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Vertical Price Transmission in the Ukrainian Sunflower Oil Supply Chain

Vertikálna cenová transmisia v dodávateľskom reťazci slnečnicového oleja na Ukrajine

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ABSTRACT

Sunflower is one of the most popular and extensively produced crops in Ukraine. Almost all production of sunflower is processed further into sunflower oil. During the last 20 years, the amount of produced and exported Ukrainian sunflower oil have increased markedly, so Ukraine has become the world's biggest producer of sunflower oil and its exporter. However, due to the increasing industry concentration and rapid sunflower oil price growth starting from mid-2020, the Antimonopoly Committee of Ukraine started its investigation of the sunflower oil supply for the possible competition issues. There are suspicions that there might be a collusion of sunflower oil producers aimed at an artificial price increase. Those concerns have motivated us to study the potential manifestation of market power in the Ukrainian sunflower oil supply chain. For this purpose, the Threshold Autoregressive Cointegration model was estimated, using monthly producer and consumer sunflower oil prices from January 2013 to September 2021. The results of this analysis bring evidence about a long-term cointegration between price pairs. Moreover, there is a noticeably more dynamic price correction for the negative deviations from the long-run equilibrium than for positive deviations.

Keywords: market power, cointegration, asymmetric price pass-through

ABSTRAKT

Slnečnica je jednou z najpopulárnejších a najviac pestovaných plodín na Ukrajine. Takmer celá produkcia slnečnice sa ďalej spracováva na slnečnicový olej. Za posledných 20 rokov sa výroba a export slnečnicového oleja na Ukrajine výrazne zvýšili, takže Ukrajina sa stala najväčším svetovým producentom a exportérom slnečnicového oleja na svete. V dôsledku zvyšujúcej sa koncentrácie priemyslu a rýchleho rastu cien slnečnicového oleja od polovice roku 2020 Protimonopolný úrad Ukrajiny začal vyšetrovanie hospodárskej súťaže vo výrobe slnečnicového oleja. Existujú podozrenia, že by mohlo existovať dohodu výrobcov slnečnicového oleja zameraná na umelé zvyšovanie cien. Tieto obavy nás motivovali preskúmať možnú prítomnosť trhovej sily v ukrajinskom dodávateľskom reťazci slnečnicového oleja. Na tento účel bol odhadnutý prahový model autoregresnej kointegrácie s použitím mesačných výrobných a spotrebiteľských cien slnečnicového oleja od januára 2013 do septembra 2021. Výsledky tejto analýzy prinášajú dôkazy o dlhodobom kointegračnom vzťahu medzi cenami. Naviac, pri záporných odchýlkach od dlhodobej rovnováhy sa ceny prispôsobili podstatne rýchlejšie ako pri kladných odchýlkach.

Kľúčové slová: trhová sila, kointegrácia, asymetrický prenos cien

INTRODUCTION

Ukraine is a country with a long-standing history of agricultural production. Favorable climatic conditions and high quality of soil with abundance of arable land provide good opportunities for the effective cultivation of a wide variety of crops. Sunflower production has been traditionally crucial for the Ukrainian agricultural sector due to several factors. First of all, oil produced from sunflower is the most preferred kind of edible oil consumed by Ukrainians. Moreover, among the various oilseed crops, sunflower offers the best profitability for Ukrainian farmers (USDA FAS, 2021). As a result, there has been a steady growth of sunflower's harvesting areas and production over the last two decades. With regard to sunflower harvesting areas, Ukraine has the second-largest area sown with sunflower in the world. The cultivated area of sunflowers in Ukraine increased from 2.94 million hectares in 2000 to 6.4 million hectares in 2020 (Vasylkovska et al., 2021).

Nevertheless, thanks to the high yields, Ukraine is the world's largest producer of sunflower seeds. In 2020, the production volumes of sunflower seed reached 13.2 million tons, which is 3.7 times more than in 2000 (USDA FAS, 2021). Almost all sunflower seed produced in Ukraine is used as raw material for the processing industry to produce sunflower oil. Hence, Ukraine is also the biggest global sunflower oil manufacturer and exporter. In 2020, the production volumes were so high that besides satisfying internal demand, almost 95% of sunflower oil produced in Ukraine was exported abroad (Table 1).

The range of Ukrainian domestic and international policies could explain the significant increase in production and export of sunflower oil between 2000 and 2020. For example, to boost the export of sunflower oil rather than seeds the Differential Export Tax (DET) was introduced in 1999. The DET in Ukraine consists of an export tax on sunflower seeds, with no tariffs for sunflower oil and meal export. In 1999 the 23% export tax on sunflower seeds was imposed; it was later decreased to 17% in 2001; and subsequently to 16% in 2005 (Parlament of Ukraine, 1999). When Ukraine became a member of the World Trade Organization in 2008, the export duty for sunflower oil was reduced to 10% in 2013 (Hamulczuk et al., 2021). Moreover, sunflower oil export is likely to grow further due to the decrease in export tax for sunflower oil from 5.5% in 2020 to 0% in 2026, which is related to the international obligations of Ukraine agreed within the context of free trade agreements with the EU and Canada (Gonchar et al., 2020).

Concentration in sunflower oil supply

Due to the high profitability of sunflower oil production in Ukraine, this sector has become attractive to foreign investments, which might have also contributed to the

Table 1. Balance of sunflower oil (thousand tons)

	2005	2010	2015	2017	2018	2019	2020
Production	1437	3101	4581	6277	6243	6894	7549
Change of stocks	114	-151	-71	8	-10	-30	11
Import	264	319	160	239	259	250	245
Total resources	1587	3571	4812	6508	6512	7174	7783
Export	900	2850	4253	5988	5986	6644	7241
Domestic total consumption	635	680	525	496	501	504	512
Per capita (in kg)	13.5	14.8	12.3	11.7	11.9	12.0	12.3

Source: State Statistics Service of Ukraine industry's significant growth during the last decades (Zavorotniy and Bilyk, 2017). However, the industry's fast growth has resulted in an increase in concentration. In their recent paper, Zavorotniy and Bilyk (2017) demonstrated that in 2020 the eight biggest oil extracting enterprises in Ukraine accounted for 75% of the total sunflower oil market. Empirical studies confirm that large companies may benefit from their size (Tóth, 2019; Tóth et al., 2020). Moreover, examining other studies related to the sunflower oil industry reveals that the concentration has increased substantially throughout the last decades. The Herfindahl – Hirschman Index on the sunflower oil market has grown from 775 in 2010 (Gerasimenko, 2011) to 2,591 in 2017 (Katran, 2018). The US Federal Trade Commission (2015) defines the markets with the Herfindahl – Hirschman Index higher than 2,500 as highly concentrated ones.

The primary producers of sunflower oil in Ukraine are vertically integrated domestic as well as international holdings with significant production capacities for processing and logistics of oilseeds (e.g. Vioil Group, Kernel Group, Cargill Group, Bunge Group, Myronivsky Hliboproduct Group etc. (Gonchar et al., 2020)).

Increase of sunflower oil price

Starting from the mid-2020, the prices for sunflower oil in Ukraine started to increase rapidly. The internal sunflower oil prices have grown by 88% during one year, from 34.6 UAH/litre in August 2020 to 64.9 UAH/litre in August 2021 (Figure 1). Due to the high industry concentration and such a swift price increase, the Antimonopoly Committee of Ukraine (ACU) started its investigation of the competition environment and possible collusion on the market of sunflower oil (Antimonopoly Committee of Ukraine, 2021a, 2021b).

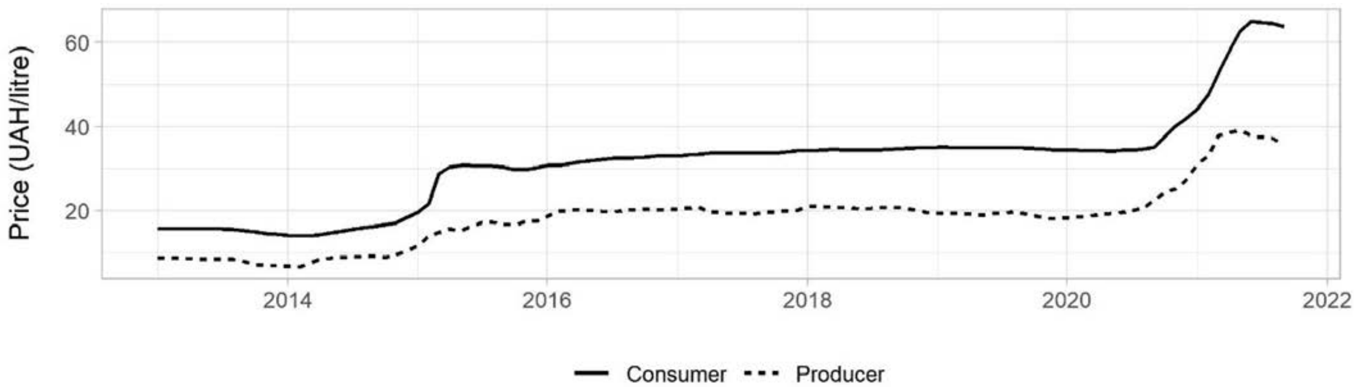

Figure 1. Dynamics of producer and consumer sunflower oil prices in Ukraine

Source: Own elaboration based on data from the State Statistics Service of Ukraine

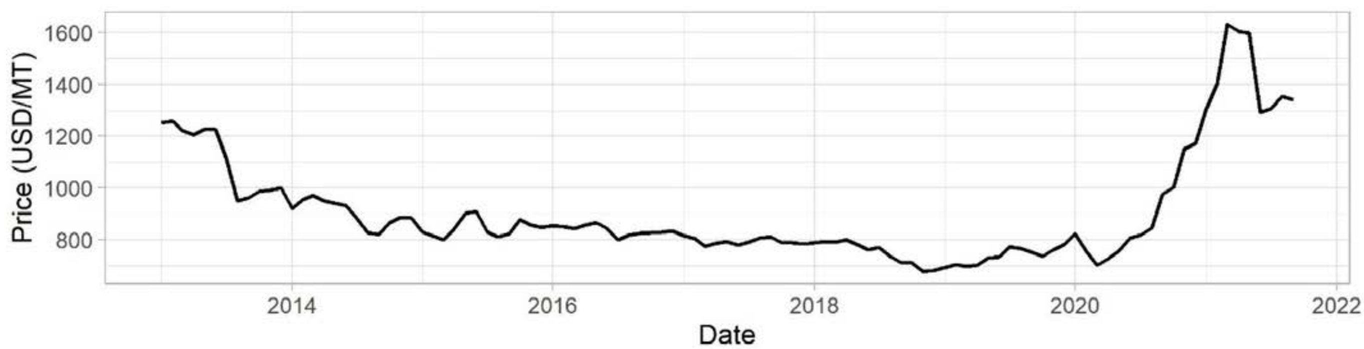

Figure 2. Dynamics of average world sunflower oil price (FOB Rotterdam)

Source: Own elaboration based on data from the French National Institute of Statistics and Economic Studies

To alleviate this issue, the Ukrainian Ministry of Economics on one side, and the producer association "Ukroliyaprom" on the other side, signed a Memorandum of Understanding to ensure the predictable volumes of sunflower oil exports for the 2021 marketing year to stabilize the prices for this product (Ministry of Economics, 2021). The parties agreed to limit the maximum volumes of sunflower oil export to 5.38 million tons in 2021. Finally, in order to prevent further sunflower oil price increase in December 2021 Cabinet of Ministers of Ukraine included sunflower oil in the list of goods of significant social importance. Companies selling this product must now announce the increase in price in advance (Cabinet of Ministers of Ukraine, 2021).

World price

However, it should be noted that the rapid sunflower price increase in Ukraine coincided with the similar growth of world sunflower oil prices (Figure 2). In November 2021, FAO's vegetable oil price index reached an all-time high of 185, which is 74% higher than in November 2020 (FAO, 2021). The Food and Agriculture Organization associates such a rapid growth of sunflower oils with increased worldwide demand, specially from countries like India, that reduced the import duties on edible oils. Moreover, late harvesting in most countries led to smaller than previously estimated crushing, which further supported the sunflower oil prices increase. Finally, the increase in the price of crude oil has also influenced the vegetable oil price grow in 2021 (FAO, 2021).

All the above-mentioned issues and concerns of the ACU prompted this study to investigate the possible presence of anticompetitive behavior in the Ukrainian sunflower oil supply chain using the price transmission between sunflower oil producers' and consumers' prices.

Various scholars have extensively used the asymmetric price transmission (APT) framework throughout the last decades. This method has been utilized to investigate the possible presence of uncompetitive behavior *vertically* - along various stages of the food supply chain and also *horizontally* - among various markets or products.

APT in a particular supply chain may be presented as a more complete and rapid price reaction at one level (e.g. consumers) to a rise in price at another level (e.g. producers) than to a decrease. This case is perceived as a positive asymmetry (Meyer and von Cramon-Taubadel, 2004). Most of the empirical papers prove that APT is caused by non-competitive market behavior, and furthermore, some researchers suggest that market power (MP) leads to the presence of APT (Frey and Manera, 2007). In a recent study conducted by Hamulczuk et al. (2021), authors investigated horizontal price transmission between the EU market of sunflower oil and the domestic Ukrainian market. They concluded the existence of a cointegrating relation between sunflower oil prices in Ukraine and the EU. They also concluded that the short-term and the long-term corrections of prices between the markets varied considerably throughout the last decades. Finally, they demonstrated that there is a causal link from the EU sunflower oil prices to the internal sunflower oil prices in Ukraine in a Granger sense.

In the context of this study, the vertical price transmission among the sunflower oil prices of producers and retailers is investigated. To the best of our knowledge, no previous studies examined vertical price pass-through along the Ukrainian sunflower oil supply chain.

MATERIAL AND METHOD

In this paper, we started with testing the stationarity of the individual time-series data. Non-stationary price series can later be tested for presence of cointegration between price pairs. In this paper we used the test proposed by Engle-Granger to check the existence of cointegration and estimated the Momentum Threshold Autoregressive (MTAR) and Threshold Autoregressive (TAR) models. In TAR and MTAR, the null hypothesis of cointegration absence is formulated as (H_0: $\rho_1 = \rho_2 = 0$) and then examined using the F-test. If the series are cointegrated, we can move further to test the null hypothesis of symmetrical price adjustments (H_0: $\rho_1 = \rho_2$). Finally, the asymmetric error correction model is estimated in the last step.

We used both TAR and MTAR models to study the price transmission mechanism in the Ukrainian sunflower oil supply chain. This methodology was described by Enders and Siklos (2001) and extended by Engle and Granger (1987). The equation 1 can describe the general TAR model:

$$\Delta\mu_t = I_t\rho_1\mu_{t-1} + (1 - I_t)\rho_2\mu_{t-1} + \sum_{i=1}^{p} \gamma_i\Delta\mu_{t-i} + v_t \tag{1}$$

The term I_t is the "Heaviside indicator" defined as:

$$I_t = \begin{cases} 1 \; if \; \mu_{t-1} \geq \tau \\ 0 \; if \; \mu_{t-1} < \tau \end{cases} \tag{2}$$

where τ is a threshold value. The adjustment proces is modelled by ρ_1 μ_{t-1}, if μ_{t-1} is higher than the threshold value and by the term ρ_2 μ_{t-1}, if μ_{t-1} if it is lower than the threshold value. The MTAR model has a similar structure, but in MTAR, the term μ_{t-1} is substituted with $\Delta\mu_{t-1}$. As explained by Enders and Siklos (2001) the TAR can capture a deep cycle process, while the MTAR is suitable to assess sharp sequential movement.

Four different models were estimated in this analysis, TAR as well as MTAR models, both with zero threshold and non-zero threshold, which is estimated via the procedure proposed by Chan (1993). The best model was chosen via Akaike and Bayesian information criteria (Enders and Siklos, 2001). The asymmetric error correction model with threshold cointegration is given by:

$$\Delta Y_t = \theta_Y + \delta_Y^+ ECT_{t-1}^+ + \delta_Y^- ECT_{t-1}^- + \sum_{j=1}^{J} \alpha_{Yj}^+ \Delta Y_{t-j}^+ + \sum_{j=1}^{J} \alpha_{Yj}^- \Delta Y_{t-j}^- + \sum_{j=1}^{J} \beta_{Yj}^+ \Delta X_{t-j}^+ + \sum_{j=1}^{J} \beta_{Yj}^- \Delta X_{t-j}^- + \mu_{ct} \tag{3}$$

where ΔY_t represents a dependent variable, θ is an intercept, δ is an error correction term (ECT) parameter, α and β are lagged coefficients for producer and consumer prices, respectively, μ is an error term, t represents time, and j denotes the number of lags. Lagged time series in their first difference (i.e., ΔY_{t-j}^+ and X_{t-j}^+ are split into positive and negative changes, which is denoted by the superscripts + and –. The most suitable lag order was determined based on the AIC and BIC information criteria, and Ljung–Box Q to avoid serial correlation.

Monthly time series of producer and consumer sunflower oil prices were obtained from the State Statistic Service of Ukraine. The sample period starts from January 2013 to September 2021. The graphical representation of the data can be seen in Figure 1. Natural logs of consumer and producer sunflower oil prices are used, using the R language and environment for statistical computing (R Core Team, 2020), including the apt package developed by Sun (2011).

RESULTS AND DISCUSSION

To check the stationarity of the price series we utilised Phillips-Perron and the Augmented Dickey-Fuller tests. It should be noted that the potential shortcoming of both beforementioned tests is that they do not account for the possible presence of structural breaks in the investigated time series, wihich might distort their results.

To address this issue, we also examine the robustness of the beforementioned tests results using the Zivot-Andrews and Lee-Strazicich tests. The results of the tests strongly suggest that all the price series are non-stationary, but integrated of order one. Out of brevity considerations, we do not report summary statistics regarding the unit root tests; this information could be obtained upon request. The Engle-Granger cointegration test confirmed the existing cointegrating relationship. Thus, the nonlinear cointegration tests were performed with the MTAR and TAR models and their alternatives with non-zero threshold. Results of the tests are shown in table 2. The residuals diagnostics using AIC and BIC information criteria and Ljung–Box Q test revealed that a lag of order two is the most suitable for performing threshold cointegration tests. As seen from table 2, all four estimated models strongly reject the null hypothesis of absence of cointegrating relationship between time series, which is in line with the Engle-Granger cointegration test results.

Three out of four models (CTAR, MTAR and CMTAR) reject the null hypothesis of symmetric price transmission at the 5% level of statistical significance. Therefore, we could conclude that price adjustment process is asymmetric.

Table 2. Results of threshold cointegration tests

	TAR	CTAR	MTAR	CMTAR
Parameters				
Lags	2	2	2	2
τ	0	-0.065	0	-0.021
p_1	-0.149*	-0.152**	-0.131	-0.156**
p_2	-0.335***	-0.41***	-0.363***	-0.517***
Diagnostics				
AIC	-384.422	-386.664	-385.952	-389.372
BIC	-371.297	-373.539	-372.828	-376.247
LB (4)	0.991	0.997	0.945	0.976
LB (8)	0.968	0.94	0.989	0.952
LB (12)	0.854	0.887	0.892	0.875
Hyphotheses				
$H_0: \rho^+ = \rho^- = 0$	8.449***	9.726***	9.317***	11.306***
$H_0: \rho^+ = \rho^-$	2.668	4.906**	4.19**	7.674***

Note: *, **, *** indicate 10%, 5% and 1% significance levels respectively. LB(j) denotes the significance level for the Ljung-Box Q statistic; CTAR and CMTAR denote consistent TAR and MTAR models with an estimated threshold

Source: Estimated by authors

Based on AIC and BIC, the CMTAR model is the most suitable and discussed in more detail. The coefficient of the price adjustment demonstrates that the positive deviations from equilibrium, which results in a rise of the sunflower oil producer price or fall in the consumer price (higher than threshold value -0.021), are removed at 15.6% per month.

On the other side, negative deviations that result from a decline in the producer price of sunflower oil or a rise in the consumer price (lower than threshold value -0.021) are corrected at a speed of 51.7% monthly. Thus, there is an evidence of much faster convergence for negative deviations from the long-run equilibrium than positive ones. The detailed results of the CMTAR model are shown in table 3. The error correction terms (δ^+, δ^-) are significant and negative, as desirable, in the equation for consumer sunflower oil price. These results imply that consumer prices adjust to their long-run equilibrium after the shock. The diagnostics Ljung-Box Q suggest no autocorrelation in the models' residuals, and the R^2 and the information criteria statistics suggest a much better fit for a consumer price model.

Finally, the Granger causality tests showed that the sunflower oil producers' price do cause the consumers' price in Granger sense. However, the F-statistic of 0.448 and p-value 0.77 indicate that the consumer price of sunflower oil does not Granger cause the prices of producers.

Table 3. Result of Asymmetric Error Correction Model

	Producer	p-value	Consumer	p-value
Parameters				
θ	0	0.936	-0.003	0.35
a_1^+	0.696***	0	0.425***	0
a_2+	0.133	0.45	0.062	0.525
a_1^-	0.429	0.22	0.04	0.836
a_2^-	-0.037	0.917	-0.206	0.297
b_1^+	0.114	0.532	0.288***	0.005
b_2^+	-0.152	0.256	0.014	0.85
b_1^-	0.186	0.873	0.029	0.964
b_2^-	-0.562	0.594	0.569	0.326
δ^+	0.033	0.697	-0.113**	0.016
δ^-	0.254	0.161	-0.279***	0.006
Diagnostics				
R-squared	0.360		0.736	
AIC	-371.469		-493.932	
BIC	-339.969		-462.432	
LB(4)	0.989		0.801	
LB(8)	0.874		0.984	
Hypotheses				
H_{01}: $a_i^+= a_i^-= 0$	5.834***	(0)	6.186***	(0)
H_{02}: $b_i^+= b_i^-= 0$	0.448	(0.77)	3.189**	(0.02)

Note: *, **, *** indicate 10%, 5% and 1% significance levels; H_{01}: Granger causality test (producer price does not Granger cause ...), H_{02}: Granger causality test (consumer price does not Granger cause ...), LB(j) is the significance level for the Ljung-Box Q statistic

Source: Estimated by authors

CONCLUSIONS

The process of price pass-through along the Ukrainian sunflower oil supply chain was analysed using a consistent MTAR model. This analysis aimed to tackle competition issues in the Ukrainian sunflower oil market. Due to the high concentration and a rapid sunflower oil price increase, the Antimonopoly Committee of Ukraine initiated its investigation regarding the possible collusion among sunflower oil producers aimed at an artificial increase of the prices. The concerns of the Ukrainian government officials prompted investigation of the nature of the rapid sunflower oil price increase and the possible presence of market power within the Ukrainian sunflower oil supply chain.

This study reveals that there is a long-term cointegrating relationship between consumers' and producers' sunflower oil prices in Ukraine. The second finding is that three out of four developed models reject the symmetric price transmission hypothesis. Thus the price adjustment process of the producer and/or consumer sunflower oil prices to the long-term equilibrium is asymmetric, suggesting the possible presence of market power and/or unfair trading practices within the Ukrainian sunflower oil supply. In other words, the convergence for negative deviations from long-run equilibrium (which stretches the margin) is noticeably faster than the correction to positive deviations (which squeezes the margin). The final insight from the econometric model is that producer sunflower oil prices Granger cause the prices of consumers, although the consumer sunflower oil prices do not have a similar effect on producer prices. Therefore, the producer prices of sunflower oil can be considered as a main driving force in the Ukrainian sunflower oil supply chain. All those beforementioned findings suggest that sunflower oil producers at least partially contributed to the rapid consumer price increase in early 2021 and that there might be some competition issues along the sunflower oil supply chain. However, it should be noted that other factors might have impacted the significant sunflower oil price growth in 2020-2021. First, the sunflower oil price increase in Ukraine corresponded with the equivalent growth of the world prices for vegetable oils and sunflower oil in particular. Other scholars investigated the price transmission between the Ukrainian and the EU sunflower oil prices and suggested that the EU prices have a casual effect on the internal Ukrainian sunflower oil (Kuts and Makarchuk, 2020; Hamulczuk et al., 2021). Moreover, considering that almost 95% of sunflower oil produced in Ukraine is exported, the rapid price increase for sunflower oil in Ukraine in 2020-2021 might also be caused by the market forces, particularly by the increase in international demand for vegetable oils.

However, even though the situation on the world market co-impacted the internal price for sunflower oil, we are not able to reject the hypothesis of no market power within the Ukrainian sunflower oil supply chain. As mentioned by Deconinck (2021): "Price transmission studies are thus best seen as providing a 'first pass' test, to be complemented with more detailed investigations". Therefore, this study serves also as the first attempt to analyze the Ukrainian sunflower oil supply chain for possible competition issues.

This paper was written before the Russian military intervention in Ukraine on February 24th 2022. Since that day, everything has dramatically changed, and the fate of the Ukrainian economy has become hardly predictable. Nevertheless, we believe that this article might be of use for researchers who study competition issues in other developing economies.

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