Income Inequality and Food Security in the Light of the Experience of the OECD Countries

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Abstract. The main aim of this article is evaluate the relationships between income inequality and food security in the light of the experiences of the OECD countries. Understanding the problems of inequality of income and food security is one of the main challenge for economic and social development of the contemporary world. In the part of empirical studies one has used a data from the selected OECD countries by prism of the Gini coefficient of income distribution and relative poverty. In turn, food security is presented from the perspective of the global index of food security (Global Food Security Index), which was developed at the request of DuPont by the Economist Intelligence Unit (EIU). In the case of empirical verification one has used regression analysis and cluster (agglomeration) for typing of the studied countries. Time scope of analysis refers to the period 2010–2015. It was stated that there is a considerable variation in the level of food security, and especially income inequality between countries. This is a consequence of both the differences in the level of economic development, as well as the model of functioning of the economy. A relationships between income inequality and food security are complex and ambiguous. A clearer regularities can be seen in the case of income inequality and food security in the dimension related to the economic affordability of food price. This is due to the fact that issues related to food security are mainly connected with low level of income. In turn, the cluster analysis made it possible to distinguish three groups of countries with different characteristics in terms of income inequality and food security.

Keywords: income inequality, food security, OECD, Gini coefficient, poverty, economic development.

JEL Classification: H55, D63, Q18.

Conference topic: Contemporary Issues of Economics and Management Studies: Problems and Perspectives.

Introduction

The growing world population and an uneven economic development between countries make the issues of income inequality and food security are presented generally in the context of contemporary challenges and problems of economic world development. On the other hand food security is an important components of the culture of each society (Wilkin 2015), and its meet affects also the ecological balance, economic, or social (Małysz 2009). It enables to move to the "higher" social needs. Currently, food markets are generally surplus, and the problem is varied in spatial dimension. Even in countries with medium and high level of economic development due to income inequality, there are social groups in which there are unmet food needs.

Food security is trying to explain a variety of reasons, often economic. So the question is: how income inequality affect food security? This is one of the causative factors of food security. Although other determinants such as income level, the development of agriculture, climate change, access to water are more exposed at these issues (Rosegrant, Cline 2003). It doesn't mean that economic inequality are not significant. The main aim of this article is to evaluate the relationships between inequality of income and food security in the light of the experiences of countries covered by the OECD[1] statistics. It should be noted that within individual countries, there are significant regional differences for example in range of dispersion of income. However, due to restrictions on the volume of the article, as well as access to the data they were not subject of considerations. Simultaneously it is worth noting that the group of the OECD countries isn`t homogeneous, although the countries belong to the democratic of medium and

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[1] The OECD databases except information about the members of this organization, there are also data relating to non-members, and aspiring to the OECD, for example Russia. One has used in the article also this case.

high level of economic development. Topics covered have their justification in the undertaken studies due to the existing challenges and threats of an economic and social related.

The most commonly used definition of food security (although it is constantly changing) is the affirmed by the FAO: *Food security is a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life* (Pieters *et al.* 2012). Understanding "food security" in the study were presented from a similar perspective. Due to the need to operationalize this term one has used the global index of food security (Global Food Security Index). This index was developed at the request of DuPont by the Economist Intelligence Unit (EIU). This synthetic index is the result of three indicators that relate to the dimensions of the food security (affordability[2], availability[3], quality and safety[4]) based on a total of 28 measurers involved. The food security factor is closer to a value of 100 the favorable situation of the country. It is worth to note that in the literature the term "food security" is treated ambiguously. One can even meet with the statement that this concept is classified as so-called wicked problems (Dentoni *et al.* 2012). In turn, the data on income inequality are taken from the databases of the OECD. One has used in this case, the Gini coefficient of income distribution and relative poverty[5]. Due to the fact that not all countries of the OECD there are in the database of Global Food Security Index (despite of the fact that it includes 109 countries) limited group of countries were surveyed (31) in the article. Within this group was divided into countries more and less developed. Delimitation was based on the value of median of the indicator of the GDP per capita for the surveyed countries. Time analysis refer to the mean for the period 2010–2015 for the OECD data and 2012–2015 for data connected with food security. It results from the incomplete data for each year of this sub-period in the case of the data from databases of the OECD, and availability of the data from of the DuPont database (since 2012). Moreover, such an approach made it possible to reduce fluctuations of the examined variables. It made impossible the use of a panel regression. Therefore, there are regression analysis, correlation and clustering (agglomeration) in the article.

Theoretical perspective and previous studies

Income inequality is an integral part of the market economy, due to differences in qualifications, performance, production resources during the social division of labor. A certain degree of inequality depends on a specific conditions in each country and is desired, what would encourage for economic activation, increase skills, level of education. However, excessive dispersion of income, whether the scale of poverty are harmful due to the increasing cost of social marginalization of the poorer groups of society, reducing of trust in democratic institutions, and a threat to social and political stability (Rist, Martin Fernandez 2016). It's not about going in the direction of social egalitarianism because, as shown the experiences of the centrally planned economy, it weakens the growth stimuli and propensity to innovation (Grzelak 2016a).

The issue of income inequality is undertaken in the literature relatively often. It results mainly from social role of economics as a science. The market mechanism makes the primary income distribution is uneven which implies the need for the revision of the state. An important role in the study of inequalities of income played the hypothesis (curve) of Kuznet's (Kuznets 1955). According to this concept, income inequality is a function of an economic development of a non-linear shape of an inverted letter: "U". It is due to the transition from an economy based on agriculture to an industrial economy. It is worth noting that this hypothesis is still widely discussed and verified. While in the United States after the II World War dispersions of incomes fell to 50s twentieth century. In the next two decades, they remained at a similar level (Piketty, Saez 2003). The increase in recent decades, income inequality in the most OECD countries highlighted in turn by (Keeley 2015). However, dominates the view that the reduction of income inequality improves the overall social welfare (OECD 2015). It is exposed at these issues the need of sustainable development that would ensure the reduction of income disparities and thereby improve food security for poorer groups of society (Popławski, Rutkowska 2011).

The phenomenon of differentiation of income, poverty starting from the last decades of the twentieth century were more and more connected with the issue of food security. Significant contribution to the study of food security and its links with differentiations of income, poverty brought (Sen 2002). He stresses the importance of the purchasing power of households in eliminating poverty, improving food security and increasing the number of social groups in economic decision-making in order to improve well-being. So there is a strong relationship between food security, poverty and income differentiation. In turn Swinnen (2015) states that the correlation between food security and the income level is 70%. Also he notes that farmers are often the less wealthy social groups. In this way, paradoxically, they are more exposed to food insecurity. So growth of the production in the agricultural sector, is key

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[2] One takes into account when it is calculated, inter alia the share of food consumption in household expenses, the GDP per capita, the percentage of the population below the poverty line.

[3] It takes into account, among others, sufficiency of food supply, the stability of agricultural production, the level of food loss, the level of political stability.

[4] It includes inter alia measures such as diversification of diet, food standards, quality of protein, the availability of micronutrients.

[5] It is calculated by estimating half of the median of income in a given country. Then, the share of households whose incomes do not exceed half of the median income was set.

to improving food security of the poor countries. Therefore, in terms of higher prices of agricultural products their situation should improve this area. While (Rosen, Shapouri 2001) indicate that increase food security in less developed countries may be take place on the path of growth in purchasing power primarily a group of people with the lowest incomes. However the problem in this case are strong budgetary constraints in those countries. Similar conclusions come (Agwu, Oteh 2014), who stress the need to reduce disparities of income to increase food security in the light of research in Nigeria. These disparities are particularly relevant rural population. Simultaneously they indicate that income inequality were linked with such features as: the level of education or age of the head of household. In turn (Magña-Legmus *et al.* 2016) paid attention on the issue of the importance of education and demographic factors in shaping food security and income stability in Mexico. While (De Castro, Di Mambro 2013) emphasize that in recent years, one of the sources of these problems was the inadequate distribution of food and its waste.

Using a neoclassical point of view, the market should itself solve the problems of food security and income inequalities not only by price adjustments and wage (for income inequality), but using export, in a situation of surplus or import in terms of food shortages. Meanwhile, the market mechanism in a limited extent takes into account environmental constraints, issues of a distribution of the effects of economic growth, environmental and social dumping, excessive speculation. The importance of transnational corporations in the global food market, makes that food security remains now, in some extent, outside the operation of the market. Consequently in a limited extent can be set prices (national or global) by the market mechanism, which express the full (social) costs of food production (Brown 2011). It reduces the function of the efficiency of the market and increasing perturbations (Gałązka, Grzelak 2015). It requires a broader research perspective, taking into account, inter alia, income inequality, but also the importance of foreign trade. One can argue that the mainstream economics theories are not able to satisfactorily explain the problems of food security and income inequality in the conditions of globalization of economic processes. It is connected with the need for a holistic perception of these problems. It is about inclusion in the research paradigm of sustainable development, and to promote local development (local food systems) (Carvalho 2016).

For most of the EU countries farmers can produce food now more than national needs. Therefore, the bigger problem for food security, in terms of the needs of balance seems to be the level of income of the poorer part of society, and thus the issues of income inequality. Paradoxically however, the problems of food security, in the sense of balance, has 9% of the population of the EU countries (Pawlak 2012). This is mainly due to worsening the situation of the labor markets in the EU countries as a consequence of the economic crisis (increase an unemployment) and rising food prices. It resulted an increase of poverty in these countries and the growth differentiation of income. Not without significance is also the intensification of the immigration processes in Europe. In total, currently in 11 European countries (Austria, Belgium, Denmark, Finland, France, Greece, Netherlands, Norway, Sweden, Switzerland, Italy) there are no problems with the malnutrition for significance for public health.

Previous conclusions regarding the problems of food security are also supported by the Eurobarometer public opinion of the citizens of the EU[6]. They show that 90% of the EU citizens believe that the quality and price are important factors when buying food, and more important than origin (71 percent) and brand (47 percent). When it comes to food security, 75% of the EU citizens expressed concern about the challenge of ensuring food for all inhabitants of the globe. Therefore 84 percent of respondents agree with the fact that the EU should help other countries increase their food production.

Empirical verification

Initially can be seen tendency, in the analyzed group of the OECD countries, when the higher level of food security is accompanied by a more equal distribution of income and a lower poverty indicator (Fig. 1). However these relationships are not strong and thus clear. Dispersion of observations around the linear regression function was not significant in the case of the Gini coefficient. The most outlaying objects were the United States and Russia, which resulted from the extreme value of the indicator of food security. Slightly stronger links (r coefficient accordingly –0,59 and –0,48) took place in the case where the dependent variable was the affordability of food price that is a partial component of the synthetic index of food security. Perhaps it is due to the relatively greater importance of economic context of food security. For other dimensions of food security physical (physical availability of food) and quality (food safety) relationships were weak or statistically insignificant. The lowest level of food security was noted in Russia and Turkey, where a high (but not the highest) was also a level of income disparities and poverty. In the first of these countries, this was mainly due to the restrictions on physical availability of food, in the second one primarily from the relatively low level of price affordability of food (the ability of consumers to purchase food) because of low level of income. In turn, Mexico and Chile noted slightly higher level of food security, accompanied

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[6] Eurobarometer: Europeans, Agriculture and the Common Agricultural Policy (CAP), the research conducted in 2013 on a population of 26,5 thousand citizens of the EU member states [access November 2016, http://europa.eu/rapid/press-release_IP-12-748_pl.htm]

by a greater income dispersion. In contrast, a very high level of poverty in Israel results from the high unemployment rate among ultra-Orthodox men and the Arab women (Chaczko 2014). Attention is paid also the situation in the USA, where we had to deal with the highest level of food security, but also the relatively high level of the indicator of income disparities what is caused by rather low participation of the state in socio-economic processes. On the other hand, the level of income even less wealthy groups there is relatively high in this country. Simultaneously according to other studies (Kraciuk 2015), there are disparities between countries and highly underdeveloped in terms highlighted three dimensions of food security. The greatest imbalance occurred (for the 109 countries covered by the statistics of the global index of food security) in the case of affordability of food price.
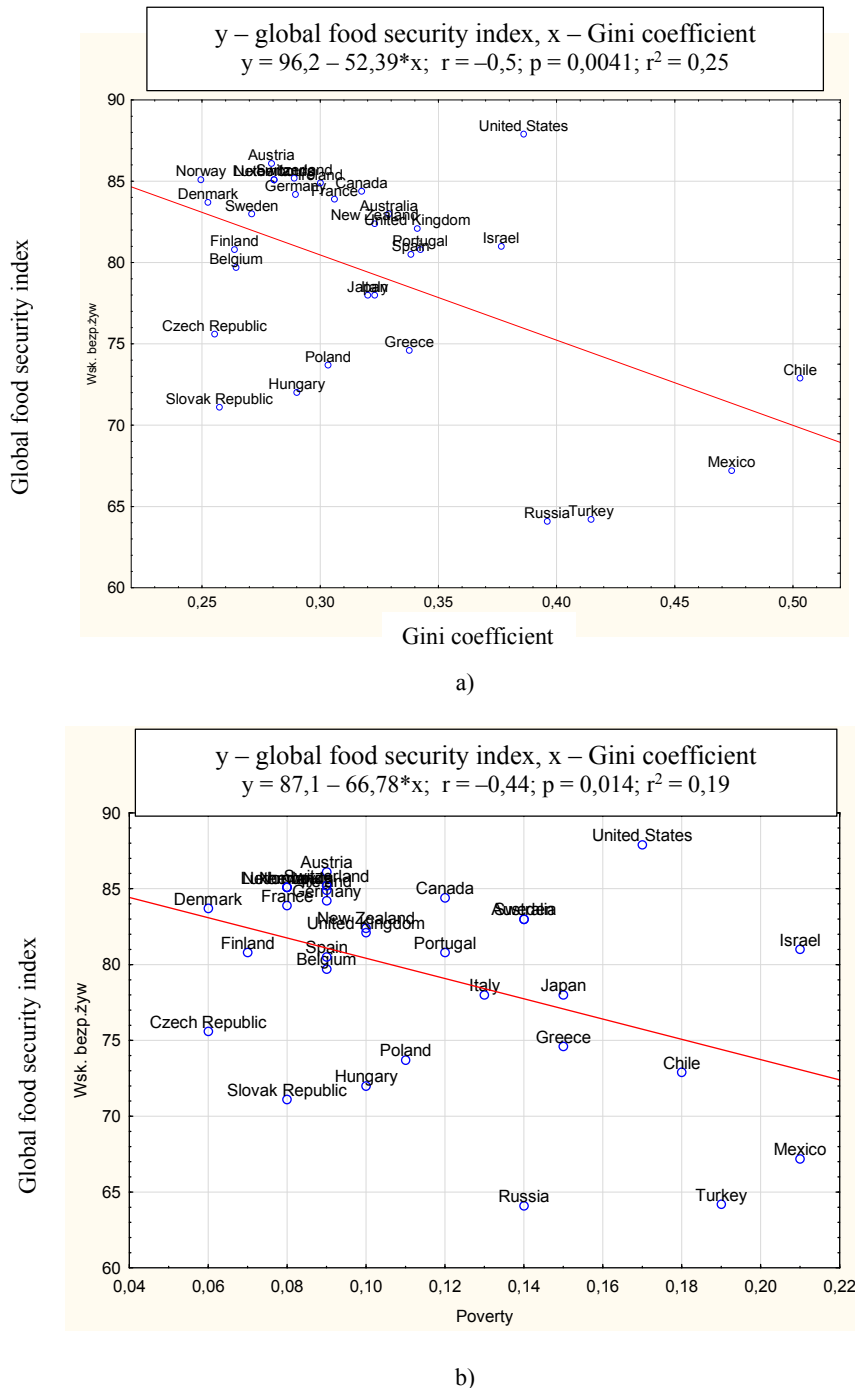

a)

b)

Fig. 1. The Gini coefficient of income inequality in the OECD countries (the mean for 2010–2015) and the global food security index (the mean for 2012–2015) (a) and the relative poverty indicator in the OECD countries (the mean for 2010–2015) and the global food security index (the mean for 2012–2015) (b)

(*Source*: Own elaboration based on OECD data and Global Food Security Index, http://foodsecurityindex.eui.com and using STATISTICA12.0)

Earlier findings are confirmed in the case when we make the division of the surveyed countries into two groups according to the level of GDP per capita (Table 1). The analysis shows that in more wealthy countries were lower income inequality and also a higher level of food security. Simultaneously the examined group of less wealthy countries was a less homogeneous. It is indicated by a higher coefficient of variation. It is due to the significant disparities in socio-economic development in these countries, which is a consequence of the transformation process (eg. Poland, the Czech Republic, Hungary) and different types of economy (eg. Russia, Mexico, Israel, Portugal). Moreover, the greatest variation was noticed, in the studied groups of countries, for indicators of income disparities. It shouldn't surprise, due to the fact that food is one of the most important human needs. Hence the need her ensure makes lower the differences between countries. It reflected also in the evolution of the share of household expenses on food.

Table 1. Description of the parameters concerning income inequality and food security in the group of countries covered by the OECD statistics (the mean for the years 2010–2015 and 2012–2015 for food security)
(*Source*: Own elaboration based on OECD data and Global Food Security Index, http://foodsecurityindex.eui.com and using STATISTICA12.0)

Specification		Mean	Minimum	Maximum	Coefficient of variation
Gini coefficient	a	0,30	0,25	0,39	12,23
	b	0,35	0,25	0,49	20,44
Indicator of relative poverty	a	0,10	0,06	0,17	30,28
	b	0,13	0,06	0,21	34,81
Global food security index	a	84,69	82,10	87,90	2,18
	b	74,41	64,10	82,42	7,99
Index of affordability of a price	a	89,17	85,90	92,82	2,35
	b	78,09	62,51	85,23	8,72
Index of availability of a food	a	81,06	74,41	85,13	3,78
	b	69,61	54,42	80,41	9,46
Index of quality and safety of a food	a	83,51	80,50	87,59	2,37
	b	78,43	67,12	88,50	8,95

a – more wealthy countries, b – less wealthy countries.

One has noted that in the group of wealthy countries changes in income inequality (Gini coefficient and indicator of poverty) remained in the same direction as the change of food security (Table 2). It was especially visible for the index of affordability of food price. It is worth to note that in these countries the level of income per capita even less wealthy groups is relatively high, and the average level of income inequality is lower in them than in the second group of surveyed countries. Furthermore, if we exclude from the observation the United States, where the level of food security was the highest (89,9) at a relatively high level of income inequality (Gini coefficient of 0,39 and 0,17 indicator of relative poverty), then it would be the lack of any statistically significant trend in this group of countries. Hence, these relations are more complex. It is possible that after exceeding a certain threshold of wealth existing income differences, which are still lower compared to less wealthy countries, do not constitute a greater barrier (especially affordability of food price) in terms of achieving food sovereignty and thus food security. It is because of the fact that the food is relatively cheap good, despite that the reduction of income inequality affect the further increase food security especially among the poorest groups in these countries. Relatively clearer links were recorded in relation poverty-economical availability of food for this group of countries. It may result from the fact that poverty is a relatively stronger determines affordability of food. On the other hand, one should treated these links with caution because the distribution of the variable "poverty" was only close to normal. Clearer depending one has noticed in the case of a group of less wealthy countries. It results from them that ensuring food security in poorer countries doesn't favor income inequality (Grzelak 2016b). As well as in the group of more wealthy countries dependences was observed in the case of index affordability of price and the indicator of poverty. It may result from the fact that poverty is relatively stronger pricing determines of the affordability of food (Karmakar, Sarkar 2014). It may be related to the fact that, above all, a fairly large group of people less well have problems with the achievability of food price (income barrier).

In the next stage of research the examined group of countries was divided due to the indicators of income inequality and food security (Fig. 2). The analysis of variance confirmed that all the variables proved statistically significant descriptors ($p < 0,05$). Applying comparing of binding distance figure one has established the limiting distance at the level of 10 (Fig. 3). It allows the separation of the three relatively homogeneous groups. The first group included countries with relatively high levels of income inequality, lower index of food security (Table 3), and rather low level the GDP per capita. The second group included countries of the Central and Eastern Europe, so called transition economies, which undergone transformation. The indicators of food security, in this case, reached

Table 2. Selected parameters of regression equations[7] relating to income inequality and food security among the OECD countries (based on the mean of the data for 2010–2015 and 2012–2015 for food security)

(*Source*: Own elaboration based on OECD data and Global Food Security Index, http://foodsecurityindex.eui.com and using STATISTICA12.0)

| The group of more wealthy countries (com. introduction)		
y – the dependent variable – the global food security index; x – the independent variable – the Gini coefficient of income differentiations		
Y = 74,47 + 32,8x		
p = 0,05 (or model), p = 0,06 (for independent variable)	R2 = 0,24	coefficient of correlation = 0,49
y – the dependent variable – the index of affordability; x – the independent variable – the Gini coefficient of income differentiations		
Y = 79,27 + 35,09x		
p = 0,02 (for model), p = 0,03 (for independent variable)	R2 = 0,29	coefficient of correlation = 0,54
y – the dependent variable – the index of affordability; x – the independent variable – the indicator of relative poverty		
Y = 84,24+48,98x		
p = 0,008 (for model), p = 0,01 (for independent variable)	R2 = 0,51	coefficient of correlation = 0,71
The group of less wealthy countries (com. introduction)		
y – the dependent variable – the global food security index; x – the independent variable – the Gini coefficient of income differentiations		
Y = 83,40 – 31,40x		
p = 0,15 (for model), p = 0,16 (for independent variable)	R2 = 0,14	coefficient of correlation = –0,38
y – the dependent variable – the index of affordability; x – the independent variable – the Gini coefficient of income differentiations		
Y = 99,31 – 57,71x		
p = 0,02(for model), p = 0,02 (for independent variable)	R2 = 0,38	coefficient of correlation = –0,62
y – the dependent variable – the index of affordability; x – the independent variable – the indicator of relative poverty		
Y = 88,02 – 73,75x		
p = 0,05 (for model), p = 0,06 (for independent variable)	R2 = 0,26	coefficient of correlation = –0,51
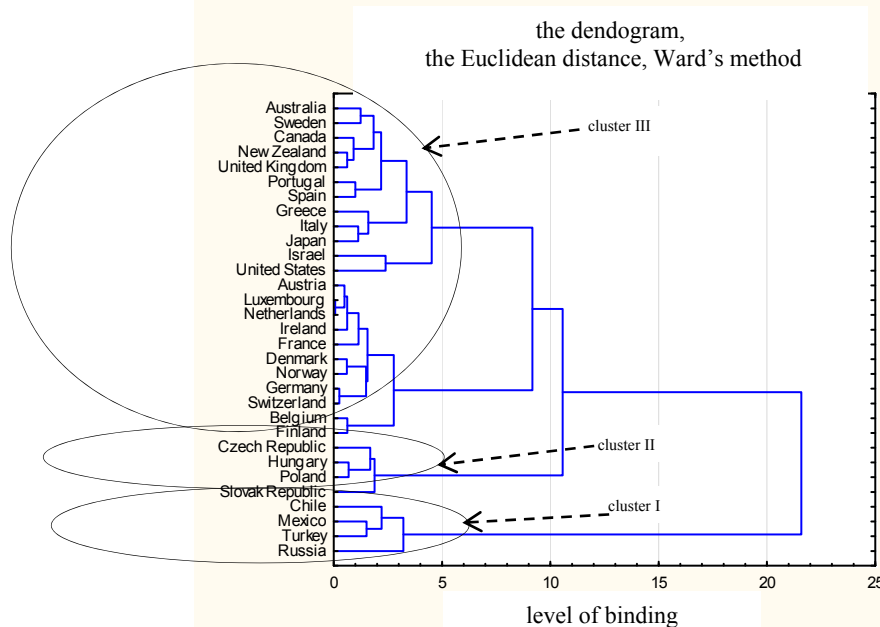
Fig. 2. The dendogram of the OECD countries due to income inequality (the Gini coefficient and the indicator of relative poverty) (mean for period 2010–2015) and food security indicators (mean for period 2012–2015)

Source: Own elaboration based on OECD data and Global Food Security Index, http://foodsecurityindex.eui.com and using STATISTICA12.0

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[7] The studied variables were tested Shapiro-Wilk test and Lilliefors distribution for normality. They show that at the given p = 0,05 distributions were generally comply the condition of normality. Due to the use of the cross-sectional studies it was not necessary testing homoscedasticity and autocorrelation of regression equations

the medium level (like the level of the GDP per capita), but income inequality was the lowest. In turn, other countries create the least homogeneous group, also due to the largest number. High level of food security is accompanied not the smallest income inequality. Simultaneously this group of countries reached relatively high levels of economic development. It is worth to note that the cluster no 1 is the most different from the others in a range of examined characteristics[8]. This is due the highest income inequality, accompanied by a low level of food security.
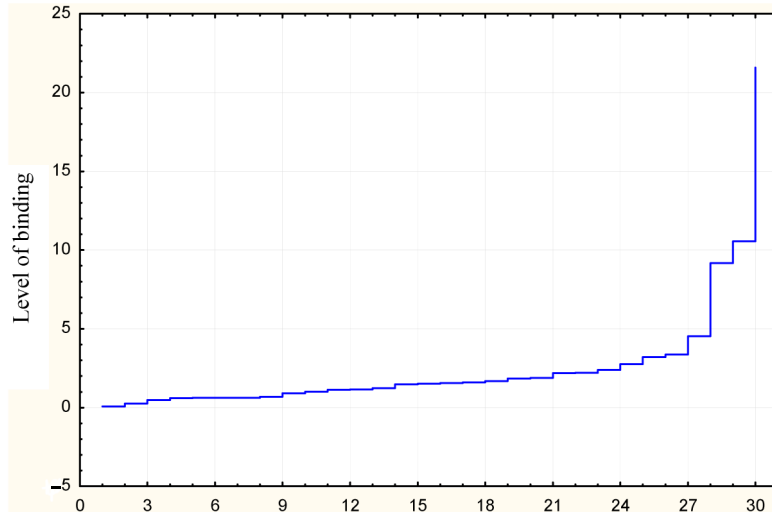

Fig. 3. Comparing level to binding distance for the dendogram (com.fig. 2)
(*Source*: Own elaboration using STATISTICA12.0)

Table 3. Selected parameters of income inequality and food security in the analyzed clusters (com.fig. 2)
of countries of the OECD
(*Source*: Own elaboration based on OECD data and Global Food Security Index,
http://foodsecurityindex.eui.com and using STATISTICA12.0)

Specifiaction	Mean	Minimum	Maximum	Coefficient of variation
Cluster I (n = 4)				
Gini coeficient	0,45	0,40	0,50	11,20
Indicator of relative poverty	0,18	0,14	0,21	16,35
Index of affordability of a price	68,7	62,52	74,51	7,45
Index of availability of a food	64,17	54,43	72,04	11,34
Index of quality and safety of a food	71,15	67,10	74,33	4,20
Cluster II (n = 4)				
Gini coeficient	0,28	0,25	0,30	8,65
Indicator of relative poverty	0,09	0,06	0,11	25,34
Index of affordability of a price	79,22	77,94	81,59	2,05
Index of availability of a food	66,92	64,12	69,38	3,66
Index of quality and safety of a food	74,67	68,91	77,52	5,24
Cluster (n = 23)				
Gini coeficient	0,31	0,24	0,39	12,18
Indicator of relative poverty	0,11	0,06	0,21	33,41
Index of affordability of a price	87,02	77,30	92,81	4,21
Index of availability of a food	78,31	67,69	85,10	6,28
Index of quality and safety of a food	83,82	79,31	88,50	2,89

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[8] It was also confirmed by RIR Tukey test at p < 0,05

Final conclusions

The considerations tend to the conclusions:

– there is a considerable differentiations in both the level of food security, and especially income inequality between countries. This is a consequence the differences in the level of economic development, as well as the model of functioning of the economy. These problems relate to the greatest extent the less wealthy countries, as well as the poorer strata of society in developed economies

– the relationships between food security and income inequalities are complex and ambiguous. In the literature prevailing the view that the increase of income inequality reduces the level of food security. According to research, these relationships are clearer in the case of less wealthy countries. But for wealthy countries it is difficult to make such generalizations. The level of food security there is a relatively high, and the scale of income inequality generally quite low, but not always the lowest (eg. the USA). So there are reserves to increase the level of food security by reducing income inequality through eg. a wider range of budgetary redistribution.

– one has noted stronger links between inequalities income and food security related to the economic affordability of food price. This is due to the fact that especially the "bottleneck" problems of food security is the demand side of the food, so economic availability. It can be assumed that with the development of the economic, problems of food security will move towards issues of food safety.

– one can identify three reasonably homogeneous group of countries with relatively similar characteristics in terms of the analyzed indicators in the surveyed countries. It shows that the problems of income inequality and food security have a different nature between countries, despite of the similarities.

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