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Article

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Impact of Oil Exports on Imports of Food and Agricultural Products

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ABSTRACT

This research reveals the impact of oil export on some food and agricultural products from January 2013 to August 2021. For this purpose, we used ARDL model to evaluate short −term and long−term relations between variables. Moreover, we also used FMOLS and DOLS dynamic models as well as CCR canonic cointegration regression model to get reliable data from the empirical research. The outcomes confirm the existence of cointegration among the variables. ARDL unveils that oil export has a positive impact on some food and agricultural products in a long term. Besides, the positive relations between the growth of food −agrarian products and oil export show the importance of these data for the diversification of the non −oil sector and the economy in Azerbaijan.

Keywords: Oil Export, Impact Food and Agricultural Products, FMOLS, DOLS, CCR, Engle–Granger, ARDL
JEL Classifications: Q13, Q37, Q48, O13, O24

1. INTRODUCTION

Since oil is the main energy resource, its fluctuation affects both oil −importing and oil exporting countries. It is sufficient to say that if oil prices increase, the price of products increases but the competitiveness of the products in oil−importing countries lowers. If the reverse happens, the price of products declines, the competitiveness of products in terms of price and value decreases too. In turn, both situations seriously trigger consumerism. The changes in consumerism is important since the majority of oil−importing countries are developed countries. The falling of oil price will negatively affect oil−exporting countries while the world economy is intended to improve in the middle term (Mukhtarov et al., 2020; Mikayilov et al., 2020; Kopytin et al., 2021). In fact, the main contributors are developing countries in the market. Therefore, the serious decline impacts on the revenue of oil−exporting countries. “Gold Average” rule might refer to all fields. Oil −exporting countries also import some other products such as food and this trend affects them too.

Some countries with huge oil deposits depend on the revenues generated from oil in order to import goods including food. Besides, oil-rich countries are reluctant to invest in agriculture but are willing to import expensive goods. That is why it becomes difficult to finance those tools that stabilize social expenditures.

Moreover, the fluctuation of revenues in oil export impacts agriculture directly and indirectly (Djella et al., 2019).

Obviously, oil prices suffered due to Covid pandemic in 2020. The demand for energy declined but commenced to increase recently to the same level before the pandemic. This is a signal for economic recovery. However, the question is how it will impact agriculture (Andrew and Elder, 2021).

All sorts of international trade are in compliance with the basic market law, to be exact–the law of demand and supply. To explain this further, the competitive and cost−effective products which satisfy the internal market are exported to different countries. Actually some products should be excluded here. Of course, these foods are high −rated products. In fact, exported products provide the flow of foreign currency into the country and it compensates the imported products. These products include cars and accessories, machines, technology, appliances and some food and agricultural products. Research reveals that oil is an influencing factor while meat, butter, milk, tobacco, fruit and vegetables, wheat and plants are being influenced. Since the internal market of the exporting countries is provided with both local and foreign imported products, encouraging local production and diversification of economy is the main state policy. The core principle of our research mainly serves to determine this dependency and the impact of the world oil prices on Azerbaijani oil as well as on food and agriculture. However, the similar researches encompass the influence of the oil price fluctuations on food price, agriculture and other related sectors. This is one of the unique researches devoted to identifying the impact of oil exports on food prices in oil −exporting countries.

The first chapter of the research reveals how important the topic is while the second one refers to the literature. The third chapter analyzes data and models as well as hypotheses either to confirm or to deny. The fourth chapter is about the calculations of the outcomes. Finally, the last chapter is devoted to showing the results and giving some recommendations.

We can list the literature as the following.

2. LITERATURE REVIEW

Firstly, it is worth noting that the relations between the oil export and the import of agricultural products have not been much researched. However, there are only some related researches.

2.1. Oil Price and GDP in Agriculture

Ivanova et al. (2018) researched using the VAR method how oil fluctuations affect the efficiency of agricultural products and the formation of business policy. While Echeazu was researching master thesis about the influencing factors of agriculture in 1970−1980 in Nigeria noted that economists conducted several researches on expansion of stability, export and diversification in order to assess how oil export affects economic development of a country (Echeazu, 1983). Later, Zafeiriou et al. (2018) researched the impact of future prices of oil on corn and soybean between 1987−2015. The research revealed the impact of oil price on biodiesel as well as agricultural products for ethanol production. They also researched the mutual relations between energy markets and agricultural products using ARDL cointegration method. During the research in 1992−2013 in Ghana, it was revealed that there was a reverse dependency between oil price and agricultural products. Since oil resources are depletable and oil prices can be unstable, a comprehensive investment plan for agriculture and diversification is strongly recommended. Our results confirm this research too. Thus, if oil prices increase, the import goes up too and as a result, local production becomes weak (Ishmael, 2016).

Using the ECM model, Oluwatayo and Ukpe (2015), researched the influence of oil prices on agriculture between 1970 and 2010 in Nigeria. He thinks that oil−exporting and food−importing countries are more sensitive to global price fluctuations. The price increase not only affect economy of the country but also agriculture. Using the ECM model, Sekumade (2009) concluded that while the export and import of oil increases, manufacturing in agriculture also goes up between 1970−2003. However, the production value of agriculture had a reverse dependency on production of agriculture. Based on the outcomes, some practical recommendations were designed in order to reduce the negative results of oil dependency on economics and to improve agriculture sector.

Krishna et al. (2020) researched mutual relations between economic development in agriculture and energy consumption in India from 1985 to 2017. They reviewed the short −term relations using the VEC method. However, the long −term balance between energy consumption and economic development in agriculture was approved by Yohansen, Trace, and Lmax tests. Abdlkarim et al. (2018) studied long−term relations between GDP in agriculture and oil price in 35 oil−exporting countries from 1975 to 2014 using FMOL, DOLS, and PMG methods. Cointegration panel assessment reveals the significant yet negative impacts of oil prices and exchange rates in agriculture.

The increase in export ad real exchange rate causes the reduction of production volume in the non −oil sector. There is a positive relationship between the real exchange rate and GDP in agriculture. It approves that the increase in real exchange rates badly affects the agriculture sector in oil−dependent countries.

Mohd et al. (2013) researched the impact of oil shocks on oil prices in Malaysia. The outcomes show that oil prices significantly affect agriculture.

2.2. The Relations between Oil Price, Exchange Rate, and the Price of Agricultural Products

Christiane and Kilian (2014) reveal that the increase of retail food prices is related with macroeconomic indicators although the influence of oil prices cannot be totally deniable. They do not only substantiate it with oil prices but also agricultural products. They also mentioned that agricultural products have a little impact on food prices. Interestingly enough, they also don’t hold the view that oil prices heavily affect packaging, manufacturing, storing, haulage and distribution. It is also the same in developing countries. However, food prices are closely related with retail prices in the developing countries.

Using panel econometric methods (VECM, ARDL), Anthony (2015) studied the long−term relations between the prices of oil, exchange rate, and 35 agricultural products from 1983m06−2013m06. He concluded that the impact of oil prices on agricultural products in a long term is positive and statistically significant. Besides, using the ARDL method, Muhammad et al. (2021) researched the export and funding of agricultural products on ecology in Pakistan in 1975−2015. The research revealed that the export of agricultural products causes to reduce ecological consequences in a long and short term perspective.

Using the ARDL method Oluwatoyese et al. (2020) researched the impact of exchange rate and oil prices on the export of agricultural products in Nigeria from 1981 to 2016. The outcomes reveal that there are important mutual relations between the export of agricultural products. However, this is not related to crude oil price but exchange rate.

2.3. The Relationship between Oil Price and the Price of Different Agricultural Products

According to the research, we can agree with the statement: countries depend on the exports and its fluctuations so that revenues from exports finance imports and investments for the future (UNDP, 2011). The inflation on food prices and its distribution is a great concern now and is under question for future. Let's assume that the oil price increase is one of the factors to lead to soar up the agricultural products (Mohamed and Abdel Hameed, 2009). One research about the impact of oil price fluctuation on food in Nigeria reveals the mutual relations of these two in a short and long term and cause and effect relationships from 2000 to 2013. VAR model indicated that there is a positive relations between oil price and food except rice and wheat (Nwoko et al., 2016). Azeez (2018) researched the impact of oil prices on food prices both in the city and countryside in Nigeria before and after crises and he concluded that there are expenditure inequalities. TY models reveal that the total and average food prices respond to oil fluctuations positively. However, average food prices in the countryside respond to oil prices negatively. Average food prices recover significantly after crises since they suffer a lot from higher oil prices.

Kunlapath and David (2018) analyzed the dependency of daily prices for three agricultural products (soybean, corn, and wheat) and two energy resources (ethanol and crude oil) from 2006m06 to 2016m06. The outcomes reveal that corn and oil price is related to the ethanol market. It is also revealed that agricultural products were dependent on the oil prices statistically during a market crash. However, it is independent while the market is higher than expected. Later, other researchers (Wei and Chen, 2016) used the VAR model to study the relations between the oil prices and the price of three agricultural products–soybean, wheat, and corn from 3 January 2006−2022 February 2012. It was determined that the change in wheat prices heavily depends on the fluctuations in oil prices and other agricultural products. Besides, there is a mutual relation between the productivity of agricultural products and oil profitability. Lucy and Okova (2016) studied the relations between the price of diesel, corn, bean, cabbage, and potato through cointegration and cause and effect test by Grainger in 2010−2018. As a result, it has been identified that there is a cause and effect relation between the price of diesel and cabbage and potato. However, there are no such relations between corn and bean prices. The purchased products reveal that there is a long − term relation between easily −spoiled products and the oil price. So, the increase in diesel prices causes the increase of cabbage and potato prices significantly. Kamaruddin et al. (2021) used the NARDL method and researched the asymmetric impact of the oil price on agricultural products including the price of coffee and its sales in Indonesia. As a result, it has been revealed that coffee producers in Indonesia get a lot of profit while the world oil prices are lower. Other researchers Xiangcai (2018) used the GARCH assessment method and studied the dynamic relations between oil prices and the price of agricultural products based on data given in a quarter in the Republic of Korea in 1970−1985, 1985−2000 and 2009. He concluded that the price of agricultural products is too sensitive to oil prices.

Abdullah et al. (2019) used the NARDL method and reviewed the asymmetric impact of the oil fluctuations on food prices based on data given in a quarter in Nigeria in 2010m01−2017m12. The results show that the changes in oil prices affect food prices positively and significantly.

3. DATA AND METHODOLOGY

3.1. Data Descriptions

The research used time series (2013m01−2021m08) to study the dependency of some food and agricultural products on oil export. All indicators are in US dollar and taken from Azerbaijan Customs Office (Table 1, Graph 1).

3.2. Methodology

The research is based on the orthodoxly ARDL (Pesaran and Shin, 1999) method and Engel−Granger cointegration test (Engel and Granger, 1987). ARDL method provides consequent and reliable outcomes using ECM. Thus, it creates an opportunity to define dependencies in the short and long term. Mixed integrated (I(0) and I(1)) variables might also be used in this method (Musayev and Aliyev, 2017).

3.3. URT

Before using regression equation, we need to use URT to provide stability. This is important to determine the integration level and stationary for time series (variables) in modern empirical researches. So, using non −stationary time series causes wrong regression. That is why selecting the most appropriate model is important. The article used Augmented Dickey−Fuller, (ADF)

Table 1: Data and internet resource

O	Oil	www.customs.gov.az
FP	Food products	www.customs.gov.az
B	Butter and other fats made from milk	www.customs.gov.az
W	Wheat	www.customs.gov.az
Mt	Meat	www.customs.gov.az
Mk	Milk	www.customs.gov.az
FV	Fruits and vegetables	www.customs.gov.az
V	Vegetable and animal fats and oils	www.customs.gov.az
T	Tobacco and tobacco products	www.customs.gov.az

(Dickey and Fuller, 1981), Phillips‒Perron (PP) (Phillips and Perron, 1988), and Kwiatkowski‒Phillips‒Schmidt‒Shin (KPSS) (Kwiatkowski et al., 1992) tests.

The following hypothesis was put forth in the research:

H_0: The growth in oil export leads to the increase of the import of food and agricultural products. The following equations were used to study the impact of oil export on food and agricultural products.

		Logarithmically	
FP=f(O)	(1)	*LnFP=β0+β1 LnO+ε*	(9)
Mt=f(O)	(2)	*LnMt=β0+β1 LnO+ε*	(10)
Mik=f(O)	(3)	*LnMik=β0+β1 LnO+ε*	(11)
B=f(O)	(4)	*LnB=β0+β1 LnO+ε*	(12)
FV=f(O)	(5)	*LnFV=β0+β1 LnO+ε*	(13)
W=f(O)	(6)	*LnW=β0+β1 LnO+ε*	(14)
V=f(O)	(7)	*LnV=β0+β1 LnO+ε*	(15)
T=f(O)	(8)	*LnT=β0+β1 LnO+ε*	(16)

3.4. ARDLBT (Autoregressive Distributed Lags Bounds Testing)

The equation (9‒16) as an initial step to evaluate the mutual relationships between variables in the long and short term was presented in ARDL model (Pesaran et al., 2001) Equations (18‒25)) as the following:

$$\Delta LnFP_t = \beta_0 + \sum_{i=1}^{p}\beta_{1i}\Delta LnFP_{t-1} + \sum_{i=0}^{p}\beta_{2i}\Delta LnO_{t-i} + \lambda_1 LnFP_{t-1} + \lambda_2 O_{t-1} + \varepsilon_t \quad (18)$$

$$\Delta LnMt_t = \beta_0 + \sum_{i=1}^{p}\beta_{1i}\Delta LnMt_{t-1} + \sum_{i=0}^{p}\beta_{2i}\Delta LnO_{t-i} + \lambda_1 LnMt_{t-1} + \lambda_2 O_{t-1} + \varepsilon_t \quad (19)$$

$$\Delta LnMik_t = \beta_0 + \sum_{i=1}^{p}\beta_{1i}\Delta LnMik_{t-1} + \sum_{i=0}^{p}\beta_{2i}\Delta LnO_{t-i} + \lambda_1 LnMik_{t-1} + \lambda_2 O_{t-1} + \varepsilon_t \quad (20)$$

$$\Delta LnB_t = \beta_0 + \sum_{i=1}^{p}\beta_{1i}\Delta LnB_{t-1} + \sum_{i=0}^{p}\beta_{2i}\Delta LnO_{t-i} + \lambda_1 LnB_{t-1} + \lambda_2 O + +\varepsilon_t \quad (21)$$

$$\Delta LnFV_t = \beta_0 + \sum_{i=1}^{p}\beta_{1i}\Delta LnFV_{t-1} + \sum_{i=0}^{p}\beta_{2i}\Delta LnO_{t-i} + \lambda_1 LnFV_{t-1} + \lambda_2 O_{t-1} + \varepsilon_t \quad (22)$$

$$\Delta LnW_t = \beta_0 + \sum_{i=1}^{p}\beta_{1i}\Delta LnW_{t-1} + \sum_{i=0}^{p}\beta_{2i}\Delta Ln_{t-i} + \lambda_1 LnW_{t-1} + \lambda_2 O_{t-1} + \varepsilon_t \quad (23)$$

$$\Delta LnV_t = \beta_0 + \sum_{i=1}^{p}\beta_{1i}\Delta LnV_{t-1} + \sum_{i=0}^{p}\beta_{2i}\Delta LnO_{t-i} + \lambda_1 LnV_{t-1} + \lambda_2 O + +\varepsilon_t \quad (24)$$

$$\Delta LnT_t = \beta_0 + \sum_{i=1}^{p}\beta_{1i}\Delta LnT_{t-1} + \sum_{i=0}^{p}\beta_{2i}\Delta LnO_{t-i} + \lambda_1 LnT_{t-1} + \lambda_2 O + +\varepsilon_t \quad (25)$$

Having established mutual relations, the next step will be to evaluate the short and long term relations among variables. ECM was used to evaluate short term dependency (26‒33):

ARDLBT check if there is any dependency among variables after establishing ECM. The cointegration method to check ARDL boundaries is used Wald (F‒stat) test to check the existence of long term cointegration test among selected variables. The mutual relation of cointegration is checked (H_0:λ_1=λ_2=0; H_1:$\lambda_1 \neq \lambda_2 \neq 0$). Alternative hypothesis means to have the cointegration mutual relations among variables. Based on F‒test statistics, there are 2 types of boundaries (upper and lower bound) (Pesaran et al., 2001).

$$\Delta LnFP_{tt} = \beta_0 + \sum_{i=1}^{p}\beta_{1i}\Delta LnFP_{t-1} + \sum_{i=0}^{p}\beta_{2i}\Delta LnO_{t-i} + \varphi_1 ECT_{t-1} + \varepsilon_t \quad (26)$$

$$\Delta LnMt_t = \beta_0 + \sum_{i=1}^{p}\beta_{1i}\Delta LnMt_{t-1} + \sum_{i=0}^{p}\beta_{2i}\Delta LnO_{t-i} + \varphi_2 ECT_{t-1} + \varepsilon_t \quad (27)$$

$$\Delta LnMik_t = \beta_0 + \sum_{i=1}^{p}\beta_{1i}\Delta LnMik_{t-1} + \sum_{i=0}^{p}\beta_{2i}\Delta LnO_{t-i} + \varphi_3 ECT_{t-1} + \varepsilon_t \quad (28)$$

$$\Delta LnB_t = \beta_0 + \sum_{i=1}^{p}\beta_{1i}\Delta LnB_{t-1} + \sum_{i=0}^{p}\beta_{2i}\Delta LnO_{t-i} + \varphi_4 ECT_{t-1} + \varepsilon_t \quad (29)$$

$$\Delta LnFV_t = \beta_0 + \sum_{i=1}^{p}\beta_{1i}\Delta LnFV_{t-1} + \sum_{i=0}^{p}\beta_{2i}\Delta LnO_{t-i} + \varphi_5 ECT_{t-1} + \varepsilon_t \quad (30)$$

$$\Delta LnW_t = \beta_0 + \sum_{i=1}^{p}\beta_{1i}\Delta LnW_{t-1} + \sum_{i=0}^{p}\beta_{2i}\Delta LnO_{t-i} + \varphi_6 ECT_{t-1} + \varepsilon_t \quad (31)$$

$$\Delta LnV_t = \beta_0 + \sum_{i=1}^{p}\beta_{1i}\Delta LnV_{t-1} + \sum_{i=0}^{p}\beta_{2i}\Delta LnO_{t-i} + \varphi_7 ECT_{t-1} + \varepsilon_t \quad (32)$$

$$\Delta LnT_t = \beta_0 + \sum_{i=1}^{p}\beta_{1i}\Delta LnT_{t-1} + \sum_{i=0}^{p}\beta_{2i}\Delta LnO_{t-i} + \varphi_8 ECT_{t-1} + \varepsilon_t \quad (33)$$

If the evaluation value of F‒test statistics is less than the lower bound, there is no significant long‒term mutual relations among variables. Otherwise, if F‒test exceeds the upper bound, there is a long term mutual relation. If the given statistics of F‒test are within accepted values, the outcomes are uncertain.

3.5. FMOLS, DOLS and CCR

Fully modified ordinary least squares (FMOLS) (Phillips and Hansen, 1990), Dynamic Ordinary Least Squares (DOLS) (Stock and Watson, 1993), Canonical Cointegrating Regression (CCR) (Park, 1992) and analysis of the results of Engle–Granger analysis (Engle and Granger, 1987) are very useful in the research process. Because reviewing the results several times through the ARDLBT co‒integration approach allows for a more reliable analysis. Engle–Granger and Phillips–Ouliaris (Phillips and Ouliaris, 1990) cointegration tests were used to test for all regression equations evaluated using FMOLS, DOLS, and CCR.

3.6. Engel‒Granger Cointegration Test

The Engel‒Granger (EG) cointegration test provides an opportunity to check the long‒term relations, research the short‒term relations as well as define the mutual relations among variables. The regression equation is evaluated for the variables in the first stage of the EG cointegration test. So, the following equations are given for two variables (equations (34‒41)):

Here, *β0, λ1*, are regression coefficiencies. *LnFP, LnMt, LnMik, LnB, LnFV, LnW, LnV, LnT* are dependent variables. LnO is free

$$LnFP_t = \beta 0 + \lambda_1 LnO_t + \varepsilon_t \quad (34)$$

$$LnMt_t = \beta 0 + \lambda_1 LnO_t + \varepsilon_t \quad (35)$$

$$LnMik_t = \beta 0 + \lambda_1 LnOt + \varepsilon_t \quad (36)$$

$$LnB_t = \beta 0 + \lambda_1 LnO_t + \varepsilon_t \quad (37)$$

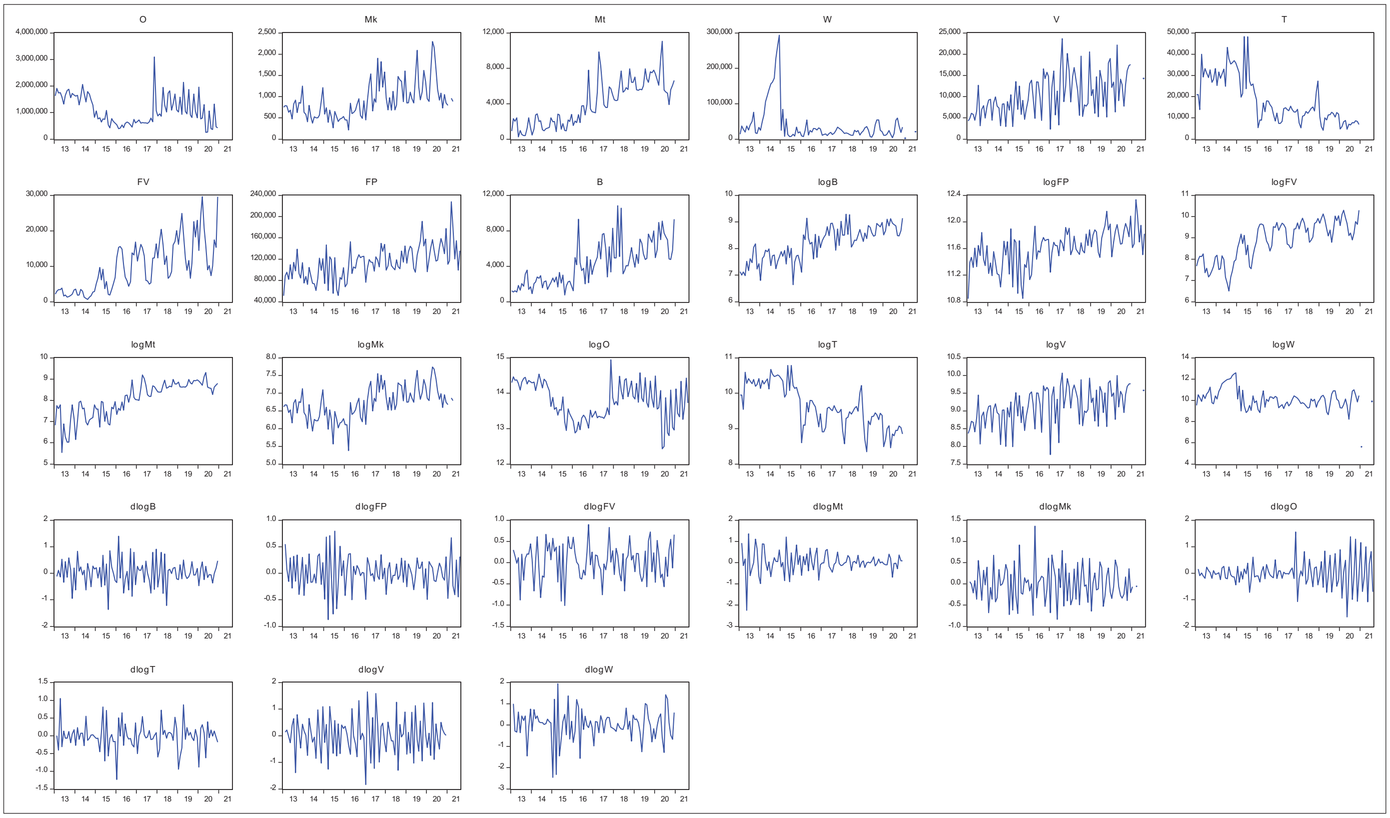
$$LnFV_t = \beta 0 + \lambda_1 LnO_t + \varepsilon_t \quad (38)$$

$$LnW_t = \beta 0 + \lambda_1 LnO_t + \varepsilon_t \quad (39)$$

$$LnV_t = \beta 0 + \lambda_1 LnO_t + \varepsilon_t \quad (40)$$

$$LnT_t = \beta 0 + \lambda_1 LnO_t + \varepsilon_t \quad (41)$$

Graph 1: Dynamics of indicators



coefficient. ε is white noise error, t is time. Having evaluated the regression equation, the reliability of white noise error is reviewed. If ε is stationary, there is the cointegration relation among variables and this is true. Reliant on them, these equations are long term equations (34–41). Finally, ECM is evaluated using stationary variables, periodical lag, and white noise error ($ECT_{(t-1)}$). These variables are used to check cause and effect relations, in other words, to define the direction of power and dependency (equation (26–33)).

Here, $\beta 0$, $\beta 1i$, $\beta 2i$ and $\varphi 1$, $\varphi 2$, $\varphi 3$, $\varphi 4$, $\varphi 5$, $\varphi 7$, $\varphi 8$ are coefficients. p – is the optimal lag and ε is the white noise error of the model. They define the mutual relations among variables. The regression equation is evaluated for variables in the first stage of the EG cointegration test. For example, if there is the cointegration relations, this dependency is evaluated. If the cointegration is stable, then ECT_{t-1} is negative in terms of statistical significance. This coefficient is usually between –1 and 0.

Using Equations 26–33, the following cause–and–effect relationships can be tested:

The Granger cause–and–effect relationship for the short run is evaluated using F-statistical or *Xi*-square statistical values by checking the statistical significance of the coefficients of all delayed first–order differences (all ΔLnO_{t-i}) together for each free variable (null hypothesis: H_0:β_{2i}=0,i=1…p). The rejection of the null hypothesis suggests that LnO have short–term effects on *LnFP, LnMt, LnMik, LnB, LnFV, LnW, LnV* and *LnT*.

Using the t test to check the Granger cause–and–effect relationship for the long run, the statistical significance of the coefficient ECT_{t-1} is checked. The null hypothesis for this (H_0: φ_1=0, φ_1=0, φ_3=0, φ_4=0, φ_5=0 və φ_6=0) needs to test. If, as a result, the null hypothesis is rejected, this long–run period shows that deviations from the equilibrium state have an effect on the dependent variable and will return to the equilibrium state over time.

The Granger cause–and–effect relationship for the short run is evaluated using F-statistical or -square statistical values by checking the statistical significance of the coefficients of all delayed first–order differences (all ΔL) together for each free variable (null hypothesis: :=0,i=1…p). The rejection of the null hypothesis suggests that LnO have short–term effects on LnFP,LnMt, LnMik, LnB, LnFV, LnW, LnV and LnT.

Using the t test to check the Granger cause–and–effect relationship for the long run, the statistical significance of the coefficient is checked. The null hypothesis for this (:=0, =0,=0,=0,=0 və =0) needs to test. If, as a result, the null hypothesis is rejected, this long–run period shows that deviations from the equilibrium state have an effect on the dependent variable and will return to the equilibrium state over time.

A strong cause–and–effect relationship is, in fact, both a short–term and a long–term and–effect relationship. In other words, using the F-statistic or *Xi*-square statistical values through the Wald test as a null hypothesis for each variable taken (H_0: β_{2i}=φ_1=0, i=1…p,; H_0:β_{2i}=φ_2=0,i=1…p,;

Table 2: Results of unified root tests

Model	Variable	ADF	PP	KPSS	Stationarity	Integrir I(0,1,2)
With Intercept only	At level form					
	LnO	−1.92	−6.33***	0.24	N/S	I(1)
	LnFP	−4.24***	−7.8 7***	1.18***	S	I(0), I(1)
	LnMt	−1.32	−2.95**	1.18***	N/S	I(1)
	LnB	−1.68	−4.18***	1.35***	N/S	I(0), I(1)
	LnMik	−3.28**	−4.88***	0.92***	S	I(0), I(1)
	LnFV	−2.16	−2.18	1.09***	N/S	I(1)
	LnW	−4.45***	−4.38***	0.50**	S	I(0), I(1)
	LnV	−2.18	−9.50***	1.35***	N/S	I(1)
	LnT	−2.94**	−2.62*	1.06***	S	I(0), I(1)
	At first differencing					
	ΔLnO	−19.28***	−26.29***	0.35*	S	I(0)
	ΔLnFP	−9.18***	−55.18***	0.21	S	I(0)
	ΔLnMt	−9.57***	−27.36***	0.21	S	I(0)
	ΔLnB	−8.65***	−46.48***	0.28	S	I(0)
	ΔLnMik	−8.90***	−31.87***	0.17	S	I(0)
	ΔLnFV	−9.80***	−9.80***	0.02	S	I(0)
	ΔLnW	−13.35***	−20.63***	0.30	S	I(0)
	ΔLnV	−11.29***	−58.23***	0.18	S	I(0)
	ΔLnT	−12.88***	−18.06***	0.19	S	I(0)
With intercept and trend	At level form					
	LnO	−1.68	−6.82***	0.17**	N/S	I(1)
	LnFP	−10.00***	−10.00***	0.05	S	I(0), I(1)
	LnMt	−6.17***	−6.12***	0.19**	S	I(0), I(1)
	LnB	−6.15***	−7.95***	0.12*	S	I(0), I(1)
	LnMik	−6.35***	−6.28***	0.15**	S	I(0), I(1)
	LnFV	−5.01***	−3.87***	0.15**	S	I(0), I(1)
	LnW	−4.85**	−4.72***	0.07	S	I(0), I(1)
	LnV	−11. 89***	−12.07***	0.09	S	I(0), I(1)
	LnT	−5.35***	−5.35***	0.09	S	I(0), I(1)
	At First differencing					
	ΔLnO	−19.28***	−28.87***	0.32***	S	I(0)
	ΔLnFP	−4.05**	−54.06***	0.12*	S	I(0)
	ΔLnMt	−7.12***	−25.72***	0.18**	S	I(0)
	ΔLnB	−8.62***	−50.87***	0.26***	S	I(0)
	ΔLnMik	−8.85***	−31.47***	0.17**	S	I(0)
	ΔLnFV	−9.82***	−9. 85***	0.02	S	I(0)
	ΔLnW	−13.27***	−20.55***	0.29***	S	I(0)
	ΔLnV	−11.23***	−57.95***	0.17**	S	I(0)
	ΔLnT	−12.82***	0.18	0.15**	S	I(0)
					S	I(0)
No Intercept & No Trend	At level form					
	LnO	−0.39	−0.51	N/A	N/S	I(1)
	LnFP	0.47	1.17	N/A	N/S	I(1)
	LnMt	0.96	1.18	N/A	N/S	I(1)
	LnB	1.05	1.65	N/A	N/S	I(1)
	LnMik	−0.02	−0.12	N/A	N/S	I(1)
	LnFV	0.45	0.47	N/A	N/S	I(1)
	LnW	−0.29	0.30	N/A	N/S	I(1)
	LnV	0.90	0.65	N/A	N/S	I(1)
	LnT	−0.52	−0.96	N/A	N/S	I(1)
	At first differencing					
	ΔLnO	−19.35***	−26.23***	N/A	S	I(0)
	ΔLnFP	−9.19***	−46.50***	N/A	S	I(0)
	ΔLnMt	−9.57***	−21.12***	N/A	S	I(0)
	ΔLnB	−8.57***	−29.52***	N/A	S	I(0)
	ΔLnMik	−8.95***	−31.88***	N/A	S	I(0)
	ΔLnFV	−9.82***	−9.82***	N/A	S	I(0)
	ΔLnW	−13.47***	−20. 87***	N/A	S	I(0)
	ΔLnV	−11.28***	−51.89***	N/A	S	I(0)
	ΔLnT	−12.95***	−17.63***	N/A	S	I(0)

ADF denotes the Augmented Dickey–Fuller single root system respectively. PP Phillips–Perron is single root system. KPSS denotes Kwiatkowski–Phillips–Schmidt–Shin single root system. ***, ** and *indicate rejection of the null hypotheses at the 1%, 5% and 10% significance levels respectively. The critical values are taken from MacKinnon (Mackinnon, 1996). Assessment period: 2013M01−2021M08. Legend: S–Stationarity; N/S–No Stationarity N/A–Not Applicable

Table 3: VAR Lag order selection criteria

	Lag	LogL	LR	FPE	AIC	SC	HQ
F_{LnFP}=(LnFP/LnO)	0	−85.30103	NA	0.021132	1.818771	1.872195	1.840366
	3	−27.65350	52.24321	0.008169	0.867781	1.241749*	1.018945*
	5	−17.98934	11.02638*	0.007902*	0.833111*	1.420774	1.070654
F_{LnMt}=(LnMt/LnO)	0	−164.3673	NA	0.150367	3.781076	3.837379	3.803759
	3	−69.17096	39.50614	0.022713	1.890249	2.284371*	2.049031
	5	−58.98365	7.118999	0.021654*	1.840538*	2.459872	2.090052
F_{LnMik}=(LnMik/LnO)	0	−127.5197	NA	0.062964	2.910554	2.966479	2.933096
	3	−64.33153	40.22916*	0.019944*	1.760259*	2.151730*	1.918050*
F_{LnB}=(LnB/LnO)	0	−143.3861	NA	0.093339	3.304230	3.360533	3.326913
	3	−73.12862	33.78256	0.024850	1.980196	2.374318*	2.138978
	5	−59.13796	15.32921*	0.021730*	1.844045*	2.463379	2.093559*
F_{LnFV}=(LnFV/LnO)	0	−177.9479	NA	0.204738	4.089726	4.146029	4.112409
	3	−69.60242	35.82479	0.022937	1.900055	2.294177*	2.058837
	4	−63.39046	11.15330	0.021829*	1.849783*	2.356511	2.053931*
F_{LnW}=(LnW/LnO)	0	−177.5934	NA	0.203095	4.081669	4.137972	4.104352
	3	−115.9314	34.17823*	0.065737	2.952985	3.347107*	3.111767*
	4	−111.2803	8.350672	0.064821*	2.938190*	3.444918	3.142338
F_{LnV}=(LnV/LnO)	0	−132.0429	NA	0.072127	3.046430	3.102733	3.069113
	3	−91.52189	34.13774	0.037747	2.398225	2.792346*	2.557006
	5	−78.86164	17.70575*	0.034020*	2.292310*	2.911644	2.541824*
F_{LnT}=(LnT/LnO)	0	−142.9711	NA	0.092462	3.294799	3.351102	3.317482
	3	−56.86761	35.22088	0.017172	1.610627	2.004749*	1.769409*
	4	−51.06005	10.42721*	0.016494*	1.569547*	2.076275	1.773695

*Indicates lag order selected by the criterion. AIC: Akaike information criterion, SC: Schwarz information criterion

Table 4: Models

Model 1	F_{LnFP}=(LnFP/LnO)	ARDL(1,0) C @TREND (AIC) (Automatic selection) Unrestricted Constant and Restricted Trend
Model 2	F_{LnFP}=(LnFP/LnO)	ARDL(1,0) C @TREND (SIC) (Automatic selection) Unrestricted Constant and Restricted Trend
Model 3	F_{LnMt}=(LnMt/LnO)	ARDL(1,0) C @TREND(AIC) (Automatic selection) Unrestricted Constant and Restricted Trend
Model 4	F_{LnMt}=(LnMt/LnO)	ARDL(1,0) C @TREND(SIC) (Automatic selection) Restricted Constant and No Trend
Model 5	F_{LnMik}=(LnMik/LnO)	ARDL(1,1) C @TREND(AIC) (Automatic selection) Unrestricted Constant and Unrestricted Trend
Model 6	F_{LnMik}=(LnMik/LnO)	ARDL(1,1) C @TREND(SIC) Unrestricted Constant and Restricted Trend
Model 7	F_{LnB}=(LnB/LnO)	ARDL(3,0) C @TREND(AIC) (Automatic selection) Unrestricted Constant and Restricted Trend
Model 8	F_{LnB}=(LnB/LnO)	ARDL(2,0) C @TREND(SIC) (Automatic selection) Unrestricted Constant and Restricted Trend
Model 9	F_{LnFV}=(LnFV/LnO)	ARDL(3,1) C @TREND (AIC) (Automatic selection) Unrestricted Constant and Unrestricted Trend
Model 10	F_{LnFV}=(LnFV/LnO)	ARDL(3,1) C @TREND(SIC) (Automatic selection) Unrestricted Constant and Unrestricted Trend
Model 11	F_{LnW}=(LnW/LnO)	ARDL(2,0) C @TREND (AIC) (Automatic selection) Restricted Constant and No Trend
Model 12	F_{LnW}=(LnW/LnO)	ARDL(1,0) C @TREND(SIC) (Automatic selection) Restricted Constant and No Trend
Model 13	F_{LnV}=(LnV/LnO)	ARDL(5,1) C @TREND (AIC) (Automatic selection) Unrestricted Constant and Restricted Trend
Model 14	F_{LnV}=(LnV/LnO)	ARDL(5,1) C @TREND(SIC) (Automatic selection) Restricted Constant and No Trend
Model 15	F_{LnT}=(LnT/LnO)	ARDL(1,0) C @TREND (AIC) (Automatic selection) Unrestricted Constant and Unrestricted Trend
Model 16	F_{LnT}=(LnT/LnO)	ARDL(1,0) C @TREND(SIC) (Automatic selection) Restricted Constant and No Trend

Table 5: Results from bound tests

Dependent variable	F–statistic	Significance								
		I(0) Bound				I(1) Bound				
		10%	5%	2.5%	1%	10%	5%	10%	5%	
Model 1	33.46***	4.05	4.68	5.3	6.1	4.49	5.15	5.83	6.73	Cointegration
Model 2	50.10***	4.05	4.68	5.3	6.1	4.49	5.15	5.83	6.73	Cointegration
Model 3	12.71***	4.05	4.68	5.3	6.1	4.49	5.15	5.83	6.73	Cointegration
Model 4	3.57*	3.02	3.62	4.18	4.94	3.51	4.16	4.79	5.58	Cointegration
Model 5	24.64***	5.59	6.56	7.46	8.74	6.26	7.3	8.27	9.63	Cointegration
Model 6	16.45***	4.05	4.68	5.3	6.1	4.49	5.15	5.83	6.73	Cointegration
Model 7	8.95***	4.05	4.68	5.3	6.1	4.49	5.15	5.83	6.73	Cointegration
Model 9	7.38***	4.05	4.68	5.3	6.1	4.49	5.15	5.83	6.73	Cointegration
Model 9	15.33***	5.59	6.56	7.46	8.74	6.26	7.3	8.27	9.63	Cointegration
Model 10	15.33***	5.59	6.56	7.46	8.74	6.26	7.3	8.27	9.63	Cointegration
Model 11	4.81**	3.02	3.62	4.18	4.94	3.51	4.16	4.79	5.58	Cointegration
Model 12	8.38***	3.02	3.62	4.18	4.94	3.51	4.16	4.79	5.58	Cointegration
Model 13	4.63*	4.05	4.68	5.3	6.1	4.49	5.15	5.83	6.73	Cointegration
Model 14	29.83***	3.02	3.62	4.18	4.94	3.51	4.16	4.79	5.58	Cointegration
Model 15	13.70***	4.05	4.68	5.3	6.1	4.49	5.15	5.83	6.73	Cointegration
Model 16	4.20**	3.02	3.62	4.18	4.94	3.51	4.16	4.79	5.58	Cointegration

Table 6: ARDL long run form and bounds test long run coefficients

	Variable	Coefficient		
		Levels Equation	Conditional Error Correction Regression	ECM Regression
Model 1	*LnO*	0.03	0.03	
	@TREND	0.01***	0.01***	0.01***
	C		10.72***	10.72***
	LnFP (−1)		−0.98***	
	CointEq(−1)			−0.98***
Model 2	*LnO*	0.03	0.03	
	@TREND		0.01***	0.01***
	C		10.72***	10.72***
	LnFP (−1)		−0.98***	
	CointEq(−1)			−0.98***
Model 3	*LnO*	0.08	0.05	
	@TREND	0.03***	0.01***	
	C		3.47**	3.4**
	LnMt (−1)		−0.59***	
	CointEq(−1)			−0.59***
Model 4	*LnO*	−0.05	−0.23	
	C	2.28	11.28	
	LnMt (−1)	−0.20***		
	CointEq(−1)			−0.20***
Model 5	*LnO*	0.20*	0.35*	
	@TREND	0.01***		0.01***
	C	1.33	1.33***	
	LnMik (−1)		−0.65***	
	Δ*LnO*		0.00	0.00
	CointEq(−1)			−0.65***
Model 6	*LnO*	0.35		
	@TREND	0.01***	0.01***	
	C		1.33	1.35***
	LnMik (−1)		−0.65***	
	LnO (−1)		0.20**	
	Δ*LnO*		0.00	0.00
	CointEq(−1)			−0.65***
Model 7	*LnO*	−0.70	−0.10	
	C	18.18*	2.65*	
	LnB (−1)		−0.14*	−0.14*
	Δ*LnB* (−1)		−0.54***	
	Δ*LnB* (−2)		−0.10	−0.10
	Δ*LnB* (−3)		−0.35**	−0.35**
	Δ*LnB* (−4)		−0.37***	−0.37***
	CointEq(−1)			−0.54***
Model 8	*LnO*	−0.09	−0.05	
	C		5.18***	5.19***
	@TREND	0.02***	0.01***	
	LnB (−1)		−0.60***	
	Δ*LnB* (−1)		−0.28**	−0.28**
	CointEq(−1)			−0.60***
Model 9	*LnO*	−0.39*	−0.17*	
	C		5.87***	5.87***
	@TREND		0.01***	0.01***
	LnFV (−1)		−0.45***	
	LnFV (−1)		0.20*	0.20*
	LnFV (−2)		0.37***	0.37***
	Δ*LnO*		0.03	0.03
	CointEq(−1)			−0.45***
Model 1−	*LnO*	−0.39*	−0.17*	
	C		5.87***	5.87***
	@TREND		0.01***	0.01***
	LnFV (−1)		−0.45***	
	LnFV (−1)		0.20*	0.20*
	LnFV (−2)		0.37***	0.37***
	Δ*LnO*		0.03	0.03
	CointEq(−1)			−0.45***
Model 11	*LnO*	0.70	0.2	
	C	0.45	0.15	
	LnW (−1)		−0.33***	
	LnW (−1)		−0.15	−0.15
	CointEq(−1)			−0.33***
Model 12	*LnO*	0.70*	0.28*	
	C	0.57	0.23	
	LnW (−1)		−0.39***	
	CointEq(−1)			−0.39***
Model 13	*LnO* (−1)	−0.10	−0.10	
	@TREND	0.01***	0.01**	
	C		11.06***	11.06***
	LnV (−1)		−1.08***	
	Δ*LnV* (−1)		−0.15	−0.15
	Δ*LnV* (−2)		−0.29	−0.29
	Δ*LnV* (−3)		−0.33*	−0.33*
	Δ*LnV* (−4)		−0.33**	−0.33**
	Δ*LnO*		0.09	0.09
	CointEq(−1)			−1.08***
Model 14	*LnO*(−1)	−0.18	−0.18	
	C	11.36***	11.18***	
	LnV (−1)		−0.98***	
	CointEq (−1)			−0.98***
Model 15	*LnO* (−1)		0.15	
	C		2.81*	2.81***
	@TREND		−0.01***	−0.01***
	LnT (−1)		−0.47***	
	Δ*LnO*		0.23*	0.23*
	Δ*LnO* (−1)		−0.05	−0.05
	Δ*LnO* (−2)		−0.05	−0.05
	Δ*LnO* (−3)		−0.29**	−0.29**
	CointEq(−1)			−0.47***
Model 16	*LnO*	0.63	0.18	
	C	0.95	0.20	
	LnT (−1)		−0.23***	
	CointEq(−1)			−0.23***

*P≤0.05, **P≤0.01, ***P≤0.001

$H_0{:}\beta_{2i}=\varphi_3=0, i=1\ldots p,$; $H_0{:}\beta_{2i}=\varphi_4=0, i=1\ldots p,$; $H_0{:}\beta_{2i}=\varphi_5=0, i=1\ldots p,$; $H_0{:}\beta 2i=\varphi_6=0, i=1\ldots p,$; $H_0{:}\beta_{2i}=\varphi_7=0, i=1\ldots p,$; $H_0{:}\beta_{2i}=\varphi_8=0, i=1\ldots p,$) hypotheses are tested.

3.7. Diagnostics

In this study, both the Breusch−Godfrey LM test (Breusch, 1978; Godfrey, 1978), (Breusch− Godfrey (BG) Test) the heteroscedasticity test, and the Breusch−Pagan−Godfrey test (Breusch and Pagan, 1979), as well as the Autoregressive Conditional Heteroskedasticity test (Bollerslev, 1986), test ARCH (Engle, 1982) and Ramsey RESET Test (Ramsey, 1969) (statistical) check the stability of the ARDL model. The J−B Normality test (Jarque et al., 1980, 1981, 1987) will be used to check the normal distribution of white noise error. The CUSUM and CUSUMSQ tests (Brown et al., 1975) are also used to investigate the stability of the ARDL model.

Table 7: ARDL model coefficients and error corr*ect*ion (short run) model coefficients

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16
ARDL model coefficients																
Δ*LnFP* (−1)	−0.49***	−0.49***														
LnFP	0.95***	0.95***														
Δ*LnMt* (−1)			−0.43***	−0.30***												
LnMt			0.70***	−0.03												
Δ*LnMik* (−1)					−0.48***	−0.48***										
LnMik					0.71***	0.71***										
Δ*LnB* (−1)							−0.54***	−0.51***								
LnB							0.29***	0.76***								
Δ*LnFV* (−1)									−0.19	−0.19						
LnFV									0.35***	0.35***						
ΔLnW (−1)											−0.38***	−0.38***				
LnW											0.45***	0.45***				
Δ*LnV* (−1)													−0.50	−0.50		
LnV													0.95	0.95		
ΔLnT (−1)															−0.39***	−0.33***
LnT															0.55***	0.23***
Δ*LnFP* (−1)	0.04	0.04	0.02	0.22***	0.07	0.07	−0.08	−0.05	0.05	0.05	0.19	0.19	−0.06	−0.06	0.09	0.10
LnFP	−0.05	−0.05	−0.04	0.08	−0.15*	−0.15*	0.08	0.00	0.06	0.06	−0.24	−0.24	0.19	0.19	−0.08	−0.08
C	−10.08***	−10.08***	−4.20**	−2.88	−2.34*	−2.34*	−3.48*	−5.56***	−3.35*	−3.35*	−1.15	−1.15	−11.44	−11.44	−4.78***	−1.29
@ TREND	−0.01***	−0.01***	−0.02***		−0.01***	−0.01***		−0.01***	−0.01**	−0.01**					0.01***	
Error corr*ect*ion (short run) model coefficients																
Δ*LnFP* (−1)	−0.10	−0.10														
Δ*LnMt* (−1)			−0.00	−0.18												
Δ*LnMik* (−1)					−0.17	−0.17										
Δ*LnB* (−1)							−0.47***	−0.37***								
Δ*LnFV* (−1)									0.18	0.18						
ΔLnW (−1)											−0.17	−0.17				
Δ*LnV* (−1)													−0.10	−0.10		

(Contd...)

Table 7: (*Continued*)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16
ΔLnT (−1)															−0.29**	−0.20*
ΔLnO	−0.00	−0.00	−0.06	−0.00	−0.08	−0.08	−0.07	−0.11	−0.00	−0.00	0.16	0.16	0.03	0.03	0.06	0.10
$ECT_{(-1)}$	−0.84***	−0.84***	−0.51***	−0.15	−0.51***	−0.51***	−0.19**	−0.51***	−0.31***	−0.31***	−0.38***	−0.38***	−0.90***	−0.90***	−0.09	−0.17**
C	−0.22***	−0.22***	−0.57***	0.01**	−0.23**	−0.239**	0.02	−0.35**	−0.36**	−0.36**	0.02	0.02	0.01	0.01	−0.02	−0.01
@TREND	0.00***	0.00***	0.01***		0.00**	0.00**		0.01***	0.01***	0.01***					0.00	

* P ≤0.05, ** P ≤0.01, *** P ≤0.001

4. RESULTS AND DISCUSSION

4.1. Unit Root Tests Results

According to ADF, with intercept only—LnFP, LnMik, LnB, LnW, LnT variables I(0), with intercept & Trend—LnFP, LnMt, LnMik, LnB, LnFV, LnW, LnV, LnT variables I(0) and No Intercept & No Trend—all variables I(1) (Table 2).

According to PP test, with intercept only—LnO, LnFP, LnMt, LnMik, LnB, LnW, LnV, LnT variables I(0), with intercept & trend—LnO, LnFP, LnMt, LnMik, LnB, LnW, LnV, LnT variables I(0) and No Intercept & No Trend—all variables I(1) (Table 2).

The ADF, PP, and KPSS unit root test evaluation results suggest that the ARDL method and the ARDL boundary − test approach can be used to evaluate the short−term and long−term associations between variables (Table 2).

4.2. VAR Lag Order Selection Criteria

In order to determine optimal lag for ARDL model, VAR Lag Order Selection Criteria was employed and we got the below–mentioned results. The models selection criterion used is AIC. The results of models selection criteria are reported in (Tables 3 and 4).

4.3. Cointegration Testing Results

The results of the ARDL boundary test are given in Table 5. In all ARDL equations (models) *F* test result indicates the existence of cointegration between the variables.

Table 5 shows whether there is a cointegration relationship between these variables. Thus, there is a long–term relationship. According to Narayan (2005), *F*-statistic is higher than upper bound at 5%.

4.4. ARDL Long Run and Short Run Results

Table 6 presents the results of the long−term and short−term approach of ARDL.

4.5. Diagnostic Test Results

The Table 7 presents the results of diagnostic tests ARDL models. The evaluation results of the Breusha – Godfrey (BG) method confirmed that our ARDL model had no problems with sequential correlation. The results of the Breusha−Pagan−Godfrey (BFG) and ARCH methods later confirmed that heteroscedasticity was not a problem. According to the Ramsey RESET test, that the model is well defined. The table shows the total amount of recursive balances (CUSUM) and the squares of recursive balances (CUSUMQ) indicating that the ARDL model is constant during the sampling period (CUSUM).

4.6. FMOLS, DOLS, CCR and Engle–Granger Analysis Results

FMOLS, DOLS, CCR cointegration methods and analysis of the results of Engle–Granger analysis are very useful in our study (Tables 8 and 9). This is because the revision of the results obtained with the ARDLBT co–integration approach with the application of these methods allows for a more reliable analysis.

Table 8: Diagnostic test results

	Normality Test (Jarque–Bera) JB	Ramsey RESET Test (t–statistic	Heteroskedasticity test ARCH χ2	Heteroskedasticity test Breusch−Pagan−Godfrey	Breusch–Godfrey serial correlation LM Test: χ2	R^2	D_W
(LM version)							
Model 1	1.867300	0.257083	1.402131	4.063713	0.795246	0.358981	1.990884
	0.393116	0.7977	0.2364	0.2547	0.6719		
Model 1	1.867300	0.257083	1.402131	4.063713	0.795246	0.358981	1.990884
	0.393116	0.7977	0.2364	0.2547	0.6719		
Model 3	3.665267	0.816164	0.905671	1.462568	0.768843	0.732568	1.910208
	0.000000	0.4166	0.3413	0.0022	0.6808		
Model 4	1.116222	2.290648	0.891774	4.894120	5.241096	0.659504	2.268945
	0.000000	0.0243	0.3450	0.0865	0.0728		
Model 5	0.434615	0.403954	0.044105	4.971649	1.771936	0.472847	2.013314
	0.804683	0.6872	0.8337	0.2902	0.4123		
Model 6	0.434615	0.403954	4.971649	0.044105	1.771936	0.462142	2.113314
	0.804683	0.6872	0.2902	0.8337	0.4123		
Model 7	1.114387	0.714370	0.747458	6.446091	3.492108	0.634883	1.907625
	0.003803	0.4769	0.3873	0.3751	0.1745		
Model 8	4.020680	0.585411	0.066655	7.476983	3.357947	0.659355	2.036887
	0.133943	0.5598	0.7963	0.1127	0.1866		
Model 9	0.858736	0.585411	1.360114	5.324917	1.406197	0.852026	2.087152
	0.650920	0.5598	0.2435	0.5029	0.4950		
Model 10	0.858736	0.585411	1.360114	5.324917	1.406197	0.852026	2.087152
	0.650920	0.5598	0.2435	0.5029	0.4950		
Model 11	1.638875	2.392392	1.020710	1.155421	0.626554	0.466349	1.970101
	0.440679	0.0188	0.0014	0.0091	0.7310		
Model 12	0.807231	2.474978	2.972761	1.096841	3.537110	0.450173	2.168140
	0.667901	0.0152	0.0000	0.0042	0.1706		
Model 13	4.725685	0.328056	1.300925	1.442494	0.810634	0.312865	1.928145
	0.094152	0.7436	0.2540	0.0713	0.6668		
Model 14	3.555068	0.642648	3.545865	3.161489	4.845777	0.028060	2.063144
	0.169054	0.5221	0.0597	0.2058	0.0887		
Model 15	1.184349	1.242403	0.000141	1.911141	1.588171	0.772167	2.071738
	0.002681	0.2173	0.9905	0.9646	0.4520		
Model 16	14.76624	1.242403	0.372738	0.509948	4.233207	0.678494	2.339801
	0.000622	0.2173	0.5415	0.7749	0.1204		

(F Version)

	Normality Test (Jarque–Bera) JB	Ramsey RESET Test (t–statistic	Heteroskedasticity test ARCH χ2	Heteroskedasticity test Breusch−Pagan−Godfrey	Breusch–Godfrey Serial Correlation LM Test: χ2	CUSUM –5%– Significance	CUSUM Squares–5%– Significance
Model 1	N/A	0.066092	1.393798	1.355443	0.377374	STB	NO/STB
	N/A	0.7977	0.2406	0.2609	0.6867		
Model 1	N/A	0.066092	1.393798	1.355443	0.377374	STB	NO/STB
	N/A	0.7977	0.2406	0.2609	0.6867		
Model 3	N/A	0.666123	0.895025	5.519744	0.363080	NO/STB	NO/STB
	N/A	0.4166	0.3466	0.0016	0.6966		
Model 4	N/A	5.247067	0.881160	2.498500	2.627587	NO/STB	NO/STB
	N/A	0.0243	0.3503	0.0878	0.0778		
Model 5	N/A	0.163179	0.043196	1.242529	0.837328	STB	STB
	N/A	0.6872	0.043196	0.2985	0.4362		
Model 6	N/A	0.403954	1.242529	0.043196	0.837328	STB	STB
	N/A	0.6872	0.2985	0.8358	0.4362		
Model 7	N/A	0.510325	0.736968	1.067310	1.636154	NO/STB	NO/STB
	N/A	0.4769	0.3930	0.3887	0.2010		
Model 8	N/A	0.342706	0.065268	1.922759	1.611512	STB	NO/STB
	N/A	0.5598	0.7989	0.1136	0.2055		
Model 9	N/A	0.342706	1.350512	0.870530	0.644806	STB	STB
	N/A	0.5598	0.2483	0.5200	0.5273		
Model 10	N/A	0.342706	1.350512	0.870530	0.644806	STB	STB
	N/A	0.5598	0.2483	0.5200	0.5273		
Model 11	N/A	5.723538	1.121891	4.204292	0.295249	STB	STB
	N/A	0.0188	0.0012	0.0078	0.7451		
Model 12	N/A	6.125517	4.255234	6.004253	1.740268	STB	NO/STB
	N/A	0.0152	0.0000	0.0035	0.1813		

(Contd...)

Table 8: (*Continued*)

	Normality Test (Jarque–Bera) JB	Ramsey RESET Test (t–statistic	Heteroskedasticity test ARCH χ2	Heteroskedasticity test Breusch–Pagan–Godfrey	Breusch–Godfrey serial correlation LM Test: χ2	R^2	D_W
Model 13	N/A	0.107621	1.290672	1.930859	0.359525	STB	STB
	N/A	0.7436	0.2590	0.0662	0.6991		
Model 14	N/A	0.412997	3.606464	1.583524	2.418744	NO/STB	STB
	N/A	0.5221	0.0607	0.2108	0.0948		
Model 15	N/A	1.242403	0.000138	0.254568	0.720205	STB	STB
	N/A	0.2173	0.9907	0.9694	0.4897		
Model 16	N/A	1.543566	0.366260	0.248255	2.098723	NO/STB	STB
	N/A	0.2173	0.5465	0.7807	0.1286		

N/A: Not applicable

Table 9: FMOLS, DOLS, CCR results

		ect						
		ADF / PP/ KPSS			Cointegration Test –			
		Constant	Constant, Linear Trend	None	Engle–Granger		Phillips–Ouliaris	
					tau–statistic	z–statistic	tau–statistic	z–statistic
Fully modified least squares (FMOLS) Model 1−2								
LnO	–0.07	–1.87/	–9.28***/	–7.62*/	–1.90	–8.71	–7.52***	–77.40***
C	12.63***	–7.59***//	– 9.29***/	–1.89*/	0.57	0.42	0.00	0.00
		1.03***	0.12*	N/A				
Dynamic least squares (DOLS) Model 1 −2								
LnO	–0.07	–4.19***/	–9.10***/	4.22***	–1.90	–8.71	–7.52***	–77.40***
C	12.53***	–7.35***//	–9.10***/	–7.37***/	0.57	0.42	0.00	0.00
		1.01***/	0.13*/	N/A				
Canonical cointegrating regression (CCR) Model 1 −2								
LnO	–0.07	–1.87/	–9.24***/	–1.88*/	–1.90	–8.71	–7.52***	–77.40***
C	12.63***	–7.57***/	–9.28***/	–7.62***/	0.57	0.42	0.00	0.00
		1.03***	0.12*	N/A				
Fully modified least squares (FMOLS) Model 3 −4								
LnO	–0.45	–1.57/	–5.98***/	–1.51/	–1.28	–2.89	–3.18	–17.18
C	14.40***	–3.10**/	–5.94***/	–3.12***/	0.83	0.88	0.07	0.08
		1.04***	0.14**	N/A				
Dynamic least squares (DOLS) Model 3 −4								
LnO	–0.45	–3.11**/	–5.61***/	–3.13***/	–1.28	–2.89	–3.18	–17.18
C	14.72***	–2.76*/	–5.57***/	–2.88***/	0.83	0.88	0.07	0.08
		1.05***	0.14*	N/A				
Canonical cointegrating regression (CCR) Model 3 −4								
LnO	–0.45	–1.57/	–5.96***/	–1.57/	–1.28	–2.89	–3.18	–17.18
C	14.72***	–3.19**/	–5.92***/	–3.23***//	0.83	0.88	0.07	0.08
		1.03***	0.14**	N/A				
Fully Modified Least Squares (FMOLS) Model −5 −6								
LnO	0.04	–3.28**/	–6.51***/	–3.28***/	–3.36	–22.45*	–4.95***	–38.11***
C	6.09**	–4.92***/	–6.52***/	–4.97***/	0.06	0.02	0.00	0.00
		0.94***	0.13*	N/A				
Dynamic Least Squares (DOLS) Model −5 −6								
LnO	0.06	–3.23**/	–6.51***/	–3.23***/	–3.36	–22.45*	–4.95	–38.11***
C	5.84**	–4.89***/	–6.57***/	–4.88 ***/	0.06	0.02	0.00	0.00
		0.98***	0.12*	N/A				
Canonical Cointegrating Regression (CCR) Model −5 −6								
LnO	0.05	–3.28**/	–6.51***/	–3.28***/	–3.36	–22.45*	–4.95***	–38.11***
C	6.00**	–4.95***/	–6.53***/	–4.95***/	0.06	0.02	0.00	0.00
		0.95***	0.12*	N/A				
Fully Modified Least Squares (FMOLS) Model 7 −8								
LnO	–0.41**	–2.88 */	–4.28 ***/	–2.83***/	–2.65	–13.62	–4.39***	–29.35***
C	13.96***	–4.57***/	–8.52***/	–4.49***/	0.21	0.17	0.00	0.00
		1.18***	0.12*	N/A				
Dynamic least squares (DOLS) Model 7 −8								
LnO	–0.41*	–2.51/	–3.95**/	–2.57**/	–2.65	–13.62	–4.39***	–29.35***
C	13.95***	–4.01***/	–7.36***/	–4.05***/	0.21	0.17	0.00	0.00
		1.19***	0.13*	N/A				
Canonical Cointegrating Regression (CCR) Model 7 −8								

(Contd...)

Table 9: (*Continued*)

		ect ADF / PP/ KPSS			Cointegration Test –			
		Constant	Constant, Linear Trend	None	Engle–Granger		Phillips–Ouliaris	
					tau–statistic	z–statistic	tau–statistic	z–statistic
LnO	–0.45*	–2.88 */	–4.37***/	–2.89***/	–2.65	–13.62	–4.39***	–29.35***
C	14.22***	–4.38***/	–7.3 7***/	–4.52***/	0.21	0.17	0.00	0.00
		1.17***	0.12*	N/A				
Fully modified least squares (FMOLS) Model −9−10								
LnO	–0.80**	–3.37**/	–5.10***/	–3.50***/	–3.11	–17.83	–3.05	–16.94
C	13.96***	–3.37**/	–5.15***/	–3.39***/	0.09	0.08	0.10	0.08
		1.08***	0.11	N/A				
Dynamic least squares (DOLS) Model −9−10								
LnO	–0.82*	–2.39/	–5.45***/	–2.35**/	–3.11	–17.83	–3.05	–16.94
C	20.28***	–2.39***/	–3.90**/	–2.35**/	0.09	0.08	0.10	0.08
		1.08***	0.10	N/A				
Canonical cointegrating regression (CCR) Model −9−10								
LnO	–0.85***	–3.57***/	–5.16***/	–3.60***/	–3.11	–17.83	–3.05	–16.94
C	20.53***	–3.38**/	–5.28***/	–3.50***/	0.09	0.08	0.10	0.08
		1.06***	0.11*	N/A				
Fully modified least squares (FMOLS) Model −`11−12								
LnO	–0.64**	–4.97***/	–5.12***/	–4.99***/	– 5.04***	– 40.39***	– 5.04***	– 39.81***
C	1.28	–4.97***/	–5.12***/	–4.99***/	0.00	0.00	0.00	0.00
		0.45**	0.06	N/A				
Dynamic least squares (DOLS) Model −`11−12								
LnO	0.72**	–4.85***/	–5.019***/	–4.86***/	– 5.04***	– 40.39***	– 5.04***	– 39.81
C	–0.85	–4.70***/	–4.88***/	–4.71***/	0.00	0.00	0.00	0.00
		0.45***	0.06	N/A				
Canonical cointegrating regression (CCR) Model −`11−12								
LnO	0.65*	–4.98***/	–5.14***/	–5.00***/	– 5.04***	– 40.39***	– 5.04***	– 39.81***
C	1.11	–4.98***/	–5.14***/	–5.00***/	0.00	0.00	0.00	0.00
		0.45*	0.06	N/A				
Fully Modified Least Squares (FMOLS) Model −`13−14								
LnO	–0.28*	–9.99***/	–11.72***/	–10.05***/	–9.87***	–96.35***	–9.92***	–102.65
C	12.71	–10.02***/	–11.94***/	–10.06***/	0.00	0.00	0.00	0.00
		1.29***	0.07	N/A				
Dynamic least squares (DOLS) −`13−14								
LnO	–0.28*	–9.92***/	–11.70***/	–9.98***/	–9.87***	–96.35***	–9.92***	–102.65***
C	12.86	–9.92***/	–12.02***/	–9.98***/	0.00	0.00	0.00	0.00
		1.36***	0.07	N/A				
Canonical cointegrating regression (CCR) Model −`13−14								
LnO	–0.28*	–10.01***/	–10.06***/	–10.03***/	–9.87***	–96.35***	–9.92***	–102.65***
C	12.98	–10.03***/	–11.81***/	–10.08***/	0.00	0.00	0.00	0.00
		1.28***	0.07	N/A				
Fully modified least squares (FMOLS) Model −15 −16								
LnO	0.53***	–2.70*/	–6.04***/	–2.71***/	–2.53	–13.86	–3.50*	–21.23*
C	2.17	–3.82***/	–6.09***/	–3.87***/	0.28	0.12	0.03	0.03
		1.09***	0.13	N/A				
Dynamic least squares (DOLS) Model −15 −16								
LnO	0.51**	–2.82*/	–6.05***/	–2.83***/	–2.53	–13.86	–3.50*	–21.23*
C	1.72	–3.92***/	–6.10***/	–3.92***/	0.28	0.12	0.03	0.03
		1.08***	0.14*	N/A				
Canonical cointegrating regression (CCR) Model −15 −16								
LnO	0.52**	–3.29**/	–5.65***/	–3.36***/	–2.53	–13.86	–3.50*	–21.23
C	1.51	–3.12***/	–5.65***/	–3.14***/	0.28	0.12	0.03	0.03
		1.10***	0.12*	N/A				

Another feature that indicates a cointegration relationship between the variables is that the white noise errors obtaine from the estimates are stationary. Table 8 shows the results of the stationary test by applying single root tests ADF, PP and KPSS on the white noise error of each long-run equation evaluated by FMOLS, DOLS and CCR. In general, white noise errors are stationary. Based on these results, the fact that white noise errors are stationary in all models and thus the existence of a cointegration relationship is once again confirmed. This result does support the results of the Engle-Granger and Phillips-Ouliaris cointegration tests given above.

Short-term and long-term cause-and-effect relationships can be more clearly analyzed using the Granger cause-and-effect relationship using the Engle-Granger cointegration method. It has

Table 10: Granger cause−and−effect analysis evaluation results. Wald Test

	Short−term period		Long−term period		Strong impact	
	$\Delta LGDP$		ECT_{-1}		ECT_{-1} and $\Delta LGDP$	
	Chi–sq.	F–st.	t–st.	Chi–sq.	Chi–sq.	F–st.
Model 1	0.01 (0.92)	0.01 (0.92)	–6.11*** (0.00)	37.35*** (0.00)	18.98*** (0.00)	37.97*** (0.00)
Model 2	0.01 (0.92)	0.01 (0.92)	–6.11*** (0.00)	37.35*** (0.00)	18.98*** (0.00)	37.97*** (0.00)
Model 3	0.47 (0.49)	0.47 (0.50)	–4.85*** (0.00)	23.50*** (0.00)	11.87*** (0.00)	23.52*** (0.00)
Model 4	0.01 (0.94)	0.01 (0.94)	–2.41*** (0.02)	5.83*** (0.02)	2.93*** (0.06)	5.87*** (0.05)
Model 5	1.41 0.23)	1.41 (0.23)	–4.64*** (0.00)	21.53*** (0.00)	21.53*** (0.00)	10.87*** (0.000)
Model 6	1.41 (0.23)	1.41 (0.23)	–4.64*** (0.00)	21.53*** (0.00)	21.53*** (0.00)	10.87*** (0.000)
Model 7	1.88 (0.17)	1.88 (0.17)	–4.33*** (0.00)	18.75*** (0.00)	9.51*** (0.00)	19.09*** (0.00)
Model 8	1.88 (0.17)	1.88 (0.17)	–4.33*** (0.00)	18.75*** (0.00)	9.51*** (0.00)	19.09*** (0.00)
Model 9	0.00 (0.95)	0.00 (0.95)	–4.07*** (0.00)	16.57*** (0.00)	9.03*** (0.00)	18.07*** (0.00)
Model 10	0.00 (0.95)	0.00 (0.95)	–4.07*** (0.00)	16.57*** (0.00)	9.03*** (0.00)	18.07*** (0.00)
Model 11	1.37 (0.22)	1.37 (0.22)	–3.89*** (0.00)	15.20*** (0.00)	15.57*** (0.00)	7.18*** (0.00)
Model 12	1.37 (0.22)	1.37 (0.22)	–3.89*** (0.00)	15.20*** (0.00)	15.57*** (0.00)	7.18*** (0.00)
Model 13	0.03 (0.85)	–0.18 (0.85)	–8.36*** (0.00)	68.38***0022)	70.42*** (0.00)	35.81*** (0.00)
Model 14	0.08 (0.97)	0.08 (0.97)	–6.15*** (0.22)	37.88*** (0.00)	39.62*** (0.00)	19.81*** (0.00)
Model 15	0.92 (0.39)	0.92 (0.39)	–1.22*** (0.00)	1.50 (0.22)	2.38 (0.30)	1.19 (0.30)
Model 16	1.02 (0.30)	1.05 (0.30)	0.47 (0.63)	0.22 (0.63)	1.10 (0.57)	0.57 (0.57)9
ADF unit root test						
–1.90 –1.28	–3.28**	–2.62*	–9.82***	–3.09**	–5.18***	–9.82***
–9.65*** –5.95***	–6.37***	–4.47***	–11.97***	–4. 87***	–5.28***	–11.987***
–1.90* –1.28	–3.30***	–2.65***	–9.87***	–3.11***	–5.18***	–9.87***

Note: ***, ** and *indicate rejection of the null hypotheses at the 1%, 5% and 10% significance levels respectively

been confirmed that there is a long-term relationship and a strong cause-and-effect relationship between the variables (Table 9).

5. CONCLUSION AND POLICY IMPLICATIONS

The main export of our Republic is oil while food and agricultural product are among the imported items. The research studied the impact of crude oil on meat, butter, milk, tobacco, fruit, wheat, plant and animal fats, and oil. Since the internal market heavily depends on export and world prices, the state policy to diversify and stimulate the market should be of paramount importance. The research reveals that oil export positively affects food and agricultural products in a long term. Besides, the positive ratio between oil export and the import of food and agricultural products is evidence of importance for the development of the non-oil sector in Azerbaijan, especially agriculture. However, oil fluctuation in the world market (decreasing the price) caused the downsizing trend of Azerbaijan oil export in value. In turn, it negatively affected food and agricultural products. On the one hand, it causes food shortage in the market, on the other hand, it thrives economy to boost to find alternative ways to replace imports. But we must not forget that the accumulated problems in Azerbaijan's agriculture over the past decade require a systematic, integrated approach to their solution (Nazaraliev, 2018).

The latest events prove the significance of our research. It is noteworthy to mention that either pandemia or the war between Russia and Ukraine negatively affect food safety both in Azerbaijan and in the world. To curb the problem before it bursts, The Cabinet of Ministers announced a decree "On measures to regulate the export of a number of basic foodstuffs included in the minimum consumer basket and goods used in their production." It aims to monitor the export or sales of goods to another country until the end of the current year. The government started to take full control of the whole process since the prices are getting to rise and designed an anti-inflation action plan and review system in the country. The government's decisions on the inflation and protection of the domestic market are a manifestation of this.

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