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RESEARCH PAPER

The Impact of the Russian-Ukrainian War on the Consumer Prices of Food Products in Saudi Arabia

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ABSTRACT:

PURPOSE: The purpose of this study was to assess the impact of the Russian-Ukrainian war on consumer prices of food products in Saudi Arabia.

METHODOLOGY: To achieve its objectives, this research relied on the equations of joint integration to study the factors determining consumer prices for foodstuffs in the Kingdom of Saudi Arabia during the period 1990-2021. The Consumer Price Index of food products was then calculated during the year of the war (2022) and was compared to the pre-war period (1990-2021).

RESULTS: The findings of this study reveal significant differences between the average Consumer Price Index of food products in Saudi Arabia before and during the Russian-Ukrainian war in relation to bread, cereals, meat, poultry, fish, milk and its products, as well as eggs, oils, fats, vegetables, sugar, jam, honey, chocolate, and sweets, amongst others. On the other hand, differences in price for fruits and nuts were discovered to be insignificant. It was also found that there was an increase in the World Food Price Index and the total population of Saudi Arabia during the study period (1990-2021) by 10%. Consequently, both these factors had an impact on increasing the Consumer Price Index of food products by 1.22% and 4.95%, respectively. Moreover, the Consumer Price Index of food products in Saudi Arabia is expected to reach 137.7 in 2022, which is 12.2% more than it was in 2021. In the context of the Russian-Ukrainian war, the supply of food commodities to Saudi Arabia is affected, having obvious implications on strategic stocks. It is imperative that strategic

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stocks are sufficient enough to allow food commodities in the Kingdom to continue flowing to local markets, thus enabling the government to control inflation and rising prices.

KEYWORDS: *Russian-Ukrainian war; Consumer Prices; Food Products; Saudi Arabia*

INTRODUCTION

Due to the outbreak of the Russian-Ukrainian war on 24 February 2022, the FAO Food Price Index increased from 135.6 in January 2022 to 159.7 in March 2022, and later dipped to 135.9 in October 2022 (FAO, 2022). In Saudi Arabia, food and beverage prices increased by 17.3% in 2021 compared to 2018, in addition to a 14.9% increase in tobacco prices, a 12.9% increase in transportation services, while there was also a 12.5% and 11.2% increase in restaurants and hotels, and the telecommunications industry, respectively (Figure 1).

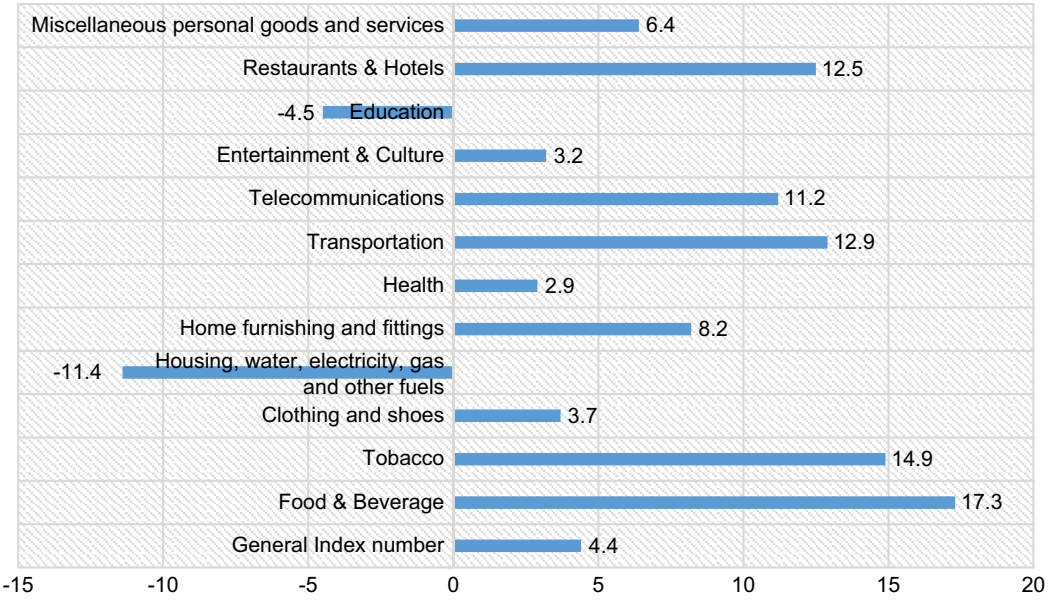

Figure 1: Growth Rate in Prices of Products and Services in 2021 Compared to 2018
Source: Saudi Central Bank (2022)

As Saudi Arabia is a net importer of food, any rise in global food prices leads to a rise in both the country's wholesale and consumer prices of foodstuffs. This was reflected in the increase in the average Food Price Index from 117.83 during the pre-war period (January 2021-January 2022), to 122.32 during the ongoing war period (February 2022-October 2022) (FAO, 2022).

There is no doubt that the Russian-Ukrainian war had several negative repercussions on the global economic system. A study by Abdul Nabi (2022) showed that the Russian-Ukrainian war

affected the economic and social situation of Central Asian countries, as it impacted growth rates, price levels, inflation, trade movement, capital flows, foreign investments, remittances of workers abroad, debt, tourism movement, migration rates, and poverty rates. It was also found that the war caused a reduction in foreign trade between Central Asian countries and Russia and Ukraine, exacerbating their trade deficits, and making it more challenging for them to benefit from their natural and petroleum resources. The Ministry of Planning and International Cooperation of the Republic of Yemen (2022) studied the economic and social repercussions of the Russian-Ukrainian war on Yemeni society. It found that the outbreak of the war compounded inflationary pressures, and as such, expected inflation to rise by 45% in 2022, due mainly to higher oil and food prices. Rising food prices and the risk of food insecurity are also expected to cause the greatest damage to underprivileged households, as they spend most of their income on food and energy.

A study by Abdul Shafi (2022) argues that the Russian-Ukrainian war threatens the future of food security, as Russia is the largest exporter of wheat in the world, and Russia and Ukraine, together, provide more than a third of global grain exports. In light of the ongoing developments of the crisis, the prices of foodstuffs, especially wheat and corn, increased by rates ranging from 40% to 60%. Consequently, global supplies of key food products (wheat, barley, maize, and sunflower oil) are projected to fall by 10-50%.

Lopez-Acevedo *et al*. (2022) conducted a study that showed that inflationary pressures are exacerbating in the Middle East and North Africa, where the Russian-Ukrainian war affected the quantity and value of food imports. Due to high food prices, the inflation rate in the Middle East and North Africa reached 14.8% in 2021. Some countries in the region also experienced worryingly high inflation rates, such as Iran (43%), Lebanon (154%), and Yemen (30%). According to FAO data, some 50 countries, including Egypt, Libya, Djibouti, Yemen, Lebanon, and Tunisia, rely on Russia and Ukraine for at least 30% of their wheat imports.

In the context of Saudi Arabia, Ghanem *et al*. (2023) studied the reverberations of the Russian-Ukrainian war on the value of imports and the food trade balance. Due to the fact that the value of imports outweighed the value of food exports during the study period (1990-2021), the amount of deficit in the food trade balance increased from 11.58 billion riyals in 1990, to 72.98 billion riyals in 2021. The difference between the average world Food Price Index before and during the Russian-Ukrainian war in relation to meat, dairy products, cereals and vegetable oils, falls at the probability level of 1%. Ghanem *et al*.'s study (2023) also showed that increasing the global Food Price Index by 10% during the study period (1990-2021) led to an increase in the value of food imports to the Kingdom of Saudi Arabia by 6.98%, thus increasing the value of the food trade balance deficit by 7.87%. Furthermore, an increase in the Food Production Index by 10% led to a decrease in the value of food imports for Saudi Arabia by 1.88%. Lastly, an increase in the value of Saudi Arabia's food exports by 10% reduced the value of Saudi Arabia's food trade deficit by 5.24%. Comparing this to the war period, with the Food Price Index increasing to 145.8 in 2022, the value of both food imports and the food trade deficit increased, reaching 37.1% and 44.5%, respectively. Nevertheless,

given large fiscal surpluses as a result of high oil prices, Saudi Arabia is able to withstand a high import bill and a food trade deficit.

RESEARCH OBJECTIVES

This research aimed to measure the impact of the Russian-Ukrainian war on the consumer prices of food products in the Kingdom of Saudi Arabia, through the following objectives:

1. studying the difference between the average Consumer Price Index of food products before and during the Russian-Ukrainian war;
2. testing the stability of specific consumer price variables for food products in the Kingdom of Saudi Arabia;
3. estimating the model of joint integration between the determining factors of the Consumer Price Index for food products during the period 1990-2021;
4. forecasting the value of the Consumer Price Index for food products in Saudi Arabia during the outbreak of the Russian-Ukrainian war in 2022.

RESEARCH METHODOLOGY

In order to achieve its objectives, this study relied on the equations of joint integration to study the factors determining consumer prices for foodstuffs in the Kingdom of Saudi Arabia during the period 1990-2021. The stability of the variables was detected using unit root tests, the most important of which was the Augmented Dickey-Fuller test (ADF). The degree of complementarity of the variables included in the model was determined, and if the time series was stable at the first differences, the time series was integrated by the first order (Dickey and Fuller, 1979). The Vector Autoregressive model (VAR) was estimated using the maximum likelihood function. The Johansen–Juselius test assumes the presence of P economic variables in the autoregressive vector of degree K as follows:

$$X_t = \mu + \pi_1 X_{t-1} + \ldots\ldots\ldots\ldots + \pi_k X_{t-k} + e_t$$

Where: μ represents the fixed part, π represents a matrix of degree P (Johansen and Juselius, 1992).

The number of cointegration vectors was determined using the following tests:

1. The trace test (the sum of the elements of the diameter of the matrix) is calculated as follows:

$$\lambda_{\text{trace}} = -T \sum_{i=r+1}^{P} \ln(1-\lambda_i)$$

2. The maximum eigenvalues test is calculated as follows:

$$\lambda_{max} = -T \ln(1-\lambda_{r+1})$$

By comparing the possibility ratio with critical values at the probability level of 1% and 5%, it was possible to determine the number of cointegration vectors, and thus use the Error Correction model (ECM), which could be formulated as follows:

$$\Delta Y_t = a\Delta X_t + \theta(Y_{t-1} - BX_{t-1}) + \mu_t$$

Where: ΔY_t equal $Y_t - Y_{t-1}$, the error correction model shows that the change in Y_t depends not only on the change in the X_t, but also on how far it is from the balance between (X_t Y_t). The error correction model is characterised by reflecting the kinetic changes in the model, as well as the long-term relationship, without losing its properties (Johansen, 1996).

RESULTS

Objective 1: Studying the Difference Between the Average Consumer Price Index of Food Products Before and During the Russian-Ukrainian War

The Consumer Price Index is one of the most important indicators that measures the fluctuation and unstable nature of prices. Studying the difference between the average Consumer Price Index of food products before and during the Russian-Ukrainian war, it is clear from the data in Figures 2 and 3, and Table 1 that:

1. The average Consumer Price Index (CPI) of food in Saudi Arabia increased from 117.83 during the period January 2021-January 2022, to 122.32 during the period February 2022-October 2022. This means that the average Consumer Price Index of food products increased during the Russian-Ukrainian war by 3.81%. At the commodity group level, the rate of increase in the average Consumer Price Index during the Russian-Ukrainian war ranged from a low of 0.14% for fruits and nuts, to a high of 11.0% for milk, milk products, and eggs.
2. By studying the significance of the difference between the average Consumer Price Index of food products before and during the Russian-Ukrainian war, it is clear that the calculated value of (t) is greater than its tabular counterpart of 2.764 at the probability level of 1% for each of the CPI of food products (bread, cereals, meat, poultry, fish, milk and its products, as well as eggs, oils, fats, vegetables, sugar, jam, honey, chocolate, and sweets, amongst others). On the other hand, the difference between the average Consumer Price Index before and during the Russian-Ukrainian war for fruits and nuts was found to be insignificant.

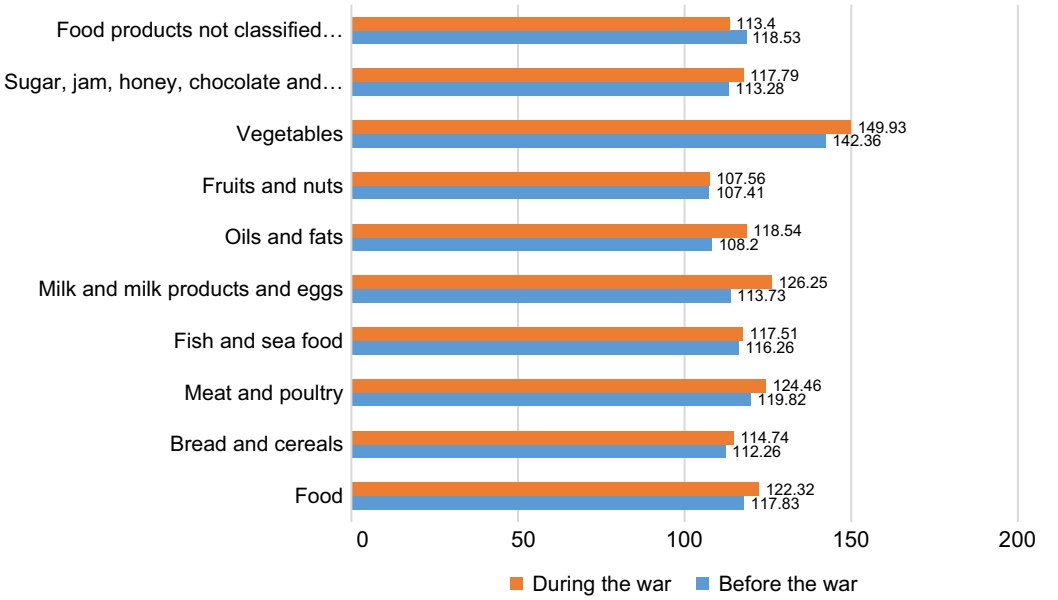

Figure 2: Average Consumer Price Index of Food Products Before and During the Russian and Ukrainian War

Source: Saudi Central Bank (2022)

Table 1: Test (t) for the Significance of the Difference Between the Average of Consumer Price Index for Food Products Before and During the Russian-Ukrainian War

Commodity Group	Average Food Price Index		σ^2		Test t
	January 2021-January 2022	February 2022-October 2022	January 2021-January 2022	February 2022-October 2022	
Food	117.83	122.32	1.75	4.81	6.27**
Bread and cereals	112.26	114.74	0.43	2.15	5.60**
Meat and poultry	119.82	124.46	0.67	10.97	4.99**
Fish and sea food	116.26	117.51	3.70	2.46	1.73 (ns)
Milk and milk products and eggs	113.73	126.25	1.49	20.49	9.78**
Oils and fats	108.20	118.54	2.74	18.58	8.14**
Fruits and nuts	107.41	107.56	2.25	6.12	0.18 (ns)
Vegetables	142.36	149.93	69.09	17.93	2.74*
Sugar, jam, honey, chocolate, sweets	113.28	117.79	1.25	2.57	8.19**
Other Food Products	118.53	113.40	1.09	3.99	-8.17**

**Significant at the probability level 1%, *Significant at the probability level 5% ns non-significant

Source: Data from Figure 2

Objective 2: Testing the Stability of Specific Consumer Price Variables for Food Products in the Kingdom of Saudi Arabia

It is clear from the data presented in Figure 3 and Table 2, that the variables included in the study take a general upward trend, with annual growth rates ranging from a minimum of 2.0% for the Food Production Index, to a maximum of 6.2% for the average spot prices of crude oil. The stability of the specific consumer price variables for food products during the period 1990-2021 was identified using the unit root test (Augmented Dickey-Fuller). It is clear from the data in Table 3 that all variables determining consumer prices for foodstuffs contain the unit root, that is, they are variables that are unstable in the level, as the calculated values of (t) are less than the critical values at the level of 5%. Taking the first differences of the variables used in the estimation, they all became stable, that is, they did not contain the unit root, as the calculated t-values became greater than the critical values at a significant level of 5% or 1%. In this case, the variables are first-order integral and stable, which justifies proceeding with the estimation of the cointegration equations.

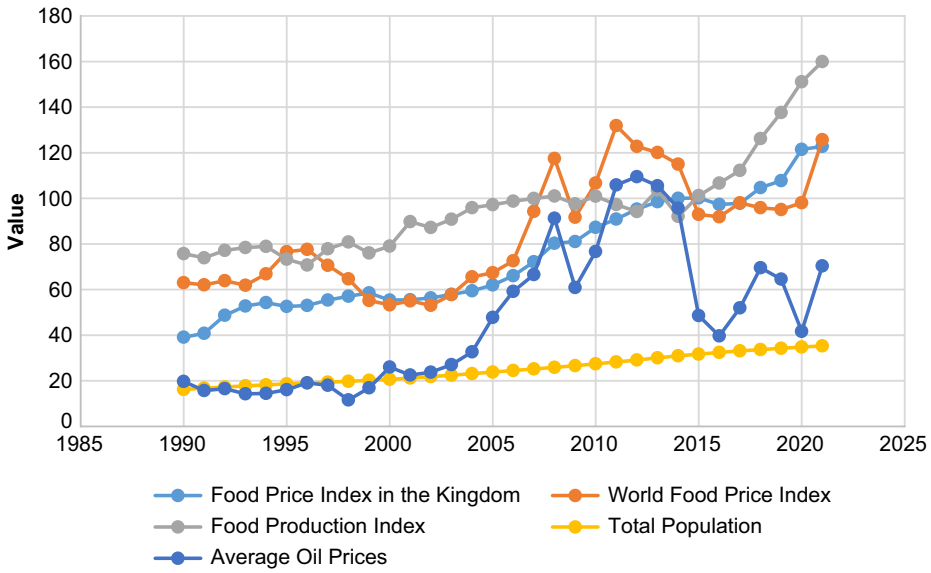

Figure 3: Evolution of Determining Factors for Consumer Prices of Foodstuffs in the Kingdom of Saudi Arabia During the Period 1990-2021

Source: Saudi Central Bank (2022)

Table 2: Equations of the General Trend of the Evolution of the Factors Determining Consumer Prices of Foodstuffs in the Kingdom of Saudi Arabia During the Period 1990-2021

Statement	Annual Growth Rate %	*F*	R^2	Equation
Consumer Price Index for Foodstuffs	3.4	553.62	0.95	$LnY = 3.706 + 0.034X$ (137.42)** (23.53)**
World Food Price Index	2.3	39.08	0.57	$LnX_1 = 4.013 + 0.023X$ (57.98)** (6.25)**
Food Production Index	2.0	135.36	0.82	$LnX_2 = 4.218 + 0.020X$ (130.69)** (11.63)**
Total Population	2.6	10845.79	0.99	$LnX_3 = 2.760 + 0.026X$ (584.13)** (104.14)**
Average spot prices of crude oil	6.2	59.65	0.67	$LnX_4 = 2.595 + 0.062X$ (17.13)** (7.72)**

**Significant at the probability level of 1%

Source: Collected and calculated from the data in Figure 2

Table 3: Unit Root Test (Augmented Dickey-Fuller) for Specific Variables for Consumer Prices of Foodstuffs in the Kingdom of Saudi Arabia

Characteristics		Significance Level	Intercept	Trend and Intercept	None
Variables	Critical values	1% 5% 10%	-3.66 -2.96 -2.62	-4.31 -3.57 -3.22	-2.64 -1.95 -1.61
Consumer Price Index for foodstuffs	Level	(t) value (AIC) standard value	-0.72 -3.24	-2.73 -3.74	4.35 -3.26
	First differences	(t) value (AIC) standard value	-4.01 -3.58	-3.86 -3.20	-2.88 -3.15
World Food Price Index	Level	(t) value (AIC) standard value	-2.01 -1.21	-1.95 -1.15	-1.88 -1.25
	First differences	(t) value (AIC) standard value	-7.86 -1.13	-7.73 -1.06	-7.99 -1.19
Food Production Index	Level	(t) value (AIC) standard value	1.12 -2.76	-0.99 -2.78	2.32 -2.79
	First differences	(t) value (AIC) standard value	-5.69 -2.71	-6.12 -2.74	-1.11 -2.63
Total Population	Level	(t) value (AIC) standard value	-1.58 -11.32	-1.05 -11.30	2.06 -11.16
	First differences	(t) value (AIC) standard value	-3.06 -11.30	-3.32 -11.32	-0.80 -11.22
Average spot prices of crude oil	Level	(t) value (AIC) standard value	-1.09 0.38	-1.94 0.36	0.57 0.36
	First differences	(t) value (AIC) standard value	-4.84 0.43	-4.76 0.49	-4.68 0.41

Source: Collected and calculated from the data in Figure 2

Objective 3: Estimating the Model of Joint Integration Between the Determining Factors of the Consumer Price Index for Food Products During the Period 1990-2021

By conducting the simple correlation matrix between the variables used in the estimate, it is clear from the data in Table 4 that there is a strong correlation of 0.84 between the world Food Price Index and crude oil prices, and that there is a strong correlation of 0.89 between the Food Production Index and the total population, in addition to a strong correlation of 0.82 between the total population and crude oil prices. In the case of a strong correlation between two variables, one of them needs to be excluded to avoid the problem of multicollinearity, which leads to biased and inconsistent estimates.

Table 4: The Simple Correlation Matrix Between the Variables Used in Estimating the Model

Variable	LnY	LnX_1	LnX_2	LnX_3	LnX_4
LnY	1.00	0.83	0.87	0.98	0.81
LnX_1	0.83	1.00	0.62	0.77	0.84
LnX_2	0.87	0.6	1.00	0.89	0.67
LnX_3	0.98	0.77	0.89	1.00	0.82
LnX_4	0.81	0.84	0.67	0.82	1.00

Source: Collected and calculated from the data in Figure 2

The Johansen and Juselius co-integration test was conducted to estimate the relationship between the Consumer Price Index of food products and its determining factors during the period 1990-2021. It is clear from the results of the trace tests and the maximum eigenvalue contained in Table 5 rejecting the null hypothesis, that there is no cointegration between the variables at a significant level of 5%, as the calculated value of the trace test of 38.28 is greater than the critical value of 29.80. Regarding the next value, which is 8.48, it is less than the critical value of 15.49. Therefore, the trace test indicates that the null hypothesis of the existence of at most a single vector for joint integration, is not rejected. The maximum eigenvalue test also gave the same results as the trace test.

Table 5: Johansson Test for the Joint Integration of the Determining Factors of the Consumer Price Index for Food Products

Null Hypothesis of the Integration Vector	Eigenvalue	Trace Statistic	Maximum Eigenvalue Statistic	Critical Value at a Significant Level of 5%	
				Trace Test	Maximum Eigenvalue Test
R = 0*	0.63	38.28	29.80	29.80	21.13
R ≤ 1	0.22	8.48	7.49	15.49	14.26
R ≤ 2	0.03	0.99	0.98	3.84	3.84

*Refers to the rejection of the null hypothesis at the significant level of 5%

Source: Collected and calculated from the data in Figure 2

By estimating the autoregressive vector model of the determining factors of the Consumer Price Index of food products by the maximum likelihood method during the period 1990-2021, it can be expressed by the following equation:

$$Ln_Y = -0.017 + 0.835LnY_{t-1} - 0.325LnY_{t-2} + 0.122LNX_1 + 0.495LNX_3$$
$$(0.11) \quad (0.17) \quad (0.16) \quad (0.04) \quad (0.13)$$
$$R^2 = 0.98 \quad F = 493.65 \quad Log\ Likelihood = 60.19$$

It is clear from the estimated model that there has been an increase in the World Food Price Index and the total population of Saudi Arabia by 10% during the study period (1990-2021). Both these factors consequently led to an increase in the Consumer Price Index of Food Products by 1.22% and 4.95% respectively. The parentheses indicate standard error values and are statistically insignificant at the significant level of 1%. The log likelihood value was about 60.19. It was also found that the independent variables included in the model explain about 98% of the changes that occurred in the Consumer Price Index of food products during the study period, while the rest of the changes, estimated at about 2.0%, are due to other factors not included in the estimated model.

Objective 4: Forecasting the Value of the Consumer Price Index for Food Products in Saudi Arabia During the Outbreak of the Russian-Ukrainian War in 2022

To understand the impact of the Russian-Ukrainian war on the Consumer Price Index of food products in Saudi Arabia, the Consumer Price Index of food products was predicted during the outbreak of the war in 2022, and compared to its pre-war counterpart in 2021. The Consumer Price Index for food products was predicted by forecasting the total population of the Kingdom to be 37.26 million, using the general trend equation presented in Table 2, and increasing the world Food Price Index to 145.8 in 2022, representing the average of the world food price index during the period from February 2022 to October 2022. Using the autoregressive vector model estimated in this study, the Consumer Price Index for food products in the Kingdom of Saudi Arabia was calculated to be 137.7 in 2022, which is 12.2% higher than its counterpart in 2021, which was 122.78.

DISCUSSION

Since the outbreak of the Russian-Ukrainian war, global food prices have risen, causing inflationary pressures for Saudi Arabia, given that it is a net food importer. The Consumer Price Index is one of the most important indicators that measures the fluctuation and unstable nature of prices. The average food price index increased from 117.83 during the pre-war period (January 2021-January 2022), to 122.32 during the ongoing war period (February 2022-October 2022).

At the commodity group level, the rate of increase in the average Consumer Price Index during the Russian-Ukrainian war ranged from a low of 0.14% for fruits and nuts, to a high of 11.0% for milk, milk products, and eggs. In examining the difference between the average Consumer Price

Index for food products before and during the Russian-Ukrainian war, it becomes clear that there are significant differences for bread, cereals, meat, poultry, fish, milk and its products, eggs, oils and fats, vegetables, sugar, jam, honey, chocolate, sweets, as well as other food products. In light of the rise in prices, real per capita income decreases, and thus the quantities of food commodities purchased decrease, in addition to the inability of low-income classes to buy some food commodities. With the continuation of the Russian-Ukrainian war, the suffering of net food importing countries worldwide, especially countries that import food commodities from Russia and Ukraine, increases.

By estimating the autoregressive vector model, it was found that there was an increase of 10% in both the World Food Price Index and the total population of Saudi Arabia during the study period (1990-2001). Both these factors consequently led to an increase in the Consumer Price Index of food products by 1.22% and 4.95% respectively. It was also found that the independent variables included in the model explain about 98% of the changes that occurred in the Consumer Price Index of food products during the study period, while the rest of the changes, estimated at about 2.0%, are due to other factors not included in the estimated model.

To study the impact of the Russian-Ukrainian war on the Consumer Price Index of food products in Saudi Arabia, the Consumer Price Index of food products was predicted during the outbreak of the war in 2022, and compared to its pre-war counterpart in 2021. The Consumer Price Index for food products was predicted by forecasting the total population of the Kingdom in 2022, which was estimated at 37.26 million, and increasing the world Food Price Index to 145.8 in 2022. Substituting in the autoregressive vector model estimated in this study, the Consumer Price Index for food products in Saudi Arabia was 137.7 in 2022, which is 12.2% higher than its counterpart of 122.78 in 2021.

In the context of the Russian-Ukrainian war, the supply of food commodities to Saudi Arabia is affected, meaning the period of coverage of imports for domestic consumption decreases, affecting the amount of surplus directed to stock development in the Kingdom. Consequently, the amount of withdrawal from stocks increases to meet food consumption demands among Saudi citizens, which means the size of the strategic stock and food security factor decreases, having obvious implications on strategic stocks. It is imperative that strategic stocks are sufficient enough to allow food commodities to continue flowing to local Saudi markets, thus enabling the government to control inflation and rising prices.

CONCLUSIONS

In conclusion, the Russian-Ukrainian war broke out before the world had an opportunity to recover from the negative effects of the coronavirus pandemic; particularly its impact on the global economy, and specifically net food importers such as Saudi Arabia. As world food prices continue to escalate, the value of food imports increases, and in light of the instability of the quantity and value of food exports, the amount of deficit in the food trade balance has increased. The Russian-Ukrainian war also affected the supply and flow of food to domestic markets, driving up consumer prices in rural and urban areas. It is clear that inflation and rising prices weaken the trade power of the national

currency of Saudi Arabia, which will become particularly concerning the longer the Russian-Ukrainian war lasts.

The war also led to a rise in oil and gas prices in the Kingdom, which led to higher production costs and, consequently, to higher farm prices of food products. It is well known that food security is linked to local production, imports, and Saudi agricultural investment abroad. With Saudi's weak contribution of domestic production to overall food security, the Russian-Ukrainian war has affected the nation's food supply and, accordingly, the amount of surplus directed to the development of strategic stocks. In the absence of a safe strategic stock that allows the continuous flow of food commodities to local Saudi markets, the government may find it difficult to maintain a stranglehold on escalating inflation and rising prices.

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BIOGRAPHIES

Prof. Adel Mohammed Khalifa Ghanem is a Professor at the Department of Agricultural Economics, College of Food and Agricultural Sciences, King Saud University. He has published 140 papers in local and international journals. He is the author of five books in the areas of food security, environment, price analysis, and financial, economic, and environmental feasibility studies. He supervised 15 masters and doctoral theses, and participated in the implementation of 31 studies for government agencies and the private sector, in addition to participating in research in many conferences, seminars, and workshops in Egypt and Saudi Arabia. He has also lectured in seven training courses for government and international agencies.

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