COMPARISON AND EVOLUTION OF WAGES BY GRADE LEVEL IN THE SLOVAK AND CZECH ECONOMY

LUBOŠ MAREK
University of Economics, Prague, Faculty of Informatics and Statistics,
Department of Statistics and Probability,
W. Churchill Sq. 4, Prague, Czech Republic
e-mail: marek@vse.cz

PETR DOUCEK
University of Economics, Prague, Faculty of Informatics and Statistics,
Department of System Analysis,
W. Churchill Sq. 4, Prague, Czech Republic
e-mail: doucek@vse.cz

Abstract

The aim of this article is to compare average wages of employees in the Czech and Slovak Republic for the last 13-15 years. Some data have already been published for the years 1998 – 2014, and others for 2002 – 2014. The source of the data for the Slovak Republic is the website of the Statistical Office of the Slovak Republic. With regard to the Czech data, their source is the firm Trexima Ltd., which conducts statistical surveys on wages for the Czech Statistical Office. We worked with a sample ISPV file (Average Earnings Information System). Both data involve annual time series with average wages given in the national currency. It was therefore necessary to convert the figures for the Czech Republic into the other currency, the €. For the conversion we used the average exchange rate for the relevant period made public by the Czech National Bank on its website. The comparisons were made with a view to the level of completed education. The results are presented as clearly arranged tables and graphs. Since time series are involved, we were interested in the basic descriptive characteristics (in particular, growth rate and trend) of the analysed time series.

Key words: *wages, comparison of wages in the Czech and Slovak Republic, education level.*

1. Introduction

Economic evolution and its periods of growth and crisis are reflected in diverse parts of our lives. One of them is the area of wages. It is governed at present by generally accepted principles of the world economy, where the greatest menace is stagflation or even deflation. This is why the wages in our economy suggest a slow upward stemming from the inflation economy paradigm. According to some studies, a growth in wages is caused by increased productivity of labour and by extension (Marek, 2010; Marek, 2013; Malá, 2015), by the positive influence of information and communication technologies (Hančlová et al., 2015; Hančlová and Doucek, 2012; Maryška et al., 2015; Manďák and Nedomová, 2014). Others ascribe the wage growth changes to increasing or decreasing performance of economic sectors (quotation) or to international cooperation at regional and national level. In times of crisis we often hear politicians and leading economists say that a very effective investment in the development of the economy is education. Therefore, we looked at the Czech and Slovak

economies in terms of wages according to the level of completed education. Some sources (Sixta et al., 2013) study the effectiveness of the tertiary education system, others the methods of its financing, and yet other studies focus on the stability (Bartošová and Longford, 2014) and on the influence of ICT in the Czech economy, or the influence of education on certain areas, such as ICT (Doucek et al., 2015, Nedomová et al., 2015). The aspect of gender in ICT professional wages is presented for example in.

The aim of this article is to compare the evolution of average wages in the Czech and Slovak Republics in terms of grade levels. We had the annual time series covering 13-15 years. This article sets itself a single goal: to compare the real wages in the two states and their fluctuations in time (all wages in data queue are recalculated to the level of year 2014). It therefore disregards further economic factors, such as real purchasing power, inflation, or the exchange rate CZK/€. These factors could be taken into consideration but they are more useful as a subject for further research.

2. Methodology

To analyse the time series we used two data sources. The Czech data were collected by the firm Trexima Ltd. during regular statistical surveys on average wages – Average Earnings Information System. The data were collected regularly for the second quarter of the relevant calendar year as in these quarters are the most stable working hours and the data can be best compared in the individual years. Since the Slovak data are given in €, it was necessary to convert the Czech data. For their conversion into € we used the average exchange rate CZK/€ for the second quarter of the year published on the website of the Czech National Bank, "CNB"[1]. The source of the Slovak data is the database Slovstat on the website of the Statistical Office of the Slovak Republic[2]. We were also interested in the time series of average wages by education. We performed the comparison in MS Excel, largely graphically, and we calculated and compared growth tempos and average absolute growth.

We took into account the inflation rate. All data about wages have been recalculated into wage level of the year 2014. Inflation rates of the Czech and Slovak Republic were used from web pages of the Czech Statistical Office[3] and Slovak Statistical Office.

Because, we compare the average wage according to the education grade, it is necessary to test hypothesis o equality of locations in two samples (for two countries). There is no possible to apply standard two-sample t-test, because the data characteristics do not allow to test it by this way. We are working with data in the form of data queues which show linear trend. So they do not fulfil the presumption of normality and independence. That is why we used ordered test, concrete the Mann-Whitney test (Kotz, 2006) about equality of medians of both samples. We applied this test on the first difference of data queues for wages.

We tested hypothesis H_0 vs. alternative hypothesis H_1 at usual level $\alpha = 0.05$. These hypotheses represent:

$H_0: \ median1 = median2$,

$H_1: \ median1 \neq median2$, resp. $H_1: \ median1 < median2$,

where $median1$ is median of wages in Slovakia, $median2$ is median of wages in Czech Republic. Mann-Whitney test statistic has the form

$$U_1 = R_1 - \frac{n_1(n_1+1)}{2}, \text{ resp. } U_2 = R_2 - \frac{n_2(n_2+1)}{2}, \tag{1}$$

[1] Available on the website: http://www.cnb.cz (accessed March, 15, 2016).
[2] Available on the website: http://www.statistics.sk (accessed March, 15, 2016).
[3] Available on the website: www.czso.cz (accessed March, 15, 2016).

where n_1 (n_2) is the sample size for sample 1 (sample 2), and R_1 (R_2) is the sum of the ranks in sample 1 (in sample 2). The smaller value of U_1 and U_2 is the one used when consulting significance tables. Tables of critical values for is available at internet[4]. Because we have $n_1 = n_2 = 14$ (we work with first differences) for all test, the critical value is the same in all cases and is equal to 55.

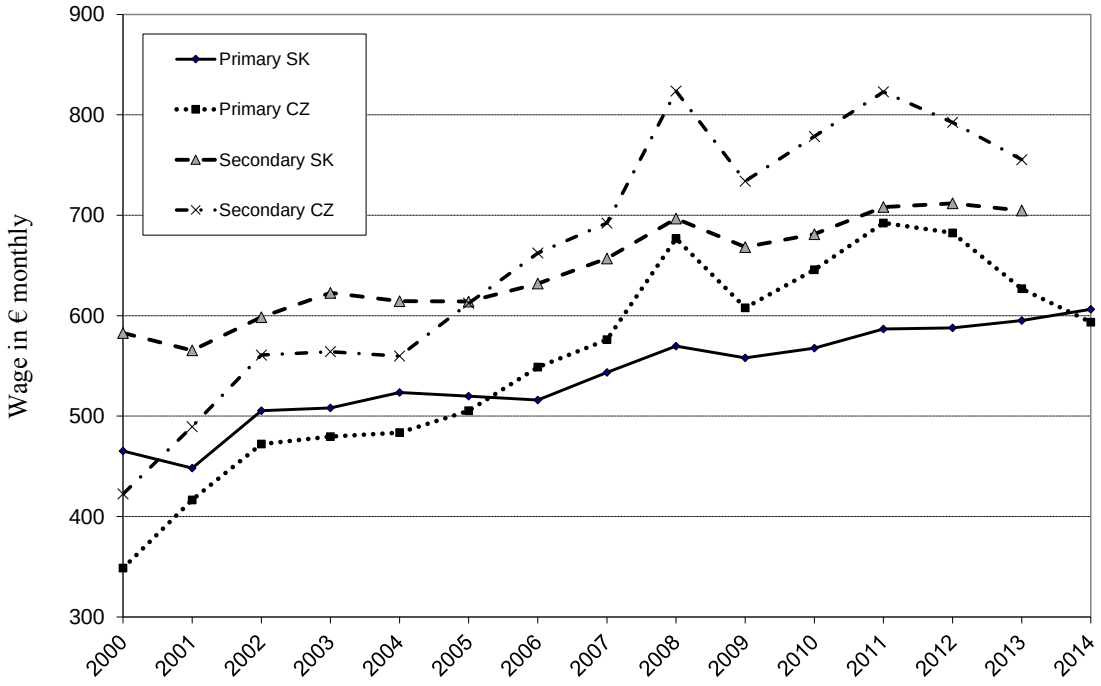
3. Results of Analyses

For this article we compared average wages by the following educational levels: primary, secondary technical, secondary with maturita, bachelors, masters, and scientific (PhD title). We divided the results for the sake of clarity into three groups. The first is primary and secondary technical education; the second separate group is secondary education with maturita, and the third is tertiary education.

3.1 Primary and Secondary Technical Education

To present the results we decided to compare the wage amounts by education. The first is primary and secondary technical education. The evolution of the wages in this group is shown in Figure 1. We only had data for secondary technical education until 2013.

Figure 1: Evolution of Primary and Secondary Technical School Leavers' Wages



Source: the authors based on data from Trexima Ltd.

The comparison of the evolution of primary school leavers' wages indicates that in the group of employees with primary education during the period under review, from 2000 to 2007, the evolution is practically identical in the Slovak and Czech economy despite the strengthening of the Czech koruna in this period. The wages in the Czech economy differed

[4] Available for example on the website: http://cit.vfu.cz/statpotr/POTR/Teorie/tabulky.htm#Mann (accessed in March, 15, 2016).

more in 2008, when the Czech koruna strengthened on the previous year by 12.17%. A repeated weakening of the Czech koruna after 2011 led to equalisation of the wages between the two economies. In 2014, as a result of the CNB intervention, the Czech currency fell by 6.26%. After the intervention the wage in Slovakia was a little higher than that in the Czech economy. A comparison of average wages in the secondary technical education category had very similar dependencies as for the wages of primary school leavers, with one difference: after the CNB intervention in 2013 no equalisation of wages between the two economies occurred.

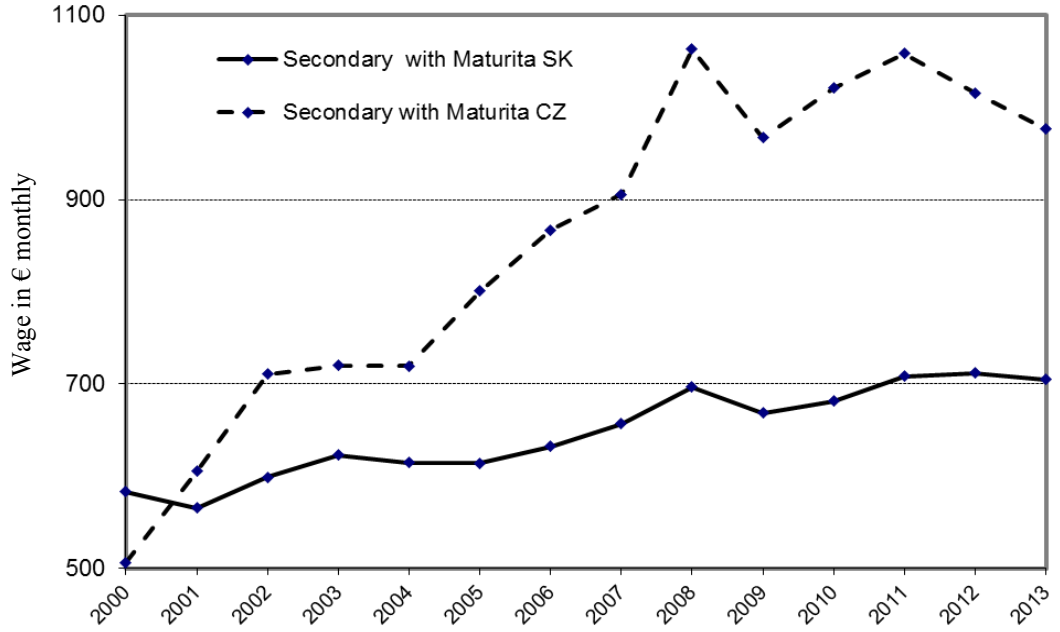
3.2 Comparison of Secondary Education with Maturita

Comparison of wages for secondary education with maturita is shown in Figure 2.

Figure 2 clearly shows that from the very beginning of the period under review the wages in the Czech economy had a faster growth tempo throughout the period from 2000 to 2011 also higher in the Czech Republic. In the Czech Republic this trend can be described with the linear function $y = 50.125t - 99{,}848$ with the index of determination $R^2 = 0.8566$, whereas in Slovakia the trend function has the formula $y = 11.285t - 21{,}997$ with the index of determination $R^2 = 0.918$. The fall in the secondary school leavers with maturita was caused in 2012 – 2013 by weakening of the Czech koruna against the €.

In 2013 the average wages in this category were 977 € in the Czech Republic and 705 € in the Slovak Republic.

Figure 2: Evolution of Wages for Secondary School Leavers with Maturita



Source: the authors based on data from Trexima Ltd.

Because in testing $H_0: median1 = median2$ against $H_1: median1 < median2$ we have $U = 65 > 55$, we reject H_0. The test confirms that the level of wages is greater in Czech Republic for category Secondary.

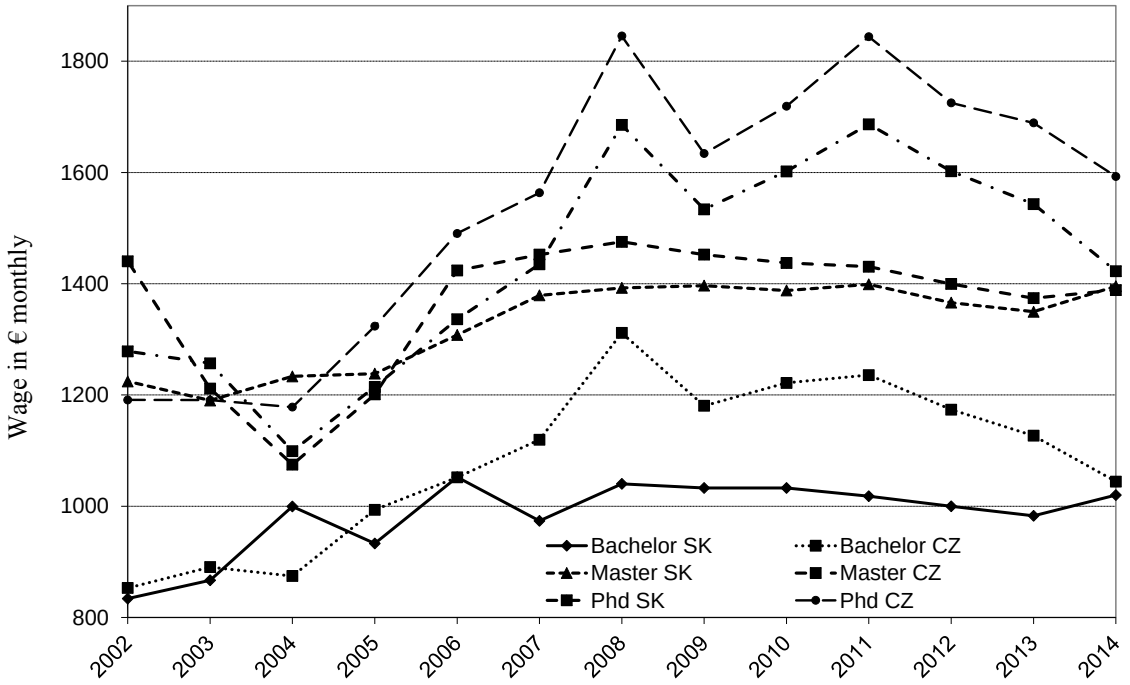
3.3. Comparison of University Graduates

The evolution of the wages of university graduates is shown in Figure 3. Bachelors level in the Slovak Republic shows permanent growth while in the Czech Republic there has been

since 2011 a visible decline in average wages in this category, caused by the drop in the exchange rate of the Czech koruna. This drop almost led after eight years to equalisation of the wages in this category between the two states. In 2014, the average wage was 1,044 € in the Czech Republic and 1,020 € in the Slovak Republic.

Because in testing $H_0 : median1 = median2$ against $H_1 : median1 < median2$ we obtain $U = 86 > 55$, we reject H_0. The test confirms that the level of wages is greater in Czech Republic for category Bachelor.

Figure 3: Evolution of university graduates' wages



Source: the authors based on data from Trexima Ltd.

Masters level. Comparison of the average wages between the two countries at the beginning of the period under review in 2002 clearly favoured the Czech Republic (1,279 € in the Czech Republic and 1,224 € in the Slovak Republic). In 2004 the two countries changed places because the average wage was 1,233 € in the Slovak Republic and 'only' 1,099 € in the Czech Republic. For another three years the wages in this category evolved in both counties in parallel: In 2008 (as a result of the strengthening of the Czech koruna against the €) masters' average wages in the Czech economy were much higher in comparison with Slovakia. After the drop in the exchange rate of the Czech koruna in 2011 – 2014 the two values were practically equalised (in 2014 it was 1,396 € in the Slovak Republic and 1,423 € in the Czech Republic).

Because in testing $H_0 : median1 = median2$ against $H_1 : median1 < median2$ we obtain $U = 84 > 55$, we reject H_0. The test confirms that the level of wages is greater in Czech Republic for category Master.

Doctoral level. Generally speaking, the doctoral level should be a gateway to higher positions in management, which are well paid, but, also to academic careers where the wages are more meagre. At the beginning of the period under review, in 2002, the average wages in this category clearly favoured the Slovak Republic (1,259 € in the Slovak Republic, 814 € in the Czech Republic). Afterwards the evolution of average wages differed significantly. While in Slovakia their value decreased, in the Czech Republic it stagnated. After 2004, growth in

average wages in this category began both in Slovakia and in the Czech Republic, amounting in Slovakia to 1,453 € and to 1,563 € in the Czech Republic in 2007. After this the evolution of wages in Slovakia had a relatively low dynamic of evolution, whereas in the Czech Republic wages rose more steeply. These changes were naturally accompanied by a change in the exchange rate (rapid growth in 2008; subsequent decline from 2011). By the end of the period under review the difference was relatively high, despite the depreciation of the Czech koruna, amounting to almost 200 € (1,389 € in the Slovak Republic, 1,593 € in the Czech Republic).

Because in testing $H_0 : median1 = median2$ against $H_1 : median1 < median2$ we obtain $U = 72 > 55$, we reject H_0. The test confirms that the level of wages is greater in Czech Republic for category Doctoral.

An identified specific of the comparison between the masters and doctoral level in the Slovak Republic was that wages in these two categories evolved with a minimum difference. It follows that in the Slovak Republic there is no great difference between the average wages in these two categories (in 2014 it was only 7 €). This is unlikely to motivate workers employed in Slovakia to pursue doctoral study programmes.

3.4 Basic Descriptive Characteristics of the Time Series

In Table 1 we show the basic characteristics of the observed time series. These are the average annual growth tempo and average annual growth in average wages throughout the period under review by individual level of education.

Table 1: Average Growth Tempo and Average Absolute Growth in Period Under Review

Level of education	Average annual growth rate	Average annual absolute increase in €
Primary SK	1.019	10.9
Primary CZ	1.039	18.8
Secondary Technical SK	1.015	10.2
Secondary Technical CZ	1.046	27.7
Secondary with Maturita SK	1.015	10.2
Secondary with Maturita CZ	1.052	39.2
Bachelor SK	1.017	16.9
Bachelor CZ	1.017	17.4
Master SK	1.012	15.0
Master CZ	1.041	43.8
Phd SK	1.007	9.3
Phd CZ	1.049	55.6

Source: the authors based on data from Trexima Ltd.

These basic characteristics only bear out what we had read from the graphs. With the exception of bachelors study the average growth tempo is higher in the Czech Republic, sometimes markedly (masters and scientific level). This is in keeping with the average absolute growth values. They only confirm that in the Czech Republic (again excluding bachelors) the average absolute wages rise more rapidly than in Slovakia. For example, at the PhD level the average yearly increase is 0.7% as against the value of 4.9% in Slovakia, which represents in absolute figures an average growth of 55.6 € per annum, whereas in Slovakia it is only 9.3 €.

4. Conclusions

After comparing average wages in different educational categories between the Czech and the Slovak economy we arrived at the following conclusions:

Average wage in the categories primary and secondary technical education in both economies was practically equal in 2014. Although in the period under review the average wage in the Czech economy in 2008 in both categories differed from the Slovak one, but as a result of the CNB intervention at the end of 2013 (the impact is quantified for the year 2014) the average wages in each category were again equalised.

Average wage in the category secondary education with Maturita shows a very different trend. In this category the average wage in the Czech Republic is markedly higher throughout the period under review. In the first year, 2002, the difference in favour of the Slovak economy was 77 €, but by the end of the survey, despite the drop in the exchange rate of the Czech koruna against the €, the difference already amounted to 273 € ion favour of the Czech economy. In Slovakia, in this category, the average wage was only 72.16% of the wage in the Czech Republic.

University education is typified by three educational categories – bachelors, masters, and scientific (PhD).

- Average wage in the bachelors category evolved similarly to the primary and secondary technical categories. From the beginning of the period under review, that is 2002 to 2006, the average wage evolved similarly in both states. After 2007 the strengthening of the Czech koruna against the € led to a rise in the average wages in the Czech Republic as against Slovakia. This trend was equalised by the CNB intervention and by the end of the period under review in 2014 the average wage in both states was practically equal (1,040 € in the Czech Republic, 1,020 € in the Slovak Republic).
- Practically identical conclusions are reached in the masters category as in the bachelors category, with one difference: At the beginning of the period in 2002 the average wage in the Slovak Republic was higher by 273 € in this category. By the end of the period under review this difference was only 27 € in favour of the Czech Republic.
- However, the situation is significantly different with regard to the average wages in category of scientific education (PhD). At the beginning of the period under review, in 2002, the average wage in the Slovak Republic was 445 € higher in this category. Throughout the period under review (except the last two years) this average wage rose very rapidly in the Czech economy. In the Slovak economy the growth was permanent throughout the period under review, but it was very protracted. As a consequence, by the end of the period under review in 2014 there was a difference of 204 € in favour of the Czech average wages. In Slovakia in this category the average wage was only 87.18% of the wage in the Czech Republic.
- Another thought-provoking conclusion that we reached by analysing the wages in the Slovak economy is the fact that the average wage in the category of masters and scientific education in 2014 differed little, by only 7 €. In addition, Figure 3 illustrates the evolution: Since 2006 the average wage in the scientific education category was slightly higher than in the masters category. As a result, workers do not have financial motivation to pursue PhD fields of study as in the countries of Western Europe and in the USA, and after completing a doctoral course of study do not go to work in the Slovak economy.

In the Czech Republic (except for bachelors education), average absolute wages rise faster than in Slovakia (see Table 1).

Acknowledgements

This paper was written with the support of the Czech Science Foundation project No. P402/12/G097 „DYME – Dynamic Models in Economics“. The paper was processed with contribution of long term institutional support of research activities by Faculty of Informatics and Statistics, University of Economics, Prague. IP 400040

References

[1] BARTOŠOVÁ, J., LONGFORD, N. T. 2014. A study of income stability in the Czech Republic by finite mixtures. In Prague Economic Papers, 2014, vol. 23, iss. 3, pp. 330–348. ISSN 1210-0455.

[2] DOUCEK, P., NEDOMOVÁ, L., MARYŠKA, M. 2015. Is it attractive to be the ICT professional in the Czech economy? In IDIMT-2015 Information Technology and Society Interaction and Interdependence. Linz : Trauner Verlag Universität, 2015, ISBN 978-3-99033-395-2, pp. 73–88.

[3] HANČLOVÁ, J., DOUCEK P. 2012. The impact of ICT capital on labor productivity development in the sectors of the Czech economy, In: IDIMT-2012 – ICT Support for Complex Systems. Linz : Trauner Verlag Universität, 2012, ISBN 978-3-99033-022-7, pp. 123-133.

[4] HANČLOVÁ, J., DOUCEK, P., FISCHER, J., VLTAVSKA K. 2015. Does ICT capital affect economic growth in the EU-15 and EU-12 countries? In Journal of Business Economics and Management, 2015, vol. 16, iss. 2, pp. 387-406.

[5] KOTZ, S. 2006. Encyclopedia of statistical sciences, Volume 7. Hoboken : Wiley, 2006, ISBN 0-471-74375-5, pp. 4476.

[6] MALÁ, I. 2015. Vícerozměrný pravděpodobnostní model rozdělení příjmů českých domácností. In Politická ekonomie, 2015, vol. 63, iss. 7, pp. 895–908.

[7] MANĎÁK, J., NEDOMOVÁ, L. 2014. Measuring performance of European ICT sectors using output-oriented DEA models. In IDIMT-2014 (Networking Societies – Cooperation and Conflict). Linz : Trauner, 2014, ISBN 978-3-99033-340-2, pp. 79-86.MAREK, L. 2010. Analýza vývoje mezd v ČR v letech 1995-2008. In Politická ekonomie, 2010, vol. 58, iss. 2, pp. 186–206.

[8] MAREK, L. 2013. Some aspects of average wage evolution in the Czech Republic. In International Days of Statistics and Economics. Slaný : Melandrium, 2013, ISBN 978-80-86175-87-4, pp. 947-958.

[9] MARYŠKA, M., DOUCEK, NEDOMOVÁ, L. 2015. ICT professionals wages development. In Liberec Economic Forum. Liberec : Technical University of Liberec, 2015, ISBN 978-80-7494-225-9, pp. 101–111.

[10] NEDOMOVÁ, L., DOUCEK, P., MARYŠKA, M. 2015. ICT professionals in the Czech economy, structural changes in human resources. In Proceedings of the 11th international conference on Strategic Management and its Support by Information Systems 2015 (SMSIS). Ostrava : VŠB TU FE, 2015, ISBN 978-80-248-3741-3, pp. 419-430.

[11] SIXTA, J., VLTAVSKÁ, K., FISCHER, J. 2013. The development of gross domestic product in the Czech Republic and Slovakia between 1970 and 1989. In Ekonomický časopis, 2013, vol. 61, iss. 6, pp. 549–562.