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## **Food Trade Dependency Index for EU28 Countries in the Context of Food Security**

### **Introduction**

Food security is particularly important for developing countries because nutrition is a human right. People need food to live. Food provides business opportunities and also supports public health and culture. Food is transported from kilometer-long distances by food supply chain because some products cannot be produced in domestic markets. In addition, health depends on food. The major reasons of death and disability in a society (cancer, cardiovascular diseases, diabetes, etc.) arise from the food habits and lifestyles of its citizens. The importance of food security, which is significant in every period, has become more important nowadays. Food security was firstly discussed in 1970, when the world faced a food crisis due to problems related to the food supply chain. A global food conference was held by national governments, in order to find a way out of the global food crisis in 1974. It was understood that food security needs to be redefined in the midst of 1970s (ODI 1997).

Food security is a flexible concept. There are different definitions in literature related to food security. Food security was defined at the World Food Summit in 1974 as follows: “availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices” (UN 1975). According to the Food and Agriculture Organization (FAO), food security is “ensuring that all people at all times have both physical and economic access to the basic food that they need” (FAO 1983). Food security was defined at the 1996 World Food Summit as: “Food security (at the individual, household, national, regional and global levels) is achieved

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when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life” (FAO 1996).

Different trade indexes are used in the literature to examine trade structure of countries, trade policies, economic openness, real exchange rates, etc. Economists, like Kravis, Lipsey, Kuznets and Edwards, advice to use the ratio of trade to gross domestic product (GDP). The Trade Dependency Index (TDI) is used in the article and it is calculated for the European Union (EU) 28 countries in the period 1999–2017. TDI is not applied for all the years due to data limitations. The agriculture-related TDI covers both export dependency and import dependency indexes.

## 1. Literature review

There are many studies related to food security in various countries and regions. Some of these studies are as follows. Van Zyl and Kirsten (1992) indicated that there is a partial food security in South Africa, but food security is not adequate for South African people, because 21% of people from urban areas and 63% of people from rural areas live under hunger limit. The agricultural technology should be improved and a food marketing system should be developed to solve the food insecurity problem. The study of Booth and Smith (2001) showed that there is no food security in Australia, due to inadequate food production conditions. The food insecurity circumstance affects especially young, elderly, unemployed, singles and migrants negatively. The government should work with experts to solve the food insecurity problem.

Angeles-Agdeppa (2002) stated that Philippines didn't have a good food security policy. According to Agdeppa, insufficient economic growth, energy shortage and adverse domestic political factors are the main reasons of food insecurity. Chilton and Donald (2009) showed that the United States do not have a strong food security. Food insecurity affects the mental and emotional development of people negatively. Food security should be accepted as a human right for solving the food insecurity problem. Ahmad and Farooq (2010) explained that there is a rapid population increase in Pakistan which causes food insecurity in the country. Governments have increased the number of arable peasant farms and supported wheat production to solve food insecurity in the country. Fengying et al. (2010) studied the effect of food security on China in the period of 2002–2007. According to the author, China ensured food security in a lot of provinces, but 9 provinces and 271 counties had not had food security as yet. Inadequacy in education, income and land are the reasons of the food insecurity. Hussain and Routray (2012) explained that there is a food insecurity in Pakistan. Pakistan can use 30% only of its cultivated lands. Food security is lower in federally administered tribal areas. Incorrect food procurement, marketing and distribution

systems, food smuggling, lower purchasing power and natural disasters also lead to food insecurity in the country.

Attah (2012) argued that although Nigeria has huge natural and human resources, it does not have food security. If Nigerian government wants to solve food insecurity problem, the following measures should be taken: rural development, adequate budgetary allocations to agriculture to the food crop sub-sector, political stability, peasant farmers education, and decrease in rural poverty. Wheeler and Braun (2013) explained that climate change will cause hunger and drought, and they advised climate-smart food system. Kirwan and Maye (2013) found that the United Kingdom has a strong food security position. They evaluate food security as an asymmetrical power. The UK produces more food than domestically required. Begum et al. (2013) investigated food security in Bangladesh. According to their research, food insecurity is persistent in that country. Ferdoushi and Siwar (2013) explained that Malaysia has not a well developed food security system. Because people are poor, they cannot have a good health. In addition, Malaysia is import dependent on food products such as wheat, beef, mutton, etc. The solution of food security in the country is to reduce dependency on food imports as well as to secure self-sufficiency level in most of the food requirements.

Bala et al. (2014) thought that food security in Malaysia was highly dependent on rice supply. Therefore, policy makers should support and educate farmers about rice production. Narayan (2015) studied food security system of India. According to his views, Indian government performs a lot of projects related to food security, but these projects are inadequate. The government should also support food production, food diversity and nutrition quality. Nath (2015) investigated food security in Bangladesh. In his opinion, Bangladesh has not food security. The uncertain global trade and land scarcity are the main causes. The country can solve the problem by increasing domestic production. Matemilola and Elegbede (2017) argue that Nigeria does not apply a good food security policy. Nigeria has big petroleum resources so that people have more income. Therefore, policy makers prefer to import foods instead of producing it. This situation leads to food insecurity of the country. According to the authors, Nigerian government can solve the food insecurity problem via new agricultural policies. Ritchie et al. (2018) express the view that India has not a strong food security system. Therefore they recommend to optimize local production, reduce waste and participate in international trade.

## 2. Methodology

The TDI is obtained from the well known macroeconomic constituents of GDP as follows:  $C$  – consumption,  $G$  – government expenditures,  $I$  – investment,  $M$  – import,  $X$  – export.  $GDP = C + I + G + X - M$ . We can obtain the final value of goods and services produced by a country by deleting  $M$ , so that we ob-

tain:  $C + I + G + X$ . But usually, all the constituents of the domestic production include imports. By adding these imports to the domestic production we get:  $GDP = C_d + I_d + G_d + X_d + M$ , where the subscript  $d$  symbolises domestic value added.

TDI is formulated as follows (Johnston 1992, p. 2–3):

$$TDI = (X_d + M)/(GDP + M) \tag{1}$$

or

$$TDI = TDI_X + TDI_M \tag{2}$$

where:

$TDI_X$  is trade dependency attributable to export:  $TDI_X = (X)/(GDP + M)$ .

$TDI_M$  is trade dependency attributable to import:  $TDI_M = (M)/(GDP + M)$ .

All our observations were at constant prices and annual. Data on GDP was achieved from World Development Indicators database of the World Bank. Data on food export and food import were taken from the World Trade Organization.

### 3. Mathematical description of the index

The TDI has some important features as follows. It is measurable, it has a function that goes up monotonically, and it progresses to the upper part asymptotically; therefore, there is no interruption between relative independency and perfect dependency. The values of TDI have a relationship with perfect dependency continuum. The relationship can be understood via following equations.

In an economy totally independent of trade, total trade  $Tr = (X_d + M) = 0$ ; hence  $TDI = 0$ , as follows (Johnston 1992, p. 4):

$$TDI|_{Tr=0} = \frac{0}{E} = 0 \tag{3}$$

where  $E = C_d + I_d + G_d$  denotes production of goods and services consumed in the country.

Perfect dependency (the country imports all goods that are consumed and exports all goods that are produced) may be written as follows:

$$TDI|_{E=0} = \frac{Tr}{Tr} = 1 \tag{4}$$

All intermediate positions are given by:

$$TDI = TDI_X + TDI_M \tag{5}$$

The equations and inequalities given below, showing the derivatives and limits of TDI, illustrate the character of the relationship between trade and TDI:

$$\frac{\partial TDI}{\partial Tr} = \frac{E}{(E + Tr)^2} > 0$$

$$\frac{\partial^2 TDI}{\partial Tr^2} = \frac{2E}{(E + Tr)^3} > 0$$

$$\lim_{Tr \rightarrow \infty} TDI = \lim_{Tr \rightarrow \infty} \frac{Tr}{E + Tr} = Tr \lim_{x \rightarrow \infty} \frac{1}{\frac{E}{Tr} + 1} = 1$$

$$\lim_{E \rightarrow 0} TDI = \lim_{E \rightarrow 0} \frac{1}{\frac{E}{Tr} + 1} = 1$$

$$\lim_{Tr \rightarrow \infty} \frac{\partial TDI}{\partial Tr} = \lim_{Tr \rightarrow \infty} \frac{1}{(E + Tr)^3} = 0$$

The function has a maximum and is strictly concave. These features are seen for the whole range of TDI, between autarky and perfect dependence, since  $E + Tr > 0$  (Johnston 1992, p. 5).

#### 4. Empirical results

The empirical results of our calculation are presented in Table 1. For each of the EU28 countries, we calculated indices showing their food trade dependence in the period of 1999–2017. The table gives the average values of three indices, calculated for the whole period:

- FEDI (Food Export Dependency Index),
- FIDI (Food Import Dependency Index), and
- FTDI (Food Trade Dependency Index),

the latter being the sum of the two former indices.<sup>1</sup>

According to the results for both food import dependency rate and food trade dependency rate, Belgium, Bulgaria, Denmark, France, Hungary, Ireland, Lithuania, Netherlands, Poland and Spain have food security; in these countries, the average food export dependency index is bigger than the average food import dependency index. But Austria, Cyprus, Croatia, Czech Republic, Estonia, Finland, Germany, Greece, Italy, Latvia, Luxembourg, Malta, Portugal, Romania, Slovakia, Slovenia, Sweden and the UK do not have food security, because their average food import dependency index is bigger than the average food export dependency index. In other words, 18 EU countries cannot meet food demands of their people. Putting it another way, the majority of EU member countries do not have food security.

<sup>1</sup> The yearly data may be obtained from the author on request.

**Table 1**  
**Food Trade Dependency Index for EU28 Countries, 1999–2017**

Country	FEDI	FIDI	FTDI
Austria	2.447368	2.670774	5.118143
Belgia	7.121681	6.494458	13.616139
Bulgaria	5.480180	3.991564	9.471744
Croatia	2.341660	3.809009	6.150670
Cyprus	2.952002	5.073043	8.025045
Czech Republic	2.626174	3.251615	5.877790
Denmark	5.654448	3.410458	9.064906
Estonia	5.234869	6.871408	12.106278
Finland	0.658684	1.766000	2.424684
France	2.443847	1.968228	4.412076
Germany	1.716705	2.085035	3.801740
Greece	2.008931	2.872253	4.881184
Hungary	4.993151	2.883193	7.876345
Ireland	4.788057	2.950083	7.738141
Italy	1.600101	2.018830	3.618931
Latvia	4.847465	6.087799	10.935264
Lithuania	7.326999	6.225633	13.552632
Luxembourg	2.822773	5.044816	7.867590
Malta	1.874088	6.237427	8.111516
Netherlands	8.878304	5.967353	14.845658
Poland	3.285820	2.541722	5.827542
Portugal	2.180894	4.149548	6.330443
Romania	1.910266	2.796585	4.706852
Slovakia	2.587184	3.715686	6.302870
Slovenia	2.136031	4.220662	6.356693
Spain	2.844681	2.456005	5.300687
Sweden	1.318139	2.385572	3.703711
United Kingdom	0.963345	1.998439	2.961784

Source: own calculation.

Therefore, the EU policy makers should support agriculture sector. Cultivated areas should be used more consciously. Accurate agricultural policies should be implemented. Cultivated areas cannot be poisoned by chemicals. Rural development should be supported by good education of farmers and proper health

policies. Also food prices should be set at optimal levels. Product range in farms should be increased for providing food security. The EU policy makers should support food production in domestic markets so that they can control it more efficiently.

## Conclusion

Food security is defined in terms of food use and food access. Food security is ensured if there is sufficient food for all individuals in a country. Food access is provided if households and all individuals have sufficient resources to obtain appropriate foods for their diets. The access to food depends on household income, income distribution and food prices.

Nowadays, some countries use food as a weapon against other countries. Therefore, import of all foods is not a sensible method. Politicians should support domestic production of food for the future of their countries. Authorities should promote investigations related to genetically modified products, pesticide residues, and various additives and hormones added to foods. All food products could not be evaluated within the scope of food trade index because there is no export and import data for each food product. This situation narrows the scope of the article. Researchers working in this field can eliminate this deficiency if food production and trade data will be published for each product in the following years.

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## Bibliography

- Ahmad M., Farooq U., *The State of Food Security in Pakistan: Future Challenges and Coping Strategies*, "The Pakistan Development Review" 2010, no. 49(4).
- Angeles-Agdeppa I., *Food and Nutrition Security and Poverty Alleviation in the Philippines*, "Asia Pacific Journal of Clinical Nutrition" 2002, no. 11(1).
- Attah A., *Food Security in Nigeria: The Role of Peasant Farmers in Nigeria*, "African Research Review" 2012, no. 6(27).
- Bala B.K. et al., *Modelling of Food Security in Malaysia*, "Simulation Modelling Practice and Theory" 2014, no. 47.
- Begum M.E.A., Hossain M.I., D'Haese L., *Food Security in Bangladesh: Present Status and Trend*, "Progressive Agriculture" 2013, no. 24.
- Booth S., Smith A., *Food Security and Poverty in Australia: Challenges for Dietitians*, "Australian Journal of Nutrition and Dietetics" 2001, no. 58(3).
- Chilton M., Donald R., *A Rights-Based Approach to Food Insecurity in the United States*, "American Journal of Public Health" 2009, no. 99(7).
- FAO, *World Food Security: A Reappraisal of the Concepts and Approaches*, Director General's Report, Rome 1983.
- FAO, *Rome Declaration on World Food Security and World Food Summit Plan of Action*, World Food Summit, Rome 1996.

- Fengying N., Jieying B., Xuebiao Z., *Study on China's Food Security Status*, "Agriculture and Agriculture Science Procedia" 2010, no. 1.
- Ferdoushi A., Siwar C., *Food Security Status, Issues and Challenges in Malaysia: A Review*, "Journal of Food, Agriculture and Environment" 2013, no. 11(2).
- Hussain A., Routray J.K., *Status and Factors of Food Security in Pakistan*, "International Journal of Development Issues" 2012, no. 11(2).
- Kirwan J., Maye D., *Food Security Framings within the UK and the Integration of Local Food Systems*, "Journal of Rural Studies" 2013, no. 29.
- Johnston P.V., *Trade Dependency Index Tables for Total, Merchandise and Agricultural Trade, 1960–88*, Economic Research Service, U.S. Department of Agriculture, "Statistical Bulletin" 1992, no. 835.
- Matemilola S., Elegbede I., *The Challenges of Food Security in Nigeria*, "Open Access Library Journal" 2017, no. 4(12).
- Narayanan S., *Food Security in India: The Imperative and Its Challenges*, "Asia & The Pacific Policy Studies" 2015, no. 2(1).
- Nath C.N., *Food Security of Bangladesh – Status, Challenges and Strategic Policy Options*, 2015; <http://bea-bd.org/site/images/pdf/080.pdf>
- ODI (Overseas Development Institute), *Global Hunger and Food Security After the World Food Summit*, ODI Briefing Paper, London 1997.
- Ritchie H., Reay D., Higgins P., *Sustainable Food Security in India – Domestic Production and Macronutrient Availability*, 2018; [https://www.researchgate.net/publication/323981786\\_Sustainable\\_food\\_security\\_in\\_India\\_Domestic\\_production\\_and\\_macronutrient\\_availability](https://www.researchgate.net/publication/323981786_Sustainable_food_security_in_India_Domestic_production_and_macronutrient_availability)
- UN, *Report of the World Food Conference*, Rome 1974, New York 1975.
- Van Z.J., Kirsten J., *Food Security in South Africa*, "Agrekon" 1992, no. 31(4).
- Wheeler T., Braun J., *Climate Change Impacts on Global Food Security*, "Science" 2013, no. 6145.

## FOOD TRADE DEPENDENCY INDEX FOR EU28 COUNTRIES IN THE CONTEXT OF FOOD SECURITY

### Abstract

Food security is one of the most important issues in the contemporary world because nutrition is one of the basic needs of people. The changing climate and rising food prices affect negatively food security of the countries. The aim of this article was to determine the degree of food security in terms of food trade dependence for EU28 countries in the period 1999–2017. The method chosen was to calculate Food Trade Dependency Index (TDI) based on the Johnston's formula (1992). According to the research results, only Belgium, Bulgaria, Denmark, France, Hungary, Ireland, Lithuania, Netherlands, Poland and Spain have food security in the EU28 in the sense that their import dependence in food products is lower than export dependence.

**Keywords:** food security, trade dependency index, export, import, EU

**JEL:** F14, F15, L66



# WSKAŹNIK ZALEŻNOŚCI OD ZAGRANICY W HANDLU ŻYWNOŚCIĄ DLA KRAJÓW UE28 W KONTEKŚCIE BEZPIECZEŃSTWA ŻYWNOŚCIOWEGO

## Streszczenie

Bezpieczeństwo żywnościowe jest jednym z podstawowych zagadnień współczesnego świata, ponieważ żywność zaspokaja podstawowe potrzeby ludzkie. Zmiany klimatu i rosnące ceny żywności wpływają negatywnie na bezpieczeństwo żywnościowe krajów. Celem artykułu było określenie stopnia bezpieczeństwa żywnościowego krajów UE28 w latach 1999–2017 w kategoriach zależności od handlu zagranicznego żywnością. Metodą wybraną do obliczenia wskaźnika zależności od handlu żywnością jest formuła Johnstona (1992). Zgodnie z wynikami obliczeń spośród krajów UE28 jedynie Belgia, Bułgaria, Dania, Francja, Hiszpania, Holandia, Irlandia, Litwa, Polska i Węgry są krajami posiadającymi bezpieczeństwo żywnościowe w tym sensie, że ich zależność od importu żywności jest mniejsza niż zależność od eksportu żywności.

**Słowa kluczowe:** bezpieczeństwo żywnościowe, wskaźnik zależności od handlu żywnością, eksport, import, UE

**JEL:** F14, F15, L66

# ПОКАЗАТЕЛЬ ЗАВИСИМОСТИ ОТ ВНЕШНЕЙ ТОРГОВЛИ ПРОДОВОЛЬСТВИЕМ ДЛЯ СТРАН ЕС28 В КОНТЕКСТЕ ПРОДОВОЛЬСТВЕННОЙ БЕЗОПАСНОСТИ

## Резюме

Продовольственная безопасность является одной из основных проблем современного мира, т.к. продовольствие удовлетворяет основные жизненные потребности. Изменение климата и растущие цены на продовольствие отрицательно влияют на продовольственную безопасность стран. В статье делается попытка определить степень продовольственной безопасности стран ЕС28 в 1999–2017 годах в категориях зависимости от внешней торговли продовольствием. Показатель этой зависимости рассчитывался по формуле Джонсона (1992). Расчеты показали, что среди стран ЕС28 только Бельгия, Болгария, Дания, Франция, Испания, Нидерланды, Ирландия, Литва, Польша и Венгрия являются странами, имеющими продовольственную безопасность в том смысле, что их зависимость от импорта продовольствия меньше, чем зависимость от экспорта продовольствия.

**Ключевые слова:** продовольственная безопасность, показатель зависимости от внешней торговли продовольствием, экспорт, импорт, ЕС

**JEL:** F14, F15, L66