

## WHAT IS THE INFLUENCE OF THE GLOBAL ECONOMIC CRISIS ON THE DEVELOPMENT OF THE WAGE DISTRIBUTION OF CZECHS AND SLOVAKS?



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### ABSTRACT

#### Keywords

Wage distribution according to the gender  
Wage growth, Financial crisis  
Wages of Czech and Slovak employees  
Gini coefficient of concentration  
Development of wage  
Forecasts of wage distribution  
Wages in the world.

#### JEL Classification:

J31, G01, H24, E24, D31, O15.

This paper deals with the development of wage distribution by gender in the Czech and Slovak Republics in the years 2005–2012. Special attention is given to the changing in the behavior of the wage distribution in relation to the onset of the global economic recession. The different behavior of the wage distribution of Czech and Slovak employees during the period is the subject of research. The article discusses the differences in wage level between men and women in the Czech and Slovak Republics. There are the total wage distributions of men and women together, both in the Czech Republic and in the Slovak Republic on the one hand, and wage distributions according to the gender separately for men and for women on the other hand. Comparison of wage levels in the world and the position of wages of the Czech employees in the international context is included, too.

### 1. INTRODUCTION

Development of employee wage of Czech and Slovak Republics in the last two decades requires us to pay more attention to the issues of their differentiation in the research. This leads to strong changes in this area. Wage structure of the population changes, the level and differentiation grow. Groups of people with very high wages arise here and they are gradually becoming more pronounced. In the research of wage differentiation it is not enough to focus only on the assessment of the current situation and forecast future development based on the average wage broken down by different socio-economic, time-spatial and demographic considerations, but it is helpful to move from the level characteristics to the whole of frequency distribution.

Considerable attention is paid to the wage and income distribution in the statistical literature. A number of authors in the Czech and Slovak Republics dealt with the analysis of wage and income

distribution, see for example Bílková (1995), Bílková (2012), Marek (2010) or Pacáková and Sipková (2007). Many authors researched the area of wages and incomes also in the world, see for example Behr (2007), Kaasa (2006), Mallick (2008), Milanovic (2002), Monti and Santoro (2009), Rothschild (2005), Wessels (2008), and Wolff (2009). Publications of Italian author are very famous in the world, see Dagum (1997) and Dagum (1999). Because the establishment and development of the minimum wage influence strongly the development of the wage and income distribution, considerable attention is paid to the issue of minimum wage in the statistical literature, see Cunningham (2007) or Waltman (2000). The question of wages is closely related to the development of unemployment, see for example Löster and Langhamrová (2011) or Miskolczi (2011) or to the development of inflation, see Franta *et al.* (2010), or to another macroeconomic aggregates.

The theoretical nature of the methods used is not described here due to the focus of this journal. Used descriptive characteristics of the wage distribution are explained for example in Triola (2003). One-way analysis of variance test used is explained for example in Turner and Thayer (2001).

## 2. DATABASE

Processed data come from the Official website of the Czech Statistical Office and of the Statistical Office of the Slovak Republic. There are the data in the form of the interval frequency distribution with open extreme intervals. The researched variable is the gross monthly wage in EUR. Conversion of CZK to EUR and SKK to EUR (2005–2008) was made using the exchange rate to half of that calendar year, see Table 1.

Table-1. Exchange rates for half of the calendar year

Exchange rate	At the date of							
	July 1, 2005	June 30, 2006	June 29, 2006	July 1, 2008	July 1, 2009	July 1, 2010	July 1, 2011	June 29, 2012
CZK/1 EUR	30.000	28.495	28.715	23.825	25.775	25.760	24.315	25.640
SKK/100CZK	78.153	74.302	85.360	78.902	—	—	—	—

www.cnb.cz

Because the focus of research is the nominal wage, Table 2 presents the development of average annual rate of inflation in both countries during the period. Since the level of minimum wage markedly affects the wage distribution, Table 2 also provides an idea of the development of minimum wage in both states in the researched period. In 2013 the minimum wage is 312.0 EUR in the Czech Republic and 337.7 EUR in the Slovak Republic. As the wage development is strongly tied to the development of such indicators as unemployment rate and gross domestic product (GDP), Table 2 provides an overview of the development of these indicators for the comparison. Figures 1 and 2 show the growth rate of GDP in the period.

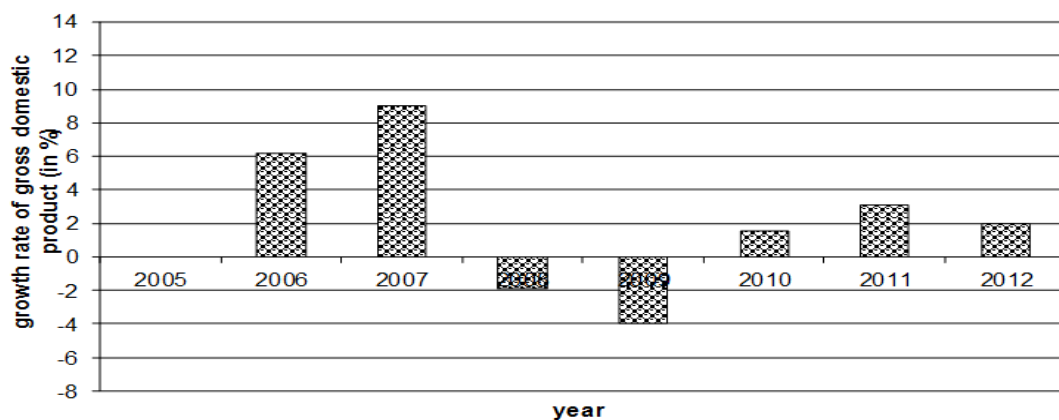
Data were processed using the spreadsheet Microsoft Excel and statistical program packages SAS and Statgraphics.

**Table-2.** Minimum wage (in EUR), unemployment rate (in %), average annual inflation rate (in %), gross domestic product at current prices calculated by income approach (in mil. EUR)

Year	Czech Republic				Slovak Republic			
	Minimum wage	Unemployment rate	Inflation rate	Gross domestic product	Minimum wage	Unemployment rate	Inflation rate	Gross domestic product
2005	239.5	7.9	1.9	103,868.5	169.3 <sup>1</sup>	16.2	2.7	49,315.2
2006	265.7 <sup>2</sup> 279.2 <sup>3</sup>	7.1	2.5	117,655.7	179.9 <sup>4</sup>	13.3	4.5	55,081.9
2007	278.6	5.3	2.8	127,549.1	225.9 <sup>5</sup>	11.0	2.8	61,501.1
2008	335.8	4.4	6.3	161,528.3	268.3	9.6	4.6	66,842.3
2009	310.4	6.7	1.0	145,838.2	295.5	12.1	1.6	62,794.4
2010	310.6	7.3	1.5	147,161.5	307.7	14.4	1.0	65,869.5
2011	329.0	6.7	1.9	157,244.5	317.0	13.5	3.9	69,108.3
2012	312.0	7.0	3.3	149,997.1	327.2	14.0	3.6	71,463.0

Source: <http://www.czso.cz>, <http://portal.statistics.sk>, own research

### 3. COMPARISON OF THE DEVELOPMENT OF WAGE LEVEL IN THE CZECH AND SLOVAK REPUBLICS



**Figure-1.** The growth rate of gross domestic product (in %) in the Czech Republic in the period 2005–2012

Source: Own research

<sup>1</sup> from 1 October 2004 to 1 October 2005

<sup>2</sup> from 1 January 2006 to 30 June 2006

<sup>3</sup> from 1 July 2006 to 31 December 2006

<sup>4</sup> from 1 October 2005 to 1 October 2006

<sup>5</sup> from 1 October 2006 to 1 October 2007

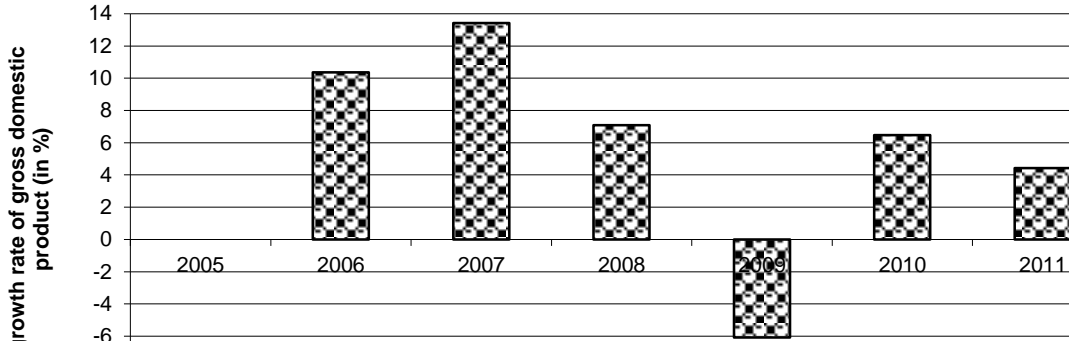


Figure-2. The growth rate of gross domestic product (in %) in the Slovak Republic in the period 2005–2012

Source: Own research

Figure 3 shows the development of location characteristics of total wage distribution (for men and women together) in the Czech and Slovak Republics in the researched period 2003–2012 including forecasts for 2013 and 2014. Figures 4 and 5 show the same thing, but for men and women separately. Tables 3 and 4 represents growth annual coefficients and average growth annual coefficients of the arithmetic mean, median and medial of gross monthly wage in the period 2005–2012 including the predictions for 2013 and 2014 in the Czech and Slovak Republics according to the gender.

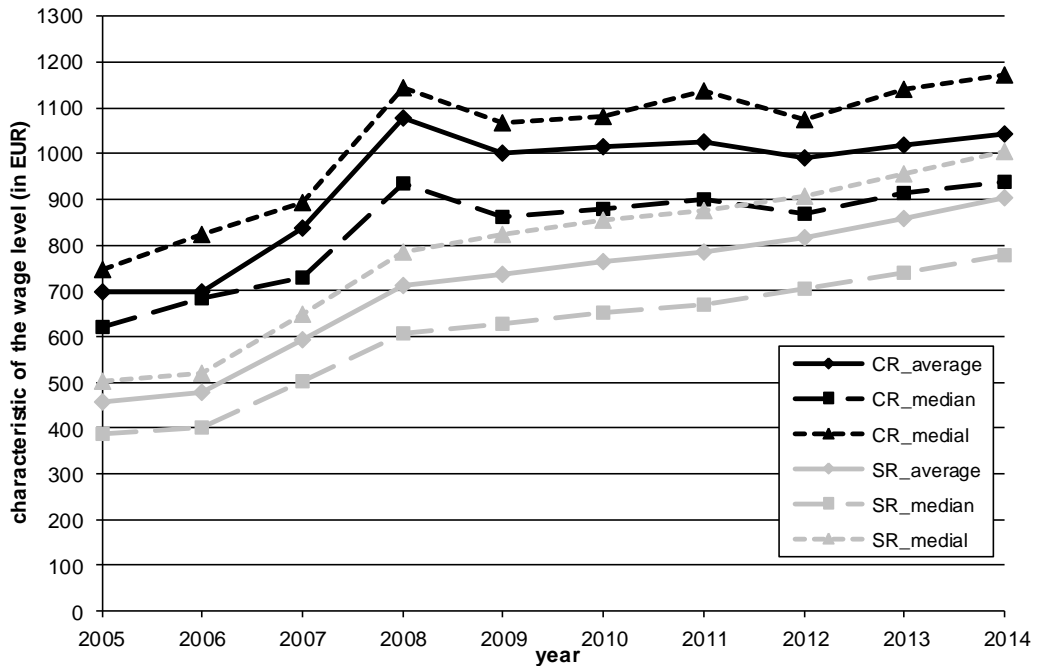


Figure-3. Development of the location characteristics of wage distribution of the Czech and Slovak employees (total set) between 2005 and 2012 including the prediction for 2013 and 2014

Source: Own research

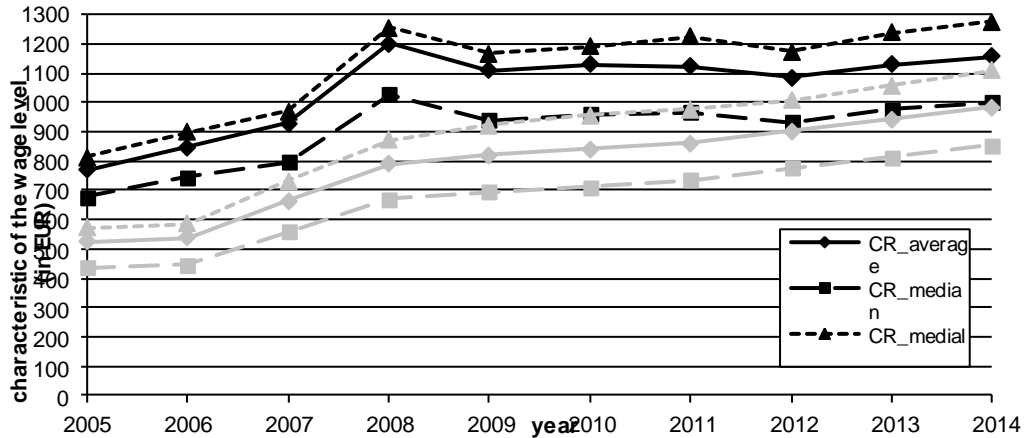


Figure-4. Development of the location characteristics of wage distribution of the Czech and Slovak employees (set of men) between 2005 and 2012 including the prediction for 2013 and 2014

Source: Own research

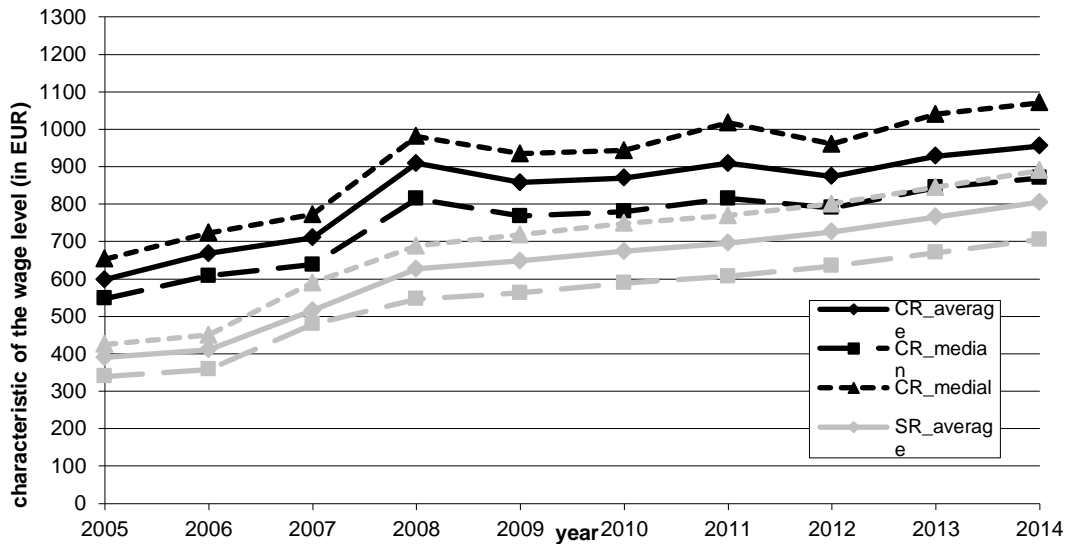


Figure-5. Development of the location characteristics of wage distribution of the Czech and Slovak employees (set of women) between 2005 and 2012 including the prediction for 2013 and 2014

Source: Own research

Medial is such a characteristic of wage level that workers with wages less than or equal to medial get half of the total amount of wages and workers with wages greater than or equal to medial get the other half of the total amount of wages.

Comparison of the development of wage level between the Czech and Slovak Republics is interesting. While in the first year of the financial crisis in 2009 we record appreciable drop in the wage level in the Czech Republic, both in terms of total wage distribution for men and women together, and in terms of separate wage distribution individually for men and women, wages in the Slovak Republic in 2009 continue to grow, even though they are far below the growth rate before

the financial crisis, see Figures 3–5 and Tables 3–4. We can see a similar drop in the wage level in the Czech Republic in 2012, unlike the Slovak Republic, where wage increases in this year.

**Table-3.** Growth annual coefficients and average growth annual coefficients of the arithmetic mean, median and medial of gross monthly wage in the period 2005–2012 including the predictions for 2013 and 2014 in the Czech Republic according to the gender

Year	Total			Men			Women		
	Average	Median	Medial	Average	Median	Medial	Average	Median	Medial
2005	–	–	–	–	–	–	–	–	–
2006	1.109	1.105	1.102	1.103	1.101	1.103	1.117	1.109	1.107
2007	1.083	1.063	1.084	1.095	1.070	1.081	1.063	1.049	1.068
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2008	1.287	1.282	1.284	1.292	1.289	1.295	1.280	1.276	1.271
2009	0.929	0.925	0.932	0.923	0.914	0.928	0.944	0.943	0.953
2010	1.015	1.017	1.014	1.016	1.022	1.021	1.014	1.016	1.009
2011	1.012	1.023	1.050	0.995	1.006	1.030	1.045	1.045	1.078
2012	0.966	0.965	0.946	0.969	0.965	0.958	0.961	0.969	0.944
2013	1.026	1.053	1.062	1.038	1.048	1.056	1.062	1.068	1.083
2014	1.109	1.105	1.102	1.103	1.101	1.103	1.117	1.109	1.107
Ø 2005-08	1.156	1.146	1.153	1.160	1.149	1.156	1.150	1.141	1.145
Ø 2008-12	0.980	0.982	0.984	0.975	0.976	0.983	0.990	0.993	0.995
Ø 2005-12	1.052	1.049	1.053	1.050	1.047	1.054	1.056	1.054	1.057
Ø 2012-14	1.026	1.04	1.044	1.032	1.036	1.042	1.045	1.049	1.056
Ø 2005-14	1.046	1.047	1.051	1.046	1.044	1.051	1.053	1.053	1.057

Source: Own research

**Table-4.** Growth annual coefficients and average growth annual coefficients of the arithmetic mean, median and medial of gross monthly wage in the period 2005–2012 including the predictions for 2013 and 2014 in the Slovak Republic according to the gender

Year	Total			Men			Women		
	Average	Median	Medial	Average	Median	Medial	Average	Median	Medial
2005	–	–	–	–	–	–	–	–	–
2006	1.041	1.041	1.040	1.029	1.023	1.024	1.054	1.053	1.059
2007	1.243	1.251	1.244	1.236	1.251	1.245	1.255	1.338	1.311
2008	1.197	1.209	1.210	1.185	1.201	1.192	1.215	1.140	1.166
2009	1.038	1.035	1.050	1.039	1.034	1.060	1.033	1.031	1.044
2010	1.035	1.035	1.039	1.028	1.026	1.037	1.040	1.046	1.043
2011	1.028	1.031	1.026	1.024	1.035	1.020	1.033	1.031	1.027
2012	1.042	1.048	1.035	1.045	1.053	1.032	1.043	1.046	1.042
2013	1.051	1.053	1.053	1.047	1.050	1.051	1.055	1.055	1.055
2014	1.041	1.041	1.040	1.029	1.023	1.024	1.054	1.053	1.059
Ø 2005-08	1.157	1.164	1.161	1.146	1.154	1.150	1.171	1.171	1.174
Ø 2008-12	1.036	1.037	1.037	1.034	1.037	1.037	1.037	1.038	1.039
Ø 2005-12	1.086	1.089	1.089	1.081	1.086	1.084	1.093	1.093	1.095
Ø 2012-14	1.051	1.051	1.052	1.046	1.049	1.050	1.053	1.054	1.054
Ø 2005-14	1.078	1.081	1.08	1.073	1.077	1.076	1.084	1.084	1.086

Source: Own research

We can say that wage growth in the Czech Republic has virtually stopped during the global economic crisis, while the Slovak wage also grows in the period of financial recession, in spite of they are far below the growth rate before the financial crisis. However, it can be assumed that wage development is very closely tied to the development of gross domestic product. We can see from Figures 1 and 2 that the Slovak Republic evinces more positive development of GDP during all period of the financial crisis (with the exception of 2011) than the Czech Republic. Figures 3–5 also show a strongly higher wage level in the Czech Republic compared to the wage level in the Slovak Republic. The obtained results also show that although the development of wage level in the Czech Republic during the world economic crisis shows an average annual decline and the development of wage level in the Slovak Republic in this period shows an average annual growth, the level of nominal wage in the Slovak Republic is still markedly below the nominal wage in the Czech Republic now. However, Figure 6 shows that the difference between the wage level in the Czech Republic and in the Slovak Republic is decreasing with time.

Figures 7 and 8 represent a different development of differences in wage levels between men and women in the Czech Republic and in the Slovak Republic. We can observe from these figures that while the difference in wage levels between men and women in the Czech Republic is on a downward trend since the beginning of the financial crisis, the difference of wage levels between men and women in the Slovak Republic has a growing tendency even in times of global financial crisis, which is likely related to the increase in the level of wages in the Slovak Republic during the crisis. Difference in wage levels between men and women is now approximately the same in the Czech and Slovak Republics, see Figures 7–8.

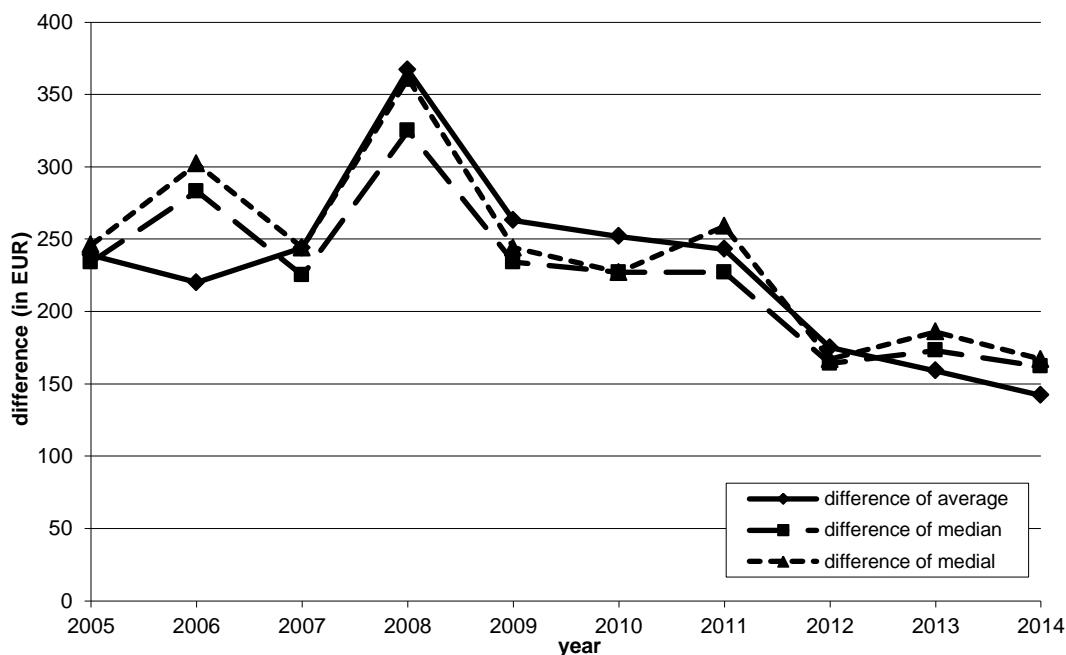


Figure-6. Differences of the location characteristics of wage distribution between the Czech and Slovak employees (total set) between 2005 and 2012 including the prediction for 2013 and 2014

Source: Own research

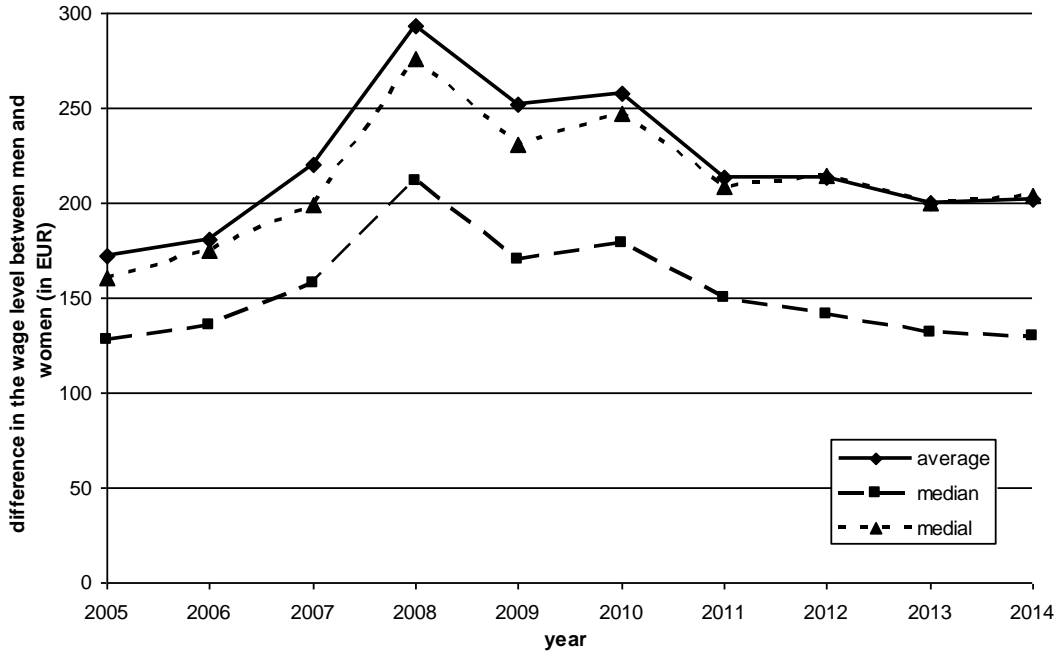


Figure-7. Differences in the wage level (in EUR) between the Czech men and women employees in the period 2005–2012 including the prediction for 2013 and 2014

Source: Own research

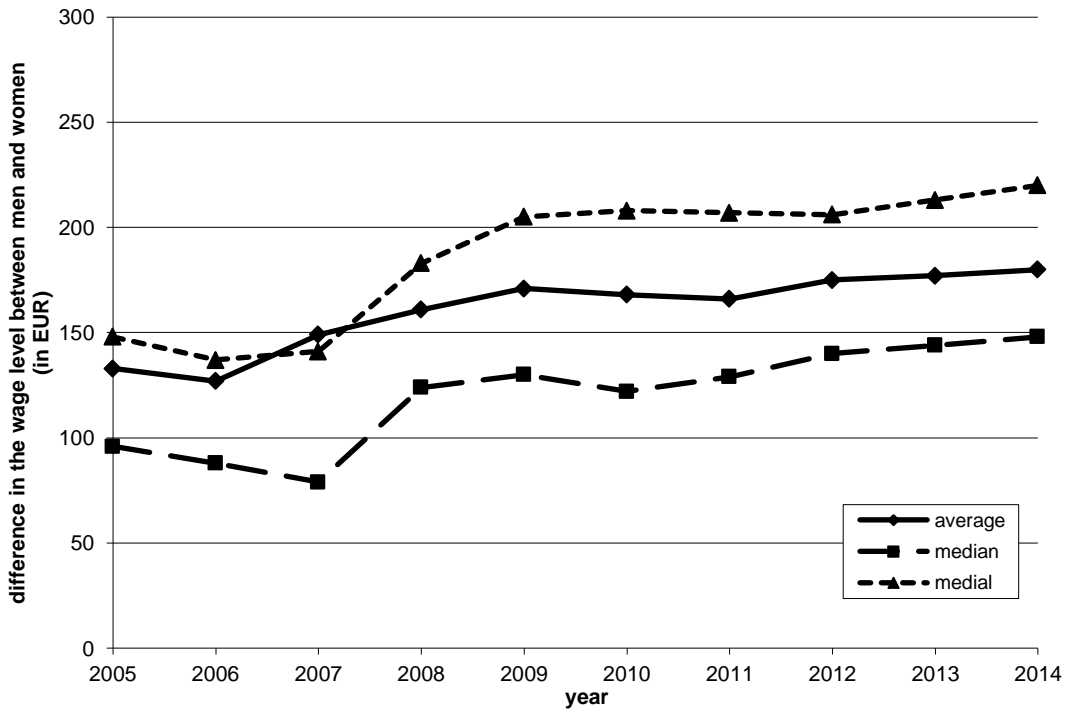


Figure-8. Differences in the wage level (in EUR) between the Slovak men and women employees in the period 2005–2012 including the prediction for 2013 and 2014

Source: Own research



#### 4. DEVELOPMENT OF WAGE DIFFERENTIATION, SKEWNESS AND CONCENTRATION

Known characteristics of differentiation and skewness were used to descriptive the development of wage distributions of men and women in the Czech and Slovak Republics in the years 2005–2012, see Tables 5–6.

We observe an increasing absolute variability (standard deviation) of wages of Czech men and women in the period before the economic crisis, while the absolute variability of wages of Czech men and women rather fluctuates during the economic recession. Absolute variability of Slovak men and women grows all over the researched period.

Because the absolute variability of wages increases with the level of wages, the use of relative characteristic (coefficient of variation) of wages is useful in this regard. While relative variability of wages of men and women in the Czech Republic has rather a growing trend in all monitored period, the relative variability of wages of men and women in the Slovak Republic has rather a downward tendency in this period. This is evident from the results that the global economic crisis does not considerably affect the wage distributions in terms of their relative variability in the Czech and Slovak Republic. Tables 5–6 provide an overview of the development of moment measure of skewness of wage distributions, too.

**Table-5.** Development of sample characteristics of variation and skewness of the gross monthly wage (standard deviation (in EUR), coefficient of variation (in %) and moment measure of skewness (without unit)) of the Czech employees in the period between 2005–2012 according to the gender

Year	Men			Women		
	Standard deviation	Coefficient of variation	Moment skewness	Standard deviation	Coefficient of variation	Moment skewness
2005	390	50.65	2.052	306	51.17	0.877
2006	424	49.94	1.947	337	50.45	0.855
2007	564	60.65	2.868	408	57.46	1.914
2008	717	59.65	2.717	523	57.54	1.728
2009	675	60.81	2.673	490	57.11	1.721
2010	680	60.28	2.610	493	56.67	1.706
2011	717	63.90	2.426	519	57.10	1.777
2012	683	62.83	2.480	498	56.98	1.838

Source: Own research

Gini coefficient was used to characterize the development of concentration of wage distribution of men and women in the Czech and Slovak Republics in the period. Gini coefficient is related to the famous Lorenz curve, see Figure 9, Lorenz curve is a bold here (including two extreme possibilities of shape for the case of zero concentration and for the case of maximum possible concentration). Lorenz curve is plotted in a rectangular chart with two scales from 0 percent to 100 percent. The cumulative relative frequencies (percentage) of the units representing the wearers of studied variable are the abscissa. Employees are carriers of gross monthly wage in this case. Cumulative totals of concentrated variable (percentage) are located on the axis of ordinates. Gross monthly wage is concentrated variable in this case. Cumulative relative

frequencies of units (in %), which represent the wearers of studied variable, and their corresponding cumulative totals of concentrated variable (in %), thus represent the coordinates of points on the Lorenz curve. Lorenz curve merges with a diagonal of the graph in the case of zero concentration, when the same proportion of the total sum of values of the researched variable falls on each unit. In this case, this situation would be if every employee had the same gross monthly wage. Lorenz curve bends more the concentration of researched variable is greater, when the concentration of considerably large part of the total sum of values of the variable grows into a small number of units. The highest concentration occurs when the total sum of values of variable is only concentrated into a single unit.

**Table-6.** Development of sample characteristics of variation and skewness of the gross monthly wage (standard deviation (in EUR), coefficient of variation (in %) and moment measure of skewness (without unit)) of the Slovak employees in the period between 2005–2012 according to the gender

Year	Men			Women		
	Standard deviation	Coefficient of variation	Moment skewness	Standard deviation	Coefficient of variation	Moment skewness
2005	347	66.35	2.630	227	58.21	2.626
2006	364	67.66	2.578	248	60.34	2.659
2007	431	64.81	2.408	306	59.30	2.465
2008	495	62.82	2.259	364	58.05	2.168
2009	517	63.13	2.182	373	57.56	2.047
2010	527	62.59	2.077	385	57.12	1.921
2011	527	61.14	2.042	393	56.47	1.885
2012	531	58.93	2.029	395	54.41	1.821

Source: Own research

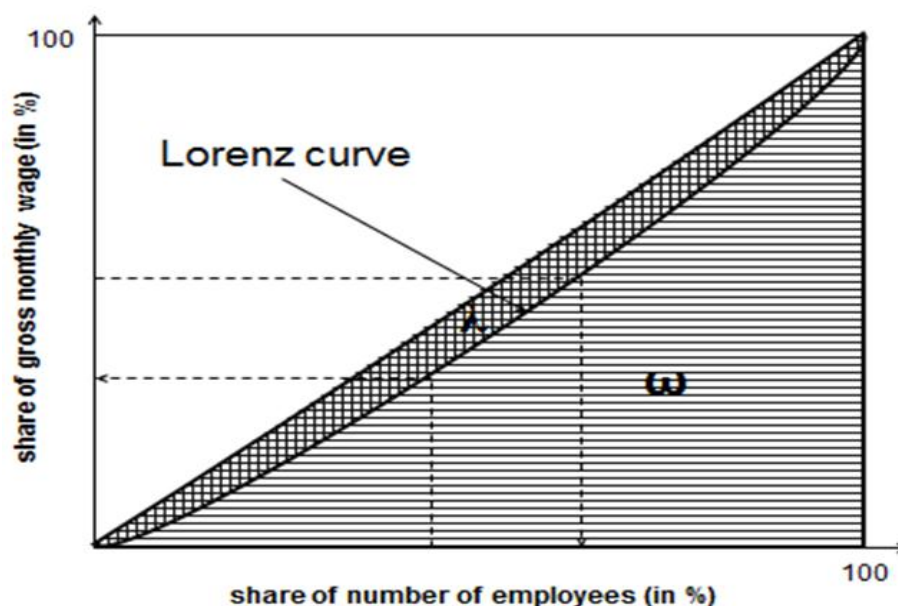


Figure-9. Lorenz curve

Source: Own research

Gini concentration coefficient is the ratio of the area content that define the diagonal of the graph and the Lorenz curve, which is indicated  $\lambda$  in Figure 9, and the content of the total area of the triangle below the diagonal of the graph, which is indicated by an area  $\lambda + \omega$  in Figure 9

$$G = \frac{\lambda}{\lambda + \omega}$$

The value of Gini coefficient is thus ranges from zero at extreme leveling (zero concentration), where all employees have the same wage, to one with extreme differentiation (maximum possible concentration), where all wage belongs to one employee.

We can observe again the different behavior of the wage distributions in terms of their concentration both, among the Czech and Slovak Republics, and between men and women in both these countries, see Figure 10. While the concentration of total wage distribution in the Czech Republic for men and women together gradually increases with the exception of the last year 2012, the concentration of total wage distribution in the Slovak Republic for men and women together is still approximately at the same level throughout the followed period (with a slightly decreasing trend). Although the concentration of this total wage distribution in the Czech Republic is sharply lower than in the Slovak Republic at the beginning of researched period, it is approximately at the same level at the end of this period. The concentration of wage distributions of men develops approximately the same way as the concentration of corresponding total wage distribution in the state (in both countries), see Figure 10. In both countries the concentration of wage distributions of women develops in very different ways than that of wage distribution of men and it is approximately at the same level throughout the period, with slight fluctuations.

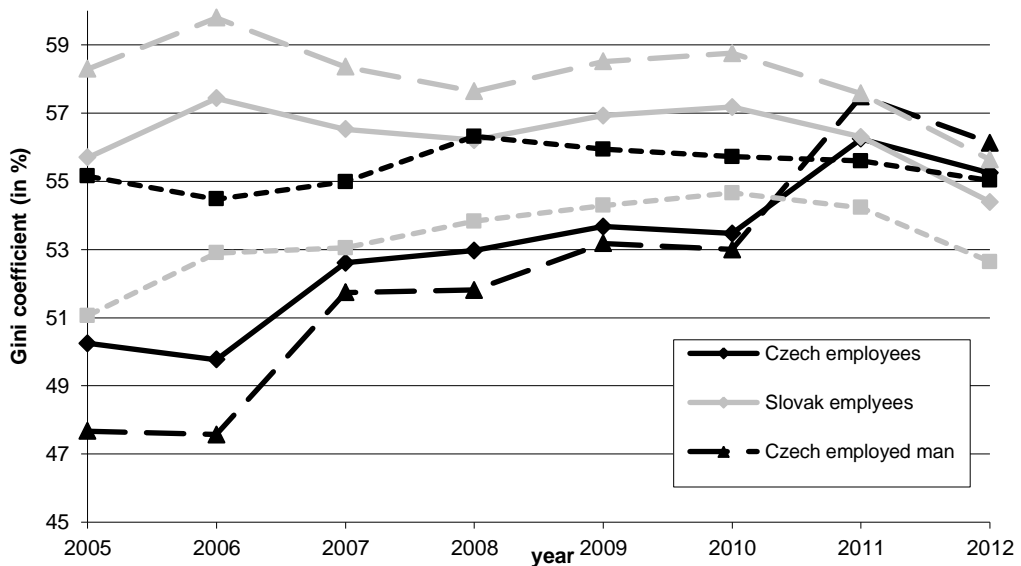


Figure-10. Development of Gini coefficient of concentration (in %) of the Czech and Slovak employees in the period between 2005–2012 according to the gender

Source: Own research

## 5. DEPENDENCE OF WAGE ON WHETHER THE EMPLOYEE WORKS IN THE CZECH OR SLOVAK REPUBLIC

Table 7 indicates the dependence of gross monthly wage of employee on what, whether he is employed in the Czech or Slovak Republic. One-way analysis of variance test known as the ANOVA was used to verify this dependence, see Turner and Thayer (2001). Gross monthly wage in EUR is an explained (dependent) variable. State with variations Czech Republic and Slovak republic is the explanatory (independent) variable.

**Table-7.** Sample characteristics of the total set for Czech and Slovak Republics together – the total average wage (in EUR), the total standard deviation (in EUR), the total coefficient of variation (in %), intergroup variance (in EUR<sup>2</sup>), intragroup variance (in EUR<sup>2</sup>), the value of test criterion *F*, the value of the coefficient of determination

Year	Arithmetic mean	Standard deviation	Coefficient of variation	Intragroup variance	Intergroup variance	Criterion F	Determination coefficient
2005	590	352	59.63	109,798	14,116	351,980	11.39
2006	642	387	60.30	128,324	21,458	483,282	14.33
2007	731	470	64.30	206,007	14,643	211,024	6.64
2008	919	592	64.45	317,415	33,043	313,541	9.43
2009	884	558	63.15	294,406	17,059	171,483	5.48
2010	902	562	62.28	300,066	15,701	157,501	4.97
2011	913	578	63.23	318,872	14,701	148,113	4.41
2012	939	576	61.31	325,107	6,449	98,925	1.94

Source: Own research

Table 7 presents the decomposition of the total variance of gross monthly wage into intragroup and intergroup folders and the output of the test, too. Therefore, it is the dependency of one numeric variable on one categorical variable, which is called a factor. Intragroup variability is the variability of individual gross monthly wages around the corresponding group average wage (the average wage in the Czech Republic and the average wage in the Slovak Republic). Intergroup variability is the variability of the group average wages around the overall average wage for Czechs and Slovaks together. It is assumed that the intergroup variability is explained by the given factor, while the intragroup variability is not explained by it.

In other words, the variability between groups is the originator of this dependency, and thus as the intergroup variability will be larger (the intragroup variability must be smaller), we will prove the dependency more even on the given significance level<sup>6</sup>.

It is obvious at the first glance to Table 7 that the decomposition of the total variance of gross monthly wage into individual components does not lead to too tight dependency of gross monthly wage on that, whether the employee is employed in the Czech republic or in the Slovak republic. It is evident that intragroup variability greatly exceeds the intergroup variability. The critical value is 3.84147 for 5% significance level and 6.63492 for 1% significance level in all cases due to the

<sup>6</sup> The significance level is the upper limit for the error probability of the first type, i.e. the probability that we reject our null hypothesis of independent (and we accept the alternative hypothesis supposing the dependence), although the tested hypothesis is true.

large sample sizes of wage distributions. The P-value is 0.00000 in all cases. It is clear from Table 7 that the F value of the test criterion unequivocally outperforms the critical value in all cases, even at the 1% level of significance, which leads to proving of this dependence.

The disproportion between the greatness of intragroup and intergroup variability in Table 7 on one side and (which indicates rather in favor of independence) and the relation between the test criterion values and the critical value (which shows dependence) on the other hand, is due to the large sample sizes, which are used working with wage distributions. In the case of such large sample sizes very high power test already exists and test reveals all the slightest deviations from the “independence”, which leads to the rejection of the tested null hypothesis of independence and to the proving of dependence at the given significance level. The dependence of gross monthly wage on that, whether the employee is employed in the Czech Republic or in the Slovak Republic is therefore statistically significant even at the 1% significance level.

Determination ratio then gives the tightness (power, intensity) of this dependence, it is the ratio between intergroup folder of variability and total variability. Determination ratio therefore indicates after the multiplication by a hundred, how many percent the intergroup variability (originator of the dependence) contributes to the total variability. This follows from the data in Table 7 that the dependence of gross monthly wage on that, whether the employee is employed in the Czech Republic or in the Slovak Republic is very weak throughout the period studied (variability within each level of factor clearly dominates). Moreover, we can say that the intensity of this dependence decreases over time, with the exception of 2003.

## **6. CONCLUSION**

The wage distribution of men and women in the Czech and Slovak Republics changes over time. Their absolute amount grows with relatively fast pace in the period before the global economic crisis (2003–2008). Wage growth in the Czech Republic has virtually stopped in the period immediately after the onset of economic recession. Later this sharp impact of the economic recession on wage growth eases in the Czech Republic in both genders and absolute wage levels begin to rise again (with the exception of 2012), but it is far below the rate of growth before the crisis. In contrast, in the Slovak republic, wage growth continues despite the period of economic recession in both genders, although wage growth has noticeably slowed down during the financial crisis. Although the level of nominal wages in the Czech Republic is still strongly higher than in the Slovak Republic, Slovak wages are closer to the level of Czech wages due to the different response of gross monthly wage in connection with the onset of economic recession in the Czech and Slovak Republics since the start of the financial crisis.

One-way analysis of variance tests clearly show the dependence of gross monthly wage on that, in which country the employee is employed, even at the 1% level of significance, however, observed intensity of this dependence is generally very weak.

In an international comparison of the level of wages with regard to the purchasing power parity the Czech Republic has a similar wage level as Croatia, Turkey, Qatar and China Hong-Kong.

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