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Multidimensional Determinants of National Food Security in Azerbaijan: an Application of the ARDL Approach

Abstract. Food intake is a prerequisite for human beings to live a healthy life style. The attainment of food security is crucial and is a prime development priority for all developing countries. The inability to provide reliable evidence of national food security has remained a problem for both policymakers and researchers alike. The present study helps fill this gap by incorporating the multidimensional determinants of food security at the national level in Azerbaijan. The specific objectives of the study are to evaluate the short-term and long-term dynamics of these determinants on food security. The empirical analysis draws from nationally representative time series data over the period 1991 to 2018, taken from FAO and WDI. The ARDL model suggested that food import, exchange rate, inflation, climate change, and urban population growth harm national food security dynamics of Azerbaijan. On the other hand, trade to GDP ratio has a positive impact on food security. Overall results suggest that there is a pressing need to improve its institutional framework if the Azerbaijan government sincerely desires to have sustainable food security, as organizations control all other issues.

Keywords: Food Availability, Food Access, Food Stability, Azerbaijan

JEL Classification: Q2, Q1, O13, P42

Introduction

Food plays a fundamental role for living organisms to achieve a healthy routine. The achievement of food security is a complex and important development priority for all developed and less developed countries (FAO,2015a). Food security is an international concern for every human being; about 805 million people around the globe are food insecure (FAO, 2015b). In Azerbaijan, the situation of food security is more critical due to climate change vulnerability and land degradation (Jafarova, (2016). The agricultural sector is the third leading contributor to the gross domestic product of Azerbaijan, after construction and oil sectors. It contributes around 8% to the national economy (ROA,2016), and employs about 40% of the labor force as compared to 1.5 % in the oil sector. Similarly, agro-based industry plays a vital role in food security by the processing of dairy, meat products and canning of fresh vegetables and fruits. According to a national report on 2015 data, the value of total imported commodities was above $9 billion, out of which 13.5% was food, beverages, and live animals.

Food security has garnered great attention from researchers and policymakers since the food price shock in 2007-08, because of the dependence of many countries on imported food (such as in Azerbaijan). Empirical evidence from this period suggests that middle and lower-middle-class households (largely from rural areas in Azerbaijan) are especially hard hit during such catastrophes because prices of food and staple cereals increase sharply

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beyond their purchasing power (Schmitz and Kennedy, 2016). Although the poverty rate has decreased from 49% in 2004 to 10% in 2016, data show massive disparities between urban and rural areas. The majority of poor people live in rural areas, where social and economic conditions remain a prime issue of concern, and a great number of rural households remain vulnerable to food insecurity. Despite the improvements made through domestic and global efforts to eradicate poverty, people in Azerbaijan, particularly in rural areas, still have critical challenges of food access and affordability (FAO,2015a). The massive rate of malnourishment and undernourishment among this segment of society suggests that food and nutritional insecurity will persist as a core issue to be tackled by policymakers and the research community (Sutton, et al, 2013).

Most of the existing studies have shown that lack of yield-enhancement, low adoption capacity, dysfunctional output and input markets, poor access to extension services and declining soil fertility are the main drivers of national and household food insecurity in developing countries (Willer and Lernoud, 2015). Climatic variability in the form of increased carbon emission and temperature variability and expiated in-season and mid-season droughts also worsen the situation. (Clapp, 2017). A recent study by Watson (2017) shows that unless substantial investments are made to accelerate per-capita food availability in Azerbaijan, the great number of rural people facing undernourishment and hunger will increase considerably. National food security is a multi-dimensional and complex phenomenon, like poverty, with a variety of indicators and definitions. The significance of a nation's food security has become an issue of sustainable governance globally during the past few decades (ADB, 2006). A nation is food secure when all people at all time have sufficient economic and physical access to nutritious and safe food for meeting their food requirements, and to achieve an active and healthy lifestyle (FAO,2003). It is also a prime focus of millennium development goals and mainly observed as a helpful measure for examining the progress of a government in term of social and economic well-being (Akramov,2012).

Achieving sustainable food security at the national level remains a great challenge not only for less developed countries but also for developed nations (Barrett, 1996). Although the Azerbaijan government has introduced many programs and policy interventions aimed at attaining national food security, all these efforts have not produced the required objectives (Chaaban, et al,.2018). The main reason for this is that food availability and accessibility in Azerbaijan has not increased enough to meet the demand for the socioeconomic circumstances at household and individual levels. The gap between food supply and demand has led to increasing import of food and livestock products, as well as food inflation and currency depreciation, which make it more difficult for the middle and lower middle-classes to meet their dietary needs (Chabot and Tondel, 2011). The inability to provide reliable data on the household and national food security situation in Azerbaijan has remained a problem for policymakers. Agencies that implement government programs, as well as policymakers, are gradually seeking food security measurement tools that are reliable and easy to use and that can help interpret the dynamics of the national food situation (Clapp, 2017). The analysis of national food security determinants and its status is, therefore, useful not only for policy making but also for better policy implementation (FAO,2015b).

There are numerous factors affecting food security – both directly and indirectly – that have been examined empirically in Azerbaijan at the micro level or using targeted group approaches at the household or farm level (Djuric, et al, 2017). However, to the author's

best knowledge, none of the recent studies on food security have employed macro or large-scale data to estimate the national dynamics of the food security situation and its key determinants like the present study. Target population or micro studies of determinants of food security will not only mislead policymakers but give a misleading situation analysis for Azerbaijan and other less developed countries (Ilyasov, 2016).

The present study helps fill this gap by incorporating the multidimensional determinants of food security at the national level. The prime objective of this study is to examine the determinants of the national food security situation in Azerbaijan. The specific objectives of the study are to analyze the short-term and long-term dynamics of these determinants on food security status.

Theoretical Background

Food insecurity generally happens when people don't have physical, economic or social access to safe and healthy food, and chronic food insecurity occurs whenever they are incapable of diminishing or absorbing the adverse impact of food price shocks (FAO,2003). Food insecurity is interrelated yet separate from other social issues such as malnutrition and poverty. Primarily, the failure of efforts to control food insecurity is possibly the result of overemphasis on ensuring food availability at the national and household level (IFAD,2010). While a sustainable food security situation hangs on total food production and agricultural performance, it also is contingent on food access, utilization and stability (Jafarova, 2016). Therefore, looking only at the food availability component is a weak estimator of food security, as such analysis only conveys one aspect of the entire population (FAO,2015a). Most of the existing literature empirically observes the food availability component for national food security. However, food availability and accessibility cannot be explicitely distinguished at the national level, where constraints of data availability fail to disclose the extent to which food is physically and economically available in the domestic market. In addition, people's attitudes towards food acquisition don't always reflect food accessibility (Khalilov, et al, 2015). So the food availability approach to food security might not relate to its latent benefits, consequences, and causes.

This study gives a marginally different framework to explain how food security dynamics are examined and managed at the national level. The paper asserts there to be three main components of national food security analysis: food availability; food accessibility; and food utilization. This framework is very suitable for our analysis, subject to data and time constraints. While a reliable approximation of food security dynamics is a prerequisite for well-targeted policies and effective program implementations, there is no unique procedure for food security measurement. And despite the FAO's strong theoretical foundation, there exists no uniform tool that apprehends all dimensions of food security (FAO, 2003). The unattainability of such a gold standard makes it ineffective to employ a single benchmark as an accurate assessment of food security. Due to its multidimensional nature, it is typically agreed that a group of indicators is required for the accurate study of food security (IFAD,2010). This study employs the quantitative approach to explore how multidimensional determents affect the food security dynamics in Azerbaijan at the national level. This analysis will be useful for food security policymaking and monitoring analysis.

Agro-ecology and food security of Azerbaijan

Azerbaijan is situated in southwestern Asia. Most of its land falls in the Asian zone, while a small area in the northern range is located in Europe. Azerbaijan's total population is around 10 million and its economy is greatly dependent on natural resources and oil production (ROA, 2016). Azerbaijan possesses various climate zones and topographies which allow for agro-based products of a variety of animals, plants, and fisheries. The agricultural sector is the third leading contributor (8%) to Gross National Product but crucial issues limit agricultural growth, largely because of serious land degradation and fragmented holdings of natural resources. Climate change and mishandling in animal and plant production have led to waterlogging, desertification, soil erosion, reduction of soil fertility and increase in secondary salinization (FAO,2010). All these problems have damaged the food security and agricultural growth rate. In Azerbaijan, the agricultural sector can play an important role in reducing poverty and food insecurity. Even though its contribution to national income is quite low, particular focus is being dedicated to non-oil sectors, mainly agriculture, in order to expand socioeconomic activities and to bring higher levels of food security. However, the climate outlook for Azerbaijan is categorized by increasingly extreme and frequent rainfall and a rise in temperatures. Therefore, it is a common perception that climate variability will turn out to be a multiplier increasing the prevailing risks to food security.

Data description and sources

The empirical analysis draws from nationally representative time series data over the period 1991 to 2018, to examine the dynamics of food security in Azerbaijan. Annual time series data is taken from the Food and Agricultural Organization (FAO) and World Development Indicators (WDI). The food supply (per capita/year) is used as a proxy for national food security and as an endogenous variable in the model. Annual food import (FIM), trade to GDP ratio (TGDP), exchange rate (ER), consumer price index (CPI), carbon emission CO2 as a proxy of climate change (CC), and urban population growth (UPG) are used as exogenous variables and major determinants of food security. The food supply (per capita/year) as a proxy of food security also uses calorie availability at the national level. Historical carbon emission CO2 data are obtained from FAO for estimating the impact of annulling climate change in Azerbaijan. In this article, time series analyses include the annul series of all relevant determinants of various food security components (availability, access, affordability, stability) at the national level.

Methodological Setup

It is a precondition to test the stationarity and order to the integration of each variable in a model before employing the short and long run econometric technique. For this purpose, this study used the ADF test (Dickey and Fuller, 1981) for analyzing the order of stationarity of each time series. Unit root analysis was used for both conditions, with and without trend at 5 percent level of significance. The general equation of the augmented Dickey-Fuller (ADF) is bellow (Eq. 1).

$$\Delta Y_t = \alpha + \beta_1 t + \delta Y_{t-i} + \sum_{i=1}^{m} \lambda_i \triangle Y_{t-i} + \varepsilon_t \quad (1)$$

Where ε_t is error-term (white noise).

Specification of Co-Integration Model

There are numerous models proposed to estimate cointegration such as Enger-Granger (1987), Johansen and Juselius test (1990), and ML-based Johansen model (1992). It is a criterion for the applications of these cointegration approaches that time series variables be stationary or integrated at the same time; otherwise they produce spurious results (Kim *et al*., 2004). ARDL bounds testing approach or Autoregressive Distributive Lag Model to estimate long-run cointegration as developed by Pesaran *et al*. (2001), which is appropriate to small samples (Haug, 2002). This model can also be relevant, regardless of stationary level e.g. I (1) or I (0) (Pesaran *et al*., 2001). In ARDL test, if estimated F-statistics value exceeds the upper critical bound value, then the time series is said to be cointegrated and vice versa. If the estimated F-statistics fall between the lower and upper bound values, then the series is said to be inconclusive cointegration. After establishing the long-run cointegration, the error correction method (ECM) used to examine the short-run relationships take the form defined in Eq (3) below:

$$\Delta FS = a + \sum_{i-1}^{m} \emptyset\dot{1}\ FIM \underset{t-i}{\rightarrow} + \sum_{i-1}^{m} \emptyset\dot{2}\ TGDP \underset{t-i}{\rightarrow} + \sum_{i-1}^{m} \emptyset\dot{3}\ ER \underset{t-i}{\rightarrow} + \sum_{i-1}^{m} \emptyset\dot{4}\ CPI + \sum_{i-1}^{m} \emptyset\dot{5}\ CC + \sum_{i-1}^{m} \emptyset\dot{6}\ UPG + \sum_{i-1}^{m} \emptyset 7\ FS + \in \ ----------Eq2$$

$$\Delta FS = \sum_{i-1}^{m} \emptyset\dot{1}\ \Delta FIM \underset{t-i}{\rightarrow} + \sum_{i-1}^{m} \emptyset\dot{2}\ \Delta TGDP \underset{t-i}{\rightarrow} + \sum_{i-1}^{m} \emptyset\dot{3}\ \Delta ER \underset{t-i}{\rightarrow} + \sum_{i-1}^{m} \emptyset\dot{4}\ \Delta CPI + \sum_{i-1}^{m} \emptyset\dot{5}\ \Delta CC + \sum_{i-1}^{m} \emptyset\dot{6}\ \Delta UPG + \sum_{i-1}^{m} \emptyset 7\ \Delta FS + \in \ ----Eq3$$

F test of the null that: $\phi_1 = \phi_2 = \phi_3 = \phi_4 = \phi_5 = \phi_6 = 0$

Result and Discussion

The Augmented Dickey-Fuller (ADF) test was applied to examine whether the data used in this paper had a unit root problem or not (Table 1). First series ADF estimation shows that food security did not have a unit root problem and was stationary at level form. ADF unit root testing of the remaining variables indicates that four of the time series variables which include FIM food imports, TGDP trade to GDP ratio, ER exchange rate

and CPI consumer price index attain their stationarity at order one, which means they were all integrated at first difference while UPG urban population growth and FS food security make stationarity at level and integrated at zero. Above results indicate that all series were not integrated in identical order, thus we employ the ARDL bound testing model (Table 2).

Table 1. Unit Root Results

Endogenous & Exogenous	Log Level Form		Log Level Form		Decision
	Without Trend	Pro	With Trend	Pro	
LnFS	-4.19	0.03	-2.34	0.05	Stationary
LnFIM	-1.20	0.34	-3.01	0.47	I(0) Non-Stationary
LnTGDP	-1.34	0.48	-1.54	0.78	I(0) Non-Stationary
LnER	-1.52	0.49	-1.80	0.64	I(0) Non- Stationary
LnCPI	1.30	1.70	-3.17	0.03	I(0) Non- Stationary
LnCC	-0.87	1.20	-1.41	0.42	I(0) Non- Stationary
LnUPG	-4.65	0.04	-2.80	0.04	Stationary
Log First Difference Form					
LnFIM	-5.69	0.00	-6.76	0.00	Stationary
LnTGDP	-4.40	0.00	-6.15	0.00	Stationary
LnER	-5.70	0.00	-6.03	0.00	Stationary
LnCPI	-3.06	0.04	-4.85	0.00	Stationary
LnCC	-8.10	0.01	-7.10	0.00	Stationary

Source: Author's own calculations.

To estimate the long-term food security dynamics, the cointegration test is used to attain the equilibrium between multidimensional determinants and the food security situation in Azerbaijan. Table 2 below gives the results of the ARDL bounds test. Empirical evidence shows that the value of F-statistics (5.020) drives beyond the upper bound critical values at 5% level of significance, confirming the long term cointegration between multidimensional determinants and food security dynamics, explaining the long term relationship. The coefficients of long term cointegration estimated following the empirical finding of the ARDL model are given in Table 3.

Table 2. ARDL bound test

ARDL Bounds Test		
Null Hypothesis: No long-run relationships exist		
Test Statistic	Value	k
F-statistic	5.020390	6
Critical Value Bounds		
Significance Level	Lower Bound	Upper Bound
10%	2.24	3.25
5%	2.76	3.60
2.50%	2.88	4.20
1%	3.35	4.58

Source: Author's own calculations.

The empirical findings of long-term estimates show that food import has a negative and statistically significant impact on the domestic food supply of Azerbaijan. The coefficient of food imports suggests that a 1% increase in food import will lead to a decrease of 0.38% in the domestic per capita food supply in Azerbaijan. The existing evidence supports this long-term negative relationship (Mary, S. 2019).). Empirical evidence suggests that if Azerbaijan adopts more in-ward looking policies to develop the agriculture sector, it will improve the sustainable food supply and security as well as economic growth and trade terms. However, the long-term estimates show trade to GDP ratio has a positive and significant impact on access to food security. The estimated coefficient of trade to GDP ratio suggests that a 1% increase in trade to GDP ratio leads to an improvement of 0.13% for the access to food security in the long term in Azerbaijan. In Table 3, empirical results show that depreciation in the exchange rate has a negative and significant impact on the food security situation because Azerbaijan's national food security largely depends on import of food products. Depreciation in domestic currency against the foreign currency leads to an adverse impact on food access and availability in Azerbaijan.

Table 3. Coefficients of long-term relationships

Long Run Co-integrating Form				
Dependent Variable: LnFS				
Selected Model: ARDL(6, 6, 6, 5, 6, 6)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LnFIM	-0.380	0.170	-2.234	0.048
LnTGDP	0.134	0.065	2.061	0.034
LnER	-0.196	0.052	-3.769	0.040
LnCPI	-0.415	0.123	-3.373	0.005
LnCC	-0.503	0.114	-4.412	0.008
LnUPG	-0.151	0.053	-2.849	0.019
C	-22.519	7.617	-2.956	0.038

Source: Author's own calculations.

This study employed carbon emission CO2 as a proxy of climate change in Azerbaijan. The increase in carbon emission leads to climate change vulnerabilities, but its impact is ambiguous in Azerbaijan. Climate change creates volatility and insecurity in domestic food supply, thus it slows down the rate of agricultural growth in Azerbaijan. The low agricultural growth rate does create food insecurity and malnutrition, particularly for the poor, and thus adversely impacts sustainable development (see FAO,2010; FAO2013). Our empirical findings confirm those found by Swart, et al, (2003) and Chaaban, et al, (2018). Climate change has an adverse and significant impact on national food security. For Azerbaijan, a 1% change in the current state of climate leads to deterioration of long term food security dynamics at both a national and household level. Similarly, UPG urban population growth also has a negative and significant impact on national food security dynamics in Azerbaijan.

Table 4. ECM results

Dependent Variable: LnFS				
Selected Model: ARDL(6, 6, 6, 4, 6, 6)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LnFIM)	0.51	0.22	2.318	0.01
D(LnTGDP)	0.11	0.03	3.667	0.04
D(LnER)	-0.18	0.05	-3.600	0.03
D(LnCPI)	-0.28	0.13	-2.153	0.01
D(LnCC)	-0.05	0.02	-2.501	0.00
D(LnUPG)	-0.14	0.13	-1.07	0.28
ECM (-1)	-0.44	0.15	-2.03	0.05
Cointeq = LnFS - (0.51*LnFIM + 0.11*LnTGDP – 0.18 *LnER -0.28*LnCPI -0.05*LnCC -0.14*LnUPG-C0)				

Source: Author's own calculations.

Table 4 reports and discusses the empirical findings from Error Correction model (ECM) technique and if ECM value falls between 0 to -1 the results will confirm the short term existence of long term established cointegration. In this study, the value of ECM is -0.44 and significantly indicates that the convergence from the equilibrium level of food security during the present period will be adjusted by 44% in coming years. The empirical finding confirms that in the short term, food security appears to be better with an increase in food imports from foreign countries. The results show that short term coefficient of food imports is significant and positive, which indicates that the Azerbaijan government is successfully filling the local food supply and demand gap. The exchange rate, inflation, and climate change have a negative and significant impact on food security. In Azerbaijan, rural people have limited purchasing power, therefore, they face a lot of problems in food access and affordability due to poverty. Rapid urbanization and urban population growth are inversely correlated with national food security dynamics. Urban food demand also seems to increase food insecurity in Azerbaijan.

Conclusions and policy recommendations

This paper was motivated to empirically analyze the dynamic relationship between food security and selected multidimensional determinants (food import, trade to GDP ratio, exchange rate, inflation rate, climate change, urban population growth) in Azerbaijan by employing ARDL approach. The ARDL model suggested that food import, exchange rate, inflation, climate change, and urban population growth have a negative impact on national food security dynamics of Azerbaijan. On the other hand, trade to GDP ratio has a positive impact on food security. This study finding is quite comparable to (Sutton, et al, 2013) because his paper also focused on food security dynamics and also examined its linkages with socioeconomic determinants and climate change. Normally, in less developed countries like Azerbaijan, the limited adaptive and innovation capacity to develop agriculture poses a limitation on small farmers' agricultural production, creation of income and investment. Food import in Azerbaijan is seen as an effective short term policy for improving food insecurity at the national level.

To attain the sustainable food security objectives in Azerbaijan, in-ward looking policies need to be developed and agricultural research and development should be expanded in order to raise agricultural growth and the livelihood of rural farmers. There is no doubt that these types of policies will contribute immensely to improving the national and household food security levels. As would achieving the GDG 2 sustainable development goals, which are targeted at eradicating hunger and malnourishment and attaining sustainable food security in developing countries like Azerbaijan by the end of 2030. In light of this, the present paper also advocates broadening the frontiers of knowledge for policymakers in order to help overcome the problem of food insecurity, including the potential impact of climate change phenomena on national food security in Azerbaijan. Policymakers should develop a set of policies to mitigate climate change and food insecurity concurrently. This study suggests that there is a very strong requirement to develop effective institutional structures if the Azerbaijan government genuinely hopes to attain sustainable food security.

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