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(Original Article)

Perspective Econometric Analysis for Egypt's Edible Plant Oil Gap and Variables Influencing

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Abstract

The problem of the research is studying: what are the most important factors effecting the vegetable oil gap in Egypt? The study used time series data during the period (1975-2021), and the results showed that the biggest three crops produced were cotton seed, olives, and groundnuts, according for about 89% of oil crop production during the study period. While olive oil production multiplied one hundred times during the study period, cotton seed production decreased by about 88.6% from 1980 to 2020. The results show that the study variables are significantly affecting the vegetable oil gap in Egypt despite population growth and the world vegetable oil price. Accordingly, the study's findings on economic relationships can consolidate the current research on Egypt's vegetable oil gap. Policymakers and decision-makers can also ascertain the impact of variables influencing the vegetable oil gap.

Keywords: *Vegetable oil crops, Edible plant oils (EPO), EPO gap, Double log model.*

Introduction

Vegetable oil crops are these crops that are cultivated to extract oil from their seeds. Egypt uses soybeans, groundnuts, sunflowers, cotton seeds, sesame, flaxseeds (linseed), and olive oil as source of oil.

Edible plant oil (EPO) is used for food-based applications as a non-polluting renewable resource that is edible and provides a wide diversity of Fatty Acids (FAs)that play a crucial role in human nutrition as well as the prevention of diseases (Kumar, Sharma, & Upadhyaya, 2016), which consist of triacylglycerols (TAG) that are a major source of essential fatty acids in the human diet (Zahran, Gad, Al-Okbay, & Hassan, 2021). In addition, it contains fat-soluble vitamins (A, D, E, and K), which are important for overall health and have many benefits. Vegetable oils have fatty acids, which are important for the therapeutic and prophylactic prevention of diseases, maintaining brain function, the human embryo's growth and development, and the prevention of several dangerous illnesses such as inflammation and cardiovascular disease. In addition, FAs are now known as anticancer, and as more and more studies are conducted, the significance of lipids and fatty acids in human nutrition is becoming more widely recognized. Moreover, plant oils are identified as a rich source of omega -3 (e.g.

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flaxseed and olive oil) and omega-6 (e.g., sunflower and soybeans) fatty acids, which are important for improving vision, skin, joint, and brain function. Also, EPO represents an important source of healthy fats in a diet regime as it helps lower cholesterol and triglyceride levels and reduces the risk of heart disease and stroke. FAs are not only a vital part of the human diet, but they are also used in many industrial applications, including paints, lubricants, soaps and detergents, cosmetics, ink, and varnish. Thus, vegetable oil seeds are a growing market from both a nutritional and industrial standpoint (Combs, Jr. & McClung, 2016) (Jafari, Ebrahimi, Assatarakul, & Jafari, 2022).

The EPO industry is one of the important food industries in production industries, which provide major food commodities used in food-based applications. On average, a facility engaged in producing EPO provides job opportunities ranging from 420 to 480. The number of facilities that work in the EPO industry in 2015 was 31, representing about 0.4% of all facilities, which are 7942 facilities. While the number of workers in the EPO industry in 2015 was 14.7 thousand, representing 1.5% of the size of the workforce.(CAPMAS, 2018)

Despite the importance of vegetable oil on both a health and economic level, Egypt is suffering from a vegetable oil gap, whose self-sufficiency decreases gradually from 95% in the first sixteenth to 60% in the first seventeenth, while it reaches 24% in 2020.(Haggag & Ahmed, 2022), and the consumption of vegetable oils was 855.99 thousand tons on average during the period from 2001 to 2015, with a significant growth rate of 4.14% (Bassyouni , 2017).

Materials and Methods

The main idea of this research is to study: what are the most important factors effecting the vegetable oil gap in Egypt during the period (1975-2021)? Applying multiple logarithmic regression and using secondary data from 1975 to 2021 long time series in regression offers a powerful tool to understand the relationship between study variables (Hyndman & Athanasopoulos, 2018). The FAO database was used to obtain the data (FAO, 2023).

The model was estimated as follows:

$$\ln y = \beta_0 + \beta_1 \ln popr + \beta_2 \ln ex + \beta_3 \ln Cons + \beta_4 \ln O + \beta_5 \ln wp \qquad \textbf{Eq. 1}$$

Where (y) the vegetable oil gap in Egypt, ($popr$) population growth rate, (ex) exchange rate, ($cons$) vegetable plant oil consumption, (O) local vegetable plant oil production, and (wp) world vegetable plant oil price.

This equation is known as the log-log model or double log model and is also known as the constant elasticity model, in which the slop coefficient can be interpreted as elasticity(Gujarati D. , 2015)(ASTERIOU & HALL, 2021).

Elasticity is the ratio of the percentage change in one variable divided by the percentage in another variable.(Gujarati D. N., 2004)(Andren, 2007)(Stock & Watson, 2020), so:

$$\beta_i = \frac{\partial \ln y}{\partial \ln x} = \frac{\partial y/y}{\partial x/x} = \frac{percentage\ change\ in\ y}{percentage\ change\ in\ x} \qquad \text{Eq. 2}$$

Where ∂ refers to the partial derivative, x the independent variable, and y the dependent variable, β_i the regression coefficient, i denotes the number of coefficients (i=1,2,…,5).

This study estimates the effect of population growth rate, real GDP per capita, vegetable oil production, consumption, and world prices of vegetable oil on the vegetable oil gap in Egypt during the period (1975-2021).

The model and check for diagnostic purposes were obtained using the (Eviews 10) program to accomplish this process(Vogelvang, 2005)(Agung, 2009).

Results and Discussion

Figure 1represents the share of average Egyptian production of oil crop seeds. During the study period, cotton seeds, olives, groundnuts, and soya beans represented the biggest share of oil crop seeds, representing56%, 24%, 9%, and 5%, respectively, and 94% collectively, while sesame seeds, sunflower seeds, and linseeds represented 2% in each and6% collectively.

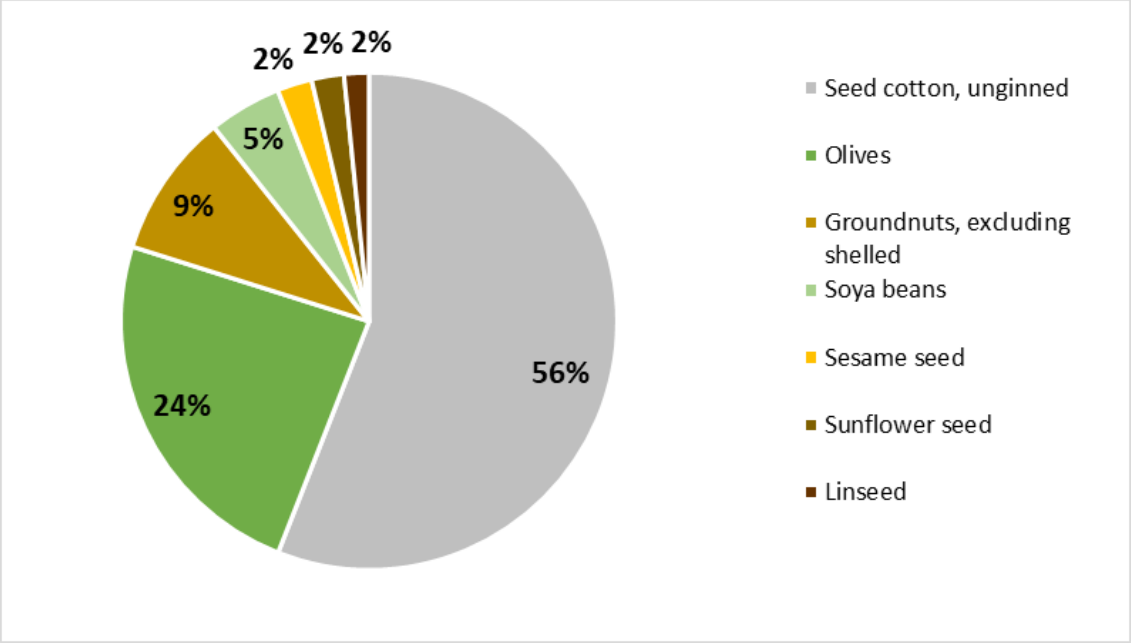

Figure 1. The Average of Egyptian production of oil crop seeds during (1975-2021).

Whereas cotton seeds represent the biggest vegetable oil share by more than half, and Egypt was dependent on cotton seed for producing edible oil, cotton seed production decreased from 1.4 million tons in 1980 to 160 tons in 2020, which means that the biggest vegetable oil production share decreased by 88.6% in forty years, as shown in Figure 2.

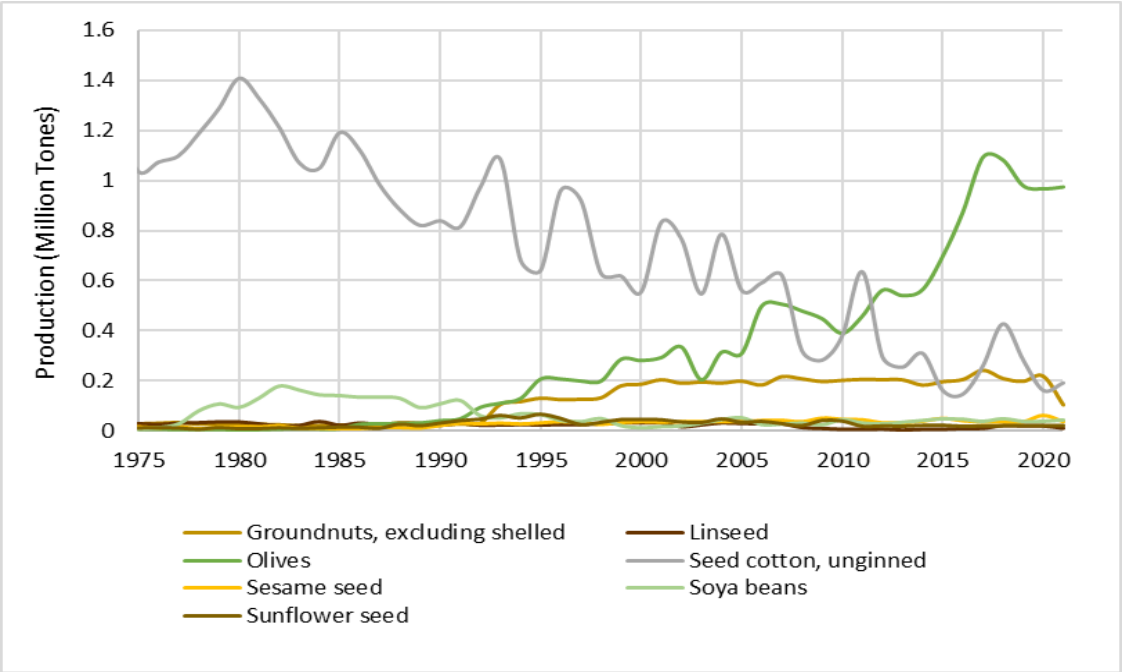

Figure 2. Egyptian production of oil crop seeds during (1975-2021).

The results also show that Egyptian production of oil seeds of groundnuts, soya beans, sesame seed, sunflower seed, and linseed did not exceed 2.5 thousand tones for each of them during the study period, as shown in Figure 2

1-Estimating the Log-Log model

By estimating the regression, the results show that exchange rate, and vegetable oil consumption have a positive significant relationship with the vegetable oil gap, while local oil production has a negative significant relationship with the vegetable oil gap, but there are no significant effects of population growth and world oil prices, as shown in Table 1.

Table 1. Regression results of the log-log model

independent Variables	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.149543	0.200712	-5.727324	0.0000
POPR	0.078439	0.041171	1.905200	0.0638
EX	0.015740	0.007265	2.166543	0.0361
CONS	1.373333	0.015538	88.38530	0.0000
O	-0.349533	0.012694	-27.53425	0.0000
WP	-0.009682	0.015447	-0.626791	0.5343
R-squared	0.998390	Mean dependent var		13.34827
Adjusted R-squared	0.998193	S.D. dependent var		0.578399
S.E. of regression	0.024584	Akaike info criterion		-4.454688
Sum squared resid	0.024780	Schwarz criterion		-4.218499
Log likelihood	110.6852	Hannan-Quinn criter.		-4.365808
F-statistic	5084.329	Durbin-Watson stat		1.399630
Prob(F-statistic)	0.000000			

Where: (popr) population growth rate, (ex) exchange rate, (cons) consumption of vegetable plant oil, (O) local vegetable plant oil production, and (wp) world vegetable plant oil price.

2-Goodness of fit

The results show that the F-test is statistically significant at the 1% level, and the adjusted coefficient of determination $\bar{R}^2$=0.9981, means that 99.81% of the change in the vegetable oil gap is dependent on study variables, while the standard error of regression (SER), which measures the variability of the model estimator, is equal to 0.02. So, this model is appropriate to describe the vegetable oil gap in Egypt after a diagnostic check.

3-Diagnostic check

To evaluate the model assumption, the diagnostic tests are estimated as follows:

-Multicollinearity

-Serial correlation

-Heteroscedasticity

-Normality

- **Multicollinearity**

Table shows the Variance Inflation Factors (VIF) of independent variables in the estimated model. The table clearly shows that the VIF does not exceed 10, which means that there is no collinearity among the regressors.

Table 2. The variance inflation factor of independent variables in regression model
Variance Inflation Factors
Sample: 1975 2021
Included observations: 47

Variable	Centered VIF
POPR	2.226482
EX	4.039872
CONS	4.760705
O	3.599583
WP	3.757484

- **Serial correlation**

According to Table 1, the Durbin-Watson test (*d*) is equal to 1.4, where the lower (*dl*) and upper (*du*) limits of the critical value are 1.11 and 1.58, respectively. This means that the *dw* value lies in an inconclusive region, and no certain conclusion about autocorrelation may be made.

Figure 3shows that the residual has no pattern chronologically, which means that there is no evidence of autocorrelation in the error of the regression model estimated.

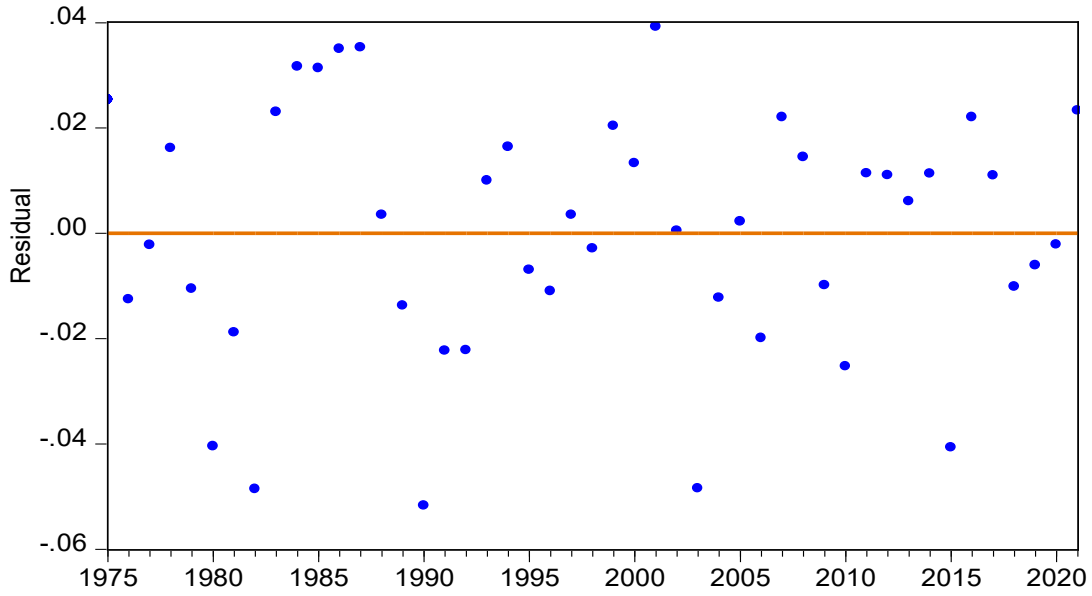

Figure 3. the residual of estimated regression model.

- **Heteroskedasticity test**

The result of the Breusch-Pagan-Godfrey test shows that the estimated model is homoscedastic, where the probability of chi2is more than 5%, as shown in Table 2.

Table 2. The result of Heteroscedasticity Breusch-Pagan-Godfrey test.

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	2.219476	Prob. F(5,40)	0.0706
Obs*R-squared	10.01157	Prob. Chi-Square(5)	0.0749
Scaled explained SS	6.198028	Prob. Chi-Square(5)	0.2874

- **Normality test**

The residual of the estimated model is normally distributed, with the skewness close to zero and the kurtosis close to 3. And the Jarque - Bera test is not significant, which means that the residual is normally distributed, as shown in Figure 5.

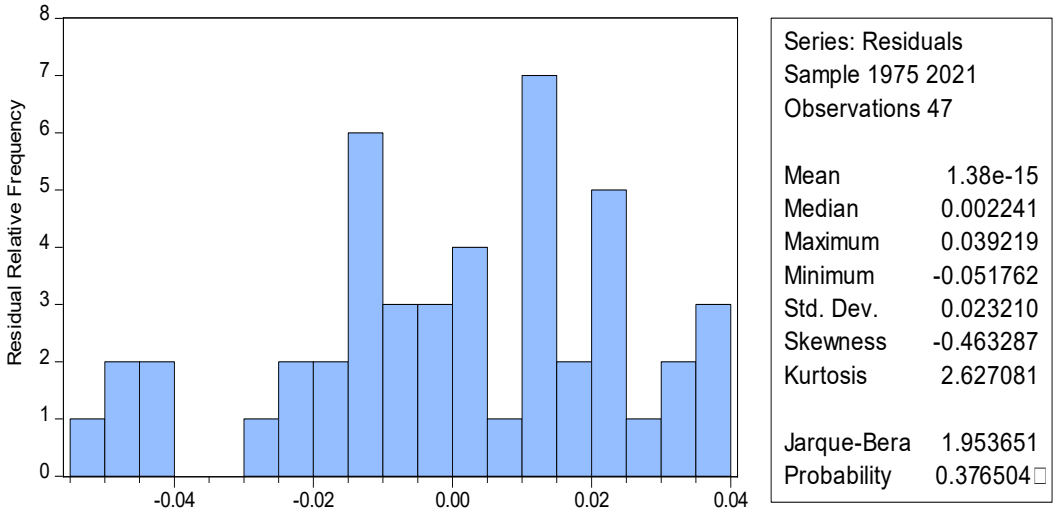

Figure 4.The summary statistics and normality test of estimated model residuals.

After a diagnostic check, it was clear that the estimated model was appropriate to describe the vegetable oil gap according to the study period.

4-Interpretation of the model

The results show that if the exchange rate increases by 10%, on average, the vegetable oil gap increases by 0.2%, holding the other variable constant. While consumption increases by 1%, on average, the vegetable oil gap increases by 1.37%, holding the other variable constant. But if the local oil production increases by 1%, on average, the vegetable oil gap decreases by 0.35%, holding the other variable constant. While the population growth rate and the world price of vegetable oils had no significant effect on the vegetable oil gap in Egypt during the study period.

The results in Table 1 can be written as follows:

$$\ln y = \underset{}{-1.15} + \underset{(-5.73)^{**}}{0.08 \ln popr} + \underset{(1.91)}{0.02 \ln ex} + \underset{(2.17)^{*}}{1.37 \ln Cons} - \underset{(88.39)^{**}}{0.35 \ln O} - \underset{(-27.53)^{**}}{0.01 \ln wp}$$
$$\underset{(-0.63)}{}$$

$$F = 5084.33^{**} \qquad \bar{R}^2 = 0.9981$$

This equation can be shown in Figure 5, which shows the estimated model of the vegetable oil gap, the actual values, and the error during the study period from 1975 to 2021.

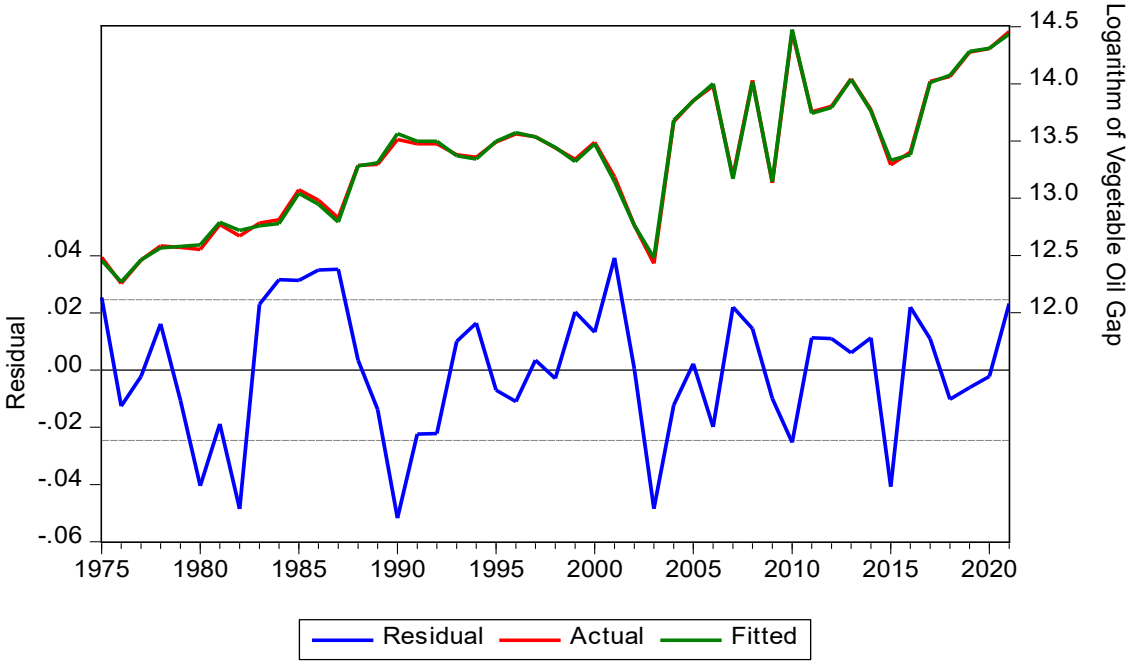

Figure 5. The actual, fitted, and residual of vegetable oil gap in Egypt during (1975-2021).

Conclusions

In this study, the vegetable oil gap in Egypt was inserted into a double-log model to study the variables that affected it. The FAO database was used to get the study data from 1975 to 2021, where cotton seed, groundnuts, and olives were the top three crops produced throughout the study period, making up almost 89% of the total production of oil crops. Production of cotton seed fell by roughly 88.6%

between 1980 and 2020, although production of olive oil multiplied 100 times throughout the research period. as well as the fact that throughout the study period, Egypt produced fewer than 2,500 tons of each of the oil seeds from groundnuts, soybeans, sesame seeds, sunflower seeds, and linseed. According to the regression analysis and after testing the diagnostic check, the signs of the study variables are consistent with the economic logic; while all variable coefficients are significantly affecting the vegetable oil gap in Egypt, the population growth rate and the world vegetable oil prices have no significant evidence affecting the vegetable oil gap. The biggest positive effect on the vegetable oil gap was oil consumption, then the growth rate of the population, then the exchange rate, while local oil production is the only element that has an inverse effect on the vegetable oil gap in Egypt, according to the estimated model. And the weakening of oil production crops and the deterioration of cotton production are among the most important factors that helped increase the size of the vegetable oil gap in Egypt. So, the results of this research can help policymakers and decision-makers understand the factors that affect the vegetable oil gap and the magnitude of the effect of these factors, which enhances handling the vegetable oil gap in Egypt.

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تحليل اقتصـــادي قياســـي لفجوة الزيوت النباتية الصـــالحة للأكل في مصـــر والمتغيرات المؤثرة عليها

أحمد محمد عبد العزيز الشافعي

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الملخص

محاصيل الزيوت النباتية هي تلك المحاصيل التي تزرع لاستخلاص الزيوت منها، وترجع أهمية الزيوت النباتية في تغذية الإنســـان والحفاظ عليه من الامراض لاحتوائها على الأحماض الأمينية الأساسية والفيتامينات الذائبة فيها، كما انها تعتبر مصـدر جيد لأوميجا 3، 6، وقد اهتمت هذه الدارسة بالتعرف على فجوة الزيوت النباتية في مصر وتحديد مدى تأثير معدل النمو السكاني وسعر الصرف والاستهلاك والإنتاج المحلي وأسعار الزيوت العالمية على تلك الفجوة. واستخدمت الدراســـة في تحقيق أهدافها بيانات الســـلاســـل الزمنية من عام 1975 إلى عام 2021، وأظهرت النتائج أن أكبر ثلاثة محاصـــيل زيتية منتجة هي بذرة القطن والزيتون والفول الســـوداني بنســـبة حوالي 89% من إنتاج المحاصيل الزيتية خلال فترة الدراسة. وبينما تضـاعف إنتاج زيت الزيتون مئة مرة خلال فترة الدراسة، انخفض إنتاج بذرة القطن بنحو 88.6% في الفترة من 1980 ،2020. وجاءت نتائج الدراسـة تتفق مع المنطق الاقتصـادي، وأظهرت النتائج أن متغيرات الدراسـة تؤثر بشـــكل معنوي على فجوة الزيوت النباتية في مصـــر عدا معدل النمو الســـكاني والســـعر العالمي للزيوت النباتية. وعليه فقد توصلت نتائج الدراسة للعلاقات الاقتصادية التي يمكن أن تعزز البحث الحالي حول فجوة الزيوت النباتية في مصـــر والعوامل المؤثرة عليها وحجم ذلك التأثير. ويمكن لواضـعي السياسات وصـناع القرار أيضًا توظيف متغيرات الدراسة التي تؤثر على فجوة الزيوت النباتية في تقليل الفجوة الزيتية والحد من تفاقم هذه المشكلة في مصر.

كلمات مفتاحية: *محاصـــيل الزيوت النباتية، الزيوت النباتية الصـــالحة للأكل، الفجوة من الزيوت النباتية، النموذج اللوغاريتمي المزدوج.*