FACTORS EVALUATION AFFECTING SUNFLOWER OIL PRICES IN UKRAINE

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Abstract

In the article were evaluated factors that influence on Ukrainian sunflower oil prices. There was made price analysis, where domestic sunflower seed prices and European sunflower oil prices were taken into account. The research results showed that nowadays the sunflower oil production increased twofold compare to 2010. It could be explained by using modern processing technologies and growth demand for vegetable oils on the world market. Thus, it leads to increase Ukrainian export of sunflower oil more than twofold worldwide in 2021. Our research has shown Granger causality between the series of Ukrainian sunflower oil and European sunflower oil using VAR modeling. Indeed, European sunflower oil prices Granger-causes Ukrainian sunflower oil price at 0.01 significance level. In turn, it means that the past changes in European sunflower oil prices make it possible to forecast current changes of Ukrainian sunflower oil prices. Opposite interactions are also significant. However, there was not confirmed causality between the series of Ukrainian sunflower oil and Ukrainian sunflower seed. The absence of causality between Ukrainian sunflower oil and Ukrainian sunflower seeds could be explained due to the fact that sunflower seed prices domestically more influenced by the conjucture formed at vegetable oil market and not vice versa.

Key words: *sunflower oil, sunflower seeds, market, price analysis, VAR modeling, linkage*

INTRODUCTION

Sunflower oil production is one of the important branches of the agricultural complex in Ukraine. The main its competitive advantages include innovative technologies of enterprises, developed infrastructure of the industry, elevator logistics and sea ports [1]. All these factors contributed to the increase in production in the country and enhance export capacities of sunflower oil. Prior to COVID-19, the domestic market was relatively stable; the oil producers used a price leadership strategy and a differentiation strategy. One of the areas of implementation of the differentiation strategy in both domestic and foreign markets was the production of unique products (the high oleic oil, organic sunflower oil and produced sunflower oil using environmentally friendly technologies) [14]. In recent years, the oil industry companies have been operating under quarantine restrictions related to COVID-19 pandemic

and the influence of the price situation in the world and domestic markets [2; 9].

In 2021, the world market showed low dynamics of supply of sunflower oil due to poor yields of sunflower seeds in the Black Sea producers. The 2020-2021 harvest in Ukraine, Romania, Bulgaria and Moldova was restrained by arid conditions during the growing season, resulting in lower yields and oil content in the seeds [13]. At the same time, there is forecasted until 2030 a further increase in prices for oilseeds (sunflower, rapeseed) in the European market in accordance with growing demand [4].

In the domestic market in 2020/21 MY, there was an increase in oil prices, which was due to a sharp rise in commodity prices and its deficit. The cost of growing sunflower seeds was about $250-280, but selling price of seeds was getting to $350-360. So it leaded to price change of sunflower oil in during the season to $950-980. In Ukrainian market, there was a restraint in the sale of sunflower seeds by agricultural producers and a failure to supply

this raw material under previously concluded forward contracts with processing enterprises [16]. Thereby, sunflower oil producers were forced to buy seeds at the rising price. At the same time, the supply of sunflower oil for export under previously concluded forward contracts was carried out at lower prices than supplied to the domestic market in some periods.

At the beginning of 2022, Ukrainian and foreign analysts predicted a significant increase in sunflower oil production in Ukraine (over 7.2 million tons). This was primarily due to the level of sunflower seed harvest in Ukraine in 2021, which amounted to 16.5 million tons that is higher on 20% compare to 2020. Active supply was in line with growing demand as global economic growth resumed after the COVID-19 crisis. The opening of hotels, restaurants and catering establishments has been favorable for sunflower oil demand [17].

Ukrainian sunflower oil market is integrated to the world market that is emphasized by its export orientation. The market integration analysis is covered in many articles. Agricultural producers, processing enterprises and traders are concerned about the price shocks of different markets [5]. This interest is connecting with the development trade in agricultural commodities on financial markets.

Traditionally, market integration is characterized by the level of price transfer between vertical or spatial markets. Hamulczuk et al. observed the integration of the agricultural market between the Ukrainian (UA) and European (EU) markets. The results show a direct and indirect integration of these markets through the physical trade flows of rapeseed, cake and oil, which indicates that Ukrainian and European rapeseed prices are integrated [8].

The existence of integration between the sunflower oil markets in Ukraine, the European Union and United States was researched by Kuts and Makarchuk, where their findings provided evidence of high price transmission between the UA and EU markets, conversely lower price transmission was observed between the UA and US [11].

Undoubtedly, the formation of prices for vegetable oils, including sunflower oil, will be affected by rising energy prices and demand for biofuels purposes.

Many researchers indicate the following trends in the sunflower oil market in Ukraine over the past 10 years: growing demand for sunflower oil worldwide; and increase in production and export of sunflower oil, which is determined by favourable price conjuncture on the vegetable oil market [14].

In such circumstances, we can observe a stable demand for sunflower seeds from processing plants. Indeed, special attention in the article will be paid to the price analysis of UA sunflower oil market with UA domestic sunflowerseed and EU sunflower oil markets. Getting linkages gives possibilities to conclude which factors are dominating in UA sunflower oil price changes and therefore influence on its competitiveness worldwide since approximately 90% goes for export. The evaluation of factors influencing sunflower oil prices in Ukraine was taken into account in the paper because it is actual subject in terms of narrow connection the market from domestic factors as well as foreign market.

The paper is constructed as follows: Section 2 highlights the main materials and empirical investigation methods; Section 3 consist the results and discussions; and Section 4 shows the conclusions of research.

MATERIALS AND METHODS

The aim of this paper is to study the possible linkage between domestic sunflower oil prices and European sunflower oil market; and evaluation of domestic sunflower oil prices and domestic sunflower seeds prices. On one hand the sunflower oil market is high integrated to the world market, it highlighted the fact that Ukraine exports 90% of sunflower oil, where approximately 56% of UA sunflower oil consists in the world export. Therefore, there is expected to be close connection between markets. On the other hand, UA sunflower seed as a domestic factor could influence on sunflower oil prices due its high share (approximately 70%) in production cost. In these regards, we will consider which

factors (internal or external) leads to fluctuations of UA sunflower oil price.

In the article is used weekly series from January 2021 to January 2022 that was taken from the source of APK inform to analyze the linkage between Ukrainian sunflower oil prices and European sunflower oil prices; Ukrainian sunflower oil prices and Ukrainian sunflower seeds prices. All prices are expressed in US dollar per tonne. Figure 1 shows price series that were mentioned in the period from January 2021 to January 2022.
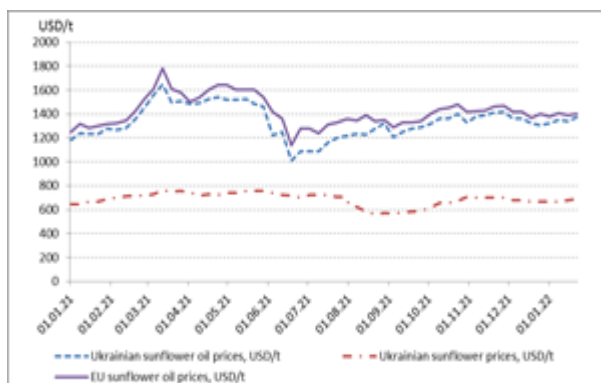

Figure 1. UA sunflower oil prices (USD/tonne), UA sunflower seeds prices (USD/tonne) and EU sunflower oil prices (USD/tonne)
Source: Built based on APK-inform data [2].

From Fig. 1 we can see the prices show how UA sunflower oil prices are close follow EU sunflower oil prices. There is observed also UA sunflower seeds prices repeat fluctuations of UA sunflower oil prices. However, in some period of time could be not stable paths, i.e. from August 2021 to October 2021 was observed decrease in UA sunflower seeds prices and at the same time favorable situation on the world market of sunflower oil leads to increase UA sunflower oil prices.

In Fig. 1 we can see how the UA sunflower oil prices are close to the prices of sunflower oil in the EU. There is also a recurrence of fluctuations in sunflower oil prices in Ukraine. However, in some period of time there may have been an unstable path, i.e. from August 2021 to October 2021 there was a decrease in prices for sunflower seeds in Ukraine, and at the same time a favorable situation on the world market of sunflower oil lead to higher prices for sunflower oil in Ukraine.

To evaluate the closeness of price relationship between UA sunflower oil and EU sunflower oil, UA sunflower oil and UA sunflower seed several methods were used. In order to test stationarity of each series the Augmented Dickey-Fuller unit root test (ADF) was used. The null hypothesis of this test is that time series are not stationary, i.e. has unit root. Opposite to the null hypothesis, alternative states that time series are stationary. ADF test is based on tau-statistics of coefficient φ from OLS estimation. There is used the following formula [3]:

$$\Delta y_t = \alpha_t + \varphi y_{t-1} + \sum_{i=1}^{p} \delta_i \Delta y_{t-i} + \varepsilon_t \quad (1)$$

where: y_t – the analyzed price rows; α_t – deterministic term (constant, trend); p – number of lags that ensure white noise properties of random component;
ε_t, δ_i – coefficients that describe the short-run persistence of Δy_t.

In the case of a linear combination of time series is stationary I(0) then non-stationary of time series are co-integrated. Thus, the Engle-Granger cointegration test (E-G) was applied to check the existence of long-term relationship between series that is based on the regression [3]:

$$y_t = \beta_0 + \beta_1 t + \beta_2 x_t + \varepsilon_t \quad (2)$$

where:
x_t, y_t – variables tested for existence of cointegration; β_0, β_1, β_2 – structural parameters; ε_t – residuals.

When the residuals ε_t are stationary, there is could be conclude about existence of co-integration between variables x_t and y_t.

Next step of the analysis was performed using a Vector Autoregressive Model (VAR). The VAR model has the following form [6]:

$$x_t = A^0 d_t + \sum_{i=1}^{r} A_i x_{t-i} + e_t, \quad (3)$$

where: $x_t = x_{1t},.....x_{mt}{}^T$ is a vector of observation on the current values of the variables; $d_t = d_{ot},.....d_{kt}{}^T$ – is a vector $k + 1$ of deterministic components of equation; A_0 – is a matrix of parameters in the d_t, vector variables; A_i – is a matrix of parameters in the delayed variables of a vector x_t, where maximum lag order is equal to r; $\varepsilon_t =$

$\varepsilon_{1t}, \ldots \varepsilon_{mt}{}^{T}$ – vectors of the model equation residuals [3].

Vector of the model equation residuals should satisfy assumption (zero mean, constant variance, absence of autocorrelation), while covariance between residuals of the individual equations can be different from zero. The lag order (r) was chosen using AIC criterion.

RESULTS AND DISCUSSIONS

Market analysis of Ukrainian sunflower oil.
Sunflower oil production in Ukraine is very dynamic develop and profitable agricultural sector. Enterprises for the production of sunflower oil are strategically important for national economy because traditionally UA population consume sunflower oil, thus it is one of important product for food safety. However, in average 10% of produced sunflower oil consume domestically and the rest of it goes for the export. In this context UA is one of the leaders in the processing and exporting of sunflower oil worldwide.

Until 1999 UA exported only sunflower seeds and from early 2000s began to process it inside the country. In this regard policy regulation was played a crucial role. According to the Law of Ukraine "On export rates (export) duties on seeds of certain types of oilseeds cultures" that was enforced from 10.09.1999 (No. 1033-XI) in 1999 there was introduced export duty for sunflower seeds in the amount 23% from the customs value. Indeed, the rates of export duty on sunflower seeds in 2001 were decreased to 17% in accordance with the amendments to this law. When Ukraine entered to the World Trade Organization (WTO) in 2008, the country committed from 2013 decrease annually export duty by 1% to reach the amount of 10% that exists now [12].

Such measures allowed to reorient the structure of exports of oil and fat complex from raw materials to final food products and make Ukraine a world leader in the production and export of sunflower oil.

According to the Deep and Comprehensive Free Trade Area (DCFTA), Ukraine has agreed to reduce the export duty on sunflower seeds to all EU member states to zero by 2027. For

other countries, the requirements adopted by Ukraine upon accession to the WTO in 2008 apply, in particular the reduction of export duties on sunflower seeds to 10%, no additional reduction under WTO conditions is required.

Thus, the development trends of UA oil and fat complex demonstrate a fairly deep integration into the world trade space, which allows our country to influence the world market situation in this segment and increase the export potential of sunflower oil.

Dynamics of UA sunflower oil production demonstrates that UA share in the world sunflower oil production is high and in 2021/2022 was equaled to 33%. As we can see the share of UA export of sunflower oil in the world export was approximately 50% over the last years (Fig. 2).
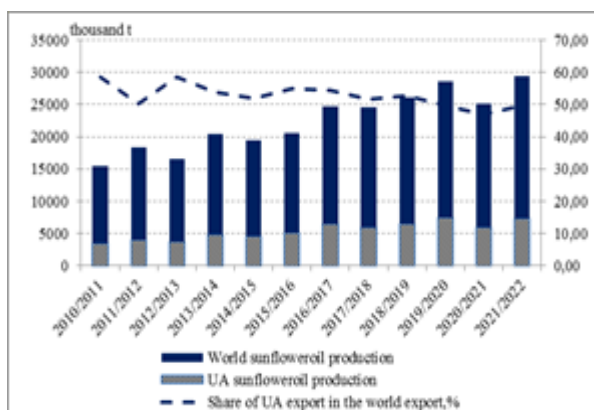

Fig. 2. Dynamics of UA sunflower oil production in the world production, thousand MT
Source: Own calculation based on USDA-FAS (2022) [18].

Analyzing the sunflower oil balance in Ukraine, it should be noted that its production grew every year due to the profitability. In 2021/22 MY 7.3 million tons of sunflower oil were produced, where 6.7 million tons were exported (91%) (Table 1).

At the same time, the largest importers of UA sunflower oil remain EU countries, i.e. approximately 30% of total exports. The coefficient of self-sufficiency is growing every year, which indicates the coverage of domestic consumption. In 2021/22 MY self-sufficiency ration was equaled to 13.

Table. 1 Sunflower oil balance sheet for Ukraine, thousand MT

Indices	2010/ 2011	2012/ 2013	2015/ 2016	2018/ 2019	2021/ 2022
Beginning Stocks	144	462	344	279	264
Production	3,335	3,638	5,010	6,364	7,289
Imports	1	1	1	0	0
Total Supply	3,480	4,101	5,355	6,643	7,553
Exports	2,652	3,245	4,500	6,063	6,650
Industrial Dom. Cons.	30	30	30	30	40
Food Use Dom. Cons.	500	520	520	515	535
Domestic Consump.	530	550	550	545	575
Ending Stocks	298	306	305	35	328
Total Distribution	3,480	4,101	5,355	6,643	7,553
Self-sufficiency ratio	6.3	6.6	9.1	11.7	12.7

Source: Own representation based on USDA-FAS (2022) [18].

In Figure 3 could be observed the increase as in production and total supply that confirm growing demand on the world market for sunflower oil.
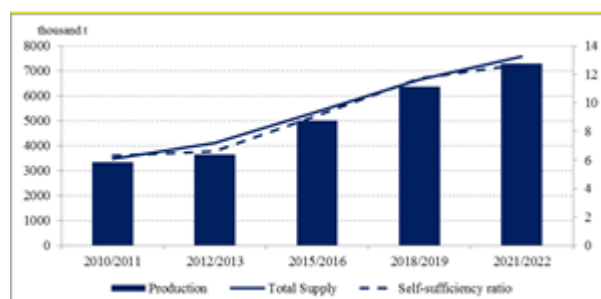

Fig. 3. Dynamics of sunflower oil production, total supply and self-sufficiency
Source: Own calculation based on the State Statistics Service of Ukraine (2022) [15].

Consider the influence of the price factor on the supply and demand of sunflower oil. Many specialized experts in the field of vegetable market agreed that at the world market will continue a tendency to increase sunflower oil and vegetable fats prices. In general, there are both internal reasons that encourage price growth and external factors that seriously determine the price situation in the country. In fig. 1 visible occur the following of UA sunflower oil prices EU

prices. It is worth noting that the domestic price is directly related to the world. Thus, the production of sunflower oil is about 7.3 million tons, where at the domestic market we consume approximately 575 thousand tons, i.e. exports account for more than 90% of domestic production. Therefore, oil producers will not sell sunflower oil to the domestic market cheaper than they sell to the foreign market, which may further affect domestic demand.

In turn, due to the pandemic and the decline in the total harvest of oilseeds on world markets, the conditions for price growth have objectively been formed. In addition, China has entered the world market with great demand, which is now sharply increasing its domestic food reserves. Thus, according to the FAO, the price of vegetable oils has increased by 45% [18].

Also among the reasons for rising prices, experts call the rise in energy prices. However, according to expert forecasts, further increase in the price of sunflower oil in the domestic market will not occur.

Thus, the supply of sunflower oil will only increase due to favorable price conditions (capacity will increase depending on the gross sunflower harvest), and demand (especially domestic) will fall due to insolvency if prices rise.

To evaluate how Ukrainian sunflower oil market linkage to the world and UA raw materials (sunflower seeds), the price analysis was done in the following part.

Price analysis. In order to analyze price series of UA sunflower oil, UA sunflower seeds and EU sunflower oil, price series were transformed into logarithmic data. ADF test was used to check stationarity of price series. Getting results of this test are presented in the Table 2.

ADF test results showed that log levels are not stationary because tau values for all variables are lower than critical value tau, which is equaled to 3.398. Therefore, there is accepted the null hypothesis about non-stationary of price series. In contrast to it, first differences are stationary due to the tau statistics of the models for first differences

with a constant are higher than the critical value tau.

Table 2. ADF test results

Variable	ADF		
	tau	p-value	lag
l_UAsunfloweroil	-2.4136	0.1379	2
dl_UAsunfloweroil	-3.8731	0.0023	1
l_UAsunflower	-2.4057	0.1401	2
dl_UAsunflower	-3.4620	0.0090	4
l_EUsunfloweroil	-2.3064	0.1699	0
dl_EUsunfloweroil	-7.6606	4,807e-012	0

Source: authors' calculation.

In turn, it means that the null hypothesis should be rejected for the first differences of price series and accepted the alternative hypothesis about existence of price series stationarity. Indeed, investigated price series are integrated in order one I(1).

At the next stage we evaluated the existence of the long-run equilibrium relationship between UA sunflower oil prices and UA sunflower seeds prices; UA sunflower oil prices and EU sunflower oil prices using the E-G co-integration test (Table 3).

Table 3. Engle-Granger co-integration test results

Specification	Values
Cointegration equation UA sunfloweroil-UA sunflowerseeds: $l\_UA \ Sunflower \ oil = 4.23 + 0.45 * l\_UA\_Sunflowerseeds_t + \varepsilon_t$	
Estimated φ	-0.3720
Tau-value	-2.4245
P-value	0.3132
Cointegration equation UA sunfloweroil-EU sunfloweroil: $l\_UA \ Sunflower \ oil = -0.97 + 1.12 * l\_EU\_Sunfloweroil_t + \varepsilon_t$	
Estimated φ	-0.3518
Tau-value	-1.7353
P-value	0.6617

Source: authors' calculation.

The results obtained for both models with a constant allow us reject the null hypothesis about the existence of co-integration. P-values are higher than the critical value 0.05 or 0.1. It means that in the long run period, there is no significant force to push prices towards a common path.

Similar results were obtained for Ukraine by Hamulczuk and Makarchuk [7].

The absence of co-integration between Ukrainian sunflower oil and Ukrainian sunflower seeds might be caused due to the fact that sunflower seeds prices domestically more influenced by the conjuncture formed at vegetable oil market and not vice versa. In both models the lack of co-integration may be also caused by the fact that the magnitude of interaction varies over time.

VAR modeling. Stationarity and cointegration test results indicate integration of variables in order one, however they are not co-integrated. Hence, for the further analysis was based on the VAR model estimated on the first differences. In the table 4 are presented estimated models.

Table 4. VAR estimated results (based on first differences of natural logs – ld)

Variable	Cofficient	P-value
Model for Ukrainian sunflower oil (1)		
dl_UA sunfloweroil_1	0.069	0.363
dl_EU sunfloweroil_1	0.935	2.61e-015 ***
Model for Ukrainian sunflower oil (2)		
dl_UA sunfloweroil_1	-0.184	0.183
dl_UA sunflowerseed_1	0.381	0.150
Model for European sunflower oil		
dl_EU sunfloweroil_1	-0.051	0.493
dl_UA sunfloweroil_1	0.748	1.96e-015 ***

Source: authors' calculation.

Getting results showed Granger causality between Ukrainian sunflower oil and European sunflower oil price series. EU sunflower oil prices Granger causes UA sunflower oil price at the 0.01 significance level. In turn, this means that past changes in sunflower oil prices in the EU make it possible to forecast current changes in Ukrainian sunflower oil prices. Opposite interactions are also significant.

CONCLUSIONS

Sunflower oil production is one of the key branches of the agricultural complex in Ukraine. Over the past 15 years it has become a powerful industry, whose profitability is constantly increasing.

Essential to emphasize that Ukraine's oil industry is one of the few that is developing rapidly even in the context of the global financial and economic crisis and is a budget-generating sector of the agro-industrial complex with a strong export potential. Oil and fat industry of Ukraine includes 64 processing plants, 48 oil extraction plants, exports to more than 120 countries and 350 million US dollar in investments.

It worth noting that the Ukrainian sunflower oil production in 2021/2022 MY was about 7.3 million tons, where at the domestic market consumed approximately 10% of the total production, and 90% was exported. In this context domestic sunflower oil prices are directly related to the world. Indeed, oil producers get profits due to the favorable vegetable oil prices on the world market.

Since 70% in cost production of sunflower oil is UA sunflower seeds, in our research were taken into account domestic sunflower seed prices and EU sunflower oil prices as external factor, which could influence on UA sunflower oil prices and find linkages between them.

The long-run equilibrium linkage between UA sunflower oil, UA sunflower seeds and EU sunflower oil prices was not confirmed by the Engle-Granger co-integration test. This means that in the long run period there is no significant force that would push prices in the same way.

Applied stationarity and co-integration tests indicated that variables are integrated in order one, however they were not co-integrated. In these circumstances the VAR model was used. Received results state about Granger causality between UA sunflower oil and EU sunflower oil price series at 0.01 significance level. It can be explained that past changes in sunflower oil prices in the EU allow us to forecast current changes in sunflower oil prices in Ukraine and vice versa.

Model for UA sunflower oil and UA sunflower seeds prices showed that UA sunflower seeds prices are not significantly influence UA sunflower oil prices. The lack of a causal link between these factors can be explained by the fact that the prices of sunflower seeds in the country depend more on the situation that is formed at the vegetable oil market, and not opposite.

Further uncertainties on sunflower oil market could be related to the war in Ukraine. After the start of the war in Ukraine, the sunflower production forecast for world remained at 57.2 million tons, however sharply reduced the estimation of sunflower oil exports. After Russia's invasion, almost all Ukraine's oil refineries and ports have suspended operations, and Western countries have imposed sanctions that have stopped exports from the aggressor country. The share of the Black Sea region in world exports of sunflower oil is 80%., but the share of sunflower oil in the world consumption of food oils is only 12%, and in total consumption of vegetable oils (including biofuels and other industrial uses) - 9%. In the world trade in vegetable oils, the share of sunflower oil is 14%, as well as soybean. Indeed, due to the lack of supplies from Ukraine and Russia vegetable oil prices have increased significantly on the world market [10].

Further research could be related to consequences as from COVID-19 and the war in Ukraine on the world vegetable oil markets; the further development of Ukrainian sunflower oil market in the context of rebuilt after the war.

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