METODY ILOŚCIOWE W BADANIACH EKONOMICZNYCH
X, 2009, str. 42 - 49

THE ANALYSIS OF UNEMPLOYMENT VARIATION MEASURES IN THE EU MEMBER STATES

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Abstract: The issue of unemployment may be examined from many aspects. It is not only unemployment rate itself, but also the distribution of unemployment in a given country that are of major importance. To conduct such research, it is necessary to analyze measures of unemployment variation. The article presents unemployment variation measures together with their unique character.

Keywords: unemployment, pseudo-variance

INTRODUCTION

Unemployed represent a certain percentage in the total of population in every free-market economy. It is a phenomenon natural for every economy. It becomes a problem only when it increases considerably [Kwiatkowski 2007]. Unemployment is found both in rich and poor countries. Hence, in most countries there are institutions the aim of which is to combat and prevent the unemployment [Layard et al. 1991]. In many countries, unemployment has a regional character. There are regions that are particularly affected by unemployment [Horodelski and Sadowska-Snarska 2003]. Therefore, the research must involve analyses aimed at comparing not only unemployment rates, but also their spatial and temporal variation.

Temporal and spatial variation may be described with the use of distribution. To carry out more comprehensive analyses, it is necessary to define arithmetic operations on distribution. Convolution [Feller 2006] is the operator of addition, yet defining the operation contrary to convolution, i.e. equivalent of subtraction,

poses a major problem[1]. If one adopts definition of subtraction that is in accordance with axioms of algebra, distribution may not be a result in some cases. In practice, this leads to a situation when it is not plausible to employ methods based on algebra. The only solution is to generalize the notion of distribution, i.e. introduce the notion of pseudo-distribution [Borawski 2008]. Subtracting of two distributions does not have to result in a distribution but always in a pseudo-distribution, due to which, on the basis of pseudo-distributions set, one may introduce arithmetic operations that are in keeping with axioms of algebra. Pseudo-distribution may be classified as an element of the full set, in which all the possible distributions and their inverse elements are included. Proper definition of the pseudo-distribution is very difficult because of the fact, that, for most opposite elements, their counterpart in real world cannot be found. Similar situation occurs when the arithmetic calculations on the size of the set are conducted. If the difference in sets' size is examined and it is negative, it is not possible to determine the counterpart of negative number, because the sets with negative number of elements do not exist. On the other hand, such negative numbers are indispensable. Similar problem arises while defining the actions for parameters describing the distribution, particularly those parameters that measure variation (e.g. standard deviation, variance, range). To conduct a more comprehensive analysis, it is necessary to define arithmetic operations in a proper way and make generalizations that may consist in generalizing the variance as pseudo-variance that may take negative values. For formal reasons, most methods cannot be used without making such a generalization. Due to the fact that certain axioms are not satisfied, algebra does not allow to make calculations for correlation variance, create econometric models, etc. On the contrary, it is possible in the case of pseudo-variance as it satisfies these axioms. Pseudo-variance can be defined as an element of the full set, to which all possible variances and their inverse elements are included.

Relativity measures determine the variation of a given factor. As far as unemployment is concerned, these measures determine how unevenly distributed unemployment is in a given region. According to data derived from Eurostat, unemployment rate among people aged 25 and more amounted to 8.3% in 2007 in Poland. However, this does not indicate that unemployment rate is the same in the entire Poland. Unemployment rate can be calculated individually for each administrative unit. The comparison between these rates enables one to determine the extent to which they are different, which can be defined with the use of variation measures.

Standard deviation, describing the distribution, is one of the most frequently used variation measures. In the case of unemployment, the distribution of rates is the case. It determines the broadness of distribution, i.e. how much the rate fluctuates around its mean value. High and low rates may be considered favourable de-

[1] Operation opposite to convolution has been discussed in the following publications: Mikusiński [1953], Mareŝ [1989], Mareŝ [1994].

pending on the rate under consideration. As for unemployment, high standard deviation can be considered unfavourable as it indicates that unemployment distribution is extremely uneven in the area investigated.

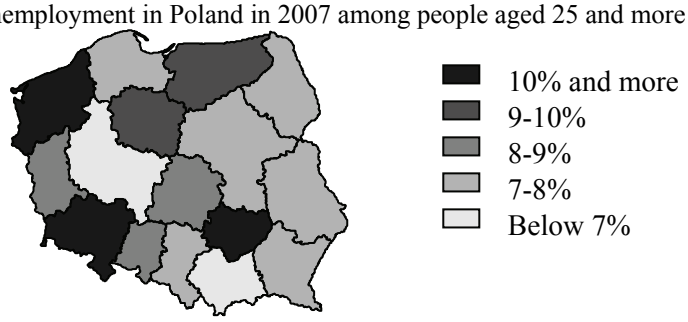
Furthermore, high standard deviation will translate into uneven supply and demand for labour in different regions of a particular administrative unit. On the one hand, this will lead to migration of population from regions characterized by higher unemployment to regions where it is lower. On the other hand, working places will "migrate" to regions where unemployment is higher in order to find employees whose pay demands are low.

Actions aimed at reducing the disproportion in unemployment may have different character than actions aimed at bringing down the unemployment itself. The disproportion may be reduced via improving transport infrastructure. The construction of motorways and dual clearways enables people to commute to work even from far away places. Motorways increase this distance nearly twofold. Everyday journey from place situated even 150 km away from working place becomes real, which can considerably reduce disproportion in employment in communes and counties.

EVENNESS OF SPATIAL DISTRIBUTION OF UNEMPLOYMENT

The fact that unemployment rate amounts to 8.3% in Poland does not indicate that unemployment is distributed evenly in the entire country. Figure 1 shows large disproportion among particular voivodships. In eastern Poland, unemployment amounts to about 7-8%, yet unemployment rates in western Poland are characterized by considerable disproportion. Wielkopolskie voivodship, where unemployment rate is low, neighbours Zachodniopomorskie voivodship and Dolnośląskie voivodship where the rates are extremely high.

Figure 1. Unemployment in Poland in 2007 among people aged 25 and more



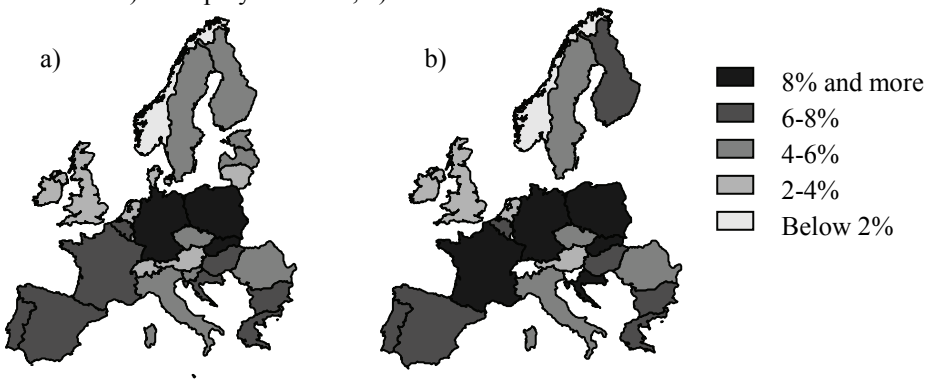
Source: own elaboration based on data derived from Eurostat

Unemployment rate for a particular country is calculated for the entire area without taking rates for particular administrative units into account. To determine spatial distribution of unemployment, one must use parameters describing the distribution of unemployment. Hence, one must calculate unemployment rates for

particular administrative units and then calculate parameters describing the distribution of unemployment in the entire country. Mean value and standard deviation are the most important parameters describing the distribution.

Mean value is an equivalent of unemployment rate in the entire country, yet it is not the same (which is shown in Figure 2). It can be noticed that mean unemployment rates calculated for particular countries at NUTS2 level and unemployment rates recorded in these countries are very much similar. The only difference lies in their interpretation. Mean value defines the mean value of the rate for NUTS2 administrative units and hence it refers directly to the value of the rate. Difference in values of both parameters results from the fact that mean value refers to administrative units as objects without paying attention to their scale (in the case of unemployment – number of residents).

Figure 2. Unemployment in Europe in 2007 among people aged 25 and more: a) unemployment rate, b) mean values of rates for NUTS2 administrative units

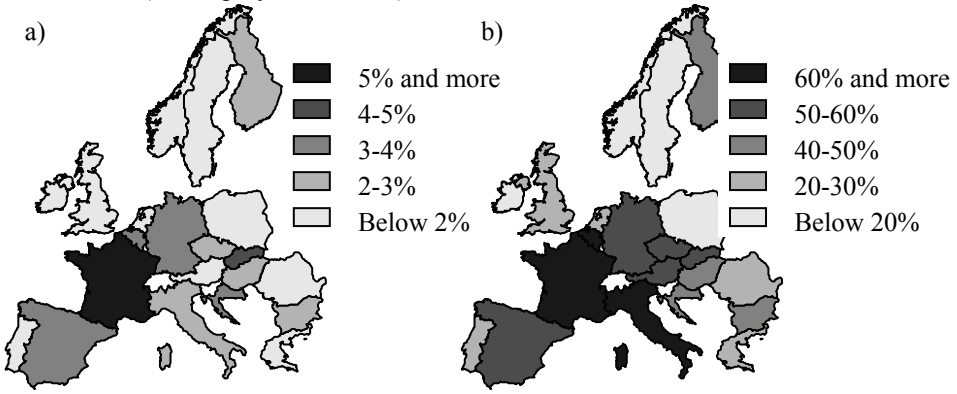


Source: own elaboration based on data derived from Eurostat

Standard deviation is the other important parameter. It defines the extent to which value fluctuates around mean value. The higher the deviation, the greater the fluctuation. Standard deviation is expressed in units of values that it describes. Standard deviation of unemployment rates in particular countries may be calculated when unemployment rates for administrative units at different levels are known (e.g. NUTS2, NUTS3). Hence, it defines the variation of unemployment rate at a given level.

Figure 3a shows the variation of unemployment rates in countries determined for NUTS2 level, which corresponds to Polish voivodships. Low values of standard deviation are the most favourable. Like Ireland, Norway or Sweden, Poland is among countries with low standard deviation of unemployment rate, which implies that the unemployed are distributed quite evenly in particular voivodships (compared to other countries).

Figure 3. Unemployment in Europe in 2007 among people aged 25 and more: a) unemployment rate, b) mean values of rates for NUTS2 administrative units



Source: own elaboration based on data derived from Eurostat

Standard deviation is expressed in units of rate for which it has been calculated. Such a way of expressing standard deviation does not always illustrate the situation well. Deviation with two units should be interpreted in a different way when mean value of the rate has four units, and in a different way when it has two hundred units. In the former case, variation of value should be considered extremely high, whereas in the latter case – very low. Therefore, value of standard deviation should always be related to mean value. To make the interpretation of standard deviation independent of mean value one can multiply them. The product of such an operation is variation coefficient, usually expressed as the percentage of mean value.

Figure 3b shows variation coefficient values for particular countries. It can be noticed that many affluent countries are characterized by high scatter coefficients exceeding 50%, which indicates that there is large disproportion among particular administrative units as far as unemployment rates are concerned. This state of affairs often stems from regional differences, just like in Italy (North-South) or Germany (in the past, the Federal Republic of Germany and the German Democratic Republic).

CORRELATION AMONG MEASURES OF RATES' VARIATION

Correlation formula may be derived in many ways [Borawski 2007]. Vector calculus is one of options. However, this requires defining vector space for variation measures. In the case of variance and standard deviation, it is necessary to make a generalization that allows negative values. The coordinates of vectors are ordered pairs that include mean value and generalized standard deviation (or mean value and variance generalization). These pairs can be added and multiplied by real value in accordance with universally accepted rules underlying arithmetic opera-

tions on mean values, variance and standard deviation [Jaworski 1979]. Thus, vectors defined for these pairs can be added and multiplied by scalar. On the basis of vector space defined in such a way, one may derive variance correlation and standard deviation formula which is analogical to mean value formula.

As far as arithmetic operations on variation measures are concerned, operations on standard deviation and variance can be distinguished. Arithmetic operations on standard deviation refer to random variables entirely dependent on one another, and operations on variance – to entirely independent ones. In practice, real result is somewhere in between values calculated for standard deviation and variance, which stems from the fact that random variables are usually partially dependent.

Table 1. Correlation between unemployment rates and other rates

	Unemployment rates by sex and age, at NUTS levels 1, 2 and 3 (%)			Long-term unemployment (12 months and more), at NUTS levels 1 and 2 (1000; %)		
	Mean value	Standard deviation	Variance	Mean value	Standard deviation	Variance
Unemployment rates by sex and age, at NUTS levels 1, 2 and 3 (%)	1	1	1	0.59	0.04	0.21
Long-term unemployment (12 months and more), at NUTS levels 1 and 2 (1000; %)	0.59	0.04	0.21	1	1	1
Economic activity rates by sex and age, at NUTS levels 1 and 2 (%)	-0.56	0.46	0.50	-0.53	-0.10	0.03
Average number of usual weekly hours of work in main job (full-time), at NUTS levels 1 and 2 (hours)	0.75	-0.04	-0.09	0.59	0.18	0.21

Source: own elaboration based on data derived from Eurostat

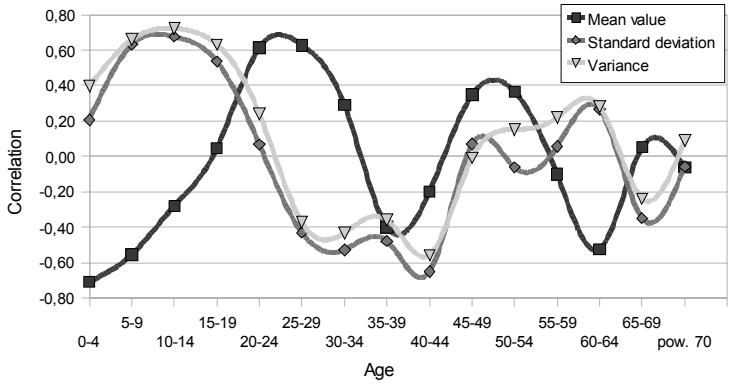
Table 1 shows correlations determined. It can be noticed that unemployment rate is strongly correlated with the average number of working hours, which results from the fact that the more hours employees spend at work, the fewer workers are needed for accomplishing a given task. In consequence, employers offer employment to smaller number of people.

Unemployment rate is negatively correlated with people's economic activity. Thus, the greater this activity, the lower the unemployment. At the same time, the variation of this activity is positively correlated with unemployment variation. Hence, it may be concluded that in regions characterized by great economic activ-

ity, unemployment is either very high or very low. In the case of variation measures, positive and negative values of correlation cannot be interpreted explicitly. It can only be stated that correlation is found, but it is impossible to determine its character.

Figure 4 shows the correlation between unemployment rate and percentage share of people from particular age groups in the total of population. It can be noticed that mean value is strongly and negatively correlated with the number of people aged 0-4, which can be justified on the grounds of the fact that parents decide have children when their financial situation is stable, i.e. when one of them has regular work. On the other hand, one parent can take maternity leave and hence is not considered unemployed.

Figure 4. Correlation between unemployment rate and percentage share of people from particular age groups in the total of population



Source: own elaboration based on data derived from Eurostat

The maximum is reached for people aged 20-29, which stems from the fact that they are just entering labour market. As they have no professional experience, their situation on the market is worse, they find it difficult to find a job and remain unemployed much longer. Having gained certain experience, at the age of 35-40 they are sought by employers and thus unemployment rate is the lowest among them. As they grow old, they are less and less efficient and able, and so are less attractive as potential workers, which is reflected in higher unemployment rate. Finally, people aged 60-64 are in a way protected, due to which employers cannot dismiss them so frequently. On the other hand, they can take early retirement instead of becoming unemployed. As a result, unemployment rate is lower in this age group.

CONCLUSION

The analysis of variation may provide additional information concerning the spatial distribution of unemployment, which allows to determine how evenly it is distributed among administrative units under consideration. Furthermore, it is plausible to determine the correlation between the variation measures of different rates and unemployment. On the basis of the research conducted, it can be stated that spatial distribution of unemployment is correlated with economic activity of unemployment and the number of people aged 5-15.

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Analiza miar zmienności bezrobocia w krajach Unii Europejskiej

Streszczenie: Problem bezrobocia można rozpatrywać w wielu aspektach. Interesującym czynnikiem jest nie tylko sam wskaźnik bezrobocia, ale także rozłożenie liczby bezrobotnych na obszarze danego kraju. Aby wykonywać tego rodzaju badania konieczne jest przeprowadzanie analiz miar zmienności bezrobocia. W artykule przedstawiono badanie miar zmienności bezrobocia z uwzględnieniem specyfiki tych miar.

Słowa kluczowe: bezrobocie, pseudowariancja.