with 3.2% occupies a place below the OECD average.

Figure 15 illustrates the overlaps of the performance of the best-achievers in reading, mathematics and science between the CR and the OECD average.

Figure 15: The proportion of best-performing students in the tests of reading, mathematical and scientific literacy in the CR



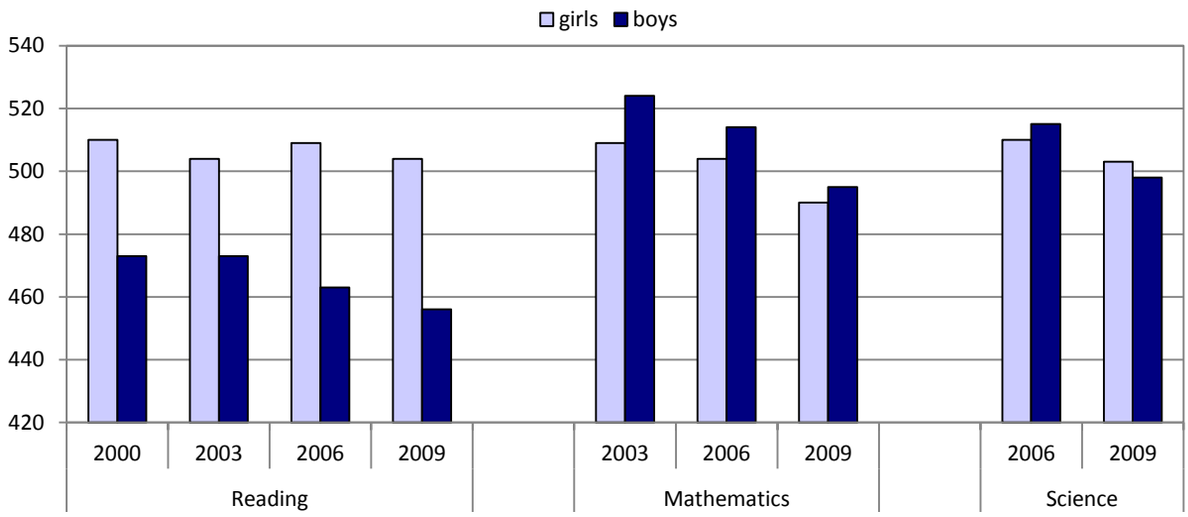
Source: OECD (2010e).

2.1.5 Gender differences

The literacy scales in the PISA studies regularly reveal differences in performance in terms of gender. Girls achieved better scores in reading literacy in all countries that participated in the survey (girls reached an average of 39 points more than boys for the OECD as a whole[3]). In the Czech Republic this so-called "gender gap" in reading literacy is above the average – 48 points. In the first PISA study in 2000 the difference was 37 points (the OECD average for the gender gap was then 32 points). The gap between the performance of girls and boys is therefore widening more quickly in the Czech Republic than in the OECD. Czech girls' scores in reading literacy have only decreased by 6 points since 2000. This decline is not statistically significant. With the total score of 504 points Czech girls still hover slightly above the OECD average. A major decrease in the performance of boys (by 17 points – from 473 points in 2000 to 456 points in 2009) is the most striking feature that reflects the alarming deterioration in the reading scores of Czech pupils.

[3] **OECD** (2010e).

Figure 16: The development of differences between boys and girls in the Czech Republic in the three types of literacy examined by PISA (points)



Note: The data for mathematical literacy in 2000 and for scientific literacy for 2000 and 2003 are not presented, since they are not statistically comparable with the following years (due to a change in the methodology). Source: OECD (2000, 2003, 2009a).

Reading literacy is traditionally considered to be the girls' domain. Boys, on the other hand, have always been viewed as stronger in mathematics, and the international results of PISA confirm this (in 2009 boys had 12 points better scores on average than girls in the OECD as a whole). The Czech Republic is no exception – boys perform better in the PISA mathematics test. However, their scores decreased gradually from 2003 and approached those of girls (in 2009 boys had only 5 points better scores than girls, and this difference is not statistically significant). Scientific literacy, as measured by PISA, is not unequivocally linked to gender. On average, the difference between boys and girls in OECD countries was virtually zero. In the CR there were some minor differences between boys and girls, but they were of no statistical significance in any of the years when the survey was carried out. Nevertheless, a trend has become apparent in recent years that the scores of boys in scientific literacy drop more considerably than those of girls. This is in line with the development of the two remaining scales and it may be assumed that the gender gap might be widening in this domain as well. **Boys' performance deteriorates more significantly as compared to girls in all three domains measured.**

In the Czech Republic we are witnessing a phenomenon that, for some years, has been discussed by experts in many developed countries (e.g. the UK and the USA): While in the 2nd half of the 20th century these countries were addressing, hand in hand with the women's emancipation movement, the issue of girls lagging behind boys in both academic and, consequently, professional performance, the turn of the millennium brought about a robust and relatively rapid shift in the opposite direction. Boys gradually began to show far worse school and academic results than girls, one consequence of this being that a smaller proportion of men than women complete tertiary education. For example, in the UK the proportion of men in the total number of tertiary education graduates dropped from 46.8% in 1998 to 42.7% in 2009. In the Czech Republic this decline is even steeper – in 1998 there were 49.5% of men completing tertiary studies while in 2009 the share was only 39.9% [4]. There is a similar trend in nearly all European countries.

However, regardless of the better educational attainment of women, in most developed countries (e.g. in the USA and the UK) including the CR there continues to be a so-called "gender pay gap" – i.e. a situation where women are paid less than men for the same job. There are hypotheses that attribute the worse school performance and academic results of boys to this inequality. For example, American school psychologist Michael G. Thompson argues that boys are not sufficiently motivated to perform well at school, since their better remuneration at work is "guaranteed" (see, for example Kindlon, Thompson, 2000.) Paul Cappon (Canadian Council on Learning) points in his study "Exploring the ¨Boy Crisis¨ in Education" (2011) to research concerned with return on investment in education. The return is higher for women, because men have more chances of getting a well-paid job without advanced education (e.g. in industry). Again, the author sees this as a reason for the lower motivation for education on the part of men.

This phenomenon deserves attention not only as a manifestation of a new kind of inequality in access to education, but also as a potential source of increased risk of social exclusion of some groups of men, of a larger degree of fragmentation of society and, consequently, of further social problems. This risk is also augmented by the trend of the increasing proportion of boys who achieve very poor results in reading – those failing to reach proficiency Level 2 (see above). Students who fall short of achieving this level are likely to display major weaknesses in basic competencies that are necessary to succeed in the labour market and to undergo further education. In the Czech Republic this concerned virtually one third of boys in 2009 (30.8%), while in 2000 it was less than a quarter (23.6%). This points to a worrying increase in the proportion of boys with inadequate competencies in reading. The proportion of girls at this proficiency level also increased, but this change was much smaller (from 11.5% to 14.3%), and this difference is not statistically significant – i.e. it cannot be generalised to apply to the entire population. A corresponding trend may be observed on the other end of the spectrum – i.e. among the best performing students who reach Levels 5 and 6.

[4] See Eurostat (2011e).

The proportion of boys in this category showed a statistically significant reduction (from 5.3% in 2000 to 2.8% in 2009), whereas the proportion of girls decreased only slightly (from 8.6% to 7.8%, which is not statistically significant).

Interesting hypotheses about reading literacy that also imply interconnection with gender differences are presented in a document of 2006 authored by Eva Potužníková and Jana Straková (2006). The authors focused, among other things, on analysing the results of PISA 2003 in terms of comparison with the TIMSS international tests (an international survey of mathematics and science achievement among basic and secondary school pupils that was carried out in 1995 and 1999). Their analysis points to the fact that PISA tests in all three types of literacy are demanding in terms of reading skills – i.e. that the tasks in mathematics and science are presented so that they require a good competence to read and understand the assignment. In each task there is a real life element or situation that necessarily requires a more extensive description (a longer text) as compared to the way in which e.g. mathematical problems are usually presented in Czech textbooks.

Another important finding presented by the article is the major correlation between the reading literacy scores and the enjoyment of reading that applies regardless of gender. This means that not the inherent (inborn or culturally determined) characteristics of boys but the degree of their subjective interests is what plays a more important role in this respect. We may therefore say that the key to dealing with this problem is not merely encouraging boys to read more, but, most importantly, enhancing their spontaneous interest in reading.

These conclusions are supported also by PISA 2009 results. The Czech Republic is the country that saw the largest **decline in the proportion of pupils who read for pleasure,** which, again, is an alarming finding. Reading for pleasure is also one of the areas where there are considerable gender differences. The proportion of the most avid readers – i.e. children who read one hour a day and more because they enjoy it – did not virtually change in the Czech Republic in the period from 2000 to 2009 (it was approximately 24% of girls in both 2000 and 2009 and 11% and 10% of boys in 2000 and 2009 respectively). However, what changed significantly, is the proportion of children who never read for pleasure. In 2000 it was 15% of girls and 40% of boys, while in 2009 this proportion increased to 25% of girls and the alarming 52% of boys.

The Czech Republic is among the countries where the decrease in the proportion of children who read for pleasure is the largest and, at the same time, where there is the greatest difference between boys and girls in terms of reading as a form of enjoyment. The growing number of children who never engage in reading may be seen as one of the principal factors behind the deterioration of reading literacy scores of Czech students. Reasons for this trend should be looked for not only in the school environment, but also in the general development of the society, in changes of lifestyle and values, particularly within the generation of today's pupils' parents. Identification of how to improve this trend would require a thorough analysis aimed, above all, at decomposing the motivation and preferences of the students themselves. Schools and education policy-makers should see this finding as an impetus to seek better ways to teach reading, to choose materials for use in classrooms and, most importantly, to help pupils generate enthusiasm for reading.

This is another issue on which PISA can provide valuable information that makes it possible to partly reveal the pupils' reading preferences. The outcomes of the study reveal that boys and girls differ as to what kinds of written text they prefer. Table 12 provides an overview of the changes in the answers of Czech children concerning their preference for certain types of text in the period from 2000. As concerns the chosen categories of printed materials, boys read newspapers and comics more frequently than girls. Girls engage more frequently in the reading of all other categories of text apart from non-fiction where the preferences are quite balanced (although there are signs that girls' interest in non-fiction is growing and, conversely, boys show a decreasing interest in this category of texts). In general, these data also show, unfortunately, that there is a clear decrease in the proportion of children who read written texts as such.

The proportion of frequent readers (i.e. children who answered that they read the particular type of text several times a month or week) decreased by some 10-20% for boys in all categories under review – except for newspapers where the decrease is negligible. Moreover, there was an increase in the proportion of boys who never read texts in the given categories, again except for newspapers. The worst situation is reported for longer, continuous texts. In 2009, 61% of boys answered that they hardly ever read fiction and 47% never read non-fiction. In girls there are signs of a similar development, but it is less striking. The proportion of girls who frequently read non-fiction or newspapers even increased. A very significant decrease (by nearly one third) occurred in girls in the fiction category. The share of girls who hardly ever read fiction went up from 11% to 21%. Apart from non-fiction and newspapers girls also show an increasing proportion of "non-readers" in other categories. As mentioned before, the decline in reading literacy scores in 2000-2009 was not as large for girls as it was for boys. Some changes that were reported – such as the steep increase in the number of girls who do not read fiction and also their growing interest in the reading of newspapers and non-fiction (including, for example frequent reading of e-mails that will be analysed in the following part) - suggest that the patterns of reading preferences of girls are getting closer to those of boys. Among other things this situation points to a risk that girls' performance will decline sharply if they continue "following" the trend seen in boys.

Table 12: Change in reading preferences of Czech boys and girls from 2000 until 2009

	Share of boys or girls who read these types of text several times in a month or several times in a week (%)									
	magazines		comics		fiction		non-fiction		newspapers	
	2000	2009	2000	2009	2000	2009	2000	2009	2000	2009
girls	83	74	13	12	44	32	12	14	57	63
boys	76	64	22	18	12	10	15	13	70	69
	Share of boys or girls who never or almost never read these types of text (%)									
girls	1	1	49	50	11	21	37	34	11	9
boys	3	5	41	41	55	61	47	47	9	8

Source: OECD (2000, 2009a). Own calculations.

The development of ICT and deterioration in reading literacy

One of the hypotheses cited in connection with the worsening reading skills in boys concerns the negative impact of the development of ICT and the increasing degree to which they are used by children and young people. This hypothesis is based on the assumption that children are increasingly engaged in electronic communication or other activities on computers and mobile phones (e.g. playing games), which reduces the time they would before devote to other activities (particularly reading). There is also a decreasing need to obtain information via reading traditional texts (a lot of information is easily accessible on the Internet, often in a simplified form). At the same time, most of electronic communication takes the form of simple, short or multi-media messages that do not provide much room for reading development.

A multi-perspective analysis of the data from PISA studies suggests that there is no clear answer to this problem and that it cannot be assessed outside the context of the education systems of the given countries. However, it is possible to point to some intricate contexts that underline the complexity of the problem.

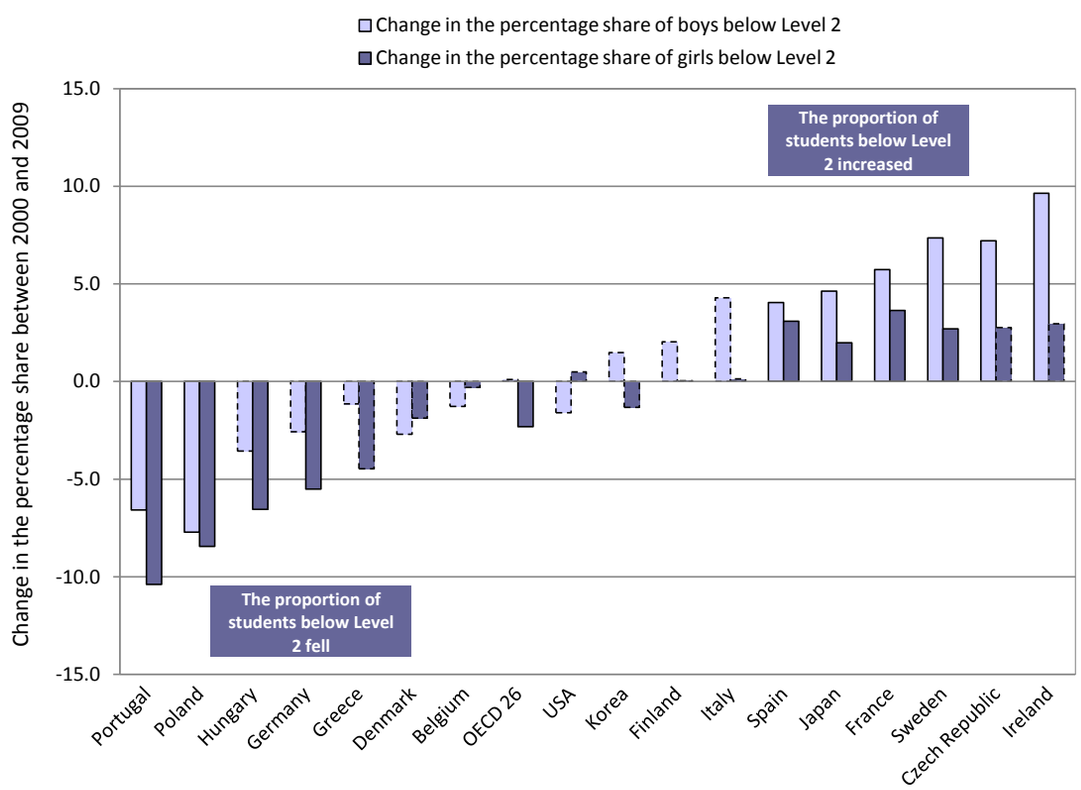
The hypothesis of the negative impact of ICT on reading is not supported by the results of countries that participated, as part of PISA 2009, in a survey into the use of ICT (19 countries, the CR was not one of them). Children in these countries used computers to carry out tasks that were also focused on the testing of so-called digital reading literacy. If the aforementioned hypothesis was valid, we could assume that the high level of ICT literacy would imply a lower traditional print reading literacy. However, both types of literacy show similar trends. Countries with a high level of digital literacy and particularly those where this score is higher than that for print literacy normally display above average results in both types of literacy [5].

As boys use modern technologies more often and more enthusiastically than girls, the hypothesis should also imply that although boys achieve lower scores in traditional reading literacy, they develop digital literacy due to their intensive use of ICT. The basic data from PISA do not clearly support this assumption either. On the contrary, it turns out that, surprisingly, girls achieve better digital literacy scores than boys in all countries surveyed. Still, a certain "advantage" of boys in the digital area as compared to traditional printed texts can be traced. The gender difference in digital literacy scores is smaller in all countries as compared to the reading of printed texts (an average of 24 points vs. 38 points [6]. At the same time, the size of this gender gap is independent of the overall result of the relevant country.

[5] See OECD (2011d)

[6] These are average data for 16 OECD countries that participated in the ICT survey.

Figure 17: Change in the share of low-performing boys and girls between 2000 and 2009.



Note: Changes in the share of students that are statistically significant are marked by a dashed line. Countries are ranked in ascending order of change in the percentage of all students below Level 2 on the reading scale between 2000 and 2009. Source: OECD (2009a).

If we compare the digital reading and printed text reading scores separately for boys and girls, there is another finding that seems to support the hypothesis about the link between ICT activities and the deteriorating results of boys in reading printed texts. On average, boys fared better in digital literacy as compared to reading printed texts, while girls showed better results in reading printed texts as compared to digital ones. The question is whether this result is only due to girls' "delayed" interest in rapidly expanding ICT and their scores in digital literacy will equal those in printed text reading in the future, or whether this is a warning signal that girls might fall behind with respect to the growing extent to which information and communication technologies impact upon day-to-day life. In any case, education policy makers should not be reassured by the illusion that girls are "out of risk" as their absolute scores in both types of literacy are higher than those of boys.

As concerns a deeper analysis as to how the development of ICT is linked to deterioration in reading literacy, there is the key question of how children spend their time working with ICT. However, this issue cannot, unfortunately, be examined over time, since the questions in the PISA study that were focused on this area differed in individual years and cannot be statistically compared. Still, we may get a rough idea on the degree to which ICT is used by 15-year-olds and on the activities they prefer. For example, in 2000 pupils answered the question of how often they read e-mails or websites because they want to do so. In the Czech Republic, some 36% of boys answered they read e-mails or websites several times of week or several times a month. 44% of boys never or hardly ever read that type of text in 2000. These activities were less popular among girls in 2000 – 24% of them read e-mails or websites several times a week or several times a month. 55% of girls answered they never or exceptionally read these types of text. There were similar data obtained from answers to questions concerning other ways of using computers that were part of a separate questionnaire focused on ICT as part of PISA: 51% of Czech boys used the Internet once a month or more (40% of girls), 35% of boys and 44% of girls never used the Internet. There was a striking difference in the playing of computer games. In 2000 more than one third of boys (34%) played nearly every day as compared to 13% of girls. On the other hand, girls used computer more for learning – 41% of girls and 37% did so once a month or more often.

In 2009 the question concerning the reading of e-mails was part of a different set of questions and it was formulated in a slightly different manner (it was not specified that these should be activities that pupils do because they want to; and it only concerned e-mails and not websites). It is therefore impossible to compare the results of the two years directly in a statistical manner. Nevertheless, even insufficiently comparable data reveal a marked change towards a mass and virtually continual use of ICT by the Czech young people today. The results also suggest that the differences between boys and girls might tend to level out, or that there might even be a slight shift in favour of girls. However, fully comparable data would have to be available to verify this trend. In 2009 73% of boys and as many as 80% of girls answered that they read e-mails several times a week or even daily. The number of children who never or exceptionally read their e-mails dropped significantly – to 8% of boys and 4% of girls. 73% of boys and 72% of girls engage daily in chatting at their computer at home, and 70% of boys and 66% of girls browse the Internet for pleasure. Boys continue to show prevalence in terms of the frequency of playing computer games.

The results do not reveal that the more time a pupil spends at the computer the worse his/her scores in reading. For example, the answers about the frequency of reading e-mails show that low average scores are achieved by children (both girls and boys) who rarely read e-mails, and there is a positive correlation between a higher frequency of reading e-mails and reading literacy scores. However, in the 2009 survey there is an interesting trend where a group of children who check their e-mails most often (several times a day) – nearly a third of all children – reach worse scores in reading literacy than the group who read their e-mails "only" several times a week. In other words, it seems that a more frequent use of e-mail is associated with better results in reading, except for the group who read e-mails several times a day. In the case of the Czech Republic this trend is statistically demonstrable at 0.1 level of significance, thus that may be applied to the entire population of fifteen-year-olds with the likelihood of 90%.

If we observe the results of other countries, there is a similar pattern of performance that is in place in nearly all countries where PISA was carried out. In many countries the result is statistically significant with 95% reliability (e.g. Germany, Slovakia and Austria). **Excessive use of electronic communication** (reading e-mails several times a day when the child attends school means that these activities must also be done in school – probably via mobile phones, etc.) entails risk in terms of performance in reading literacy. A similar pattern may be observed for other on-line reading activities about which children were asked (reading on-line news, using on-line dictionaries or encyclopaedia, etc.). In the case of computer games this pattern is even more pronounced.

The existence of the relation between excessive use of ICT and reading skills is indirectly confirmed by the results of tests in digital reading literacy administered in some countries (the CR was not among them – see above). OECD experts analysed the link between ICT activities of pupils and their performance on tests. Although it was the reading performance of electronic texts on the computer that was measured, no clear evidence was revealed that the more "practice" at the computer, the higher level of this literacy. It turned out that the highest levels of proficiency in digital reading are achieved by children who use PCs with a medium frequency. Those who rarely use a computer as well as those who use it very often reached worse scores [7].

In the 2009 data we may also see a pattern that indicates that boys in the CR display more extremes than girls in relation to reading activities via ICT. It is true for most IT activities examined that more boys than girls engage in them on a daily basis. Paradoxically, on the other end of the continuum where children state they have no idea what the activity means or that they never engage in it, we also find higher proportions of boys in most categories (apart from on-line news and participation in forums that more girls tend to find unfamiliar). We may therefore state that boys display higher proportions of both those who use ICT "excessively" and those who have a minimum experience in this area and therefore constitute a very endangered group in terms of the future participation in the labour market (this group was perhaps socially excluded already when filling in the questionnaire). There are various proportions for various activities examined – just for illustration, 1.2% of boys do not know what chatting means, 2.8% of boys do not know what web discussions and forums are. For girls the proportions are lower – 0.2% and 1.4% respectively.

[7] OECD (2011d).

The structure of answers also points to **different preferences** and interests between **boys and girls** in this area. This should be made use of in designing activities to support reading in Czech children (particularly boys). If we compare the groups of children who engage in a given activity several times a week or daily, we can see that girls show a slight predominance over boys in reading e-mails. As for chatting, searching for information on the Internet or using dictionaries and encyclopaedias, the preferences of boys and girls are approximately the same. Boys predominate in reading online news and participating in discussions and forums.

Although the available data and the analyses suggest a likely link between ICT development and reading skills, it is yet impossible to make an explicit conclusion that the worsening reading skills of children (particularly boys) correlate with their intensive ICT activities. We assume that it is "too early" to identify a distinct correlation in this respect. In the recent decades of turbulent developments and the gradually increasing accessibility of ICT, the groups of population with a higher level of educational attainment and socio-economic status have been first to get the chance of developing their computer literacy. More frequent ICT activities and higher reading literacy levels therefore were aligned not because of their positive correlation but as a result of this third factor.

As a whole, the information presented points to a **changing world of reading in children** in the Czech Republic. Traditional reading is slowly declining. In particular, the popularity of reading longer, continuous text for pleasure is in decline (i.e. fiction, and for boys also non-fiction). Children increasingly engage in electronic communication. In the case of printed material they prefer shorter texts of an informative nature (newspapers, magazines) that are more likely to have been designed ad hoc and, in terms of their length, they are bound to be relatively superficial and sketchy. There is a risk of certain "consumerism" in how children use this quick, ad hoc information the meaning and value of which they cannot fully understand and assess (see the aforementioned poor result of the Czech Republic on the subscale "Reflect and evaluate").

The competitiveness of society is, to a large degree, built on educated workforce and, particularly in science and research (but not only in this area) on the capacity of independent innovative assessment of reality and thinking in contexts. In line with this, reading literacy turns out to be a major precondition for success not only in humanities, but also in science and technology. Earlier analyses of PISA 2000 [8] showed that a country's results on the reading scale display a positive correlation with the proportion of higher education graduates in science and technology in the relevant age cohort, and also with the proportion of these graduates in the total number of graduates. In other words, the better the result a country scored in the reading literacy of fifteen-year-olds, the higher the proportion of higher education graduates in science and technology.

The current negative trends that PISA scores reveal should therefore be an imperative for education policy-makers and a starting point for more profound analyses of the problem and its roots – i.e. focusing on schooling from its beginning, on families and the social backgrounds of children with poor results and social groups displaying stronger signs of cultural, social and economic marginalisation.

[8] See CES VŠEM, NTF-NOET (2009).

2.1.6 The link between school achievement and PISA test scores

We may arrive at interesting findings if we analyse the results of PISA tests in comparison with ordinary pupil assessment in the relevant subjects in schools. Marks are the main instrument for assessing study performance and competencies achieved in various subjects in schools in the CR. Therefore they are normally seen as an instrument for identification of talent and potential higher education students and research and development elites. In view of this we may assume that there should be quite a strong relationship between a mark – as an instrument of direct measurement of competencies in the given subject – and the PISA score on the relevant scale. However, a detailed analysis [9] revealed that these correlations are relatively weak (see below) and that among pupils with good PISA scores there is a good number of those who receive lower marks in school and vice versa – there are many students who perform very well in terms of marks and achieve worse results in PISA. These outcomes were confirmed in various types of school. Therefore the weak correlations cannot be attributed to a heterogeneous sample in terms of varying assessment standards in schools at different levels. Moreover, correlations for boys and girls were compared separately so as to see whether any other factors that are reflected in school assessment (e.g. discipline) may weaken the correlation. The results show that the correlations are approximately the same for boys and girls with no statistically significant differences.

The correlation of the mark in the Czech language and the reading literacy test score was approximately -0.41; the correlation of the mark in mathematics with the score in mathematical literacy was -0.35. In order to establish the correlation in scientific literacy marks in physics, chemistry, natural history and geography were used (the correlations were -0.30, -0.34, -0.28 and -0.32 respectively). The correlation coefficient is negative since this is an indirect correlation – we compare the points gained in the test with school marks where the scale is reversed and a lower figure means better assessment. All the results may be generalised to apply to the entire population of fifteen-year-olds with the likelihood of 95%. If we assume that PISA tests provide an objective measure for assessing the real competencies of children we may conclude that **the relationship between school assessment via marks and the real competencies of children in the Czech Republic is relatively loose.** The situation is somewhat worse in mathematics and science as compared to the Czech language.

The outcomes were analysed in more detail in relation to the PISA performance levels. Children who achieved excellent levels (Proficiency Levels 5 and 6 – see above) are viewed by OECD experts as the potential elite among knowledge workers that are of major importance for the future competitiveness of the given country. It is therefore very surprising that, among the children who reached these levels in reading literacy in the Czech Republic (5.1% of children) there are 21.6% of those who were assessed by marks 3, 4 and 5 in the Czech language in school.

The situation concerning mathematical literacy is even more bewildering. Among the children who achieved excellent scores in mathematics (11.6% of children) there are 28% of those who received mark 3 in school subject mathematics, and as many as 8.8% got mark 4 or 5. In scientific literacy the situation is similar. We may take the mark in chemistry as

[9] Data source: OECD (2009a), IIE (2011b).

an example, as it displayed the highest correlation in the sample with the scores in scientific literacy. A total of 8.4% of children in the CR scored at the top levels. Out of these nearly one third (27.8%) were graded 3, 4 or 5 in chemistry in school.

This probably means that **not negligible groups of pupils have great talent and potential in the given areas, but schools cannot identify it.** What may contribute to this situation is the separation of the subject matter and ways of teaching from the real life situations. Some talented pupils are able to intuitively handle practical model situations as presented by PISA, but fail in the "school" type of tasks – be it due to the nature of the tasks or the pupils' low motivation for this kind of tasks. It is also possible to look at the problem from the perspective of differences between testing of competences that is being developed within PISA and testing of particularly defined range of knowledge that is mostly a base for the pupils' assessment.

The indicators were compared also in terms of various types of school. The finding was that the highest correlation between school assessment and PISA scores can be seen in basic schools (correlation -0.57 for the Czech language, -0.46 for mathematics and -0.36 to -0.44 for science subjects). At eight-, six- and four-year grammar schools (i.e. selective schools) the correlations are lower (around -0.2 to -0.3). At secondary schools providing programmes without the "maturita" examination and special education programmes the correlations were very low and, in some cases, statistically insignificant. The reason was, among other things, a small size of the sample. In order to make a relevant conclusion for these types of schools a further detailed examination would have to be carried out.

In the Czech Republic, school achievement continues to be a relatively strong determinant of pupils' further educational path and, to a large degree, also of their professional aspirations and the way in which they esteem themselves. In a situation where the demographic projections are less and less optimistic and there is an enormous competition in terms of skilled workforce from Asia and other regions we cannot afford to let talented students "slip through our fingers". Further analyses of this phenomenon and the pursuit of ways to identify and support real talent, although it is "hidden" under different school assessment categories than one might expect, should be one of the key priorities of schools and the education policy as a whole.

2.1.7 The impact of socio-economic background on student performance

It was stated in the previous years[10] in connection with the PISA study that the dependence of student performance on their socio-economic background is decreasing in the Czech Republic. Socio-economic background is measured in PISA by the compound ESCS index (Economic, Social and Cultural Status). Its link to the performance in tests is expressed as a number of points by which the average score changes with the index change by one unit (i.e. the size of one standard deviation). Between 2000 and 2009 this difference dropped from 53 to 44 points in the Czech Republic. The average difference for all countries surveyed was 37 points in both 2000 and 2009, which means that, despite this positive trend, the CR still ranks among the countries where there is an **above-average dependence of school performance on the socio-economic background of pupils**. This reduced dependency may represent a positive aspect of development towards a higher level of equity in access to educational opportunities for children from various socio-economic backgrounds. However, interpretation of this phenomenon is not so simple. A negative phenomenon pointing in the opposite direction is the very high level of selectivity of the Czech education system. The Czech Republic is among the countries with the strongest relationship between pupils' reading performance and the aggregate socio-economic background of the school. The weakening link between school performance and socio-economic background is only apparent inside schools. The impact of the overall socio-economic background of school continues to be as strong as before. This means that children with similar socio-economic backgrounds accumulate at similar schools. This determines, to a great degree, their further educational opportunities and the competencies acquired. This is in contradiction to the concept of equal access to education.

Table 13: Variance in reading performance explainable by the parents' professional status and their educational attainment (%).

	Percentage of variance explained by the occupational status of parents (HISEI index)				Percentage of variance explained by the education attainment of parents (PARED index)			
	PISA 2000	PISA 2003	PISA 2006	PISA 2009	PISA 2000	PISA 2003	PISA 2006	PISA 2009
Austria	13	15	11	14	9	7	4	8
Belgium	14	14	12	19	5	7	7	8
Czech Rep.	***15***	***10***	***13***	***14***	***14***	***9***	***3***	***3***
Denmark	9	7	8	11	13	7	6	6
Finland	6	5	6	5	3	4	4	4
France	13	12	13	12	6	8	6	8
Germany	16	14	11	13	12	11	8	10
Greece	10	8	11	12	6	4	6	6
Hungary	17	13	13	19	18	14	14	17
Ireland	10	11	8	10	3	5	6	6
Italy	8	9	6	11	6	6	3	5
Japan	1	3	3	4	:	5	7	6
Korea	4	4	2	6	5	4	3	5
Netherlands	m	11	12	11	:	5	5	4
Poland	12	12	10	11	10	7	9	11
Portugal	15	11	15	15	7	5	9	11
Slovakia	m	12	11	12	:	9	9	5
Spain	10	7	8	11	11	5	7	8
Sweden	9	8	8	10	3	4	3	5
United Kingdom	m	m	10	12	:	:	4	4
USA	11	9	m	12	8	5	:	8
Estonia	m	m	10	10	:	:	1	2
Slovenia	m	m	13	13	:	:	9	7

Note: - data are not available. Source: OECD (2006, 2009a).

If we look at the main factors that make up the ESCS socio-economic index in greater detail, we get a more apposite picture of the development in the Czech Republic. The reduced influence of socio-economic background is primarily the result of the **major decrease in the impact of the parents' educational attainment** on children school performance (so-called PARED index) – see Table 13. While in 2000 this index accounted for 14% of the variance in performance, in 2009 it was only 3% (the figures are stated for reading literacy, but the factors' impacts are similar for mathematical and scientific literacy as well). This places the CR among the

[10] See, for example, CES VŠEM, NTF-NOET (2009).

countries where this dependency is the lowest. Moreover, the relationship between student performance and parents's educational attainment turned out to be statistically insignificant in 2009 (at 95% reliability level). This means that this dependency cannot be confirmed as generally valid. Although the level of formal education of our population is increasing (this trend was also seen in a sample for the PISA survey where the number of children whose parents have either upper secondary or higher education increased in the 2000-2009 period), it turns out that the influence of this factor on children's performance has virtually disappeared.

What remains relatively stable is the percentage of variation in performance that is explicable by parents' professional status (the HISEI index). In 2000 it was 15%, in 2003 the indicator dropped to 10% and in 2009 it rose again to 14%. It may therefore be stated that pupils' performance in PISA tests – i.e. the competencies they acquire in school and, to a degree, their educational paths (see the high level of selectivity of Czech education) are still largely influenced by the professional status of their parents. This influence has remained relatively unchanged since 2000.

2.1.8 Selectivity of the education system – lessons from successful countries

As mentioned above, the CR is among the countries with a highly selective schooling system and the strongest relationship between student achievement and the aggregate socio-economic background of school. It turns out, however, that those countries that managed to improve in PISA or put their deteriorating results back on track place emphasis, above all, on work with weaker students and schools and seek to improve their outcomes as much as possible[11]. Examples of these countries are our neighbours – Poland and Germany. Their approach to reforming education systems is described in Boxes 4 and 5.

Box 4 – Poland

Poland is among the countries that saw a major improvement in PISA test results between 2000 and 2009. The Polish education system essentially does not differ from that of the CR. At the end of the 1990s reforms were implemented in Poland that introduced a 6+3 system instead of eight-year basic schooling. This means that 6 years of compulsory primary education is followed by a three-year lower grammar school. Compulsory school attendance was therefore extended. This change was accompanied by a change in teaching procedures. Moreover, binding national standards were developed and an external examination in the form of tests is attached to them (at the end of primary and lower secondary education). All pupils tested in PISA 2006 and 2009 studied in the newly established grammar school. It is apparent that the reform had a principal influence on the improvement in the outcomes of the weakest pupils who, before, would move on to lower vocational schools. While the proportion of pupils with very good results in PISA did not change much, there was a major decline in the proportion of pupils who failed to achieve Level 2. The differences in student performance therefore decreased significantly and the worst performing students got a chance to acquire better general competencies due to the reform. This made it possible for Poland to boost their average scores and enhance equity in access to education. This positive evaluation is somewhat smeared by the fact that the level of general competencies in 16-to-17-year-olds who transfer to vocational education is rapidly falling. The negative effect of tracking children to various types of secondary school was only delayed by one year and the reform did not change anything in this respect. It is therefore important to reform secondary vocational schools as well so that they support the development of general competencies, as they are also viewed as professional competencies in today's labour market.

Box 5 – Germany

The results of German pupils in PISA tests in 2000 were a great shock for Germany. No-one expected that a quarter of 15-year-olds cannot read fluently. The results of students were also dependent on their socio-economic status much more than in other OECD countries. In response to these findings an ambitious reform scheme was introduced that resulted in a major improvement in the performance of German pupils. First of all, changes were implemented that aimed at reducing the impact of the socio-economic status on the choice of secondary school at the age of 10: in some states Hauptschule and Realschule were merged to form one type of school, in others a unified lower secondary school was reintroduced or the choice of secondary school was postponed from 10 to 12 years. Until then non-existent national standards were introduced that provide a detailed description of subject-specific competencies pupils should have at the end of grade 4 and 9 (10). These standards are tested on a representative sample of the relevant age cohort. At the same time research capacity was reinforced in order to monitor and analyse data about the development of the education system and pupils' achievement so as to make sure that education policy is based on relevant empirical data. The autonomy of schools was enhanced and teachers themselves became the leading force behind the reform. In this way Germany broke the rigid pattern of streaming pupils to schools according to their background, although it has not entirely given up selective schooling practices.

While in the CR school still tends to separate good and poor achievers, education systems with good results in PISA support so-called inclusive education and try to make sure that each pupil can reach his/her full potential. The success of these systems has a common denominator:

- Training and supporting teachers so that they can discern when a pupil begins to fall behind and they can help him/her
- Identifying pupils' outcomes and tracking their progress[12].

Education systems in countries that are successful in PISA share another feature – instead of punishing those who fail they help them. Schools as part of compulsory education are not divided into selective and non-selective ones, and there are therefore relatively small differences between the outcomes of individual pupils. These systems also share a high level of autonomy of schools making it possible for them to implement their own curricula timetables. Another common feature is a non-threatening approach to assessment. Financial resources flow primarily to where they are needed most and so that all pupils regardless of their socio-economic status have an equal chance of achieving good results.

The position of teachers is also very important. In countries with the best results teachers are seen as the creators of national success, they are selected from among the best students and enjoy a high level of prestige. They receive sophisticated and systemic support for their work.

In conclusion we present basic indicators the OECD uses to assess the development of education in its member countries[13]. In order to achieve a major improvement in pupils' performance it is necessary to work on all the parameters stated below over the long term, as preferring some over others does not bring about the desired changes.

[11] Čápová (2011).

[12] EDUin (2010).

[13] OECD (2011c), Brdička (2010).

Table 14: Education development indicators (OECD)

Economic development		
Pre-industrial developing economy	<>	High value added and remuneration
Teacher quality		
Slightly higher than lower secondary education	<>	High professional quality
Curricula, methods and assessment		
Only basic literacy, rote learning	<>	Comprehensive skills (competencies), creativity
Work organisation		
Hierarchical, authoritarian	<>	Equality, team spirit
Teacher responsibility		
Towards superiors	<>	Towards the team and parents
Inclusion of pupils		
Only the best have good results	<>	All have good results

Source: EDUin (2010).

2.2 Preparation of Human Resources for Skills-Intensive Occupations

Globalisation processes based on the development of transport and communication methods lead to changes in the structure of economies, modifying thus also the demands placed on human resources. Innovations become the imperative of the economic development in the 21st century, for which the workforce with qualifications particularly in science and technology (S&T) fields is indispensable. Both levels of education – the secondary as well as tertiary – are important. The workforce with tertiary education is expected to provide advance in knowledge in other words to create innovations, while the labour force with secondary level of education shall be able to apply the new knowledge and implement innovation processes in practice.

The sub-chapter was structured with regard to the aforementioned facts. The first part deals with the development of tertiary education during 2000-2010 evaluated on the basis of changes in the numbers of students of individual type of school – tertiary professional schools (TPSs) or higher education institutions (HEIs). It compares the situation in the Czech Republic with the situation in EU Member States. Attention is paid to the representation of women in the overall number of students of HEIs both in relation to different levels and different fields of study. The adequate employability of graduates is also an important issue assessed on the basis of data on unemployment among HEIs' graduates. Attention is paid also to the quality of tertiary education.

2.2.1 Participation in tertiary education

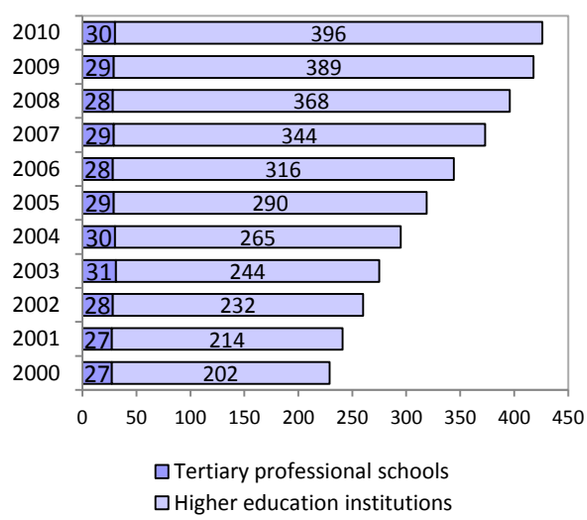
Emphasis on tertiary education is laid in the Europe 2020 Strategy, which calls on the Member States to improve the functioning of all levels of the educational system and individual forms of learning so that people are able to cope with the changing labour market requirements. In the area of tertiary education, the stress is put on its openness to the so-called non-traditional students and on the importance to increase participation in this level of education. The objective is to achieve that at least 40% of EU population aged 30-34 has tertiary education by 2020.

The Czech Republic joined in these pan-European goals in the National Reform Programme. The tertiary education reform, which is under preparation, should also contribute to the achievement of the set goals. Within the preparation of the reform, development of a new type of study programme is being considered; it is professionally oriented so-called "short cycle programmes" preparing students for an immediate entry into the labour market over the period of two years. This goal should be, along with other objectives of the reform, enshrined in the new Higher Education Act expected to come into force in 2013.

The number of students in tertiary education, in the Czech Republic, recorded steady growth thanks to expanding educational opportunities provided by both tertiary professional schools and higher education institutions. At present, with regard to the wide range of educational opportunities and demographic development, the main task is no longer further expansion of these opportunities but rather their structuring and quality of education provided, in other words excellence of the graduates.

The number of students in tertiary education saw during the period of 2000 – 2010 rather dynamic development particularly due to students of higher education institutions (see Figure 18). In 2010, the overall number of students in all types of study reached 426,104 persons, which is twice as much as in 2000 when the total number of students at HEIs and TPSs represented 201,818 individuals.

Figure 18: Students in tertiary education (thous. persons)



Note: Data for 2002/03 exclude four private HEIs (Prague Banking Institute, Business School Ostrava, Faculty of Restoration in Litomyšl, University of Public Administration and International Relations in Prague). Data for HEIs in number of individuals as of 31. 12. of the relevant year, excluding data for the HEIs of other sectors. Source: IIE (2007, 2010), own calculation.

Higher education institutions and tertiary professional schools contribute importantly to the implementation of the concept of lifelong learning. They substantially extended the range of courses and study programmes aimed at the part of population that for various reasons are not able to study in full-time/on-site programmes, but the attainment of higher level

of education is a prerequisite for their career development or just for the conservation of their current position. This situation was reflected by an increase in the number of students in other forms of study programmes. In 2010, 117 thousand persons were getting higher qualifications in these programmes at higher education institutions, which was more than three times as much as in 2000. In the period under review, the proportion of students of "distance" study programmes in the total number of students at HEIs increased from 17% to 30%.

A similar trend was recorded for the tertiary professional schools, which doubled their number of students in other forms of studies reaching 8.5 thousand students in 2010. Thus, their proportion in the total number of students increased from initial 14% in 2000 to 29% in 2010.

The trend of the growing proportion of students in other forms of studies is without doubt positive. However, with regard to the information revealing some non-standard practices in meeting the requirements of study programmes, it is vital that individual educational institutions make sure that not only students but also the teachers fulfil their obligations properly. Otherwise, not only the relevant schools, but the whole sector of tertiary education will be discredited.

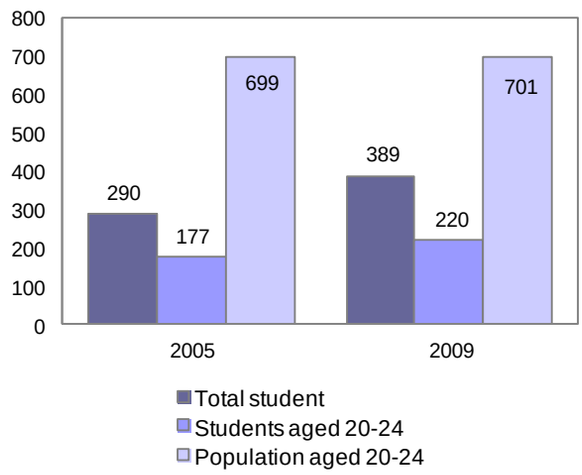
The numbers of students are the result of a number of factors, whose impact is to a considerable extent interconnected. It is primarily the capacity of relevant educational institutions, financial resources of the state and individuals, requirements on level of education in particular occupations, economic structure of the state and the related demand for particular professions, the value orientation of individuals and last but not least also the demographic development, i.e. the frequency of population in adequate age for tertiary education.

The indicator, which to a certain extent reflects the influence of most of the mentioned factors, is the participation rate in tertiary education. This indicator is calculated as a net or gross participation rate. The gross participation rate expresses the ratio of students regardless of their age and form of study programme to the age group typical for the given level of education. By contrast, the net participation rate relates specifically to the age group typical for the given level of education.

Due to the existing difference in the length of study programmes at HEIs and tertiary professional schools, it is necessary to calculate participation rates separately for these two types of tertiary education. Study programmes at higher education institutions last usually 5 years; therefore, the age group typical for this level of education was defined as 20 – 24. Similarly, for the study programmes at tertiary professional schools (TPS), where the study programmes usually take 3 years, was the typical age group limited by the age of 20 – 22. The whole age group is taken into consideration, including even the persons without "maturita", which is otherwise one of the basic prerequisites for access to tertiary education. This fact is reflected in the indicator expressing the inflow into tertiary education, based on which the situation in the CR is evaluated in comparison with the other EU Member States (see below).

Given that, at the time of this chapter processing, data on age structure of the population for 2010 were not available, the indicators of participation rates of the population in the tertiary education are calculated as of 2009. Figure 19 indicates developments in the values of the parameters used in the calculation of participation rates in the tertiary education in 2005 and 2009. While, in 2009, the number of people aged 20-24 increased by approximately 2 thousand persons in comparison to 2005; the number of students in this age group grew in the same period by 43 thousand, and the overall number of students increased by 99 thousand people. As a consequence of this development, both the gross as well as net participation rates in tertiary education increased substantially.

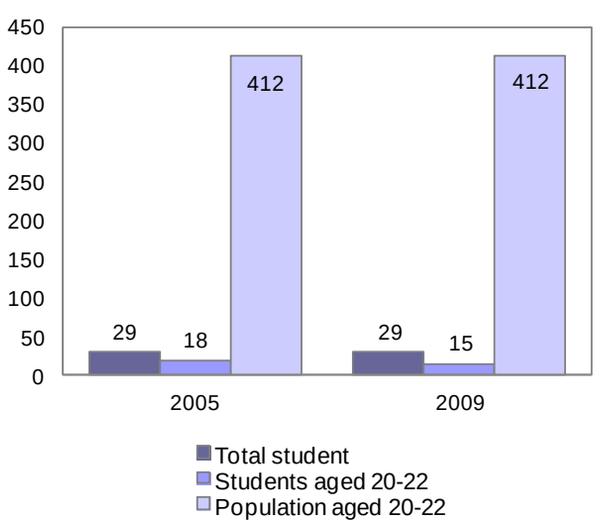
Figure 19: Students of higher education institutions and population aged 20-24 (thous. persons)



Source: IIE (2010), CZSO (2006, 2010b), own calculation.

The gross participation rate in tertiary education reached in 2005 almost 42%, in 2009 even 56%. The net participation rate was substantially lower representing 25% in 2005 and 31% in 2009. The differences between the two indicators stem from relatively low representation of the age group typical for this level of education. The share of the age group 20-24 in the total number of students represented 60% in 2009. As for the other age groups, the most frequent - accounting for 20% - was the age group 25-29. The persons over 30 contribute to the total number of students by the remaining 20%.

Figure 20: Students of tertiary professional schools and population aged 20-22 (thous. persons)



Source: IIE (2010), CZSO (2006, 2010b), own calculation.

The situation in the area of tertiary professional schools was different. As illustrated in Figure 20, the size of the 20-22 age

group remained unchanged and so did the total number of students, however, the number of students in this age group decreased by approx. 3 thousand persons. It is evident that young people prefer to study at the HEIs rather than at the TPSs. The establishment of the tertiary professional schools was made possible as late as 1995 when an Amendment to the Education Act was passed; however, this type of study had been piloted since 1992/93 and, therefore, represents a relatively new element in the educational system. The fact that the labour market has not yet got used to the tertiary professional schools is also linked to the aforesaid, the demand for graduates from the TPSs still remains extremely low.

Lower interest in studying at the TPSs stems also from the fact that this type of study is, in contrast to the studies at the public HEIs, associated with tuition fees, even if they represent a rather symbolic amount. The amount of tuition fees is regulated by the Decree of Ministry of Education, Youth and Sports (MEYS), (No 10/2005 Coll.) and depending on the type of study it varies within the range of CZK 2,500 – CZK 5,000 per school year. Even the fact that an increasing number of TPSs set up cooperation with HEIs offering thus to their students the opportunity to continue the studies there upon a validation of some part of the TPS studies, which would allow them to conclude a Bachelor degree programmes in shorter scope of time and get the academic title Bc., or even to continue the study in Master degree programmes, has not succeeded in increasing the interest in this type of schools.

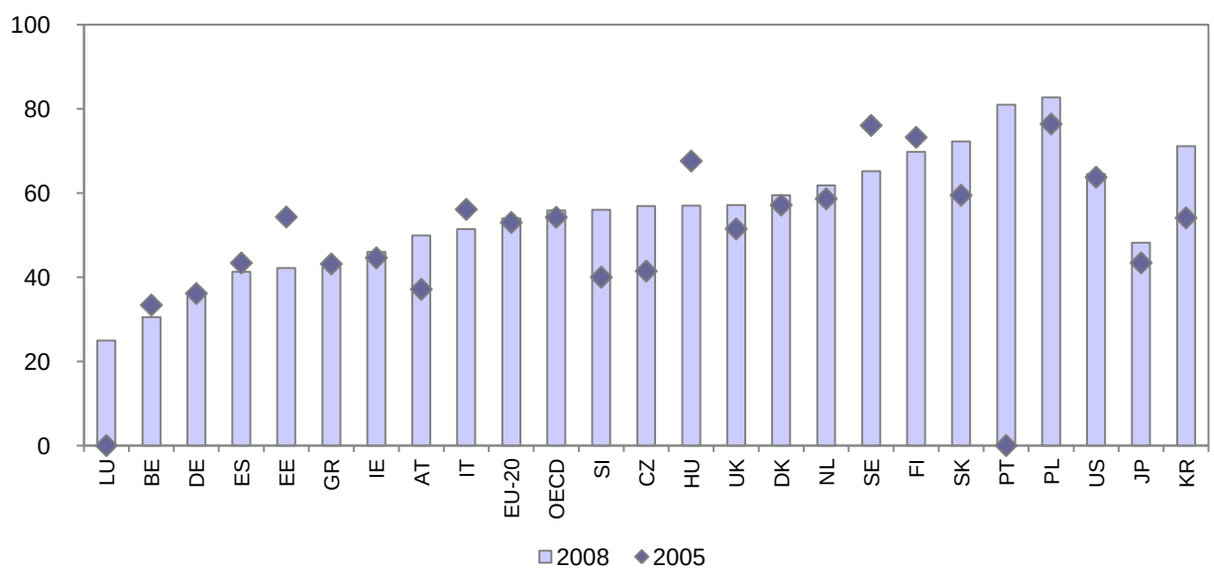
Given the stable overall number of students as well as the size of the age group, the gross participation rate in tertiary education remained unchanged in both years under review, representing 7%. The change occurred only in the net participation rate, which decreased from 4.4% in 2005 to 3.6% in 2009. The development of the net participation rate was affected mainly by the drop, in absolute terms, in the number of students within the age group of 20-22 upon a relatively stable size of this group. The difference between the gross and net participation rates is determined by the fact that the crucial age group of 20-22 year-olds accounted for only 47% of students. Another 20% represented the students aged 19 and 23 which are the age groups directly related to the crucial age group.

As noted before, the participation rates in tertiary education calculated in relation to the overall scope of relevant age groups of the population, take no account of the fact that successful participation in the "maturita" examination is still one of the prerequisites for access into tertiary education. This aspect is reflected only in the indicator of the tertiary-level entry rate published by the Organisation for Economic Cooperation and Development (OECD) and is used to identify the position of the CR in international comparison.

The indicator of entry rates into tertiary education shows the percentage of people with secondary education that will enter different types of tertiary education in the course of their lives. This indicator reflects both the accessibility, in other words, capacity of tertiary education and the perceived value of attending tertiary programmes related to the students' awareness of the economic and social benefits as well as costs associated with this education level. Given the growing internationalisation of tertiary education, it is necessary to point out that the indicators for the countries that represent frequent destinations of foreign students are usually in relevant volume overstated and vice versa, the indicators are understated for the countries from where the students leave to do their studies abroad.

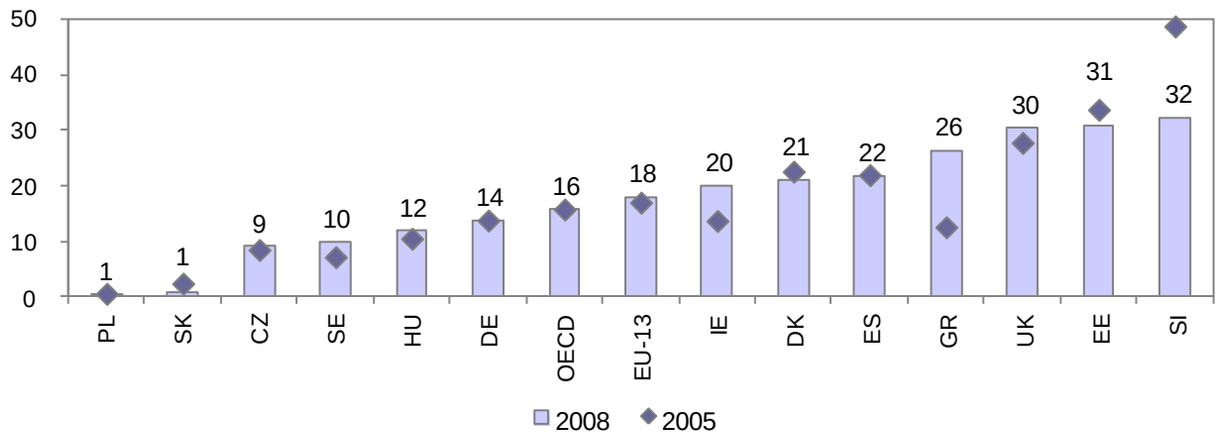
The indicator of the entry rate into tertiary education is calculated separately for two levels of tertiary education – ISCED 5 A and ISCED 5 B. In the CR programmes at ISCED 5 A can be studied at higher education institutions. This level covers both Bachelor and Master programmes. Bachelor study programmes focus, in accordance with the Higher Education Act (No 111/1998 Coll. As amended), on the development of key competencies of the students and their preparation for the follow-up studies in Master degree programmes. The standard length of Bachelor programmes is at least three and maximum four years.

Figure 21: The net entry rate into Bachelor and Master study programmes at higher education institutions (ISCED 5A, %)



Note: Non-weighted average from the data available. Source: OECD (2007, 2010a), Table A2.4.

Figure 22: The entry rate into tertiary education (ISCED 5B, %)



Note: EU - non-weighted average from data available. Source: OECD (2007, 2010a), Table A2.4.

Master study programmes are oriented on the acquisition and application of theoretical knowledge and development of creative potential of the students. This type of study follows the Bachelor programme and its standard length is at least one and at most three years. A specific Master programme is constituted by the study programme that does not follow Bachelor programme and whose length of study is at least four and at most six years.

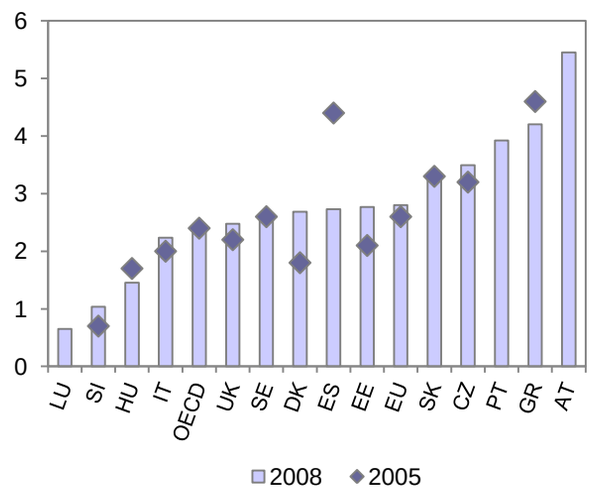
Data indicate (see Figure 21) that 56% of young people in the OECD countries and 54% of them in the EU countries, who completed secondary studies in 2008, will during the course of their lives enter into tertiary education (ISCED 5A). The Czech Republic along with Slovenia recorded during the period of 2005 - 2008 within the EU the most robust change, thanks to which the Czech Republic moved from its under EU-average rates in 2005 (41%) to the over-EU as well as OECD average rates in 2008 (57%). In 2008, the highest entry rates into tertiary education were achieved by Poland (83%) and the lowest were recorded by Luxemburg (25%), where the young population traditionally receives their tertiary education mainly abroad.

Interest in tertiary education in general increases not only with a growing proportion of the population who completed education at the secondary level, but also with their improving prospects of employability on the labour market stemming from a wider range of occupational opportunities as well as better remuneration and lower unemployment rates.

Tertiary education at ISCED 5B level is not as widely spread as the ISCED 5A level, which is confirmed among other pieces of evidence by the fact that data on this level of education are available only for a limited number of countries. In the CR, tertiary education at ISCED 5B is provided by tertiary professional schools and it is, compared to the EU as well as OECD averages, still underdeveloped (see Figure 22). In 2008, the average entry rate into this type of education represented in the OECD countries 16%, in the EU countries, for which the data are available, 18%. In the Czech Republic, this indicator showed only 9%. The lowest entry rate was recorded in Poland along with Slovakia (1%), while Slovenia together with Estonia and the UK scored the best results (approx. 30%). With a certain degree of simplification, we can say that those countries that show high inflow rates into the programmes at ISCED 5A level, record low inflow rates into the programmes at ISCED 5B and vice versa. The data also indicate that this type of education is less common in the post-communist countries than in countries with uninterrupted democratic development.

The highest level of qualification can be obtained through study in Doctoral programmes (ISCED 6) that last usually three years and prepare graduates particularly for scientific and research careers. In 2008, the EU average rate of entry into Doctoral studies slightly increased in comparison with 2005, the OECD average remained unchanged. In the same year, the highest value of this indicator from all European countries, for which the data were available, was recorded in Austria (5.4%) while Denmark showed the most robust increase in this indicator (by 1% p.p.). However, the Doctoral studies entry rate in some countries dropped. This negative trend manifested most notably in Spain, where this indicator decreased by almost 2 p.p. The Czech Republic, with the indicator representing 3.2% and 3.5% respectively in the years under review, ranks slightly above the EU as well as the OECD average (see Figure 23).

Figure 23: The entry rate into Doctoral programmes (ISCED 6, %)



Note: EU - non-weighted average from data available. Source: OECD (2007), Tab.C2.4, OECD (2010), Table A2.3.

The available data illustrate that in general, countries with a lower level of economic development show a larger interest in Doctoral studies as compared to countries with higher economic standards. Austria is the only exception, although

the net entry rate excluding the influence of foreign students decreases to 4.1%, Austria along with Greece rank at the top of the scale. By contrast, countries with a high level of economic development (UK, SE, and DK) do not reach the average EU values. Table 15 illustrates the differences in entry rates into tertiary education according to gender.

Table 15: The entry rates into individual study programmes by men and women in 2008 (%)

	ISCED 5B		ISCED 5A		ISCED 6	
	men	women	men	women	men	women
EU-19	16	20	47	62	2,8	2,9
OECD	14	17	50	63	2,4	2,3
Belgium	31	44	29	32	m	m
Czech Rep.	6	12	50	65	3,9	3,0
Denmark	21	21	46	73	2,8	2,6
Estonia	22	40	33	52	2,3	3,2
Finland	a	a	61	79	m	m
Ireland	19	21	43	49	m	m
Italy	n	n	43	60	2,1	2,4
Luxembourg	n	n	25	25	0,6	0,7
Hungary	7	17	52	62	1,5	1,5
Germany	11	17	36	37	m	m
Netherlands	n	n	57	67	m	m
Poland	n	1	76	90	a	a
Portugal	n	n	71	92	2,9	5,0
Austria	7	10	44	56	5,7	5,2
Greece	27	26	33	53	4,7	3,7
Slovakia	1	1	59	86	3,2	3,3
Slovenia	32	32	43	69	0,8	1,3
Spain	20	23	35	48	2,4	3,0
Šweden	9	10	53	78	2,7	2,5

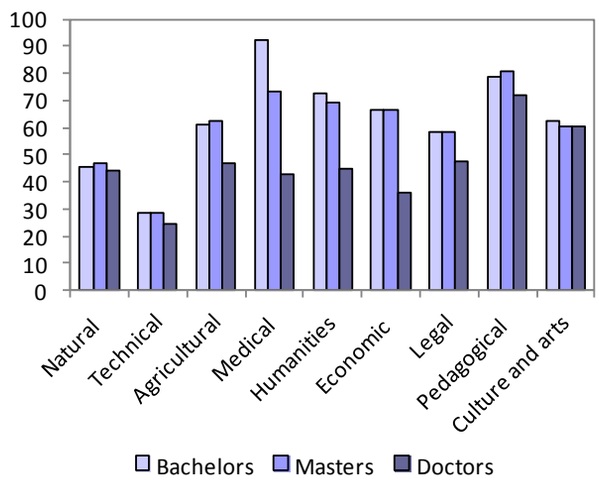
Note: EU - non-weighted average from data available. Explanatory note: m – missing data, n – negligible value, a – absent category. Source: OECD (2010a), Table A2.3.

Demand for tertiary education expressed as the entry rate differs considerably for men and women. Tertiary studies are in general more popular among women, both in the EU and OECD average. This applies to all levels of tertiary education, although, the women lead in terms of Doctoral studies participation diminishes and its rate is practically equal to the participation rate of male students. There are, however, significant differences among individual countries. The Czech Republic ranks among the countries with rather prominent deflection of the values in favour of women. For tertiary professional schools, the entry rate of women is twice as high as the one of men; in the case of higher education institutions the female entry rate is exceeding the male by one quarter. In general, higher entry rates of women are largely due to the structure of educational provision with predominating proportion of programmes focused on humanities in which women are traditionally more interested.

Figure 24 illustrates the proportion of women in the overall number of graduates in particular fields of study and education levels in the CR. Data include all types of study programmes – full-time/on-site, distance as well as combined ones.

In 2010, the proportion of women was largest in graduates from Bachelor programmes in medical disciplines, representing over 90%. This is partly due to their high interest in the medical profession but also to the fact that professional medical nurses need to complete studies of Bachelor degree to be able to perform their occupation. And representation of the male population among medical nurses is practically zero. Women predominate also among graduates of both Bachelor and Master education levels in all fields of study except for science and technology programmes (S&T). The situation, however, shifts in favour of men on the level of Doctoral studies.

Figure 24: The proportion of women in graduates of individual fields of study and education levels (2010, %)



Source: IIE (2011c), Table F4.2, own calculation.

In total, regardless of field of study, women account for 40% of all Doctoral programmes' graduates. Lower representation of women among the graduates of Doctoral studies is due to the fact that most Doctors graduate in S&T programmes, where the representation of females is traditionally low. Doctoral programmes are much less frequent in the fields of study with female predominance. Lower representation of women in these fields may be attributed also to their lower interest in research and scientific activities, which is reflected in their lower proportion in these positions (see Chapter 3.2), but also to problems with reconciling their personal and professional lives with the demands of Doctoral studies, as the majority of Doctoral programmes are concluded in the distance or combined form of studies (78% of all graduates).

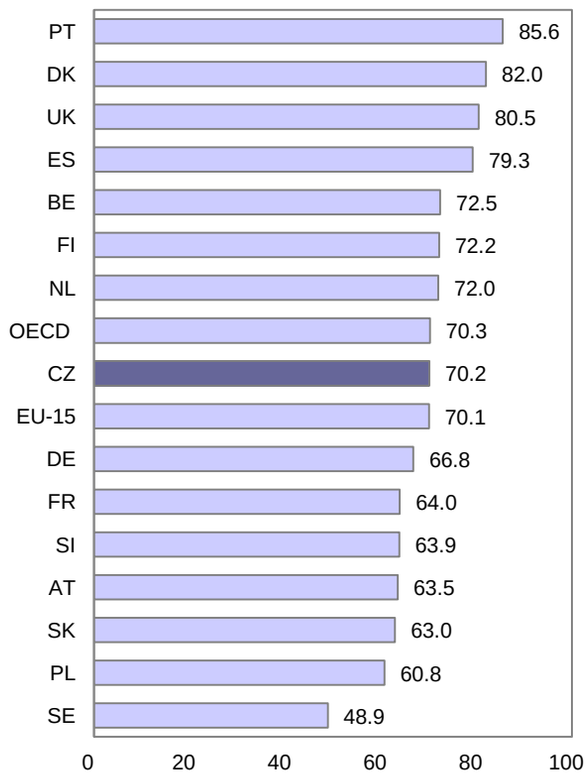
Even at the Doctoral level of education, there are two fields of study in which women predominate among the graduates. It is particularly pedagogy, teaching profession and social work (in Figure 24 shown as Pedagogical sciences) where women account for over 70% of graduates. Although in terms of numbers, this field is very small. In 2010, only 91 persons graduated in pedagogical sciences, a mere 4% of the total number of Doctors. Another field of study in which women predominate is sciences on culture and arts (in Figure 24 shown as Culture and arts), where women account for 60% of graduates. Similarly as in the case of pedagogical sciences, also this field of study accounts for a very low proportion in the total number of Doctoral programmes' graduates, less than 3%.

Inflow of the workforce with tertiary qualifications into the labour market depends not only on the availability of tertiary education but also on the rate of success in graduation (see Figure 25).

Failure in studies is always associated with inefficient spending of both public and private resources that do not bring expected benefits and their return is, therefore, zero or significantly lower than originally expected. The loss, however, not only financial but it is also of non-financial nature; time could be spent more effectively, failure might lead to reduced self-esteem, etc. Therefore, it is necessary to prevent failure

through critical assessment of study aptitudes and professional interests identifying thus appropriate field of study and education level. At this stage, good quality and accessible counselling and guidance services are crucial. Reduction of the proportion of unsuccessful students can be achieved through permeability of the tertiary education system but also by means of an elaborate system of subsidies or student loans. Nevertheless, successful completion of studies is always related primarily to responsible attitude of an individual.

Figure 25: Completion rate in ISCED 5A study programmes (2008, %)



Note: EU - non-weighted average from data available. Values relate to the completion of at least the lower – Bachelor education level. Source: OECD (2010a), Table A4.1.

The success of students in tertiary education is, for the purposes of international comparisons, facilitated by means of the indicator of completion rate. This indicator expresses the ratio of students who completed tertiary education in the given year to the number of students who commenced studies in the year corresponding to the standard length of studies. For the study programmes at ISCED 5A level, completion rate relates to the achievement of at least Bachelor qualifications.

There are significant differences among individual EU countries in terms of the completion rate values, in 2008 the indicator ranged from 49% (Sweden) to 86% (Portugal). The completion rate for the CR is around the EU and OECD averages, i.e. approx. 70%. The question is to what extent are the differences among individual countries affected by differing accessibility of education and varying demands of studies.

Differences among individual national systems of tertiary education to some extent affect not only the international comparisons of data, but they also inhibit mobility of both workforce with tertiary qualifications and students. Therefore, certain activities aimed at improving comparability of the tertiary education systems have been implemented at EU level.

2.2.2 European dimension of tertiary education

One of the most important activities of the EU aimed at securing greater international comparability of tertiary education and promoting international cooperation between the institutions of tertiary education were the activities implemented within the so-called Bologna process. This process was started in 1999 with the objective to create by 2010 an attractive and internationally competitive European Higher Education Area (EHEA).

The principle steps for its creation:

- Adoption of a system of easily readable and comparable degrees,
- Adoption of a system based on two main cycles,
- Establishment of a system of credits,
- Promotion of mobility of students and teachers,
- Promotion of European cooperation in quality assurance,
- Promotion of European dimensions in tertiary education.

The European area of higher education was declared at the Ministerial conference in Budapest and Vienna in 2010. Joint declaration has been adopted already by 47 countries. In addition to the member countries of the EU-27, it was also Norway, Liechtenstein, Iceland, Switzerland, Croatia, Turkey, Albania, Bosnia and Herzegovina, Macedonia, Serbia, Montenegro, Armenia, Azerbaijan, Georgia, Kazakhstan, Moldova, Russia, Ukraine, Andorra and the Holy See.

At the conference, it was stated that the countries of the Bologna process managed to create quite harmonized architecture of study programmes composed of three cycles - Bachelor, Master and Doctoral. Highly appreciated was also the creation of joint standards and guidelines for quality assurance in education and setting up of eight European qualifications frameworks.

Box 6 – Assignment of the initial education levels to the European Qualifications Framework (EQF) levels in the CR

EQF 8 – tertiary – Doctoral study programmes

EQF 7 – tertiary – Master study programmes

EQF 6 – tertiary – Bachelor study programmes, tertiary professional education including conservatories

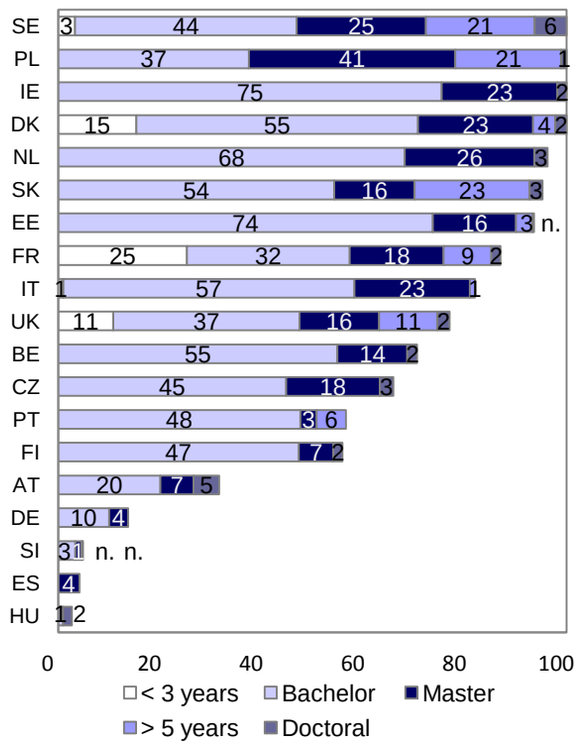
EQF 5 – short-cycle programmes (to be developed)

The European Qualifications Frameworks (EQF) are important instruments in achieving comparability within the national education systems. Since 2008, individual Member States have been working on the assignment of their national qualifications systems of initial education to the eight reference levels according to set parameters. Four levels have been reserved for the area of tertiary education (QF 5-8, see Box 6).

Figure 26 illustrates specifics of national systems of tertiary education and degree of adapting curricula structures to those recommended in the Bologna process. The Figure shows the proportion of graduates of the study programmes in line with the Bologna Declaration in the overall number of tertiary education graduates in 2008. Among the countries for which data are available, the study programmes structure is entirely adequate to the Bologna Declaration in Sweden, Poland, Ireland and Denmark. However, only in Ireland the

total number of graduates breaks down into three fundamental study cycles – Bachelor, Master and Doctoral. In the remaining three countries, larger or smaller proportion of graduates comes from other types of study programmes, which are classified as programmes meeting the Bologna criteria. The smallest progress in the restructuring of tertiary education has been so far achieved in Hungary, Spain and Slovenia.

Figure 26: Structure of tertiary education graduates according to the structure defined by the Bologna process (2008, %)



Source: OECD (2010a), Table A3.4.

In 2008, the proportion of graduates of study programmes in line with the Bologna declaration reached 66%; the remaining 34% represented mainly graduates of on-going traditional "long" Master programmes. The share of the graduates of "long" Master degree programmes is decreasing, although it is evident that this type of study programmes will not disappear totally as the Academic representation believes that some of them are unsuitable for the division into Bachelor and Master cycles. In 2010, according to the IIE data, the graduates of all types of study in "long" Master degree programmes (study programmes of 4-6 years) accounted for only 11% in the overall number of graduates.

The CR, as compared to other countries, still shows a rather high proportion of graduates of Bachelor study programmes who continue in the follow-up Master degree studies. This indicates that both the population and the labour market are not yet ready to adopt Bachelor level education as a type of completed tertiary education. The problem might be also the fact that not all the Bachelor study programmes are designed in that way and they still remain rather a precursor to Master study programmes. Although increasing proportion of young people enter the labour market as soon as they complete the Bachelor level education, a large number of them still continue their studies in Master programmes through distance or combined form of studies. At present, approximately three quarters of the Bachelors continue in the follow-up Master study programmes.

Specific short-cycle study programmes with a period of study shorter than three years are in some EU countries incorporated in the tertiary education system. This type of study is most advanced in France, where its graduates in 2008 accounted for 25% of all tertiary education graduates as well as in Denmark where their share was 15%.

Introduction of similar type of study is being considered in the CR in connection with the reform of higher education, which assumes structuring of higher education institutions into professional oriented, educational and research ones. The Draft Intention of Higher Education Act comes up with the thesis of two-year professional oriented so-called Diploma study programmes focused on acquisition of knowledge, skills and competences needed for an immediate and independent performance of professional activities within a specialized range of occupations. It will be possible to follow a Diploma study programme either separately or as a self-contained part of a Bachelor study programme.

This would most likely contribute to increasing the share of population with tertiary qualifications, the question is whether this type of study will appeal to students, employers but also to the providers of education who will be in charge of developing these programmes. Although, the experience with structuring the Bachelor programmes as studies preparing the graduates not only for the follow-up study at Master level, but also for immediate application in practice, do not provide much reason for optimism.

At least at the early stage of introduction of the short-cycle programmes, we cannot expect much interest from the graduates of secondary schools as they do not show increasing interest in tertiary professional schools or in conclusion of studies after achieving the Bachelor degree either. The labour market demand for graduates of the Bachelor programmes or study programmes provided by tertiary professional schools in the labour market is not significant. This situation is also reflected in the advertised supply of job vacancies. If the requirements on qualifications level are mentioned, they rarely include tertiary professional schools or Bachelor degree. For the performance of skills-intensive occupations the qualifications acquired at the HEIs are usually required and education completed by "maturita" examination is sufficient for less demanding professions.

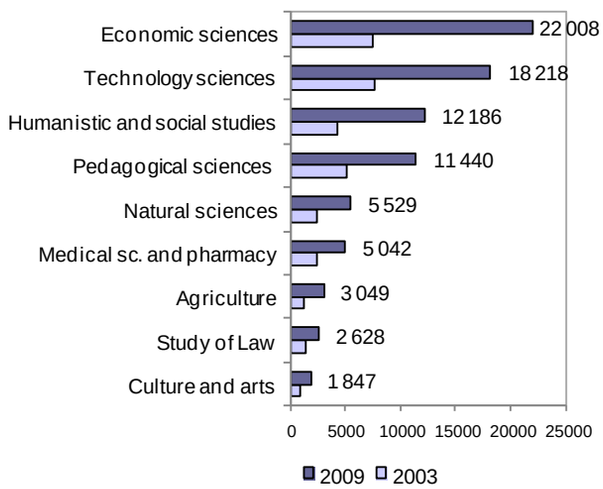
Tertiary level of education brings positive effects to the society as well as to an individual, these effects are developed to their full potential only if the graduates find on the labour market application adequate to their qualifications. Increasing numbers of graduates should develop in a certain relation to the increase or release of jobs requiring tertiary qualifications in a specific field of study.

2.2.3 Fields of study structure of HEIs' graduates

The numbers of students and graduates of higher education institutions in the CR are growing intensely, but unevenly in different fields of study (see Figure 27). In all disciplines, with the exception of study of law, the numbers of students grew more than twice over the period of 2003-2009. Economic sciences along with humanistic and social studies recorded the highest increase rate in number of graduates in that period. In these two fields of study the number of graduates increased almost three times. The lowest increase was recorded for the aforementioned study of law, by three quarters only.

In terms of the proportion of graduates from various fields of study in the total number of graduates, there have been no significant changes. Economic sciences and technology consistently account for the largest share. In 2003, both disciplines contributed equally, by 23%, to the overall number of graduates, while in 2009 the share of economic sciences increased to 27% and technology saw a drop to 22%. Precisely, it is the science and technology programmes graduates who are expected to contribute most to the innovations and innovative processes, which are essential for the companies to maintain or increase their share in the relevant commodity market. The proportion of the natural sciences graduates reached 6.7% in 2009. Detailed classification of science and technology programmes is included in the Chapter Human resources for research and development.

Figure 27: Graduates of HEIs by fields of study (Classification of Basic Branches of Education, in persons)

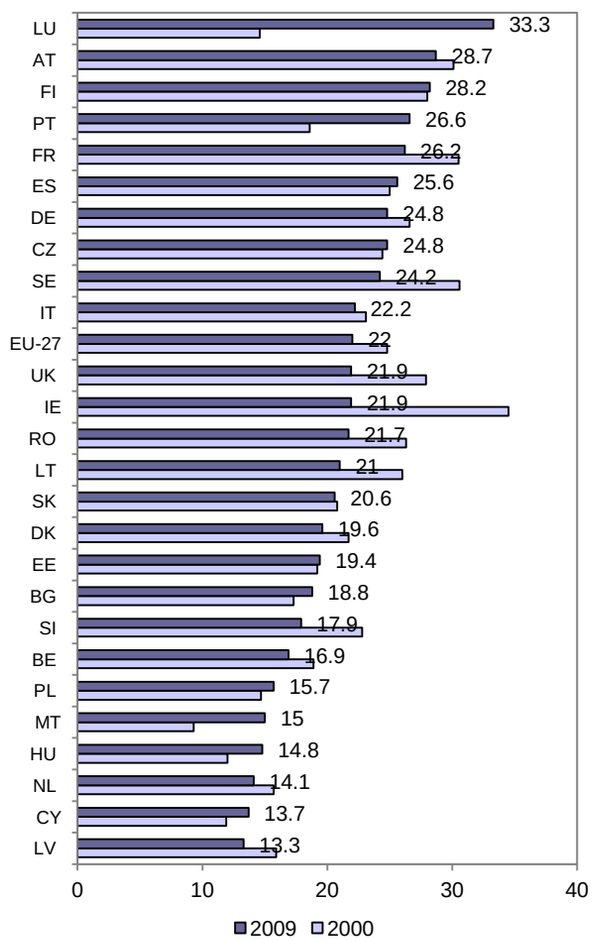


Source: IIE (2010), Table F 4.2. Note: included graduates of Bachelor, Master and Doctoral study programmes at public and private HEIs in on-site, distance or combined types of study.

When selecting a field of study, young people are influenced not only by their interests and study capabilities, but their decisions are also driven, among a number of other factors, by information on wage possibilities in particular occupations. This type of information is usually acquired through acquaintances or from daily press and prevailing stereotype is that economists and lawyers are more likely to reach high level earnings than individuals with qualifications in technology fields. Such view, however, is confirmed by statistical data provided by the Average Earnings Information System of the Ministry of Labour and Social Affairs (MoLSA). The survey carried out within the business sector in the last quarter of 2010 shows that comparison of two occupations with same qualification requirements differing only by fields of study (economic sciences versus technology) turns out in favour of the economic disciplines. As an example can be used also the fact that a median salary of the Research and development department manager (ISCO 1237) amounted to CZK 55,355; whereas the salary of Finance and administration department manager (ISCO 1231) was CZK 62,325.

Lower interest of young population in science and technology study programmes as compared to humanities is not, as illustrated by Figure 28 [14], a specific feature of the Czech Republic. On the contrary, in the European Union the Czech Republic ranks among the countries with above average proportion of science and technology graduates of tertiary education. In 2009, the EU average of this indicator represented only 22%, while the CR showed 25%. The CR also recorded more favourable development, as within the EU the number of these graduates on average decreased by almost 3 p.p. as compared to 2000, while in the CR it remained almost unchanged (it decreased by 0.4 p.p. only). In this respect, the best results have been over a long term recorded in Austria, France, Finland and Estonia where the proportion of technology and science graduates exceeded 25% in both years under review.

Figure 28: The proportion of science and technology programmes (ISCED 5, 6) graduates in the total number of tertiary studies graduates (%)



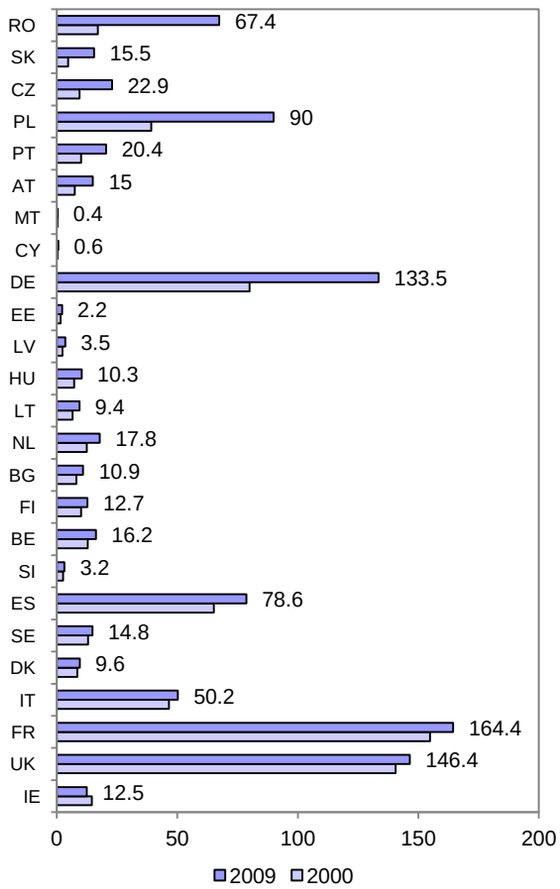
Note: For LU in 2009 the data used are from 2008. The stated numerical values refer to 2009. Source: Eurostat (2011e), Table Code: educ_thflds, date of access 8.8.2011.

The European Union actively responded to the decreasing interest of young population in science and technology fields of study. As one of the objectives of the Lisbon process the EU has set out to increase the number of graduates of S&T programmes by an average of 15% by 2010 as compared to

[14] The proportion of graduates of science and technology programmes for the CR does not correspond to the shares stated in Figure 28. This is due to the fact that different classifications of fields of study have been used. Statistics in the CR apply the national classification system - Classification of Basic Branches of Education (Czech abbreviation - KKOV) while the international statistics are based on the International Standard Classification of Education (ISCED).

2000. To what extent individual countries succeed in fulfilment of this objective is illustrated in Figure 29, in which the countries are sorted by the percentage increase in graduates in these fields in 2009 as compared to 2000. The Figure shows the numbers of graduates in absolute terms, which are used for calculation of percentage increases.

Figure 29: Number of graduates of science and technology programmes (ISCED 5, 6, thous. persons)

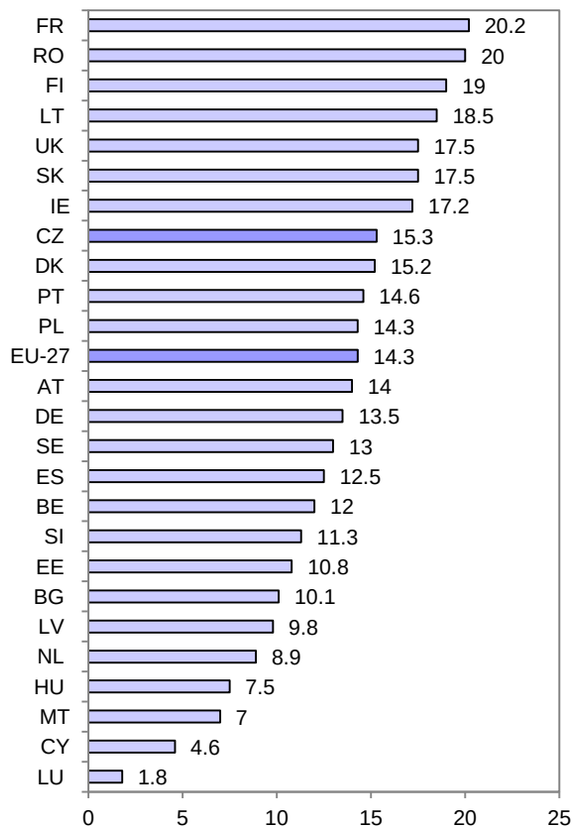


Note: Numerical values refer to 2009. Source: Eurostat (2011e), Table Code: educ_itertc, date of access: 8.8.2011.

It is evident that the objective of the Lisbon strategy to increase the number of S&T graduates had already been achieved of even surpassed in most EU countries in 2009, which was reflected in the EU-27 average increasing by 38%. The CR ranked with an increase of almost 244% in the third place, a higher increase rate was achieved just by Romania (394%) and Slovakia (330%). Only six EU countries reported lower increase than 15%. Ireland seems to have biggest difficulties with getting even near to the 15% threshold; by contrast, it even recorded 14% decrease in the number of graduates of S&T fields of study. The increase rates in the remaining five countries ranged from 4% (UK) up to 14% (Sweden). This indicates that it is rather difficult to achieve an increase in the number of S&T graduates in countries where their proportion in the total number of graduates has been already quite high. This holds true for France in particular, but to some extent also for Sweden and Italy.

Relatively fast increase in the proportion of graduates of science and technology programmes achieved in most EU member countries was reflected in the positive development of another indicator.

Figure 30: The number of graduates of tertiary studies (ISCED 5, 6) in science and technology fields per 1,000 persons aged 20-29 in 2009



Source: Eurostat (2011e), Table Code: educ_thflds, date of access: 8.8.2011.

The indicator monitors the extent to which individual countries are equipped with this type of graduates in relation to the population aged 20-29. In 2009 there were, on average, 14 graduates of science and technology programmes per 1,000 persons aged 20-29 in the EU, while the Czech Republic reported 15. The most favourable ratio was achieved in France with 20 graduates.

Although both the numbers and proportions of S&T graduates show quite favourable development within the EU and the CR, it is needed, in accordance with the opinion of a number of economists, to point out that Europe and also the U.S. began to lose their economic and technological lead to the Asian countries primarily. It can be, in addition to many other factors, attributed to significantly higher ambitions of young people from these countries to achieve high-quality education in technology fields. As mentioned before, the numbers of tertiary studies graduates should develop in tune with the demand for this type of workforce. That can only be achieved through providing those interested in studying with thorough information on the current as well as anticipated situation in the labour market. It is essential that this kind of information entered into decision making of young people when choosing their professional careers.

2.2.4 Applicability of tertiary education graduates in the labour market

To what extent the structure of the supply of workforce with tertiary qualifications corresponds to the relevant demand for labour can be derived from the rates of graduate unemployment in particular fields of study.

Table 16: Higher education graduate unemployment

Fields of study/faculties	Number of faculties in selection	Number of unemployed graduates		Graduates unemployment rate (%)	
		September 2009	April 2010	September 2009	April 2010
Agriculture	11	404	179	23.7	11.0
Artistic disciplines	13	52	39	15.2	11.0
Economy	51	1, 234	757	16.0	8.7
Natural	9	161	128	10.2	8.3
Technology	40	864	554	13.0	7.8
Philosophical, theological and social	28	444	383	8.3	6.6
Pedagogical and sports	13	351	268	5.6	4.2
Law	5	74	63	4.2	3.7
Medical	15	145	33	5.1	1.2

Source: Education Policy Centre (2011).

Given that high unemployment rate may also be associated with a negligible number of unemployed graduates, it is necessary to take into account also absolute numbers of unemployed graduates (Table 16). Evaluation based on both indicators, however, provides only general idea, as it does not reflect whether the employed graduates use their qualifications to the full and whether their job corresponds to their education level and field of study. Nevertheless, data needed for such a thorough evaluation are not available. It also does not reflect the influence of the employers' requirements on practice, which rather frequently inhibits recent graduates from getting an adequate job. We assume that this effect is roughly the same for all disciplines.

Applicability in the labour market differs significantly depending on the time elapsed since graduation. Unemployment rates over the next six months will reduce in graduates of all fields of study, though to varying degrees. This indicates that a certain part of graduates needs more time to find a job. Leaving aside the impact of changes in demand for labour, we may conclude that reduction in graduate unemployment is often a consequence of certain compromise on rather unrealistic expectations of application opportunities in the labour market. Thus, the graduates are ready to accept lower wages, jobs not requiring tertiary studies, working positions outside their main field or with more distant employer.

In both periods under review (September 2009, April 2010), the highest unemployment rate was recorded among the graduates of faculties of agriculture despite the fact that over time it dropped to less than half of the initial value; from almost 24% in September 2009 to 11% in April 2010. The same unemployment rate showed in April 2010 also the graduates from artistic disciplines, where the unemployment rate compared to baseline (15%) did not see any significant decrease (it dropped by 4 p.p. only). By contrast, the lowest unemployment rate, in April 2010, was reported by the medical faculties' graduates (1.2%) and faculties of law graduates (3.7%).

In terms of numbers of graduates the labour market showed the largest surplus of graduates of economic faculties (757 persons) and faculties of technology (554 persons). The surplus of young economists is not surprising in light of the aforementioned extremely fast growth in the number of these graduates (Figure 27). However, in graduates of faculties of technology is such development rather unexpected given the prevalent views among general public that there is a lack of graduates of technology fields of study and efforts need to be made to encourage interest in these disciplines. Graduate unemployment, though, indicates that the problem is not the numbers but rather the quality of graduates and their structure in terms of fields of study. It can be expected that the graduates whose specialisation relates to industry, which is withdrawing from the CR (e.g. chemical or textile industries), will find it more difficult to get a job that those specialized in engineering or computer technology.

As for the quality of graduates, according to the survey concerned with employers' requirements carried out by NOET in 2009 within the project Support for Technology and Science Study Fields, the employers are generally satisfied with the graduates' knowledge in their main field or discipline. However, they believe that graduates lack skills and competences within project and process management as well as quality and lean management, they do not show sufficient ability to focus on the ultimate goal, to proceed in steps and complete a stage, to meet deadlines, make decisions and justify their actions or to communicate within the project (for detail see The Competitiveness of the Czech Republic 2008-2009, Quality of Human Resources, Chapter 1.2).

Insufficient mastery of the above mentioned so-called soft skills is not typical only for graduates of technology programmes but also for graduates of many other disciplines, as the way of education at tertiary and secondary schools provides students with only limited opportunities to gain these skills during the tuition of relevant professional subjects. Active learning still does not represent the principal form of education and students' team work skills are not sufficiently fostered either.

The most successful in terms of employment are graduates of medical faculties, who show the lowest unemployment rate (1.2% in April 2010) and lowest number of the unemployed (33 persons). Their favourable situation is partly influenced by the fact that some medical doctors move abroad in view of better working as well as financial conditions thus increasing the demand for labour within the sector.

Good prospects in the labour market were also enjoyed by the graduates of the faculties of law. They recorded low unemployment rate (3.7% in April 2010) as well as low number of the unemployed (63 persons). Despite the existing immense interest in law studies, the faculties of law, unlike the economic ones, expand their capacity very slowly, which is evident from the relatively slow growth in number of graduates (Figure 27).

Another indicator revealing different behaviour of faculties of economics and faculties of law is the proportion of the students admitted in the total number of those who turned up for the admission proceedings. According to data provided by

IIE[15], in the academic year 2010/2011, 39,250 persons filed applications for economic sciences and 27,477 of them were admitted, i.e. 70%, while the faculties of law recorded 10,335 applicants but only 3,730 students were admitted, i.e. 36%. The question arises whether differing policy of faculties of economics and faculties of law on the capacity expansion is somehow influenced by the private sector. Statistics do not indicate such involvement, on the contrary, in the given year the share of students admitted to private law faculties accounted for 33% in the total number of admissions, while the economical faculties for 29% only.

To what extent are the individuals with tertiary qualifications prepared to perform the skills-intensive occupations depends on quality of education provided but also on specific capabilities and diligence of each and one of them. Therefore, the following part of this section focuses on quality evaluation of the education provided by higher education institutions.

2.2.5 Quality of tertiary education

Close attention needs to be paid to quality assurance in tertiary education as well as in all other educational levels. It is not possible to secure quality of education provided by higher education institutions and tertiary professional schools without good quality education at earlier stages.

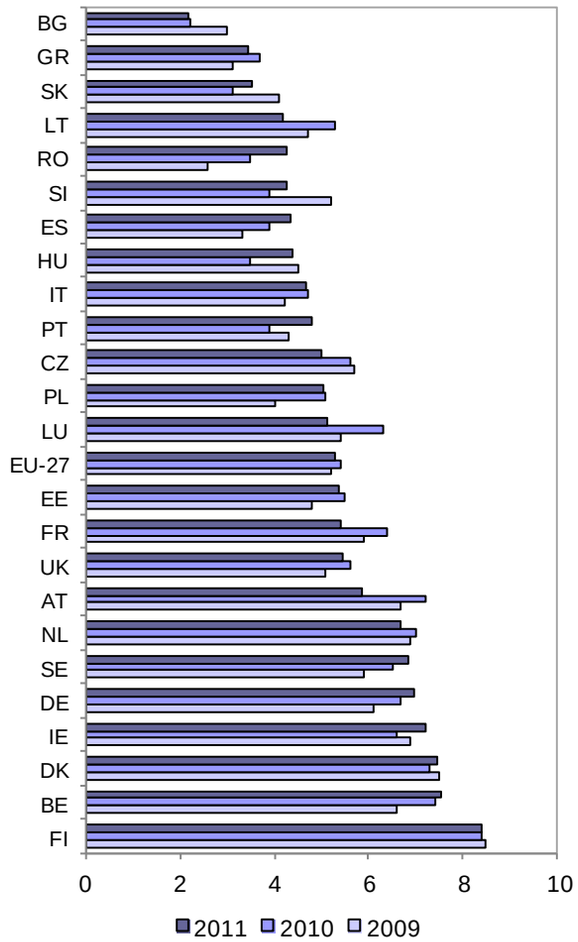
One of leading institutions involved in quality evaluation of tertiary education on international level is the International Institute for Management Development (IMD) seated in Switzerland. Their comprehensive survey carried out cross-nationally included a question concerning the ability of tertiary education to meet the needs of a competitive economy. Respondents for each country were domestic and foreign experts as well as representatives of public administration. (For detail information on methodology and results for specific EU member countries in given year see the Statistics section - Indicator of quality of higher education.)

The indicator of quality of higher education is published on annual basis in the IMD World Competitiveness Yearbook. Rating of quality is changing year-on-year, however, most countries do not show any specific long term trend even though in education, by its nature, the shifts in quality stem from long term processes. Unless the structure of teachers or students undergoes dramatic changes which are usually associated only with a change of political regime, major year-on-year shifts in quality of education are not plausible.

Deterioration or improvement of the quality of education is always slow and gradual. It is evident that the expert evaluation is to a certain level affected also by other factors, such as impact of the economic situation and related optimistic or pessimistic expectations. Nevertheless, this assumption was not confirmed by the subsequent correlation analysis, which did not show that positive growth rates would lead to more favourable evaluation of tertiary education and vice versa.

During the period 2001-2011, the Czech tertiary education got the best rating in 2003 and 2006 when receiving 6.1 out of 10 points. The worst evaluation results were reported in 2007, when the CR was granted only 4.7 points by the experts, which represented a year-on-year drop in quality by almost one third. Comparing the quality evaluation of tertiary education with the growth rates of GDP at constant prices, we can see that also the example of the CR proves that there is no link between these values.

Figure 31: Quality of higher education (points)



Note: 0 – the lowest value, 10 – the highest value. Source: IMD (2011).

In the years when the Czech tertiary education got the best ratings, the economic growth rates differed significantly and vice versa, when the growth rates were recording rather similar values the quality evaluation results for tertiary education varied a lot. In 2003 and 2006, when the quality of tertiary education consistently rated at 6.1 points, the rates of economic growth represented 3.6% and 6.8% respectively. By contrast, upon the relatively consistent GDP growth of 6.3% (in 2005) and 6.1% (in 2006), the quality of tertiary education was evaluated significantly differently – 4.7 and 6.1 points respectively.

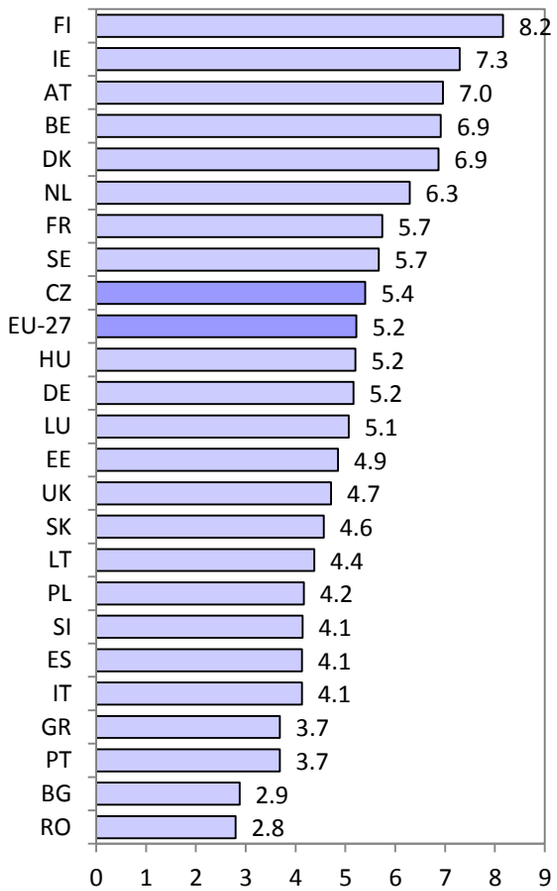
The year-on-year variation in quality evaluation of tertiary education in individual EU Member States during 2009-2011 is illustrated in Figure 31.

As shown in Figure 31, in the last three years quality evaluation results were consistently improving only for Finland, Germany and Romania. In the period 2009-2011, the Czech Republic was the only country where the quality of tertiary education was every year awarded worse rating than the year before. Decreasing ratings are related to the respondents' view that tertiary education does not timely and adequately responds to changing demands of practice, which in addition to cutting-edge expertise increasingly requires also the so-called soft skills, i.e. particularly communication and presentation skills, team work, etc.

[15] IIE (2011c), Table F3.8.

To assess the situation in the CR in relation to the EU average and to other countries, an average value of indicator calculated as arithmetic mean of the values for individual years 2001-2009 was used (see Figure 32).

Figure 32: Quality of higher education (average 2001-2011, points)



Note: 0 – the lowest value, 10 – the highest value. Source: IMD (2011).

With the quality average for the last eleven years representing 5.4 points, the Czech Republic ranks slightly above the EU average and in relation to other member countries just behind Sweden. Looking at the evaluation for the last year, i.e. 2011, we can see that there is a rather robust gap between the Czech Republic and Sweden. Swedish higher education sector was evaluated at 6.9 points while the CR only 5 points. Relatively favourable average position of the CR is therefore due mainly to positive evaluation results in the past. The evaluation values for the limit years, i.e. 2001 and 2011, show that the rating of the Czech higher education dropped from 5.4 to 5.0 points while the evaluation of the Swedish one increased from 5.1 to 6.9 points.

From all EU countries, Finland has the best quality higher education system. This corresponds with extremely good results that Finnish fifteen-year-olds achieve in tests of knowledge and skills acquired in the course of compulsory education (for detail see Chapter Basic competences of young population). There is a rather significant divide between Finland and other countries in terms of quality of higher education, almost one whole point. This applies to Ireland, Austria, Belgium and Denmark where the average quality approached or slightly exceeded 7 points, while in the case of Finland it was 8 points. The worst evaluation results recorded countries that became EU members only in 2007, i.e. Romania, Bulgaria and then also the southern Member States – Portugal and Greece.

In order to increase quality of higher education a number of EU initiatives have been set up, one of them promotes international mobility of students and teaching staff. Positive influence undoubtedly also has the possibility to draw resources from the European Social Fund to improve the quality of education, and then it depends on individual countries how effectively they use these means.

The CR makes every effort, also by means of financing measures, to motivate higher education institutions to improve their quality. Unlike in the past when financing was linked to the numbers of students, at present greater emphasis is put on indicators reflecting the quality of education through results achieved in educational, research and scientific activities, which can be expressed as graduate employability or points counted in the Information Register of R&D results (RIV) collecting data on results of research projects funded from public sources.

Quality of higher education in individual countries is assessed also through the quality of particular universities, when international rankings of universities are compiled. One of the most renowned and cited rankings is the Academic Ranking of World Universities (ARWU) published for the first time in 2003 and whose original purpose was to find a global standing of top Chinese universities. Until 2008, the ranking was developed by two institutions the Center for World-Class Universities and the Institute of Higher Education of Shanghai Jiao Tong University, in 2009 an independent institution – the Shanghai Ranking Consultancy took the task over. The ranking incorporates five hundred world's best universities out of thousand that are evaluated and is published annually on relevant website.

To rank individual universities ARWU uses four objective indicators reflecting particularly quality of research work of both teaching staff and students and their publishing activities. For each indicator a hundred points are granted to university with best evaluation and every other institution gets such a number of points, which expresses percentage score to that maximum. The final ranking is determined as the weighted average of the number of points received for individual indicators. For the overview of these indicators and their weights see Box 7.

Box 7 – Indicators and their weights to build ARWU ranking

1. *Quality of Education:* alumni of an institution winning Nobel Prizes and Fields Medals (equivalent to Nobel Prize awarded for mathematics) – weight - 10%

2. *Quality of Faculty: (a)* staff of an institution winning Nobel Prizes and Fields Medals – weight - 20%
(b) highly cited researchers in 21 broad subject categorie– weight - 20 %

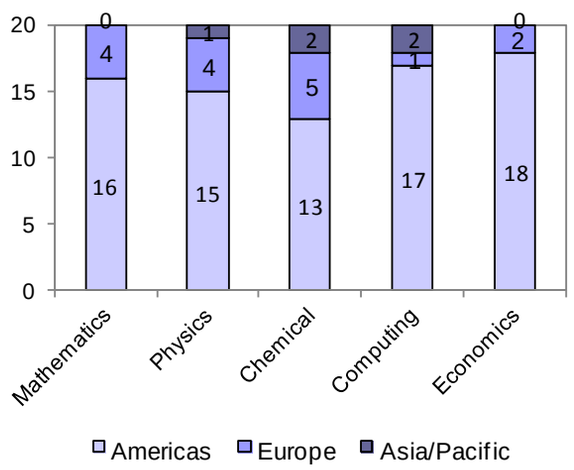
3. *Research results: (a)* papers published in Nature and Science– weight - 20 %*
(b) papers indexed in Science Citation Index – Expanded and Social Sciences Citation Index – weight 20 %

4. *Per capita performance:* weighted average of the above indicators related to number of academic staff and converted to full-time – weight - 10 %

* For institutions that specialize in humanities and social sciences this indicator is not applied and the respective weight is allocated to the remaining indicators.

As any other ranking, also ARWU has many critics whose reservations are directed primarily to the selection of criteria, which reflect the quality of education provided only indirectly, mostly through the scientific and research achievements of students and teaching staff. It is evident that there may be no direct correlation between high-quality scientist and high-quality educator. Another objection states that evaluation method favours science and technology universities over those oriented on humanities. Also the teachers and students who are native English speakers benefit from the fact that records are kept mostly of publishing in English language journals. Disadvantaged to certain level are also those universities located in countries where the prevailing language is not English and also the smaller countries as the ranking of countries takes into account number of universities from one country that ranked among the top ones.

Figure 33: Representation of European universities among the world's top 20 universities in 2010



Source: Shanghai Ranking Consultancy (2010).

There are only two EU representatives among the top 20 universities worldwide, they are both located in the UK. During the period 2005-2010 no changes occurred and no other European university succeeded in getting among the world's elite so far. However, the ranking by fields of study facilitates more favourable view of European higher education (see Figure 33). In 2010, five European universities ranked among the top 20 universities worldwide in chemical disciplines, four universities in mathematics and physics, two universities in economic sciences and one university in computing. In the last field of study Europe already lags behind Asia. Dominant position in all fields of study is held by American universities.

The fact that European universities are failing to enter the world's elite is illustrated in Table 17 comparing the representation of universities from individual EU countries among the top 100 and 500 universities worldwide in 2005 and 2010. They lose their positions mostly to Asian countries, among those China in particular, which in 2005 recorded 18 universities among the top 500, however, in 2010 the number almost doubled (34 universities). By contrast, Japanese universities are rather rapidly losing their position, far faster than the European ones. During the period under review, the number of Japanese universities among the top 500 decreased from the original 34 to 25, although five Japanese universities maintain their ranking among the top 100.

In 2010, there were 28 representatives from eight EU countries among the top 100; United Kingdom recorded the highest number of universities (11). Steadily, the CR has only one representative – Charles University. Given the Charles University ranked among the top 300, the CR scores among the 39 assessed countries better than e.g. Hungary with two representatives among the top 500 though with a worse ranking. The Czech Republic ranked 30th and Hungary 31st. Thus, the CR achieved the best ranking of all post-communist countries.

Table 17: Development of representation of European Universities among the top 100 and 500 universities worldwide

State	top 100		top 500	
	2005	2010	2005	2010
DE (4)	5	5	40	39
UK (2)	11	11	40	38
FR (6)	4	3	21	22
IT (16)	1	0	23	22
NL (10)	2	2	12	12
SE (9)	4	3	11	11
ES (19)	0	0	9	10
AT (21)	1	0	6	7
BE (17)	0	1	7	7
FI (14)	1	1	5	6
DK (11)	1	2	5	4
IE (27)	0	0	3	3
PL (32)	0	0	2	3
PT (35)	0	0	2	3
HU (31)	0	0	2	2
GR (29)	0	0	2	2
CZ (30)	0	0	1	1
SL (38)	0	0	0	1
Japan (3)	5	5	34	25
China (18)	0	0	18	34
South Korea (20)	0	8	0	10

Source: Shanghai Ranking Consultancy (2010). Note: Numbers in parenthesis indicate ranking of individual EU Member States among 39 evaluated countries.

It is obvious that different methods of quality assessment of higher education provide varying results. Even though many objections might be raised to each method of quality evaluation, they all facilitate important indicative information. A comparison of the results of both aforementioned evaluations proves that Finland is the European leader in terms of adjusting the higher education to the needs of practice, while German universities are the most successful in terms of contribution to the advance in scientific knowledge. Here needs to be pointed out the influence of the size of individual countries and to that related number of universities. It would be interesting to calculate the proportion of universities ranked in ARWU in the total number of universities for each country. For such a calculation, however, there are no data available on numbers of universities in individual countries.

2.3 Educational structure and mobility

The competitiveness of countries depends, to a large degree, on the knowledge and skills of their population and on the proportion of individuals who achieve good education. No less important is the degree to which this education is transformed into economic performance and to which people do jobs that fully use their knowledge and skills acquired in the relevant fields. The educational attainment of the population

is increasing along with the growing demands of the economy and the enlarging capacity of education systems, and younger generations achieve more advanced levels of education than older generations.

This subchapter is divided into two parts. The first part compares the educational structure of the 25-64-year-old population of the CR with the rest of the EU. Attention is also paid to the relationship between the proportion of individuals with tertiary qualifications and the country's economic performance. Another issue that is explored is whether there is a proportionate increase in the number of people with tertiary education in relation to the number of jobs for which these qualifications are required. The second part of this subchapter concerns the intergenerational shift in educational attainment – i.e. whether the generation of children achieve higher levels of education than the generation of their parents.

2.3.1 Educational structure

In relation to the growing and, most importantly, changing requirements concerning the knowledge and skills, emphasis is placed on the necessity of lifelong learning. The imperative of learning throughout one's life is not new, it is only the concept of lifelong learning that changes over time. Apart from formal education attention is paid to non-formal education and recognition of its outcomes.

However, the principal indicator that allows for tracking the development of the educational structure of the population is still the level of formal education achieved. International comparability of data is guaranteed by the use of the ISCED standard classification of education that discerns three basic levels of education (see Box 8).

Box 8 – Formal education levels

Basic education (primary and lower secondary level, ISCED 1, 2), is of general nature and normally covers the period of compulsory school attendance.

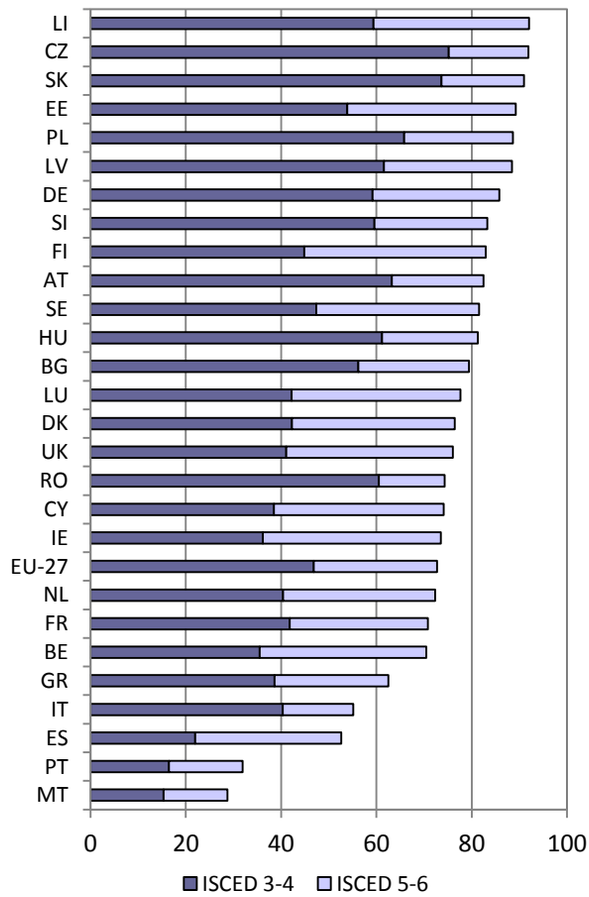
Secondary education (upper secondary level - ISCED 3) is of general or vocational/technical nature and is completed by a school leaving examination ("maturita") (ISCED 3A), a vocational certificate (ISCED 3C) or a final examination (ISCED 3C). In the CR it also includes so-called "follow-up" courses for those who complete secondary education with a vocational certificate and wish to pass "maturita" (ISCED 4).

Tertiary education (ISCED 5, 6) is of professional or artistic nature. It includes higher education at Bachelor and Master levels and tertiary professional education (ISCED 5), and doctoral education (ISCED 6).

One of the objectives the EU intended to achieve by 2010 as part of the Lisbon strategy was to increase the educational attainment of the population. As compared to 2000 when 64% of the population aged 25-64 had at least secondary education, this proportion was to be increased to 80% by 2010. As Figure 34 illustrates, this target was not reached, as less than 73% of the population aged 25-64 had at least secondary education in 2010.

The objectives of the Lisbon strategy were formulated at a time when the EU only had 15 member states. EU enlargement in 2004 by ten new member countries (the CR, Estonia, Cyprus, Lithuania, Latvia, Malta, Hungary, Poland, Slovakia and Slovenia), and by another two countries (Bulgaria, Romania) in 2007 did not have a negative effect in terms of meeting the objective. Evidence of this is that EU-15 had 70% of the population aged 25-64 with at least secondary education in 2010, while this proportion was the aforementioned 73% for the EU-27. Even though the educational structure improved in all EU member countries, the progress was slower than the expectations were when the target was set.

Figure 34: The proportion of population aged 25-64 with secondary and tertiary education in 2010 (%)



Source: Eurostat (2011), table code lfsa_pgaed, date of access: 13.7.2011, own calculation.

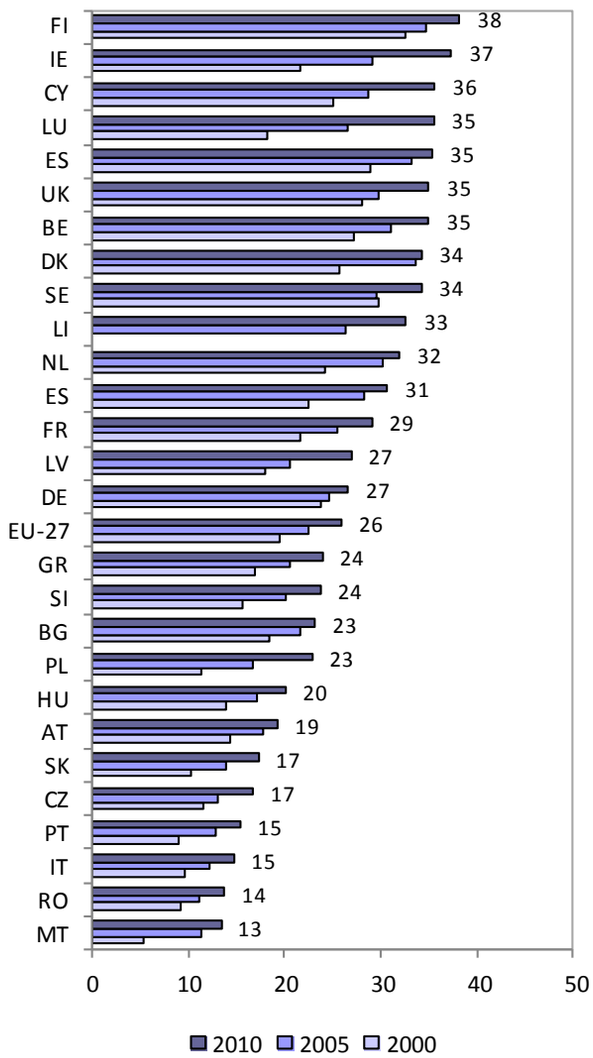
Although the EU as a whole did not reach the objective, twelve member countries scored higher than this reference level. Three countries exceeded the level by the largest margin (the CR, Slovakia and Lithuania). More than 90% of the population aged 25-64 has at least secondary education in these countries. On the other hand, the least favourable situation in terms of qualification levels can be found in southern countries where in Malta and Portugal less than one third of the relevant population had at least secondary education.

Member countries vary significantly in terms of the educational structure of the population with at least secondary education. New member states are characterised by large proportions of people with secondary qualifications. This is true for the Czech Republic in particular, but also for Slovakia where some 80% of the population with at least secondary education are those who acquired secondary qualifications only. This is still the consequence of the very limited accessibility of higher education in former Soviet bloc countries and the advanced state of development of secondary education. In 2010 Belgium showed more or less the same proportions of people with secondary and tertiary qualifications. The same was true of Portugal and Malta. In Ireland and, most importantly, in Spain the proportion of individuals with tertiary education is even higher compared to people with secondary

qualifications. One characteristic feature of the educational structure in Portugal, Malta and also Spain is the large proportion of people who only have basic education (some 70% in Malta and Portugal, and roughly 50% in Spain).

The increasing accessibility of tertiary education and its diversification have made a major contribution to the enhanced level of educational attainment in the population. This diversification occurred both in terms of physical space (institutions providing tertiary education were also established outside traditional centres of education), and in terms of the length of studies necessary for acquiring a tertiary qualification. This made it possible for a higher number of young people to achieve tertiary education and for the working population to acquire tertiary qualifications as part of continuing education.

Figure 35: The proportion of population aged 25-64 with tertiary education (2000. 2005, 2010, %)



Note. The figures are for 2010. Source: Eurostat (2011e), table code lfsa_pgaed, date of access: 13.7.2011, own calculations.

As Figure 35 clearly illustrates, the share of population with tertiary degrees increased in all EU countries in 2000-2010. Malta and Poland saw the largest increases – the proportions of people with tertiary qualifications doubled in these countries. The Czech Republic is among the countries that display a gradual development. The proportion of individuals with tertiary education increased from 12% in 2000 to 17% in 2010. This gradual development is associated, to an extent, with underdeveloped short study programmes, as the population and industry still prefer traditional five-year studies over Bachelor or tertiary professional degrees.

The Czech Republic ranks among the countries where this indicator reaches below average levels. In 2010 26% of the population aged 25-64 had tertiary education in terms of the EU average – i.e. 9 percentage points more than the CR. In twelve out of 27 member countries this proportion exceeded 30%. Finland had the largest percentage of individuals with tertiary qualifications (38%), followed by Ireland (37%). Malta and Romania were at the bottom end of the scale (13% and 14% respectively).

However, the process of enhancing the educational attainment of the population is not always viewed as clearly positive. Employers, in particular, complain about the lack of young people who master crafts and who are able and willing to do skilled manual work. The worsening situation in terms of the availability of people with vocational qualifications is documented by the decreasing proportion of these individuals in the population aged 25-64 in the period between 2000 and 2010 (see Table 18). If in 2000 they accounted for 42% of the workforce aged 25-64, in 2010 the proportion was less 36 %. The situation is further aggravated by unfavourable demographic development that is manifested by a smaller size of younger age cohorts.

Table 18: The educational structure of population aged 25-64 in the CR (%)

The highest educational attainment	2000	2005	2010
Basic	14.8	10.5	8.1
Secondary without "maturita"	42.2	40.6	39.8
Secondary with "maturita"	31.5	35.5	35.5
Tertiary professional (VOŠ)	0.6	0.6	1.0
Higher education (VŠ)	10.9	12.9	15.6

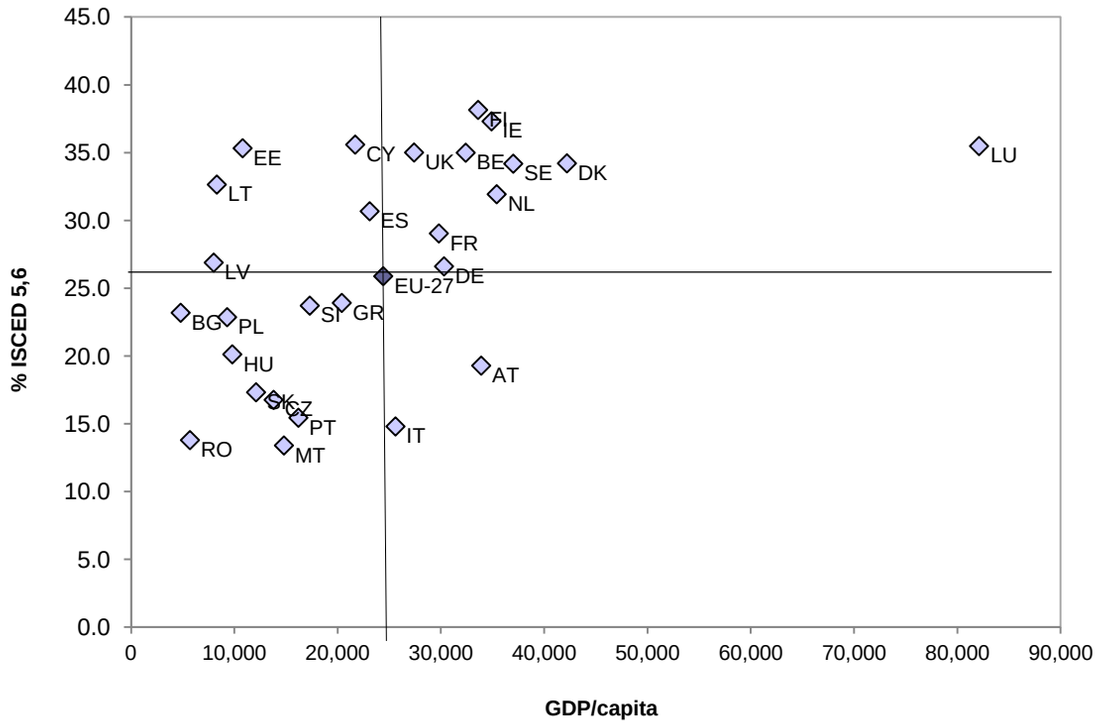
Source: VŠPS, 2nd Q of the relevant year, own calculations.

A large number of countries, including the CR, tackle the problem of insufficient interest in so-called "apprenticeship education" (ISCED 3) on the part of young people (or their parents). Various motivational schemes are therefore implemented ranging from promotional campaigns to financial incentives offered by some regions in the form of scholarships for trainees in selected fields. Some countries, such as Germany, no longer rely on the German population only. Instead, they offer scholarships and other advantages in order to attract young people from border areas in neighbouring countries to undergo vocational training in Germany.

The educational attainment of the population is linked, to a degree, to the economic performance of the country, as there is a relatively strong correlation between these two economic variables. It applies in general that higher economic standards of a country correlate positively with higher proportions of population with tertiary qualifications, and that workforce with these qualifications contribute to the economic growth. The level of the correlation coefficient between the GDP per capita and the proportion of the population with tertiary education in the 25-64 age group points to this dependency (it constantly hovers at around 0.5 or slightly, in terms of hundredths, above this level).

As compared to less developed economies, more advanced countries spend larger amounts of public resources on education even with the same ratio of education spending to

Figure 36: GDP per capita (EUR) and the proportion of population with tertiary qualification in the population aged 25-64 (%) in 2010



Source: Eurostat (2011a, e), table code nama_gdp_c; lfsa_pgaed, date of access**:** 13.7.2011, own calculations.

GDP. Apart from public resources there is a larger share of private resources flowing into education in these countries. Most families in strong economies can afford to invest more in education depending on their individual priorities. Moreover, better educated population has more influence on economic standards – not only as workforce but also as consumers. As workforce they are more engaged in the creation of new ideas and their putting into practice, as consumers they are normally more demanding in terms of the quality and technical standards of the products and services. In this way, through demand, they stimulate companies to innovate and provide more sophisticated products and services.

Figure 36 presents a comparison of the GDP levels and the proportions of the population with tertiary education within the EU. Several countries do not conform to the general rule of a positive correlation between the economic standards and the proportion of population with tertiary qualifications. Italy and Austria show a below-average proportion of the population with tertiary degrees while their economic performance is higher than the EU-27 average. What is more common, however, is a situation where countries with lower economic performance have an above-average proportion of people with tertiary qualifications. This is true of Cyprus, Estonia, Lithuania, Latvia and Spain. Apparently, tertiary education is among both social and individual priorities in these countries.

For the workforce with tertiary education to have the expected impact on economic development and for the resources and efforts entailed in achieving such education not to be wasted, it is important that these people perform skills intensive occupations. These are mainly those falling in the ISCO 1 and 2 categories (managers and professionals respectively). These positions should be occupied by individuals with tertiary qualifications. More detailed information about individual occupations within these two categories is presented in Box 9.

If we compare the proportion of people with tertiary qualifications aged 25-64 with the development of the proportion of individuals in this age group who are employed as managers and professionals we may get overall information about how these variables develop. The question is whether people with tertiary qualifications stand a chance of finding appropriate employment and vice versa – i.e. whether there is a sufficient number of individuals with appropriate qualifications for skills intensive jobs. The field of study has been omitted in this case, although it does have a significant impact on the link between supply and demand.

Box 9: Occupations with the highest level of skills intensity (ISCO)

ISCO 1 – Chief executives, senior officials and legislators

11 – Legislators and senior officials

12 – Corporate managers

13 – General managers

ISCO 2 –Professionals

21 – Physical, mathematical and engineering science professionals

22 – Life science and health professionals

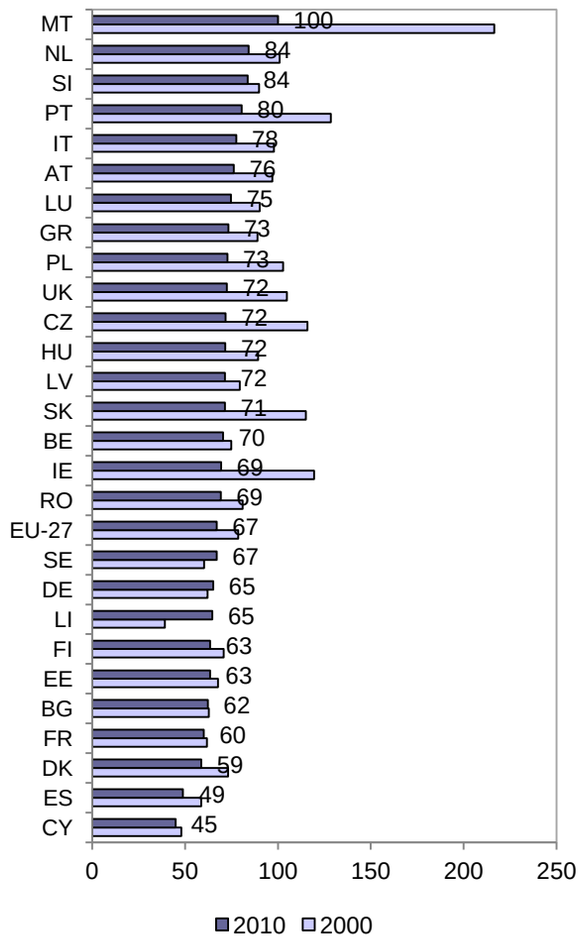
23 – Teaching professionals

24 – Other professionals

In 2000-2010 the number of people with tertiary qualifications increased faster than the number of jobs in the two highest occupational categories (ISCO 1 and 2). Evidence of this is the lowering number of people employed in these categories per 100 individuals with tertiary education (see Figure 37). In 2000 there were, in terms of EU average, 79 people working as managers and professionals per 100 individuals with

tertiary qualifications, while in 2010 the figure was only 67. Although people with tertiary education still maintain a more favourable position in the labour market as compared to people with lower qualification, and also show lower levels of unemployment and their remuneration is higher, it is apparent that recent graduates face worse prospects of finding appropriate employment then did graduates ten years ago.

Figure 37: The number of jobs in ISCO 1 and 2 categories per 100 individuals with tertiary education aged 25-64

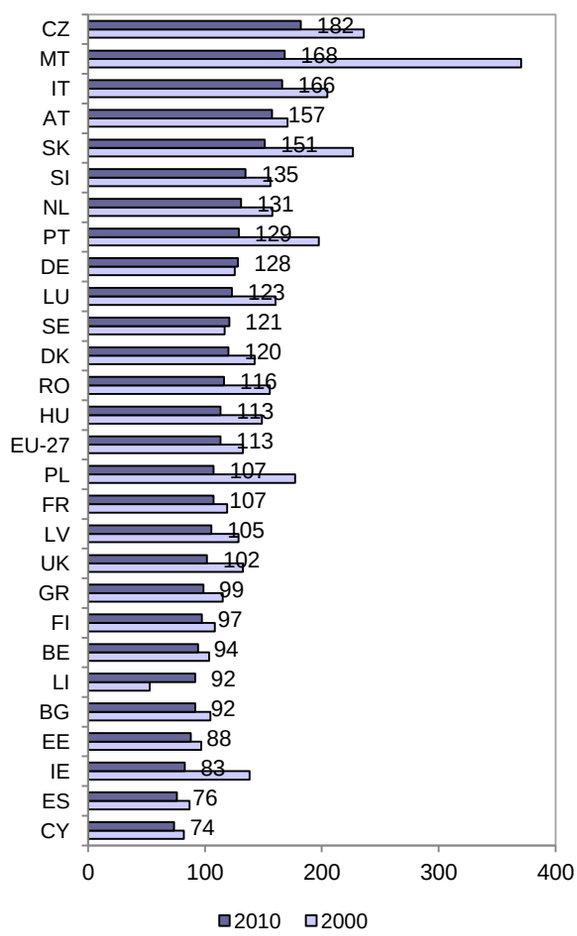


Note: The jobs in ISCO 1 and 2 groups are expressed by means of the number of people aged 25-64 employed in these positions. Source: Eurostat (2011c, e), table code lfsa_egais; lfsa_pgaed, date of access: 13.7.2011, own calculations.

As for EU-27, there are three member countries that do not conform to the general trend of the worsening ratio between the number of individuals with tertiary education and the number of jobs with the highest levels of skills intensity. In Germany and Sweden the number of these jobs grew faster than the number of people with tertiary qualifications. In Lithuania, a more favourable ratio was achieved both by an increase in the number of the relevant jobs (ISCO 1 and 2) and by a decrease in the number of people with tertiary education between 2000 and 2010. As the absolute number of tertiary education graduates grew in this period in Lithuania, we may assume that the drop in the number of individuals with tertiary qualification was caused by a negative development concerning the number of people with tertiary education in more senior age groups – i.e. by the fact that a certain part of the population with this level of education was older than 64 in 2010 and another group of these individuals found employment abroad. Ireland saw the largest decline in the ratio of the number of jobs requiring the highest skills to the number of individuals with tertiary qualifications - from 119 jobs per 100 individuals with tertiary education in 2000 to 69 jobs in 2010. The second largest decline was seen in Portugal – from 128 to 80. The CR ranks among the countries with the steepest decline in this ratio – from 116 to 72 jobs.

This mismatch results in a situation where a part of people with tertiary degrees take up jobs in occupations within lower ISCO categories. Figure 37 reveals that, provided that there was full employment among individuals with tertiary qualifications, some 28% of people with tertiary education aged 25-64 had a job in categories other than those with the highest skills intensity in the CR in 2010. In reality, this proportion is bound to be higher for the CR as well as for other countries, since there are also people who do the jobs of managers and professionals and do not have tertiary education. They make up for the lower level of formal education by their actual knowledge, skills and experience.

Figure 38: The number of jobs in ISCO 1, 2 and 3 occupational categories per 100 individuals with tertiary qualifications aged 25-64



Note: The jobs in ISCO 1, 2 and 3 groups are expressed by means of the number of people aged 25-64 employed in these positions. The figures are for 2010. Source: Eurostat (2011c, e), table code lfsa_egais; lfsa_pgaed, date of access: 13.7.2011, own calculations

We may assume that additional jobs individuals with tertiary degrees most frequently take up fall in the third occupational category (ISCO 3). With respect to technological advancements it is clear that a growing number of these occupations require more than a secondary qualification and that tertiary

education graduates can make appropriate use of their knowledge and skills in these jobs. This concerns, above all, graduates of lower levels of tertiary education – i.e. Bachelor (Bc.) or tertiary professional education (DiS.). An overview of occupations included in the third category is provided in Box 10.

Box 10: Skills intensive occupations (ISCO)

ISCO 3 Technicians and associate professionals

31 – Physical and engineering science associate professionals,

32 – Life science and health associate professionals,

33 – Teaching associate professionals

34 – Other associate professionals

If we assume that the jobs of technicians and associate professionals should be filled with people with tertiary qualifications, then we have to say that there is still a lack of individuals with these qualifications in the EU, although the situation is improving (see Figure 38). The number of jobs in ISCO 1-3 per 100 individuals with tertiary degrees decreased, in EU average terms, from 132 to 113.

In most EU member countries the total number of skills intensive jobs (ISCO 1-3) exceeds the number of people with tertiary education. The situation where this ratio equals or is higher than 1.5 (i.e. that there are at least 150 skills intensive jobs per 100 individuals with tertiary degrees) was found in the following five countries in 2010: the Czech Republic, Malta, Italy, Austria and Slovakia. It is apparent that in these countries such jobs are mainly filled with individuals with secondary qualifications. In the CR these jobs are taken up by people with the "maturita" examination.

However, there are EU countries where the number of people with tertiary education exceeds the total number of jobs classified into the top three occupational categories. This points to a certain degree of over qualification of the workforce, which is associated with a number of negative phenomena. These range from ineffective use of public and private resources through individual frustration from failure at the labour market to the underutilisation of knowledge and skills. On the other hand, the availability of the workforce with tertiary qualifications may play a positive role in terms of an inflow of investment in skills intensive activities. A prerequisite of this is, however, an appropriate structure of education.

A major excess of the workforce with tertiary education in 2010 was found in Cyprus and in Spain. Countries with an insufficient number of jobs for this workforce may, in the course of time, face a brain drain situation, since international competition for talents and individuals with advanced qualifications, particularly in technology, is stiffening.

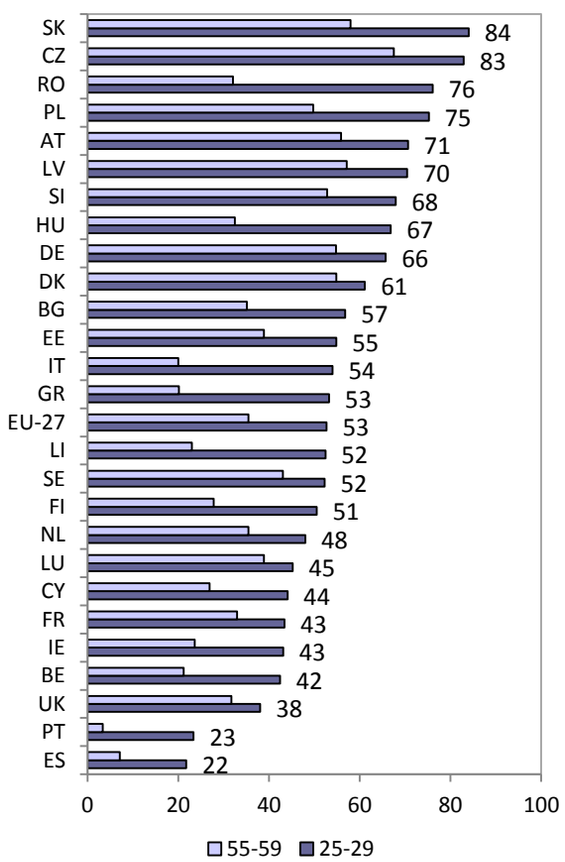
2.3.2 Educational mobility

Educational mobility is a characteristic feature of the development of society where younger generations achieve more advanced education than older generations. At micro-level, educational mobility is normally examined as a relationship between the level of formal education achieved by children and the education attained by their father. At macro-level, educational mobility is tracked by means of changes in the educational attainment of junior and senior age groups.

There are a number of factors that affect the education of children. One of the most important factors is the education of parents and the position education occupies on the family value scale. Parents with higher levels of education normally place greater demands on their children. They are more interested in their education, seek the most suitable educational paths for them and stimulate children to attain the highest possible qualifications.

Non-stimulating family background should be offset by the work of teachers or social workers. They should encourage children to achieve appropriate educational levels irrespective of the educational attainment of their parents. At the same time, they should work with parents to ensure they do not prevent their children from doing so. However, it is very difficult to eliminate the influence of a family background where minor significance is attributed to education. One example is the families of farmers where it is of utmost importance that the child takes over the family business. A similar situation may be found in families involved other business activities that do not require advanced education. Another factor is the way in which education is funded, whether it is provided for free or for a payment. Free education expands the opportunities of getting appropriate education for children from low-income families. Educational mobility is therefore the result of the combined influence of the family background, school and society – particularly its education and social policies.

Figure 39: Educational mobility for secondary education (ISCED 3, 4) in 2000 (%)



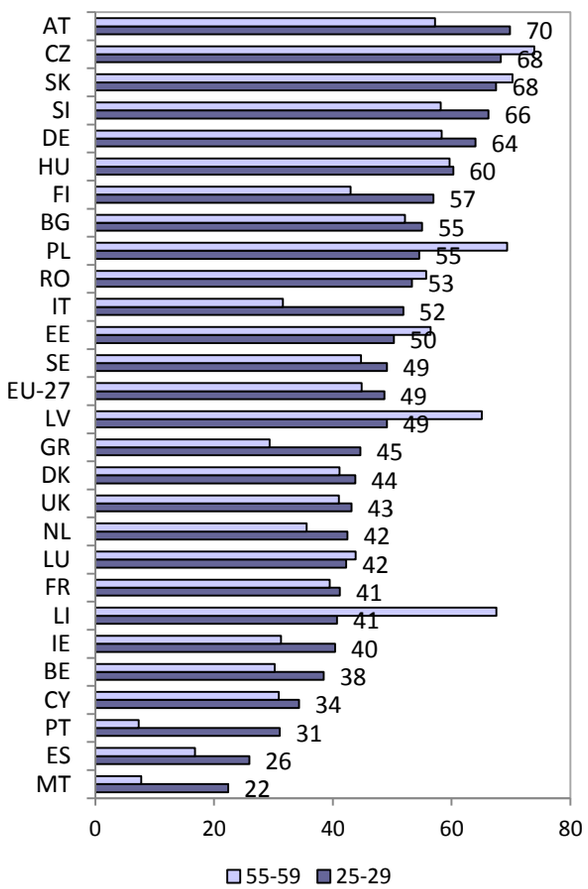
Note: The figures relate to the population aged 25-29. Source: Eurostat (2011e), table code lfsa_pgaed, date of access: 13.7.2011, own calculations.

In the following text educational mobility is explored by means of a shift in the educational attainment of two five-year age groups. The younger age group covers people between 25 and 29 years of age – i.e. when it is realistic to expect that a lower cycle of tertiary education has been completed (Bachelor or tertiary professional education). Statistics are focused on this very level of education. The older age group

should be as close as possible to the younger group's parents. In view of the trend of postponing parenthood until a higher age a thirty-year difference was chosen – i.e. the group aged 55-59. Educational mobility is first examined for secondary education and then for tertiary education.

As concerns secondary education, positive educational mobility was displayed in EU average terms both in 2000 (see Figure 39) and in 2010 (see Figure 40). In 2000, an average 53% of individuals aged 25-29 had secondary education in the EU, while in the population aged 54-59 it was only 35%. Portugal saw a remarkable expansion of secondary education in the last thirty years. In this country the proportion of people with secondary education in the younger age group was six times higher compared to the older age group. However, this high level of educational mobility was achieved from a very low level. Only a maximum of 3% of the older population had secondary education.

Figure 40: Educational mobility for secondary education (ISCED 3, 4) in 2010 (%)



Note: The figures relate to the population aged 25-29. Source: Eurostat (2011e), table code lfsa_pgaed, date of access: 13.7.2011, own calculations.

A similarly small share of the population with secondary qualifications was behind the overwhelming growth in educational mobility in Spain. This country saw a three times higher proportion of individuals with secondary education in the 25-29-year-olds as compared to the 54-59 age group (22% vs. 7%). Greece reported a comparable change (53% vs. 20%) and Italy (54% vs. 20%). These are southern EU member countries where agriculture played an important role in the past and it is rural areas that normally show lower levels of educational attainment. The Czech Republic ranks among the countries with a high proportion of people with secondary qualifications in all age groups. In 2000 there were 83% of individuals aged 25-29 with these qualifications, and 68% of the population aged 55-59.

However, 2010 saw a major decline in educational mobility for secondary education as compared to 2000 (see Figure 40). The proportion of the population aged 25-29 with secondary education approached that of the population aged 55-59. In average EU terms the difference was only 4 percentage points in favour of the younger age cohort, while in 2000 it was 18 pp. The countries that reported a speedy development in this area in 2000 continue to follow this trend. This concerns primarily Portugal and, to a lesser degree, Italy, Spain and Greece. Malta is also among these countries, although there are no data available for this country for 2000.

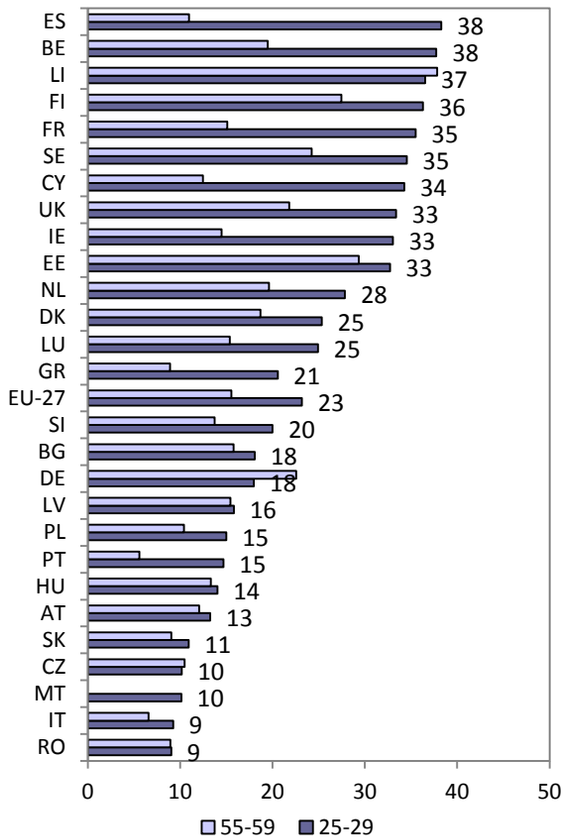
The general trend towards lower educational mobility for secondary education is positive, since it points to the increasing proportion of young population with tertiary education (see below). Consequently, some countries show a negative mobility, which means that there are larger proportions of people with secondary qualifications among older generations as compared to younger ones. This trend was apparent in 2010 in eight member countries. With the exception of Luxembourg these are the so-called "post-communist" countries: Poland, Lithuania, Latvia, Estonia, Romania and the Czech Republic. The 54-59-year-old population in these countries had extensive opportunities for achieving secondary education that was virtually accessible for all thanks to its diversified structure. As distinct from this, tertiary education was not diversified, its capacity was very limited and, as a result, it was highly selective. This is why there was a low proportion of the population with tertiary qualifications. Following the political changes the accessibility of tertiary education was significantly expanded. New opportunities arose primarily for younger age groups. The older population only made a limited use of this situation. This development became evident in the negative educational mobility in terms of secondary education.

There is interconnection between educational mobility for various levels of education. Positive mobility for secondary education is evidence of positive trends on the assumption that there is also positive mobility for tertiary education. As Figure 41 below illustrates, positive mobility for tertiary education was a reality in all countries in 2000. The only exception was Germany where the population complete tertiary education at a higher age – i.e. 30-34. There may be a number of reasons for this ranging from a later commencement of tertiary studies to interruption of studies due to various reasons. However, detailed data are missing and therefore a more accurate assessment cannot be made. In Lithuania and the Czech Republic the lower proportions of people with tertiary education in younger age groups are negligible in terms of statistics. In Lithuania the difference is 1 pp., in the CR it is only 0.3 pp.

In 2000 there was 23% of the population aged 25-29 in the EU who had attained tertiary education, which was 8 pp. more as compared to the 55-59 age cohort. The fastest development of educational mobility was seen in countries with lower shares of individuals with tertiary degrees among the population that forms a basis for comparison. These countries were, in particular, Spain, Cyprus and France – the level of this educational mobility reached more than 20 pp. This pace of development placed these countries among ten member states where at least one third of the young population had tertiary education. Within the EU the Czech Republic ranked nearly at the bottom

of an imaginary scale together with three other countries where the proportion of young people with tertiary education was 10% or even below this level.

Figure 41: Educational mobility for tertiary education (ISCED 5, 6) in 2000 (%)



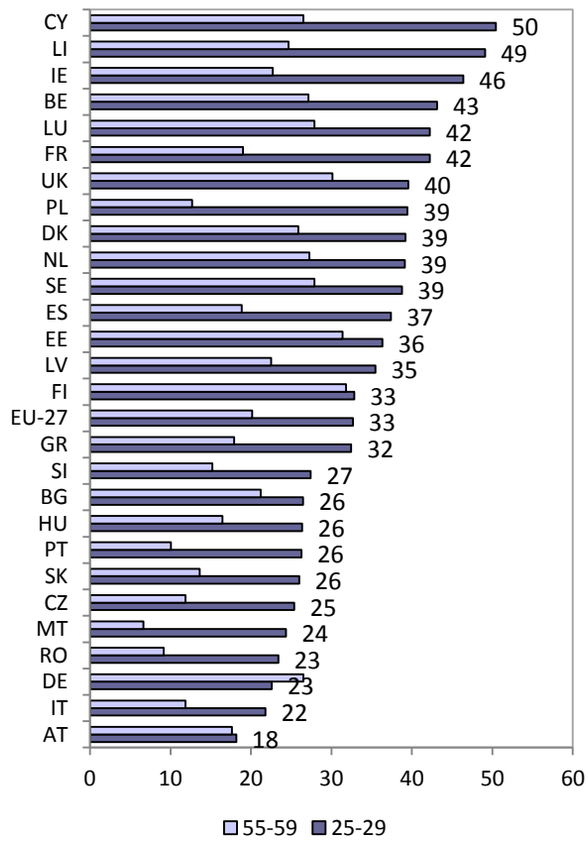
Note: The figures relate to the population aged 25-29. Source: Eurostat (2011e), table code lfsa_pgaed, date of access: 13.7.2011, own calculations.

There was also positive mobility for tertiary education in the following years. In 2010 one third of the young population had tertiary education in EU average terms. In Lithuania and Cyprus as many as 50% of the population aged 25-29 have tertiary qualifications. Despite the relatively fast increase in the proportion of the population with this level of education in the CR, the position of our country within the EU has not changed much. The CR still ranks among the countries with the lowest figures in this respect. A relatively rapid positive development was typical of nearly all member countries with the exception of Austria.

A more detailed picture of the proportions of the population with tertiary degrees in five-year age cohorts in 2010 is provided in Figure 43. In this year there was an average 17% of the adult population that had tertiary qualifications. The most favourable situation is in the youngest age cohort (25-29) that shows a major margin of 5 pp. The 30-34 age group ranks second. The proportions of people with tertiary education in the age groups covering the 35-54 span are more or less similar and range between 15-17%. The lowest proportion of individuals with tertiary degrees can be found in the oldest population group aged 55-64.

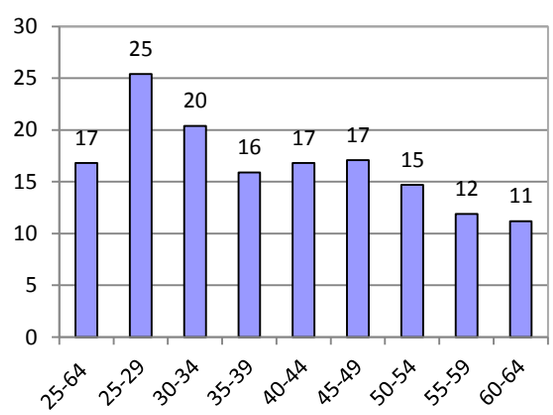
The educational mobility for tertiary education has a natural threshold level, if there is not to be a radical softening of the requirements for completion of this education or its further inner differentiation. It is therefore advisable to provide for a more detailed breakdown of tertiary education for statistical purposes so as to make it possible to track separately individuals who underwent shorter programmes and those who completed longer ones. The educational objectives of these programmes differ and there are, consequently, also differences in the level and scope of the knowledge and skills the graduates acquire.

Figure 42: Educational mobility for tertiary education (ISCED 5, 6) in 2010 (%)



Note: The figure relate to the population aged 25-29. Source: Eurostat (2011e), table code lfsa_pgaed, date of access: 13.7.2011, own calculations.

Figure 43: Proportions of individuals with tertiary education in various age cohorts in the CR in 2010 (%)



Source: Eurostat (2011e), table code lfsa_pgaed, date of access: 13.7.2011, own calculations.

3. Human Resources in Research and Development

Human resources in research and development (R&D) represent an important indicator of the knowledge intensity of an economy. The workforce employed in this sector is, in particular, expected to bring shifts in knowledge and create a knowledge base for innovations. This chapter is composed of three subchapters. The first one deals with specific aspects of R&D employment in the CR comparing them with the situation in other EU Member States. It examines not only the overall employment but also the employment in terms of structure, sectors and fields. The second subchapter assesses development level of R&D in individual regions of the CR and identifies key factors determining the inter-regional differences. The last subchapter brings information on graduates of Master and Doctoral study programmes representing a crucial resource for the profession of researchers and evaluates the situation in this segment of the labour market.

3.1 Employment in R&D in the CR

Basic characteristics of research and development are identified through a specific statistical survey carried out by relevant national statistical offices in individual EU Member States. The results of the survey are internationally comparable as they respect rules and principles set by the OECD (Frascati Manual) and the relevant Commission Regulation on statistics on science and technology. Numbers of R&D personnel are observed for all legal entities as well as individuals, regardless the size (number of employees), sector or industry, that carry out R&D as their main or complementary activity. For specification of R&D for the purposes of statistical monitoring see Box 1.

Box 1 – Specification of R&D for the purposes of statistical monitoring

Research and development comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, to acquire new knowledge or to apply this stock of knowledge in practice through the methods facilitating confirmation, completion or refutation of acquired facts. R&D covers the following activities:

Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, their causes and potential effect, without any particular application or use in view.

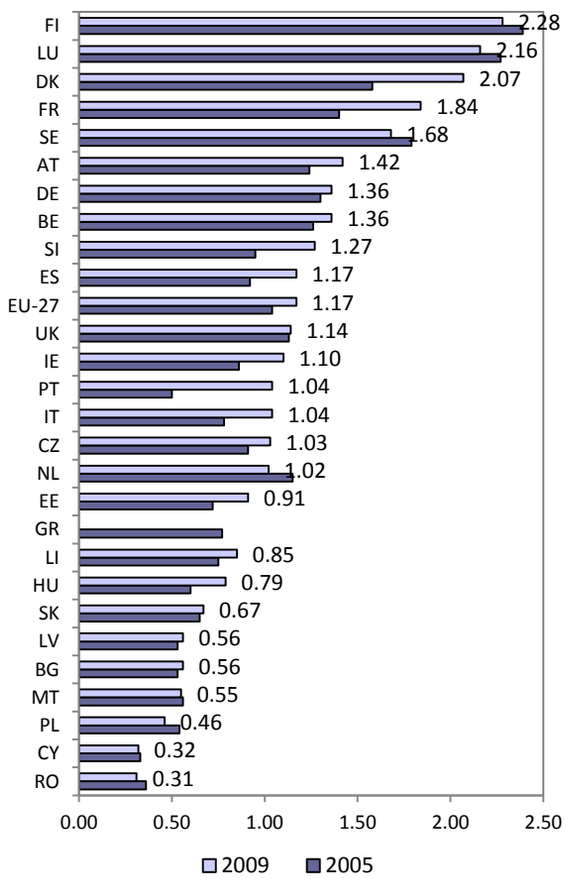
Applied research is experimental or theoretical work undertaken in order to acquire new knowledge and skills for development of new or substantially perfect products, processes or services. It is, however, directed primarily towards a specific practical aim or objective.

Experimental development is systematic work, drawing on knowledge (of scientific, technological, business or other nature) gained from research a practical experience, that is directed to producing new or substantially improved products, processes, systems and services.

Numbers of R&D personnel are monitored on one hand through the registered number of employed individuals (head count) expressing how many persons were engaged in R&D activities as of the end of the year under review regardless time they actually devoted to these activities. This aspect is reflected in the indicator of average registered number of personnel converted into full-time equivalents (FTE) dedicated to research and development activities. The FTE indicator provides comprehensive information on human capacities in R&D as it also includes conversion of hours worked by R&D personnels with part-time contracts or contracts on work. This subchapter is based exclusively on FTE indicator.

Research and development in terms of employment does not represent a sector of major significance. In 2009, on EU average it accounted only for 1.1% of total employment. Its importance, however, is gradually increasing, it grew by 0.13 p.p. between 2005 and 2009 (see Figure 1). Positive development of employment in this economic sector was recorded in most EU countries. Out of twenty-six countries, for which data are available, employment increased in nineteen countries, the Czech Republic was one of them. Despite the positive trend, the CR still ranks under the EU average and the gap remains practically unchanged. In 2005, the CR lagged behind the EU average by 0.13 p.p., in 2009 the lag represented 0.14 p.p. In 2009, the R&D personnel accounted for 1.03% of total employment in the CR.

Figure 1: Proportion of R&D personnel in total employment in 2005 and 2009 (FTE, %)



Note: Numerical values relate to 2009, for Greece to 2005. Source: Eurostat (2011g), Table Code: rd_p_perslf, 24.10.2011, own modificaiton.

Within the European Union, there are three countries with a significant lead over the others. These countries show the R&D employment accounting for more than 2% of total employment, it is particularly Finland followed by Luxemburg and Denmark. It is evident that at the top of the ranking are placed the economically most advanced countries and, by contrast, the bottom of the scale is occupied by the new member countries – Romania, Cyprus and Poland with less than 0.5% proportion of R&D employment in the total employment. The very intimate connection between the economic level and R&D employment is also illustrated by correlation coefficient between the proportion of R&D employment in the overall employment and the proportion of GDP used to cover R&D expenditure, which represented 0.86 in 2009.

There is no determined optimum proportion of R&D human resources in total employment, therefore it is believed that the higher such a proportion is the more favourable situation in terms of research, development and innovations in the given country. This holds true provided the adequate results are being achieved, which depends not solely on R&D departments being equipped with appropriate technology but also on the prestige of particular workplaces, which is another prerequisite needed to attract and retain high-quality workforce. It is also vital to cooperate with sectors where the results of R&D are applied.

3.1.1 Occupational structure of R&D personnel

In terms of results achieved, an important role is played also by occupational structure of R&D personnel. The R&D personnel is divided according their occupational activity into three basic groups, which are described in Box 2.

Box 2 – R&D personnel

Researchers – are professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems and also in the management of the projects concerned. Researchers are classified in ISCO-88 (International Standard Classification of Occupations) Major Group 2 – "Professionals" and within Major Group 1 in "Research and Development Department Managers" (Sub-major Group 1237).

Technicians and equivalent staff – are persons who participate in R&D by performing scientific and technical tasks involving the application of concepts and operational methods usually under the supervision of researchers. Technicians and equivalent staff are classified in ISCO Sub-major group 32 – "Physical and Engineering Science Associate Professionals" and "Life science, Health, Agriculture and Related Fields Associate Professionals".

Other supporting staff in R&D – includes skilled and unskilled workers (such as craftsmen, secretarial staff) but also clerical and managerial staff whose activity is directly associated with R&D projects.

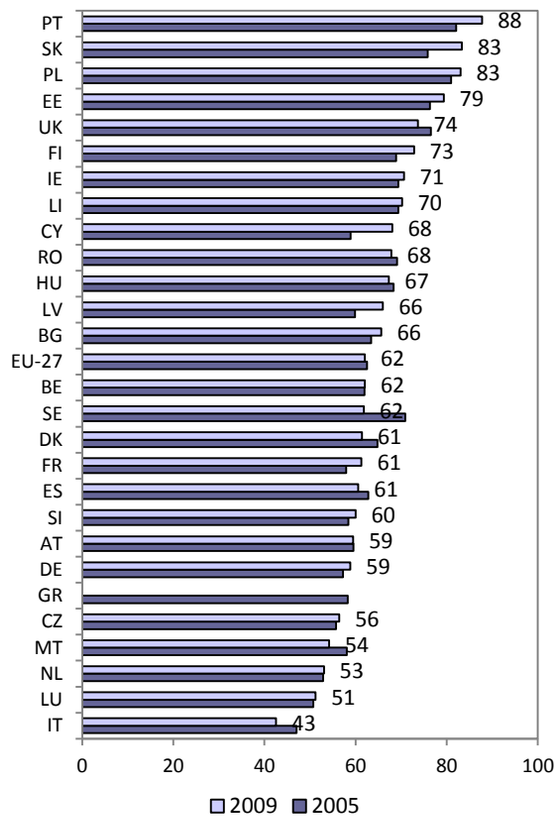
Although participation of all types of personnel is important for securing R&D complexity, the highest contribution is expected from the researchers. Their proportion in overall R&D employment is illustrated in Figure 2.

The proportion of researchers in the overall R&D employment is varying considerably in individual EU countries. In 2009, it ranged from 43% in Italy to 88% in Portugal. It is rather surprising that the highest proportions of researchers are recorded in countries with less developed R&D sector, i.e. the overall R&D employment is under the EU average (Portugal, Slovakia, Poland). Except for Italy, in all other EU countries the researchers account for more than 50% of all R&D personnel. It is not possible to conclude on the basis of available data whether the higher proportions of other types of R&D personnel (technicians and equivalent staff and other supporting staff) should be attributed to lower intellectual requirements of R&D and / or to higher administrative and managerial demands.

The average share of researchers in the EU was during 2005-2009 rather stable, representing approx. 62%. In 2009, however, there was a very slight negative shift when the proportion of researchers in R&D employment dropped by 0.5 p.p. as compared to 2005. Norway together with Italy contributed most to this decrease (a drop of 9.1 p.p. and 5 p.p. respectively). Against this negative trend a positive development acted in countries where the proportion of researchers grew, such as Cyprus (by 9 p.p.) and Slovakia (by 6 p.p.).

For this indicator, the Czech Republic ranks among countries that do not reach the EU average, nevertheless, it is possible to trace a slight positive trend in them. The proportion of researchers increased in 2009 as compared to 2005 by less than 1 p.p., however, in 2009, the CR with 56% share was still ranked only in fifth positon from the bottom.

Figure 2: Proportion of researchers in overall R&D employment in 2009 (FTE, %)



Note: Numerical values relate to 2009, for Greece to 2005. Source: Eurostat (2011g), Table Code: rd_p_persocc, 24.10.2011, own calculation.

3.1.2 Employment in R&D sectors

R&D is carried out in four basic sectors (see Box 3).

Box 3 Sectors of R&D performance

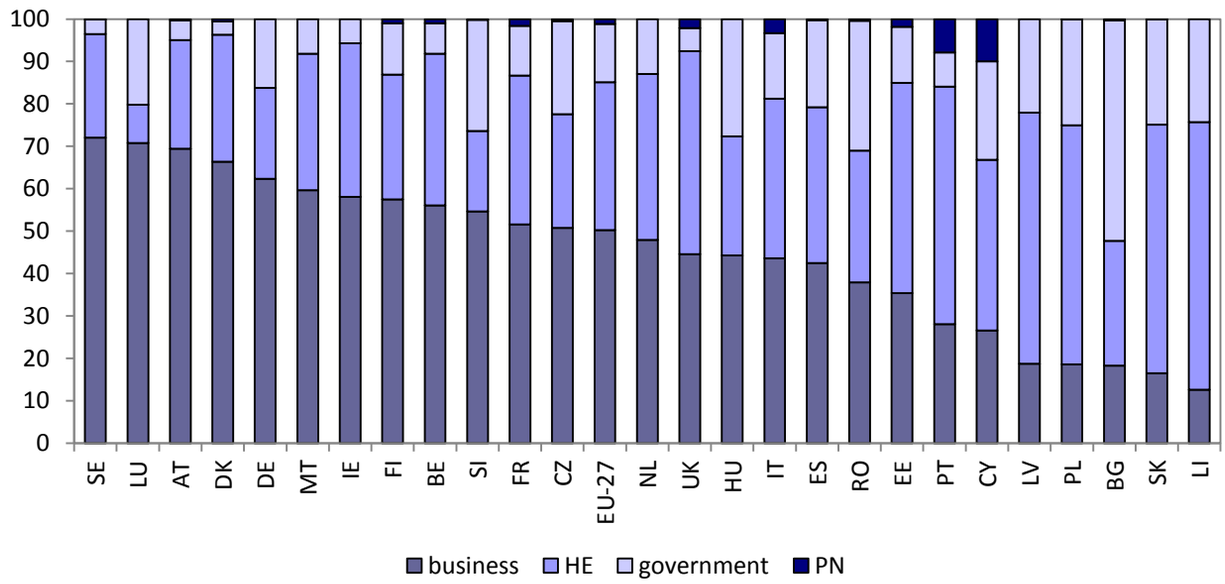
Business enterprise sector includes all firms, organisations and institutions whose primary activity is the market production of goods and services for sale to general public at an economically significant price.

Government sector in R&D includes mainly specific institutes of the Academy of Sciences of the CR and other R&D institutes, which in 2007 in their majority became public research institutions, then public libraries, archives, museums and other cultural facilities performing R&D as a complementary activity.

Higher education sector comprises all the public and private universities, higher education institutions and other institutions of post-secondary (post-Maturita) education. This sector includes also all research institutes, experimental stations and clinics operating under the direct control of or administered by or associated with higher education institutions.

Private non-profit sector comprises private institutions, including individuals, whose primary aim is the provision of non-market services. They mainly represent associations of research organisations, societies, unions, foundations, etc.

Figure 3: Proportion of individual sectors in overall R&D employment in 2009 (%)



Notes: business = business enterprise sector, HE = higher education sector, PN = private non-profit sector. Source: Eurostat (2011g), Table Code: rd_p_persqual, 24.10.2011, own calculation.

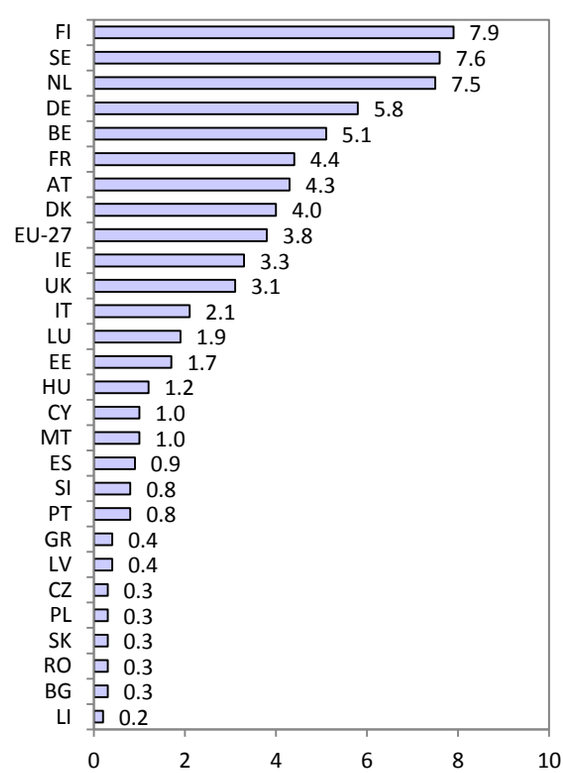
In 2009, in the EU on average a half of all R&D personnel were concentrated in the business enterprise sector, more than one third (35%) worked in the higher education sector and 14% were employed in the government sector. Importance of private non-profit sector was negligible (1%). As illustrated in Figure 3, the situation in individual countries differs a lot, it is not practically possible to find two countries with similar proportions of relevant sectors. It is obvious that in the post-Soviet countries there is a significantly larger share of the government sector than in the countries with traditional market economy. As soon as the totalitarian regimes took over in those countries, the existing non-university scientific and research institutions were abolished and replaced by newly established Academy of Sciences with relevant scientific institutes.

In 2009, the proportion of the government sector in the overall R&D employment was in CR almost twofold compared to the EU average (22% versus 14%), the share of the business enterprise sector was comparable (51% versus 50%), the proportion of higher education sector was lower (27% versus 35%). In terms of advance in knowledge within individual research areas and its practical application in form of innovations, it is not important in which sector are these achievements accomplished. It is the results that matter.

3.1.3 Results of R&D

For the purposes of international comparison of R&D results achieved in individual EU member countries, the following text is using a patent-based indicator of number of high-tech patent applications submitted to the European Patent Office (EPO). This indicator is published by Eurostat per 1 million inhabitants in the given country. It was therefore recalculated per 1,000 persons engaged in R&D and in order to eliminate the influence of year-on-year variations, an average for the period 2005-2008 was calculated. The year of 2008 is the last year for which data on patent applications are available. The definition of the high-tech patents is included in the International Paten Classification (IPC). The high-tech patents category comprises patents from the following fields: computers and automated business equipment; aviation; micro-organism and genetic engineering; lasers; semi-conductors; communication technology. It is obvious that number of these patents is affected by both the quality of R&D in given fields and by the representation of these fields in R&D.

Figure 4: Number of European high-tech patents per 1,000 persons employed in R&D (annual average for 2005-2008)



Source: Eurostat (2011g), Table Code: rd_p_persocc, tsc00010, demo_gind, 24.10.2011, own calculation.

Finland together with Sweden and the Netherlands are the leaders in the field of high-tech patents within the EU. These countries record on average almost 8 patent applications per 1,000 persons employed in R&D, which is almost twice the European average.

Currently, there is an abysmal difference between the old and the new Member States, although certain influence might be attributed to the lack of experience with applications submitting, financial and time requirements of the application processing and filing, etc. The highest, however, is the impact of poorly developed research in relevant field not only in the new Member States but also in the so-called south wing of the old Member States (Greece, Portugal and Spain).

Among the new Member States, the best results are recorded by Estonia and Hungary. The CR ranks among countries showing less than 0.5 patents per 1,000 persons employed in R&D per year, namely 0.3 patents per year, which represents approximately one tenth of the European average.

3.1.4 Human resources in individual fields of science

Varying human capacities that are available in particular EU countries for the development of specific R&D sectors can be monitored according to the fields of science defined in Frascati Manual. Classification of these fields is shown in Box 4.

Box 4 Classification of fields of science and technology for the purposes of R&D statistical monitoring

Natural sciences – mathematics, computer and information sciences, physical sciences, chemical sciences, Earth and related environmental sciences, biological sciences, other natural sciences

Engineering and technology – civil engineering, electrical engineering, electronic engineering, information engineering, mechanical engineering, chemical engineering, material engineering medical environmental engineering, environmental biotechnology, industrial biotechnology, nanotechnology, other engineering and technologies

Medical sciences – basic medicine, clinical medicine, health sciences, medical biotechnology, other medical sciences

Agricultural sciences – agriculture, forestry and fisheries, animal and diary sciences, veterinary sciences, agricultural biotechnology, other agricultural sciences

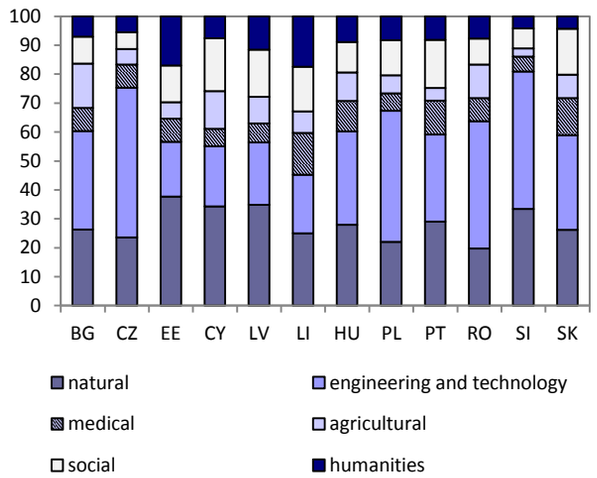
Social sciences – psychology, economics and business, educational sciences, sociology, law, political sciences, social and economic geography, media and communication, other social sciences

Humanities – history and archaeology, languages and literature, philosophy, ethics and religion, arts, other humanities

There is limited data on availability of human resources in individual fields of science. The most recent figures relate to 2008, however, given that there have been no significant year-on-year shifts in occupational structure within R&D, the relevant time lag is of less importance than the fact that data are available for only very limited number of countries. Out of 27 EU Member States, data are available only for 12 countries, majority of which are the new Member States.

Employment in engineering and technology dominates in most countries for which data are available. In the CR, the employment in engineering and technology fields accounted for 52% of total employment in R&D in 2008, which was the highest proportion from all countries under review. The employment in natural sciences prevails in five out of twelve countries, most notably in Estonia (38%), in the CR this proportion represented 24%. With the exception of Lithuania, the aggregate employment in engineering and technology and natural sciences accounts for more than half of total R&D employment. Representation of other fields of science varies, on average for the countries under review the most frequent are social sciences, then to the same degree humanities and medical sciences and to the lowest degree agricultural sciences. The CR differs from the average by the proportion of medical sciences, which is slightly higher than the share of social sciences and humanities.

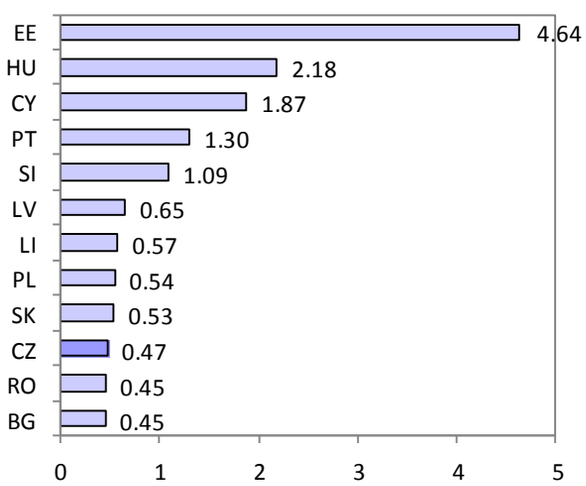
Figure 5: R&D employment structure by field of science in 2008 (%)



Source: Eurostat (2011g), Table Code: rd_p_persocc, own calculation.

Data concerning numbers of employed in sciences and technology fields allow for more precise calculation of R&D effectiveness expressed by the number of high-tech patent applications per 1,000 persons employed in R&D. These patents are not developed by all persons employed in R&D but namely by personnel engaged in sciences and technology fields.

Figure 6: Number of European high-tech patents per 1,000 persons employed in science and technology fields of R&D (yearly average for 2005-2008)



Source: Eurostat (2011g), Table Code: rd_p_persocc, tsc00010, own calculation.

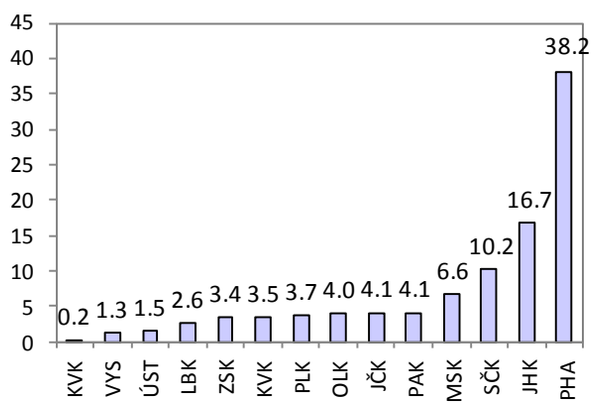
As illustrated in Figure 6, the ranking of the countries remains unchanged (see Figure 4), the best results are consistently reported by Estonia together with Hungary. Effectiveness of R&D increased in Lithuania and Estonia where the number

of high-tech patent applications per 1,000 employees in natural sciences and technology fields grew almost three times in comparison with the number of patent applications per 1,000 persons employed in R&D in total. It is due to the fact, that in these countries the proportion of employment for these fields in the overall employment is much smaller than in other countries.

3.2 Employment in research and development in Czech regions

Distribution of employment in research and development across different regions of the CR is rather uneven. More than one third of all R&D personnel is concentrated in Prague, followed by the Jihomoravský region accounting for 17% of all R&D personnel. Prague together with the Jihomoravský region cover more than half of total R&D employment in the CR. A significant number of R&D staff is recorded in the Středočeský and Moravskoslezský regions. The Karlovarský, Vysočina and Ústecký regions show the smallest share of R&D employment (see Figure 7).

Figure 7: Shares of individual regions in overall R&D employment in 2010 (%)



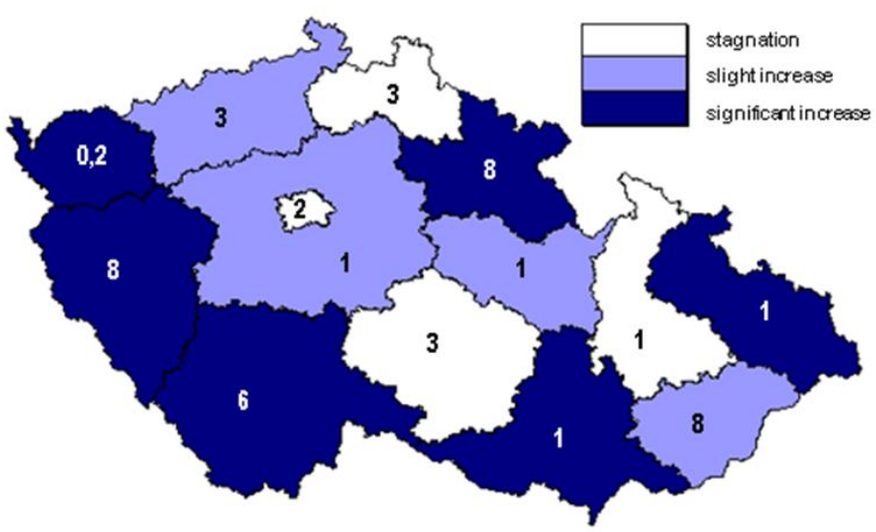
Source: CZSO (2010d), Table 7b., own calculation.

The proportion of R&D personnel in the overall employment in the region indicates the importance of this sector. To improve comparability of data proceeding from various sources, the number of persons working in the region was used to calculate the indicator instead of the usually used number of employed inhabitants of the region. The highest proportion of R&D personnel in the overall employment is recorded in Prague and Jihomoravský regions contributing importantly to the value of the national average (10.3 R&D employees per 1,000 employed persons. In addition, a relatively high share of R&D personnel in the overall employment is reported also by the Středočeský, Pardubický and Plzeňský regions (see Figure 8).

The aforementioned Jihomoravský region is a very promising research and development centre with a great potential. Not only it shows the second largest share in R&D employment (right after Prague), but during 2005-2010, it saw an increase in this share (by 17%). In Prague the employment in R&D has stagnated. Considerable increase in R&D employment was reported by the Plzeňský, Královehradecký, Moravskoslezský and Jihočeský regions. The Vysočina and Ústecký regions with lowest share in R&D employment do not improve their position, their shares are either stagnating or growing very slightly. The Karlovarský region recorded an increase of R&D share in overall employment. Given the very small absolute numbers it is difficult to conclude whether this development represents a trend or just temporary fluctuation Stagnation has been also recorded in the Olomoucký and Liberecký regions (see Figure 8).

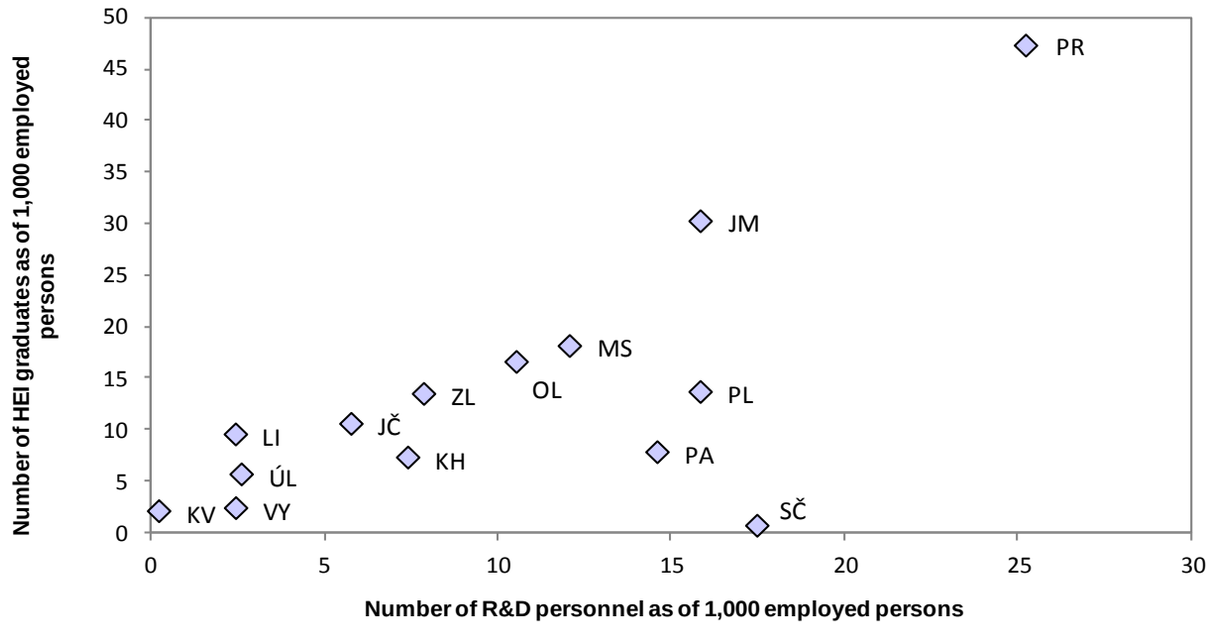
One of the main factors of R&D development is the existence and capacity of higher education institutions in the region. The proportion of R&D personnel in overall employment strongly correlates with the capacity of higher education institutions in the region (see Figure 9). The trend is mainly driven by high HEIs' capacity and R&D employment in Prague and Jihomoravský region on one side and the low values of both indicators in the Karlovarský, Ústecký and Vysočina regions on the other. In the middle of the spectrum, there is a cluster of regions with comparable capacity of HEIs and proportion of R&D personnel and the correlation is not so evident. The Středočeský region has a specific position due to students commuting to HEIs in Prague.

Figure 8: Proportion of R&D personnel per 1,000 inhabitants working in the region and its changes during 2005-2010



Note: Stagnation=change up to 10%, slight increase = increase up to 24%, significant increase = increase of 25 % and more. Statistics on R&D employment use the full-time equivalence (FTE) data. Employment in the region – data on number of persons working in the region. Source: CZSO (2010d), CZSO (2005-2009), own calculation.

Figure 9: Correlation between HEIs' capacity and proportion of R&D employment (2010)



Note: Statistics on R&D employment use the full-time equivalent (FTE) data. Employment in the region – data on number of persons working in the region. Source: CZSO (2010d), Education Policy Centre (2011), CZSO (2005-2010), own calculation.

The mentioned correlation (0.885) is not attributable to the research carried out at higher education institutions only, since the HE research accounts just for about one third of R&D employment and therefore it is necessary to seek a deeper connection related to inter-regional mobility of students and subsequently skilled workforce.

The share of R&D employment is also associated with the share of employment in knowledge-intensive industries. There is particularly high correlation with the proportion of employment in knowledge-intensive services in the overall employment (0.920), however, there is also a significant reciprocity with the proportion of high-tech manufacturing in the overall employment in manufacturing (0.634). This indicates that the development of R&D within the region is related to the development of high-tech and knowledge-intensive industries.

Actual R&D forms, of course, a part of these industries, however, not in such a volume which would be able to reverse the overall trend. In this context, it is necessary to seek deeper causes related to the qualifications of the workforce in the region that allow for more intensive development of both the R&D as well as the high-tech and knowledge-intensive industries. Obviously, this process in not unidirectional, skilled workforce is at the same time attracted to the regions offering better job opportunities.

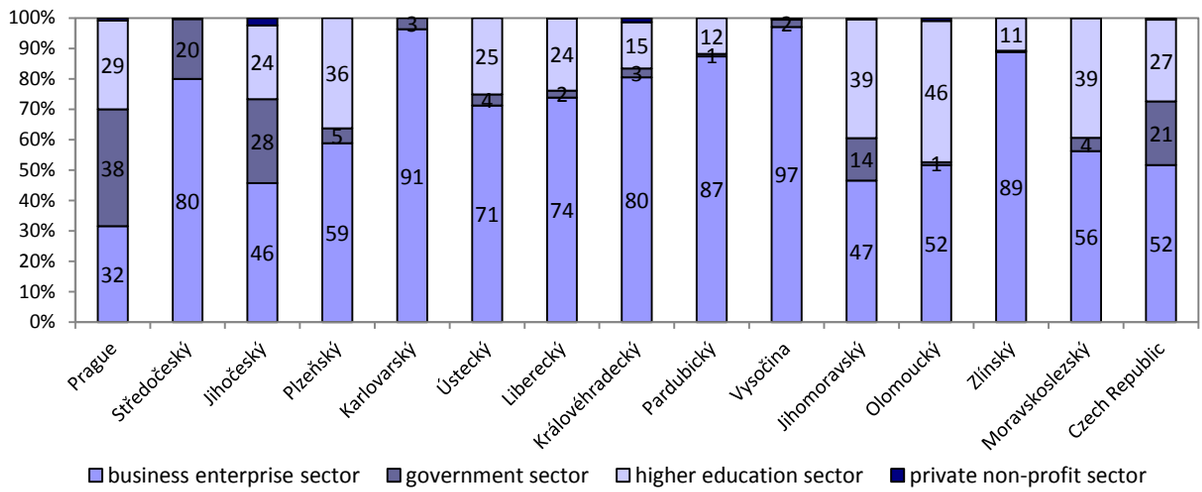
Low workforce mobility of the Czech population indicates that the potential labour force commutes usually only for the purposes of education and the graduates with tertiary qualifications later on very often stay in the region of the studies, where they create potential for development of both the R&D and the skills-intensive sectors of the economy.

3.2.1 Sectoral structure of R&D employment

Shares of individual sectors in R&D employment differ a lot between regions. The proportion of private non-profit sector is negligible in all regions, most regions show predominance of business enterprise sector. This holds true particularly for the Vysočina and Karlovarský regions, however, also in the Zlínský and Karlovarský regions the business enterprise sector represents the dominant employer within the R&D. Exceptional situation is displayed in Prague, Jihomoravský and Jihočeský regions, where more than half of R&D employment is covered by the government and the higher education sectors. The share of higher education sector is in addition to three aforementioned regions significant also in the Plzeňský and Moravskoslezský regions where large universities are located. The government sector accounts for a relatively large proportion in R&D employment also in the Středočeský region (see Figure 10).

Main differences between the regions are due to the uneven distribution of government and higher education sectors. The analysis of sectoral structure of R&D employment confirms the importance of regional higher education institutions for the development of R&D as such. Correlation between the capacity of higher education institutions and the proportion of R&D business enterprise sector is lower than in case of the government and higher education sectors, nevertheless, it is still significant (0.476). Thus the absence of higher education and government research and development centers in the region affects not only research within this sector but it also inhibits the development of R&D business enterprise sector in the region. Skilled workfoce stays in regions with higher education institutions and subsequently the business enterprise sector establishes there the R&D centers. Thus it is rather difficult for regions with no HEIs to create any kind of research and development capacity.

Figure 10: Proportions of individual sectors in R&D employment in 2010



Source: CZSO (2010d), Table 10 b., own calculation.

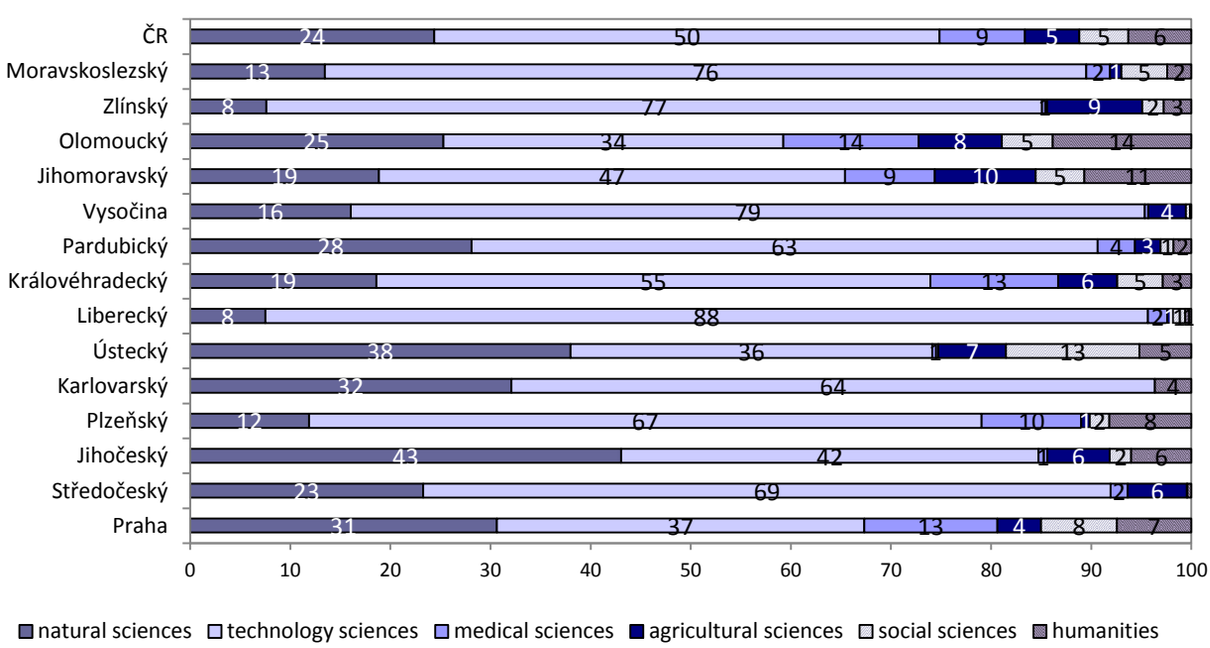
3.2.2 Field structure of R&D employment

The field structure of R&D employment in individual regions is illustrated in Figure 11. In all regions the employment in technology fields accounts for the biggest share, namely in 2010 on national average the technology fields accounted for 52% of overall R&D employment. Traditionally, the highest proportion of persons employed in technology fields is recorded in the Liberecký region (80%). The second most developed field in terms of employment are usually the natural sciences. The Ústecký and Jihočeský regions are the exception to the rule, as the proportion of natural sciences slightly exceeds technology fields.

Among the other fields of science, medical sciences account for a significant share in employment in the Olomoucký region (14%), Prague and Královehradecký regions (both 13%). Agricultural sciences are relatively substantial in the Jihomoravský region (10%) and in the Zlínský (9%) and Olomoucký regions (8%). Social sciences account for a larger proportion of R&D employment in the Olomoucký region (19%), Ústecký region (18%) and Jihomoravský region (16%).

Employment structure in specific fields of science more or less reflects the field structure of employment in individual regions. This is, of course, only a rough correlation, however, we cannot fail to notice higher proportion of agricultural sciences in regions with higher share of employment in agriculture or social sciences in regions with larger proportion of services.

Figure 11: Proportion of individual sectors in R&D employment in 2010 (%)



Source: CZSO (2010d), Table 9 b., own calculation.

Table 1: Shares of individual regions in overall employment in the fields of science (2010, %)

Regions	Sciences					
	Natural	Technology	Medical	Agricultural	Social	Humanities
Prague	48	28	60	31	59	45
Středočeský	10	14	2	11	0	1
Jihočeský	7	3	0	5	2	4
Plzeňský	2	5	4	1	1	5
Karlovarský	0	0	0	0	0	0
Ústecký	2	1	0	2	4	1
Liberecký	1	4	1	0	1	0
Královéhradecký	3	4	5	4	3	2
Pardubický	5	5	2	2	1	1
Vysočina	1	2	0	1	0	0
Jihomoravský	13	15	18	31	17	28
Olomoucký	4	3	6	6	4	9
Zlínský	1	5	0	6	2	1
Moravskoslezský	4	10	2	1	6	3

Source: CZSO (2010d), Table 9 b., own calculation.

As the overall R&D employment is among the regions distributed rather unevenly, the field structure of employment in individual regions is not indicative in terms of shares of particular regions in the overall employment in specific fields and thus indirectly of their contribution to the development of these fields. Major part of R&D employment remains concentrated in the main research centers – Prague and the Jihomoravský region (see Table 1). In addition to these two, a significant proportion of employment in natural sciences is concentrated in the Středočeský and Jihočeský regions and employment in technology sciences in the Středočeský and Moravskoslezský regions.

As for medical sciences, 60% of employment is concentrated in Prague and another 18% in the Jihomoravský region. Prague and the Jihomoravský region account for 60% of human capacities in agricultural sciences, the Středočeský region also shows a significant proportion (11%). Social sciences and humanities are concentrated in regions with universities, which focus mainly on the development of these fields of study – Prague, Brno and Olomouc.

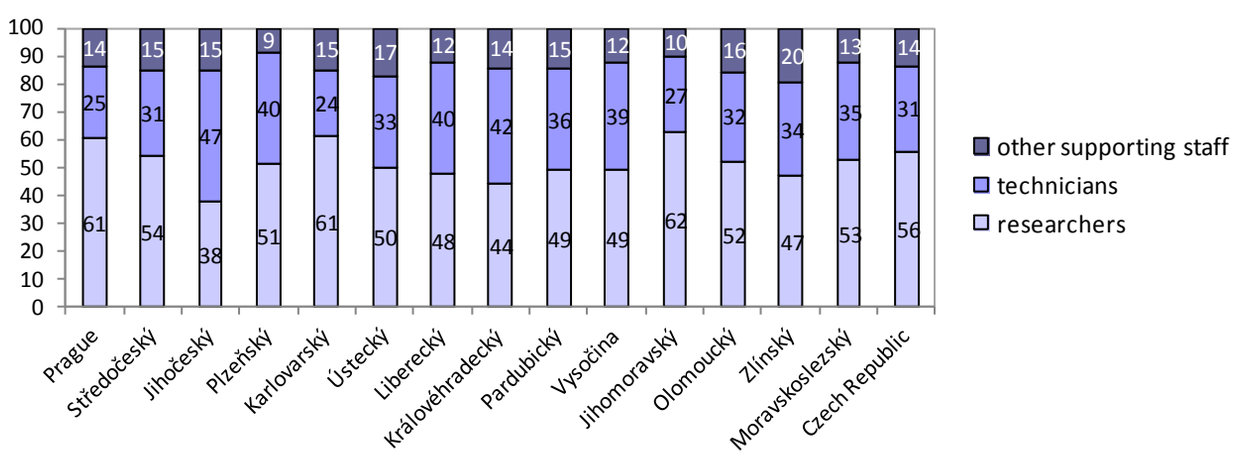
3.2.3 Occupational and educational structure

The proportion of researchers in the overall R&D employment ranges from 40% in the Liberecký region to 62% in the Jihomoravský region. A low proportion of researchers is usually compensated for by a higher proportion of technicians. The share of other supporting staff is in no way related to the proportion of researchers as such. It ranges from 9% in the Plzeňský region to 20% in the Zlínský region (see Figure 12).

The ratio of the researchers to the technicians and equivalent staff in R&D is influenced by the focus of research on various scientific disciplins. Regions with higher proportion of employment in engineering and technology fields show higher employment of technicians and equivalent staff. Conversely, there is a positive correlation between the proportion of employment in social sciences and humanities and the proportion of researchers. The dependencies are not very strong (correlation coefficients between 0.1 and 0.2) yet still noticeable. The proportion of other supporting staff is not associated with the focus of research but rather with its institutional and organisational structure and level of outsourcing of supporting activities related to the research.

During 2000-2010, the proportion of researchers in the overall R&D employment slightly increased in the whole CR. A significant growth was recorded mainly in the Karlovarský (20 p.p.) and Zlínský (8 p.p.) regions. Increasing number as well as propotion of researchers might result in both a shift in R&D quality as well as positive impact on R&D productivity. Some regions, however, recorded a trend of decreasing proportion of researchers, namely the Jihočeský region (-12 p.p.) and Královehradecký region (-10 p.p.). In addition to the participation of specific occupations, an important role is played also by the educational structure of R&D personnel.

Figure 12: Occupational structure of R&D employment in 2010 (%)

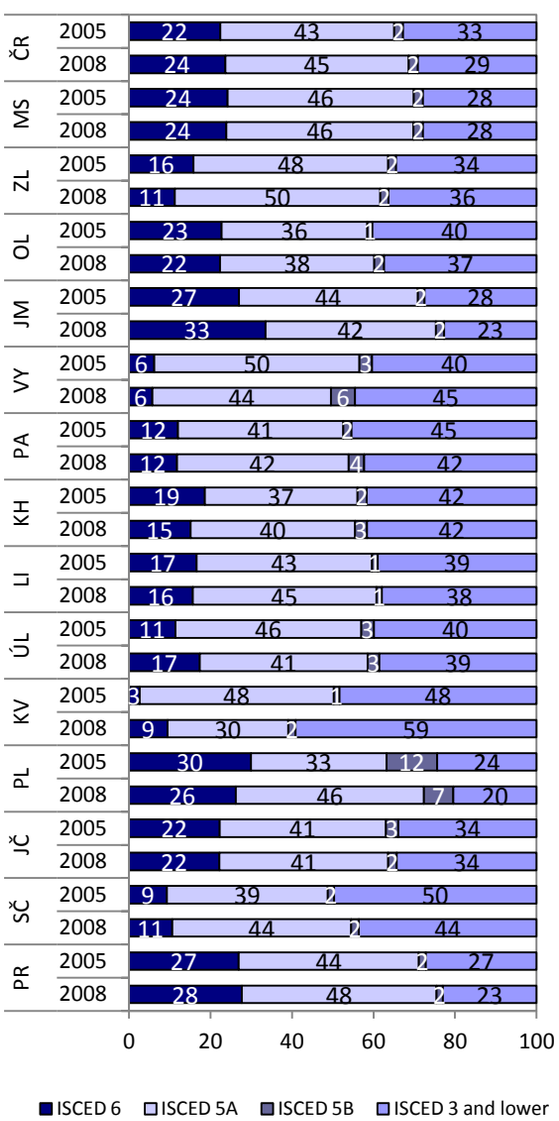


Source: CZSO (2010d), Table 5 b., own calculation.

The most recent data available showing the educational structure of R&D personnel in individual regions relate to 2008. There is a correlation between the educational and occupational structure, the higher proportion of researchers in the overall R&D employment in the region, the higher total number of persons with tertiary qualifications as well as the number of Doctoral programmes' graduates.

During 2005-2008, the Czech Republic as a whole saw an increase in the proportion of graduates of tertiary education and Doctoral programmes within the R&D. The fastest increase in the number of tertiary educated R&D personnel was recorded in the Plzeňský, Středočeský and Jihomoravský regions and in Prague. The situation was not the same in all regions. The Zlínský, Vysočina and Karlovarský regions recorded between the two years a growing proportion of persons with secondary education. Worth noticing, in terms of educational structure in individual regions, is the relatively high proportion of persons with tertiary professional education in the Plzeňský region (see Figure 13).

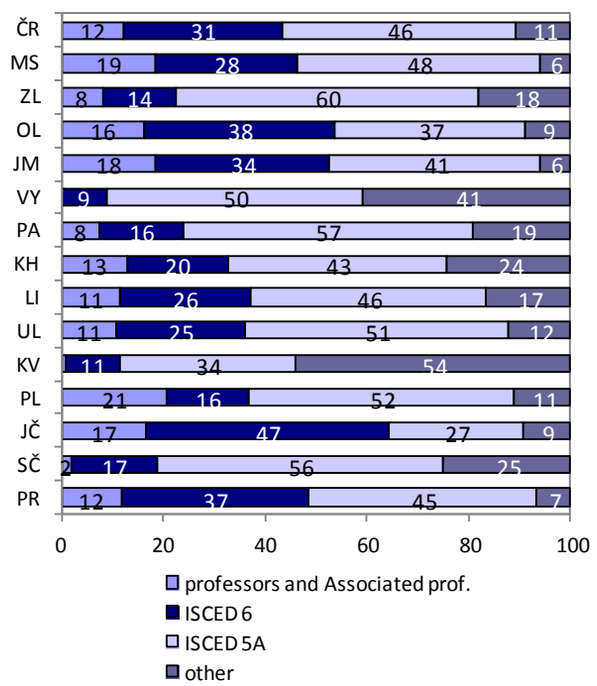
Figure 13: Educational structure of R&D employment in 2005 and 2008 (%)



Source: CZSO (2010d), Table 10, own calculation.

Educational structure of R&D personnel is related to the occupational composition of R&D, therefore, while comparing regional educational structures, it is adviseable to take into consideration the occupational group, which represents the top in terms of qualifications – the category of researchers. Even upon such a close look focusing specifically on the researchers, there are still significant differences between individual regions. In regions with lower proportion of R&D employment the researchers show lower educational level, which confirms that the development of R&D is inhibited by the lack of skilled workforce in these regions. Approximately half of researchers in the Karlovarský and Vysočina regions lacked tertiary qualifications, whereas the Jihomoravský and Moravskoslezský regions recorded only 6% (see Figure 14).

Figure 14: Educational structure within the category of researchers (2008, %)



Source: CZSO (2010d), Table 11, own calculation.

Table 2: Correlations between sectoral proportions in R&D employment and the proportions of researchers in formal qualification levels by region (correlation coefficients)

	Business enterprise	Government	Higher education
Professors and Associated prof.	-0.813	0.174	0.941
ISCED 6	-0.794	0.639	0.554
ISCED 5A	0.340	-0.310	-0.207
other	0.819	-0.404	-0.770

Source: CZSO (2010d), Table 11, own calculation.

The eduacational structure of the researchers is related to the sectoral composition of R&D in the region. Correlations between the regional proportions of individual sectors and the proportions of researchers in particular levels of formal qualification are illustrated in Table 2. The correlations indicate that the business enterprise sector does not place distinctive emphasis on formal qualification of the researchers. The regions with larger share of business enterprise sector in

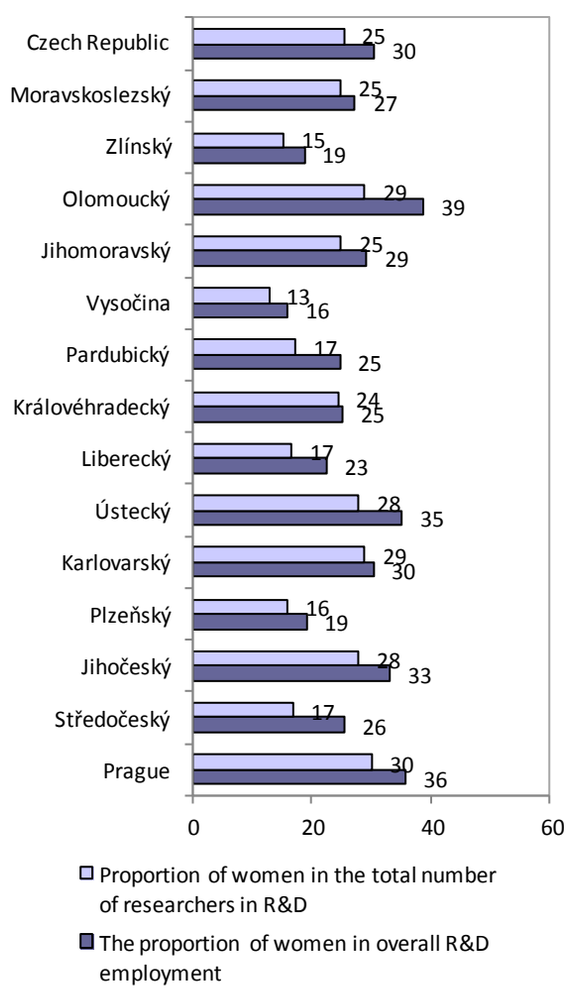
the R&D show higher proportion of researchers without tertiary qualifications at ISCED 5A lavel. Government sector representation has a positive impact on the proportion of personnel with Doctoral degrees, while the higher education sector positively correlates with the proportion of personnel with higher academic qualifications, which are not required to such an extent by the other sectors.

3.2.4 Participation of women in R&D

Throughout the whole CR, the research and development is dominated by men. The highest proportion of women in total R&D employment was recorded in the Olomoucký region (39%) and in Prague (36%), the lowest female participation is in the Vysočina region (16%) and in the Zlínský and Plzeňský regions (both 19%), (see Figure 15). A large proportion of females engaged in R&D is employed in less skilled occupations of technicians and other supporting (particularly secretarial) staff.

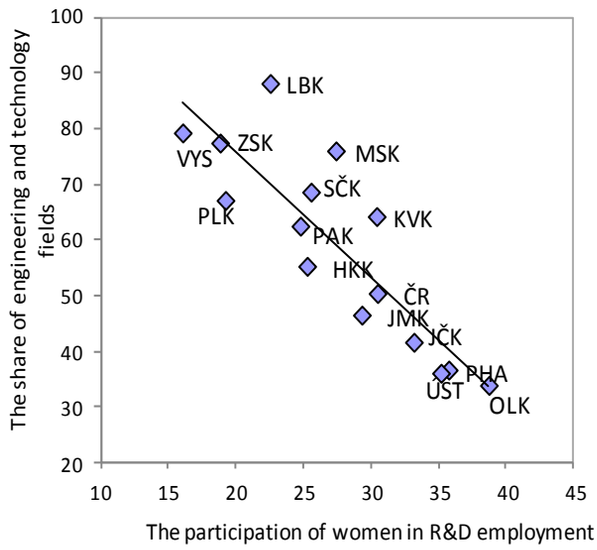
In all regions, the proportion of women among researchers is lower than their overall proportion in R&D. The most robust difference between the female proportion in the overall R&D employment and among researchers was recorded in the Olomoucký (10 p.p.) and Středočeský (9 p.p.) regions. By contrast, the slightest difference was shown in the Královehradecký and Karlovarský regions (both 1 p.p.).

Figure 15: Proportion of women in overall R&D employment and in the total number of researchers in 2010 (%)



Source: CZSO (2010d), Table 11b, Table 16b, own calculation.

Figure 16: Correlation between the participation of women and the share of engineering and technology fields in R&D employment (2010,%)



Source: CZSO (2010d), Table 16b, Table 9b., own calculation.

The proportion of women in overall R&D employment in the region is associated with R&D fields of science (see Figure 16). The higher share of engineering and technology fields, the lower proportion of women (correlation coefficient -0.857). Conversely, there is a positive correlation between the proportion of women and the share of natural and social sciences and humanties (0.727 and 0.729). This shows that certain stereotypes concerning traditionally female or male fields of science still persist not only when young people select the field of study but also at the level of top experts. Attempts to increase female participation particularly in engineering and technology fields are consistently failing.

In 2008, men employed in R&D showed in all regions higher level of formal qualification than women. This is probably due to higher female participation in the so-called other supporting staff category of R&D personnel, mainly in secretarial positions. Looking more closely at the category of researchers only, we can see that there are differences between regions. Overall in the Czech Republic, 10% of researchers lacked tertiary qualifications and there are no evident differences between men and women in this respect.

Table 3: Educational structure of male and female researchers in selected regions (2008, %)

Regions		Educational structure			
		Professors and Associated prof.	ISCED 6	ISCED 5A	Other
Středočeský	Men	2	16	59	21
	Women	1	19	44	33
Jihočeský	Men	22	41	26	9
	Women	6	61	28	5
Plzeňský	Men	20	13	56	8
	women	23	32	32	12
Vysočina	Men	0	9	52	33
	Women	0	7	40	45
Czech Rep.	Men	14	28	47	10
	Women	8	40	42	10

Source: CZSO (2010d), Table 9, own calculation.

There are, however, significant differences among specific levels of tertiary education. Female researchers are less likely to stop their studies at Master level of education and more often than men continue their studies in Doctoral programmes. Senior academic ranks (associate professor and professor), by contrast, are achieved by significantly higher proportion of men. In some regions, however, the educational structure of researchers does not follow this general trend. These regions are listed in Table 3.

In the Plzeňský region, the proportion of women with tertiary qualifications of higher levels was larger than the one of men. While 64% of men completed tertiary education at Master level or lower, for women this proportion represents only 44%. A similar pattern of educational structure became evident also in the Olomoucký and Pardubický regions and to some extent also in the Královehradecký region. It is possible that higher proportion of men in these regions is engaged in the business enterprise sector where academic degree is not such an important factor in carreer advancement, whereas the women are employed particularly in the higher education and government sectors. This explanation would have to be verified on the basis of more detailed data on males and females in individual sectors, however, such data in regional breakdowns are not available.

Although, there might be another explanation for the situation in regions with very low proportion of female researchers, among which the Plzeňský and Pardubický regions belong. In the environment with a strong predominance of men, in the research get involved only the women who are the top experts in their fields and therefore they achieve qualifications of higher levels. This hypothesis, though, should be verified in follow-up research.

Some regions show a higher proportion of women without tertiary education than men in researchers' positions. These include the Středočeský, Vysočina, Karlovarský regions and to a lesser extent also the Plzeňský region. In other regions, the situation is reversed which results in offsetting differences on a national level.

3.3 Preparation of human resources for R&D

Within new workforce entering the labour market, the highest potential of applicability in science and research can be expected in graduates of Master and Doctoral study programmes at higher education institutions. As the main development indicator of this potential can be used the development of number of graduates of Master and Doctoral study programmes. This indicator has been monitored for the five main fields of science reported in the statistics on science and research.

3.3.1 Graduates of Master and Doctoral study programmes

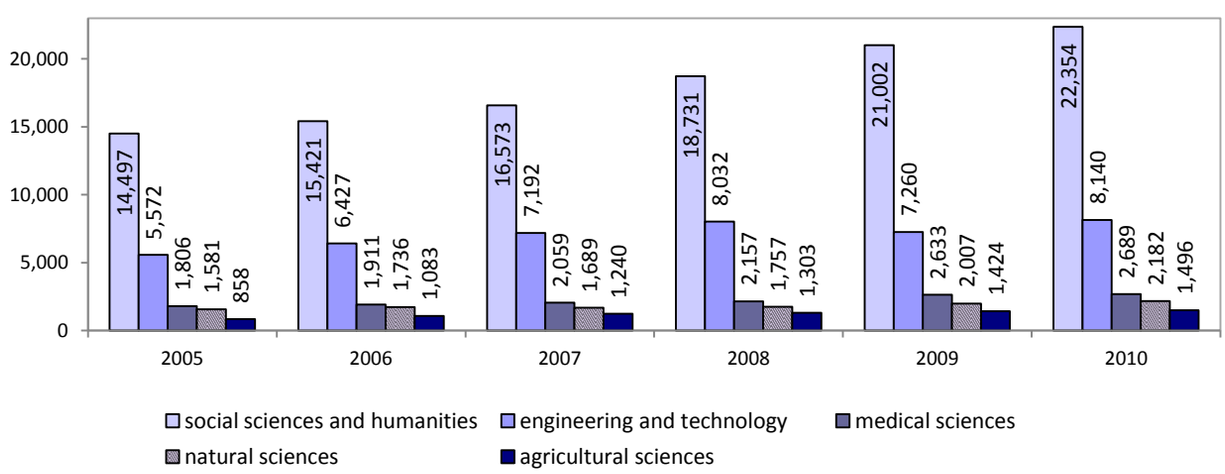
The graduates of Master and Doctoral study programmes represent workforce, which is ready to enter the labour market immediately or, possibly, which has been already actively participating in the labour market in the course of their studies (especially most students in Doctoral programmes).

Table 4: Graduates of Master study programmes – development of total number and structure by field of science.

		2005	2006	2007	2008	2009	2010
Higher education institution - total		24,224	26,489	28,645	31,852	34,175	36,720
%	social sciences and humanities	59.8	58.2	57.9	58.8	61.5	60.9
	engineering and technology	23.0	24.3	25.1	25.2	21.2	22.2
	medical sciences	7.5	7.2	7.2	6.8	7.7	7.3
	natural sciences	6.5	6.6	5.9	5.5	5.9	5.9
	agricultural sciences	3.5	4.1	4.3	4.1	4.2	4.1

Note: Number of graduates includes all forms of study (full-time/on-site, distance, combined; Master study programmes as well as the follow-up Master degree programmes); the sum of proportions for individual years slightly exceeds 100% (in the order of tenths of a percent), which is due to the students who have competed two or more different study programmes. Source: IIE (2011a), own calculation.

Figure 17: The number of graduates of Master study programmes (individuals)



Note: Number of graduates includes all forms of study (full-time/on-site, distance, combined; Master study programmes as well as the follow-up Master degree programmes). Source: IIE (2011a), own calculation.

Traditionally, the graduates of social sciencies and humanities (also economic sciences and law are classified within this group) account for a significant majority (about 60%) of the graduates of Master study programmes. The graduates of engineering and technology represent the second most numerous group (approx. 22% in 2010). The medical sciences graduates accounted for slightly over 7% of all graduates, the natural sciences graduates for slightly under 6% and the agricultural fields remain marginal with the share of approx. 4% of graduates (see Table 4).

It is a known fact that the overall number of graduaduates of Master study programmes has been in recent years continuously growing. During 2005-2010, it increased by approximately 50%. However, the above outlined structure of main fields of science, except for minor fluctuations, has not seen major changes. In 2005-2010, we may only point out a slight increase in the proportion of the graduates in social sciences and humanities (1 p.p.) and agricultural sciences (0.5 p.p.). In the other fields, there was a slight decline, most notable in engineering and technology (0.8 p.p.). These changes are negligible, often lower than the annual shifts in individual years, and therefore they are not indicative in terms of trend identification.

Different dynamics of development in individual fields of science is illustrated in Table 5. Categories are based on the national classification system – Classification of Basic Branches of Education not on the academic focus of faculties or higher education institutions. The category of agricultural sciences therefore comprises only study programmes truly associated with agriculture, not e.g. economic programmes tought at faculties of agriculture. Agricultural sciences prove to be the fastest growing field in terms of new graduates of Master study programmes. The number of graduates in these fields increased in 2005-2010 by 74%, nevertheless their proportion in the total number of graduates represents 4% only (see above). The increase is most likely due to the growing number of students in fields related to ecology and forestry, it also needs to be taken into account that student inflow into relevant faculties in its majority is not inhibited by entrance examinations. Social sciences and humanities recorded also a significant growth (54% since 2005). Other fields of science are growing as well, nevertherless their growth rates do not reach the overall growth rate of the total number of Master studies graduates. Since 2005, the number of medical sciences graduates has increased by 49%. Although the growing interest in medical studies indicates certain expansion of basic research potential for the medical fields in the Czech Republic, given the commencing outflow of medical doctors abroad, which might be even increasing, the most important issue to tacle is finding the way of retaining the human resources potencial in the Czech Republic. The slowest growth was recorded in graduate numbers in engineering and technology (46%) and natural sciences (39%) fields. Despite showing a growth, these values are not sufficient to maintain the position within the overall number of tertiary education graduates, therefore as earlier noted, their proportion is slightly decreasing. Data indicate that the potencial of expanded capacity of higher education institutions is not exploited enough towards development of technology and natural sciences fields and the growing proportion of young population who have the opportunity to study at higher education institutions favour other fields of study (particularly social sciences or humanities).

Table 5: Development of the number of graduates of Master study programmes (2005 = 100%)

		2006	2007	2008	2009	2010
Higher education institution – total		**109.4**	**118.3**	**131.5**	**141.1**	**151.6**
%	agricultural sciences	126.2	144.5	151.9	166.0	174.4
	social sciences and humanities	106.4	114.3	129.2	144.9	154.2
	medical sciences	105.8	114.0	119.4	145.8	148.9
	engineering and technology	115.3	129.1	144.1	130.3	146.1
	natural sciences	109.8	106.8	111.1	126.9	138.0

Note: Number of gradutes includes all forms of study (full-time/on-site, distance, combined; Master study programmes as well as the follow-up Master degree programmes). Data are sorted by increase rate in 2005-2010. Source: IIE (2011a), own calculation.

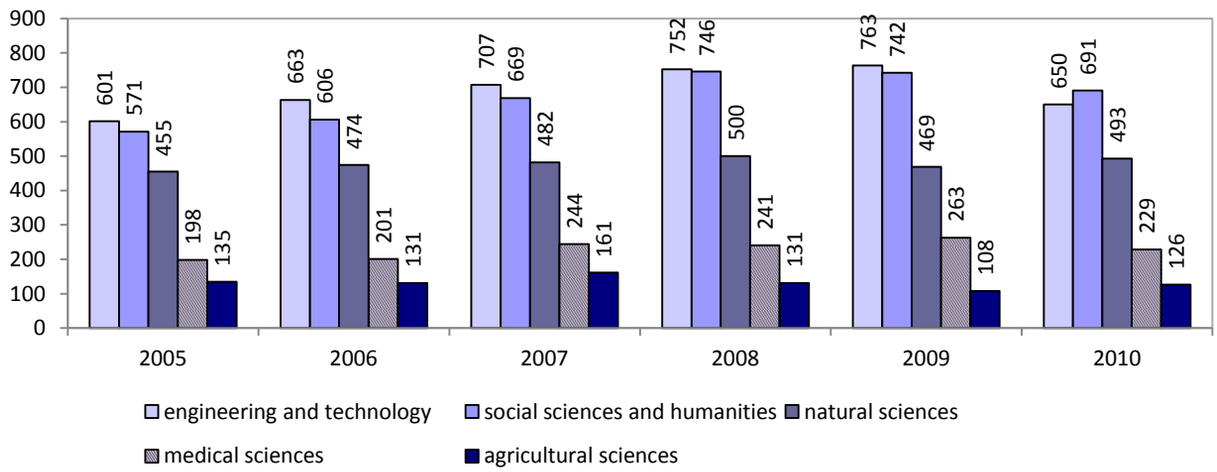
Doctoral study programmes are in line with the Higher Education Act (No. 111/1998 Coll.) specifically designed to prepare students for independent scientific and research activity, therefore it is likely that the highest proportion of Doctoral studies graduates is going to get engaged in research and development or they are already employed in this sector during the course of their studies. There might be also an opposite correlation when the graduates of Master study programmes, who get a job in research and development, are more motivated to follow their studies at post-gradual level than the graduates of Master studies employed in other sectors.

Table 6: Graduates of Doctoral study programmes – development of total number and structure by field of science

		2005	2006	2007	2008	2009	2010
Higher education institution – total		**1,960**	**2,075**	**2,263**	**2,370**	**2,345**	**2,189**
%	social sciences and humanities	29.1	29.2	29.6	31.5	31.6	31.6
	engineering and technology	30.7	32.0	31.2	31.7	32.5	29.7
	natural sciences	23.2	22.8	21.3	21.1	20.0	22.5
	medical sciences	10.1	9.7	10.8	10.2	11.2	10.5
	agricultural sciences	6.9	6.3	7.1	5.5	4.6	5.8

Note: Number of gradutes includes all forms of study (full-time/on-site, distance, combined). Source: IIE (2011a), own calculation.

Figure 18: Number of graduate of Doctoral study programmes (individuals)



Note: Number of gradutes includes all forms of study (full-time/on-site, distance, combined). Source: IIE (2011a), own calculation.

In similar way as the number of graduates of Master study programmes, increased also the overall number of graduates of Doctoral study programmes, however, the trend growth is not too pronounced and explicit: by 2008 the number had increased by approx. 20%, in 2009 it commenced to decline and in 2010 it represented approx. 112% of the value in 2005. In line with that, until 2008 or 2009, more or less all fields of science saw a steady increase in the number of graduates of Doctoral study programmes and then their number began to decline. The length of Doctoral studies is rather variable and available data do not allow for concluding whether the decline in the last two year-on-year comparisons is actually attributable to a lower number of successful graduations or merely to the fact that the students postpone completion of their Doctoral studies, which might be fostered by the impact of economic crisis and uncertain career prospects on the labour market.

A difference appears in terms of the field structure compared to the graduates of Master study programmes: also here the social sciences and humanities graduates accounted for the highest proportion (32%) in 2010, nevertheless the graduates of engineering and technology fields recorded almost identical share (30%). Technology fields were the most affected by the overall decline in the number of Doctoral study graduates in 2010, whereas prior to 2009 their proportion was even slightly exceeding the one of humanities and social sciences. The values of the changes are relatively low and so are the absolute numbers of Doctoral students, therefore it is not possible to reliably infer explicit long-term trends. Generally speaking, higher proportion of engineers among the Doctoral graduates than among the Master programmes graduates is certainly positive in terms of potential for scientific and technological development. Unless the trend of deviation from engineering and technology fields towards humanities and social sciences changes in the upcoming years, it could cause weakening of human resources' base for this kind of research.

The proportion of the third group – the graduates of Doctoral studies in natural sciences - has decreased in the course of the last six years by 0.7 p.p. to 22.5% in 2010. Fluctuating trend is reported by medical sciences (share of around 10-11%) as well as agricultural sciences (around 5-7%). Agricultural sciences represent the only field showing a decline also in absolute numbers of Doctoral study graduates as compared to 2005. However, in these marginally represented fields we talk only in the order of hundreds of graduates and on the basis of available data it is not possible to determine with certainty to what extent is the decline also in absolute numbers of graduates due to the postponement of studies' completion.

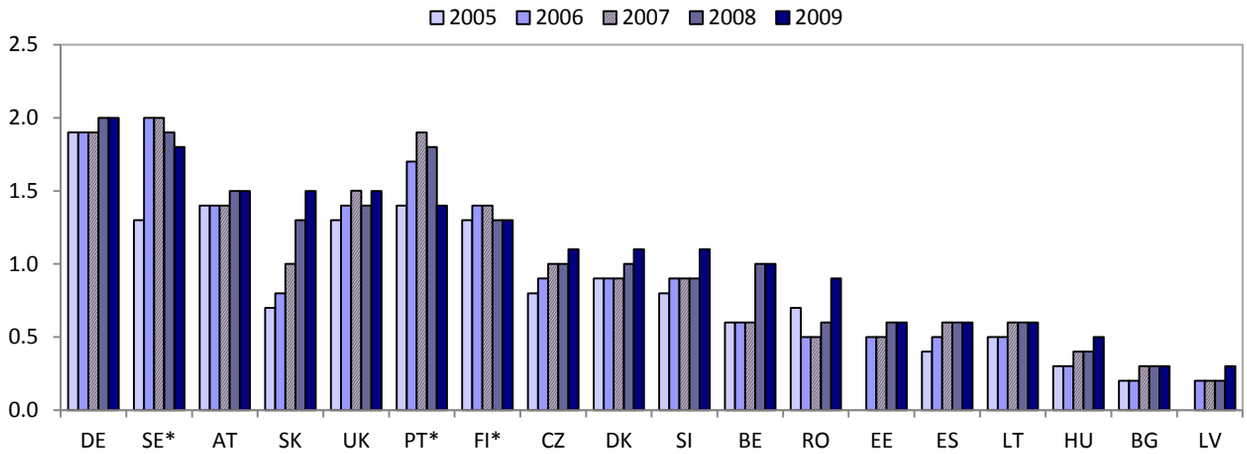
Table 7: Development of the number of students of Doctoral study programmes (2005 = 100 %)

		2006	2007	2008	2009	2010
Higher education institution – total		**105.9**	**115.5**	**120.9**	**119.6**	**111.7**
%	social sciences and humanities	106.1	117.2	130.6	129.9	121.0
	medical sciences	101.5	123.2	121.7	132.8	115.7
	natural sciences	104.2	105.9	109.9	103.1	108.4
	engineering and technology	110.3	117.6	125.1	127.0	108.2
	agricultural sciences	97.0	119.3	97.0	80.0	93.3

Note: Number of gradutes includes all forms of study (full-time/on-site, distance, combined). Data are sorted by increase rate in 2005-2010. Source: IIE (2011a), own calculation.

Dynamics within the number of Doctoral study graduates is illustrated in Table 7 The situation, compared to the Master degree graduates, differs considerably mainly in the case of agricultural sciences where the number of graduates has decreased by approx. 7% since 2005. Potential created by the growing number of Master study programmes is not exploited towards the engagement in research activity within Doctoral studies. All other fields of science recorded an increase, most notably humanities and social sciences (21%) and medical sciences (16%). Also the engineering and technology sciences saw a growth, however it showed lower rates compared to the overall growth rate of total number of students in Doctoral programmes (12%). In terms of research and development potential embodied in the fields of technology and natural sciences, the structure of Doctoral graduates is still more favourable that the structure of Master degree graduates. However, the question is whether in the future the trend of deviation from natural sciences and technology towards other fields of science will continue and expand also within the area of Doctoral studies.

Figure 19: Graduates from ISCED 6 level (Doctoral study) aged 25-34 per 1,000 of the corresponding age population



Note: *) In Sweden and Finland, in addition to the graduates of Doctoral study programmes also the graduates of Master research programmes were included. Until 2008, the graduates of Master research programmes were included also in Portugal, in 2009 they were excluded. The countries are ranked by the proportion in 2009. Source: EUROSTAT (2011e), Table Code: educ_itertc, 31.10.2011.

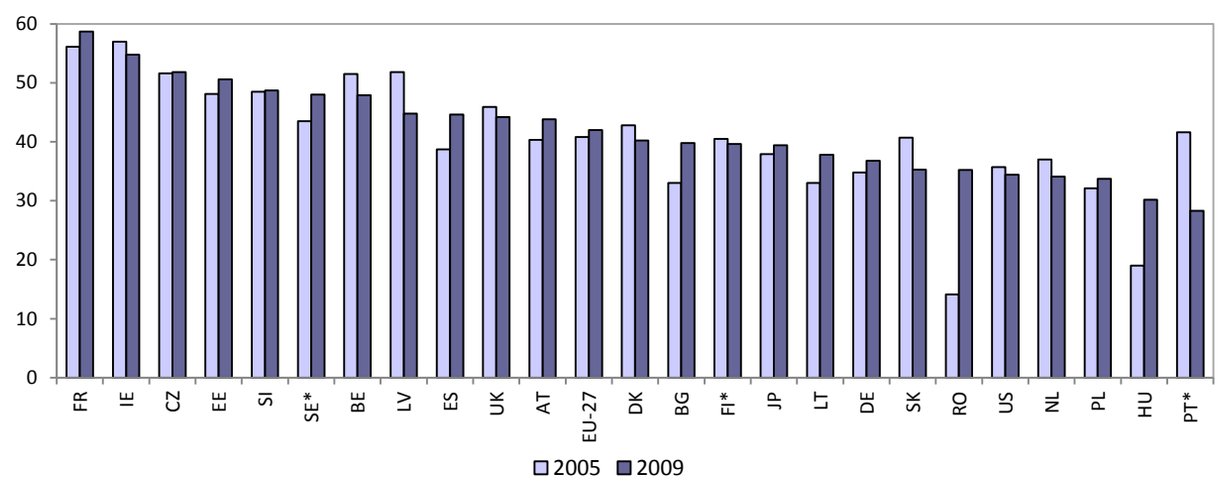
International comparison

In terms of international comparison of human resources potencial for R&D an indicative information is provided by the proportion of Doctoral programmes graduates in the population. The proportion of Doctoral graduates in the corresponding age population (25-34), which is monitored by the Eurostat, was used to outline the current situation of young generation embodying the basis of human resources for the future development of science and research. Included are: all graduates regardless field of study and only those countries for which data are available.

Figure 19 indicates that the Czech Republic ranks around the average of evaluated countries (EU countries for which comparable data are available). If we did not take into account the results of Sweden and Finland that include in the statistics also graduates of Master research programmes, the Czech Republic would rank in a relatively favourable position. There is a notable trend of the increasing proportion of graduates of Doctoral study programmes not only in the CR but in most EU countries.

A different perspective is provided by comparison of the proportions of Doctoral graduates in the fields of study that are considered crucial in terms of future scientific and technological development and innovations. These fields are comprised in the international classification ISCED 97 in sections 3 (natural sciences, mathematics and computing) and 4 (engineering, manufacturing, construction). Figure includes the EU countries for which data are available and also the United States and Japan for the purpuses of further comparison. In the international context, the Czech Republic ranked on a quite good positon. The increase in the number of these graduates during 2005-2009 represents a positive fact, however, most EU countries in that period showed significantly more pronounced increase and if this trend continues the Czech Republic's position might deteriorate rapidly.

Figure 20: Graduates of Doctoral study programmes (ISCED 6) in the fields of natural sciences, mathematics, computing, engineering, manufacturing and construction as a percentage of all Doctoral graduates.



Note: *) In Sweden and Finland, in addition to the graduates of Doctoral study programmes also the graduates of Master research programmes were included in the statistics. Until 2008, the graduates of Master research programmes were included also in Portugal, in 2009 they were excluded. Data sorted by results of individual countries in 2009. Source: EUROSTAT (2011e), Table Code: educ_itertc, 31.10.2011.

3.3.2 Applicability of Doctoral graduates in R&D

As stated before, the principal aim of Doctoral study programmes is to prepare students for independent scientific and research activity. To what extent are the graduates of these programmes engaged in industries allowing for full exploitation of their expertise can be verified through data provided by the Labour Force Survey.

The used data cover the graduates of Doctoral study programmes who completed their studies during 2005-2009. The survey examined to what extent are these graduates getting employed in industries with potentially highest proportion of R&D activities. These are mainly the following four:

- research and development fully focused on R&D activities,
- education, in which the R&D activities are developed mainly at the higher education institutions,
- health, social work, veterinary activities where particularly medical sciences are being developed,
- manufacturing focusing exlusively on development of innovations, i.e. product innovations and process innovations.

Based on data analysis it was concluded (see Table 8) that the graduates of Doctoral study programmes were most successful in terms of employment in two industries, namely (a) health, social work, veterinary activities and (b) education. In the period under review, approximately 50% of the new Ph.D. holders got a job in these two industries.

The R&D sector contributed to the overall employment of the Doctoral degree graduates about as much as the sector of public administration and defence; compulsory social security. Although the public administration offers much less opportunities to exploit knowledge and skills acquired through Doctoral study.

Table 8: Sectoral structure of employment of Doctoral graduates (average for 2005-2009, %)

Sector	Graduates of Doctoral study programmes
Research and Development)	9
Health, social work, veterinary activities	29
Education	22
Public administration, defence, social security	10
Manufacturing	3
Other services	22
Other branches	5
Total	100

Source: CZO (2005, 2010c), own calculation.

Given that a high proportion of Doctoral graduates consists of students of distance and combined forms of study (representing 77% in 2009), approximately only one third of new graduates seeks for a job. The rest remains in their jobs, in other words, in the sectors where they were employed in the course of the Doctoral study. Therefore we may conclude that despite the public administration offers limited opportunities for actual research and development, it makes it possible for the employees to increase their qualifications, i.e. to participate in the Doctoral study.

Only a small proportion of Doctoral graduates is getting envolved in manufacturing. This indicates that whitin the sector there is either not much emphasis placed on R&D development or that this sector does not require that the employees engaged in R&D activities have the Doctoral level qualifications. The latter is evidenced also by the fact that the business enterprise sector shows much lower proportion of R&D personnel with Doctoral level education than the government sector and particularly the higher education sector.

In 2009 in the CR, only 6% of R&D personnel in the business enterprise sector had Doctoral level education, while in the government sector this proportion represented 32% and 51% in the higher education sector (Source: CZSO – Research and Development, R&D Personnel, Table 7, own calculation).

High proportion of Ph.D. graduates employed in the higher education sector is influenced primarily by the fact, that they devote only part of working hours to R&D and their larger proportion is associated with pedagogical work, in which acquisition of Doctoral degree education is a prerequisite of carreer advancement and achievement of Academic ranks. To some extent it is also due to the fact that the higher education institutions provide Doctoral level education and a part of the Doctoral graduates remains there as employees.

Overall, in the period under review, on average 63% of graduates got employment in the four industries identified as key in terms of exploiting the knowledge and skills acquired through Doctoral study.

3.3.3 Mismatch in R&D labour market

To what extent is there a match between the supply and demand for high-skilled labour within the R&D can be derived from data on job vacancies and on numbers of job applicants with relevant qualifications.

Basic information on unmet demand for labour is available in the database of the Ministry of Labour and Social Affairs (MoLSA), which collects data on job vacancies reported by the employers to individual labour offices. Despite employers are legally obliged to report the job vacancies and their specifications to the relevant labour office, the database is not comprehensive. Some employers do not fullfil this duty and particularly in the case of skills-intensive occupations they seek for adequate employees through different channels – specialized web portals, employment agencies, etc. Therefore, to get a comprehensive picture of the situation on the labour market it is necessary to add at least the information from the most used web portals to the labour offices data.

The qualification-intensive segment of labour market for R&D can be defined by occupations classified in ISCO 2 – Professionals. The following Table 9 indicates the annual average of job vacancies for the period of 2007-2011 and the annual average of job applicants with relevant qualifications. The table includes only those occupations for which the demand or supply exceeded annual average of ten vacancies or ten job applicants.

Table 9 Average numbers of job vacancies and job applicants in 2007-2011

ISCO	Occupation	Job vacancies	Job applicants	Job vacancies / Job applicants
2111	Physicists and astronomers	18	6	3,0
2143	Electrical engineers	80	39	2,1
2145	Mechanical engineers	129	64	2,0
2119	Other scientists nad professionals in related sectors	17	10	1,7
2144	Electronics and telecommunications engineers	32	22	1,5
2131	Computer systems designers and analysts	80	63	1,3
2113	Chemists	26	39	0,7
2114	Geologists and geophysicists	12	24	0,5
2211	Biologists, botanists, zoologists and related professionals	6	16	0,4

Note: Average of January values for relevant year. Source: MoLSA (2011a), own calculation.

The table shows that the number of vacancies was several times higher than the number of suitable applicants particularly in the case of both physicists and engineers. It is evident that in the labour market there is a shortage of mainly those able to apply the knowledge to design and construction of machinery and electrical machinery.

As stated before, as for the job vacancies' supply it is necessary to take account of the fact that the number of vacancies reported to the labour offices is, particularly for the high-skilled occupations, several times lower than the actual number. Based on data for June 2010 it was determined that the MoLSA database covers about 62% of the total supply of job vacancies while for the high-skilled occupations (ISCO 2) it comprises only 43%. The rates of coverage for individual occupations differ significantly.

This also applies to the occupations identified in Table 9 as "in short supply" meaning that there is less than one job applicant per vacancy. As for the "computer systems designers and analysts" occupations only 20% of vacancies were registered with the labour offices and only 28% of vacancies concerning the occupation of "mechanical ingeneer". For other occupations the coverage rate exceeded 50% and in case of "physicists and other scientists" it represented even 90% of vacancies registered with the labour offices.

Based on data provided by the labour offices which are corrected by the knowledge of the vacancies' coverage rates for individual occupations, it is possible to conclude that in the R&D labour market, there is the most robust shortage of workforce in these three occupational groups:

- Computer systems designers and analysts (ISCO 2131) - especially the systems and database analysts and specialized developers and programmers are demanded;
- Electrical engineers (ISCO 2143) – the most frequently required are the profession of electrician, engineer, sampler, worker in / manger of innovations, energy sector engineer, reactor physics engineer;
- Mechanical engineers (ISCO 2145) - the most frequently demanded are the profession of construction designers, mechanical engineers - designers, technology engineers.

Despite growing numbers of graduates from both Master and Doctoral levels of education, it is evident that the student interest in fields of study does not entirely match the existing demand for occupations. It is vital that the young people have sufficient high-quality information not only on the current situation on the labour market but also on the medium-term development in individual occupational segments of the labour market, i.e. information concerning anticipated demand for occupations for the period when they enter the labour market.

4. Conclusion

The quality of human resources as a factor of the Czech Republic's competitiveness was examined in three chapters. The first chapter focuses on selected aspects of the impact of economic crisis on the labour market. The second chapter deals with the literacy level of fifteen-year–olds and with the tertiary education including employability of HEIs' graduates and quality of higher education. The attention is paid also to the educational structure and to the shifts in educational attainment across generations. The third chapter provides information on employment in research and development. It assesses the employment structure in relation to basic aspects, including inter-regional variability, the inflow of graduates of Master and Doctoral study programmes and developments in R&D segment of the labour market.

Mechanisms of adjustment and reaction of the labour markets to economic recession

The response of the labour markets in EU countries to the recent economic recession has been influenced by a varying extent of use of all mechanisms of adjustment. Available data indicate that labour markets in EU countries responded to the economic recession not only through changes in employment and changes in volume of vacancies, but also through reduction of working hours and other measures cutting labour costs of the companies, such as freezing or reducing salaries, paid or unpaid holidays, changing the employment contracts types, etc. Employers' decisions, concerning the **mix of responses to the market changes**, were in a number of countries importantly affected also by the short-term measures of labour market policies. These policies aimed at preservation of jobs and attempted to reduce or slow down the impact of the recession on employment.

Milder impact on employment was achieved at the expense of **labour productivity**, which can be attributed mainly to the fact that the employers opted for adjustment through mechanisms of internal numerical flexibility rather than those of external numerical flexibility. In Germany, Luxemburg, Austria, Belgium, Czech Republic, the Netherlands, Italy, Slovenia and Slovakia, almost all changes accounted for the decline in labour productivity with minimal changes in employment. Reduction of working hours represented one of the key mechanisms of adjustment used by the firms in response to the decline in demand for production.

As soon as signs of economic trouble appear, the employers reduce the **recruitment process** in order to avoid increased labour costs in economically difficult times. Therefore, on the European level, the job vacancy rates responded rather directly to the economic cycle (pronounced slump already in the course of 2008), even though, these developments are covering significant differences in individual EU countries.

Deeper analysis of sectoral and occupational structure of **job vacancies**, in the example of the CR, shows that the most affected by the decline were the less-skilled occupations (ISCO 8 and 9) and occupational groups demanded in industries most hit by the recession.

Employment and unemployment

The decline in employment in most EU countries was significantly smaller (approx. half the size) than the decline in **economic activity** during the crisis and delayed (in the case of the CR by 2 quarters of a year). From the territorial perspective, the impact of the crisis on employment in EU Member States was rather uneven. Significant impact can be identified in Spain while the German labour market was affected by the economic recession only to a limited extent. Manufacturing and construction were the most affected industries, both in absolute as well as relative numbers, which applies, to varying extent, to almost all EU countries.

The example of the CR illustrates that the **occupational structure of employment** recorded changes in the course of the crisis; we may not, however, conclude that the recession affected primarily less-skilled occupations. The most affected, in addition to ISCO 7 occupations, were also the high-skilled occupations (ISCO 1). By contrast, some occupational groups recorded growth in employment.

Given that the rate of economic activity of the population remained virtually unchanged, the impact of recession was reflected in the shift of the labour force from employment to unemployment. Differences in timing and extent of **unemployment** growth can be observed across all EU countries. The countries recording, over a long term, high unemployment rates, which further increased due to the crisis (Spain, Lithuania, Estonia, Ireland, Greece, Slovakia and Hungary), face the most critical situation. Whereas, the countries showing at first low unemployment rates and then recording their dramatic increase are in more favourable situation (Malta, United Kingdom, Romania, Finland, Austria, Luxemburg).

From the perspective of **time structure of unemployment** in the EU, it is evident that a major part of short-term unemployed shifts to the categories of long-term unemployment. Therefore, given the stagnant number of unemployed, the proportion of the long-term (over 12 months) unemployed is increasing. Persistence of this situation brings risk of a permanent increase in long-term unemployment due to a phenomenon called hysteresis.

Moreover, the impact of recession did not affect all occupational groups equally within the EU. Differences can be found not only by sectors or occupations but also by **gender, age, education level** or region. Men were affected more, though, only over a short term, due to their higher proportion in the crisis-affected sectors. The crisis deepened the difficulties of young people up to 24, whose unemployment rate exceeded the 20% threshold. It is not surprising, that the impact of the crisis varies also depending on education level. Education acts as a protection against unemployment, although not absolutely. The crisis impacted also on the skills-intensive occupations, and it is evident that this situation is due to several factors that are co-decisive in terms of employability and job retention. Similar developments have been observed also in the CR.

Impact of the crisis on the overall imbalances between the **regional labour markets** may vary depending on the sectoral structure of regional economy. The example of the Czech Republic illustrates that the least deterioration was experienced by those regions that had been affected by unemployment and structural problems already before the crisis; this resulted in mitigating regional disparities.

Despite the observed improvements, the **transformation of labour markets** in EU countries might not be only temporary. Unstable economic situation, in a number of Member States, suggests that a return to the pre-crisis - relatively favourable - developments in the labour markets can still be rather complicated.

Basic competencies of the young population

The PISA study provides a wide range of interesting data. Their analysis from various perspectives could contribute, to a large degree, to understanding the roots of the deteriorating competencies of Czech children and to uncovering the weaknesses of the Czech education system and the school environment in the Czech Republic. The **decline in the PISA test scores experienced by Czech children** could be a signal for developing a strategy for profound and evidence-based changes in the Czech schooling system.

In the area of **reading literacy** the CR is among the countries that displayed a major deterioration in student scores between 2000 and 2009 (by 13 points). Moreover, it is one of the countries where a nearly quarter of students do not reach the basic level of reading proficiency (i.e. Level 2). This proportion increased by 5.6 p.p. between 2000 and 2009. The proportion of the best performing students, which was below the OECD average as early as 2000, dropped further to 5%. Czech students are particularly far behind on the "Reflect and evaluate" subscale, which means they are not used to assess critically what they read.

The CR is also among the countries that saw the most striking decline in **mathematical literacy scores** between 2003 and 2009 (by 24 points). This has placed the Czech Republic below the OECD average, while in 2003 Czech students scored above the average. This coincided with an increase in the proportion of students at the lowest level of proficiency in mathematics. While in 2003 the CR showed a proportion of these students that was lower than the OECD average, in 2009 it was higher than the average. As opposed to this, the proportion of students at the top levels of mathematical literacy dropped below the OECD average.

As concerns **scientific literacy,** the CR ranks among the countries with the most robust decline in the scores between 2006 and 2009 (by 12 points). This has placed our students at the OECD average, while in 2006 they scored above this average. The CR also witnessed a slight increase in the proportion of students at the lowest level of scientific literacy. This means we now rank at around the OECD average. As concerns the best-achievers, the CR saw the largest decline in their proportion of all countries reviewed. As a result we are now at the OECD average.

Overall, the results of fifteen-year-old students in the PISA studies focusing on the three types of literacy are not very good for the CR. This applies, above all, to reading literacy that has a major influence on the educational paths of individuals. Particularly alarming is the downward trend for the scores in all the areas examined. What is also a matter of concern is the very low (and still decreasing) proportion of students who achieve excellent results. This points to the **limited potential** of human resources in terms of skills intensive occupations, as it is these students who may become successful graduates from higher education programmes and experts with advanced qualifications in the future.

In reading literacy, in particular, there is a widening **gap between boys and girls** – boys' scores deteriorate significantly, while girls' results show only a slight decline. The worsening scores of boys should not only be seen as the main cause of the steep fall of Czech children's results in terms of international comparison. Most importantly, they point to a society-wide risk of growing inequality and a further enlargement of differences between and separation of various groups in terms of gender, education, social status etc. This is a development that has been observed, discussed and analysed in many western countries for several years. The worsening results of boys in reading is likely to be a consequence of a cumulative working of several factors that include, above all, growing lack of interest in reading. In this context there appears to be a risk – although not yet clearly identified and proven in terms of statistics – of an excessive use of ICT that is more widespread among boys. However, analyses of the trends reveal that girls are not out of danger either, and a hypothesis may be posed that the deterioration in their performance is only "delayed" and that a similar development as that for boys will occur in the near future.

Analyses of the correlations between PISA test scores and school evaluation also suggest that the Czech schooling system does not have a sufficient capability to **recognise talent** (particularly in mathematics) and provide talented students appropriate support for their further education and use of their capacities in society. School assessment fails to provide appropriate information about the real talent of students, but still, marks are often seen – be it by parents, the public or schools – as its most important indicator.

Another major feature of the Czech education system that deserves attention is the relatively **low level of equity in access to education**. This is related to the high degree of determination of the children's educational path (particularly depending on the professional status of parents). It is likely that there are two factors working in parallel that reinforce each other. These are the large degree to which the choice of school depends on parents' professional status on the one hand and the selectivity of the schools system (the existence of prestigious selective schools alongside ordinary schools – e.g. eight-year grammar schools and Stage 2 of basic school) on the other hand.

Preparation of Human Resources for Skills-Intensive Occupations

Expanding capacity of tertiary professional schools and higher education institutions in particular, led to a dynamic **growth in student numbers**. In 2010, the total number of students in all types of tertiary education reached 426 thousand persons, representing a twofold increase since 2000. This development can be attributed mainly to the higher education institutions whose students in 2000 accounted for 88% of all tertiary education students and in 2010 already for 92%.

An important indicator of availability of tertiary education is the **participation rate in university education** (higher education institution). Gross participation rate in this type of tertiary education reached almost 42% in 2005 and already 56% in 2009. The net participation rate was lower, representing 25% in 2005 and 31% in 2009. The difference between gross and net participation rates is given by the age structure of the students. In 2009, the age group typical of university education (20-24 years) accounted only for 60% of all students.

The student interest in **tertiary professional schools' programmes** is significantly lower not only because of the tuition fees but also due to the fact that for its short history in the CR this type of study has not been fully accepted neither by the population nor the labour market yet. Gross participation rate in this type of tertiary education remained unchanged in both years under review represented 7%, net participation rate decreased from 4.4% in 2005 to 3.6% in 2009.

In terms of **international comparison** the CR still lags behind the average of both the EU and the OECD. Czech population is every time less likely to enter tertiary education in the course of their lives. In terms of the entry rate into

Doctoral programmes the CR exceeds the OECD average. The rate of success in graduation oscillates around the OECD average.

There have been certain changes in terms of programme structure of HEIs graduates although the largest proportions have been consistently recorded by economic and technology programmes. While the proportion of graduates in economic programmes was increasing – from 23% in 2003 to 27% in 2009, the proportion of technology programmes graduates dropped from 23% to 22%. Lower student interest in science and technology programmes as compared to humanistic and social studies is not a specific feature of the CR, it practically occurs in all economically developed countries.

Despite the decline in the proportion of science and technology graduates, the CR as well as most other EU Member States managed to meet the objective of the **Lisbon strategy**, namely to increase the number of graduates of S&T programmes by an average of 15% by 2010 as compared with 2000.

Important indicator in terms of effectiveness of financial and non-financial costs in the attainment of tertiary qualifications is **graduate employability in the labour market**. In 2010, the highest unemployment rates were recorded by the graduates of faculties of agriculture and artistic fields, whereas the most successful in terms of employment were the graduates of medical and law. In absolute terms, the highest number of the unemployed was recorded among graduates of economics and technology faculties.

According to the results of the survey concerning employers' requirements, the graduates of natural science and technology programmes lack mainly **skills and competences** within project and process management as well as quality and lean management, they do not show sufficient ability to focus on ultimate goal and proceeding in steps towards its achievement, make decisions and justify their actions. These weaknesses related mostly to the soft skills will be displayed with a high degree of probability also by the graduates of other disciplines as the way of education does not place enough emphasis on students acquiring these soft skills.

As for the higher education, its further expansion is no longer an issue, what matters now, is improving its quality. **Quality of higher education** is on yearly basis evaluated by the International Institute for Management Development. During the period 2009-11 the quality of higher education was according to the evaluation decreasing every year. This reflected the respondents' view that higher education does not timely and adequately responds to changing demands of practice. However, calculated average of these three ratings shows that the Czech higher education ranks slightly above the EU-27 average, but deep under the Finnish higher education system, which is at the top within the EU.

Various institutions are involved in quality assessment of higher education, there are different rankings available and it is obvious that different evaluation methods provide varying results. Some partial information on quality of the Czech higher education within the international context can be expected from the results of the international survey on adult competencies that is being conducted under the OECD guidance. Results will be available in 2013.

Educational structure and mobility

The CR is characterised by a large share of the population with **secondary education**. Due to the diversified system of secondary education virtually all people in the CR have an opportunity to complete that level of secondary education that suits their individual aptitudes and diligence. Although the EU as a whole failed to meet the objective set out in the Lisbon strategy (i.e. that 80% of the population aged 25-64 should have at least secondary education by 2010), the CR together with Slovakia and Lithuania exceed this target by a large margin. People with secondary education accounted for some 92% of the population of the given age in CR.

Despite the positive development in the area of **tertiary education** the CR still lags behind the EU for the proportion of individuals with tertiary degrees. It is one of five member countries where this proportion in the population aged 25-64 was lower than 20% in 2010. There is a relatively robust correlation between the proportion of the population with tertiary qualification and the economic performance of a country. It applies, in general, that the higher the GDP per capita, the higher the proportion of people with tertiary education. However, there are exceptions to this general rule such as Estonia, Lithuania or Cyprus. These countries have a relatively large proportion of these people and still their economic performance is relatively low.

The majority of EU countries share one characteristic feature in that the increase in the number of individuals with tertiary degrees at the **labour market** is faster than the availability of jobs classified into the first and second occupational category – i.e. jobs that require the individuals with tertiary education. Evidence of this is the decreasing number of these jobs per 100 individuals aged 25-64 who hold tertiary qualifications. In EU average terms this figure was only 67 jobs in 2010. The CR is among the countries that witnessed the fastest decrease in this ratio between 2000 and 2010. If in 2000 the ratio was 116 to 100, in 2010 it was 72 to 100.

Individuals with tertiary education increasingly fill the jobs falling into the **third occupational category.** In the past these jobs used to be taken up by secondary qualification holders. The question is whether the skills intensity of these occupations increases or whether there is underutilisation of the qualifications obtained. If there was a rule that jobs in the third occupational group should be filled by people with tertiary education, then most EU countries would have a lack of these individuals. However, in 2010 there were fewer than 100 jobs in the first three categories per 100 people with tertiary qualifications in nine member countries. In the CR the ratio was 182 jobs in these three categories per 100 individuals with tertiary education in 2010.

The generation of children achieve higher levels of education than the generation of parents. This positive **educational mobility** generally occurs in all EU member countries. Along with an increasing accessibility of education at various levels this increase in the educational mobility is becoming less intensive. This is manifested, above all, in the mobility for secondary education. For example, in Portugal there were six times more people with secondary education in the younger population (25-29) than in the older population (55-59) in 2000. Ten years later the number was only four times higher.

In countries that are characterised by a large proportion of people with secondary education in the older population there is **negative educational mobility** at this level. This trend is also apparent in the CR and it is offset by the positive trend in the mobility for tertiary education. In 2010 there were only 12% of individuals with tertiary qualifications in the older generation (55-59), while it was twice as many in the younger

generation (25-29) – i.e. 25%. The EU average for this indicator was more favourable for both age cohorts. The proportion of those with tertiary degrees in the older generation was 20%, and for the younger generation it was 33%.

Employment in research and development in the Czech Republic

In 2005-2009, **the overall R&D employment** recorded a favourable development. The number of employees was growing even when the overall employment in the economy recorded a decline. This indicates that the whole society as well as individual institutions recognize the irreplaceable role of R&D in maintaining and enhancing competitiveness. Despite this positive trend, the CR still lags behind the EU average in terms of proportion of R&D employees in the overall employment and the lag remains the same so far. Even more significantly the Czech Republic falls behind countries such as Finland or Denmark. In 2009, the R&D personnel accounted for 1.03% of the overall employment in the CR, while Finland recorded 2.28% proportion. It demonstrates the very strong link between the level of economic development and the proportion of R&D employment in the overall employment (correlation coefficient represented 0.86 in 2009).

The R&D outcomes and their quality depend also on the **occupational structure** of R&D personnel. Even if the role of all categories of R&D personnel is indispensable, the major part is played by the researchers. In 2005-2009 in the EU, the average share of researchers in the overall R&D employment was more or less stable representing approx. 62%. There are considerable differences between individual EU Member States, the proportion ranges from 43% in Italy to 88% in Portugal. The CR recorded 56%, scoring thus bellow the EU average. This might be one of the reasons why the Czech R&D shows lower international competitiveness.

The R&D is carried out in a total of **four sectors**, however, the importance of the private non-profit sector is negligible. On average in the EU, half of all persons engaged in R&D were concentrated in the business enterprise sector, more than one third of them were employed in the higher education sector and 14% worked in the government sector. In terms of representation of individual sectors there is an evident difference in countries that went through a period of centrally planned economy. These countries show a significantly higher proportion of the government sector, in the other countries the larger share belongs to the higher education sector. Although, the most developed sector is the business enterprise sector in the overwhelming majority of the EU member countries. In the Czech Republic in 2009, those employed in the business enterprise sector accounted for 50% of overall R&D personnel, 22% were employed in government sector representing twice the EU average share and finally 27% worked in the higher education sector.

It is not important in what sector the R&D activities are carried out, it is the achieved **results** that matter. They might be monitored in various ways. In terms of annual average of the number of high-tech patents per 1,000 R&D employees, the best results were achieved by Finland together with Sweden and the Netherlands in 2005-2008. The Czech Republic ranked far bellow the EU average representing 3.8 high-tech patents per 1,000 R&D employees, while the CR reported only 0.3 high-tech patents.

The number of submitted high-tech patents to a large extent depends on the proportion of individual **fields of science**. Most EU countries, for which data are available, show the highest proportion of employment in the field of engineering and technology sciences. This applies also to the CR where employment in technology fields accounted for 52% of total R&D employment and the natural sciences for a 24% share. It is obvious, given the proportion of employment in technology fields, that we might expect better results in terms of submitted high-tech patent applications. Their number depends not only on the quality of R&D outcomes but also on the experience in terms of patent filing, in other words development of specialised services provided to the researchers in the area of application processing. Into account also needs to be taken the influence of financial requirements of both the specialised services and actual submitting of patent application to the European Patent Office.

Employment in research and development in Czech regions

The CR shows rather uneven distribution of R&D across **individual regions**. More than half of the R&D employment is concentrated in two regions, namely Prague and the Jihomoravský region. These regions show a significant lead over others in terms of R&D share in the overall regional employment. This share, recalculated per 1,000 inhabitants working in the region, ranges from only 0.2 in the Karlovarský region to 25 in Prague.

Dynamics of employment in research and development over 2005-2010 indicate that the regional differences in R&D distribution should diminish in the future. The **capacity of higher education institutions** is the principle factor influencing uneven distribution of R&D in regions. Not only it affects the proportion of employment in actual higher education research but also employment in the other sectors of R&D, including the business enterprise sector. The proportion of high-tech manufacturing industries and high-tech services in the region relates to the R&D share. Therefore, the existence and capacity of higher education institutions are prerequisites for the development of employment in the region towards a knowledge-oriented economy.

There are regional differences in **occupational and educational structure** of R&D employment, which are to some extent determined by the share of individual sectors and the field focus of research in the region. Higher proportion of engineering and technology fields requires higher participation of technicians and equivalent staff, which is the case in the Liberecký and Plzeňský regions. However, there are exceptions to the rule, the Pardubický region shows a remarkably high percentage of employment in engineering and technology fields as well as a large proportion of researchers, which might be associated with the development of high-tech manufacturing industry in the region.

The share of individual **sectors** in regional R&D affects educational structure of the researchers. While the business enterprise sector does not place significant emphasis on level of formal qualification, the government and higher education sectors require researchers with higher academic degrees. Regions with low proportion of R&D in total employment are at the same time afflicted with a shortage of skilled workforce for R&D. Almost half of persons working in the positions of researchers lack tertiary qualifications in the Vysočina and Karlovarský regions.

The share of women in R&D also varies across regions, ranging from 39% in the Olomoucký region to mere 16% in the Vysočina region. The proportion of women among researchers is in most regions even lower, women are within

the R&D frequently employed as the so-called other supporting staff whose activities are often related to general administration. The proportion of women is also associated with field focus of the research, in regions with dominance of engineering and technology fields there are much less women in R&D than in regions with higher proportion of natural and social sciences.

Preparation of human resources for R&D

The graduates of Master and Doctoral study programmes have the biggest applicability potential for R&D. In recent years, their total number has been increasing significantly, which is a consequence of policies aimed at making the tertiary education more accessible. However, not all the graduates can and want to get engaged in R&D. Thus, the development of the number of **Master study graduates** can be perceived rather as an indicator of the young generation interest in certain areas. Traditionally, the fields of humanities and social sciences (including economic sciences and law) prevail among the Master study graduates. The graduates in technology fields still account for a rather high proportion; however, their share in the field structure has slightly decreased since 2005; similarly, as did the share of natural sciences. Despite their absolute numbers have increased since 2005, their decreasing share compared to other fields proves that the expanded capacity of higher education institutions is not exploited towards the development of fields with potential for scientific and technological research.

The graduates of **Doctoral study** are far more likely to create real human resources potential applicable within the R&D than the Master study graduates. Doctoral study programmes are designed to prepare students for independent scientific and research activity. Among Doctoral graduates, the graduates in technology fields predominate, followed by humanities and social sciences and natural sciences rank the third. The share of natural science and technology fields at Doctoral level is much higher than in Master study; the proportion of Doctoral study programmes in technology fields has since 2005 - unlike the proportion of Master study programmes - increased. Increasing is also the share of humanities, medical and social sciences, while natural sciences are relatively declining. Doctoral studies, therefore, do not show the trend of massive development of “popular” fields at the expense of science and technology fields to such an extent as do the Master study programmes.

In **international comparison**, the R&D potential of human resources can be derived from e.g. the proportion of young people with a Doctoral degree in corresponding age population. The Czech Republic ranked around the average of assessed countries, the upward trend of this indicator is a positive thing. It needs to be pointed out, however, that reported growth rate is rather low compared to other countries, (e.g. Slovakia). However, this indicator follows the graduates as a whole not differentiating between field structure. Potential of development in the area of natural sciences and technology - expressed as a proportion of the Doctoral graduates, in these fields, in the overall number of graduates - is in the CR relatively high compared to other EU countries. Since 2005, most countries have been showing a significant increase in this indicator, while the Czech Republic reported only moderate growth, which may result in a gradual loss of its position.

Results of comparison of student interest in Master study programmes with the one in scientific training in Doctoral study programmes, assessed through the indicator of **first time enrolments,** showed high and further growing proportions of the first time enrolled in Doctoral programmes as well as of the students enrolled in all forms of Master studies. The growth rate recorded for the Doctoral programmes is much lower and less favourable given that it is one of the prerequisites for the development of R&D. There is a significant difference in student interest, in individual fields of science, between the Master and Doctoral levels of study. While, at the level of Master study, the highest student interest – despite the continuously fast growing number of students enrolled in science and technology fields – have recorded humanities and social sciences, at the level of Doctoral study there has been a shift of student interest towards the fields of technology, agriculture and natural sciences. This can be regarded as beneficial in terms of future scientific and technological development. Assessment of correlation between the first time enrolments in Doctoral studies and graduates of Master study programmes indicates a decrease in the proportion of Master study graduates enrolled in Doctoral study programmes, most notably in humanities and social sciences. Development in other fields can be classified as quite favourable although natural sciences report a slight decline and medical sciences report a significant decline.

Based on data for 2005-2009, it can be stated that most of Doctoral study graduates heads for the **health and social work and education sectors**. About 50% of new graduates found employment in these industries. In both actual **R&D sector** and **public administration sector**, got employment 10% of Doctoral graduates. Given that the graduates of combined form of study account for almost three-quarters of all Doctoral graduates, we can conclude that these sectors provide their employees with the most favourable conditions for acquiring this level of education.

Correlation between the supply of job vacancies, for the occupational class of professionals, and the number of job applicants, with adequate qualifications, indicates that in the Czech **labour market,** in 2007-2011, there was a shortage of computer systems designers and analyst, electrical engineers and mechanical engineers. It is evident that young people interest in the fields of study does not fully match the demand for occupations. Therefore, it is essential that young people, when deciding on their professional career, have comprehensive information not only on the existing but also the anticipated demand for skills.

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List of Abbreviations

AT – Austria
BE – Belgium
BG – Burgaria
CH – Switzerland
CY – Cyprus
CZ – Czech Republic
DK – Denmark
DE – Germany
EE – Estonia
ES – Spain
FI – Finland
FR – France
GR – Greece
HU – Hungary
IE – Ireland
IS – Iceland
IT – Italy
JP – Japan
LV – Latvia
LT – Lithuania
LU – Luxembourg
MT – Malta
NL – Netherlands
NO – Norway
PL – Poland
PT – Portugal
RO – Roamnia
SI – Slovenia
SK – Slovakia
SE – Sweden
UK – United Kingdom
US – United States

PR (PHA) – Prague
ST (SČK) – Středočeský region
JH (JČK) – Jihočeský region
PL (PLK) – Plzeňský region
KV (KVK) – Karlovarský region
UL (ÚST) – Ústecký region
LB (LBK) – Liberecký region
HK (HKK) – Královéhradecký region
PA (PAK) – Pardubický region
VY (VYS) – Vysočina region
JH (JMK) – Jihomoravský region
OL (OLK) – Olomoucký region
ZL (ZSK) – Zlínský region
MS (MSK) – Moravskoslezský region
ČR – Czech Republik

AES – Adult Education Survey
AHM – Ad-hoc modul (on Lifelong Learning)
BUT – Brno University of Technology
CET – continuing education and training
CI CR – Confederation of Industry of the Czech Republic
CU – Charles University in Prague
CTU – Czech Technical University in Prague
CZSO – Czech Statistical Office
ČSRLZ – The Czech Society for Human Resources Development (Czech acronym)
EC – European Comission
EPC FE – Education Policy Centre, Faculty of Education, Charles University
EU – European Union
EWCS – European Working Conditions Survey
HE – higher education
ICT Prague – Institute of Chemical Technology Prague
ICT - Information and Communication Technologies
IIE – Institute for Information on Education
ISCO - International Standard Classification of Occupations
ISCED - International Standard Classification of Education
KKOV - Classification of Basic Branches of Education
LFS – Labour Force Survey
MEYS – Ministry of Education, Youth and Sports
MoLSA – Ministry of Labour and Social Affairs
NACE – Statistical Classification of Economic Activities
NOET – National Observatory of Employment and Training
NTF – National Training Fund
OECD - Organization for Economic Cooperation and Development
PISA – Programme for International Student Assessment
p.p. – percentage points
ROA – The Research Centre for Education and the Labour Market
SPČR – Confederation of Industry of the Czech Republic (Czech acronym)
S&T – science and technology
VŠB-TU Ostrava – Technical University of Ostrava
VŠPS – Labour Force Survey (Czech acronym)

National Observatory of Employment and Training of National Training Fund (NOET-NTF)

The National Observatory of Employment and Training is an analytical section of the National Training Fund. Its research work is focused on labour market issues – i.e. employment, human resources development, forecasting skill needs and both initial and, in particular, continuing vocational training.

The Observatory provides information about the development of human resources, collects data and analyses trends in education and the labour market against the background of social and economic changes. As part of the analyses extensive surveys are conducted, the results of which facilitate up-to-date information concerning specific areas that are not covered by regular statistical data.

The main NOET activities are:

- Forecasting skill needs - development of a methodology for forecasting labour market skill needs, quantitative projections based on a mathematical model and qualitative approaches based on analyses and expert assessments of future development in economic sectors (sector studies)
- Research into human resources - quality of human resources as one of the factors of the competitiveness of a country, inequalities in the chances of acquiring education, on the demands that the knowledge society places on the quality and training of human resources, the links between population ageing and education, and other issues.
- Participation in the expert European network: ReferNet (network for providing information and analyses on national vocational education and training systems and policies) and SkillsNet (network for co-operation in the area of forecasting skills needs).

www.nvf.cz
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The Competitiveness of the Czech Republic 2010-2011

Quality of human resources

National Observatory of Employment and Training – National Training Fund

Research Centre
for Competitiveness
of Czech Economy

NATIONAL OBSERVATORY
NTF CZECH REPUBLIC