WAGES IN THE CZECH AGRICULTURAL SECTOR: COMPARISON WITH INDUSTRIAL AND CONSTRUCTION SECTORS

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Abstract

The present paper focuses on the development of wage distribution in the Czech Republic in the period shortly before, during and after the global economic crisis. Special attention is paid to wage development in the agricultural sector and its comparison with the industrial and construction sectors' wage levels. The article deals with the development of statistical characteristics of the level, variability and concentration in the given period, mentioning the changes in these characteristics in the course of the economic recession. Since the relationship between the wage levels in the agricultural, industrial and construction sectors is monitored in other countries as well, the research topic can be analyzed within the whole European context, a comparison of the wage levels in the Czech Republic and other countries being drawn.

Key words: Global economic recession, development of wage distribution, agricultural sector, wage levels in European countries

JEL Code: J31, D31, Q14

Introduction

The economic situation of Czech farmers and their position within the European Union has been widely debated recently; e.g. in Šimpach (2012b), dealing with a particular agricultural aspect of the issue. The present paper focuses on the wage development in the Czech agricultural sector in the period prior to, during and after the global economic recession. The wage development in the above sector is compared to that in two other selected economy areas, namely the industrial and construction sectors, all three chosen fields employing almost 40 percent of people in the economy; see Table 1. Moreover, wages in the industrial and construction sectors do not differ markedly from those within other economy areas, even in comparison to the wage levels both in higher- (finance and insurance) and lower-paid (e.g.

accommodation, food services) sectors. The research explores wage distributions in the period between 2003 and 2013.

Tab. 1: Ratios of employees (in %) in Czech agricultural, industrial and construction sectors (taken together) to the number of all employees in all sectors of Czech economy

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Ratio	48.78	39.31	39.26	38.25	39.83	38.97	37.69	37.52	37.75	39.89	39.59

Source: own research

Wage and income development and distribution has become the subject of research by numerous Czech and foreign authors in recent times. As examples, we can mention Bartošová (2007), Bartošová (2009), Behr (2007), Dagum (1997), Kaasa (2006), Mallick (2008), Marek (2013a), Marek (2013b), Milanovic (2002), Monti (2009), Pacáková (2007) and Wessels (2008). The issue of wages is also closely related to the development of other key economic indicators, such as inflation, see Franta (2010), and the standard of living (the level and differentiation of wages and incomes being one of its quantifiable indicators; see Šimpach (2013)), additional issues of labour market being dealt with in, e.g. Löster (2012) and Pavelka (2013). Recently, publications of many authors have addressed the impact of the global economic crisis; see, e.g. Pivoňka (2013).

Different techniques can be employed when estimating the parameters of various curves and distributions; see Šimpach (2012a). In this paper, the method of L-moments of parameter estimation was used; see Hosking (1990) or Kyselý (2007). Three-parameter lognormal curves represent the basic probability theoretical distribution; see Johnson (1994), simple descriptive characteristics used in the calculations being explained in Triola (2003). The key variable in this study is the gross monthly (nominal) wage (in CZK).

The data for the calculations are taken from the official website of the Czech Statistical Office, namely "Employee ratios according to gross monthly wage bands divided by economy sectors", the survey sample information being drawn from "Numbers of employees and their average gross monthly wages classified by sectors and educational attainment". Staff numbers in particular sectors come from the "Employment and wages" table. All the data are for the period 2003–2013. It is to be noted that the results obtained may be, to a certain extent, affected by changes in the methodology. Consistent time series were not available for the whole research period, the Sector Classification of Economic Activities (valid over the years 2003–2008) having been replaced by the Classification of Economic Activities (2009–2013). It is also worth mentioning that CSO data do not distinguish between

"wage" in private and "salary" in public sectors, i.e. both are covered by the term "wage". The figures from the Czech Statistical Office were supplemented by the Eurostat and Trexima company data.

The data were processed using Microsoft Excel spreadsheet and SAS and Statgraphics statistical program packages.

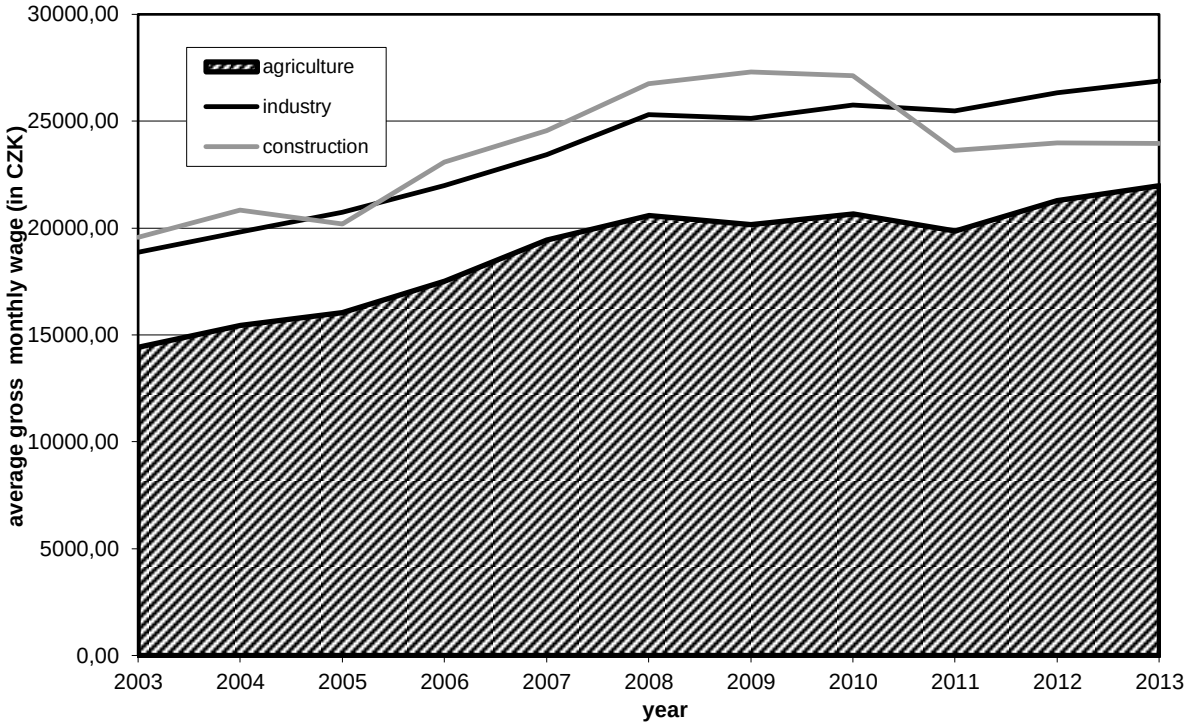
1 The Wage Development in Agricultural, Industrial and Construction Sector

Figure 1 allows us to compare the average gross monthly wage in the industrial and construction sectors with that in the agricultural sector. Similarly, Figure 2 enables a comparison of middle gross monthly wages in the above sectors. It is clear from these figures that the wage levels in the industrial and construction sectors are close to each other, while the level of wages in the agricultural sector is considerably lower in comparison to the former sectors. It is also obvious that in the period of global economic crisis, the growth of wage levels in all the three sectors virtually stopped, the earnings having fallen sharply in 2011, particularly in the construction sector. An upward trend in the wage development over the following years is much slower than before the recession, which is shown in Table 2. It follows from this table that in the pre-crisis years the average gross monthly wage in the agricultural, industrial and building sectors increased by averages of 7.36, 6.06 and 6.44 percent per annum, the middle gross monthly wage in the respective sectors rising by 7.98, 5.76 and 6.98 percent on average. In the period 2011–2013, on the other hand, the average gross monthly wage increased on average only by 2.10 and 1.42 percent a year in the agricultural and industrial sectors, respectively, in the construction sector even decreasing by average of 4.07 percent.

As already mentioned above, the wage level in the agricultural sector is significantly lower than in the sectors of industry and construction. In Tables 3 and 4, $\mu_{A,}$ μ_I and μ_C denote the expected values in the respective sectors. The null hypothesis of an equality of the expected values in the two corresponding sectors has been tested against an alternative hypothesis that the expected value in one sector is below that in another sector. The average gross monthly wage in the agricultural sector is lower than that in the industrial and construction sectors (left-sided alternative figures in Table 3) and the average gross monthly wage in the industrial sector is lower than that in the construction sector in 2003, 2004, 2006,

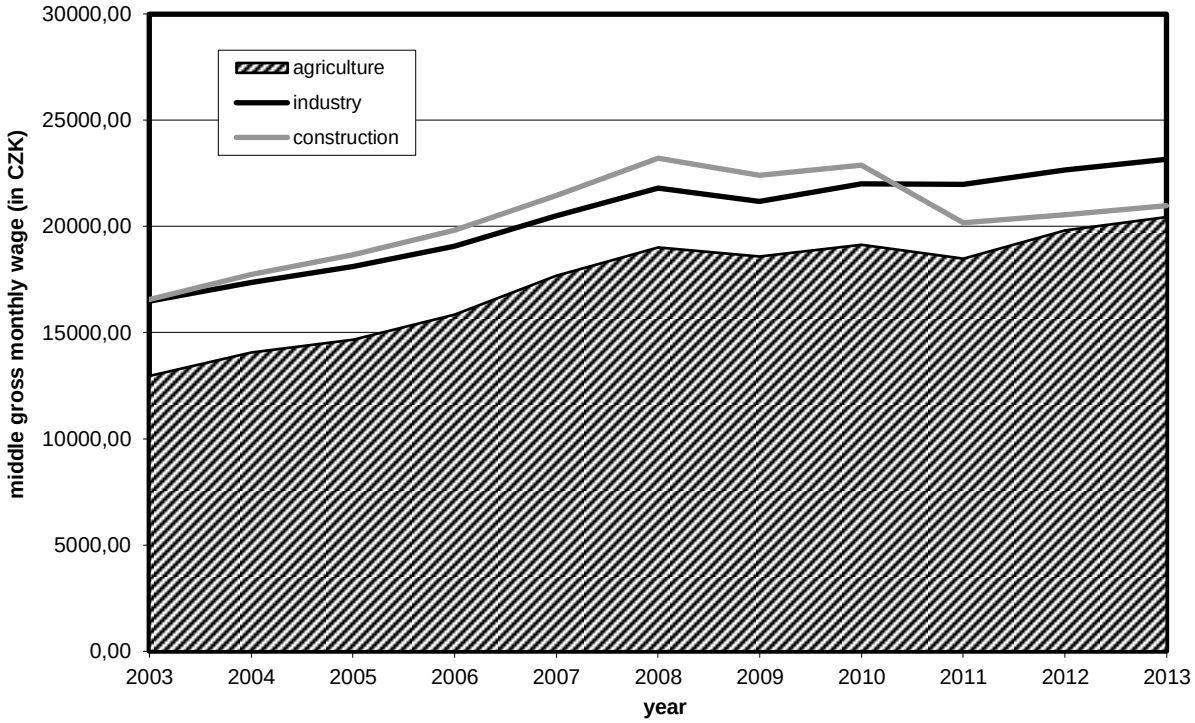
2007, 2008, 2009 and 2010 (left-sided alternative in Table 4), contrary to the years 2005, 2011, 2012 and 2013 (right-sided alternative in Table 4).

Fig. 1: Average gross monthly wage (in CZK) according to the sectors



Source: own research

Fig. 2: Middle gross monthly wage (in CZK) according to the sectors



Source: own research

Tab. 2: Annual increase (+) or decrease (-) in the level of gross monthly wage (in %)

Year	Agriculture		Industry		Construction	
	Mean	Median	Mean	Median	Mean	Median
2003	–	–	–	–	–	–
2004	7.05	8.53	5.03	5.38	6.43	7.11
2005	3.92	4.31	4.65	4.30	-3.09	5.28
2006	9.06	8.05	6.08	5.25	14.39	6.14
2007	11.10	11.45	6.55	7.58	6.38	8.26
2008	5.82	7.66	8.02	6.35	8.87	8.16
2009	-2.00	-2.36	-0.69	-2.83	2.10	-3.49
2010	2.39	3.01	2.45	3.87	-0.66	2.19
2011	-3.86	-3.36	-1.05	-0.18	-12.87	-11.92
2012	7.26	7.11	3.33	3.10	1.43	1.99
2013	3.21	3.19	2.04	2.27	-0.10	2.04
Ø 2003-08	7.36	7.98	6.06	5.76	6.44	6.98
Ø 2008-11	0.52	1.14	2.12	1.74	-0.96	-1.55
Ø 2011-13	2.10	2.22	1.42	1.72	-4.07	-2.86
Ø 2005-13	4.30	4.66	3.60	3.46	2.04	2.40

Source: own research

Tab. 3: Hypothesis testing of the equality of expected values $\mu_A = \mu_I$ and $\mu_A = \mu_C$

Agriculture – Industry			Agriculture - Construction		
Year	Alternative hypothesis	Test criterion	Year	Alternative hypothesis	Test criterion
2003	$\mu_A < \mu_I$	-93.694	2003	$\mu_A < \mu_C$	-58,878
2004	$\mu_A < \mu_I$	-96.308	2004	$\mu_A < \mu_C$	-60.559
2005	$\mu_A < \mu_I$	-105.493	2005	$\mu_A < \mu_C$	-47.422
2006	$\mu_A < \mu_I$	-83.180	2006	$\mu_A < \mu_C$	-51.851
2007	$\mu_A < \mu_I$	-64.951	2007	$\mu_A < \mu_C$	-50.856
2008	$\mu_A < \mu_I$	-66.671	2008	$\mu_A < \mu_C$	-52.955
2009	$\mu_A < \mu_I$	-69.214	2009	$\mu_A < \mu_C$	-44.361
2010	$\mu_A < \mu_I$	-67.926	2010	$\mu_A < \mu_C$	-45.876
2011	$\mu_A < \mu_I$	-75.214	2011	$\mu_A < \mu_C$	-32.923
2012	$\mu_A < \mu_I$	-134.962	2012	$\mu_A < \mu_C$	-48.509
2013	$\mu_A < \mu_I$	-136.676	2013	$\mu_A < \mu_C$	-41.616

Source: own research

Tab. 4: Hypothesis testing of the equality of expected values $\mu_I = \mu_C$

Industry – Construction				
Year	Alternative hypothesis	Test criterion	Critical range at 5% significance level	Critical range at 1% significance level
2003	$\mu_I < \mu_C$	-9.054	$W_{0.05} = \{u: u \leq -1.645\}$	$W_{0.01} = \{u: u \leq -2.326\}$
2004	$\mu_I < \mu_C$	-12.555	$W_{0.05} = \{u: u \leq -1.645\}$	$W_{0.01} = \{u: u \leq -2.326\}$
2005	$\mu_I > \mu_C$	6.702	$W_{0.05} = \{u: u \geq 1.645\}$	$W_{0.01} = \{u: u \geq 2.326\}$
2006	$\mu_I < \mu_C$	-11.147	$W_{0.05} = \{u: u \leq -1.645\}$	$W_{0.01} = \{u: u \leq -2.326\}$
2007	$\mu_I < \mu_C$	-13.083	$W_{0.05} = \{u: u \leq -1.645\}$	$W_{0.01} = \{u: u \leq -2.326\}$
2008	$\mu_I < \mu_C$	-14.423	$W_{0.05} = \{u: u \leq -1.645\}$	$W_{0.01} = \{u: u \leq -2.326\}$
2009	$\mu_I < \mu_C$	-14.413	$W_{0.05} = \{u: u \leq -1.645\}$	$W_{0.01} = \{u: u \leq -2.326\}$
2010	$\mu_I < \mu_C$	-10.899	$W_{0.05} = \{u: u \leq -1.645\}$	$W_{0.01} = \{u: u \leq -2.326\}$
2011	$\mu_I > \mu_C$	19.490	$W_{0.05} = \{u: u \geq 1.645\}$	$W_{0.01} = \{u: u \geq 2.326\}$
2012	$\mu_I > \mu_C$	47.615	$W_{0.05} = \{u: u \geq 1.645\}$	$W_{0.01} = \{u: u \geq 2.326\}$
2013	$\mu_I > \mu_C$	70.593	$W_{0.05} = \{u: u \geq 1.645\}$	$W_{0.01} = \{u: u \geq 2.326\}$

Source: own research

In Table 3, all alternative hypotheses are left-sided, thus the critical range at a 5% significance level is $W_{0.05} = \{u: u \leq -1.645\}$ and at a 1% significance level $W_{0.01} = \{u: u \leq -2.326\}$. Critical ranges for hypothesis tests are included in Table 4. There are always two independent samples. Because of the large sample sizes, the test criterion

$$U = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

has an asymptotically standardized normal distribution assuming the null hypothesis is true. In this formula, $\bar{x}_1$ and $\bar{x}_2$ denote the averages and s_1^2 and s_2^2 the variances in the first and second sample, respectively, n_1 and n_2 indicating the sample sizes.

With respect to the results shown in Table 3, it is clear that all the tests are significant, which is mainly due to large sizes of both random samples. The test of such a high power almost always leads to the rejection of the null hypothesis of equality of the expected values in both the sectors, even at a 1% significance level. We can, therefore, conclude that the level of wages in the agricultural sector is significantly lower than that in the industrial and construction sectors in the period 2003–2013. Likewise, all the tests in Table 4 came out significant as well, even at a 1% significance level, although the differences between sample wage averages in the industrial and construction sectors are not as striking as those of these two sectors compared with sample average wages in the competing agricultural sector; see Figure 1. Thus we can draw the conclusion that the level of wages in the industrial sector is significantly lower than that in the construction sector in the years 2003, 2004 and 2006–2010. In 2005, 2011−2013, on the other hand, the level of wages in the industrial sector is significantly higher than that in the construction sector.

Figure 3 shows the development of the quarterly time series of gross monthly wages in the three analyzed sectors. Seasonal variations in these quarterly time series of wages are the most evident in the construction and agricultural sectors. They are not avoided – however unnoticeable they may be – in the industrial sector either.

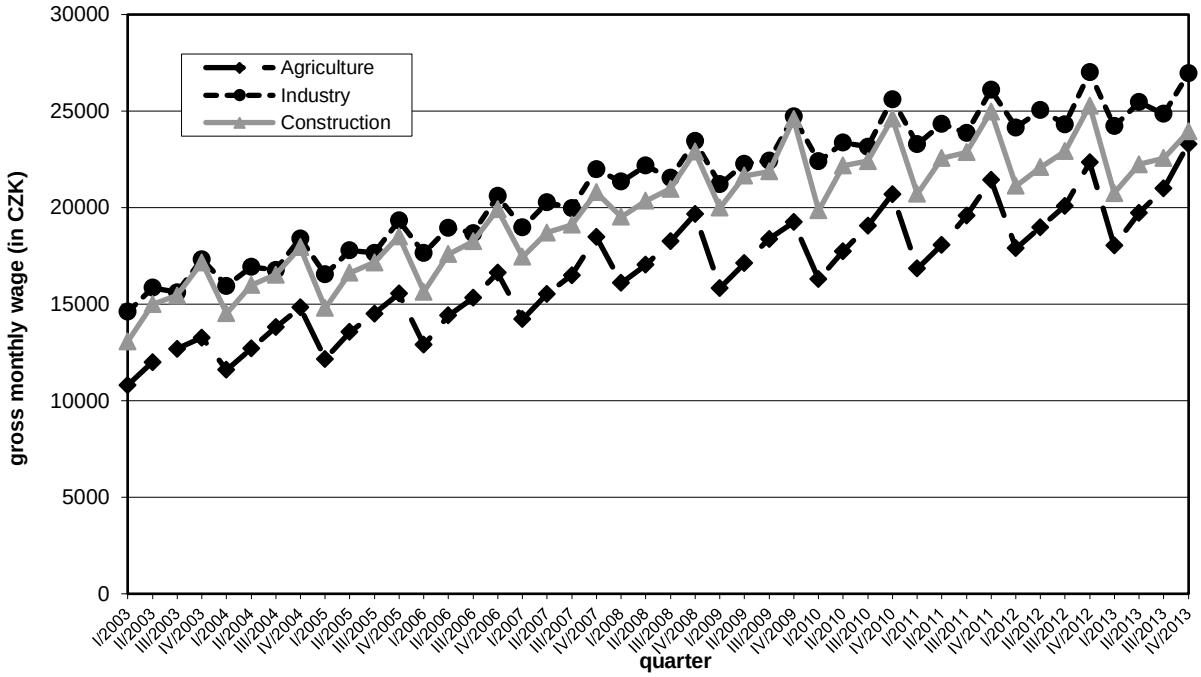
Figures 4–6 indicate the development of a theoretical (model) wage distribution in time. There are three-parameter lognormal curves with parameters estimated employing the method of L-moments. The three-parameter lognormal distribution is the most common probabilistic approach used in modeling wage and income distributions. The advantages of the method of L-moments are known from the statistical literature; see, e.g. Hosking (1990).

This method provides point parameter estimations that are sometimes even more accurate than those made by the maximum likelihood method. It is to be noted that there is the same scale on the vertical axis for all the three Figures 4–6. A very similar development of wage distribution in the industrial and construction sectors can be observed from Figures 5–6. If we, however, compare the wage development in these two sectors with that in the agricultural sector, we can report completely different findings in the latter. Since the wage distributions in the agricultural sector are characterized by large skewness and kurtosis, more workers earn much lower wages than in the industrial and construction sectors. Wage distributions in the industrial and construction sectors, on the other hand, are much less skewed with very small kurtosis.

Interestingly, Table 5 provides an overview of the average gross monthly wage in the selected professions in the agricultural sector. As expected, agricultural technologists, engineers and agronomists achieve the highest, while breeders, nurses of animals and milkmaids earn the lowest average gross monthly wages.

Figure 7 provides an overview of the concentration of gross monthly wage in the three sectors. The values of the Gini coefficient in Figure 7 are expressed in percentages, moving from zero percent for extreme leveling (so-called zero concentration; this could theoretically occur if every employee had the same gross monthly wage) to a hundred percent for extreme differentiation (maximum concentration; the whole amount of wages is paid to one employee).

Fig. 3: Development of average gross monthly wage (in CZK) in agricultural, industrial and construction sectors



Source: own research

Fig. 4: Development of the probability density function in agricultural sector

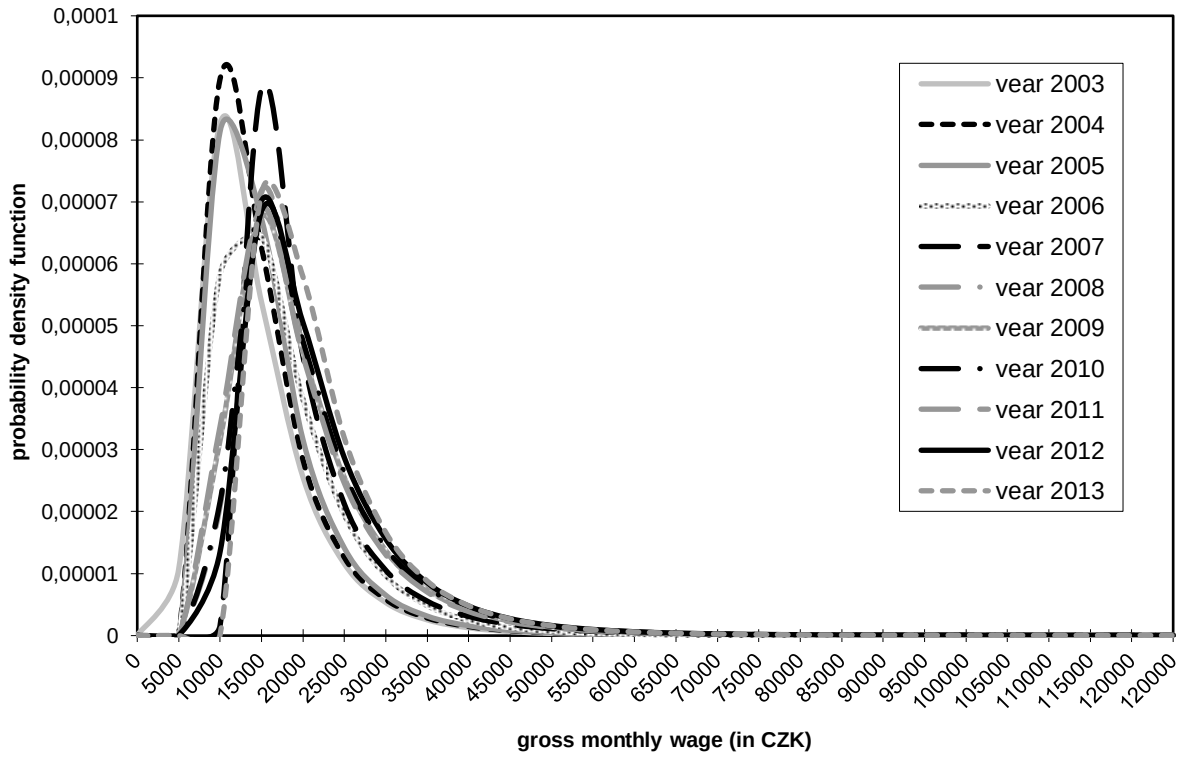


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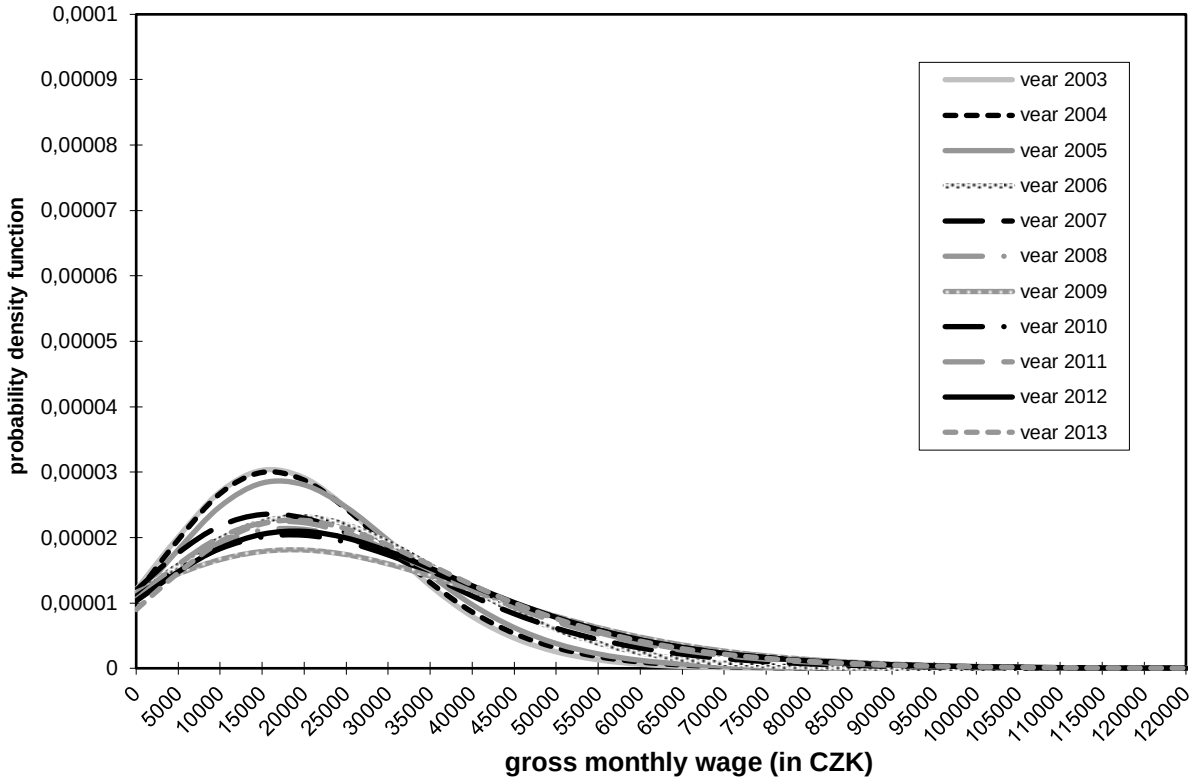
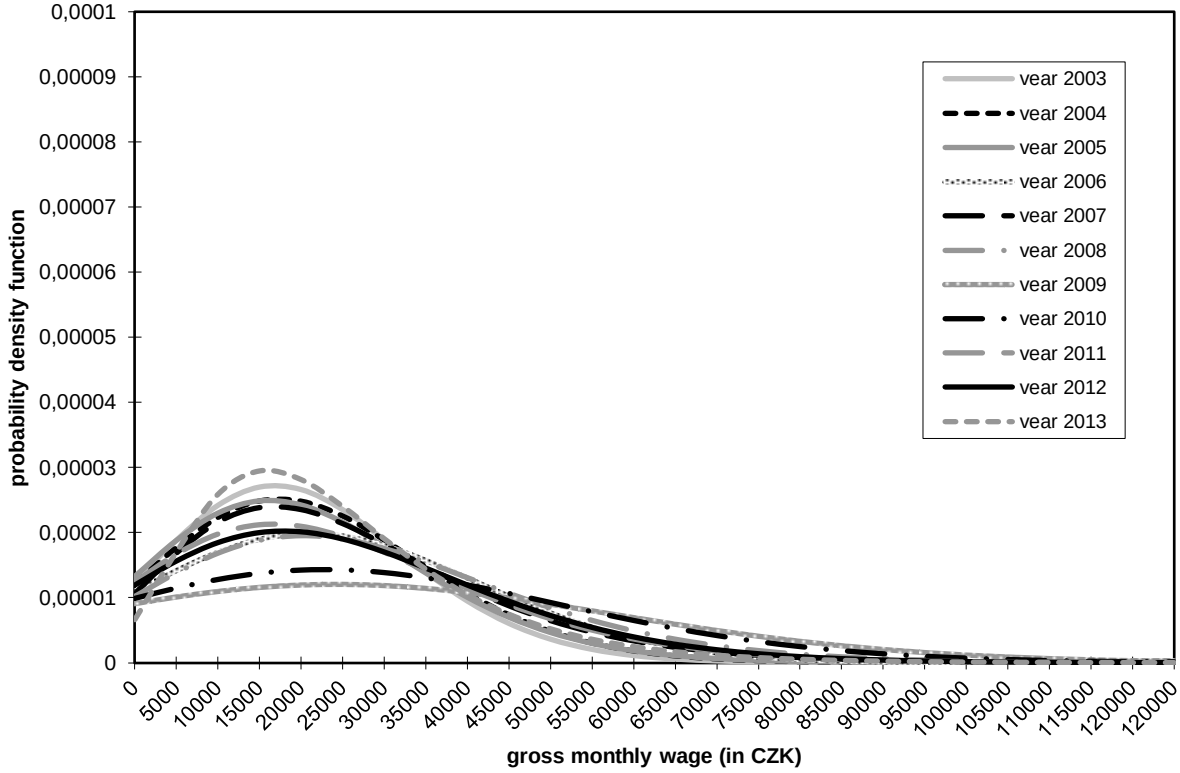
Fig. 5: Development of the probability density function in industrial sector



Source: own research

Fig. 6: Development of the probability density function in construction sector



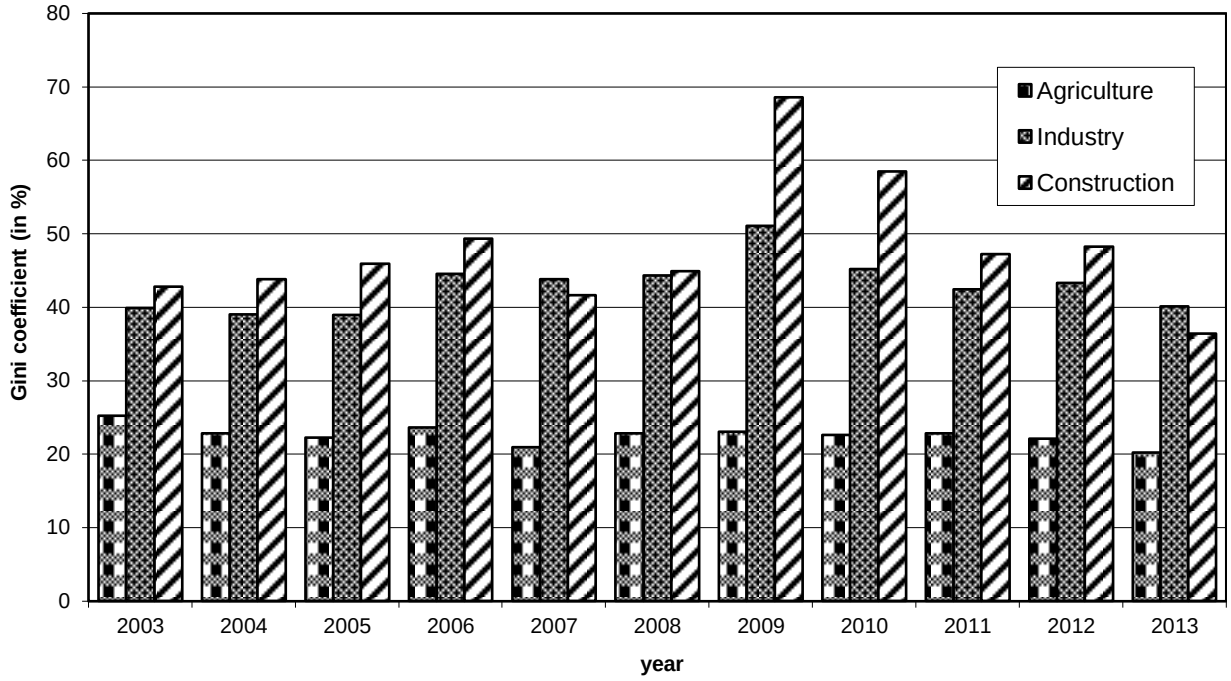
Source: own research

Tab. 5: Average gross monthly wage (in CZK) for the selected professions/jobs in agricultural sector in 2013

Profession/job	Milkmaid	Breeder, nurse of animals	Tractor driver, combine driver	Agricultural engineer, agronomist	Agricultural technician	Agricultural technologist	Zoo technician
Wage	15,997	14,766	21,839	25,320	20,864	28,833	22,575

Source: own research

Fig. 7: Gini coefficient of concentration (in %)



Source: own research

As expected, the smallest wage differences are reported among employees in the agricultural sector. On the other hand, a much higher concentration of wages is observable in the other two sectors, particularly in the construction sector, where the Gini coefficient reaches almost 70 percent in 2009. It is obvious from Figure 7 that the beginning of the global economic downturn brought about a relatively large increase in the concentration of wages in all three sectors, the construction one in particular. This is due to high wages earned by employees who acquire the best educational qualifications or top job positions; see the figures for the year 2013 in Table 6. For example, the average gross monthly wage of executives in construction and surveying was 37,802 CZK, the middle gross monthly wage being 34,992 CZK. Average and middle gross monthly wages of construction engineers were 30,111 CZK

and 29,096 CZK, respectively. Excavation workers, on the other hand, earn an average of 16,894 CZK in 2013, their middle wage amounting to only 16,635 CZK. Cleaners and house laborers earned 11,938 CZK on average, their middle wage being only 11,576 CZK.

Tab. 6: Average gross monthly wage and the middle gross monthly wage (both in CZK) in the selected professions/jobs in construction sector in 2013

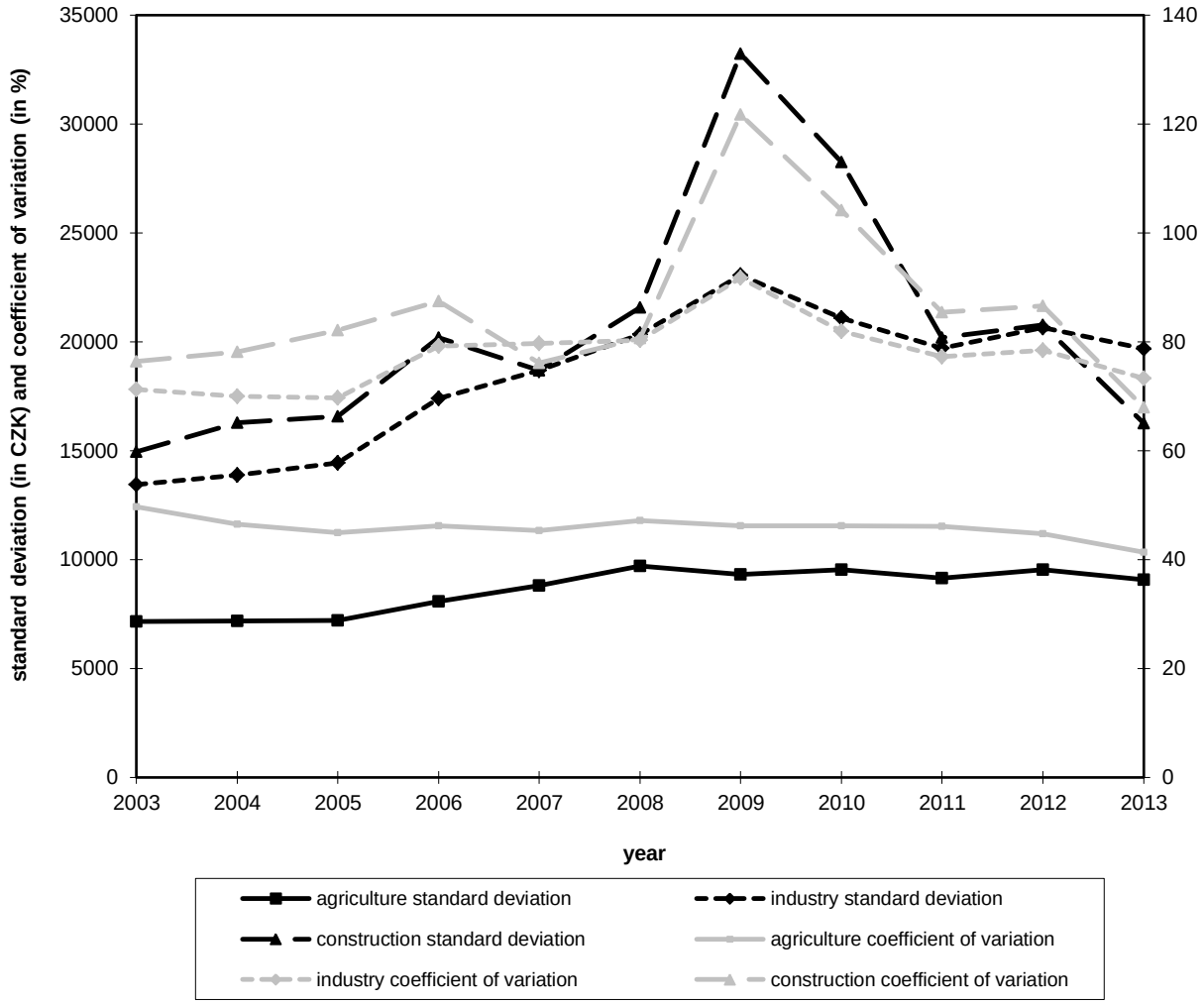
Profession/job	Middle wage	Average wage
Executives in construction and surveying	34,992	37,802
Civil engineers	29,096	30,111
Construction architects	28,396	29,767
Construction technicians	25,740	26,484
Bricklayers, stove fitters, pavers and fitters of dry buildings	18,463	18,723
Carpenters and construction joiners	17,425	17,969
Skilled construction workers, building caretakers, fitters	18,678	19,106
Plumbers, pipe fitters, construction locksmiths and tinsmiths	19,036	19,630
Painters and paperhangers	17,693	17,600
Construction and operational electricians	19,914	20,265
Builder's laborers	16,017	16,093
Excavation workers and structural engineering workers	16,635	16,894
House cleaners and laborers	11,576	11,938

Source: own research

Figure 8 informs on the development of wage variability over the research period. Standard deviation is measured on the left (in CZK) and the coefficient of variation on the right axis. It is evident that the agricultural sector has the lowest absolute and relative variability of all three analyzed sectors, while the standard deviation of wages grows moderately until the beginning of the economic crisis, getting stabilized essentially with slight fluctuations afterwards. The variation coefficient shows a decreasing trend throughout the research period. Both absolute and relative variability are much higher in the industrial and construction sectors than in the agricultural sector, developing further on. Absolute and relative variability show an upward trend until the crisis period, then turning downward. Developments of the standard deviation and the coefficient of variation are noteworthy in the construction sector in particular. We can observe a substantial growth in the recession period similar to the Gini coefficient, the value of the variation coefficient exceeding 100 percent in

2009 and 2010; thus the standard deviation is to be higher than the arithmetic mean. Then the values of both these characteristics revert to their before-crisis approximate levels.

Fig. 8: Standard deviation – left axis (in CZK) and the coefficient of variation – right axis (in %) according to sectors



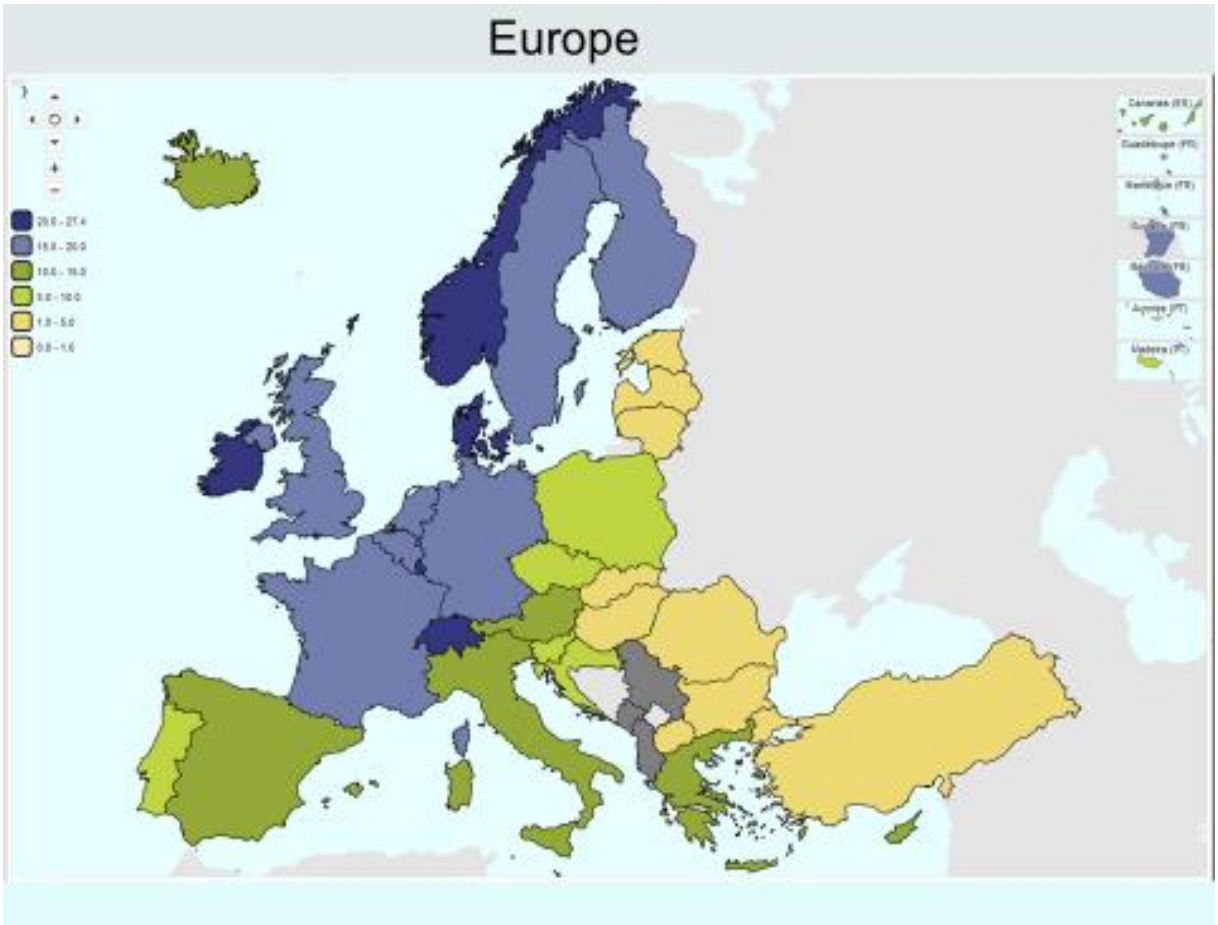
Source: own research

2 Wages in European Countries

This paragraph gives an overview of the level of wages in the European countries (including Turkey whose territory extends beyond Europe), an official Eurostat website representing the source of essential data. Unfortunately, data for some European countries which were originally part of the former Yugoslavia (Serbia, Kosovo, Montenegro and Bosnia and Herzegovina) and Liechtenstein were missing. Only the data for the period ending in 2010 were available, those on gross monthly and hourly wages in the European states (including non-EU ones) and average gross monthly wages in the agricultural, industrial and

construction sectors having been the subjects of the research. Within the agricultural sector, the "Skilled agricultural, forestry and fishery workers" database was used, which may override the level of wages in this sector to some extent. Moreover, data on the average wage in the agricultural sector in 2010 were lacking for some countries, e.g. Belgium, Croatia, Austria, Iceland and Switzerland. Attention was also focused on the average gross hourly wage, the nominal wage (in euros). (Some states, e.g. Norway, that have very high wage levels show high prices at the same time.) The countries are presented in the same order as they appear on the Eurostat website.

Fig. 9: Average gross hourly wage (in €) in European countries in 2010



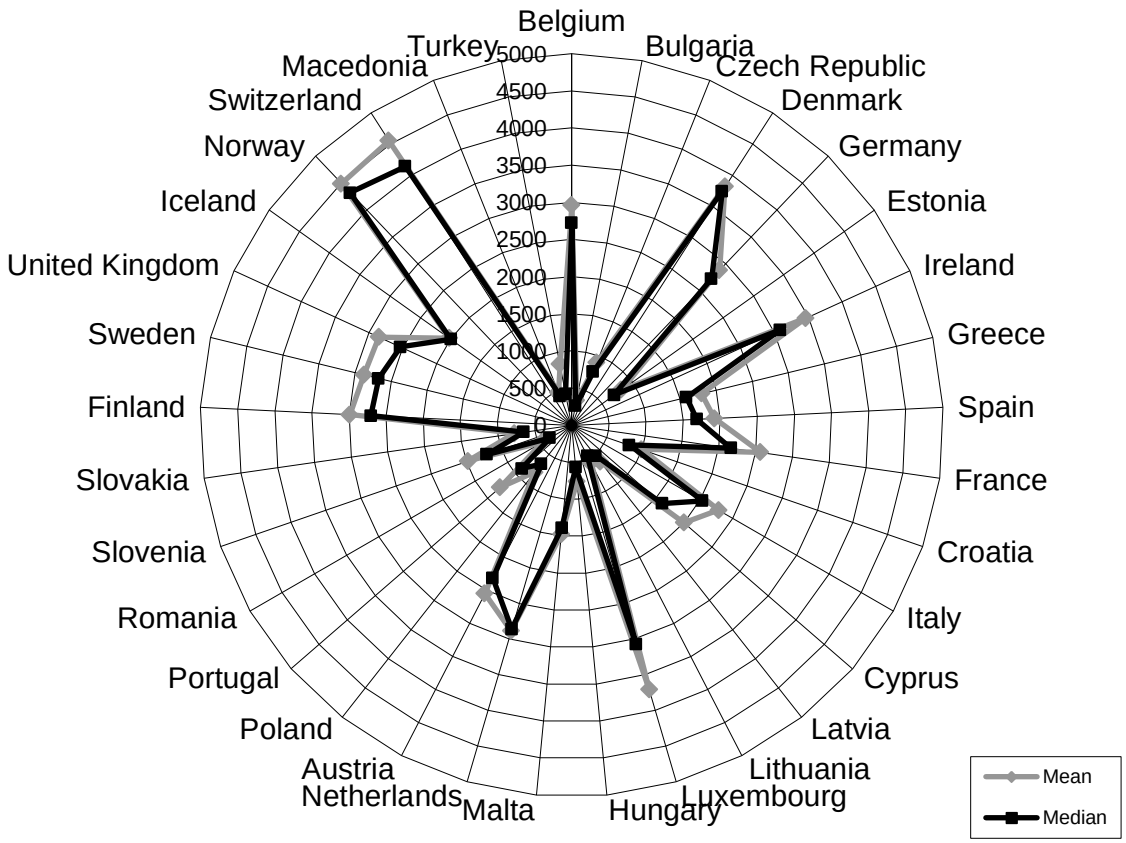
Source: http://ec.europa.eu/eurostat

Figure 9 provides an overview of average gross hourly wages in the European countries in 2010. Switzerland, Norway, Denmark, Luxembourg and Ireland have the highest, while Bulgaria, Romania, Macedonia, Lithuania, Latvia, Hungary, Slovakia, Estonia and Turkey report the lowest average gross hourly wages. The level of hourly wages in the Czech

Republic is similar to that in Poland, Slovenia, Croatia and Portugal. The hourly wage level in countries like Finland, Sweden, the United Kingdom, Belgium, the Netherlands, Germany and France is higher than in, for example, Greece, Spain, Italy, Cyprus, Malta, Iceland and also, surprisingly, Austria.

Figure 10 shows the average gross monthly wage and its median in individual European countries. The wage median is smaller than the arithmetic mean in all cases, indicating a positively skewed distribution, typical of wage distribution. The results in terms of the European level of gross monthly wages closely correspond to those regarding hourly wages.

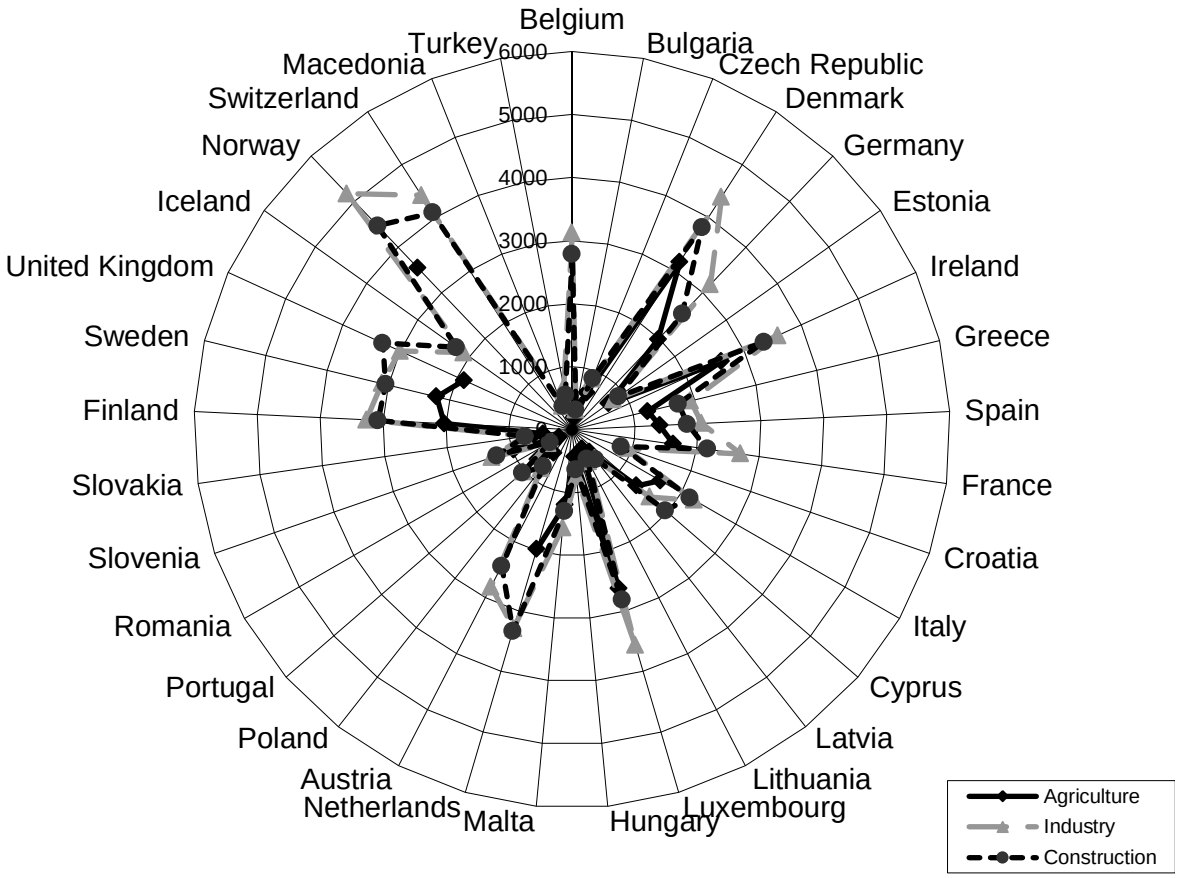
Fig. 10: Average gross monthly wage (in €) and the middle gross monthly wage (in €) in European countries in 2010



Source: own research

Figure 11 compares the wage levels in the agricultural, industrial and construction sectors in individual European states. We can observe significantly lower average gross monthly wages in the agricultural sector in comparison to industrial and construction sectors in all the countries that provided the relevant data. The results show that the average gross monthly wage in the industrial sector is higher than that in the construction sector in most countries, namely Belgium, Bulgaria, Denmark, Germany, Ireland, Greece, Spain, France, Croatia, Italy, Lithuania, Luxembourg, Hungary, Malta, Austria, Poland, Romania, Slovenia, Slovakia, Finland, Sweden, Norway, Switzerland, Macedonia and Turkey. The average gross monthly wage in the construction sector exceeds that in the industrial sector only in eight countries – the Czech Republic, Estonia, Italy Cyprus, the Netherlands, Portugal, the United Kingdom and Iceland. For the Czech Republic, these results correspond to those (for 2010) in Figure 1.

Fig. 11: Average gross monthly wage (in €) in agricultural, industrial and construction sectors in European countries in 2010



Source: own research

Further, the level of wages in the Czech Republic is slightly higher than in the Slovak Republic. In 2010, the average gross monthly wage was 907 € in the former, but only 777 € in the latter country, the middle gross monthly wage being 777 € and 653 €, respectively. The Czech Republic ranks very well among other post-communist countries in terms of average and middle wages, having the third highest average gross monthly wage (out of twelve countries; after Slovenia and Croatia).

Conclusion

Statistically, the level of gross monthly wage in the Czech agricultural sector is significantly lower than in the other two sectors of economy. The differences in the level of gross monthly wage between industrial and construction sectors are also statistically significant. However, this is probably due to the large sample sizes, which result in a high power of the test, thus leading to the rejection of the tested hypothesis. Furthermore, the relationship between the above sectors in terms of the level of gross monthly wage is changeable over time, both sectors reaching higher wage levels at certain times throughout the research period.

The global economic downturn brought about profound changes in the behavior of wage distribution, the growth of earnings having virtually stopped – a decline in both average and middle gross monthly wages in all three sectors analyzed having been reported even in 2011. With the recession subsiding, wages began to grow again, but in a much slower pace than in the before-crisis period. The economic downturn meant an increase in the concentration and variability, particularly in the construction sector. It can be concluded that the behavior of the wage distribution in the agricultural sector is noticeably different from that in the other two sectors.

In an international comparison, the countries as Switzerland, Norway, Denmark, Luxembourg and Ireland have the highest level of the gross wage, both monthly and hourly, Bulgaria, Romania, Macedonia, Lithuania and Latvia, on the other hand, showing the lowest gross wage levels. The Czech Republic has a slightly higher wage level than the Slovak Republic, holding the third place among post-communist countries.

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