Estimation of Export Demand Function in Egypt

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Abstract

In emerging economies, exports play an important role in enhancing economic growth, sustaining development, and providing foreign exchange revenue. The study explores the determinants of exports in Egypt from 1980-2021. Considering the heterogeneity of exports, the paper disaggregates the types of exports into three major sub-components according to data availability. First, the study estimates the determinants of total exports and then focuses on identifying the determinants of merchandise exports. Finally, a separate function is estimated to identify the main factors of service exports. Key empirical findings are consistent with the results of previous studies, especially about the positive and significant relationship between exports and world GDP, real domestic GDP, and the trade partnership agreement with the EU. However, a negative and significant relationship between the real effective exchange rate and the total exports has been detected, with a higher response from service exports.

Keywords: Export Demand Function, OLS, Vector error correction model (VECM), Cointegration, Egypt

1. Introduction

Exports play an important role in enhancing economic growth and sustaining development in emerging economies. Exports of goods and services are also important sources of foreign exchange resources that help generate income for exporters and those working in the feeding and related industries. Exports are also viewed as an engine of growth, as they contribute to improving the quality of goods to better compete in foreign markets. Additionally, using modern technologies in production helps enhance and increase the technological capabilities in the country, as high-technology exports usually generate higher value-added, which often translates into higher income and GDP growth. In this regard, Egypt is set to implement a new strategy that targets increasing its annual exports to the global markets to reach $100 billion compared to around $40 billion in 2021, especially since Egyptian exports have been growing at declining real rates for over a decade.

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This study investigates the behavior of exports by examining their possible determinants in light of theory and literature. The aim is to help policymakers identify the optimal policies that could help foster Egyptian exports. In this respect, measuring the income and price elasticities of export demand has received much attention because of its implications for trade policy and the balance of payments.

However, it might not be optimal to focus on the performance of total exports to explore the determinants of exports in Egypt. Total exports are composed of heterogeneous commodities and services that might respond differently to exogenous variables. For example, the devaluation of the Egyptian pound might have a different effect on fruits and vegetables than on tourism. Thus, it might be more insightful to estimate the determinants of exports for different types of exports, for example, merchandise exports vs. service exports. In this regard, the associated price and income elasticities for each type of export product and service shall be highlighted.

This study has four sections. Section 1 presents a literature review. Section 2 provides stylized facts on the current situation of exports in Egypt. Section 3 describes the export function specifications and the implemented methodology. Section 4 highlights the main empirical results and concludes.

2. Literature Review

In theory, exports depend on three main factors: the country's productive capacity and the available supply of exportable goods; the price of exportable goods compared to similar products in importing countries; and the world income that could be a proxy for global demand. Other non-price factors might affect export demand, such as quality standards and time for delivery; however, these factors are not easily measurable[1].

The export demand function takes the following form, and it includes the estimation of both income and price elasticities:

$$X_t = a C_t^\gamma \left(\frac{P_d}{P_f}\right)_t^\eta Z_t^\epsilon$$

where X is the dependent variable that refers to the export volumes; C represents the production capacity in the exporting country; and pd/pf is the ratio of the export price to the correspondent prices in the importing countries. The function also includes Z_t, the level

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[1] Thirlwall (1986),

of world income; γ export elasticity concerning production capacity; η price elasticity; and income elasticity.

The allocation of domestic production between selling the output in the domestic market versus exporting it to the international market depends on the firm's performance and the export demand curve. It is assumed that the exporting country is a price-taker because the small economy exerts no influence on the international prices of commodities.

The main aim of producers is to maximize profits when the marginal cost (MC) equals the marginal revenue in both domestic and export markets. Thus, total output is allocated towards both the domestic and foreign markets, and the price in the domestic market becomes PH and the price in the foreign market becomes PF. The total marginal revenue curve is the horizontal sum of the marginal revenue curves in both markets. Hence, if domestic demand for production increases, the quantity available for export will decrease, and if domestic demand decreases, the amount available for export will increase via changes in relative prices. Hence, there is a negative relationship between the decrease/increase in the quantity of exports and the upward/downward pressure (1974), selling the output in the domestic market. According to this theoretical framework, when there is an increase in domestic demand, domestic prices will shift upward, and hence it becomes more profitable for producers to sell more output in the domestic market and reduce the quantity that is directed towards the export market, and vice versa. Winters (1974, not listed in the reference list) has stressed the importance of identifying the changes in export profitability as measured by the ratio of the domestic price index to the export price index of manufactured goods.

Relative export profitability was considered an important additional factor that affects the performance of exports. In addition, many factors can play important roles in explaining the performance of exports. These factors are mainly concentrated in three dimensions. First, the production capacity in the home country is usually measured by real GDP growth and national savings as a percentage of GDP (Majeed and Ahmad 2006). Second, other factors emphasized external factors such as world demand for exports and foreign direct investment (Majeed and Ahmad, 2006; Mirdala et al., 2019).

For instance, the results associated with FDI are inconclusive, as the final impact depends on the type of FDI projects in the destination country. FDI might be complementary or a substitute for trade. If the FDI projects are vertically oriented and aim to localize parts of the production process in other countries, this type of foreign investment might lead to

more trade creation. However, if foreign investment is directed to benefit from horizontal expansion and market penetration, it becomes a substitute for trade (Altıntaş 2014; Delice and Birol 2011). The experience in several countries suggests that FDI strongly contributes to the transformation of the composition of exports. For instance, FDI inflows into Singapore and China helped to significantly increase the technological content of exports by strongly supporting the development of export supply capacity, including knowledge-based industries (Awolusi and Osman, 2023). However, Alaya (2012) showed that inward FDI had a negative sign in 12 countries in the MENA region, which can be explained by the fact that MENA countries usually attract a small portion of FDI that is mainly directed to labor-intensive industries. While natural resources and exports of fuel often induce positive effects on exports, this endowment might hinder export diversification.

The relative competition between exporters is essential in determining the value of exports, which is measured by the ratio of export prices to the export prices of competing economies, adjusted by the exchange rate (Mirdala et al. 2019). In this regard, devaluation of the local currency renders domestic exports cheaper and, hence, might lead to an increase in the quantity of exports. In addition, many countries, such as China and Korea, have used currency devaluation as an additional tool to enhance comparative advantage, which has helped them increase exports. However, the results of the impact of exchange rate movements were inconclusive. While several studies confirmed the positive correlation between devaluation and the increase in exports, other studies did not succeed in proving this positive association between the two variables, especially at the macro level. Another study by Chahir et al. (2019) found that a depreciation of the real exchange rate increases the value of exports without affecting the quantity of exports. This highlights the fact that the price effect is more significant than the quantity effect (Chahir et al. 2019). With a special focus on the Egyptian case, Adams and Metwally (2020) tested the Marshall-Lerner condition. Using Egypt's trade data for the period 1965–2017, they examined whether changes in the exchange rate (devaluation in Egypt) drive changes in the relative prices of imports and exports, which in turn drive changes in the volume of both exports and imports (the elasticity approach). The paper applied the ordinary least squares (OLS) method for the exports equation, where the real effective exchange rate and world GDP were used as explanatory variables. They found that real exports of Egyptian goods and services are elastic concerning changes in the real effective exchange rate. Also, another study on the determinants of Egyptian merchandise exports showed that a depreciation of the Egyptian pound could induce a small increase in the real value of Egyptian merchandise exports (Ibrahim 2012).

The volatility of exchange rate movements also matters for export performance. For example, Badr and El-khadrawi (2018) concentrated on the impact of the volatility of the exchange rate on Egyptian trade flow for the period 1980–2016. The main results of the study highlight the negative impact of exchange rate volatility and inflation on exports.

Free trade agreements (FTAs) usually facilitate export access to international markets. Cardozo, Martínez-Zarzoso, and Vogler (2020) investigated whether the adoption of pan-Euro-Mediterranean (PEM) rules of origin has a positive impact on the exports (final and intermediate goods) of Egypt, Jordan, Morocco, and Tunisia. The gravity model[2] was applied to forecast the volume of trade between two trading partners based on several factors, namely their economic mass (positive relationship) and distance between them, which is an indication of the trade cost (negative relationship). Four model specifications were presented for the effects on exports of final goods and intermediate goods for the complete sample of trading partner countries and OECD countries. Agreements signed with the EU and EFTA countries had a positive and significant effect across specifications for final goods exports but not for intermediate goods, while the agreement with Turkey is significant and positive for intermediate goods exports across specifications. Çeştepe et al. (2015) also found that free trade agreements have a positive impact on the exports of those countries, even if the exporting country has comparative disadvantages in the case of free trade. A free trade agreement can improve the export power of the exporting country by providing exceptional applications such as lower customs tariffs.

Moreover, the size and growth of the supply capacity of a country depend critically on the availability of physical infrastructure, ranging from roads and ports to energy and telecommunications. Awolusi and Osman (2023) use the internal transport infrastructure as a proxy for the infrastructure as a whole. The analysis argues that internal transport infrastructures are likely to play an important role in the early stage of export sector development (Awolusi and Osman, 2023).

Concerning the methodology that is usually implemented to estimate export functions, Awolusi and Osman (2023) investigate the factors determining export performance in Uganda and apply the OLS technique. To overcome the problem of spurious regression, they examine the time series characteristics of the variables by testing for stationery and co-integration of the variables. The Johansen procedure is used, as it assumes the possibility of more than one cointegrating relation between the variables. Altintaş and Türker (2014) estimate the export function for Turkey using the unit root test, co-integration analysis, and Granger causality tests. The same methodology was applied by

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[2] The gravity model approach includes other explanatory variables such as common language, colonial links, and the existence of trade agreements.

Haider, Afzal, and Riaz (2011) to estimate the export elasticities of Pakistan's trade with traditional trade partners, but they also estimated an error correction model (ECM), which combines the long-run relationships with the short-run dynamics. Athanasoglou and Bardakas (2010) develop a demand function for Greece's exports of manufactured goods, estimating the long run, and a vector autoregressive error correction model (VECM) for the short run. They focus on time-series econometrics.

3. Stylized Facts: Current Situation of Exports in Egypt

Egypt adopted trade liberalization in the 1990s, especially with the proliferation of free trade agreements. One of the main objectives of free trade agreements is to increase the amount of foreign trade between Egypt and its trading partners. However, the indicator of trade openness witnessed a notable decline during the 1990s, albeit the trend was reversed to attain around 70 percent of GDP in 2008 (Figure 1). Unfortunately, starting in 2009, the trade ratio as a percentage of GDP started declining again. This was due to several negative shocks, such as the global financial crisis in the late 2000s and then the political upheaval and domestic economic disturbance in 2011 and onwards. In 2021, trade openness reached 27 percent only of GDP, indicating lower integration of the Egyptian economy in the world economy compared to other emerging economies, such as Turkey, South Africa, and Jordan, where trade openness reached 60.5, 56, and 66 percent, respectively (WDI 2024).
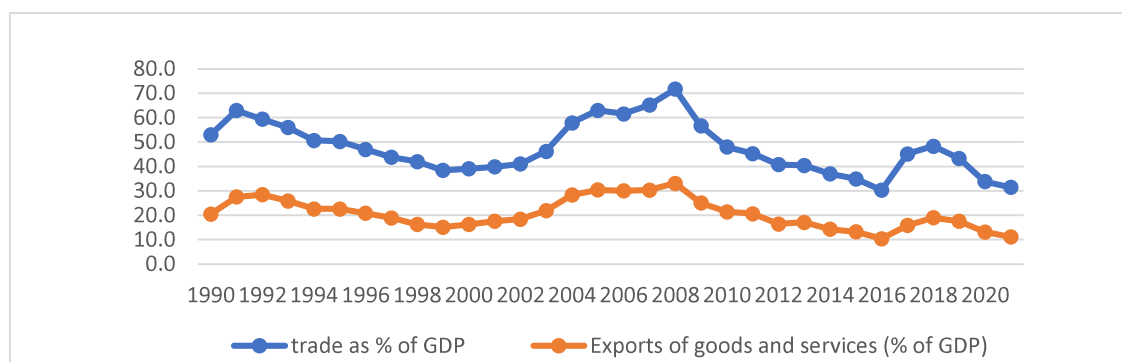

Figure 1: Trade and Exports as % of GDP
Source: World Bank, World Development Indicators.

Exports increased in real terms from around $10 billion in 1990 to about $56 billion in 2008. However, one can notice a decline in the real value of exports during the period 2010-2016, reaching only $47 billion. This loss in export revenue might be attributed to sluggish domestic economic activity as a result of political disturbances during the mentioned period. In 2016, exports more than doubled, rising from $36 billion in 2016 to more than $90 billion in 2019. After the Covid-19 outbreak, exports declined again to reach only $60 billion in 2021 (Figure 2). Figure 3 also shows the real growth of exports during the whole period. During the 2000s, exports registered positive real growth rates but later

registered zero growth rates in real terms, sometimes declining, except in 2018 and 2019 (Figure 3).
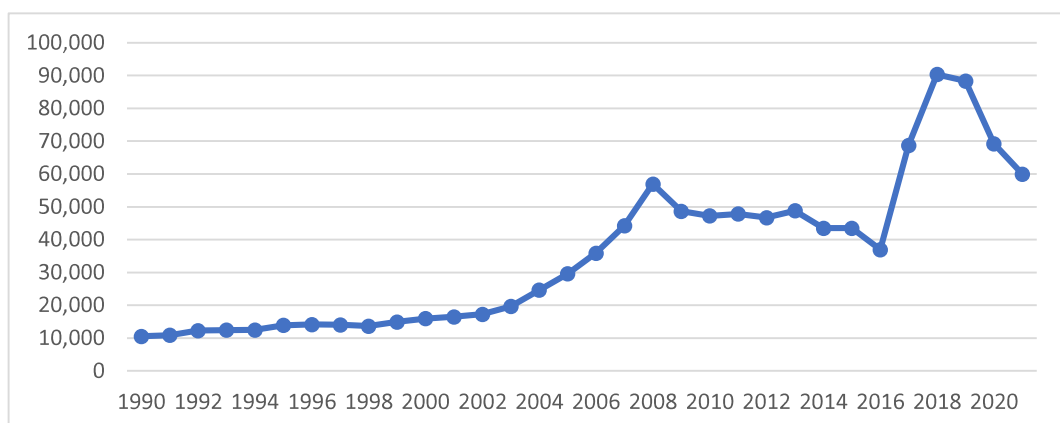

Figure 2: Exports of Goods and Services (Constant US dollar, millions)

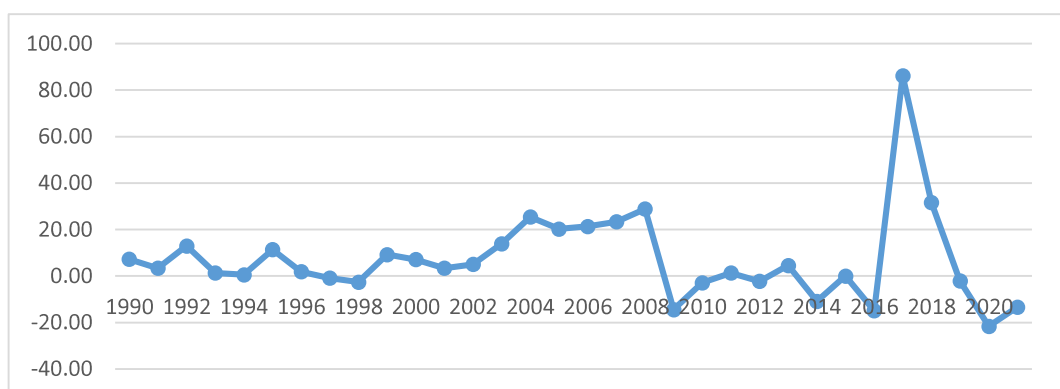**Source: World Bank, World Development Indicators.**

Figure 3: Growth Rates of Exports of Goods and Services (Constant US dollar, percent)

Source: World Bank, World Development Indicators.

Many factors could explain the performance of exports. First, Egypt signed several free trade agreements, such as the EU partnership agreement and the Qualifying Industrial Zones (QIZ) protocol, which might have led to an increase in exports for these markets, albeit to an extent not comparable to that of other international competitors. Both supply and demand factors might have played an important role in this matter. Concerning supply factors, domestic producers could not respond in a timely and adequate fashion to the new exportable products traded in international markets. In other words, Egypt continued to export more products, for which international demand was declining. In this regard, trade policy could provide incentives to producers, such as export subsidies, or abolish export barriers, such as tariff- and non-tariff barriers. This might help in giving a comparative advantage to products for which there is growing global demand in international markets.

Regarding the breakdown of exports, total merchandise, and service exports have been declining as a percentage of GDP, while the share of merchandise exports has been increasing as a percentage of total exports and the share of service exports is declining. This pattern has prevailed since the mid-2000s (Figure 5). Regarding the components of merchandise exports, Figure 4 shows that the share of oil exports has declined from around 53 percent to only 35 percent, in real terms, while the share of manufacturing has been growing. This might be due to oil price fluctuations rather than a structural change in the supply of exports.

Figure 4: Fuel vs. Manufactured Exports

Source: Central Bank of Egypt, Monthly Economic Bulletin, various years.
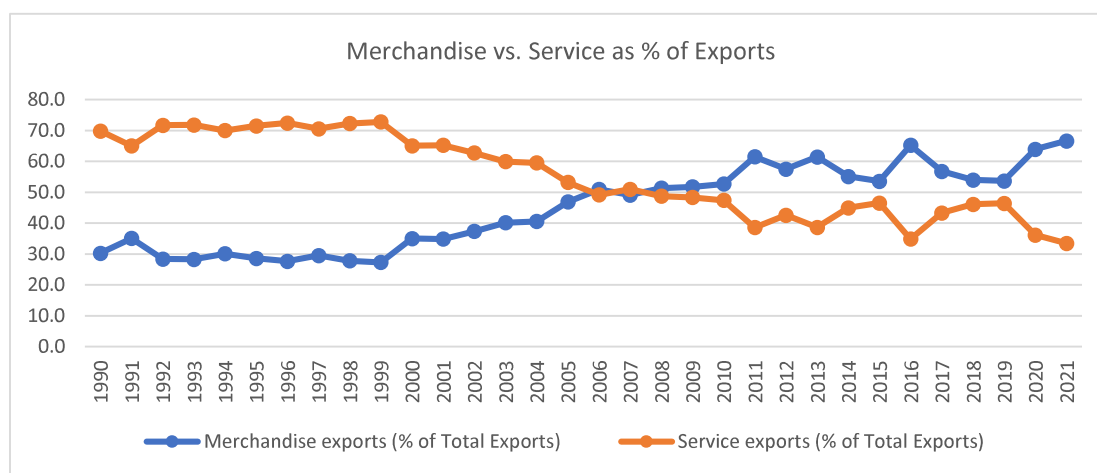

Figure5: Merchandise vs. Service Exports

Source: Central Bank of Egypt, Monthly Economic Bulletin, various years.

Concerning the structure of merchandise exports, Table 1 points to an increase in food exports to around 20 percent of total merchandise exports. Egypt has also succeeded in exporting more manufactured goods, such as chemicals and electrical appliances, which

account for 15 percent and 9 percent, respectively, of total merchandise exports. In the meantime, the share of textile exports remains almost constant.

Table 1: Structure of Exports

(Shares in percent)	2010	2015	2020
Oil exports	53.0	43.3	35.7
Food exports (without cereals)	5.3	12.1	19.0
Cereals	1.8	2.1	1.5
Textiles	9.8	12.5	10.9
Chemicals	13.0	10.8	15.7
Electric appliances	3.8	10.7	9.2
Base metals	9.2	6.7	6.7
Vehicles, cars, and other means of transportation	4.2	1.7	1.3

**Source: Central Bank of Egypt, Monthly Economic Bulletin, various years,**

Concerning whether the structure of Egyptian exports has changed from low and primary commodities to higher value-added exports, it seems that exports are still concentrated in products that are either traditional or have a low value-added, such as fuel exports. Meanwhile, Egypt succeeded in shifting towards exporting more processed products, such as processed food as well as textiles and clothing.

Exchange Rate Policy

It is often argued that currency devaluation leads to an improvement in export performance. Since 2003, several devaluations have occurred, which could be analyzed to shed more light on the exchange rate policy and examine the extent to which the devaluation of the Egyptian Pound has led to an increase in exports. To observe the exchange rate path, it is better to identify the path of the real effective exchange rate (REER) and the nominal effective exchange rate (NEER) indices. These two indices are retrieved from Brugel's database (Darvas 2012). The NEER is defined as the value of a currency against a weighted average of several foreign currencies. An increase in the NEER indicates an appreciation of a currency against the weighted basket of currencies of its trading partners. While the REER is the NEER adjusted for inflation differentials, an increase in the REER indicates that exports become more expensive and imports are cheaper.

Figure 6 shows the evolution of Egypt's REER from January 1990 to 2021. It can be seen that the REER showed an upward trend. Thus, an appreciation of the REER indicates that the domestic price level in Egypt was rising over the relevant periods.
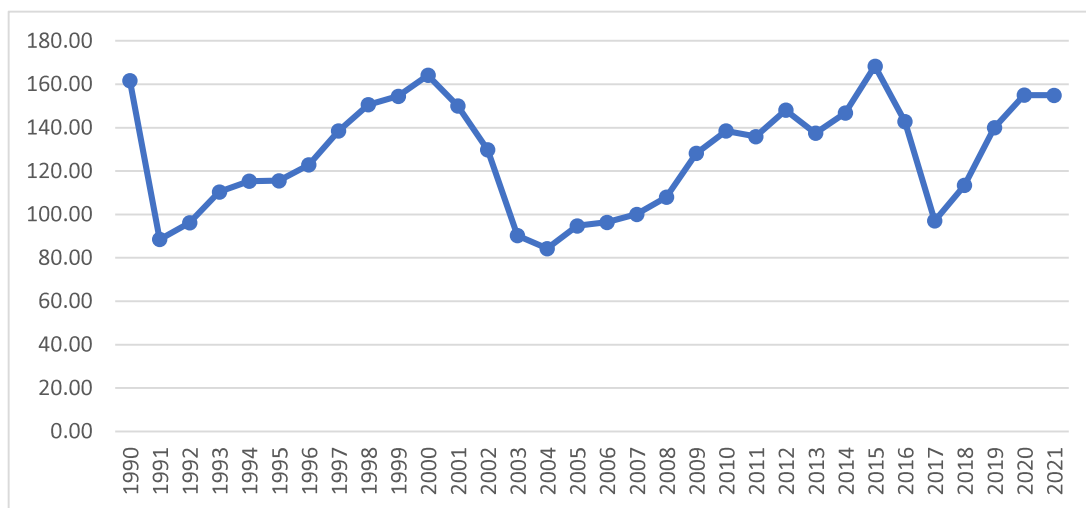
Source: https://www.bruegel.org[3]

Egypt had applied several exchange rate policies during the 1990s–2000s. Starting in 1991, Egypt adopted a unified fixed regime, and later a more flexible policy when the Egyptian pound was freely floated in 2003 (El-Masry 2021). The main objectives of floating the exchange rate were to attract more foreign capital and maintain the flow of remittances to the banking sector. However, during this period, the Egyptian pound was overvalued until 2015, as shown in Figure 6, leading to a loss in export competitiveness (El-Masry 2021). A foreign currency shortage was observed because of falling foreign direct investment and tourism revenues, especially during the 2009 financial crisis, and the political unrest that started in 2011. To avoid erosion of international reserves, the Central Bank of Egypt announced in 2016 the flotation of the exchange rate. A significant devaluation occurred, causing the Egyptian pound to lose more than 50 percent of its value, reaching EGP 18.00 against the US dollar. The objective of this policy was to increase the availability of foreign exchange resources for households and businesses, strengthen competitiveness and exports, and attract FDI (Chahir et al. 2019). In addition, the policy of exchange rate flotation was a main pillar of the new reform program, which Egypt started to apply in 2016. In another wave of devaluation, and following the Ukraine war, Egypt experienced a severe foreign capital flight of nearly $20 billion. Hence, the Central Bank of Egypt decided to devalue the Egyptian pound to address the shortage in US dollar resources. In

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[3] Darvas (2021).

this last wave of devaluation in 2021, the Egyptian pound lost another 50 percent of its value, reaching around EGP 30.00 against the US dollar by early 2023.

It is often argued that the devaluation of the local currency can enhance the price competitiveness of exports as they become cheaper in terms of foreign currency, hence the potential to increase the amount of exported goods in international markets.

4. Export Function Specification

In this section, we focus on developing the econometric specifications to model an export function for Egypt. Based on the empirical literature reviewed, we understood that several macroeconomic indicators (e.g., foreign GDP, real effective exchange rate, domestic GDP, FDI, etc.) might have a crucial role to play in the export function of Egypt.

It is difficult to consider the impact of all factors on exports. However, some factors are more significant than others. The main explanatory variables in the export demand function are world demand, domestic production capacity, and the real exchange rate. Accordingly, in this section, we estimate the various specifications using disaggregated forms of exports. In each specification, we keep these three main explanatory variables but add other independent variables that might explain the performance of exports, following the literature. First, we estimate the total export function, using the total exports of goods and services as a dependent variable, and the main independent variables are World GDP, the real effective exchange rate, foreign direct investment, a dummy variable that reflects the signing of the free trade agreement with the EU, Egypt's GDP, a measure for transportation (the amount of freight transportation provided by the World Bank WDI database), and a trend variable.

We take logarithms for both sides of the export function to estimate the resulting log-linear model, and then estimate it using the OLS method. In the second step, we estimate the log-linear function using the two-stage least squares (2SLS) method to account for possible endogeneity.

Thus, the export function is specified as follows:

$$\text{Lexpt} = \alpha_{ij} + \beta_1 logGDP_w + \beta_2 logGDP + \beta_3 logREER + \beta_4 logFDI + \beta_5 EU + e_t$$

Specifically, we are also interested in disaggregating total exports because the explanatory variables might differ depending on the type of export. Hence, in the second step, we focus on estimating the determinants of the merchandise exports solely as follows:

Lmexpt = $\alpha_{ij} + \beta_1 logGDP_w + \beta_2 logREER + \beta_3 logFDI + \beta_4 EU + e_t$

In this function, we keep the same explanatory variables.

Then, finally, a separate function will be estimated to concentrate on service exports:

Lsevxpe = $\alpha_{ij} + \beta_1 logGDP_w + \beta_2 logREER + \beta_3 crs + \beta_4 EU + e_t$

For estimating the export function, we obtain the annual data from the World

Development Indicators database for the period 1980–2021

Variable	Description
GDPw	World GDP
GDP	Gross domestic product for Egypt
TRAN	An indicator of air transport freight (in tons)
EU	Dummy variable that takes the value of 0 before 2004 and 1 onwards. This refers to the EU trade agreement that went into effect starting 2004
CRS	Dummy variable that takes the value of 1 when a negative shock occurs (for example, the financial crisis of 2008, the political upheaval in 2011 until 2013, and the Russian anti-crisis plan in 2015)
LEXPT	Total exports of goods and services in constant LCU
LMEXPE	Merchandise exports in constant LCU
LSEVXPE	Service exports in constant LCU
REER	Real effective exchange rate
FDIEC	Net foreign direct investment (as a percentage of GDP)

Stationarity Check

In this study, we generally adopt the analysis of time series variables in a multivariate context in three steps. *Firstly*, nonstationary data is present in most macroeconomic variables, and the paper tackles this problem using time series techniques. Examination of stationarity and nonstationarity is important before doing any empirical work to overcome the problem of spurious regression. This is closely linked to testing for the presence of a unit root in all the variables. *Secondly*, the integration order of the time series should be determined before conducting the cointegration analysis. If the variables are integrated of the same order I(1), the next step is to estimate a long-run equilibrium relationship using cointegration analysis. *Thirdly*, one must estimate the dynamic behavior by estimating the error correction model (ECM), provided that the variables are cointegrated (Altintaş and Türker (2014), Afzal and Riaz (2011), Athanasoglou and Bardakas (2010)). We used the Augmented Dickey-Fuller (ADF) test to check for the non-stationarity of variables. The Table below shows the ADF tests both at levels and first differences:

Augmented Dickey-Fuller (ADF) Test

Variable	Parameter	ADF Statistics	P value	Decision
GDPw	Level	-0.809	0.805	I(1)
	First Diff	-3.390	0.018	
GDP	Level	-3.293	0.084	I(0)
	First Diff			
TRAN	Level	-4.172	0.011	I(0)
	First Diff			
LEXPT	Level	-0.481	0.884	I(1)
	First Diff	-4.659	0.001	
LMEXPE	Level	-0.872	0.786	I(1)
	First Diff	-7.354	0.000	
LSEVXPE	Level	-1.600	0.473	I(1)
	First Diff	-3.745	0.007	
NFMX	Level	-0.726	0.828	I(1)
	First Diff	-8.330	0.000	
LREER	Level	-3.174	0.030	I(0)
	First Diff			
FDIEC	Level	-3.639	0.010	I(0)
	First Diff			
LInd	Level	-1.477	0.534	I(1)
	First Diff	-5.358	0.001	
LMANUF	Level	-4.266	0.002	I(0)
	First Diff			

Johansen Cointegration Test

The theory of cointegration attempts to study the interrelationships between long-run movements in economic time series. Most economic theories are about long-run behavior. Therefore, acceptance of co-integration between two series implies that there is a long-run relationship between them. From a statistical point of view, a long-term relationship means that the variables move together over time so that short-term disturbances from the long-term trend will be corrected. Based on Johansen, in this section, we conduct the cointegration test, to determine whether the variables have a stable and non-spurious cointegrating relationship among themselves.

The Johansen test for cointegration entails that if there is at least one cointegrating relationship among the variables, the short-run causal relationship among these variables can be determined by estimating the vector error correction model (VECM). It provides

information about the speed of adjustment to long-run equilibrium and avoids the spurious regression problem.

The details of the trace and eigenvalue tests are shown below:

1. For the first equation, where the dependent variable is total exports of goods and services:

Rank	Trace Test		Max eigenvalue	
	Test stat	p-value	Test stat	p-value
0	119.9830	0.0004	45.64036	0.0107
1	74.34260	0.0208	32.03493	0.0816

These results suggest that there is a cointegration vector among the variables for the analysis period. In other words, there is a long-term link between total exports, world GDP, Egypt's GDP, foreign direct investment inflow, the real effective exchange rate, and the dummy variable EU.

2. For the second equation, where the dependent variable is total merchandise exports:

Rank	Trace Test		Max eigenvalue	
	Test stat	p-value	Test stat	p-value
0	62.11938	0.0013	39.38999	0.0010
1	0.211681	0.2596	14.03326	0.3623

These results suggest there is a long-term link among merchandise exports, world GDP, foreign direct investment inflow, the real effective exchange rate, and the dummy variable EU.

3. For the third equation, where the dependent variable is total service exports

Rank	Trace Test		Max eigenvalue	
	Test stat	p-value	Test stat	p-value
0	108.0767	0.0000	47.75633	0.0006
1	60.32039	0.0022	37.26571	0.0021

These results suggest there is a long-term link among service exports, world GDP, the real effective exchange rate, and the dummy variable CRS.

After applying the Johansen test, the functions were estimated using both OLS and two-stage least squares (2STLS), and a list of instruments was used in the three specifications,

as shown in Table 2. Furthermore, to deal with the potential endogeneity problem of explanatory variables (feedback effects), we used lagged forms of the variables as instrumental variables. The use of instruments is always advisable to avoid any suspicion of endogeneity.

Table 2: Empirical Results

	lexpt	LMEXPE	LSEVXPE
C (coefficient)	-10.62	9.44	-3.73
prob	0.04	0.17	0.11
LREER	-0.16	-0.36	-0.96
prob	0.01	0.00	0.00
LYW	0.69	0.19	0.89
prob	0.00	0.29	0.00
D(LY(-1))	0.72		
prob	0.57		
EU	0.08	0.61	
prob	0.50	0.01	
LFDIEC	0.09		
prob	0.04		
LEXPT(-1)	0.54		
prob	0.00		
crs			-0.25
Prob			0.00
Adjusted R-squared	0.98	0.92	0.97
S.E. of regression	0.11	0.21	0.11
F-statistic	323.27	120.02	301.01
Prob(F-statistic)	0.00	0.00	0.00
J-statistic		37.00	36.00
Prob(J-statistic)		0.00	0.00
Durbin-Watson stat	1.85	2.12	1.51

To check the validity of the functions' specifications, we conducted several tests. First, the Breusch-Godfrey Serial Correlation LM Test was applied to check for serial correlation. The p-value is the result of the chi-squared test, and (normally) the null hypothesis is rejected for a p-value < 0.05. As shown in the table below, p-values pointed to the non-rejection of the null hypothesis. This indicates that there is no serial correlation between the errors in the three functions.

Table 3: Breusch-Godfrey Serial Correlation LM Test

Serial Correlation	p-value	Decision
Function_1	0.2518	No serial correlation
Function_2	0.6024	No serial correlation
Function_3	0.2005	No serial correlation

Another test was conducted to check that the model has no omitted variables. The null hypothesis in Ramsey's RESET test indicates that the model has no omitted variables. P-values are 0.16 for the first equation, 0.2813 for the second function, and 0.3547 for the third equation. Hence, we cannot reject H0, meaning that there are no omitted variables in the specification of the equations.

As the variables used in the three equations show the presence of a co-integration relationship between them, we conducted a vector error correction model to investigate the short-run relationship; hence, we incorporated an error correction term in the model.

Table 4: VECM Results

	Coefficient	Standard Errors	t-ratio
ECt-1	-0.512018	-0.17176	[-2.98094]
D(LEXPT(-1))	0.28552	-0.21265	[1.34266]
D(LFDIEC(-1))	0.027213	-0.04403	[0.61805]
D(LREER(-1))	-0.341689	-0.11623	[-2.93983]
D(LY(-1))	3.367951	-1.48156	[2.27324]
D(LYW(-1))	0.697446	-1.8173	[0.38378]
D(EU(-1))	-0.160951	-0.16763	[-0.96017]
R-squared	0.42212		

The results from the model (in Table 4) show that the error-correction term $ECt-1$ is statistically highly significant, and expectedly has a negative sign. This points to the soundness of our equations, indicating that between the variables there is indeed a long-term equilibrium relationship. The coefficient of $ECt-1$ (-0.512) shows that in the case of a deviation, the variables converge he equilibrium by adjusting the preceding period's disequilibrium at over 5 percent in the following period. Furthermore, the coefficients of the real exchange rate and GDP are significant. We also see that the r-squared value is 0.42.

5. Empirical Results

After conducting the Johansen co-integration tests, we estimated the different forms of export functions using both OLS and 2STLS. The main findings confirm the results of previous studies, especially about the positive and significant relationship between exports and world GDP, which might be considered a proxy for foreign income and hence international demand for Egyptian exports. In addition, it can also be concluded that there is a negative relationship between the real effective exchange rate and total exports; it is

also significant in all specifications. Egyptian exports respond immediately to the devaluation of the local currency, as Egyptian commodities become more competitive, especially service exports. Tourism benefits from the competitive prices after the devaluation of the Egyptian pound. This is consistent with several studies (Zaki et al., 2019) that indicate a favorable relationship between exchange rate devaluations and export performance. For the Egyptian case, this significant relationship was mentioned by several econometric studies (e.g., Adams and Metwally (2021) and Ibrahim (2012)).

Also, there might be other factors that hamper the increase in Egyptian exports. In addition, by checking the impact of other factors that might reflect the productive capacity of the economy, we find that the coefficient that is associated with the total Egyptian GDP is positive and significant, which is also consistent with the results of previous studies.

However, as we are dealing with total exports, we wanted to disaggregate exports by type and check the extent to which the same explanatory variables exercise the same impact. For example, when we estimated the determinants of merchandise exports, we also found that both the real exchange rate and the EU free trade agreement have a significant impact, whereas, for service exports, world GDP plays a more significant role in affecting service exports, along with the real exchange rate. Manufactured exports merit a separate study. For the remaining results, it seems that the ratification of the EU free trade agreement has enhanced the performance of Egyptian exports.

6. Conclusion

In this study, we examined the impact of the main determinants of the export function, based on theory and literature. We also disaggregated exports into types, merchandise exports, and service exports and estimated three equations. In our analysis, we focused on the period between 1980 and 2021. As a standard method of dealing with time-series data, we initially focused on identifying the probable non-stationarity of the variables. The ADF tests confirmed the presence of non-stationarity among the variables in question. Therefore, the Johansen test was conducted and showed that there is co-integration between the variables. In the presence of a long-run relationship between the variables, we modeled the variables using an error correction model. After defining the parameters and running the model, we conducted the diagnostic checks that indicated no significant presence of a serial correlation, and no omitted variables. The main findings emphasized the importance of world demand for total exports and service exports. The devaluation of the real effective exchange rate seems to exert a significant impact on all types of exports, especially service exports, while the EU agreement has facilitated the access of merchandise exports to the EU markets. Future research could focus on the subgroups of merchandise exports, especially manufactured exports, to see their response to changes in the main variables of our study.

The limitation of this study is that the frequency of data employed is annual, not monthly or even quarterly, which means that the sample size would have been larger and the estimated parameters could have been more accurate in explaining the behavior of exports. Data availability has been a concern, as monthly frequency is harder to obtain, and even if obtained for REER and export variables, it is still not available for domestic and world GDP variables. Another limitation is that there might be several other indicators that could have clear impacts on exports, so future research could investigate other trade policy variables such as export subsidies and trade tariffs.

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