



The impact of corruption on food security from a macro perspective

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Despite the positive developments in recent years, food security is a common problem of all humanity. In order to eliminate this problem, different initiatives are conducted within the fields of political and international relations. Moreover, to be able to analyze the dynamics of this problem and determine the policies to be implemented, prospective research and academic studies are carried. This study aims to elucidate the corrupt policies negatively influencing food security in a macroeconomic framework by examining the variables including unemployment, dependent population, and per capita income. To be able to realize that, panel data of 75 countries obtained between the years 2012-2016 have been analysed using Driscoll and Kraay Method. According to the obtained results, corruption, although minor, has an impact on food security. Thus, in order to realize food security the following actions need to be taken: minimizing bureaucracy; increasing interaction with the public power for the sake of activities that would support good governance of the society and non-governmental organizations; minimizing the human factor by using technological innovations more effectively in public services and; putting the deterrent laws that would eliminate favouritism into effect.

1. Introduction

Despite the positive developments on the global decrease in famine, it is estimated that one in every nine person is impoverished (Helal, 2016). Thus, food security continues to be a global problem. In order to cope with this global problem, the UN takes important initiatives. Food and Agriculture Organization of the United Nations (FAO), has undertaken different tasks since its foundation in 1945. The Food Security Action Plan was implemented in 1979. In order to attract attention on the issue, the 16th of October is celebrated as World Food Day.

Globalization enhances mutual interaction in matters of food and agriculture as it does in many other fields. International trade might balance the inequalities of food supply and demand in different geographical re-

gions. This might help achieve security in food supply to a certain extent. However, the pricing policies and incentives applied by developed countries may influence the markets of developing countries (Godfray *et al.*, 2010). Other than the mutual interaction that stemmed from globalisation, the inner dynamics of countries may also influence food security. Despite the overall increase of food production worldwide, food security is negatively influenced by natural disasters, economic crises, and conflicts. Moreover, rural poverty and corruption emerges as another important factor (Escobar *et al.*, 2009). The basic need of macro environments on food security, just like the needs in economic development, is righteousness in public government and avoidance of corruption (Tweeten, 1999).



The basic rule for achieving sustainable food security is keeping public needs aloof from changing interests of political power (Mwaniki, 2006). It is an unalienable fact that political stability and the law system are infected with widespread corruption in those countries with the lowest food security (FAO, 2005). When political power avoids transparency and accountability and corruption occurs, the food security of the country also suffers. Moving from this point, the present study aims at analysing the relationship between food security and corruption from a macro perspective. The analysis will include socio-economic factors for pioneering further studies in the field of food security.

2. The relationship between food security and corruption

In their 63rd meeting held in July 1974 after the food crisis in 1970s, FAO has ratified the “International Convention on World Food Security”. This convention underlines that food security is a common problem of all nations and cooperation is necessary in this field. In this meeting food security was defined with particular attention paid to the food supply. Accordingly, food security is availability of sufficient, safe, and nutritious food at all times preventing fluctuation in production, consumption, and prices (Shaw, 2007). In the Rome summit in November 1996, FAO has defined food security as when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food which meets their dietary needs and food preferences for an active and healthy life (Lenné, 2011). Those definitions have been extensively used in the field(s) of food security. However, food security is a complex phenomenon influenced by many factors and occurs in different physical conditions (Stringer, 2016). This fact is elucidated in Figure 1, which shows the global, national, household, and individual dimensions of food security. Food production, trade, and household income, the main determinants of food security, have been extensively affected by macroeconomic conditions and policies. Here, the government policies in ensuring food security play crucial roles.

As an indicator of good governance corruption might influence food security from a macro perspective. Corruption highlights the gap between the rich and the poor. The efforts of national and international bodies that combat famine and hunger might be

distracted by corruption. For instance, it is stated that a sum of 9 million British Pounds given to Kashiapur region of India to International Agricultural Development Fund from 1977 to 1988 was exploited through systematic corruption (Uchendu & Abolarin, 2015). In the year 2001 Malawi government has sold an important amount of strategical grain reserved to cover an international balances deficit and the people who bought the said grains resold it in the domestic market with 500% profit. Due to this and similar examples, one of the important issues in Malawi about food security is corruption (Drimie & Mini, 2003). In addition to above quoted samples concerning the direct impact of corruption on food security, there are many other ways in which corruption may indirectly affect food security. This impact might be felt as a decrease in national and per capita income. Figure 1 shows household income affects food security. In many Asian countries, high economic growth reduces poverty and increases food security (Timmer, 2005).

There are studies that establish a relationship between economic growth and corruption. While corruption is accepted as a negative concept for economy in general others emphasize its positive impacts. Mauro (1995), Tanzi (1998), Mo (2001), Semenescu (2008), Dridi (2013), and similar studies assert that corruption decreases investments as it disturbs efficient deployment of resources and thus decreases GDP. However, Leff (1964) asserts that the negative results of rigid and inefficient implementations of public administration might be stretched by corruption and economic growth might be supported. This is called “speed money” or “greasing the wheel”. Bayley (1966), Wedeman (1997), Acemoğlu and Verdier (1998), Wei (2000), and Swaleheen (2011) present empirical evidence on the positive relationship between corruption and economic growth.

While corruption might positively and indirectly influence food security as it produces “speed money” or “greasing the wheel” effects, it might also adversely influence food security if it has produced an effect that leads to decreasing economic growth. It might also be asserted that corruption directly reduces food security, as well.

3. Literature

The studies on corruption and food security are very

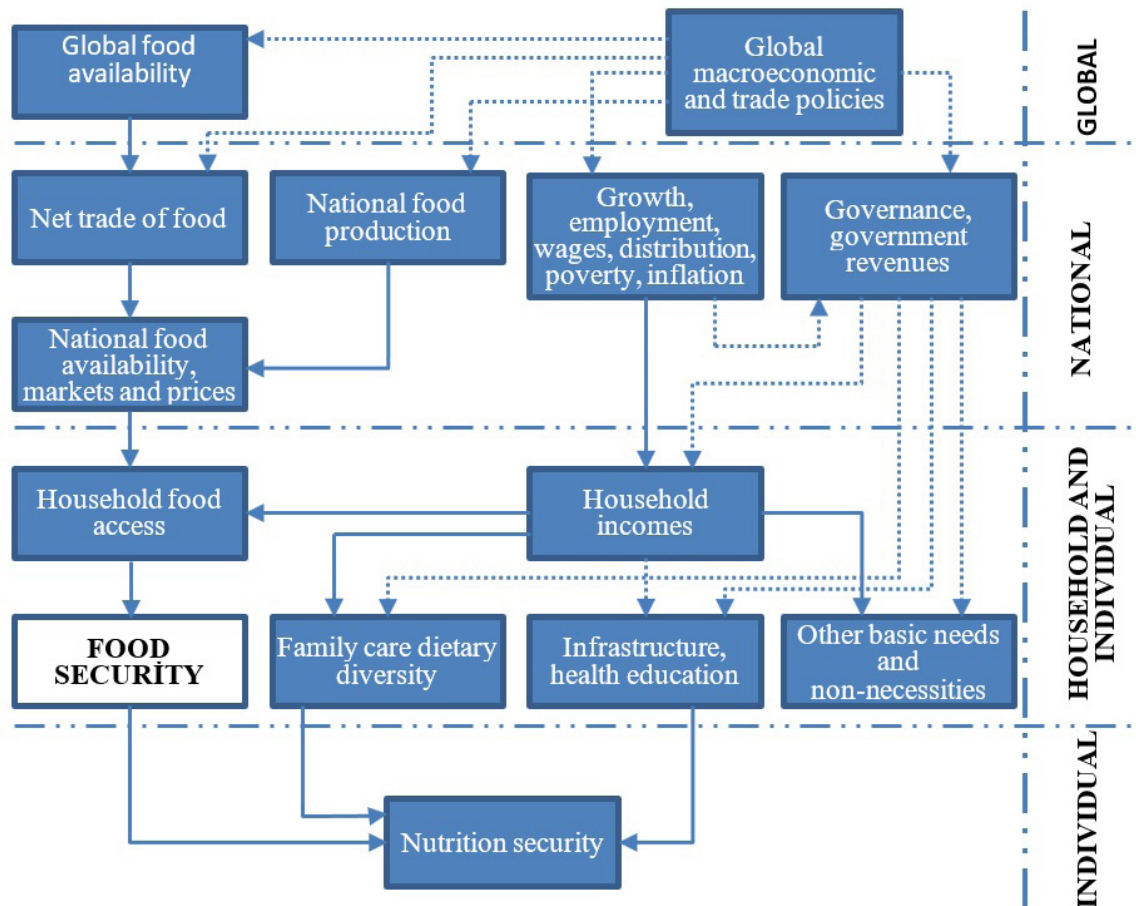


Figure 1. Food Security and Macroeconomic Policies (Eugenio, 2015)

limited. The main reason for this rests on the fact that the studies on food security are micro-level studies. In the studied literature a large number of survey studies focusing on a region, city, or group have been observed. Among the studies focusing on household food security, one might include Zezza and Tasciotti (2010), Sinyolo *et al.* (2014), Brugh *et al.* (2018), Dzanku (2019). Most of the mentioned studies were carried out on Africa and other underdeveloped countries. Similar studies on nations of different scales are very rare. For instance, Kirkpatrick and Tarasuk (2010) studied Canada, Coleman *et al.* (2014) studied the USA, Alexandri *et al.* (2015) studied Romania, Zhou *et al.* (2017) studied Pakistan in relation to food security.

Compared to household food security based studies the number of macro-level food security is very low. Those macro studies on African countries also cover a large portion of the work undertaken. Kirkpatrick and Dimitris (1985) studied food security and exchange restrictions in Sub-Saharan Africa. The authors assert that regulated income flow contributes to food security

rather than policies based on foreign exchange restrictions. Arouna *et al.* (2017) and Devereux (2016) have also studied the macro dimensions of food security on Africa. Etana and Tolossa (2017) have studied how a macro-scale problem like unemployment threatened food security in Ethiopia using a micro-based approach through surveys applied to household population. The researchers present evidence suggesting that households successfully partaking in labour market contribute to increasing food security.

These macro-scale studies investigate a rich variety of subjects alongside food security. Santangelo (2018) puts forth that using agricultural zones for direct foreign investments in developing countries endangers the food security of the country. Koizumi (2013) investigates the influence of biodiesel production on food security in China and Japan. The researchers have revealed that food security in China was under the threat of biodiesel production yet the impact was not high. Naylor *et al.* (2018), in support of Koizumi (2013), asserts that there is only a very minor relationship between biodiesel production and food se-

curity in literature. Liefert (2004) investigated Russia's economic growth and food security risks. The author states that economic growth in Russia decreases food security risk. Koç *et. al.* (2017), tried to determine the socio-economic determiners of food security in 18 MENA countries in their study and found out that price increases and inadequate water management led to a decrease of food security. Oke (2015), in their Nigerian sampling, assert that the decrease in food security related to price increases was influenced by high production costs, high exchange rates, and growing population size. Yu and You (2013) have grouped the production, consumption, distribution, import, and agricultural potential indicators of 175 countries according to food security criteria. The researchers, as a result of their study, assert that the concept of developing countries is not too inclusive in terms of food security.

Another problem analysed from the macro perspective is the relationship of corruption and food security. Helal *et. al.* (2016), who used Gallup 2014 world survey and Food Security Experience Scale of Food and Agriculture Organization in their study, assert that corruption and food security are inversely related. Anik *et. al.* (2013), in their micro-scale study using questionnaire method, conclude that corruption at the farm level decreases food security in Bangladesh. Moreover, they state that the impact is felt intensely by low-income groups. Uchendu and Abolarin (2015), tested the statistical significance between the two groups they have identified as least corrupt and most corrupt countries which they have selected using food security index values of 32 countries according to the values of The Global Food Security Index prepared by The Economist Intelligence Unit (The EIU) and Corruption Perceptions. As a result of their analysis, it has been asserted that food security and life expectancy increases in countries with low levels of corruption. They attribute this to the good governance practices of the public.

4. Research methodology and data

It is an undeniable fact that food security and corruption are the common problems of all humanity, and corruption, which is a socio-economic problem, adversely affects food security. The pioneering studies that have been carried out by Anik *et. al.* (2013),

Uchendu and Abolarin (2015) shed light on this phenomenon. The model in Equation 1 has been formed in order to test the impact of corruption on food security. It differs from the model of Anik *et. al.* (2013), as it offers a macro perspective to the impact of corruption on food security. Moreover, the present model also includes the socio-economic control variables that have not been mentioned in the study of Uchendu and Abolarin (2015). The probable food security policies to be implemented by public authorities might be influenced by the socio-economic factors of the country. At the same time, they might help in choosing the policy to be implemented. Thus, the model in Equation 1 rests on the assumption that the socio-economic factors experienced by a country influences food security.

$$FoodSec_{it} = \beta_0 + \beta_1 Unemp_{it} + \beta_2 PopDep_{it} + \beta_3 Cor_{it} + \beta_4 GDP_{it} + u_{it} \quad (1)$$

In Equation 1, the variables Unemp, PopDep, Cor ve GDP are used to account for FoodSec variable which indicates food security. It is possible to explain these variables and the FoodSec variable which is the dependent variable of the model.

FoodSec: This variable is the dependent variable of the model and it stands for food security. This variable was constructed using the data obtained from The Global Food Security Index reports prepared by the EIU unlike the study of Helal *et. al.* (2016) (The Economist, 2018b). This index prepared by the EIU in order to define food security has been used by Uchendu and Abolarin (2015). Moreover, in the studies carried out by Scardigno *et. al.* (2017), Diaz-Bonilla *et. al.* (2014), and Chen *et. al.* (2019), the same Global Food Security Index figures defining food security have been used.. This index is accepted as the first one that evaluates affordability, availability, and quality across issues of 113 countries worldwide using 28 indicators (The Economist, 2018a). it is possible with this index to compare countries with reference to their food security values. The index values range between 0-100. The closer it gets to 100 the higher ranks the food security of the country in terms of the issues on debate.

Unemp: This variable shows the unemployment values of the related country during a given period of time. This variable was derived from The World Bank,



World Development Indicators (WDI) Database. Although unemployment is generally associated with food security, few studies have been conducted on that issue. Among those are Etana and Tolossa, (2017), stating that unemployment has a negative impact on food security in African countries.

PopDep: This variable accounts for the ratio of dependent population. The mentioned variable was derived using the data from The World Bank, WDI Database and used in the model as the ratio of dependent population to total population. Pandey and Bardsley (2019) have stated that the increase in dependent population in rural areas of Nepal negatively affects food security. Adam *et. al.* (2019) emphasize a similar case in Ethiopia.

Cor: This variable stands for the perceived corruption levels of the country between given time periods. The variable was derived from The World Bank Worldwide Governance Indicators (WGI) database. The World Bank bases the data pertaining to this variable to Daniel Kaufmann and Aart Kraay methodology. This variable originally explains the power of public force in preventing corruption. The values of the variable range between 0-100. The values closer to 100 indicate the power of public force to prevent corruption. In this study, the data were reversed for ease of use. Thus, values closer to 100 would mean an increase in corruption.

GDP: This variable shows per capita income according to 2010 fixed prices. The mentioned variable was derived from The World Bank, WDI Database. Within this respect, the relationship between GDP and food security has been analyzed based on other variables. The study carried out by Manap and İsmail (2019) also states that food security has a great influence on economic growth. In a similar way, Applanaidu (2014) and Swietlik (2018) have indicated that economic growth affects food security. Thus, all these studies demonstrate that GDP and food security are interwoven and they have a positive relationship based on reciprocal basis.

The model in Equation 1 aims to test the impact of corruption on food security with the variables explained above. All data received from WDI has been used without any processing. To this end, data belonging to 75 countries for the years 2012-2016 were

used. Food Security Index data prepared by the EIU has influenced our choice of the sampled period. The EIU has disclosed the Food Security Index statistics of 113 countries for the mentioned period. The other variables in the model and countries with missing values were removed from the sampling for achieving a dataset suitable for Balanced Panel Analysis.

The dataset prepared for determining the impact of corruption level on food security will be analysed using Balanced Panel Data Analysis. In order to carry out Balanced Panel Data Analysis the dataset needs to be free of heteroscedasticity, interdependence, and autocorrelation problems. Moreover, in Balanced Panel Data Analysis the pooled dataset would be analysed using suitable statistical analysis methods for determining whether Fixed Effect or Random Effect technique would be executed. These will be explained in the Results and Discussions part of the study

5. Result and discussions

Before continuing with the tests aimed at determining the stability provisions and analysis technique to be used with balanced panel data analysis, the descriptive statistics are given in Table 1.

The mean value for the FoodSec variable showing food security is 58. While this variable can reach the highest value of 89, the lowest possible is 22. Unemp variable, demonstrating the unemployment rate, points to a mean of 6%. While the value is about 5% for the lowest country, it rises to a significant value of 22% in the highest country. While the PopDep variable, indicating dependent population, has a mean of 36%, this variable varies in a margin between 26% and 52%. The fluctuation margin appears to be higher in the Cor variable, which shows corruption. This variable ranges from 0 to 98,57. The fixed per capita prices of the countries in the sampling and GDP revenue are on average 1575\$.

In order to determine the suitability of panel data with the dataset, which was formed to determine the impact of corruption level on food security, heteroscedasticity, interdependence and autocorrelation problems have been tested, respectively, through Greene LR Panel Heteroscedasticity Test, Pesaran's test of Cross-Sectional Independence and Wooldridge Test



For Autocorrelation tests. The basic hypotheses related to these tests and the results of these hypotheses are presented in Table 2.

The results indicate that there are problems of heteroscedasticity, interdependence, and autocorrelation at the sampling at 5% statistical significance level. The existence of such problems at the dataset might result in inconsistencies at the coefficients of the analyses to be carried out. Thus, the Driscoll and Kraay

estimator which produces estimates resistant to heteroscedasticity, interdependence, and autocorrelation problems will be used in the analysis of the model shown in Equation 1 (Han & Seneviratne, 2018). Panel data systems have complex standard errors. When these standard errors are not appropriately handled it is not possible to generate consistent and convenient estimators (Reed & Ye, 2011). Driscoll and Kraay Method, although its standard errors have an optimistic inclination, produces more consistent estima-

Table 1. Descriptive Statistics

	FoodSec	Unemp	PopDep	Cor	GDP
Mean	58.56187	6.780339	36.45107	47.64027	15875.71
Median	58.00000	5.250000	34.85300	52.40385	6562.767
Maksimum	89.50000	27.47000	52.78091	98.57820	90316.97
Minimum	22.70000	0.160000	26.44025	0.000000	218.2835
Std. Er.	17.56308	5.460087	5.747841	28.59006	20253.80

FoodSec: Food Security, Unemp: Unemployment, PopDep: Dependent Population, Cor: Corruption, GDP: Gross Domestic Product, Std. Er.: Standard Error.

Table 2. Stability Provisions and Determination of the Technique to be Used

Hypotheses	Tests	Test Statistic		Prob.*
$H_0: \beta_i = \beta$	F Test	24.2724		0,0001
$H_1: \beta_i \neq \beta$				
$H_0: \sigma_u^2 = 0$	Breusch-Pagan Lagrange Multiplier Test	Cross-sec.	482,1	0,0001
$H_1: \sigma_u^2 \neq 0$		Time	18,65	0,0001
		Both	500,8	0,0001
$H_0: E(\varepsilon_{it}/x_{it}) = 0$	Hausman Test	27.8790		0,0001
$H_0: E(\varepsilon_{it}/x_{it}) < 0$				
H_0 : no autocorrelation	Wooldridge Test For Autocorrelation	83.717		0,0001
H_1 : autocorrelation				
H_0 : Homoscedasticity	Greene LR Panel Heteroscedasticity Test	9.49711		0,0498
H_1 : Heteroscedasticity				
H_0 : no Cross Sec*. Indep.	Pesaran's test of Cross Sectional Independence	34.145		0,0001
H_1 : Cross Sec. Indep.				

*Cross-sec.: Cross Section, Prob: Probability



tors compared to others especially on smaller samples with cross-sectional dependence (Hoechle, 2007). Three different analysis models can be used in Panel Data Analysis. These are Pooled OLS, Random Effect, and Fixed Effect. The model to be used is determined after a series of analyses. While F test reveals whether Pooled OLS or Fixed Effect model would work, the Breusch-Pagan Lagrange Multiplier Test determines whether Pooled OLS or Random Effect model would produce an efficient estimator. The analysis results for both tests given on Table 2 are statistically significant at 1%. The results show that Pooled OLS model would remain ineffective against both Fixed Effect and Random Effect models. In order to make a choice between Fixed Effect and Random Effect models we need to use the Hausman Test. The results of the Hausman Test presented on Table 2 are significant at 1% thus Fixed Effect model would produce efficient and consistent estimators.

Under the light of the data obtained from Table 2, the Balanced Panel Data Model presented at Equation 1 will be analysed using both Fixed Effect model Driscoll and Kraay estimator. The analysis results obtained using Driscoll and Kraay estimator and Fixed Effect model are given on Table 3.

The analysis results presented at Table 3, the probability value of the F statistics that shows the general significance of the model indicate that the overall model is statistically significant at 1%. The Unemp variable is significant at 10% while other variables are statistically significant at 1%.

One of the independent variables, GDP has a positive relationship with FoodSec variable while other varia-

bles have an inverse relationship with FoodSec variable. While the PopDep represents the highest relationship with the independent FoodSec variable (-2,19) the variable with the lowest impact is GDP variable (0,0012).

A 1% change in PopDep variable would lead to a 2.19 unit decrease at FoodSec variable. Similarly, a 1% change in GDP variable would lead to a 0,0012 unit increase at FoodSec variable. A 1% change in Unemp and Cor variables would lead to a 0,4925 and 0,095 unit decrease at FoodSec variable, respectively.

6. Conclusions

Food security is a global problem. The food crisis that took place in 1970s as a result of the agricultural structure brought about by WW1 and WW2 in addition to the effects of the world oil crisis resulted in an increasing effort to raise global awareness concerning the issue. Although these efforts contributed to finding answers to the problem, especially through food aid to vulnerable African countries, could not provide a full resolution. The widespread poverty perception of the people living in these countries raises questions about whether the aid given was received or not. Moreover, the extensive amount of corruption might contribute to low investment and low-income levels which in return threaten food security.

Developed countries experience food security problems on a different level. Although the problem is not a general one yet, it can still be considered as a problem in rural or underdeveloped regions or in the low-income group to some extent. While food aids directed to those people in need are being distributed by

Table 3. Analysis Results

Variables	Coefficient	Std. Error	Prob.
C	127,023	2,8917	0,001*
Unemp	-0,4925	0,2111	0,080**
PopDep	-2,1915	0,0654	0,001*
Cor	-0,0959	0,0151	0,003*
GDP	0,0012	0,0002	0,012*
F-statistic= 1125,8	Prob. 0.0001		

C: Constant, Unemp: Unemployment, PopDep: Dependent Population, Cor: Corruption, GDP: Gross Domestic Product, Std. Er.: Standard Error, Prob: Probability.



public officers who might hinder just and coordinated distribution for their political or personal benefits and put the food security in the country at risk. The level of income is another threat to food security. However, developed countries make strategic plans about food just like they do in the energy sector. While these plans are prepared, international food corporations might exercise political pressure which might result in losses in public welfare especially when corporate interests and public benefits are at odds.

The above mentioned factors provided the motivation for this study. The findings suggest that corruption is a phenomenon that threatens food security. The results of the study are parallel to the findings of Uchendu and Abolarin (2015), Anik *et. al.* (2013), and Helal *et. al.* (2016). An increase in the level of corruption decreases food security. However, this effect is very low compared to those of income and unemployment. After the analyses, it was determined that the most important factor for achieving food security is making people successful participants in the labour market. This complies with the results of Etana and Tolossa (2017). The results which suggest the economic growth that stems from increasing per capita income would increase food security support the claims of Liefert (2004) and Timmer (2004) about Asian countries.

Consequently, good governance that would diminish corruption should be achieved and the public structure must be transformed to be transparent and accountable. Especially, when food aids are distributed the suspicions of the philanthropists and the public need to be erased. Thus, the criteria would be previously determined and publicized and only those who meet the criteria should receive aids. If possible the records of the aids should be kept electronically and opened to the public for increased transparency and accountability. Such regulations would help diminish the direct effect of corruption on food security. For indirect effects, de bureaucratization and increasing the interaction of public force and NGOs through actions in support of good governance might be beneficial. Moreover, widespread use of technological innovations in public services and minimizing human interference in addition to active control that prevents favouritism with disincentives as measures against corruption would also positively contribute to food

security.

It must be emphasized that a learning-oriented understanding would have a large effect on food security regarding the outcomes of this study on the impact of corruption on food security. People's active participation in the labour market and their success would positively contribute to food security. Therefore, especially the integration of the disadvantaged workforce to the labour market through active employment policies would positively promote to food security on a different level. In this regard, special employment services might be founded or education of labour might be foregrounded. Participation of the unemployed workforce in production would contribute to economy in general and to food security through the increase in income.

A detailed study of the direct and indirect impacts of corruption on food security from a macroeconomic perspective might be fruitful. Structural equation modelling might be used in further studies on the issue. Thus, the impact and importance of corruption on per capita income and how it influences food security can be interrogated. Furthermore, the network of relations explored in this study might be studied for sampling from developed, underdeveloped, OECD, African, MENA, and EU countries and the dynamics of the models for subgroups might be laid bare.

Conflict of interest

The author declares that there is no conflict of interest.

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