



## THE AVERAGE INCOME OF EMPLOYEE IN THE EUROPEAN UNION FROM STATISTICAL POINT OF VIEW

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### ABSTRACT:

Average income of employees is usually determined by mean. Since the distribution of income is not symmetric, mean is not appropriate for this particular distribution. In our paper we deal with other characteristics like median, median-mean ratio and quintile ratio. We show that there is a strong correlation between these characteristics.

### 1 Introduction

Mean is usually used to determine the average income of employees. It is calculated by dividing the aggregate income of all employees by the number of employees.

The median income divides employees into two equal segments with the first half of employees earning less than median and the other half earning more than median. The median income is considered by many statisticians to be a better indicator of average income than the mean employee income, as it is not affected by extremely high or low values. When we order elements of the statistic data set into non-decreasing sequence, the median of the data is a value of an element in the middle of this sequence. In a case when the statistical data is divided into classes, we use equation [1]

$$Me = c + \frac{h \left( \frac{n}{2} - N \right)}{n_m} \quad (1)$$

where  $c$  is the beginning of the class with median (median class),  $h$  is the width of the class,  $n_m$  is the frequency of median class,  $n$  is the size of statistical data and  $N$  is cumulative frequency of class, which is just before median class. The difference between median and mean is evident from *Figure 1*. For symmetric distribution mean equals to median. However, for asymmetric distribution with right tail the mean is greater than median.

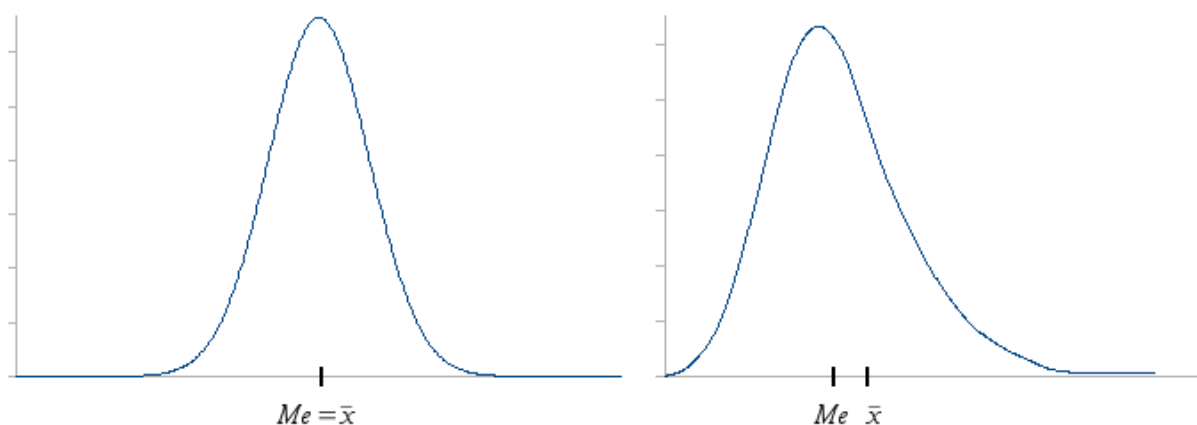


Figure 1

Besides median and mean, quintile ratio is frequently used characteristics of income of employees [2]. It is the ratio of total income of 20% of the population with the biggest income and 20% of the population with the lowest income. The bigger the quintile ratio is the bigger is the difference between the rich and the poor.

Correlation, often measured as a correlation coefficient, indicates the strength and direction of a linear relationship between two random variables.

## 2 Average income in the European Union

In all member states of the European Union mean and median is calculated from the population of people at least 15 years old (with income) [3]. The median and mean of the net yearly income (in euro) of the employees of all 25 member states of the European Union are in *Table 1*. Complete data are available for the year 2006 [4].

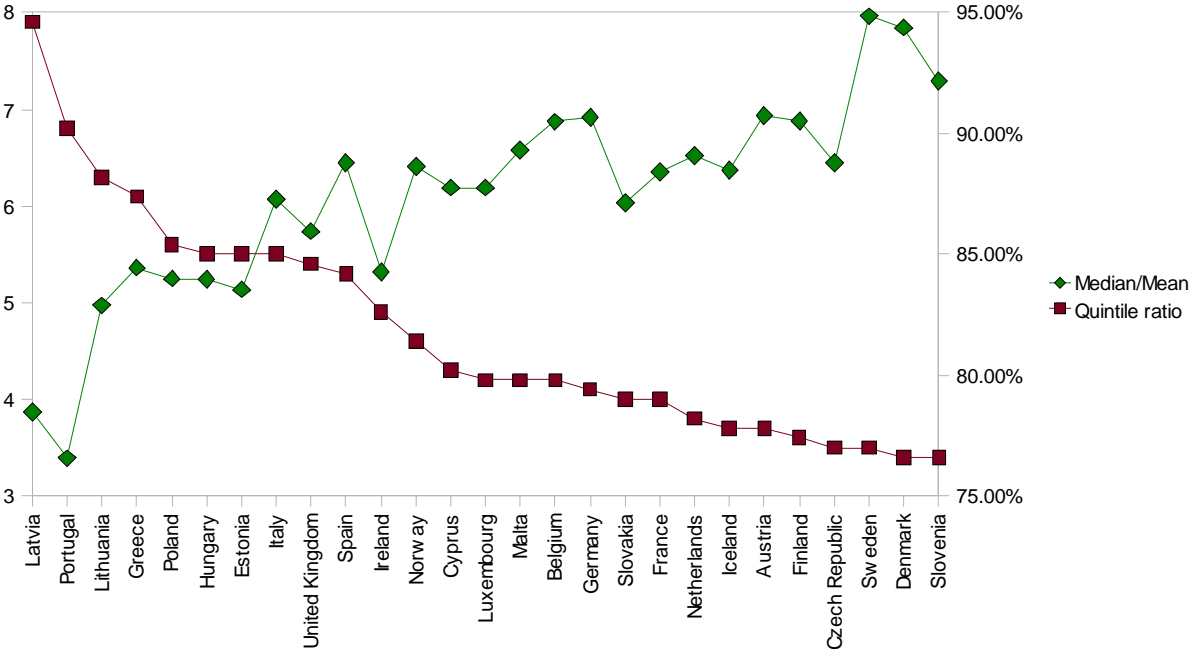
country	mean	median	country	mean	median
EU	15567	13815	Lithuania	3055	2532
Old countries of EU (15 countries)	17708	15522	Luxembourg	33822	29680
New countries of EU (10 countries)	4373	3551	Hungary	4582	3847
Belgium	19004	17194	Malta	9474	8461
Czech Republic	5403	4797	Netherlands	19376	17260
Denmark	24013	22663	Austria	19674	17852
Germany	17227	15617	Poland	3704	3111
Estonia	4355	3638	Portugal	9550	7311
Ireland	23360	19679	Slovenia	10109	9316
Greece	11664	9850	Slovakia	3803	3313
Spain	12877	11434	Finland	20234	18311
France	18313	16187	Sweden	18694	17730
Italia	16638	14520	United Kingdom	22462	19307
Cyprus	16560	14532	Island	31630	27989
Latvia	3230	2534	Norway	31351	27791

Table 1

## 2.1 Mean/Median and quintile ratios

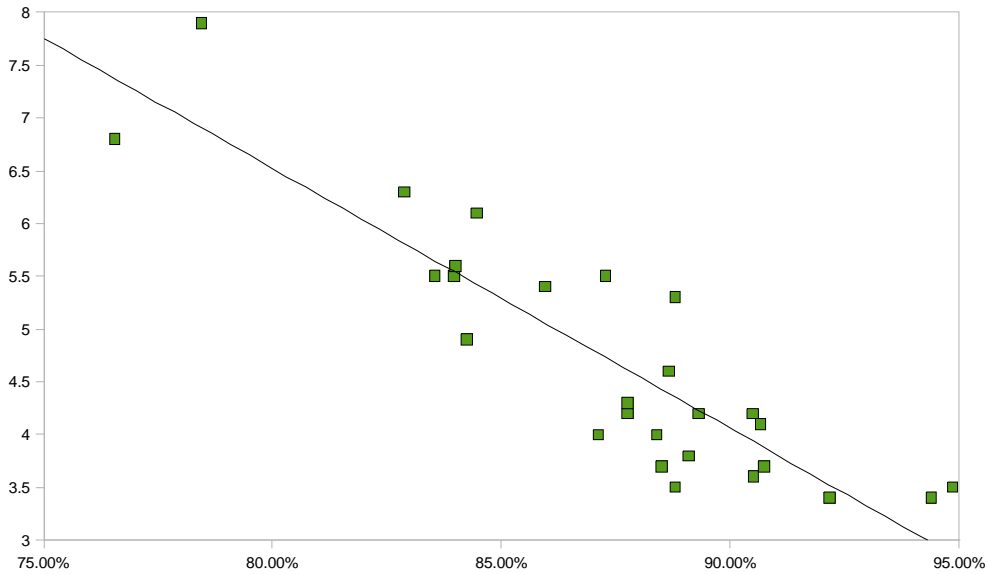
On *Graph 1* we see the median/mean ratios and quintile ratios for all 25-member states of the European Union. The biggest median/mean ratio is 94.84% in Sweden, while the lowest ratio 76.55% is in Portugal. The basic explanation for the median/mean ratio is as follows: The more is the ratio close to 100%, the more is the distribution of income symmetric. It means, that for the values of ratio that are close to 100%, the number of people with income that is less then mean is almost the same as the number of people with income that is more then mean. On the other end, states with smaller median/mean ratio have more asymmetric distribution of income. There are much more people with income bellow the mean than people with the income above the mean.

The biggest quintile ratio, 7.9, is in Latvia, while the smaller ratio is in Denmark and Slovenia, 3.4.



*Graph 1*

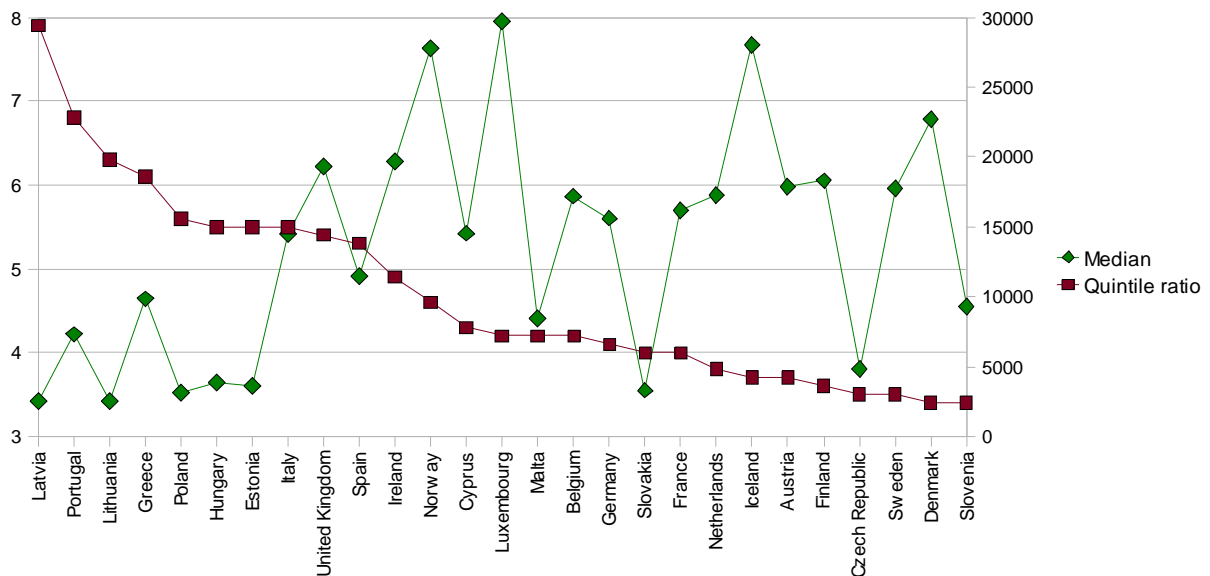
Since both characteristics describe the asymmetry of the distribution of income, we suppose that there is a correlation between the two characteristics. With median/mean ratio going close to 100%, the distribution is more symmetric. It means that there is not a big number of extremely large incomes. That is why we may expect that with increasing median/mean ratio the quintile ratio will be decreasing. It follows that the correlation coefficient should be negative. *Graph 2* gives visual evidence to our hypothesis. By calculation we get the value of correlation coefficient -0.89, which means that there is really strong linear relationship between these two characteristics. [5]



Graph 2

## 2.2 Median and quintile ratio

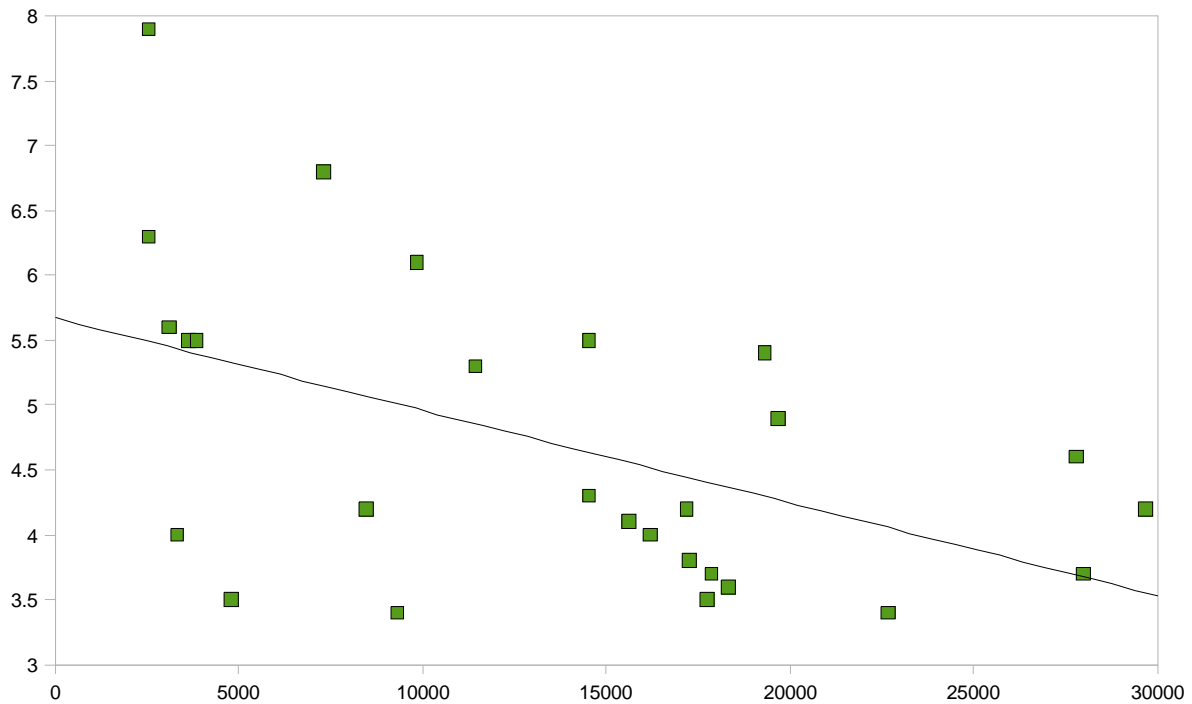
One may consider following question. Is there any correlation between the quintile ratio and median? In other word, is there any correlation between symmetry of distribution of income (described by quintile ratio) and the richness of the country? *Graph 3* shows the median and quintile ratio for all 25 countries of the European Union.



Graph 3

There is not strong graphical evidence of the correlation between the two characteristics, as we can see from *Graph 4* too. The exact value of the coefficient of correlation is  $-0.52$ , which means that there is only weak correlation between the asymmetry

of distribution, expressed by quintile ratio, and the richness of the country, expressed by median of the distribution of income. Since the coefficient of correlation is negative, with median increasing we get quintile ratio decreasing. It means that in countries with larger income the distribution of income is more symmetric than in countries with smaller income. However, we have to stress that this correlation is really small.



*Graph 4*

### 3 Conclusions

Mean is the most frequently used characteristics used in mathematical statistics. However, its usage is not appropriate when the distribution is asymmetric. In the case of the distribution of income, the median is much better characteristics than mean. So we suggest using both characteristics for the description of the average income. Mean may be used for comparison with data from previous years, while median gives us better estimation of the income of average employee.

We have showed that there is a correlation between the median/mean ratio and the quintile ratio. From the data sets of the European Union for year 2006 we calculated correlation coefficient  $-0.89$ , which gives a strong evidence of negative linear correlation between the two ratios.

We have also calculated the correlation between median and quintile ratio. The coefficient of correlation is  $-0.52$ , which represents low or medium linear relationship between the two characteristics. It means that there is only low correlation between the asymmetry of the distribution of income and the richness of the country. We have not considered correlation between median/mean ratio and median; since there is strong correlation between quintile ratio and mean/median ratio, we will get similar result.

**Bibliography:**

- [1.] Stuchlý, J., Matematika IV, Vysoká škola dopravy a spojov v Žiline, 1992
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