Research Article

Determinants and Potential of Trade Using the Gravity Model Approach: Empirical Evidence of Egyptian Rice Crop

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The aim of this study is to examine the determinants of Egyptian trade in general and Egyptian rice trade in particular with 11 rice-importing partner countries (Libya, Lebanon, Syria, Saudi Arabia, Sudan, Jordan, Turkey, the United Kingdom, Ukraine, Belgium, and Romania). To reach the main goals of the study, the gravity model was used to figure out which factors had the most impact on Egypt’s exports and imports. Using annual data on Egypt’s foreign and agricultural trade during the period 2001–2020 and data on the period 2001–2016 of rice crops with the 11 trading partners, the study reached several important conclusions. Among these conclusions, the Egyptian GDP variable had a negative effect on the total value of Egyptian imports and agriculture by increasing the value of total exports, agricultural exports, and rice exports to Egypt. Egyptian imports, exports, and population growth were all hurt by the Egyptian population variable. The study also shows that a 1% increase in export prices leads to a 3.97% increase in shipments of Egyptian rice to partner countries. According to economic theory, higher transportation expenses reduce trade volumes for both exports and imports. The variable distance between capitals has a negative effect on Egyptian exports. The study was designed based on the results of the main investigation. Based on the main investigation, the study made several important recommendations, including the need to take several measures to deflect the pace of economic growth of both the Egyptian total and agricultural export variables and rice export value, focusing on countries with high monetary and real GDP and a close geographical distribution. Improve economic relations between Egypt and its trading partners and shift from import-export cooperation to strategic food security cooperation.

1. Introduction

The agricultural sector is an important part of the Egyptian economy. It makes a big contribution to the country’s GDP and gives jobs to a lot of people [1]. In 2020, the agricultural sector’s share in Egypt’s GDP was 11.3%, employing around 28% of the labor force.

Egypt has a wide range of agricultural products, such as cereals, vegetables, fruits, livestock, and more. The country’s location between the Mediterranean Sea and the Nile River makes it an ideal place to grow crops. The country’s location between the Mediterranean Sea and the Nile River makes it an ideal place to grow crops. Also, the country exports a lot of agricultural goods. In 2020, agricultural exports will make
up about 17% of the country’s total exports, according to the Central Agency for Public Mobilization and Statistics.

Also, Egypt’s agricultural sector is a key part of making sure the country’s people always have food to eat. According to Abdel-Malek and El-Din [2], the sector provides over 90% of the country’s food needs, making it a vital pillar of the national economy.

In recent years, the Egyptian government has put in place a number of policies to help the agricultural sector. These include improving infrastructure, giving farmers money, and promoting modern farming techniques. The goal of these efforts is to boost the sector’s productivity, make it more competitive, and support long-term growth.

In conclusion, the agricultural sector is a very important part of Egypt’s economy. It creates jobs, adds to the GDP, makes sure there is enough food, and promotes sustainable growth. Egypt is a key player in the global agricultural market because of its diverse range of products, strategic location, and government policies that help the sector.

The gravity model is a widely used empirical tool in economics to analyze bilateral trade flows between countries. This model suggests that trade between two countries is proportional to the product of their gross domestic product (GDP) and inversely proportional to the distance between them [3]. In the case of Egypt, the gravity model can be applied to analyze the determinants and potential of agricultural trade, particularly in the rice crop sector.

El-Khishin and Rizk [4] say that the size of Egypt’s GDP is the first thing that affects agricultural trade flows. This is because the GDP shows how much money Egyptians have and how much they want to buy imported goods, like rice. The larger the GDP, the higher the demand for rice and other agricultural products, which can lead to increased trade flows.

The second determinant of agricultural trade in Egypt is the size of its population, which also affects the demand for food products like rice [1]. More people means more demand for rice, which can lead to even more trade in agricultural goods.

The export price of Egyptian rice is the third factor that affects agricultural trade flows in Egypt. This price is affected by global supply and demand [5]. Higher export prices can encourage rice producers and exporters to make and send out more rice, which can lead to more trade.

Finally, the distance between Egypt and its trading partners is another important factor that affects agricultural trade flows. The farther two countries are from each other, the higher the transportation costs and other barriers to trade, which can lower the volume of trade [6].

Exports boost sustainable economic growth rates by providing secure and reliable supplies of foreign cash that relieve pressure on the balance of payments and help job creation [7, 8]. Giving cash for investment broadens the manufacturing base, minimizes reliance on foreign aid, and offers specialists [9]. Several studies, including those by [10], Balassa [11–13], and Edward [14], have demonstrated that increased overseas commerce has a considerable positive effect on economic development. In contrast, Ahmad and Kwan [15] discovered in their study that there is sometimes no positive correlation between international trade and economic progress.

Rice is an important crop in Egypt because it is the only cereal that can be grown there and exported in excess. In 2017, Egypt’s rice self-sufficiency rate was 94.2% [5]. In the same year, the average rice intake per capita climbed by 11.5%, reaching 38.7 kg compared to 34.7 kg in 2016. In addition, it is a possible source of foreign exchange revenues that might assist sustainable financial development [16].

Rice, the third largest producer in the world and the second most important food for the Egyptian population, is the essential food for more than half of the world’s population. China, India, Thailand, and Indonesia, which are among the biggest producers and consumers of rice [17], are the main places where rice is grown and eaten. And in some African nations, such as the Arab Republic of Egypt, the bulk of production is accounted for.

On the agricultural side, rice is regarded as one of the most important crops in Egypt. In the governorates of Lower Egypt, rice is by far the most important crop. It provides farmers with an acceptable return compared to other crops, particularly after implementing economic reform policies and canceling compulsory supplies. From a consumer’s perspective, rice is one of the essential dietary ingredients for most of Egypt’s population, as it is a rich source of carbohydrates, and its consumption has climbed from 3,858,000 tons in 2000 to 4,889,000 tons in 2020 [18].

From 2001 to 2020, Egyptian rice exports will account for approximately 0.90% of overall Egyptian exports and 9.15% of the value of Egyptian agricultural exports (FAOSTAT). Recent government decisions to cut back on farmland and ban exports have made it harder for countries to compete on international markets. So, it is important to look into the possibility of raising the value of rice exports by looking at how Egypt sells rice in different foreign markets [19].

2. The Motivation and Significance of the Study

The motivation for this study is based on the significance of foreign trade to the Egyptian economy, particularly with regards to rice exports to 11 partner countries. Understanding the determinants of trade can assist policymakers and government officials in making informed decisions to enhance the foreign trade sector’s performance and promote economic growth. The study’s significance lies in its use of the gravity model approach to identify the most influential factors on Egypt’s exports and imports, including GDP, population, export prices, transportation costs, and distance between capitals. The study provides valuable insights for policymakers to enhance economic relations between Egypt and its trading partners and shift toward strategic food security cooperation. In addition, the study contributes to the existing literature on international trade and provides useful insights for researchers interested in studying the determinants of trade.

The study on the determinants of Egyptian trade in general and Egyptian rice trade in particular with 11 rice-importing partner countries is significant for several reasons. Firstly, foreign commerce is a crucial component of Egypt’s
economy, and the findings of this study can assist policymakers and government officials in taking appropriate measures to enhance the foreign trade sector’s performance. Secondly, the study’s use of the gravity model approach and the analysis of annual data over a 20-year period provide valuable insights into the factors that influence trade flows, such as GDP, population, export prices, transportation costs, and distance between capitals. Thirdly, the study’s identification of the most influential factors on Egypt’s exports and imports can assist policymakers in developing effective trade policies and strategies to increase trade flows, diversify exports, and promote strategic food security cooperation. Finally, the study’s recommendations on taking measures to deflect the pace of economic growth of both the Egyptian total and agricultural export variables and rice export value, focusing on countries with high monetary and real GDP and a close geographical distribution, could improve economic relations between Egypt and its trading partners and shift towards strategic food security cooperation.

3. Literature Review

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In this part of the study, the “gravity model” method was used to investigate international trade between Egypt and other countries from 2010 to 2022. The aim was to identify the major factors that could affect international trade flows. Over the past 20 years, Egypt’s economy, government, and society have undergone significant changes at the local, regional, and international levels. Among the most important are the completion of the gradual liberalization of agricultural product prices, agricultural production requirements, and exchange rates; the liberalization of agricultural land markets; the elimination of subsidies to the agricultural sector; and the end of cooperative marketing. To ensure that there was enough water for irrigation, the government also tried to limit the growth of rice fields by establishing rules for cotton fields and imposing fines when they were not followed. In summer, a field requires about 6,000 cubic meters of irrigation water, while less than 4,000 cubic meters are needed to grow corn.

Shehata [21] said that the main focus of the economic effects of trade between Egypt and COMESA was on Egypt’s main agricultural exports and that the gravity model was used. They concluded that the most influential factors on Egyptian exports are the exchange rate, the distance between Cairo and the capitals of COMESA countries, and the imports of rival countries into COMESA markets. Fayyad [22] discussed how to increase trade exchange between Egypt and Arab countries and identified the primary factors affecting the increase of trade exchange between Egypt and these countries, as well as the principal Arab countries that expand or restrict the volume of trade exchange with Egypt. In addition, they forecast the volume of trade exchange between Egypt and the vital Arab nations with which it engages. The gravity model demonstrated that a rise in real GDP in Egypt and other Arab countries leads to increased Egyptian exports to these nations.

On the other hand, exports from Egypt to Arab countries drop as the distance between them grows. The demand for imports of Egyptian products also decreases when the real per capita income of people in Arab countries increases. It was found that Syria and other Arab countries are cutting Egypt’s exports because demand for Egyptian exports has gone up. It was found that Egypt’s imports went up because of Saudi Arabia and Libya, but Egypt’s imports from other Arab countries went down as their per capita income went up.

This is one article which explains how the role of the trade policy review mechanism and its review should be improved with the aim of covering the main areas of international trade governance, such as coordinating preferential trade agreements, as well as the convergence of measures dealing with greenhouse gas emissions and other environmental policies, which are two main issues in the way of the World Trade Organization in international trade, which can play the role of the general coordinator and the main supervisor of the countries they belong to, to confront and combat financial crises and protective trends that usually follow economic difficulties [23].

In a study by Greene [24], the gravity model method for international trade was utilized to determine the effect of India’s market access policy on US exports of high-technology items. From 1990 to 2011, estimates were based on panel data and the fixed effects model for US exports to 5 manufacturing sectors and 76 trading partners. The volume of high-technology product exports is determined by average capital income, free trade, India’s level of economic development, shared culture, commerce with trading partners, and membership in a common free trade area. Transportation costs and international distance (transactions) are vital and negative factors of US high-technology exports. Inhibiting US exports are high tariffs and various problems reflected in India’s low rankings on numerous global indices. These include the size of the market, the presence of trade barriers, the free trade index, and the overall economic competitiveness index.

The main objectives of Attala’s [25] studies were to examine and determine the primary elements influencing the agricultural trade between Egypt and COMESA nations. According to the gravity model of Egyptian agricultural export results, the factors influencing the impact of Egyptian agricultural exports to COMESA nations have been determined. Changes in average Egyptian GDP per capita, average GDP per capita of partner countries, and nominal shared border variables directly impact exports from Egypt to partner nations. The gravity model results for Egyptian agricultural imports from COMESA countries indicate that when Egyptian GDP rose by approximately 1%, Egyptian agricultural imports from COMESA countries rose by 56.15%. Roughly 1% rise in these nations’ average GDP per capita will result in a 75.2% increase in Egyptian agricultural imports from these nations.
In [26], for the period 2004–2013, the gravity model was utilized in this study. According to this study’s hypothesis, the three most influential determinants of rice exports from Vietnam are gross domestic product (GDP), population size, and exchange rate. The study aimed to determine the most significant elements influencing Egypt’s foreign commerce with COMESA nations. There is a favorable correlation between Egypt’s GDP and COMESA countries, as a 1% increase in these variables results in exports of 2.18% and 0.97%, respectively. The study suggests enhancing the flow of trade between Egypt and COMESA nations and examining domestic markets.

In [27], the authors aimed to identify the main factors that affect Cambodian rice exports by applying the dynamic gravity approach. Using panel data from 1995 to 2016 and selecting 40 import partners, the results showed that historical relations, exchange rate policy, and agricultural land reform enhance rice exports. Therefore, the study recommends focusing on expanding exports to commercial partners, especially the European Union, China, and Asian countries. As a macroeconomic issue, the economic recession that hinders export flows requires more special attention.

Nag and Chakraborty [28] focused in their book on the process of identifying export markets and products, which involves determining the potential markets and products that a business can export as well as assessing their viability and suitability for exportation. It offers a structured application of key concepts and methods in trade analytics. India’s Trade Analytics introduces the reader to various technical approaches to the analysis of international trade flows, market identification, and competitiveness measurement procedures. It is intended as a practical guide for management graduates, researchers, corporate executives, and policymakers. To provide a more comprehensive analysis, we utilized crucial methodologies such as ex-post and ex-ante analyses and partial and general equilibrium models. We also conducted an in-depth interpretation of the derived output, including a competitiveness analysis and an examination of the impact of tariff reform. By employing these critical methodologies, we were able to enhance the validity and reliability of our research and arrive at meaningful conclusions based on empirical evidence. A discussion of the non-tariff barriers (NTBs) explains the role of trade facilitation measures and trade costs in international business.

In “[29],” the gravity model was used to look at how changes in the exchange rate affect exports. The empirical findings demonstrated that exchange rate changes impact both local and international commerce in COMESA countries [30]. The research suggests that policymakers in COMESA nations should not disregard exchange rate volatility when formulating trade policies and strategies. Guan and Sheong [31] analyzed intra-China-Africa trade using the gravity model and showed that GDP had a negative effect on African exports to China. It had a good impact on Chinese exports to Africa. The prevailing exchange rate negatively impacted African exports to China and imports from China. The population variable influenced African exports to China and imports from China. The study suggests enhancing the structure of African exports to China and fortifying trade agreements.

The gravity model was utilized in the study by Ibrahim et al. [32], which intended to estimate the relative significance of Egypt’s trade with the BRICS nations in main vegetable and fruit crops and their determinants. The study’s most notable findings were as follows: there is a statistically positive and moral influence of the variable distance between Egypt and the BRICS nations on the quantity of Egyptian agricultural exports and imports.

A study by Chaisse and Chakraborty [33] explore the tariffs and emergency policies of two main countries (the United States and the European Union) and developing countries (China and India) to measure the readiness of each country for future reforms. The perspective related to the manufacture of competitiveness varies greatly between these countries, which also constitutes their manufacturing policy interventions. This article concludes that, given the commercial and industrial policy options that these countries have taken in the recent past, it will be difficult to reach a multilateral trade agreement caused by the World Trade Organization on non-agricultural market access (NAMA).

Abdel et al. [34] created a gravity model to analyze Egyptian exports of dried onions. The combined regression model (CRM) revealed that exports of onions to the Netherlands, Germany, Japan, Belgium, and Indonesia grew by 1% for every 1% growth in Egypt’s gross domestic product. The exports of Egyptian tomatoes decreased by 28.1 tons for every kilogram added. With a $1 billion rise in the GDP of importing countries, Egyptian tomato exports climbed by 47.0 tons with a 1-kilometer increase, exports declined by 76 tons and by 24.1 and 39.1%, respectively, for languages with similar sounds.

In the study conducted by Eshetu and Goshu [35], the authors aimed to determine the factors that affect the export of Ethiopian coffee to 31 commercial partner countries using the dynamic gravity model and generalized moment method (GMM) of estimation. The results of the analysis showed that the openness of trade, the population in Ethiopia, foreign direct investment, and the institutional quality of Ethiopia have a positive and significant effect on the export volume of Ethiopian coffee. On the other hand, variables such as the population of partner countries, geographical distance, export volume in the previous year, and real exchange rate have a negative and significant effect on the export volume of Ethiopian coffee. The study recommended diversifying exports to ensure a reliable foreign currency source, controlling corruption, increasing government events, and ensuring the strengthening of political stability for foreign direct investment. In addition, the study suggests encouraging trade liberalization to increase the volume of Ethiopian coffee exports.
In the study by Abdullahi et al. [36], they considered experimental visions of the determinants and capabilities of food exports in Nigeria to 70 major commercial countries between 1995 and 2019 through the application of stochastic frontier analysis (SFA) for the gravity model. They also estimated a set of technologies, including the OLS method, pseudo-Poisson maximum likelihood (PPML), and Heckman models, to confirm the statistical significance of the results. The results indicated that the economic size (GDP) of Nigeria and its commercial countries, the membership of imported countries, European Union membership, and communication stimulate the export of agricultural food. The geographical distance between countries, local population, exchange rate, language, and fires all negatively affect agricultural food exports. The study recommended the need for attention to agricultural food with most major global economies (including China, the United States of America, Brazil, India, Russia, Japan, and European countries) and Nigerian border countries and the provision of policy trends to expand the export of agricultural food.

Abdullahi et al. [37] looked at the main things that affect the flow of cocoa exports from Nigeria and came up with a gravity model for the commodity with three different ways to analyze it. The results showed that GDP, exchange rate policy, European Union membership, and colonial links are positively related to the export of Nigerian cocoa. Moreover, it was observed that there is a negative impact of individual GDP, geographical distance between countries, and African Union membership on Nigerian cocoa export flows. The study recommended the necessity of expanding exports to commercial partners, especially members of the European Union (the Netherlands, Germany, France, the United Kingdom, Belgium, and Spain), Canada, Malaysia, and the United States of America. These results are important for formulating future commercial policies that can enhance Nigerian cocoa exports. This will eventually contribute to the diversification of Nigerian exports and enhance the profits of foreign countries.

“Qadous [38]” aims to establish the parameters of Egyptian tomato exports and measure the impact of global changes in language, distance, GDP, and average per capita on the principal markets for Egyptian tomato importers: Saudi Arabia, Libya, Turkey, the United Arab Emirates, Russia, and Bahrain. Predict Egyptian tomato exports for 2016–2020 utilizing the gravity model for international trade. A 1-kilometer increase in distance decreased Egyptian tomato exports by 42.1 tons, and a 1-billion-dollar increase in the gross domestic product of importing countries decreased exports by 56.0 tons. If Egypt’s GDP increases by $1 billion, tomato exports will rise by 67.0 tons, and if importing and exporting nations speak the same language, exports will rise even more.

In [39], the gravity model was used to assess the performance of Egyptian agricultural exports to Arab countries. This study indicates that trade agreements, exchange rates, and distance between Egypt and other nations negatively impact Egyptian exports of dairy goods and vegetables. The study also reveals that Egypt’s GDP directly impacts these products’ availability on Arab market places. The research also recommends periodic reviews of bilateral agreements between nations, improving Egyptian exports by incorporating exports of essential agricultural items, and labeling standards for Arab agriculture.

Abdullahi et al. [40] aimed to study the determinants and efficiency of agricultural exports in China to 114 imported countries from 2000 to 2019 using the stochastic frontier analysis (SFA) on the gravity model and fixed effect models to confirm the results. The study found that the economic size of China (GDP), imported countries, the Belt and Road Initiative (BRI), joint borders, and the Chinese language all positively affected China’s agricultural export flows. However, agricultural exports in China were negatively impacted by low per capita GDP in China and its commercial partners, a weak currency, and geographical distance. The study recommended that policymakers pay special attention to exchange rate policy. The study suggests that agricultural exports have a significant impact on the Belt and Road Initiative, and China should continue to build strong relationships with current members and develop policies that attract nonmember states.

The general conclusion to previous studies demonstrates the following findings: the analyzed studies support the use of the gravity model to study factors affecting trade between countries, including GDP, exchange rates, distance, language, historical ties, and trade agreements. Some findings, such as the effect of per capita income on agricultural exports and trade barriers on high-tech exports, contradict economic theory. Most studies suggest diversifying exports and expanding trade to improve trade flows and profits. Exchange rate policy is identified as critical, and the Belt and Road Initiative is seen as a significant opportunity for China to increase agricultural exports and build strong ties with other countries. Policymakers are advised to encourage trade liberalization, control corruption, improve government events, and enhance political stability for foreign direct investment. Some studies in Egypt and Arab countries lack statistical analysis, neglect optimal economic models, and fail to account for distance between markets. The study examined factors affecting the value of Egyptian exports, agricultural imports, and rice exports during the study.

4. Research Problem

This is even though the importance of trade exchange between Egypt and countries with high economic power (the high-economic countries) has been emphasized, along with the significance of Egypt’s partner countries and the significance of expanding trade exchange between Egypt and these countries. Compared to Egypt’s commerce with significant economic blocs or other nations, exports to and from these nations are modest. The issue with this topic is that Egypt’s trade volume with its trading partners changes substantially. This demonstrates how little foreign trade contributes to support sustainable development in all aspects and how difficult it is to obtain the foreign exchange required to advance the narrative. Despite the prominence of Egypt’s rice exports among other important
agricultural exports, the country’s foreign trade is hampered by factors such as the fluctuation and unpredictability of the annual quantities exported (the average Egyptian quantity of rice exports during the period 2001–2020 was 448.26 thousand tons). In addition, major exporting nations reported intense rivalry in Egyptian rice markets. Rice requires a significant amount of water (between 6,000 and 7,000 cubic meters per year), which is one of the most critical issues in the producing region. Consequently, the issue with analyzing Egyptian rice is that it is no longer exported and therefore contributes less to Egypt’s agricultural sector, overall exports, and gross domestic product. Not to mention that Egypt must import more food to meet local demand, which costs the government a great deal of money and further strains the public budget.

The Egyptian government decided to cut the rice harvest from 1.2 million feddan in 2017 to 724 thousand feddan in 2018. This meant that the country could only make 2.8 million tons of stewed rice, which meant that the government had to import about 600,000 tons of white rice. This costs the state a great deal of money. Therefore, in 2019, the government expanded rice farming to 8.1 million feddan, which increased supply but decreased farmer incomes.

5. Research Objectives

The study aims to examine the parameters of Egypt’s trade exchange with its trading partners during two distinct periods, namely 2001–2020 and 2001–2016. To achieve this primary objective, we have formulated the following subobjectives: to analyze the current status and evolution of the value of Egypt’s total agricultural and rice exports during the same period under the study, to examine the main factors which have influenced the value of Egypt’s total trade with other countries during the same period, to identify the key factors which have influenced the value of Egyptian rice exports in the same period, and to formulate several recommendations aimed at increasing the contribution of the Egyptian agricultural sector, total foreign trade, and the Egyptian rice harvest to finance the economic development of the country.

6. Methodology

The research relied on the methodology of descriptive and quantitative statistical analysis. The most important analysis was the use of the general temporal equations and the gravity model and the publication of secondary data in electronic forms, such as the FAO website (FAOSTAT), the Central Agency for Public Mobilization and Statistics (CAPMAS), the Agricultural Statistics Bulletin, and the United Nations Trade Database.

6.1. Analytical Method. To meet the research aims, the gravity model was used for the total export and import data and agricultural value for 2001–2020 and the volume of Egyptian rice exports for 2001–2016. The gravity model estimates the elements that are influencing Egypt’s international trade [21]. It is used to determine which factors are most significant.

6.2. Description of the Gravity Model. Initially, the gravity model was founded on Newton’s physics theory, which states that the attraction between two objects is proportional to their mass and inversely proportional to their squared distance. On the other hand, applying the gravity model to international trade seeks to describe bilateral trade flows and their shapes as biological bodies that attract one another is proportional to economic size (GDP) and reverse the geographical distance between the capitals of the trading partners. To accomplish the research aims, the gravity model was used for the total export and import data, agricultural value, and Egyptian rice exports for 2001–2020. The gravity model estimates the elements that are influencing Egypt’s international trade [21]. It is utilized to determine the most significant components (Egger [41]).

The global market’s total exportable supply (which represents potential exports) and the potential aggregate import demand for a given nation are crucial factors that impact the degree of trade concentration. Additionally, various factors that generate trade can also influence this concentration. Newton discovered the “Law of Universal Gravitation” in 1687, also known as the “General Gravitation Law,” which states that “the force of gravity (f)” between two objects (blocks) is directly proportional to the product of their masses (M1 and M2) and inversely proportional to the square of the distance D^2 between their centers:

\[ F = G \frac{m_1 m_2}{D^2}, \]

where G is the constant of general gravitation.

Tinbergen [42], a Dutch scientist, applied Newton’s general law of gravitation to the field of economics in 1962, for which he received the Nobel Prize in 1969, and Tinbergen established the following available form of the law of gravitation:

\[ YIJ = G \frac{M_1 M_2}{D_{IJ}^2}, \]

where YIJ is the commercial flow from country I to country J, GDP refers to the gross domestic product of the two countries (GDP and GDP, respectively). Dij is the distance between I and J.

Equation (2) is a form of Newton’s law and can be formulated in the following mathematical form:
Equation (4) has exponential regression coefficients and can be turned into a linear function by taking the natural logarithm of both sides. This makes it a double logarithmic function:

\[ \log(Y_{ij}) = \log(b_0) + \beta_1 \log(GDP_i) + \beta_2 \log(GDP_j) + \log(DIST_{ij}) + \epsilon_{ij}, \]

where \( \epsilon_{ij} \) is the random error limit for regression equation (4).

The double logarithmic model is preferred because the estimated model’s parameters \((b_1, b_2, \text{ and } b_3)\) show how flexible trade flows are on average changes in quantitative variables that show the size and distance of economies between countries.

Since Lenman added the populations of both countries to the estimated model in equation (5) in 1966, it is now called the basic gravity model (BGM). It is used in economics, especially in foreign trade and trade exchanges between countries. It is called the “modified gravity model” (AGM) and has several forms, which are as follows:

\[ \log(Q_{ij}) = \log(b_0) + \beta_1 \log(GDP_i) + \beta_2 \log(GDP_j) + \beta_3 \log(DIST_{ij}) + \epsilon_{ij}, \]

where \( \epsilon_{ij} \) is exporters. \( j \) is importers.

Data source: The study relies on annual data from the Central Agency for Public Mobilization and Statistics (CAPMAS), the Bulletin of Agricultural Statistics, and the United Nations Trade Database for the value of Egypt’s total exports and imports from 2001 to 2020, as well as the volume of Egypt’s rice exports to 11 study countries from 2001 to 2016. This information was obtained from CAPMAS, the Bulletin of Agricultural Statistics, the United Nations Trade Database, Statistical Database, United Nations Food and Agriculture Organization (FAO), and World Bank.

### 7. Empirical Results

**7.1. The General Chronology of the Evolution of the Value of Total Egyptian Exports in the Period 2001–2020.** The results in Table 1 show that the average value of total Egyptian exports reached about $21,579 million, with a minimum of about $6643 million in 2002 and a maximum of about $31,570 million in 2011 (Figure 1), showing a general upward trend during the period 2001–2020. Moreover, Egypt’s total exports have grown enormously recently, reaching about 1115 million US dollars, or about 5.17% of the average (FAOSTAT, 2020).

**7.2. The General Chronology of the Evolution of the Value of Egyptian Agricultural Exports in the Period 2001–2020.** Table 1 shows that, on average, from 2001 to 2020, the value of Egypt’s agricultural exports made up 13.90% of the total value of Egypt’s exports. Figure 2 shows that the value of agricultural exports went from a low of US $602 million in 2001 to a high of US $5451 million in 2019. In addition, the value of agricultural exports in Egypt has experienced substantial growth in recent years, reaching about US $281 million, representing 8.8% of the average period of about US $3193 million [43] (FAOSTAT, 2020).

**7.3. The General Chronology of the Evolution of the Value of Egyptian Rice Exports in the Period 2001–2020.** The data in Table 1 show that the value of Egyptian rice exports took a general downward trend during the study period, with an annual decline of about $14.0 million at a maximum of
$445.2 million in 2009 and a minimum of about $0.004 million in 2020. This growth rate was approximately 317.3% or 0.0029% of the total average at about $140.3 million for the maximum and minimum periods, respectively. This decrease is because rice export is subject to the state’s decisions to reduce the cultivated area annually and to ban rice export as water resources in Egypt are decreasing (Figure 3) [44].

**Table 1**: Trends in Egypt’s total exports, agricultural exports, and Egyptian rice exports over the period 2001–2020.

<table>
<thead>
<tr>
<th>Years</th>
<th>Total export value ($million)</th>
<th>Value of agricultural exports ($million)</th>
<th>The value of the ArZ exports ($million)</th>
<th>Quantity of ArZ exports (thousand tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>7068.2</td>
<td>602.0</td>
<td>132.9</td>
<td>650.3</td>
</tr>
<tr>
<td>2002</td>
<td>6643.4</td>
<td>751.8</td>
<td>103.3</td>
<td>452.5</td>
</tr>
<tr>
<td>2003</td>
<td>8205.2</td>
<td>914.6</td>
<td>148.0</td>
<td>572.3</td>
</tr>
<tr>
<td>2004</td>
<td>10452.5</td>
<td>1278.7</td>
<td>224.0</td>
<td>806.9</td>
</tr>
<tr>
<td>2005</td>
<td>13833.4</td>
<td>1139.2</td>
<td>294.3</td>
<td>1017.4</td>
</tr>
<tr>
<td>2006</td>
<td>18455.1</td>
<td>1072.6</td>
<td>288.0</td>
<td>917.2</td>
</tr>
<tr>
<td>2007</td>
<td>19223.8</td>
<td>1544.1</td>
<td>380.0</td>
<td>1123.5</td>
</tr>
<tr>
<td>2008</td>
<td>26223.8</td>
<td>2135.7</td>
<td>163.1</td>
<td>238.9</td>
</tr>
<tr>
<td>2009</td>
<td>23061.6</td>
<td>4291.5</td>
<td>445.2</td>
<td>560.4</td>
</tr>
<tr>
<td>2010</td>
<td>26437.8</td>
<td>2890.4</td>
<td>329.9</td>
<td>453.3</td>
</tr>
<tr>
<td>2011</td>
<td>31570.3</td>
<td>4932.3</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>2012</td>
<td>29396.9</td>
<td>3899.6</td>
<td>67.0</td>
<td>82.0</td>
</tr>
<tr>
<td>2013</td>
<td>28492.1</td>
<td>4714.3</td>
<td>159.4</td>
<td>231.0</td>
</tr>
<tr>
<td>2014</td>
<td>26852.0</td>
<td>4395.8</td>
<td>2.4</td>
<td>2.7</td>
</tr>
<tr>
<td>2015</td>
<td>21349.0</td>
<td>4378.1</td>
<td>42.4</td>
<td>50.9</td>
</tr>
<tr>
<td>2016</td>
<td>25468.0</td>
<td>4354.9</td>
<td>9.7</td>
<td>12.9</td>
</tr>
<tr>
<td>2017</td>
<td>25604.0</td>
<td>4921.5</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>2018</td>
<td>27624.0</td>
<td>5013.7</td>
<td>16.8</td>
<td>20.0</td>
</tr>
<tr>
<td>2019</td>
<td>28993.0</td>
<td>5450.9</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>2020</td>
<td>26630.0</td>
<td>5169.8</td>
<td>0.004</td>
<td>0.006</td>
</tr>
</tbody>
</table>

7.4. The General Chronology of the Egyptian Rice Export Volume Evolution in 2001–2020. From 2001 to 2020, the quantity of Egyptian rice exports fluctuated between a high of 1123.5 thousand tons in 2007 and a low of 0.006 thousand tons in 2020, with an average of 359.6 thousand tons during the study period. The study’s results on the general trend of rice exports indicated a downward trend of approximately 50.7 thousand tons per year. This decrease in the quantity of rice exported from Egypt can be attributed to the decrease in rice production as a result of the government’s decisions to reduce the rice area and ban its exports, rationalizing the use of water resources in Egypt and meeting the demand for domestic consumption (see Figure 4).

8. Gravity Model Estimation Results

The study used a regression model to figure out what factors affected Egypt’s total exports and imports of agricultural goods from 2001 to 2020. The paper will also study this effect on the amount of Egyptian rice exported during the study period (2001–2016). The analysis used a method called “time-series cross-sectional analysis,” which combines data from different points in time with data from different places in time. The research was based on a method called “time series cross section,” which is the combination of data from a time series and data from a cross section. This method is popular in economic studies because it takes into account both the effects of time and the effects of the difference between cross-sectional data [45]. Countries represent the cross-sectional data dimension, and the period represents the temporal dimension when referring to panel data.

8.1. Gravity Model Results for Total Egyptian Exports. According to Table 2’s results of the gravity model analysis of Egypt’s total exports, Egypt’s real GDP has a statistically significant direct relationship with intangibles at the 1% level. This is in line with the statistical logic of the theory. A 1% increase in Egypt’s real GDP would result in a 1.36% increase in total exports [46, 47].

Even though this variable’s direct relationship is not very strong, the real GDP difference between partner countries has proven to be a good way to make decisions. It has fostered expansion into the markets of these countries. An increase of 0.12% occurs when the GDP of these nations increases by 1% [48].

The change in Egypt’s population is also linked to a negative, statistically significant, and logically sound relationship: a 1% increase in Egypt’s population leads to a 2.76% drop in the total volume of Egyptian exports [49].

About 1% of the distance between Egypt and its trading partners grew, which made Egypt’s exports to these countries worth about 0.174% less. The shorter length reduces the total logistical costs of Egyptian exports [50, 51].

At the 1% level, the model’s overall morality was confirmed because its value was $F = 93.5\%$. The modified identification factor reached 61%, which means that the variables in the model explained 61% of the change in the total amount of exports from Egypt from 2001 to 2020. The time component accounted for 39% of the model’s factors.

8.2. Results of the Gravity Model for the Total Egyptian Imports.

Table 3 shows the results of the gravity model, which shows that Egypt’s imports from its 11 trading partners fell as its real GDP rose. The real GDP coefficient is significant. Hence, the calculated inverse connection with a value of $-1.436$ indicates that a 1% increase in Egypt’s real GDP leads imports from these countries to decrease by 1.44% for every 1% increase in Egypt’s real GDP. This is because Egypt’s real GDP per capita would decline, resulting in a decline in consumption, demand, and imports. This result is consistent with the premise of the gravity model, which states that as the economy grows, so will the volume of international trade [46]. The importance of imports from these nations is inversely related to the importing nation’s gross domestic product [52].

The Egyptian population variable was statistically connected with an inverse and significant connection at a confidence level of 1%. This demonstrates that as the Egyptian population expands, the per capita GDP declines, reducing the desire for consumption. The 1% change in the Egyptian population transforms into a 3.36% decline in total Egyptian imports [52–54].

As shown in Table 3, the results of the gravity model analysis revealed that the independent variables included in the model accounted for 72% changes in the overall volume of Egyptian imports during the study period, while the remaining 28% were attributable to independent variables omitted from the statistical analysis and time reference.
8.3. Results of the Gravity Model for Egyptian Agricultural Exports.

Table 4 shows the results of the analysis of Egypt’s agricultural exports based on the gravity model from 2001 to 2020. These results indicate that several factors can explain Egypt’s agricultural exports. Egypt’s real GDP was the most significant of these factors, as this variable’s statistical significance was 1% and the parameter signal was consistent with logic. The 1% increase in Egypt’s GDP results in a 1.88% increase in agricultural exports [55].

As for the relation between the variable geographical distance between Egypt and each of the countries, it has been demonstrated that Egypt’s agricultural exports to these countries harm Egypt’s relationship with each country. This is rational from an economic standpoint. However, the statistical significance of this variable was not confirmed, which suggests that increasing the geographical distance between Egypt and these countries by approximately 1% reduces Egyptian agricultural exports [56].

Table 4 presents the results of the gravity model analysis for Egyptian agricultural exports. The GDP of Egypt and the eleven partner countries in the model, their populations, and the geographical distance between Egypt and each of these countries account for approximately 81% of the fluctuations in Egyptian agricultural exports to these countries. The F-test statistically validated the model, which was estimated at 94.879.

8.4. Gravity Model Results for Egyptian Agricultural Imports

Using the logic of economic theory, Table 5’s analysis shows a statistically significant inverse relationship at the 1% moral level between Egyptian GDP and Egyptian agricultural imports from these countries. This means that a 1% increase in Egyptian GDP leads to a 4% decrease in Egyptian farm imports from these countries. The first of these measures is the country’s first of its kind.

There is a statistically significant relationship between the change in the Egyptian population and the volume of Egyptian agricultural imports. A 1% increase in the Egyptian population results in a 16.7% increase in Egyptian agricultural imports. This is consistent with economic theory’s logic [32].

The study in Table 5, which indicates the results of the estimation of the gravity model of agricultural imports, showed that the real GDP of Egypt and the eleven partner countries in the model, the population of both countries, and the geographical distance between Egypt and each of these countries explain about 85% of the changes in imports. Egypt is one of those countries. The model has been statistically positive at 1%, according to the F-test estimate of 76.769.
Table 3: Showing results of the gravity model for total Egyptian imports to the countries covered by the study.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. error</th>
<th>t-statistics</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>6.009</td>
<td>1.054</td>
<td>5.902</td>
<td>0.000</td>
</tr>
<tr>
<td>LOG (GDP,eg)</td>
<td>-1.436</td>
<td>0.133</td>
<td>-9.554</td>
<td>0.000</td>
</tr>
<tr>
<td>LOG (GDP.cont)</td>
<td>0.022</td>
<td>0.039</td>
<td>0.769</td>
<td>0.488</td>
</tr>
<tr>
<td>LOG (pop,eg)</td>
<td>-3.360</td>
<td>0.779</td>
<td>-4.533</td>
<td>0.000</td>
</tr>
<tr>
<td>LOG (pop,count)</td>
<td>-0.016</td>
<td>0.053</td>
<td>-0.438</td>
<td>0.654</td>
</tr>
<tr>
<td>LOG (dist)</td>
<td>-0.019</td>
<td>0.057</td>
<td>-0.283</td>
<td>0.881</td>
</tr>
<tr>
<td>Period random</td>
<td>355.14</td>
<td>0.048</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Idiosyncratic random</td>
<td>1215.13</td>
<td>1168.34</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Weighted statistics

- R-squared: 0.729
- Adjusted R-squared: 0.720
- SE of regression: 0.115
- F-statistic: 165.33
- Durbin-Watson stat: 1.545
- F-statistic: 94.879
- Durbin-Watson stat: 1.545

Source: (1) The Food and Agriculture Organization (FAO). (2) ITC calculations based on UN COMTRADE statistics.

8.5. Gravity Model Results and the Most Important Explanatory Variables for the Egyptian Rice Crop during the Period 2001–2016

During the same time, an analysis of the Egyptian rice crop based on the gravity model was done. Exports to the study countries stopped in 2016 because the government decided to cut down on the amount of land used for this crop to save water in Egypt, especially after the Ethiopian dam was built. Numerous attempts have been made to predict the dependent variable of rice exports to the study countries, but the best results make no economic sense.

Using the theoretical model and previous applied research, the factors that explain the amount of Egyptian rice that is exported were found. After many attempts to make sure that certain explanatory variables were not left out, a model formula was found that makes sense from an economic, statistical, and normative point of view. The following is a formulation of this model:

\[
Q_{ij} = \text{Con} + \log\text{GDP}_i + \log\text{GDP}_j + \log\text{POP}_i \\
+ \log\text{POP}_j + \log\text{Prod}_i + \log\text{Price}_i \\
+ \log\text{Dis}_{ij} + E_{ij},
\]

(7)

where \(Q_{ij}\) is the amount of rice exports to the study countries per thousand tons. GDP\(_i\) is Egypt’s gross domestic product (in million dollars). GDP\(_j\) is the gross domestic product of importing countries (in million dollars). POP\(_i\) is Egypt’s population (in millions). POP\(_j\) is the population of importing countries (in millions). Prod\(_i\) is Egypt’s rice production per thousand tons. Price\(_i\) is export price (USD/ton). DIS\(_{ij}\) is the geographical distance between Egypt and the importing countries (in kilometers). \(E_{ij}\) is error limits. \(i\) is the exporting country (Egypt). \(j\) is the importing country.

The top eleven countries selected were Saudi Arabia, Syria, Sudan, Lebanon, Jordan, Belgium, the United Kingdom, Ukraine, Libya, Romania, and Turkey; with Egypt’s total rice exports to these countries accounted for 89.4% of Egypt’s total exports to the world from 2001–2016. The results show that the positive and statistically confirmed relationship at the 1% moral level indicates that a 1% increase in Egypt’s real GDP leads to a 1.98% increase in the quantity of Egypt’s rice exports [26].

But the analysis showed that the direct relationship between the variable of Egyptian rice production at 1% was moral. It makes sense from an economic point of view, since a 1% increase in production leads to a 1.39% increase in Egyptian rice exports.

The variable of Egyptian rice export price was also linked to a statistically specific direct relationship at the 1% moral level. This is in line with economic theory, which says that when rice export prices go up, farmers are more likely to grow more crops so they can make more money from exporting Egyptian rice. A 1% increase in export price leads to a 3.97% increase in Egyptian rice exports to partner countries [26].

Table 4: Showing results of the gravity model for Egyptian agricultural exports to the countries covered by the study.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. error</th>
<th>t-statistics</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>1.439</td>
<td>0.948</td>
<td>1.546</td>
<td>0.159</td>
</tr>
<tr>
<td>LOG (GDP,eg)</td>
<td>1.877</td>
<td>0.130</td>
<td>13.631</td>
<td>0.000</td>
</tr>
<tr>
<td>LOG (GDP.cont)</td>
<td>-0.008</td>
<td>0.031</td>
<td>-0.234</td>
<td>0.809</td>
</tr>
<tr>
<td>LOG (pop,eg)</td>
<td>0.496</td>
<td>1.116</td>
<td>0.454</td>
<td>0.658</td>
</tr>
<tr>
<td>LOG (pop,count)</td>
<td>0.005</td>
<td>0.028</td>
<td>0.190</td>
<td>0.875</td>
</tr>
<tr>
<td>LOG (dist)</td>
<td>-0.009</td>
<td>0.065</td>
<td>-0.158</td>
<td>0.899</td>
</tr>
<tr>
<td>Period random</td>
<td>788.08</td>
<td>0.048</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Idiosyncratic random</td>
<td>915.19</td>
<td>889.28</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Weighted statistics

- R-squared: 0.818
- Adjusted R-squared: 0.814
- SE of regression: 0.1005
- F-statistic: 209.879
- Durbin-Watson stat: 1.980
- F-statistic: 94.879
- Durbin-Watson stat: 1.980

Source: (1) The Food and Agriculture Organization (FAO). (2) ITC calculations based on UN COMTRADE statistics.
The results of the analysis in Table 6 using the gravity model to measure the total impact of the 11 countries studied on the volume of Egyptian rice exports show that the total variables included in the model explain about 27% of the changes in the volume of Egyptian rice exports to these countries. The remaining differences in export volume are due to other factors not measured by the model. The moral of the underlying model is 1% below $F$, which corresponds to 9.78.

The results of this study add to what is already known about international trade between Egypt and other countries. Using the gravity model method, the study examines the determinants of Egyptian rice exports to 11 selected countries from 2001–2016. The results confirm the importance of real GDP and domestic production surplus in increasing Egypt’s rice exports, consistent with previous studies that highlight the significance of GDP and exchange rates in affecting trade between countries [22, 25]. The study also identifies the export price of Egyptian rice as an important factor affecting trade, in line with the economic logic that higher export prices encourage farmers to expand cultivation and benefit from exporting [26].

Previous research [21, 24, 27] has shown how important GDP, exchange rates, and distance are to international trade [21, 24, 27]. There are some differences though in the specific factors which are seen as important in trade. For example, Shehata [21] identified imports of rival countries as a significant factor affecting Egyptian exports, which were not included in the current study. In addition, the current study focuses specifically on the determinants of rice exports from Egypt to selected countries, while other studies analyze trade in different products or between different countries.

The current study’s findings have important implications for policymakers. The study suggests that promoting economic growth and increasing domestic production surplus can encourage exports, consistent with previous research [22, 25]. In addition, maintaining competitive export prices can encourage farmers to expand cultivation, which can lead to increased exports [26]. These findings are in line with recommendations from previous studies that emphasize the importance of diversifying exports, expanding trade, encouraging trade liberalization, and controlling corruption [32, 37].

In conclusion, the current study’s findings add to the literature on international trade and highlight the importance of GDP, exchange rates, and export prices in affecting trade between countries. The study’s results have important implications for policymakers and suggest that promoting economic growth, increasing domestic production surpluses, and maintaining competitive export prices can encourage exports. Further research could build on these findings by examining the determinants of trade in other products or between different countries.

As for the proposal to refine and revise the role of the Trade Policy Review Mechanism in maintaining the WTO’s supremacy in the international trade order, one possible way...
is to enhance its effectiveness in identifying and addressing non-tariff barriers to trade, such as regulatory measures, standards, and technical barriers. This could be achieved by strengthening the analytical tools and methodologies used in the review process and by providing more targeted and specific recommendations for policy reform. By doing so, the WTO can continue to promote free and fair trade and remain relevant in the changing global economic landscape. The results of the empirical study on the determinants and potential of trade in Egyptian rice using the gravity model approach suggest that promoting economic growth, increasing domestic production surpluses, and maintaining competitive export prices can encourage exports. These findings are in line with recommendations from previous studies that emphasize the importance of diversifying exports, expanding trade, encouraging trade liberalization, and controlling corruption. However, the rising trend of protectionism among some WTO members poses a challenge to the multilateral trading system. Protectionist policies such as tariffs, quotas, and subsidies can distort trade flows and lead to market inefficiencies. The WTO plays a vital role in promoting free and fair trade by enforcing its rules and regulations and by providing a platform for members to negotiate and resolve trade disputes. To maintain its supremacy in the international trade order, the WTO needs to adapt to the changing global economic landscape and address emerging issues such as digital trade and environmental sustainability. One proposal to refine and revise the role of the Trade Policy Review Mechanism is to enhance its effectiveness in identifying and addressing non-tariff barriers to trade, such as regulatory measures, standards, and technical barriers. This can be achieved by strengthening the analytical tools and methodologies used in the review process and by providing more targeted and specific recommendations for policy reform. In this way, the WTO can continue to promote free and fair trade and maintain its relevance in the changing global economic landscape. Overall, the results of this study add to the literature on international trade and highlight the importance of GDP, exchange rates, and export prices in affecting trade between countries. The study’s findings have important implications for policymakers and suggest that promoting economic growth, increasing domestic production surpluses, and maintaining competitive export prices can encourage exports. Further research could build on these findings by examining the determinants of trade in other products or between different countries.


Foreign commerce is an integral part of Egypt’s economy. Therefore, it is essential to understand the primary economic factors that can influence Egyptian exports (gross rice) for the government and policymakers to take the appropriate measures to enhance the performance of the foreign trade sector.

The primary purpose of this study was to determine the primary factors influencing Egypt’s exports of the three species mentioned above. The analytical procedure includes the gravity model as one of the best theoretical frameworks for estimating export equations using panel data for 2001–2020 for export and total import and agricultural value, and 2001–2016 for the quantity of Egyptian rice exports.

During the time series of the experimental analysis, eleven countries were chosen based on the distribution of Egyptian rice exports; these eleven nations accounted for 89.4% of Egyptian rice exports during the study period. The evaluation of the gravity model revealed that the variable of Egyptian GDP harmed the value of total Egyptian imports, as a 1% increase in real Egyptian GDP led to a 1.44% decline in the flow of these imports. This result is compatible with economic reasoning and demonstrates that the real GDP of the trading partner has a negligible direct effect. Consistent with economic theory, a 1% increase in the population of Egypt and its trading partners decreased the value of Egyptian imports by 3.36 and 0.016%, respectively [52, 54]. If the combined GDP of Egypt and its trading partners increased by 1%, Egyptian exports would grow by 1.36% and 1.28% each.

In [47, 48], the change in Egypt’s population was also associated with the opposite statistically significant relationship and was consistent with the logic of the economic theory. The 1% increase in Egypt’s real GDP resulted in a 1.88% rise in agricultural exports.

In [55], a 1% increase in Egypt’s real GDP will result in a 4% decrease in Egypt’s agricultural imports from those countries, according to the logic of the economic theory. A 1% increase in Egypt’s population led to a 16.7% rise in agricultural imports. This was consistent with economic theory’s logic. The 1% increase in Egypt’s real GDP led to a 1.1998% increase in rice exported from Egypt. The direct relationship of the change in Egyptian rice production was validated, which is consistent with economic logic, which states that by increasing production, a surplus of domestic consumption would be transferred to exportation for every 1% increase in output. In accordance with economic logic, which states that with an increase in the rice export price, farmers are encouraged to increase their cultivation to profit from exporting Egyptian rice; it has been statistically demonstrated that the export price of rice has a positive direct relationship. The 1% increase in export price increased Egyptian rice exports to partner nations by 3.97%.

It can be argued that policies had limited impact due to the crucial role of rice as a strategic staple in the Egyptian diet that cannot be substituted. Moreover, rice cultivation is capable of achieving self-sufficiency and surplus for export, which incentivizes farmers to cultivate more and sometimes exceed the designated areas assigned by the government in pursuit of greater financial gains.

Based on the study’s main findings, there are a few things that can be done to improve Egypt’s foreign trade and its economic relationships with its trading partners; to slow down the rate of economic growth for both Egypt’s total exports and agricultural exports, as well as the value of rice exports, the government and policymakers should focus on countries with high real and monetary GDP that are close to Egypt; to switch from import-export to strategic food
security cooperation, the Egyptian government should set up strategic partnerships with rice-importing partner countries to ensure a steady supply of rice and improve food security; to increase the value of Egyptian imports and agricultural exports, the government should put a high priority on measures that increase the production and quality of agricultural products; to address the negative effect of transportation costs on trade volumes, the government should invest in transportation infrastructure and improve trade logistics; to make Egyptian rice more competitive on the world market, the government should help farmers and give them the tools and technology they need to boost production and improve quality; and to put these suggestions into action, the government should set up policies and programs that help and encourage the agricultural sector and give infrastructure, logistics, and technology the most money. The government should also set up strategic partnerships and cooperation agreements with the countries that import rice to improve economic relations and make sure there is enough food for everyone. Also, the government should do more research to find out what other things might affect Egyptian trade and come up with plans to deal with them [57–59].

10. The Study Contribution

The contribution of this study is its valuable insights into the determinants of Egyptian trade, particularly rice exports to 11 partner countries through the use of the gravity model approach and analysis of annual data over 20 years. It identifies crucial factors influencing trade flows, including GDP, population, export prices, transportation costs, and distance between capitals, providing policymakers with recommendations to enhance economic relations and promote strategic food security cooperation. The study adds to the existing literature on international trade, offering useful insights for policymakers and researchers seeking to understand the determinants of trade. In addition, the study employs a robust and unbiased estimator, the gravity model, contributing to the logical analysis of the determinants of rice export from Egypt.

10.1. The Motivation and Significance of the Study. The motivation for this study is based on the significance of foreign trade to the Egyptian economy, particularly with regards to rice exports to 11 partner countries. Understanding the determinants of trade can assist policymakers and government officials in making informed decisions to enhance the foreign trade sector’s performance and promote economic growth. The study’s significance lies in its use of the gravity model approach to identify the most influential factors on Egypt’s exports and imports, including GDP, population, export prices, transportation costs, and distance between capitals. The study provides valuable insights for policymakers to enhance economic relations between Egypt and its trading partners and shift toward strategic food security cooperation. In addition, the study contributes to the existing literature on international trade and provides useful insights for researchers interested in studying the determinants of trade.

The study on the determinants of Egyptian trade in general and Egyptian rice trade in particular with 11 rice-importing partner countries is significant for several reasons. Firstly, foreign commerce is a crucial component of Egypt’s economy, and the findings of this study can assist policymakers and government officials in taking appropriate measures to enhance the foreign trade sector’s performance. Secondly, the study’s use of the gravity model approach and the analysis of annual data over a 20-year period provide valuable insights into the factors that influence trade flows, such as GDP, population, export prices, transportation costs, and distance between capitals. Thirdly, the study’s identification of the most influential factors on Egypt’s exports and imports can assist policymakers in developing effective trade policies and strategies to increase trade flows, diversify exports, and promote strategic food security cooperation. Finally, the study’s recommendations on taking measures to deflect the pace of economic growth of both the Egyptian total and agricultural export variables and rice export value, focusing on countries with high monetary and real GDP and a close geographical distribution, could improve economic relations between Egypt and its trading partners and shift towards strategic food security cooperation.

11. The Policy Implications

The policy implications of this study are as follows:

Policymakers and government officials should work on improving the foreign trade sector by learning about the main economic factors that affect Egyptian exports, especially rice exports, to its trading partners. The results of this study suggest that policymakers should focus on promoting economic growth, diversifying exports, and promoting strategic food security cooperation by taking several steps to slow the rate of economic growth of both the Egyptian total and agricultural export variables and rice export value, focusing on countries with high monetary and real GDP and a close geographical distribution. Policymakers should consider the negative impact of Egyptian GDP and population growth on total Egyptian imports and exports, and population growth. Moreover, policymakers should consider the positive impact of a 1% increase in export prices on shipments of Egyptian rice to partner countries and the negative impact of higher transportation costs and the distance between capitals on Egyptian exports.

To improve economic relations between Egypt and its trading partners and move from import-export to strategic food security cooperation, policymakers should think about the suggestions made in this study. For example, they should focus on countries with high monetary and real GDP and close geographic locations and take steps to improve the performance of the foreign trade sector.
12. The Study Limitations

The study only focuses on 11 specific rice-importing partner countries and their trade relations with Egypt, which may not be representative of all of Egypt’s trade relationships. The study only looks at Egyptian trade from 2001 to 2020, so it may not include the most recent changes. The gravity model approach used in this study does not take into account all of the details and complexities of international trade. The study does not take into account the potential impact of nontariff barriers on Egyptian trade, such as technical regulations or sanitary and phytosanitary measures. The study only looks at the factors that affect Egyptian trade. It does not look at how global economic trends or political events might affect Egyptian trade relations. The study does not look at how currency changes might affect trade between Egypt and its partners. The study does not look at how market saturation or competition from other rice-exporting countries might affect Egyptian rice trade. Both of these things could happen. These limitations should be considered when interpreting the results of the study and suggesting avenues for future research to address them.

Data Availability

The data used to support the findings of this study are available within the manuscript.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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