Food security challenges: Evidence from the southeast Europe countries

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Description of the subject. In the past half-century, the world has become increasingly aware of the challenges and threats to food security. The challenges of maintaining food security have been further increased under the influence of crises (COVID-19, Russia-Ukraine war). Many factors affect food security, and the effects of crises have additional negative consequences on food systems, with direct and indirect implications on the lives of everyone, especially the developing countries, such as countries of Southeast Europe.
Objectives. Therefore, the aim of the research is analyzing the effects of socio-economic factors and policy factors on the level of food security of Southeast Europe countries.
Method. This research covered countries of Southeast Europe: Serbia, Bosnia and Herzegovina, Montenegro, Croatia, Slovenia, and North Macedonia. The research data were taken from the FAOSTAT database and World Bank for the countries of Southeast Europe during 15 years (2006-2020), and in this paper panel data analysis was used.
Results. The results of the research showed that there is a statistically significant influence of socio-economic factors and policy factors on the level of food security of the Southeastern Europe countries.
Conclusions. The results of the research showed that food production variability, food supply variability, food imports, inflation, GDP per capita and political stability have a significant impact on the level of food security in the countries of Southeast Europe.
Keywords. Food security, crisis conditions, socio-economic factors, policy factors.

Les défis de la sécurité alimentaire : l'expérience des pays de l'Europe du Sud-Est
Description du sujet. Au cours des cinquante dernières années, le monde est devenu de plus en plus conscient des défis et des menaces qui pèsent sur la sécurité alimentaire. Les défis liés au maintien de la sécurité alimentaire se sont encore accrus sous l'influence des crises (COVID-19, guerre entre la Russie et l'Ukraine). De nombreux facteurs affectent la sécurité alimentaire, et les effets des crises ont des conséquences négatives supplémentaires sur les systèmes alimentaires, avec des implications directes et indirectes sur la vie de chacun, en particulier dans les pays en développement, tels que les pays de l'Europe du Sud-Est.
Objectifs. L'objectif de la recherche est donc d'analyser les effets des facteurs socio-économiques et des facteurs politiques sur le niveau de sécurité alimentaire des pays de l'Europe du Sud-Est.
Méthode. Cette recherche a porté sur les pays de l'Europe du Sud-Est : Serbie, Bosnie-Herzégovine, Monténégro, Croatie, Slovénie et Macédoine du Nord. Les données de recherche proviennent de la base de données FAOSTAT et de la Banque mondiale pour les pays d'Europe du Sud-Est sur une période de 15 ans (2006-2020) et l'analyse des données de panel a été utilisée dans ce document.
Résultats. Les résultats de la recherche ont montré qu'il existe une influence statistiquement significative des facteurs socio-économiques et des facteurs politiques sur le niveau de sécurité alimentaire des pays de l'Europe du Sud-Est.
Conclusions. Les résultats de la recherche ont montré que la variabilité de la production alimentaire, la variabilité de l'approvisionnement alimentaire, les importations alimentaires, l'inflation, le PIB par habitant et la stabilité politique ont un impact significatif sur le niveau de sécurité alimentaire dans les pays de l'Europe du Sud-Est.
Mots-clés. Sécurité alimentaire, conditions de crise, facteurs socio-économiques, facteurs politiques.

1. INTRODUCTION

The concept of food security has been constantly evolving over the past 70 years, and during that period numerous definitions of food security have been developed. Food security has been defined by the Food and Agriculture Organization of the United Nations (FAO) as existing "at the individual, household, national, regional and global levels, when all people, at all times, have physical and economic access to sufficient, safe food of adequate nutritional value to meet their nutritional needs and preferences necessary for an active and healthy life" (FAO, 1996). This definition consists of four dimensions: availability, accessibility, stability and utilization. Food system vulnerability occurs when one or more of the four components of food security are unsafe and insecure (FAO, 2008). How food security is multidimensional in nature, this makes its precise measurement and policy targeting quite challenging for policy makers.

Many factors affect food security and the effects of crises (COVID-19 pandemic, Russia-Ukraine war) have additional negative consequences on food systems, with direct and indirect implications on the lives of everyone, especially the poorest and most vulnerable communities. The effects of crises left its mark on food security and all its dimensions: availability (adequacy of supply), access to food, use of food and stability of supply and demand (Brankov & Matkovski, 2022).

First, the pandemic has left its mark directly on food systems through impacts on food supply and demand. Also, indirectly through a reduction in purchasing power and capacity for food production and distribution, which had a stronger impact on the poor and food insecure (Kovljenić & Škorić, 2021). According to forecasts, food prices are expected to remain at a historically high level until the end of 2024, further threatening global food security (Hassen & El Bilali, 2022; OECD, 2022). Numerous authors have predicted that the impact of the crisis on agriculture and global food security will be complex (Đokić et al., 2021) and that many consequences have not yet been identified (Jambor et al., 2020).

Countries that are largely dependent on imports of food, fuel and agricultural inputs are more vulnerable to global food price shocks and are particularly at risk for food markets created by the war in the Black Sea region (GRFC, 2022). The devastating impact of food shortages, rising food prices and inflation will be felt most by consumers in many low-income countries, leading to increased food insecurity (Brankov & Matkovski, 2022).

One of the characteristics of the countries of Southeast Europe and food supply chains is that there is a low degree of integration, which often affects the possibility of ensuring adequate supply of distribution systems because the products are not competitive either in terms of quality or price (Erjavec et al., 2014). Because of that, developing countries, such as countries of Southeast Europe, which are highly dependent on food imports and have a lower Gross Domestic Product (GDP) per capita (Matkovski et al., 2020), will be more severely affected by the consequences of crises. In the countries of the Southeast Europe the average household income is lower, compared to other EU countries. The average GDP per capita varies between 13,000 international dollars and 27,000 international dollars, while the average for EU is about 41,000 international dollars (Matkovski et al., 2020). As expected, an increase in food prices or a decrease in income has a more significant impact on the well-being of less developed societies. In developing countries, the share of food prices in the consumer price index is on average around 30%, while in developed countries the share of these prices in consumer prices is on average around 13%. Therefore, as a rule, the same global movement of food prices has a greater direct impact on inflation in countries with lower incomes (Šoškić, 2015).

Key factors affecting food security in crises conditions are classified into two groups: socio-economic and policy factors. The current food crisis has affected socio-economic factors that affect the level of food security, especially the dimension of food access (Dharmasena et al., 2016). Certain researchers have used different methods to study the relationship between food security and household income (Coates, 2013), GDP per capita (Brankov & Lovre, 2017), food prices (Morrissey et al., 2014), nutritional status and diversity in nutrition (Coates, 2013), poverty (Headey & Ecker, 2013). Thus, the primary focus of most of these studies has been on economic variables, such as household income and purchasing power (Lang & Barling, 2012). However, the concept of food security encompasses a large number of causal relationships between different variables and their impact on food security. Therefore, it is necessary to consider the interaction of environmental, socio-economic, political and cultural factors (Peng & Berry, 2019). Thus, purchasing power depends on price policy, income, subsidies, household welfare and rising prices, so rising prices can reduce physical access to food, variety and quality of nutrition especially those with lower incomes (Akbari et al., 2022).

Ensuring food security is of great importance to all governments and societies (Oger et al., 2010; Coates, 2013), and therefore it is necessary to examine the relationship between food security, policies and governance (policy factors). Bearing this in mind, a growing number of researches had studied the connection between food security and food policy (Maxwell, 1996), food sovereignty (Shaw, 2007; Lang

& Barling, 2012), governance (Candel, 2014), self-sufficiency (Wittman, 2011; Brankov & Matkovski, 2022), food production and distribution systems (Barrett, 2010; Matkovski et al., 2020), and global trade (Coates, 2013). One of the most important elements of governance in recent years has become the issue of food self-sufficiency. However, current knowledge of food governance is scarce. Therefore, it is necessary to complement the knowledge of food governance with alternative governance perspectives to strengthen the current understanding of food security governance (Akbari et al., 2022).

Numerous authors have examined the levels of food security of different countries and regions using food security dimensions. However, research papers on the topic of food security in the Southeast Europe countries in crises conditions are scarce. Papić Brankov & Milovanović (2015) analyzed food security in Serbia using a set of indicators. The results of their research showed that the biggest negative impact on the food security had low level of Gross Domestic Product per capita and corruption. Brankov & Lovre (2017) analyzed food security in the countries of the former Yugoslavia and used FAO food security indicators in their paper. Their results indicated significant differences between the analyzed countries of the former Yugoslavia, and Slovenia stood out as the country with the most favorable position when it comes to food security. Kovljenić & Raletić Jotanović (2020) investigated food security in the countries of the former Yugoslavia and the results of the research showed that there is a significant influence of the degree of economic development, the population growth, the foreign trade and investments in agriculture on the level of food security. The results also showed that of all the countries of the former Yugoslavia, Slovenia is the most food secure country, while Bosnia and Herzegovina were most food insecure. Božić & Nikolić (2020) analyzed food security system using the Global Food Security Index for Serbia, Bulgaria, Romania, Hungary, Greece and their results showed that Serbia lags behind the selected countries regarding food security. Few studies have analyzed food security in crisis conditions. Matkovski et al. (2020) analyzed factors affecting food security in the countries of the Western Balkans and the countries of the European Union (EU) and their results showed a significant difference among these countries in their levels of food security. Brankov et al. (2021) calculated the food self-sufficiency ratio for the Southeast Europe countries and their analyze showed a high level of food self-sufficiency. Brankov & Matkovski (2022) analyzed the level of food self-sufficiency in the Western Balkan countries. Their results showed that in the pre-crisis period the Western Balkans countries achieved a satisfactory level of food self-sufficiency and they are ready to respond to future challenges.

Therefore, the aim of the research is analyzing the effects of socio-economic factors and policy factors on the level of food security of the Southeast Europe countries.

2. MATERIALS AND METHODS

The research encompassed Southeast Europe countries, which are also all the countries of the former Yugoslavia: Serbia, Bosnia and Herzegovina, Montenegro, Croatia, Slovenia and North Macedonia. The data are taken from the FAOSTAT (2022) database and World Bank (2022). The data required for the research cover the period from 2006 to 2020.

The sample of the countries of Southeast Europe includes all the countries of the former Yugoslavia, which in the course of history faced numerous conflict situations and which today are at different levels of economic development. After the breakup of Yugoslavia in 1991, the paths of the newly formed states diverged, which affected the course and speed of implementing economic reforms in the countries (Kovljenić, 2022). In addition to the different levels of economic development, these countries are in different status in the EU integration process. Of the countries of the former Yugoslavia, Slovenia has been a full member of the EU since 2004, and Croatia since 2013. That is why it is important to note the differences in the economic development of these countries and the impact of existing crises on their food security.

A model for identifying key factors influencing food security was developed and estimated. The obtained data were analyzed in the software Gretl 1.10.0. Based on explanatory independent variables (**Table 1**), two models were obtained. The first model included the influence of policy factors on the level of food security in the countries of Southeast Europe. In the second model, we observed the influence of both socio-economic factors and policy factors together. The basic form of model was:

$$Y_{it} = \alpha + \beta_1 \ln GDP_{it} + \beta_2 \ln I_{it} + \beta_3 \ln FPV_{it} + \beta_4 \ln IMP_{it} + \beta_5 \ln FSV_{it} + \beta_6 \ln PS_{it} + \mu_i + \lambda_t + u_{it}$$

where Y_{it} represents the level of food security of the country i in the period t, which was measured in the sample through number of malnourished; GDP_{it} represents GDP per capita of the country i in the period t; I_{it} represents inflation of the country i in the period t; FPV_{it} represents per capita food production variability of the country i in the period t; IMP_{it} represents import value of agricultural products of the country i in the period t; FSV_{it} represents per capita food supply variability of the country i in the period t; PS_{it} represents political stability and absence of violence/

terrorism of the country i in the period t; μ_i represents individual effects in the panel model; λ_t represents temporal effects in the panel model that vary over time; u_{it} represents stochastic variable of the model.

A description of the variables with expected relationship are shown in **table 1**.

In the next section we give the detailed definition of all the independent variables that were used in the analysis. The data for the GDP per capita and inflation was taken from the World Bank database. GDP represents the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.

Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services. The data for the other variables: per capita food production variability, import of agricultural products, per capita food supply variability and political stability were taken from the FAOSTAT database. Per capita food production variability corresponds to the variability of the "food net per capita production value in constant 2004-2006 international $" as disseminated in FAOSTAT. Import value represents the import value of agricultural products in country.

Per capita food supply variability corresponds to the variability of the "food supply in kcal·caput^{-1}·day^{-1}".

Political stability and absence of violence measure perceptions of the likelihood that the government will be destabilized by unconstitutional or violent means, including politically motivated violence and terrorism.

The analysis showed that the variables do not have a normal distribution, so it was necessary to perform further transformation of the data. Therefore, a logarithmic transformation (Log) was performed. In order to prepare data for further analysis, the connection between the included indicators was examined. Pearson's linear correlation was used to examine the connection between them.

Out of three basic types of panel data models: ordinary least squares model (OLS), fixed-effect (FE) and random-effect (RE), we chose one based on the conducted tests. In order to choose the appropriate panel data model, certain tests are used, such as Hausman test, Breusch-Pagan, F test, as well as corresponding tests related to the assumptions of the existence of serial correlation, heteroskedasticity and the presence of cross-sectional dependencies in panel data.

The presence of autocorrelation, heteroscedasticity and multicollinearity was investigated in the research. The Durbin-Watson (DW) test implies the null hypothesis of the absence of autocorrelation and this test was used when testing the presence of autocorrelation. Using the Durbin-Watson test, it was shown that there is no autocorrelation in the examined models. In addition to autocorrelation, it is necessary to examine heteroskedasticity. White test and Breusch Pagan test of heteroskedasticity are most often used to determine the presence of heteroscedasticity and they showed that there is no problem of heteroskedasticity in the estimated model. One of the basic assumptions of use panel model in estimating the coefficients is that the independent variables are not mutually correlated. Multicollinearity represents the situation in which they are two or more independent variables linearly correlated with each other, and results of test showed that there is no problem of multicollinearity.

3. RESULTS

3.1. Socio-economic factors and policy factors that influence food security level

Based on **table 2**, it can be seen that the countries of Southeast Europe differ significantly according to socio-

Table 1. Description of the variables with expected relationship — *Description des variables avec la relation attendue*.

Variable	Description	Expected relationship	Source
GDP per capita (GDP)	GDP per capita (constant 2010 US$)	Negative	World Bank
Inflation (I)	Inflation, consumer prices (annual %)	Positive	World Bank
Food production variability (FPV)	Per capita food production variability (constant 2014-2016 thousand int$ per capita)	Positive	FAOSTAT
Import - Agricultural Products (IMP)	Import Value - Agricultural Products (1,000 $)	Positive	FAOSTAT
Food supply variability (FSV)	Per capita food supply variability (kcal·cap^{-1}·day^{-1})	Negative	FAOSTAT
Political stability (PS)	Political stability and absence of violence/terrorism (index)	Negative	FAOSTAT

Table 2. Socio-economic factors and policy factors in the countries of Southeast Europe — *Facteurs socio-économiques et facteurs politiques dans les pays de l'Europe du Sud-Est.*

Socio-economic factors and policy factors	Serbia	Bosnia and Herzegovina	Slovenia	Croatia	North Macedonia	Montenegro
			Average			
Per capita food production variability (constant 2014-2016 thousand int$ per capita)	50.17	26.43	16.5	35.86	24.33	18.23
Per capita food supply variability (kcal·cap⁻¹·day⁻¹)	24.93	60.53	21.26	48	49.13	118.13
Political stability and absence of violence/terrorism (index)	-0.17	-0.48	0.98	0.63	-0.30	0.31
Import Value - Agricultural Products (1.000 $)	1,183 469.20	1,325 154.80	2,419 907.13	2,077 617.80	608,031.33	416,718.93
GDP per capita (constant 2015 US$)	5,577.27	4,559.37	21,460.98	12,353.02	4,611.60	6,383.98
Inflation. consumer prices (annual %)	5.60	1.36	1.66	1.68	1.90	2.37

economic factors and policy factors. According to average food production variability, the highest average variability was recorded in Serbia (50.17 $ per capita). After Serbia, greater average food production variability was recorded in Croatia (35.86 $ per capita). Bosnia and Herzegovina are in third place according to average food production variability (26.43 $ per capita), while the lowest average food production variability is recorded in Montenegro (18.23 $ per capita) and Slovenia (16.05 $ per capita). In recent years, the countries of Southeast Europe have been characterized by the decline of arable land, aging and reduction of the rural population, the migration of young people from rural to urban areas, the abandonment of the land and the expansion of cities. Also, privatization, land reforms, high production costs, budget constraints, lack of incentives and disorganization of food supply chains have a significant impact on inefficiency and low productivity (Nestorov-Bizonj et al., 2015).

For countries of Southeast Europe it is characteristic that there is a low level of integration, which significantly affects the possibility of ensuring adequate variability in food supply. The highest average food supply variability in the observed period was recorded in Montenegro (118.13 kcal.cap⁻¹.day⁻¹), while the lowest was in Slovenia (21.26 kcal.cap⁻¹·day⁻¹) and Serbia (24.93 kcal·cap⁻¹·day⁻¹). Bosnia and Herzegovina are in second place according to average food supply variability (60.53 kcal·cap⁻¹·day⁻¹), North Macedonia is in third place (49.13 kcal·cap⁻¹·day⁻¹) and Croatia is in fourth place according to average food supply variability (48 kcal·cap⁻¹·day⁻¹).

According to the average value of import of agricultural products in the observed period from 2006 until 2020, the highest value of import of agricultural products was recorded in Slovenia (2,419 907.13 $) and Croatia (2,077 617.80 $). Bosnia and Herzegovina are in third place (1,325 154.80 $), and Serbia is in fourth (1,183 469.20 $). The lowest value of import of agricultural products was recorded in Montenegro (416,718.93 $), while in fifth place according to the value of import of agricultural products is North Macedonia (608,031.33 $). It is important to point out that Slovenia and Croatia are members of the EU. European union member states are also members of the World Trade Organization (WTO), as well as Montenegro and North Macedonia. It enables trade to take place in a stable manner that allows each country to be an equal partner in international trade negotiations (Matkovski et al., 2019). Southeast European countries must increase their level of competitiveness in order to meet the high demands of the EU market when it comes to standard food production (Matkovski et al., 2022).

If we look at to GDP per capita in the countries of Southeast Europe, there are significant variations.

The highest average GDP per capita was recorded in Slovenia (21,460.98 \$) and Croatia (12,353.02 \$). Remaining countries of Southeast Europe have a significantly lower GDP per capita. Serbia, Montenegro, Bosnia and Herzegovina and North Macedonia have approximately the same GDP per capita (5,577.27 \$; 6,383.98 \$; 4,559.37 \$; and 4,611.60 \$ respectively). The lowest GDP per capita was recorded in Bosnia and Herzegovina (4,559.37 \$). Low GDP per capita together with increasing food prices significantly reduce access to food and affect increasing food insecurity. According to the annual inflation trend, the highest average inflation rate in the observed period from 2006-2020 was recorded in Serbia, 5.60%. While the lowest average inflation rate was recorded in Bosnia and Herzegovina, 1.36%. In the other countries of Southeast Europe (Slovenia, Croatia, North Macedonia and Montenegro), an approximately similar average annual inflation trend was recorded (1.66%; 1.68%; 1.90%; and 2.37%). In the second half of 2021, inflation in the countries of Southeast Europe started to rise. So, as a result the main growth in the Consumer Price Index (CPI) in November 2022 ranged from: Slovenia 10%, Croatia 13.2%, Serbia 15%, Montenegro 16.8%, Bosnia and Herzegovina 17.4% and North Macedonia 19.5% (Trade Economics, 2022).

The countries of Southeast Europe differ significantly according to the last analyzed indicator – political stability and absence of violence/terrorism (index). The highest average political stability index was recorded in Slovenia (0.98) and Croatia (0.63), while the lowest was recorded in Bosnia and Herzegovina and Serbia (-0.48 and 0.17 respectively). It is necessary to point out that during history, the most serious consequences of the conflict in the former Yugoslavia were felt in Bosnia and Herzegovina and Serbia. Montenegro is in the third place (0.31), while North Macedonia is in fourth place (-0.30) in terms of political stability.

3.2. Estimation of influence of socio-economic factors and policy factors on the level of food security

The results of random effects (RE), fixed effects (FE) and ordinary least square method (OLS) are shown in Model I and Model II. In the first Model I the impact of policy factors on the level of food security in the countries of Southeast Europe is shown. The initial model specification is the random effects (RE) model. In the random effects model, Breusch-Pagan test (p-value < 0.05) and Hausman test (p-value > 0.05) showed that RE model was more suitable (**Table 3**).

Model I included the following variables as a set of independent variables: political stability, food imports, food supply variability and food production variability.

Based on the obtained results given in **table 3** (Model I), it can be concluded that the rate political stability, food imports, food supply variability and food production variability explain statistically significant malnutrition in the countries of Southeast Europe. Each of the independent variables statistically significantly explain the dependent variable (number of malnourished). The results of the research show that the increase in food imports and food production variability explains food security in a positive direction, while political stability and food supply variability explain food security in a negative direction. The increase in food imports and food production variability indicate an increase in the number of malnourished people in the countries of Southeast Europe. On the other hand, greater political stability and food supply variability lead to a decrease in the number of malnourished people in the countries of Southeast Europe.

Model II shows the influence of both socio-economic factors and policy factors on the level of food security in the countries of Southeast Europe. The initial model specification is the random effects (RE) model. Breusch-Pagan test in the RE model (p-value > 0.05) showed that OLS model is preferred.

Model II as a set of independent variables included the following variables: food production variability, inflation, food imports, GDP per capita and food supply variability.

Based on the obtained results given in **table 4** (Model II), it can be concluded that food production variability, inflation, food imports, GDP per capita and food supply variability explain 76% (OLS model) of malnutrition in the countries of Southeast Europe. Each of the independent variables statistically significantly explain the dependent variable (number of malnourished). The research results show that the increase in food imports, inflation and food production variability explain food security in a positive direction, while GDP per capita and food supply variability explain food security in a negative direction. The increase in food imports, inflation and food production variability indicate an increase in the number of malnourished people in the countries of Southeast Europe. On the other hand, higher GDP per capita and higher food supply variability lead to a decrease in the number of malnourished people in the countries of Southeast Europe.

4. DISCUSSION

The results of the research showed that socio-economic factors and policy factors have a significant impact on food security in the countries of Southeast Europe. At the

Table 3. Estimation of model of policy factors — *Estimation du modèle des facteurs politiques*.

Model I

RE	Coefficient	Standard error	t-Statistic	*p*-value
Constant	-0.101112	0.614246	-0.1646	0.8692
Political stability (PS)	-0.708781	0.0871070	-8.137	< 0.0001
Food imports (IMP)	0.741466	0.0877543	8.449	< 0.0001
Food supply variability (FSV)	-0.298142	0.0865120	-3.446	0.0006
Food production variability (FPV)	0.666465	0.0908783	7.334	< 0.0001
Breusch-Pagan test	4.32095 (0.0376458)			
Hausman test	0.883085 (0.347358)			
Total observations	90			

Model I

FE	Coefficient	Standard error	t-Statistic	*p*-value
Constant	-0.0970430	0.611965	-0.1586	0.8744
Political stability (PS)	-0.704231	0.0873411	-8.063	< 0.0001
Food imports (IMP)	0.740856	0.0878478	8.433	< 0.0001
Food supply variability (FSV)	-0.303706	0.0868182	-3.498	0.0008
Food production variability (FPV)	0.672509	0.0912156	7.373	< 0.0001
R Square	0.718113	Adjusted R Square	0.717655	
F-statistic (4, 84)	53.377	*p*-value(F)	0.00000	
Durbin Watson (DW)	2.078888			
Total observations	90			

Model I

OLS	Coefficient	Standard error	t-Statistic	*p*-value
Constant	-0.131850	0.633223	-0.2082	0.8356
Political stability (PS)	-0.743149	0.0891138	-8.339	< 0.0001
Food imports (IMP)	0.746071	0.0908975	8.208	< 0.0001
Food supply variability (FSV)	-0.256120	0.0879192	-2.913	0.0046
Food production variability (FPV)	0.620817	0.0922305	6.731	< 0.0001
R Square	0.694456	Adjusted R Square	0.680077	
F-statistic (4, 85)	48.29807	*p*-value(F)	0.00000	
Durbin Watson (DW)	2.070481			
Total observations	90			

same time, the research results showed that Southeast Europe countries differ significantly according to socio-economic factors and policy factors, which affects their level of food security. The effects of crises left its mark on food security and all its dimensions: availability (adequacy of supply), access to food, use of food and stability of supply and demand.

If the adequacy of supply is observed, some countries facing food crises are particularly vulnerable to food market risks created by the war in the Black Sea region (GRFC, 2022). The results of the research showed that food production variability, food imports and food supply variability statistically significantly explain the number of malnourished in the countries of Southeast Europe. Current crisis has led to the need for greater focus on food self-sufficiency. The importance of achieving food self-sufficiency as a response to crisis conditions is also emphasized in the research of Brankov et al. (2021) and Brankov & Matkovski (2022).

However, some countries lack the natural resources to produce enough food because they are limited by land, water, climate or other factors. That is why international exchange is necessary. Trade liberalization increases food security because it acts as

Table 4. Estimation of model of socio-economic factors and policy factors — *Estimation du modèle des facteurs socio-économiques et des facteurs politiques*.

Model II				
RE	**Coefficient**	**Standard error**	**t-Statistic**	***p*-value**
Constant	2.07086	0.527077	3.929	< 0.0001
Food production variability (FPV)	0.400409	0.0870627	4.599	< 0.0001
Inflation (I)	0.0432167	0.0572126	0.7554	0.4500
Food imports (IMP)	1.16276	0.0934957	12.44	< 0.0001
GDP per capita (GDP)	-1.09654	0.101721	-10.78	< 0.0001
Food supply variability (FSV)	-0.363949	0.0772867	-4.709	< 0.0001
Breusch-Pagan test	1.28956 (0.256129)			
Hausman test	0.888492 (0.345886)			
Total observations	90			

Model II				
FE	**Coefficient**	**Standard error**	**t-Statistic**	***p*-value**
Constant	2.07713	0.523591	3.967	0.0002
Food production variability (FPV)	0.410019	0.0878007	4.670	< 0.0001
Inflation (I)	0.0327266	0.0584349	0.5601	0.5770
Food imports (IMP)	1.16053	0.0936288	12.39	< 0.0001
GDP per capita (GDP)	-1.09417	0.101865	-10.74	< 0.0001
Food supply variability (FSV)	-0.370961	0.0777567	-4.771	< 0.0001
R Square	0.790931	Adjusted R Square	0.790591	
F-statistic (5, 83)	62.6706	*p*-value(F)	0.00000	
Durbin Watson (DW)	2.330233			
Total observations	90			

Model II				
OLS	**Coefficient**	**Standard error**	**t-Statistic**	***p*-value**
Constant	2.02092	0.542589	3.725	0.0004
Food production variability (FPV)	0.323838	0.0848790	3.815	0.0003
Inflation (I)	0.126802	0.0487573	2.601	0.0110
Food imports (IMP)	1.18054	0.0967999	12.20	< 0.0001
GDP per capita (GDP)	-1.11546	0.105329	-10.59	< 0.0001
Food supply variability (FSV)	-0.308076	0.0769688	-4.003	0.0001
R Square	0.772421	Adjusted R Square	0.758875	
F-statistic (5, 84)	57.02058	*p*-value(F)	0.00000	
Durbin Watson (DW)	2.231882			
Total observations	90			

a transmission system moving food from regions where there is a surplus of food to deficit regions (Kovljenić, 2022). The importance of foreign trade exchange for food security is confirmed in the papers of Brankov & Lovre (2017) and Kovljenić & Raletić Jotanović (2020). Although research shows that liberalization had a positive impact on the competitiveness of the agricultural and food sector (Matkovski et al., 2018), Southeast European countries must increase their level of competitiveness in order to meet the high demands of the EU market when it comes to standard food production (Matkovski et al., 2022). Observed according to the average value of import of agricultural products, the highest average import of agricultural

products was recorded in Slovenia and Croatia, while the lowest average value of import of agricultural products was recorded in Montenegro. The importance of foreign trade exchange for food security is confirmed in the papers of Brankov & Lovre (2017), Kovljenić & Raletić Jotanović (2020). Food supply chains in the Southeastern Europe are characterized by a low level of integration, so in order to improve economic integration and create a common market based on the free movement of people, goods, services and capital on uniform border crossing procedures, the Open Balkans initiative was launched in 2021 (Rikalović et al., 2022).

According to food supply variability, the highest average food supply variability during the observed period was recorded in Montenegro, while it was the lowest in Slovenia and Serbia. The reason for this can be found in the slightly lower level of technical efficiency of agriculture that is present in the countries of the Western Balkans compared to the EU, which certainly has an impact on food supply variability (Đokić et al., 2022). However, although a part of the food can be provided through trade and thereby ensure the availability of food, the crisis has significantly affected access to food. The average cost of a healthy diet in the world in 2020 was $3.54 per person per day; 3.3 more than in 2019 and 6.7 more than in 2017 (FAO, 2022b). Ensuring nutrition quality is a key link between food security and nutrition. Therefore, governments should strive to achieve more stable incomes, protecting the food supply and reducing the effective cost of nutritious food (FAO, 2022b).

The results of the research showed that GDP per capita significantly affects the level of food security. Papić Brankov & Milovanović (2015), Brankov & Lovre (2017), Kovljenić & Raletić Jotanović (2020) reached similar results, their results showed significant influence of GDP per capita on the level of food security. The research results showed that the highest average GDP per capita was recorded in Slovenia and Croatia, while the lowest average GDP per capita was recorded in Bosnia and Herzegovina. In low- and low-middle-income countries, the decline in economic growth affects the demand for food, which has a negative consequence on food security and nutrition (FAO, 2022a). Results of the research also showed that inflation has a significant impact on the food security of the countries of Southeast Europe. The influence of food prices on food security was also confirmed in the paper of Morrissey et al. (2014). The impact of the crisis on the reduction of GDP per capita in combination with increased inflation significantly affects access to food, which will also affect the level of food security in the countries of Southeast Europe.

The results of the research showed that political stability has a significant impact on the level of food security in the countries of Southeast Europe, which was confirmed in the papers of Papić Brankov & Milovanović (2015) and Brankov & Lovre (2017). The highest average political stability index was recorded in Slovenia and Croatia, while the lowest average was recorded in Bosnia and Herzegovina and Serbia. At the same time, it should be emphasized that political stability has serious consequences on food security, and the countries of Southeast Europe have faced numerous conflict situations throughout history, which have had consequences on the economic development and their food security.

The findings of this study can be useful for policy-makers to define appropriate responses in the event of a crisis, strengthen food systems that provide adequate and affordable food for all. In order to resist future crises, which can lead to disruptions in the supply chains, it is necessary that all the countries of Southeast Europe strive to achieve as high as possible level of food self-sufficiency and thus increase the level of food security. So, in order to achieve this in the future, it is necessary to increase the number of investments that will increase the production capacities of agricultural farms, modernize production and increase the quality of agricultural and food products.

5. CONCLUSIONS

The COVID-19 pandemic, increasing conflicts and rising global food prices have highlighted the fragility of global and local food systems. This has led to an alarmingly high incidence of acute food insecurity and malnutrition. Countries around the world are slowly recovering economically under the influence of the long-term effect of the COVID-19 pandemic, which continues to exert inflationary pressure on food. At the same time, the war between Russia and Ukraine is putting additional pressure on supply chains (FAO, 2022b).

The results of the research showed that food production variability, food supply variability, food imports, inflation, GDP per capita and political stability have a significant impact on the level of food security in the countries of Southeast Europe. The results of the research also showed that Slovenia and Croatia have better economic access to food, as they have a higher GDP per capita, lower inflation growth rate and a higher index of political stability. On the other hand, higher import values were recorded in Slovenia and Croatia, which indicates limitations in achieving food security. In crisis conditions, such as COVID-19 pandemic and Russia-Ukraine war, when international exchange is restricted and disruptions in supply chains occur, it can lead to an increase in food insecurity. In the remaining countries of Southeast Europe (Serbia, Bosnia and

Herzegovina, Montenegro and North Macedonia), a lower GDP per capita, higher inflation rates and a lower index of political stability was recorded, which significantly affect the level of food security. The lowest average GDP per capita was recorded in Bosnia and Herzegovina, which also has the lowest index of political stability. According to the movement of the annual inflation rate, the highest rate was recorded in Serbia. In addition to Bosnia and Herzegovina, North Macedonia records the lower average GDP per capita values and shares the place with Bosnia and Herzegovina in terms of GDP per capita. According to the remaining indicators, North Macedonia occupies a middle position when it comes to indicators of food production variability, import of agricultural products and food supply variability, while Montenegro has the lowest value of import of agricultural products and the highest food supply variability, which affects adequacy of supply. The above mentioned has a significant impact on the economic access to food. On the other hand, Serbia and Bosnia and Herzegovina show better indicators when it comes to adequacy of supply. Serbia and Bosnia and Herzegovina have favorable resources for agricultural production, which can enable them, with appropriate investments and modernization of agricultural production, to achieve higher food self-sufficiency and food security.

Based on the research results, it can be concluded that food security in Serbia, Bosnia and Herzegovina, North Macedonia and Montenegro is primarily a question of economic access to food, while in Slovenia and Croatia it is a question of supply adequacy. The ongoing crisis requires countries to act to mitigate the consequences of crises, especially those already experiencing the highest levels of acute food insecurity. Support to farmers should be geared towards raising productivity and improving access to markets, as well as rural communities to diversify their livelihoods and improve their resilience to shocks is crucial. In order to collectively solve the causes and consequences of the escalation of the food crisis, the international community must mobilize investments and political will to solve the consequences of the crisis.

During the conduct of the research we encountered certain limitations. Part of the data was not available for the period covered by the research. Though this research demonstrates that overall quality results of the research, further research papers will need to improve coverage and quality of data and analysis. Also, the research included part of the factors (socio-economic and policy factors) affecting food security. Therefore, further study is needed to include factors such as: investments, trade policies, urban-rural population, resource utilization, which can significantly affect the country's food security.

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