

## Assessing the Impact of Tariffs on Consumer Prices and Food Security of Red Meat and Poultry in the Kingdom of Saudi Arabia

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### Abstract

Given the potential adverse effects of tariffs on food imports, this study assesses the impact of import tariffs on consumer prices and food security for red meat and poultry in the Kingdom of Saudi Arabia using econometric analysis. The findings indicate that Saudi Arabia imposed a 5% tariff on red meat imports throughout the period 2003–2024. In contrast, tariffs on poultry meat imports increased over time, reaching 25% during 2022–2024. By the end of the study period (1990–2024), the food security indices for red meat and poultry reached 0.39 and 0.42, respectively. Because the tariff rate on red meat imports remained unchanged over the study period, its effect on the Consumer Price Index (CPI) was statistically insignificant. In contrast, a 10% increase in the tariff rate on poultry meat imports was associated with a 0.7% increase in the poultry price index. Furthermore, a 10% increase in the estimated consumer price indices for red meat and poultry was associated with decreases of 13.6% and 10.6%, respectively, in their corresponding food security indices. Based on these findings, the study recommends that the government continue to absorb the cost of tariffs imposed on imported agricultural production inputs. It also recommends determining an optimal tariff rate for food imports, with particular emphasis on strategically important food commodities, to balance the objectives of food security and consumer price stability.

**Keywords:** Imports, Consumer Prices, Strategic Stocks, Food Security, Meat.

## 1. Introduction

Tariffs are used as a policy instrument to increase tax revenues or protect domestic industries from competition with foreign products by raising the prices of imported goods. Consequently, consumers are required to pay higher prices when they choose to purchase imported goods. Tariffs may also encourage firms and companies to increase domestic production and preserve local employment. In addition, some countries use tariffs as a means of exerting economic pressure on other countries and compelling them to comply with their demands by increasing duties on essential goods and services (Thanoon, 2020).

The Zakat, Tax and Customs Authority (ZATCA) in the Kingdom of Saudi Arabia has set customs duties at 15% on all types of imported fresh vegetables, household products, automobiles, and automotive spare parts, such as oil tanks and braking systems. Customs duty rates on imported meat ranged between 2% and 15%. Meanwhile, customs duties on dairy products, bathtubs, pipes and tubes, iron, cosmetics, fruit and confectionery wrapping paper, refrigeration equipment, granite, and marble ranged from 0% to 15%.

The Ministry of Environment, Water and Agriculture (2024) announced that the Saudi government would bear customs duties on equipment and machinery used in certain agricultural projects, including poultry, dairy, plant and animal production, fisheries, storage and refrigeration facilities, and the oils required for their operation. This exemption also covers agricultural production inputs, such as seeds, fertilizers, compound-feed production inputs, and other items specified in the relevant list, for a period of two years, subject to a set of prescribed conditions and regulations. This initiative represents a strategic step toward supporting the agricultural sector, promoting domestic production, and reducing production costs. It also aims to strengthen the capacity of small-scale producers, cooperatives, and rural enterprises by enabling them to access production inputs and agricultural services and improve their access to markets. Furthermore, the initiative contributes to diversifying the productive base and enhancing food security in line with the objectives of Saudi Vision 2030.

Customs tariffs affect prices, foreign trade, and government revenues. Hoekman and Olarreaga (2004) found that a 50% reduction in tariff rates generates greater positive effects on both exports and economic welfare. The removal of border barriers, such as customs duties, can also enhance the capacity of developing countries to expand their exports and realize economic gains. Similarly, Hayakawa et al. (2020) found that a 1% reduction in import tariffs increases import freight rates by 0.8%, reduces export freight rates by approximately 1.1%, and increases export volumes by between 0.6% and 1.0%. In contrast, Djido et al. (2022) demonstrated that imposing a 35% tariff on edible oil imports in East Africa resulted in higher domestic prices and increased domestic agro-industrial production by approximately USD 283.9 million. It also improved the trade balance by USD 206 million, driven by a 7.11% increase in exports and a 13.1% decline in imports.

Glauber et al. (2025) found that the “reciprocal” tariffs announced by the United States in 2025 could reduce global agricultural trade by between 3.3% and 4.7%, accompanied by a decline in global GDP

of approximately 0.3%–0.4% and a contraction of the U.S. economy by 1.0%–1.2% if major trading partners respond with retaliatory measures. These policies could also reshape global agricultural supply chains to the benefit of competitors such as Brazil and Argentina, while adversely affecting U.S. farmers in the long run. Such developments could threaten the stability of the global food system and increase food security risks, particularly in low-income countries.

Ali et al. (2024) found that a 1% increase in the customs tariff rate leads to decreases in Egyptian imports of cereals, meat, sugar, and edible oils by 1.11%, 6.9%, 1.21%, and 0.28%, respectively. The study recommended that Egypt could meet most of its import requirements from BRICS countries in order to benefit from the preferential tariff advantages associated with its membership in the BRICS group.

Ghanem et al. (2025) examined the positive and negative effects of import tariffs on Saudi imports over the period 1990–2023. The study found that a 10% increase in the import tariff rate leads to increases of 2.6% in government revenues and 1.7% in the protection of domestic products and industries, respectively. However, a 10% increase in import tariffs also results in an 8.2% increase in consumer prices and a 19.9% decrease in the value of imports. Overall, the study concluded that the negative effects of import tariffs and value-added tax outweigh their positive effects on the Saudi economy. Therefore, reducing tariffs on imported products is recommended to help curb inflation and improve consumer welfare.

Ghanem et al. (2025) conducted another study aimed at assessing the impact of import tariffs and their integration with value-added tax (VAT) on food security over the period 2000–2024. The study found that a 10% increase in the import tariff rate leads to increases of 0.44% in the Consumer Price Index (CPI) and 0.30% in the number of people experiencing severe food insecurity, respectively. Following the integration of customs tariffs and VAT beginning in 2018, the relative negative effect on food security increased from 0.72% to 1.49%. Accordingly, the study recommended a gradual reduction in VAT to mitigate increases in food prices and reduce both the proportion and number of people experiencing severe food insecurity.

Amid the continued increase in import tariffs in Saudi Arabia and their integration with value-added tax (VAT) beginning in 2018, the ratio of net taxes to import value increased from 16.49% in 2018 to 37.24% in 2021, before declining to 29.05% in 2024 (Saudi Central Bank, 2025). Naturally, higher tax rates on imported products affect the supply of food commodities and increase the cost of obtaining them. Consequently, the period over which imports can cover domestic consumption is reduced, as are the quantities of surpluses available for developing strategic stocks and the food security coefficients of major strategic commodities.

## 2. Research Objectives

This study aims to assess the impact of customs tariffs on consumer prices and food security for red meat and poultry in the Kingdom of Saudi Arabia during the period 1990–2024. Specifically, the study seeks to achieve the following objectives:

1. Assess the current status of customs tariffs on Saudi imports and the food security situation for red meat and poultry.
2. Estimate the proposed model to examine the impact of customs tariffs on consumer prices and food security for red meat and poultry over the study period.

### 3. Study Methodology

To achieve the objectives of the study, this research relied on published data issued by the Zakat, Tax and Customs Authority (ZATCA), the General Authority for Statistics (GASTAT), and the Food and Agriculture Organization of the United Nations (FAOSTAT).

To estimate the annual growth rates of production, consumption, self-sufficiency, exports, imports, production adequacy period, and import coverage period for red meat and poultry in Saudi Arabia during the period 1990–2024, both exponential and quadratic growth models were employed. These models can be expressed by the following equations (Ismail, 2001):

#### Exponential Model:

$$\ln Y = B_0 + B_1 T \dots \dots \dots (1)$$

The above equation can be expressed in the following form:

$$Y = e^{B_0 + B_1 T} \dots \dots \dots (2)$$

Where:  $e$  denotes the base of the natural logarithm, equal to 2.71828, while  $B_1$  represents the annual growth rate, which is calculated using the following equation:

$$r = \frac{dY}{dT} \div Y = B_1 \dots \dots \dots (3)$$

#### Quadratic Model:

$$Y = a_0 + b_1 T + b_2 T^2 + e \dots \dots \dots (4)$$

The annual growth rate is calculated using the following equation:

$$r = \left( \frac{dY}{dT} \div \bar{Y} \right) \times 100 \dots \dots \dots (5)$$

This study also employed the economic equations used to estimate the strategic stock and food security coefficient for red meat and poultry, which can be expressed as follows:

$$PSP_{lc} = LPRO_m \div LCONS_d \dots \dots \dots (6)$$

$$PCI_{lc} = QIMPO_m \div LCONS_d \dots \dots \dots (7)$$

$$ASD_m = [(SLSPCI_{lc} - 365) \times LCONS_d] - QSPO_m \dots \dots \dots (8)$$

$$FSF_m = QSS_{lm} \div LCONS_y \text{ (Ghanem and Kamara, 2010)} \dots \dots \dots (9)$$

Where:

- $PSP_{lc}$ : The period of production adequacy for domestic consumption.
- $LPRO_m$ : Domestic production.
- $LCONS_d$ : Daily domestic consumption.
- $PCI_{lc}$ : The period of import coverage for domestic consumption.
- $QIMPO_m$ : The quantity of imports.
- $ASD_m$ : The amount of surplus or deficit in domestic consumption.
- $SLSPCI_{lc}$ : The combined period of production adequacy and import coverage for domestic consumption.
- $QSPO_m$ : The quantity of exports.
- $FSF_m$ : The food security coefficient.
- $QSS_{lm}$ : The strategic stock.
- $LCONS_y$ : Annual domestic consumption.

The food security coefficient (FSC) ranges from zero to one. The closer the value of the food security coefficient is to zero, the lower the level of food security; conversely, the closer its value is to one, the higher the level of food security (Ghanem and Kamara, 2010).

The study also employed the proposed model, which consists of two behavioral equations, expressed as follows:

$$Y_1 = a_0 + a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 + e_1 \dots \dots \dots (10)$$

$$Y_2 = b_0 + b_1\hat{Y}_1 + b_2X_2 + b_3X_5 + e_2 \dots \dots \dots (11)$$

The proposed model includes the following variables:

- Endogenous Variables: The Consumer Price Index (CPI) for red meat and poultry ( $Y_1$ ), and the level of food security for red meat and poultry, expressed as the ratio of the amount of surplus or deficit to domestic consumption of red meat and poultry ( $Y_2$ ).
- Exogenous Variables: The import tariff rate on meat imports into Saudi Arabia ( $X_1$ ), the red meat and poultry production index in the Kingdom of Saudi Arabia ( $X_2$ ), the Global Food Price Index ( $X_3$ ), total population ( $X_4$ ), and the quantity of Saudi imports of red meat and poultry, measured in thousand tons ( $X_5$ ).

The proposed model was estimated using the Ordinary Least Squares (OLS) method, since the matrix of endogenous variables has ones along its main diagonal, while all elements above the main diagonal are equal to zero, as follows (Gujarati, translated and reviewed by Odeh, 2015):

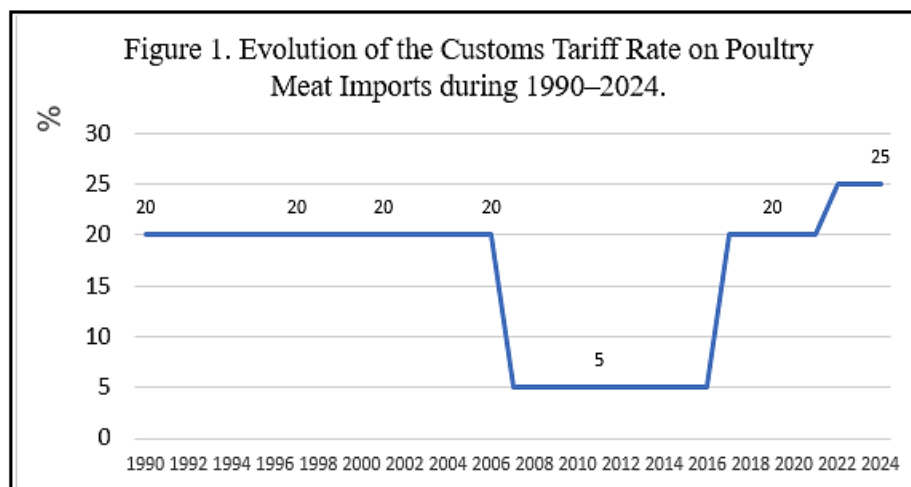
| Endogenous Variables |       | Exogenous Variables |        |        |        |        |
|----------------------|-------|---------------------|--------|--------|--------|--------|
| $Y_1$                | $Y_2$ | $X_1$               | $X_2$  | $X_3$  | $X_4$  | $X_5$  |
| 1                    | 0     | $-a_1$              | $-a_2$ | $-a_3$ | $-a_4$ | 0      |
| $-b_1$               | 1     | 0                   | $-b_2$ | 0      | 0      | $-b_3$ |

## 4. Research Results

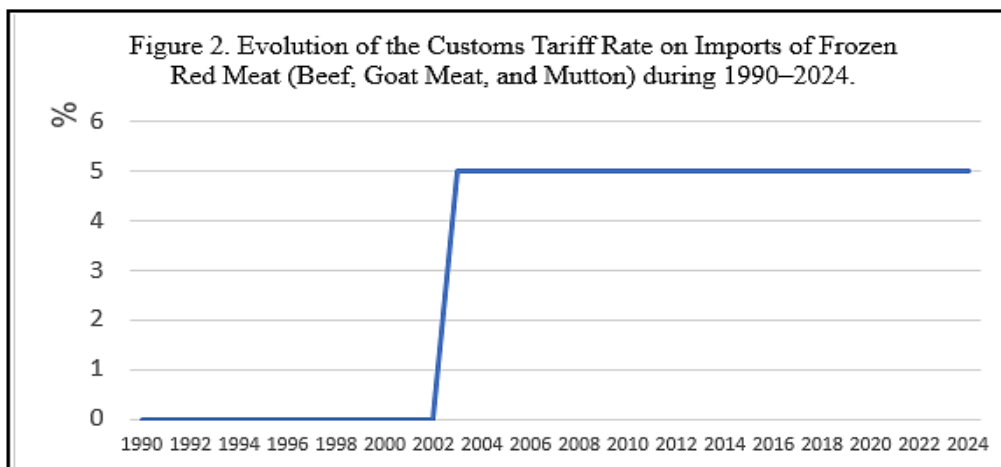
### 4.1 Current Status of Customs Tariffs on Saudi Imports of Red Meat and Poultry:

An examination of the evolution of customs tariff rates on red meat and poultry imports reveals, based on the data presented in Figure 1, that the customs tariff rate on poultry meat imports decreased from 20% during 1990–2006 to 5% during 2007–2016, before increasing to 20% during 2017–2021 and subsequently rising to 25% during 2022–2024. The reduction in the customs tariff rate on poultry meat imports to 5% during 2007–2016 can be attributed to several economic and food-related considerations, most notably: (1) maintaining poultry price stability; (2) meeting the domestic food supply gap; (3) the unified customs tariff of the Gulf Cooperation Council (GCC) countries, which was set at 5% for most food commodities, leading to a reduction in tariffs on several food products, including poultry; (4) the Saudi government's policy of reducing tariffs on certain essential commodities to mitigate the impact of inflation on consumers, particularly following the global financial crisis and the rise in food prices; and (5) the decision to reduce tariffs to 5% was implemented for a limited period to support essential commodities, after which tariffs were increased to 20% beginning in 2017, particularly following government support for and expansion of domestic production.

Regarding the evolution of the customs tariff rate on imports of frozen red meat (beef, goat meat, and mutton), the data presented in Figure 2 indicate that the Saudi government began imposing a customs tariff rate of 5% in 2003, which remained in effect through 2024.



Source: Zakat, Tax and Customs Authority (ZATCA), 1990–2024.



Source: Zakat, Tax and Customs Authority (ZATCA), 1990–2024.

#### 4.2. Current Status of Food Security Indicators for Red Meat and Poultry:

The analysis of food security indicators for red meat, based on the data presented in Tables 1, 2, and 3, reveals that the self-sufficiency ratio for red meat ranged from a minimum of 38.6% in 2002 to a maximum of 74.5% in 1993. The self-sufficiency ratio for red meat declined at a modest annual rate of 0.15% over the study period. Meanwhile, Saudi Arabia's red meat exports increased from 1.0 thousand tons in 1990 to 91.0 thousand tons in 2021, before declining to 25.48 thousand tons in 2024. Similarly, red meat imports increased from 219.0 thousand tons in 1990 to 550.0 thousand tons in 2020, before decreasing to 441.9 thousand tons in 2024. Overall, both Saudi red meat exports and imports increased during the period 1990–2024, at annual growth rates of 8.1% and 2.7%, respectively.

The period during which domestic production was sufficient to meet local consumption ranged from a minimum of 140.4 days in 2002 to a maximum of 272.0 days in 1993. This period declined at a modest annual rate of 0.39% over the study period. Similarly, the import coverage period for domestic consumption ranged from a minimum of 101.6 days in 1993 to a maximum of 263.3 days in 2005. The import coverage period for domestic red meat consumption increased at a modest annual growth rate of 0.38% over the study period.

When the surplus and deficit in red meat were calculated, the results indicated the presence of a surplus relative to domestic consumption in 1990; 1994–1995; 1997–2007; 2010; 2013–2015; 2017–2018; 2022; and 2024. The total surplus and deficit amounted to 505.57 and 333.33 thousand tons, respectively. Accordingly, the quantity of surplus allocated to building up the strategic stock exceeded the quantity of deficit, or withdrawals from the strategic stock. The surplus-to-deficit ratio reached 151.7% at the end of the period 1990–2024.

According to the concept of strategic stocks, defined as the net balance between total surpluses and

deficits, the strategic stock is estimated at approximately 172.24 thousand tons. Given that domestic red meat consumption amounted to 441.9 thousand tons in 2024, the food security coefficient for red meat is estimated at approximately 0.39 at the end of the 1990–2024 period (Table 2).

Table (1): Red Meat Production, Consumption, and Foreign Trade in Saudi Arabia during the Period 1990–2024  
(Source: Compiled and calculated from: (1) data presented in Figure 5; and (2) Food and Agriculture Organization of the United Nations (FAOSTAT), 1990–2024)

| Foreign Trade (1,000 tons) |         | Domestic Consumption (1,000 tons) |        | Domestic Production (1,000 tons) | Year |
|----------------------------|---------|-----------------------------------|--------|----------------------------------|------|
| Imports                    | Exports | Daily                             | Annual |                                  |      |
| 70                         | 1       | 0.6                               | 219    | 150.87                           | 1990 |
| 96                         | 5       | 0.65                              | 239    | 147.71                           | 1991 |
| 98                         | 6       | 0.68                              | 247    | 153.8                            | 1992 |
| 59                         | 6       | 0.58                              | 212    | 158.1                            | 1993 |
| 66                         | 5       | 0.62                              | 228    | 168.0                            | 1994 |
| 251.16                     | 4.29    | 1.02                              | 370.65 | 155.14                           | 1995 |
| 250.51                     | 3.96    | 1.03                              | 377.69 | 161.14                           | 1996 |
| 206.91                     | 4.46    | 0.89                              | 323.38 | 157.00                           | 1997 |
| 184.22                     | 7.08    | 0.78                              | 286.27 | 155.02                           | 1998 |
| 197.45                     | 9.00    | 0.85                              | 309.63 | 158.69                           | 1999 |
| 211.47                     | 3.84    | 0.88                              | 322.18 | 159.6                            | 2000 |
| 124.66                     | 6.91    | 0.66                              | 240.00 | 160.0                            | 2001 |
| 282.35                     | 8.81    | 1.13                              | 410.90 | 158.7                            | 2002 |
| 248.81                     | 11.61   | 0.99                              | 363.17 | 161.9                            | 2003 |
| 250.39                     | 15.21   | 0.98                              | 358.80 | 165.8                            | 2004 |
| 313.29                     | 23.86   | 1.19                              | 435.09 | 169.0                            | 2005 |
| 276.72                     | 29.40   | 1.09                              | 398.78 | 164.1                            | 2006 |
| 274.66                     | 36.41   | 1.11                              | 405.94 | 171.2                            | 2007 |
| 226.90                     | 42.26   | 0.98                              | 356.25 | 158.2                            | 2008 |
| 222.32                     | 38.81   | 1.03                              | 374.95 | 166.5                            | 2009 |
| 232.94                     | 46.56   | 1.01                              | 366.95 | 185.3                            | 2010 |
| 260.09                     | 44.55   | 1.19                              | 433.23 | 212.2                            | 2011 |
| 284.85                     | 52.32   | 1.29                              | 469.64 | 222.0                            | 2012 |
| 282.34                     | 17.27   | 1.34                              | 490.58 | 228.0                            | 2013 |
| 306.87                     | 19.08   | 1.28                              | 467.71 | 193.6                            | 2014 |
| 338.82                     | 18.27   | 1.39                              | 508.78 | 201.3                            | 2015 |
| 255.03                     | 20.53   | 1.22                              | 444.41 | 210.8                            | 2016 |
| 256.11                     | 21.29   | 1.20                              | 438.14 | 216.5                            | 2017 |
| 215.03                     | 22.58   | 1.11                              | 403.71 | 229.0                            | 2018 |
| 237.46                     | 21.35   | 1.46                              | 533.29 | 275.8                            | 2019 |
| 225.86                     | 82.00   | 1.51                              | 550.00 | 329.2                            | 2020 |
| 249.36                     | 91.00   | 1.41                              | 14.05  | 305.7                            | 2021 |
| 292.78                     | 90.00   | 1.21                              | 441.7  | 254.1                            | 2022 |
| 178.43                     | 12.64   | 1.34                              | 487.7  | 297.5                            | 2023 |
| 241.05                     | 25.48   | 1.21                              | 441.9  | 274.0                            | 2024 |

Table (2): Key Indicators for Assessing Red Meat Food Security during the Period 1990–2024. (Source: Data presented in Table 1)

| Deficit                     |                             | Surplus                     |                             | Import<br>Coverage<br>Period<br>(days) | Production<br>Sufficiency<br>Period<br>(days) | Self-<br>Sufficiency<br>Ratio (%) | Year |
|-----------------------------|-----------------------------|-----------------------------|-----------------------------|----------------------------------------|-----------------------------------------------|-----------------------------------|------|
| Deficit<br>Period<br>(days) | Quantity<br>(1,000<br>tons) | Surplus<br>Period<br>(days) | Quantity<br>(1,000<br>tons) |                                        |                                               |                                   |      |
| -                           | -                           | 1.7                         | 1.04                        | 116.7                                  | 251.7                                         | 68.9                              | 1990 |
| 0.1                         | 0.06                        | -                           | -                           | 146.6                                  | 226.0                                         | 61.9                              | 1991 |
| 1.4                         | 0.968                       | -                           | -                           | 144.8                                  | 227.6                                         | 62.3                              | 1992 |
| 1.7                         | 1.012                       | -                           | -                           | 101.6                                  | 272.0                                         | 74.5                              | 1993 |
| -                           | -                           | 1.5                         | 0.952                       | 105.7                                  | 268.9                                         | 73.7                              | 1994 |
| -                           | -                           | 29.8                        | 30.39                       | 246.2                                  | 152.8                                         | 41.9                              | 1995 |
| 69.9                        | 72.043                      | -                           | -                           | 143.2                                  | 155.7                                         | 42.7                              | 1996 |
| -                           | -                           | 39.7                        | 35.323                      | 232.5                                  | 177.2                                         | 48.5                              | 1997 |
| -                           | -                           | 59.8                        | 46.662                      | 236.2                                  | 197.7                                         | 54.2                              | 1998 |
| -                           | -                           | 43.8                        | 37.24                       | 232.3                                  | 187.1                                         | 51.3                              | 1999 |
| -                           | -                           | 52.3                        | 46.056                      | 240.3                                  | 181.4                                         | 49.5                              | 2000 |
| -                           | -                           | 55.8                        | 36.848                      | 188.9                                  | 242.4                                         | 66.7                              | 2001 |
| -                           | -                           | 17.5                        | 19.779                      | 249.9                                  | 140.4                                         | 38.6                              | 2002 |
| -                           | -                           | 38.1                        | 37.692                      | 251.3                                  | 163.5                                         | 44.6                              | 2003 |
| -                           | -                           | 44.2                        | 43.296                      | 255.5                                  | 169.2                                         | 46.2                              | 2004 |
| -                           | -                           | 20.2                        | 24.097                      | 263.3                                  | 142.0                                         | 38.8                              | 2005 |
| -                           | -                           | 12.5                        | 13.655                      | 253.9                                  | 150.6                                         | 41.2                              | 2006 |
| -                           | -                           | 3.8                         | 4.216                       | 247.4                                  | 154.2                                         | 42.2                              | 2007 |
| 15.2                        | 14.918                      | -                           | -                           | 231.5                                  | 161.4                                         | 44.4                              | 2008 |
| 25.2                        | 25.935                      | -                           | -                           | 215.8                                  | 161.7                                         | 44.4                              | 2009 |
| -                           | -                           | 3.0                         | 3.031                       | 230.6                                  | 183.5                                         | 50.5                              | 2010 |
| 5.5                         | 6.589                       | -                           | -                           | 218.6                                  | 178.3                                         | 49.0                              | 2011 |
| 12.7                        | 16.329                      | -                           | -                           | 220.8                                  | 172.1                                         | 47.3                              | 2012 |
| -                           | -                           | 2.9                         | 3.902                       | 210.7                                  | 170.1                                         | 46.5                              | 2013 |
| -                           | -                           | 11.1                        | 14.2                        | 239.7                                  | 151.3                                         | 41.4                              | 2014 |
| -                           | -                           | 10.5                        | 14.534                      | 243.8                                  | 144.8                                         | 39.6                              | 2015 |
| 0.0                         | 0.034                       | -                           | -                           | 209.0                                  | 172.8                                         | 47.4                              | 2016 |
| -                           | -                           | 11.1                        | 13.27                       | 213.4                                  | 180.4                                         | 49.4                              | 2017 |
| -                           | -                           | 14.7                        | 16.27                       | 193.7                                  | 206.3                                         | 56.7                              | 2018 |
| 28.1                        | 41.06                       | -                           | -                           | 162.6                                  | 188.9                                         | 51.7                              | 2019 |
| 51.7                        | 78.074                      | -                           | -                           | 149.6                                  | 218.0                                         | 59.9                              | 2020 |
| 35.8                        | 50.533                      | -                           | -                           | 176.9                                  | 216.8                                         | 59.5                              | 2021 |
| -                           | -                           | 12.6                        | 15.27                       | 242.0                                  | 210.0                                         | 57.5                              | 2022 |
| 19.3                        | 25.772                      | -                           | -                           | 133.2                                  | 222.0                                         | 61.0                              | 2023 |
| -                           | -                           | 39.5                        | 47.85                       | 199.2                                  | 226.4                                         | 62.0                              | 2024 |
| 266.6                       | 333.33                      | 526.1                       | 505.57                      | Total                                  |                                               |                                   |      |
| 172.24                      |                             |                             |                             | Strategic Stock (1,000 tons)           |                                               |                                   |      |
| 0.39                        |                             |                             |                             | Food Security Coefficient              |                                               |                                   |      |

Table (3): Annual Growth Rates of Production, Consumption, Imports, and Exports, Self-Sufficiency Ratio, Production Sufficiency Period, and Import Coverage Period for Red Meat during the Period 1990–2024. (Source: Compiled and calculated from the data presented in Tables 1 and 2)

| Equation                                                                  | $R^2$ | $F$    | Annual Growth Rates % | Variable                      |
|---------------------------------------------------------------------------|-------|--------|-----------------------|-------------------------------|
| $Ln\hat{Y}_1 = 4.88 + 0.02 T$<br>(129.53)** (11.04)**                     | 0.79  | 121.96 | 2.0                   | Production                    |
| $\hat{Y}_2 = 191.71 + 17.47 T - 0.32 T^2$<br>(3.95)** (2.81)** (-1.90)*   | 0.38  | 9.72   | 1.61                  | Consumption                   |
| $Ln\hat{Y}_3 = 4.83 + 0.027 T$<br>(38.31)** (4.45)**                      | 0.38  | 19.84  | 2.70                  | Imports                       |
| $Ln\hat{Y}_4 = 1.26 + 0.081 T$<br>(5.58)** (7.43)**                       | 0.63  | 55.24  | 8.1                   | Exports                       |
| $\hat{Y}_5 = 72.01 - 2.96 T + 0.08 T^2$<br>(19.45)** (-6.25)** (6.11)**   | 0.55  | 19.55  | -0.15                 | Self-Sufficiency              |
| $\hat{Y}_6 = 262.96 - 10.84 T + 0.28 T^2$<br>(19.58)** (-6.30)** (6.15)** | 0.55  | 19.86  | -0.39                 | Production Sufficiency Period |
| $\hat{Y}_7 = 106.93 + 14.09 T - 0.37 T^2$<br>(6.07)** (6.25)** (-6.04)**  | 0.55  | 19.51  | 0.38                  | Import Coverage Period        |

\*\* Significant at the 1% probability level; \* significant at the 5% probability level.

With regard to the food insecurity indicators for poultry meat during the period 1990–2024, the data presented in Tables 4, 5, and 6 indicate that the self-sufficiency ratio ranged from a minimum of 40.0% in 2015 to a maximum of 112.3% in 1991, with an annual average of approximately 62.9%. The self-sufficiency ratio for poultry meat declined at an annual rate of 1.6% over the period 1990–2024. Meanwhile, domestic poultry meat production increased at an annual growth rate of 3.5%, whereas domestic consumption increased at an annual growth rate of 5.0% during the same period. In addition, Saudi Arabia's poultry meat imports increased at an annual growth rate of 4.3%, while poultry meat exports increased at an annual growth rate of 6.7% during the period 1990–2024.

The domestic production sufficiency period for poultry meat ranged from a minimum of 146.13 days in 2015 to a maximum of 264.67 days in 1996, with an annual average of approximately 208.71 days. The domestic production sufficiency period declined at a slight annual rate of 0.41% during the period 1990–2024. The import coverage period for domestic consumption ranged from a minimum of 104.70 days in 2023 to a maximum of 240.27 days in 2013, with an annual average of approximately 173.78 days. The import coverage period for domestic poultry meat consumption increased at a slight annual rate of 0.51% during the period 1990–2024.

By calculating the surplus and deficit in domestic poultry meat consumption during the period 1990–2024, the data presented in Table 5 indicate a cumulative surplus of poultry meat amounting to 859.97 thousand tons during the years 1995–1999, 2001–2014, 2017–2019, 2021, and 2024. In relation to domestic consumption, this surplus was sufficient to cover approximately 348.2 days of consumption, equivalent to about 11.6 months.

A deficit in domestic poultry meat consumption was also recorded during the years 1990–1994, 2000, 2015–2016, 2020, and 2022–2023. The total deficit was estimated at approximately 168.89 thousand tons over a deficit period of about 51.3 days. Accordingly, the ratio of the surplus quantity to the deficit quantity of poultry meat reached 509.2%. According to the concept of strategic stock, defined as the net balance between the total surplus and total deficit, the strategic stock is estimated at approximately 691.08 thousand tons. In light of domestic poultry meat consumption, which amounted to 1,660.0 thousand tons in 2024, the food security coefficient for poultry meat is estimated at approximately 0.42.

Table (4): Production, Consumption, Imports, and Exports of Poultry Meat in Saudi Arabia during the Period 1990–2024. (Source: General Authority for Statistics (GASTAT) and Food and Agriculture Organization of the United Nations (FAO), 1990–2024)

| Foreign Trade (1,000 tons) |         | Domestic Consumption (1,000 tons) |         | Domestic Production (1,000 tons) | Year |
|----------------------------|---------|-----------------------------------|---------|----------------------------------|------|
| Exports                    | Imports | Daily                             | Annual  |                                  |      |
| 0.93                       | 210.08  | 0.77                              | 280.57  | 265                              | 1990 |
| 7.54                       | 244.16  | 0.70                              | 253.84  | 285                              | 1991 |
| 5.53                       | 174.03  | 0.77                              | 281.64  | 303                              | 1992 |
| 5.48                       | 168.37  | 0.81                              | 296.35  | 285                              | 1993 |
| 6.75                       | 140.67  | 0.85                              | 308.89  | 296                              | 1994 |
| 8.90                       | 264.90  | 1.55                              | 565.75  | 390                              | 1995 |
| 11.60                      | 231.60  | 1.50                              | 547.50  | 397                              | 1996 |
| 19.10                      | 213.00  | 1.76                              | 642.40  | 451                              | 1997 |
| 23.90                      | 277.00  | 1.76                              | 642.40  | 395                              | 1998 |
| 5.40                       | 366.30  | 2.13                              | 777.45  | 418                              | 1999 |
| 19.60                      | 327.50  | 2.17                              | 792.05  | 483                              | 2000 |
| 17.30                      | 322.90  | 1.90                              | 693.50  | 475                              | 2001 |
| 8.90                       | 334.40  | 2.04                              | 744.60  | 467                              | 2002 |
| 26.80                      | 413.40  | 2.16                              | 788.40  | 468                              | 2003 |
| 24.30                      | 378.40  | 2.39                              | 872.35  | 522                              | 2004 |
| 29.70                      | 468.40  | 2.66                              | 970.90  | 537                              | 2005 |
| 34.50                      | 432.80  | 2.53                              | 923.45  | 535                              | 2006 |
| 36.90                      | 480.20  | 2.54                              | 927.10  | 508                              | 2007 |
| 16.90                      | 493.70  | 2.48                              | 905.20  | 459.5                            | 2008 |
| 34.60                      | 584.60  | 2.83                              | 1032.95 | 494                              | 2009 |
| 24.80                      | 688.20  | 2.97                              | 1084.05 | 447                              | 2010 |
| 27.10                      | 788.40  | 3.44                              | 1255.60 | 529                              | 2011 |
| 21.60                      | 803.90  | 3.61                              | 1317.65 | 588                              | 2012 |
| 34.10                      | 879.40  | 3.66                              | 1335.90 | 569                              | 2013 |
| 30.60                      | 820.00  | 3.91                              | 1427.15 | 639                              | 2014 |
| 27.30                      | 930.20  | 4.19                              | 1529.35 | 612                              | 2015 |
| 33.40                      | 899.00  | 4.10                              | 1496.50 | 626                              | 2016 |
| 20.00                      | 707.10  | 3.47                              | 1266.55 | 616                              | 2017 |
| 38.00                      | 630.25  | 3.26                              | 1191.00 | 617                              | 2018 |
| 38.36                      | 650.39  | 3.71                              | 1355.25 | 753                              | 2019 |

| Foreign Trade (1,000 tons) |         | Domestic Consumption (1,000 tons) |         | Domestic Production (1,000 tons) | Year |
|----------------------------|---------|-----------------------------------|---------|----------------------------------|------|
| Exports                    | Imports | Daily                             | Annual  |                                  |      |
| 31.46                      | 617.40  | 4.11                              | 1500.15 | 900                              | 2020 |
| 40.73                      | 597.98  | 3.86                              | 1409.10 | 930                              | 2021 |
| 36.65                      | 513.73  | 4.55                              | 1661.76 | 1130                             | 2022 |
| 64.57                      | 424.28  | 4.05                              | 1478.87 | 1050                             | 2023 |
| 59.98                      | 603.63  | 4.55                              | 1660.00 | 1195.2                           | 2024 |

Table (5): Self-Sufficiency Ratio, Periods of Production Sufficiency and Import Coverage, and the Magnitude of Surplus and Deficit in Domestic Poultry Meat Consumption, 1990–2024. (Source: Compiled and calculated from the data presented in Table (4))

| Deficit               |                       | Surplus               |                       | Import Coverage | Production Sufficiency | Self-Sufficiency Ratio (%) | Year |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------|------------------------|----------------------------|------|
| Deficit Period (days) | Quantity (1,000 tons) | Surplus Period (days) | Quantity (1,000 tons) | Period (days)   | Period (days)          |                            |      |
| 0.4                   | 0.31                  | -                     | -                     | 162.1           | 203.7                  | 94.5                       | 1990 |
| 5.5                   | 3.83                  | -                     | -                     | 172.1           | 198.2                  | 112.3                      | 1991 |
| 3.0                   | 2.30                  | -                     | -                     | 135.4           | 233.8                  | 107.6                      | 1992 |
| 2.4                   | 1.92                  | -                     | -                     | 138.0           | 231.4                  | 96.2                       | 1993 |
| 2.2                   | 1.91                  | -                     | -                     | 120.2           | 250.5                  | 95.8                       | 1994 |
| -                     | -                     | 51.8                  | 80.24                 | 170.90          | 251.61                 | 68.9                       | 1995 |
| -                     | -                     | 46.3                  | 69.51                 | 154.40          | 264.67                 | 72.5                       | 1996 |
| -                     | -                     | 1.4                   | 2.50                  | 121.02          | 256.25                 | 70.2                       | 1997 |
| -                     | -                     | 3.2                   | 5.70                  | 157.39          | 224.43                 | 61.5                       | 1998 |
| -                     | -                     | 0.7                   | 1.44                  | 171.97          | 196.24                 | 53.8                       | 1999 |
| 0.5                   | 1.16                  | -                     | -                     | 150.92          | 222.58                 | 61.0                       | 2000 |
| -                     | -                     | 45.8                  | 87.11                 | 169.95          | 250.00                 | 68.5                       | 2001 |
| -                     | -                     | 23.5                  | 47.89                 | 163.92          | 228.92                 | 62.7                       | 2002 |
| --                    | -                     | 30.7                  | 66.21                 | 191.39          | 216.67                 | 59.4                       | 2003 |
| -                     | -                     | 1.6                   | 3.76                  | 158.33          | 218.41                 | 59.8                       | 2004 |
| -                     | -                     | 1.8                   | 4.80                  | 176.09          | 201.88                 | 55.3                       | 2005 |
| -                     | -                     | 3.9                   | 9.85                  | 171.07          | 211.46                 | 57.9                       | 2006 |
| -                     | -                     | 9.5                   | 24.21                 | 189.06          | 200.00                 | 54.8                       | 2007 |
| -                     | -                     | 12.5                  | 31.09                 | 199.07          | 185.28                 | 50.8                       | 2008 |
| -                     | -                     | 3.9                   | 11.05                 | 206.57          | 174.56                 | 47.8                       | 2009 |
| -                     | -                     | 8.9                   | 26.37                 | 231.72          | 150.51                 | 41.2                       | 2010 |
| -                     | -                     | 10.1                  | 34.72                 | 229.19          | 153.78                 | 42.1                       | 2011 |
| -                     | -                     | 14.6                  | 52.66                 | 222.69          | 162.88                 | 44.6                       | 2012 |
| -                     | -                     | 21.4                  | 78.37                 | 240.27          | 155.46                 | 42.6                       | 2013 |
| -                     | -                     | 0.4                   | 1.46                  | 209.72          | 163.48                 | 44.8                       | 2014 |
| 3.4                   | 14.19                 | -                     | -                     | 222.00          | 146.13                 | 40.0                       | 2015 |
| 1.3                   | 5.19                  | -                     | -                     | 219.27          | 152.61                 | 41.8                       | 2016 |
| -                     | -                     | 10.5                  | 36.46                 | 203.78          | 177.49                 | 48.6                       | 2017 |
| -                     | -                     | 5.6                   | 18.20                 | 193.15          | 189.09                 | 51.8                       | 2018 |
| -                     | -                     | 2.7                   | 9.87                  | 175.17          | 202.83                 | 55.6                       | 2019 |

| Deficit                  |                          | Surplus                     |                             | Import<br>Coverage<br>Period (days) | Production<br>Sufficiency<br>Period (days) | Self-Sufficiency<br>Ratio (%) | Year |
|--------------------------|--------------------------|-----------------------------|-----------------------------|-------------------------------------|--------------------------------------------|-------------------------------|------|
| Deficit Period<br>(days) | Quantity<br>(1,000 tons) | Surplus<br>Period<br>(days) | Quantity<br>(1,000<br>tons) |                                     |                                            |                               |      |
| 3.5                      | 14.20                    | -                           | -                           | 150.22                              | 218.98                                     | 60.0                          | 2020 |
| -                        | -                        | 20.2                        | 78.16                       | 154.9                               | 240.9                                      | 66.0                          | 2021 |
| 12.1                     | 54.85                    | -                           | -                           | 112.8                               | 248.2                                      | 68.0                          | 2022 |
| 17.0                     | 69.03                    | -                           | -                           | 104.7                               | 259.2                                      | 71.0                          | 2023 |
| -                        | -                        | 17.2                        | 78.34                       | 132.7                               | 262.7                                      | 72.0                          | 2024 |
| 51.3                     | 168.89                   | 348.2                       | 859.97                      | Total                               |                                            |                               |      |
| 691.08                   |                          |                             |                             | Strategic Stock (1,000 tons)        |                                            |                               |      |
| 0.42                     |                          |                             |                             | Food Security Coefficient           |                                            |                               |      |

Table (6): Annual Growth Rates of Production, Consumption, Imports, and Exports, Self-Sufficiency Ratio, and the Periods of Production Sufficiency and Import Coverage for Poultry Meat during the Period 1990–2024. (Source: Compiled and calculated from the data presented in Tables 4 and 5)

| Equation                                                                 | $R^2$ | $F$    | Annual Growth<br>Rates % | Variable                      |
|--------------------------------------------------------------------------|-------|--------|--------------------------|-------------------------------|
| $Ln\hat{Y}_1 = 5.63 + 0.035 T$<br>(121.41)** (15.48)**                   | 0.88  | 239.67 | 3.50                     | Production                    |
| $Ln\hat{Y}_2 = 5.85 + 0.050 T$<br>(80.39)** (14.28)**                    | 0.86  | 203.84 | 5.0                      | Consumption                   |
| $Ln\hat{Y}_3 = 5.29 + 0.043 T$<br>(51.95)** (8.72)**                     | 0.70  | 76.01  | 4.3                      | Imports                       |
| $Ln\hat{Y}_4 = 1.75 + 0.067 T$<br>(9.82)** (7.76)**                      | 0.65  | 60.29  | 6.7                      | Exports                       |
| $Ln\hat{Y}_5 = 4.38 - 0.016 T$<br>(55.40)** (-4.06)**                    | 0.33  | 16.52  | -1.6                     | Self-Sufficiency              |
| $\hat{Y}_6 = 268.89 - 8.05 T + 0.20 T^2$<br>(16.16)** (-3.78)** (3.46)** | 0.32  | 7.47   | -0.41                    | Production Sufficiency Period |
| $\hat{Y}_7 = 106.61 + 9.52 T - 0.24 T^2$<br>(7.17)** 5.00** (-4.77)**    | 0.44  | 12.56  | 0.51                     | Import Coverage Period        |

\*\* Significant at the 1% probability level.

#### 4.3. Impact of Tariffs on Consumer Prices and Food Security of Red Meat and Poultry:

The proposed model was estimated to examine the impact of tariffs on consumer prices and food security for red meat and poultry during the period 1990–2024, using stepwise multiple regression analysis in both linear and double-logarithmic forms (Gujarati, translated and reviewed by Odeh, 2015). The results indicated that the equations presented in Table (7) provided the best fit. The estimated behavioral equations of the proposed model for red meat revealed the following findings:

1. The tariff rate on imports ( $X_1$ ) has no statistically significant effect on the consumer price index (CPI) of red meat, owing to the stability of the tariff rate at 5% throughout the period 2003–2024.

2. The marginal effect of domestic red meat production was estimated at approximately  $-0.03$ , while its relative effect (elasticity) was approximately  $-0.07$ . This indicates that a 10% increase in domestic red meat production ( $X_2$ ) leads to a 0.7% decrease in the consumer price index of red meat.
3. A 10% increase in both the global red meat price index ( $X_3$ ) and total population ( $X_4$ ) results in increases in the consumer price index of red meat by approximately 2.2% and 7.6%, respectively.
4. A 10% increase in the estimated consumer price index of red meat ( $\hat{Y}_1$ ) leads to a 13.6% decrease in the food security coefficient for red meat. In contrast, a 10% increase in each of domestic red meat production and Saudi imports of red meat results in increases in the food security coefficient for red meat by approximately 5.3% and 6.4%, respectively.

With regard to the impact of tariffs on consumer prices and food security for poultry meat, the estimated behavioral equations of the proposed model revealed the following findings:

1. The tariff rate on imports ( $X_1$ ) has a statistically significant effect on the consumer price index (CPI) of poultry meat in Saudi Arabia. The relative effect (elasticity) of the tariff rate was estimated at  $0.07^*$ , indicating that a 10% increase in the tariff rate leads to a 0.7% increase in the consumer price index of poultry meat.
2. A 10% increase in domestic poultry meat production ( $X_2$ ) leads to a 1.8% decrease in the consumer price index of poultry meat.
3. A 10% increase in both the global poultry meat price index ( $X_3$ ) and total population ( $X_4$ ) leads to increases in the consumer price index of poultry meat by approximately 7.1% and 4.1%, respectively.
4. A 10% increase in the estimated consumer price index for poultry meat ( $\hat{Y}_1$ ) leads to a 10.6% decrease in the food security coefficient for poultry meat. Moreover, a 10% increase in each of domestic poultry meat production and Saudi poultry meat imports leads to increases in the food security coefficient for poultry meat of approximately 15.4% and 14.6%, respectively.
5. The estimated behavioral equations of the proposed model for red meat and poultry meat are free from the problem of serial correlation in the residuals, as indicated by the Durbin–Watson test. Furthermore, no autoregressive conditional heteroskedasticity (ARCH) is present in the residual variance, according to the ARCH test. The estimated model also demonstrated a high degree of efficiency in representing the data used for estimation, as indicated by the model performance measures, particularly Theil's inequality coefficient (U-Theil), whose value approached zero (Table 8).

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\*  $E = \frac{B}{\bar{Y}}$

Table (7): Estimated Behavioral Equations of the Proposed Model for Red Meat and Poultry Meat during the Period 1990–2024. (Source: Statistical analysis of the data used in the estimation)

| Red Meat:                                                                            |  |
|--------------------------------------------------------------------------------------|--|
| $\hat{Y}_1 = -1.698 + 33.11 X_1 - 0.03 X_2 + 0.20 X_3 + 2.71 X_4 + 0.89AR(1)$        |  |
| $(-0.08)^{ns} (0.16)^{ns} (-2.24)^* (2.42)^* (3.17)^{**} (8.81)^{**}$                |  |
| $R^2 = 0.98, F = 444.30, D.W = 1.39, Arch\ test = 0.45$                              |  |
| $Ln \hat{Y}_2 = -59.62 - 1.36 Ln \hat{Y}_1 + 0.53 Ln X_5 + 0.64 Ln X_6 + 0.317AR(1)$ |  |
| $(-4.55)^{**} (2.46)^* (3.62)^{**} (5.41)^{**} (2.31)^*$                             |  |
| $R^2 = 0.65, F = 10.92, D.W = 1.49, Arch\ test = 0.34$                               |  |
| Poultry Meat:                                                                        |  |
| $\hat{Y}_3 = -347.85 + 5.28 Ln X_1 - 14.24 Ln X_2 + 56.21 Ln X_3 + 32.55 Ln X_4$     |  |
| $(-11.0)^{**} (2.26)^* (-1.96)^* (9.09)^{**} (3.73)^{**}$                            |  |
| $R^2 = 0.96, F = 185.88, D.W = 1.55, Arch\ test = 0.15$                              |  |
| $Ln \hat{Y}_4 = -166.31 - 1.06 Ln \hat{Y}_1 + 1.54 Ln X_5 + 1.46 Ln X_6$             |  |
| $(-6.33)^{**} (1.54)^{ns} (6.23)^{**} (5.89)^{**}$                                   |  |
| $R^2 = 0.66, F = 13.08, D.W = 1.51, Arch\ test = 0.09$                               |  |

\*\* Significant at the 1% probability level; \* significant at the 5% probability level; ns not statistically significant.

Table (8): Efficiency Measures of the Estimated Equations of the Proposed Model during the Period 1990–2024. (Source: The behavioral equations of the proposed model presented in Table (7))

| Poultry Meat |       | Red Meat |       | Indicator               |
|--------------|-------|----------|-------|-------------------------|
| Second       | First | Second   | First |                         |
| 0.77         | 5.02  | 0.67     | 6.21  | Root Mean Squared Error |
| 0.62         | 4.31  | 0.51     | 5.27  | Mean Absolute Error     |
| 15.74        | 6.17  | 5.84     | 6.91  | Mean Abs. Percent Error |
| 0.09         | 0.03  | 0.10     | 0.03  | Theil Inequality Coef.  |

## 5. Conclusion

Food security refers to a country's ability to ensure an adequate and reliable supply of food from multiple sources, primarily domestic production and imports. Based on the food security indicators for red meat and poultry meat, the food security coefficients were estimated at 0.39 and 0.42, respectively, at the end of the period 1990–2024. From a food security perspective, there is a need to increase strategic meat stocks to levels sufficient to cover domestic consumption for at least six months. This would help ensure a continuous supply of meat to domestic markets and contribute to price stability.

There is no doubt that the imposition of customs tariffs on imports of red meat and poultry meat affects consumer prices and meat food security. Given the stability of the customs tariff rate at 5% on red meat imports, its effect on the Consumer Price Index (CPI) was found to be statistically insignificant. In contrast, a 10% increase in the customs tariff rate on poultry meat imports would lead to a 0.7% increase in the poultry price index. Furthermore, a 10% increase in the estimated

Consumer Price Index for red meat and poultry meat would result in a 13.6% and 10.6% decrease in their respective food security coefficients.

In light of the findings of this study, it is recommended that the government continue to bear the cost of customs tariffs imposed on imported agricultural production inputs. In addition, the optimal customs tariff rate on food imports should be determined, with particular attention given to strategic food commodities, in order to balance the objectives of domestic production protection, consumer price stability, and food security.

## References

1. Ali, M. H. G., Enany, D. F. M., & Mohamed, M. A. A. (2024). An econometric study of Egyptian agricultural trade with the BRICS bloc: Reality and prospects. *Alexandria Journal of Agricultural Sciences*, 45(2), April–June, 333–365.
2. Djido, A., Thangata, P., Muthini, D., & Nhlengethwa, S. (2022). Economic impacts and policy implications of a common external tariff on imported edibles in the East African Community. Policy Brief. AGRA – Hub for Agricultural Policy Action.
3. Ghanem, A. M. K. and Kamara, S. A. (2010). Economic factors determining the food security coefficient of sugar in Egypt. *Proceedings of the Third Conference of the Department of Agricultural Economics and Agribusiness Management: Agricultural Development Strategy and Challenges of Egyptian Food Security*, Faculty of Agriculture, Alexandria University, July 28–29; *Alexandria Journal of Agricultural Research*, 56(2), Special Issue, August 2011, 1–10.
4. Ghanem, A. M. K.; Alqunaibet, M. H., Alnashwan, O. S., & Alrwis, K. N. (2025). The impact of customs tariffs and their integration with value-added tax on food security in the Kingdom of Saudi Arabia. *African Journal of Advanced Studies in Humanities and Social Sciences (AJASHSS)*, 4(3), July–September, 120–131.
5. Ghanem, A. M. K., Alqunaibet, M. H., Alrwis, K. N., & Alnashwan, O. S. (2025). A study of the positive and negative effects of customs tariffs on Saudi imports during the period 1990–2023. *African Journal of Advanced Studies in Humanities and Social Sciences (AJASHSS)*, 4(1), January–March, 444–459.
6. Glauber, J., Piñeiro, V., & Gianatiempo, J. P. (2025, April 8). How “reciprocal tariffs” harm agricultural trade. International Food Policy Research Institute (IFPRI). Retrieved from <https://www.ifpri.org/blog/how-reciprocal-tariffs-harm-agricultural-trade>.
7. Gujarati, Damodar N., translated and review by Odeh, Hind Abdel Ghaffar and Al-Dash, Afaf Ali Hassan (2015). *Basic Econometrics, the Second Part*, Marekh House of Publishing, Cairo, P: 969- 997.

8. Hayakawa, Kazunobu; Jota Ishikawa and Nori Tarui (2020). What goes around comes around: Export-enhancing effects of import-tariff reductions, Journal of International Economics, Volume 126, September, P: 1- 17. <https://doi.org/10.1016/j.jinteco.2020.103362>
9. Hoekman, B., Ng, F., & Olarreaga, M. (2004). Agricultural tariffs or subsidies: Which are more important for developing economies? The World Bank Economic Review, 18(2), 175–204. <https://doi.org/10.1093/wber/lhh037>.
10. Ismail, M. A. R. (2001). Linear Regression Analysis. Research Center, Institute of Public Administration, Kingdom of Saudi Arabia, p. 114.
11. Ministry of Environment, Water and Agriculture (2024). Media Center: News and Events.
12. Saudi Central Bank (2025). Open Data Platform, 2000–2024.
13. Thanoon, M. A. M. (2020). Economics of Foreign Trade. 1st ed., Dar Al-Akademy for Publishing and Distribution, Amman, Hashemite Kingdom of Jordan, pp. 236–244.