

# A Cross-Country Comparison of Relative Wages

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*Abstract:* - This paper demonstrates that the relative wages are significantly different by country. The relative wages are ratios of average wages of specific occupations to the minimum wage. The possible causes of the different wage patterns are analyzed. An online database is used, which makes it possible to compare the relative wages of similar occupations corresponding to 4 digits ISCO categories. The database of the analysis includes data of 25 countries and 22 occupations. It is examined if there are certain groups of countries, where the wage patterns show similarities.

*Key-Words:* - Wage structure, ISCO'08 classification, cluster analysis, cross-country comparison

## 1 Introduction

According to neoclassical economics there should not be persistent and relevant differentials among wages in different occupations. Also it is an intuitive expectation that the same compensation should be given to employees having similar skills doing similar jobs, or at least the market mechanisms should assure that there is a tendency toward wage equalization. Experience does not support such a tendency, there are wage differentials even within a country; this phenomenon is often interpreted by not observed or not equally valued skills. It is not surprising that there are wage differentials among countries too, although the neoclassical approach suggest a tendency to wage equalization among countries in case of free trade, which is a consequence of the factor price equalization. This is however challenged e.g. by Ting (see [7]), which says that one cannot state more than the factor price gaps among countries may shrink. In fact, if there is a large gap between productivity of two countries, it means that the marginal product of the production factors is significantly different in these two countries, which leads to different factor prices.

The present paper examines the differences of wage structure by occupation and by country and tries to identify the causes of these differences. Our investigation does not focus on the different levels of wages, instead, we intended to examine the *relative wage* differentials in an international comparison, i.e. to compare the average wages of different occupations to the minimum wage in the different countries. This means that our database

consists of ratios assigned to different occupations by country. This may give a certain type of 'preference scale' of occupations for each country based on wages. Contrary to the expectations of the neoclassical approach, even these patterns are different by country. The data we used for this research clearly show that this is true even for the member countries of the European Union of similar level of economic development in spite of the free movement of goods, services, capital and labor.

The first purpose of our examination was to find internationally comparable data to verify the hypothesis that there are differentials of relative wages in the different countries. The requirement of comparability means that data should be disaggregated enough, since wages of specific occupations should be compared. The second purpose was a statistical analysis that may identify different groups of countries with similar patterns of relative wages, and may characterize the different patterns. The third purpose was to identify some factors that may explain the different patterns of the relative wages.

## 2 Preliminaries

There are not too many papers dealing with cross-country comparison of relative wages by occupation for lack of credible and internationally comparable up-to-date data. For example, the UN ILO database OWW (Occupational Wages around the World) contains data until 2008, and in general only aggregate data are accessible via the query system of the ILOSTAT. The Eurostat has data on earnings only for EU member and candidate countries and for

EFTA countries. Micro level anonymized data are available for researchers but micro enterprises (with less than 10 employees) are excluded from the statistics. The query system of OECD databases does not contain disaggregated data by occupation.

Gibbons et al ([4]) analyses inter-industry wage differentials within a country explained by non-observed or not equally valued labor skills/qualities without international comparison. In an earlier research, Davis (see [2]) compared the movement in relative wages and wage inequality in 13 developed countries in the 70s and 80s. It emphasized the role of wage setting institutions and labor market interventions. It found that the relative wages in the manufacturing industry became increasingly dissimilar in the first half of the 70-s and in the 80's, and the convergence of relative wages to the world wide average structure depended positively on the openness of the economy. Another earlier study (Katz et al. [5]) restricted the comparison to 4 countries only, it examined how the increased demand on more skilled labors changed the relative wages. A comparison of 8 countries is shown by Tachibanaki (see [6]) identifying different factors that affect wage differentials in general. This cross-country comparison was aggregated, because it considered only 6 main activity areas instead of specific occupations. It was found even in this aggregated approach that there are different wage structure in the selected developed countries that can be explained by the structure of national labor markets, wage setting institutions, supply-demand factors, and education and training systems. Freeman et al. (see [3]) found that the cross-country differences in pay for comparable work increased despite of increased world trade. It emphasized the impact of economic development on the one hand and that of wage-setting mechanisms and unions on the other hand. Caju et al. ([1]) compares wages in 8 countries by an econometric model. The differentials are function of economic development, share of small enterprises, gross operating surplus per employee and the extent of collective agreement coverage in the industry. The selected countries were compared only on 2 digits level of economic activities and not by occupation in a disaggregated way.

### 3 Comparison of the relative wages

#### 3.1 The dataset and the methodology

The direct comparison of relative wages is problematic, since there are no disaggregated,

reliable and comparable wage statistics. The disaggregation level should be the 4 digits level of ISCO (International Standard Classification of Occupations). Freeman et al. ([3]) uses the UN ILO database OWW (Occupational Wages around the World) that contains data until 2008 on the 3 digits ISCO level. The Structure of Earnings Surveys of the Eurostat includes data until 2014, but is based on the classification of economic activities (NACE) and the disaggregation level is only 2 digits.

We have chosen the database of wageindicator.org [9], which is an online developing database. Its salary check function gives the average wage of website visitors, who wish to compare their salary to the average of the same occupation in their countries. The specific occupations on this webpage can be assigned to the 4 digits ISCO categories, therefore it is suitable for cross-country comparison. This website give information about minimum wages as well, which is the base of relative wages in our analysis. There are data for 81 countries at the moment. Although the respondents' data are cleaned and scientifically checked according to the disclaimer of the website, the reliability is certainly constrained. There might be several sources of data bias. First of all, the respondents do not constitute a representative sample of workers in any country. In general, the salary data seem to be too low: the old information may not be taken out from the dataset. Probably this may be the cause why in certain cases the average does not reach the minimum wage. Another possible cause is that primarily those visitors check the salary, who feel being and are indeed underpaid. Even if there is a bias, we can suppose that it is similar in every country, so the database can be useful for international comparison. We had to restrict our analysis to certain occupations only, but there was no preconception in our selection (see the list of the chosen countries and occupations in the Appendix). We wanted to assure that our database include data of blue and white collar workers from different areas, leaders and subordinates, of employees both in the government and private sector. In certain countries there is no guaranteed minimum wage, in these cases we have taken the observed actual minimum wage: these data have been taken from [tradingeconomics.com](http://tradingeconomics.com). The data of trade unionism is taken from [6]. Also the GDP per capita on PPP (Purchasing Power Parity) in 2016 USD has been calculated for each country, the data are from the IMF World Economic Database.

The data will be analyzed first by cluster analysis in order to identify the characteristic groups of countries. A correlation matrix will be determined

then. Finally, we will make direct comparisons of data.

### 3.2. Main results

The developed dataset of relative wages supported our hypothesis that there are significant differentials in relative wages. The mean values of the proxy of relative wages vary in the interval  $[1.30;2.61]$ . There are 8 occupations that have the maximum values and there are 5 that have the minimum value in certain countries.

#### 3.2.1. Statistical analysis of relative wages

The discussion of relative wages should rely on some standard statistical analysis of the data.

*Firstly*, a cluster analysis was conducted for the dataset consisting of the relative wages and the country-specific minimum wages. The purpose of clustering was to identify typical groups of countries, where the preference pattern of occupations are similar. The results are shown by Figures 1-2. The variables have been standardized in order to prevent that the variable of GDP per capita should dominate the results: their order of magnitude is 3, while that of the relative wages is 1. The cluster dendrogram is shown by Figure 1. We prescribed 2-12 clusters for the K-means clustering, the average silhouette width more or less stabilized already at 5 clusters. Figure 2 shows the corresponding silhouette plot with 8 clusters. Our original hypothesis was that the economic and social model of the different countries (see this grouping in the Appendix) will be an important factor of the clusters, but results do not support this. It seems however that the development level is important from the viewpoint of wage pattern, which is consistent with the results of Freeman et al. ([3]). The first cluster contains developed countries with very high GDP per capita (Austria, Ireland and Netherlands). The second one proved to be robust when we changed the number of clusters; this is the group of countries that produced fast economic growth during the past decade. The seventh and eighth cluster contains primarily earlier Soviet bloc countries, the relatively developed emerging countries (Czech Republic, Estonia and Slovakia) belong to the eighth cluster. Greece, which was heavily afflicted by the crisis, proved to be closer to the middle developed emerging markets. The fifth cluster includes two developed market economies with high GDP per capita (Germany and United Kingdom). Portugal is detached from them, if we increase the prescribed number of clusters.

Similarly, India constitutes an independent cluster, which means that its wage pattern is significantly different from China. The third cluster proved to be very robust, but we cannot find any interpretation as it includes countries from different regions with different development levels. Finally, the sixth cluster contains two developed countries again (Finland and France). The above cited paper of Freeman et al. emphasized that the way and institutions of wage setting, i.e. the role of the trade unions is an important factor. In order to measure the power of trade unions we created a proxy for each country based on the ICWSS database [8]. There are two indicators in the database measuring the right of collective bargaining in the government and in the market sector (these data are available for all countries for 2013 or 2014). Both indicators may vary on the discrete scale from 0 to 3, where 3 means rights without restriction. We applied the sum of these two variables to characterize the country specific strength of trade unions in the wage setting. It seems that our results supports the statement of Freeman et al. The above mentioned sixth cluster includes two countries with strong rights of trade unions: the mean value of the proxy is 5.5, which is the highest cluster mean. The mean of the countries with very high GDP per capita (first cluster) is 4.7, while it is 5.0 in the fifth cluster including two other developed countries. The second cluster of countries with high development rates but with far lower GDP per capita is characterized by a significantly lower mean: it is only 3.3. The mean is also relatively low in case of the emerging central European economies (eighth cluster); it is 4.2, while the mean of the other emerging countries of this region (cluster) is 5.0. This means that the strength of trade unions may have a secondary factor after the development level from the viewpoint of wage structure. We acknowledge that 25 observations is a scarce sample for a cluster analysis, but the present availability of data constrained our research on the one hand. On the other hand, even this small sample showed that the different European basic types of market economies do not affect the relative wages.

*Secondly*, the correlation matrix was calculated. Not surprisingly, the correlation between GDP per capita and minimum wages are strong, and similarly the pairwise correlations of relative wages of the different occupations are high (the minimum is 0.44). Only two occupations have been found that have significant correlation with the economic development level: these are the 'Secondary education teacher' and the 'General practitioner physician'. The corresponding correlations are 0.27

and 0.18, respectively (the other values were far lower or had negative sign). It may refer to the fact that the appreciation of occupations dealing with the development and maintenance of human capital is necessary for economic development.

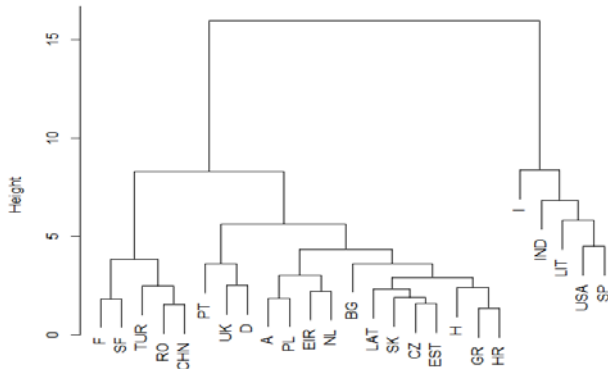


Fig. 1. Cluster dendrogram (the country codes are given in the Appendix)

Source: wageindicator.org and own calculations

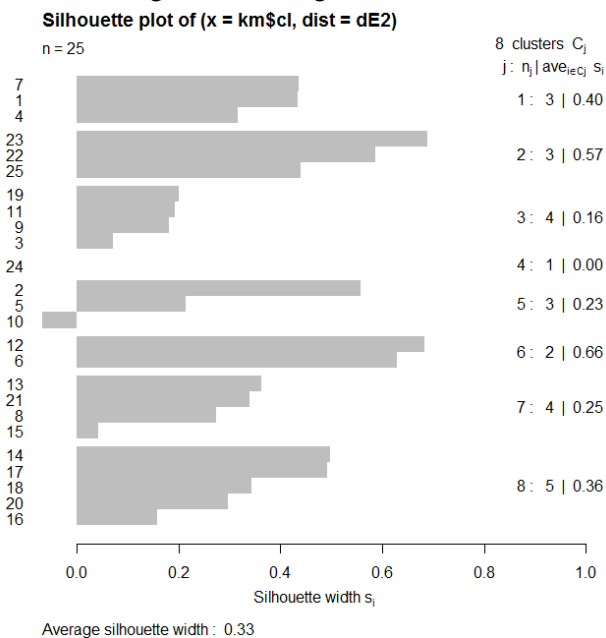


Fig. 2. Silhouette plot with 8 clusters (the serial numbers are given in the Appendix)

Source: wageindicator.org and own calculations

Thirdly, some simple data comparisons supported the wage analysis. We compared first the relative wages of intellectual (from 1210 to 2712 and 3173, see the codes in the Appendix) and physical occupations (all the other occupations) in the different countries. The average values had been calculated for both groups, and the ratio of the mean of intellectual occupations to that of physical ones was determined then for each country. As expected, the ratio is higher than 1 in every country, i.e. in general, the intellectual work is better paid (this is

compatible with Tachibanaki's results (see [6]). The explanation can be that intellectual jobs and activities have been gradually appreciated. The market acknowledges the longer education period and that the substitution of an intellectual worker with his/her special skills is generally more difficult than to find a physical worker. This ratio is typically seems to be high in the Mediterranean area (Italy, Portugal, Spain, Turkey), but similar high values can be seen in India and in the USA. Italy has the maximum value of 1.86 (although in Italy there is no minimum wage, thus the observed minimum wage was taken into account), while the smallest difference can be seen in Hungary with the ratio 1.2.

We also compared the countries from the viewpoint of the wage surplus of people in senior (leading) positions. The arithmetic mean of the relative wages of the first three categories in Table 1 was divided by that of all other categories, and this ratio was used as a proxy for this comparison. The results were surprisingly similar to the previous comparison: the highest values can be found in some Mediterranean countries: Italy, Spain, Turkey, and a similar high value characterized Romania. Again, Italy has the maximum value (1.7).

A general experience is that the market prefers occupations related to sciences than those related to art and humanities. We measured this by the ratio of relative wages of mechanical engineers to that of archivists. As expected the ratio is typically higher than one, the only exception is Ireland (with 0.96). The highest ratios have been found in the less developed emerging Central European countries (Bulgaria and Romania) and in the Mediterranean area (Italy and Spain). The IT software engineering has an exceptional position among occupations, and its importance is supposed to increase further. Thus, it is not surprising that, if its relative wages are compared to that of archivists, the ratio becomes even higher (except 5 of the 25 countries). The preference of IT engineering to art and humanities is exceptionally high in the Central European emerging economies, in Bulgaria (with the highest ratio of 2.56), Romania, Czech Republic and Hungary. Also Spain has a similar high value again. We remark that the relative wage of IT software engineering is exceptionally high in India (5.67). All this may suggest that the IT sector is preferred in emerging countries, since it is supposed that it may play a key role in the economic development and in the catch-up process.

Other key factors of economic development is the education and research. We measured it by the relative wage position of university lecturers. However, these activities do not seem to be

appreciated in the above mentioned emerging economies in the Central European region, since the relative wage of university lecturers in these countries are below the average of those of all occupations. On the contrary, the relative position of university lecturers is the best in the rapidly growing India compared to the other examined countries.

Finally, we compared the relative wages of health care, which plays an important role from the viewpoint of human capital. The average of the three health related occupations have been compared to the overall average. These ratios vary in a rather small range, from 0.87 to 1.33. If we consider the Central and South European region again, we can see that the ratio is higher than one only in the relatively developed economies (Czech Republic, Estonia, Slovakia), while in the middle and less developed ones it is below 1; the only exception is Croatia in the region. USA has the highest ratio, which is not surprising taking into consideration the fact that expenditures on health care is the highest here among the developed countries.

### 3.2.2. Discussion of results

There are several factors that can explain the differentials of relative wages in different countries. Some of these factors are not determined by market mechanisms, from neoclassical viewpoint they may seem to be phenomena of 'imperfectness' of market.

The first group of factors can be called the group of *institutional* factors. The wage-setting mechanisms, the degree of corporatism is an important factor in general, the power of certain unions and lobbies may result in different relative wages in the different countries. This is compatible with the results of Davis and Freeman et al. ([2]-[3]), and our analysis also supports this as mentioned earlier. A special important institutional factor is the setting of wages in the government sector; this is one of the main tools of income policy in general. It is worth mentioning the case of the earlier Soviet bloc countries. One of the characteristics of the so-called socialism (that was the name of the political system of the autocratic regimes under the control of communist parties) was the state control of wages and prices. Among others, wages of intellectual works were underrated by setting artificial low wages relying on the dogma that only physical work is 'value creating'. An extreme example is the health care in these countries, where the wages of physicians were set on such a low level in the 50s that the patients were actually forced to pay some 'gratitude money' to amend the doctors' salaries.

(This is actually a form of corruption that still exists in several ex-Soviet bloc countries, although there have been several initiatives already to ban it.) Ironically, all this still has an impact on the relative wages even almost 30 years after returning to market economy as discussed earlier. The relatively low wages of public education and public health care is an obstacle of the development of human capital and therefore of long-term development in the emerging Central and South European economies. Although results show that the growing importance of the IT sector resulted in a relatively high wages, other white-collar works are still relatively underpaid in these countries. On the other hand, the relative wages in the health care are conspicuously high in the USA (the value is 6.34 in case of general practitioners compared to the average of 2.43 in all the examined countries). Such a high value can be problematic from the viewpoint of regulation too, we refer to the long-running dispute on the US health care with high expenditures but suffering from inefficiencies.

There are *traditions* that may result in different relative wages in different countries. The traditions of recognition of values of intellectual works may be different and persistent, as we referred to it above. Also, the appreciation of responsibility of leading positions can be different, e.g., this seem to be relatively high in the Mediterranean countries as mentioned above. If the structure of relative wages are compared, the results can be biased depending on the extent of non-observed activities, the share of which can be very different both by country and by occupation. We have already referred to the gratitude money in the health care, but there are several other occupations – primarily in the service sector – where effective wages can be far higher than those appear in the official statistics. Obviously, the reliability level of information in general may affect the cross-country comparisons as well. As an example, we can mention typical industries in Hungary, where a lot of employees earn the minimum wage according to the books of the companies, although they are better paid in fact, since the company hides certain incomes and expenditures to reduce the tax base.

Certainly, there are factors that are market-related, and may affect the relative wages. For example the *development level* of a country may result in different wage patterns in the different countries. If the technological level is higher in a country, the statistically same occupations may require different level of skills, which affect the relative wages. Not only the development level, but also the growth rate of economic development

matters. It is closely related to the penetration of new technologies, and the different speed of such processes influences the development of the relative wages (a typical example of our days is the penetration of cyber-physical systems). There are volatilities in wages depending on temporary shortage or redundancy of labor. However, sometimes the imbalances of the labor market is persistent. This has happened in the emerging economies of the European Union, where the (free) migration of labor to more developed member countries raised the relative wages of those occupations that requires convertible skills.

The *openness of an economy* may affect the relative wages as well, e.g. if there are some key industries in the export of the country (e.g. export of energy carriers or raw materials), it may overvalue certain related occupations compared with other countries.

There are *geographical* factors that are still worth mentioning here. If the conditions of work in the same occupations are relatively more difficult (e.g. in agriculture or in extractive industries) the relative wages may be higher.

Examining the relative wages, there are certain similarities as well. The highest rated occupation is the IT software engineer: its value is the highest in 11 of the 25 countries. The lowest rated occupations are the tree feller and the sweeper, street cleaner, both having the lowest value in 7 countries. There are some occupations that seem to have lower relative wages than expected. The explanation can be that the database used for the analysis contains monthly gross wages and the wages in these occupations may be only a part of the work income: the success fee or bonuses can be high e.g. for lawyers and brokers. The position of sports coaches and trainers is unfavorable: their average relative wages can be low in spite of some outlier wages of star trainers.

## 4 Conclusion

The study demonstrated that the relative wages, i.e. the ratios of wages of certain occupations to the minimum wage are significantly different by country. The analysis relied on the data of an online developing database containing information of wages by occupation for 81 countries. The cluster analysis does not support that the wage pattern are similar in countries with similar models of capitalism (Nordic, Continental, Mediterranean and Anglo-Saxon model). The results show that the institutions of wage setting and the development

level of a country matters from this point of view. This result is compatible with earlier studies. Market-driven and other factors have been identified that may affect relative wages. The first group of affecting factors are institutional including the wage setting mechanisms and government wage regulation and interventions. Also traditions can have long-lasting effects: this can be observed for example in the earlier Soviet bloc countries. Also the development level, the openness of the country and the special geographical conditions may contribute to differentials of relative wages in the different countries.

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## Appendix

The examined countries have been grouped according to their economic and social characteristics as follows:

- Anglo-Saxon countries:
  1. Ireland (EIR), 2. United Kingdom (UK),
  3. United States of America (USA);
- European continental countries:
  4. Austria (A), 5. Germany (D), 6. France (F),
  7. Netherlands (NL);
- Mediterranean countries:
  8. Greece (GR), 9. Italy (I), 10. Portugal (PT),
  11. Spain (SP);
- Nordic: 12. Finland (SF);
- Emerging Middle European countries:
  13. Hungary (H), 14. Czech Republic (CZ),
  15. Poland (PL), 16. Slovakia (SK);
- Baltic countries:
  17. Estonia (EST), 18. Latvia (LAT),
  19. Lithuania (LIT),
- Emerging South-East European countries:
  20. Bulgaria (BG), 21. Croatia (HR),
  22. Romania (RO);
- Far East Asian countries:
  23. China (CHN), 24. India (IND)
- West Asia: 25. Turkey (TUR).

Table 1 shows the occupation categories examined in the study with the corresponding ISCO'08 4 digits category.

ISCO-08	Occupation
1210	Company director, 50-500 employee
1323	Finance manager
1327	Hospital manager
2118	Mechanical engineer
2142	IT software engineer
2212	General practitioner physician
2410	University lecturer
2421	Secondary education teacher
2511	Investment broker
2615	Lawyer
2712	Archivist
2717	Sports coach, trainer
3173	Air traffic controller
4121	Bookkeeper
5134	Restaurant cook
5222	Nursing aid
6212	Tree feller
7321	Iron worker
7511	Bricklayer
8121	Textile printer
8418	Bus driver, public transport
9211	Sweeper, street cleaner

Table 1. List of the examined occupations