International Journal of Economics and Business Administration
Volume IX, Issue 3, 2021

pp. 137-153

Determinants of Growth in Manufacturing Industries: Empirical Evidence from Egypt Using the ARDL Approach

Submitted 20/05/21, 1st revision 15/06/21, 2nd revision 18/07/21, accepted 20/08/21

Mohamed A.M. Sallam[1]

Abstract:

Purpose: *This study investigates essential determinants affecting the Egyptian manufacturing sector from 1970 to 2019.*
Design/Methodology/Approach: *The study employs annual time-series data spanning the 1970-2019 period from the databases of the World Bank. Autoregressive distributed lag approaches are employed to examine the short- and long-run relationship causality among variables.*
Findings: *The empirical results reveal a positive and statistically significant relationship between industry value-added and gross fixed capital formation, number of workers, and foreign direct investment, respectively, while the relationship of industry value-added with the gross domestic product and total factor productivity is added being negative and statistically significant. This result is explained by other sectors that contribute more to growth in the domestic product, such as the tourism sector and the Suez Canal.*
Practical Implications: *These findings provide a better understanding of the determinants affecting the Egyptian manufacturing sector*
Originality/Value: *The study would help policymakers to explore the most productive Egyptian manufacturing industries and adopt economic policies that stimulate investment in the manufacturing sector to increase economic growth and exports.*

Keywords: *ARDL, economic growth, Egypt, error correction, industry value-added, manufacturing.*

JEL classification: *O14, C32, F41.*

Paper Type: *Research Paper.*

[1]*Department of Economics, Faculty of Commerce, Kafr Elsheikh University, Egypt*
Department of Economics, College of Economics and Administrative Sciences, Al Imam Mohammad Ibn Saud Islamic University (IMSIU), Riyadh, Saudi Arabia,
Mohamedsallam_2010@yahoo.com;

1. Introduction

Since the first industrial revolution in the United Kingdom, manufacturing has evolved into the engine of economic growth. Indeed, it is found a strong relationship between sustainable growth and manufacturing output and, subsequently, total output. The manufacturing sector also helps diversifying the economy. Tregenna (2009) acknowledges that this sector created forward and backward linkages with other critical sectors of the economy. This property of the sector makes it an essential factor in transforming the economy from a developing economy to an advanced one.

The manufacturing industry has a unique and high-value position in the growth and structuring of economies in developed and emerging economies. It employs labor, solves unemployment, alleviates poverty, raises the standard of living, allows economic independence, increases export revenue, expands the foreign trade sector and foreign currency revenue, and improves the balance of payments. Dijkstra (2000) confirms that the manufacturing sector helps build infrastructure that promotes growth and creates stable and well-paying jobs in emerging economies.

Manufacturing industries play a pivotal role in developing and restructuring the economies of countries. This is especially evident from the significant capital flows to the productive sector, a phenomenon that has brought the economies of South Korea, Malaysia, and Singapore to a position of international competitiveness. There has been a qualitative shift within their production economies, especially in technological development through the diversification of industrial outputs, transfer, and localization of technology, and development of skills and competencies necessary to advance the industrial sector.

The literature emphasizes the importance of industrialization in economic development while positing that successful economic development plans rely on maturing the industrial sector. Also, the manufacturing sector has a role to promote economic growth (Sallam, 2021). Only by this way can a high economic growth rate be manifested. The Kaldor Laws (Kaldor, 1957; 1966; 1968) are the most famous and seminal works. However, other earlier empirical investigations also confirm the effect of manufacturing growth on the economy.

The industrial sector drives economic development for two primary reasons: first, the intensity of interconnectedness that links the industrial sector with the national economy, and second, the front and back interconnections among the same industrial activities. Because the manufacturing industry is the most effective in transforming low-value activities to high added value ones, it is crucial for competitiveness and development (Szirmai and Verspagen, 2015).

Several arguments support industrialization as an engine of development. Szirmai (2013) summarizes them as follows:

- a strong positive correlation between the degree of industrialization and levels of per capita income, whereby industrialized developing countries are overtaking less industrialized developing countries;
- direct and backward linkages among different sectors are stronger in the manufacturing sector;
- the ability of the manufacturing sector to absorb technological progress, and its integration with other sectors, such as services;
- it offers scope for entering international markets, which is not available to agricultural and primary production countries;
- the increasing capital accumulation in the manufacturing sector, compared with the spatially dispersed capital of the agricultural sector;
- the high level of productivity in manufacturing compared with other sectors (Elhiraika *et al.,* 2014).

To reiterate, the manufacturing sector provides a means to increase productivity, improve trade balance through substitution of imports, and subsequently expand exports. In Egypt, manufacturing is the third-largest sector, representing about 17% of the gross domestic product (GDP), 27% of total employment, and 74% of the total exports in 2019. However, few studies explore the determinants of growth in Egyptian manufacturing. There is scarce literature on why the proportion of manufacturing to GDP in Egypt still stands below the global average of 25%. This study thus clarifies the most important determinants affecting the Egyptian manufacturing sector from 1970 to 2019. To do so, it makes the following assumptions:

- the number of workers (POP), gross fixed capital formation (GFCF), average energy consumption (AEC), foreign direct investment (FDI), growth rate of the GDP (GDPg), and productivity of the factors of production (TFP) positively affect the value added in the manufacturing sector;
- the variable of trade volume (TRAD), owing to the presence of a deficit in the trade balance during the study period, negatively affects the value added in the manufacturing sector.

The remaining paper is structured as follows: sections 2 and 3 present the background of the study and literature review, respectively, section 4 presents the methodology, and section 5 concludes the study and offers the scope for future investigations.

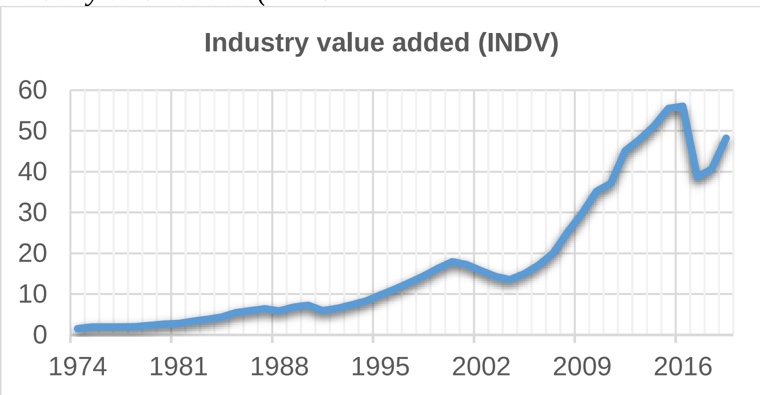
2. Literature Review

In the 1920s, the Egyptian economy was classified as an agricultural economy. Raw cotton represented three-quarters of Egyptian exports, and industrial output was mainly spinning and weaving cotton, followed by preserved foods, cigarettes, soaps, and crafts. At the time, the labor employed in the industry was nearly 500,000, although, this number accounted for a small proportion of a total population of 13 million (Hawash, 2007). The development of the Egyptian economy has relied heavily on the manufacturing sector, which serves as an import-substitution industry. It is a source of export expansion, government revenue through tax, and employment absorption and generation. Over the years, it has improved the standard of living as well and continues to do so.

The manufacturing sector has many dynamic advantages that are crucial to economic transformation. Indeed, it plays a catalytic role in a modern economy. Therefore, successive governments have sought to advance the Egyptian industry by preparing a five-year plan to affect a qualitative shift in the Egyptian economy, significantly transforming it from an agricultural economy to an advanced economy with a dominant manufacturing industry.

The manufacturing industry in Egypt primarily comprises industrial activities such as the manufacture of fertilizers and building materials and the hydrocarbon, textile and clothing, pharmaceutical, food, and chemical industries. The graph below presents the status of Egyptian manufacturing industries and the extent of their contribution to creating added value and developing export capabilities (Abul-Komasn, 2021).

Figure 1. *Industry value added (INDV*



Source: *Own creation.*

Manufacturing activities in Egypt are the primary drivers of economic growth. They are critical for Egypt to maintain a sustainable economy with a diversified production base. Egypt also has a suitable structure for investment in manufacturing industries regarding the availability of highly efficient local and low-wage labor. Since 1974, manufacturing has doubled, with its added value doubling from £1.5 billion to £48.5 billion in 2019. Nevertheless, this increase did not trigger the desired economic boom in industrial development. It also did not lead to more advanced industrialization. This kind of growth, transformation, and structural diversification through sectorial forward and backward linkages requires manufacturing to constitute at least 25-35% of the GDP. Instead, the current rate has stabilized at 15-17% since the 1980s, encouraging the manufacturing industry to focus on intermediate and consumer industries (Al Shall *et al.*, 2020).

Most importantly, Egyptian manufacturing is plagued by low performance. Further, the establishments operating in the manufacturing industry to the total establishments still have low importance and primarily focus on producing consumer goods at the expense of capital and intermediate goods. The private sector also lags in comparison. As a result, Egypt's international indicators of industrialization are concerning, and there exists a shortage of land for industrial projects, which has exacerbated the problem (Al Shall *et al.,* 2020).

There are many empirical studies in the literature on the determinants of growth in the manufacturing sector. These determinants include production factors such as trade, human capital, energy, and technology. The role of traditional factors of production such as capital and labor, and their effect on economic growth, is explored by Harrod (1939) and Domar (1947). At the same time, Solo (1956), Kaldor (1957; 1961), Romer (1986), Erol and Yu (1988), and Barrow (1991) document attempts to examine the effect of other factors on economic growth such as energy, technology, finance, and trade.

Therefore, we will review the previous studies that examined the impact of each factor of production on manufacturing industries, as follows.

Energy and manufacturing: Historical reality shows that new energy sources from coal and steam helped trigger the industrial revolution in the United Kingdom in 1750. This began the era of operating new industrial machines, which caused an increase in production. The literature, however, does not fully confirm the causal relationship between energy consumption and economic growth. The reasons for the disagreement are explained by differences in the policies and systems applied in the countries under study and the differences in methodology. Further, the patterns of energy consumption and sources vary by country (Hondroyiannis *et al.,* 2002). More recent literature has begun to focus on the linkages between economic growth and energy consumption.

The industrial sector is highly energy-intensive, consuming about 54% of the total energy in the world. For instance, Soytas and Sari (2007) find a unidirectional causality from energy consumption to value-added in the manufacturing industry of Turkey. Shuyun and Donghu (2011) show a bi-directional causality between real GDP and energy consumption in China, while Zhang and Broadstock (2016) find a two-way causality that decreased in strength over time. Chen *et al*. (2018) examined the relationship between energy consumption and economic growth for twenty-nine provinces of China. However, they find no causality in two provinces, and bidirectional causality is observed in sixteen provinces. Unidirectional causality is observed in eleven provinces.

Trade and manufacturing: To explain economic growth in developing countries, Edwards (1992), Weinhold and Rauch (1999), Dutta and Ahmed (2001), Salehezadeh and Henneberry (2002), and Dawson (2006) have studied how trade openness has a vital role in achieving economic growth (Chandran, 2009).

Free trade was first advocated by the pioneers of the classical school, Adam Smith and David Ricardo, who theorized that it would lead to specialization and division of labor and ultimately greater productivity and exporting ability. International trade leads to static and dynamic gains in the local economy. This calls for investigating the effect of trade openness on economic growth (Fu, 2004).

Empirical evidence from the US, UK, Japan, and Germany shows that exports enhance productivity (Marin, 1992; Yamada, 1998). Proudman and Redding (1998) support the idea that trade promotes productivity growth, while Auzina (2011) finds that export is an outlet for the manufacturing sector in foreign markets, making them crucial to this sector. Trade liberalization also has a positive effect on industrial growth, as shown by Dutta and Ahmed (2001) for Pakistan, Dastidar (2015) for India, Chete and Adenikinju (2002), Adebiyi and Dauda (2004), and Umoru and Eborieme (2013) for Nigeria.

Gross fixed capital formation and manufacturing: The GFCF involves spending on structures, equipment and machinery, and changes in inventories. It has a vital role in economic growth and is crucial to the GDP (Bengalwali, 1995; Ali, 2015; Meyer and Sanusi, 2019). Day and Ellis (2013) show that capital contribution explains most of the growth of the value-added in the Turkish manufacturing industry from 1992 to 2001. Limao and Venables (2001) acknowledge that the quality and availability of infrastructure affect the industry's capacity and technology and that weak infrastructure limits the participation of the country in the global economy. Finally, Kenny (2019) finds that manufacturing value-added is affected by GFCF in the long run, in line with economic theory.

Foreign direct investment and manufacturing: FDI plays a vital role in different economies. It is essential for developing economies, where FDI resources help increase domestic resources, which, in turn, can finance development projects, increase the GDP, and increase industrial output. For this reason, Egypt attracts large amounts of FDI. This study verifies the positive role of FDI in the Egyptian manufacturing sector.

The literature confirms that FDI inflows are both, directly and indirectly, beneficial to the host economy, as it expands the economy's productive base. FDI stimulates domestic firms' competitiveness and efficiency and improves workers' training. FDI strategies promote productive capacity, technological advancement, export-oriented manufacturing, efficiency, and export performance (Gallagher and Zarsky, 2004; Begum and Chowdhury, 2017). Creating an attractive environment for FDI may help create job opportunities and increase GDP. The positive effect of FDI in any country in any sector, including the manufacturing sector, lies in attracting more foreign investments. Thus, it creates the path, internally or externally, for competitive advantages within local manufacturing. The literature also confirms the positive effect of FDI in Indonesia and Bangladesh in gross capital formation, export revenues, manufacturing employment, transferring technology, and tax revenues.

Further, FDI negatively affects the balance of payments (Dhanani and Hasnain, 2002; Begum and Chowdhury, 2017). Wang (2009) emphasizes the same findings based on the data of 12 Asian economies and covering the period from 1987 to 1997. Similarly, based on cross-sectional data of 21 Croatian industrial subsectors from 1996 to 2002, Vukšić (2005) emphasizes a positive and significant effect of FDI on the volume of exports in those sectors.

Exchange rates and manufacturing: One of the macroeconomic variables that helps determining the international competitiveness of any country is the exchange rate. The exchange rate is the value of the local currency in terms of the foreign currency. Its fluctuations affect the performance of all sectors in the productive economy, especially in the manufacturing sector. Therefore, the exchange rate targets many investigations seeking to identify and demonstrate the relationship between the exchange rate and macroeconomic performance in general and the manufacturing sector in particular. Studies have found that volatilities of the exchange rate have a significant effect on several economic variables, and it makes the discompose of policymakers, especially on any economy that engaged in international trade.

The exchange rate volatility mainly affects manufacturing through the cost of imported raw materials, which, in turn, reflects the prices of the manufacturing products. Extant findings show uncertainty in the relationship between exchange rate volatility and manufacturing industries, whereas other studies find negative or positive effects. From a theoretical perspective, Hooper and Kohlhagen (1978) state that the degree of uncertainty in transaction costs is higher with exchange rate volatility, resulting in lower trade volume.

The effect of the exchange rate on the manufacturing sector can be demonstrated through exchange rate fluctuations on manufactured exports. Some studies reveal a positive relationship between the exchange rate and manufactured exports (Sekkat and Varoudakis, 2002; Kiptui, 2007; Olayungbo *et al.*, 2011; Ehinomen and Oladipo, 2012; Aiyedogbon and Anyanwu, 2016; Lawal, 2016; Amaefule and Maku, 2019; Ayobami, 2019).

Other studies show a negative relationship (Ojeyinka and Adegboye, 2017; Falaye, 2019; Vo and Zhang, 2019; Irene *et al.*, 2020). Similarly, Caglayan and Torres (2011) investigate the effects of the exchange rate in the Mexican manufacturing sector from 1994 to 2003 by using fixed capital investment as an intermediate channel. They found that currency depreciation positively affects fixed investment through the export channel but a negative effect through the import channel.

Despite the diversity of methodologies and the use of various variables, different economies, and different periods, the determinants of growth in Egyptian manufacturing remain elusive. Thus, in the following sections, we address this gap in research.

3. Methodology

3.1 Unit Roots Tests

Before choosing the appropriate model to test the hypotheses, we employ the unit root test to determine the stability of the time series for the variables and avoid false results arising from any possible instability. Thus, we employ the augmented Dickey-Fuller (ADF), Phillips-Perron (PP), Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests. The KPSS test addresses weaknesses in the ADF and PP tests when the autocorrelation of variance exists. These tests also complement each other. The KPSS test shows if a time series is non-stationary owing to a unit root or is stationary around a linear trend or mean.

Time series are stationary when their statistical properties, such as mean and variance, are constant over time (Kočenda and Černý, 2015). Further, the critical results of the KPSS depend on the Lagrange multiplier (LM) statistic values. The LM statistic value is also more significant than the absolute critical KPSS value. This way, it is possible to accept the null hypothesis if the series is stable but rejected if the time series is unstable. The mathematical formula for KPSS is as follows:

Table 1. *KPSS test results*

Variables	Level of significance	In level				In first difference				Stationary at 5%
		Intercept and trend		Intercept		Intercept and trend		Intercept		
		LM statistic								
		Test statistic	Critical values	Test statistic	Critical values	Test statistic	Critical values	Test statistic	Critical values	
INDV	1%		0.216		0.739				0.739	
	5%	0.062	0.146	0.774	0.463			0.133	0.463	I(1)
	10%		0.119		0.347				0.347	
GDPg	1%		0.216		0.739					
	5%	0.066	0.146	0.334	0.463					I(0)
	10%		0.119		0.347					
TFP	1%		0.216		0.739				0.739	
	5%	0.103	0.146	0.466	0.463			0.148	0.463	I(1)
	10%		0.119		0.347				0.347	
GFCF	1%		0.216		0.739		0.216			
	5%	0.167	0.146	0.293	0.463	0.132	0.146			I(1)
	10%		0.119		0.347		0.119			
AEC	1%		0.216		0.739		0.216		0.739	
	5%	0.189	0.146	0.913	0.463	0.092	0.146	0.271	0.463	I(1)
	10%		0.119		0.347		0.119		0.347	
POP	1%		0.216		0.739				0.739	
	5%	0.140	0.146	0.811	0.463			0.150	0.463	I(1)
	10%		0.119		0.347				0.347	
TRAD	1%		0.216		0.739					
	5%	0.090	0.146	0.138	0.463					I(0)
	10%		0.119		0.347					
FDI	1%		0.216		0.739					
	5%	0.052	0.146	0.214	0.463					I(0)
	10%		0.119		0.347					

Source: *Output EViews 10.*

$$KPSS = \frac{\sum_{t=1}^{T} S_t^2}{T^2 \hat{\sigma}^2}$$

where $\hat{\sigma}^2 = \frac{\sum_{t=1}^{T} s_t^2}{T} + 2\sum_{j=1}^{L}\left(1 - \frac{j}{L+1}\right) r_j$ and $r_j = \frac{\sum_{S=J+1}^{T} s_t s_{t-j}}{T}$. (1)

The critical values for this test are based on the LM statistic values apropos of the KPSS values (Kwiatkowski *et al.*, 1992). The null hypothesis of the KPSS test states that the data are stationary, that is, $H_0: \sigma_u^2 = 0$, and the alternative hypothesis is that the data are not stationary, that is, $H_A: \sigma_u^2 > 0$. Table 1 reports the results of the KPSS test.

3.2 The Research Model

The KPSS results from Table 1 show that the variables GDPg, TRAD, and FDI are stable for I(0), whereas INDV, TFP, GFCF, AEC, and POP are stable for I(1). Therefore, we employ the autoregressive distributed lag (ARDL) method proposed by Pesaran (1997) and Pesaran *et al.* (2001) to verify the existence of equilibrium relationships in the short and long term between the unemployment rate and economic growth. We use annual economic data of Egypt from 1970 to 2019 and employ the following ARDL model:

$$\Delta l\mathbf{INDV}_t = C + \alpha T + \beta_1 \mathbf{GDPg}_{t-i} + \beta_2 \mathbf{TFP}_{t-\mathrm{i}} + \beta_3 \mathbf{GFCF}_{t-\mathrm{i}} + \beta_4 \mathbf{AEC}_{t-\mathrm{i}} + \beta_5 \mathbf{POP}_{t-\mathrm{i}} + \beta_6 \mathbf{TRAD}_{t-\mathrm{i}} + \beta_7 \mathbf{POP}_{t-\mathrm{i}} + \sum_{i=1}^{n-1} \gamma_{1i} \mathbf{GDPg}_{t-\mathrm{i}} + \sum_{i=1}^{n-1} \gamma_2 \Delta \mathbf{TFP}_{t-\mathrm{i}} + \sum_{i=1}^{n-1} \gamma_3 \Delta \mathbf{DINV}_{t-\mathrm{i}} + \sum_{i=1}^{n-1} \gamma_4 \Delta \mathbf{AEC}_{t-\mathrm{i}} + \sum_{i=1}^{n-1} \gamma_5 \Delta \mathbf{POP}_{t-\mathrm{i}} + \sum_{i=1}^{n-1} \gamma_6 \Delta \mathbf{TRAD}_{t-\mathrm{i}} + \sum_{i=1}^{n-1} \gamma_7 \Delta \mathbf{DINV}_{t-\mathrm{i}} + \mu_t. \quad (2)$$

where the dependent variable ($\mathbf{INDV}_t$) is explained by the exogenous variables (**GDPg, TFP, GFCF, AEC, POP, TRAD, FDI)** though the short- and long-run relationship. β is the long-run parameter, while γ is the short-run parameter. T is the time trend and (μ) is the random error.

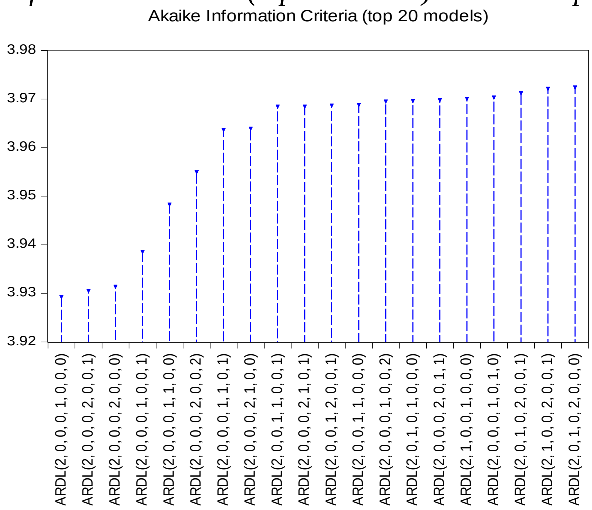
The ARDL approach is different from other cointegration approaches (Sallam and Neffati, 2019; Pesaran *et al.*, 2001). This approach is used under the following conditions:

- in small or finite samples consisting of 30 to 80 observations;
- if the variables are stationary with respect to I(0) or I(1);
- if none of the explanatory variables is of I(2) or a higher order.

The ARDL approach uses a general-to-specific modeling framework by taking enough lags to capture the data generating process. It estimates the (p+1) k number of regressions to obtain an optimal lag length for each variable. This approach can distinguish between dependent and exogenous variables and eliminate problems that may arise from endogeneity and autocorrelation. Thus, through this model, the integrative relationship between the dependent variable and the independent variables can be determined, as well as the size of the effect of each independent variable on the dependent variable. Its parameters estimated for the short and long term are more consistent than those estimated by other methods of the cointegration test.

Determination of Lags Number: It is necessary to know the optimal lags of all variables before estimating the ARDL approach and testing the existence of a cointegration relationship in the long and short run between the dependent variable and the independent variables. The standard Akaike information criteria (AIC) were chosen, following the lagged values (2, 0, 0, 0, 1, 0, 0, 0), as shown in Figure 2.

Figure 2. *Akaike information criteria (top 20 models) Source: output EViews 10*



Source: *Own creation.*

Bounds tests for cointegration: Bounds tests are used to test the existence of a long-term equilibrium relationship between the dependent variable and the explanatory variables included in the model by means of the Wald test or the F-test statistic, which have a non-standard distribution and do not depend on factors including the sample size, and the inclusion of the trend variable in the estimate. The results of the bounds test procedure for co-integration analysis between the value added in the manufacturing sector (INDV) and exogenous variables (GDPg, TFP, GFCF, AEC, POP, TRAD, and FDI) are presented in Table 2.

Table 2. *Bounds test*

F-bounds test		Null hypothesis: no levels relationship		
Test statistic	Value	Significance	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	4.835140	10%	1.92	2.89
k	7	5%	2.17	3.21
		2.5%	2.43	3.51
		1%	2.73	3.9
* p-value incompatible with t-Bounds distribution.				

Source: *Output EViews 10.*

In Table 2, the value of the F-statistic for the bounds test is 5.092, which exceeds the 1% critical value (3.9) for the upper bound I(1). Hence, we accept the hypothesis that there exists a long-run relationship of INDV with the variables GDPg, TFP, GFCF, AEC, POP, TRAD, and FDI, or reject the hypothesis, that is, there exists no "no long-run relationship." These results are consistent with the hypothesis that POP, GFCF, AEC, FDI, GDPg, TFP, and TRAD affect the manufacturing sector. Previously, we used the AIC to determine the appropriate number of lags. We also verified the cointegration relationship among the variables using the bounds test. Next, we estimate the ARDL model.

Estimation with ARDL model: After confirming a long-term equilibrium relationship between the dependent variable and the explanatory variables, we estimate the parameters of the ARDL model for the short and long terms and the error correction model (ECM) parameter using the ordinary least squares method based on the number of specified slowdown periods. The appropriate model is based on the Hendry method, which shifts from general to particular.

Long-run estimates of the ADRL process: The empirical results in Table 3 refer to the relationship of INDV with GFCF, POP, and FDI, which is positive and statistically significant. The coefficients are equal to 0.353, 1.129, and 0.364 respectively, indicating a 1% increase in GFCF, POP, and FDI that leads to a 0.353%, 1.129%, 0.364% increase in INDV, respectively. This result is line with economic theory. Thus, more investment in human development through, for example, training and healthcare, can increase GFCF and FDI with respect to the manufacturing sector, and thus increase competitiveness and labor efficiency.

Table 3. *Long-run coefficients based on ARDL (2, 0, 0, 0, 1, 0, 0, 0)*

Dependent variable: INDV				
Long-run coefficients				
Variable	Coefficient	Std. error	t-statistic	Prob.
GDPg	-0.481528	0.190072	-2.533400	0.0157
TFP	-12.36771	5.253140	-2.354345	0.0240
GFCF	0.352927	0.116981	3.016960	0.0046
AEC	-4.12E-05	0.002612	-0.015769	0.9875
POP	1.129203	0.506218	2.230664	0.0319
TRAD	-0.079161	0.036087	-2.193627	0.0346
FDI	0.363654	0.216855	1.676944	0.1020
C	-21.52743	31.10457	-0.692099	0.4932

Source: *Output EViews 10.*

Table 3 shows that the relationship of INDV with GDPg and TFP is negative and statistically significant. The coefficients of GDPg and TFP are 0.482 and 12.368, indicating that a 1% increase in GDPg and TFP will lead to about a 0.482% and 12.368% decrease in INDV, which negates economic theory. This result can be explained by the presence of other sectors in the economy that contribute more to the growth in domestic products, such as tourism and the Suez Canal. Therefore, the role of technological innovation using science and technology in high-tech industries is crucial. In contrast to economic theory, there appears to be a negative but statistically significant relationship between INDV and AEC.

Furthermore, there is a negative and significant relationship between INDV and TRAD, confirming the economic theory. The coefficient of TRAD equals 0.079, indicating that a 1% increase in TRAD will lead to about a 0.079% decrease in INDV. The coefficient of determination (R^2) is 0.54. Thus, about 54% of the variation in INDV is caused by variations in the explanatory variables. The Durbin-Watson statistics is 1.97, indicating no serial correlation.

Short-run dynamics of the ADRL process: In the ECM, the error correction limit deceleration factor reveals the speed (or slowness) of the variables returning to the equilibrium state. This parameter must be a significant and negative sign to reveal the existence of co-integration among the variables. The absolute value of the error correction limit coefficient indicates the speed of restoring the state of equilibrium. The negative sign shows the convergence of the motor model in the short term, and the negative and significant coefficient associated with slowing down the error correction limit is a more effective way to demonstrate the co-integration.

The value of the coefficient of the ECM (-0.67, at the 5% significant level) confirms the existence of a long-run equilibrium relationship. Table 4 reports the results of the ECM estimates. Alternatively, 67% of the disequilibrium in independent variables from the previous period's shock will converge back to the long-run equilibrium after approximately 1.49 years.

The results from the ARDL-ECM reveal the short-run dynamic coefficients associated with the long-run relationships (Table 4). The optimal lag length for the selected error correction representation of the ARDL (2, 0, 0, 0, 1, 0, 0, 0) model is determined by the AIC.

Table 4. *Error correction representation for the selected ARDL (2,0,0,0,1,0,0,0) model*

Variable	Coefficient	Std. Error	t-statistic	Prob
D(INDV(-1))	0.384487	0.109413	3.514092	0.0012
D(AEC)	-0.022617	0.005795	-3.902617	0.0004
ECM(−1)	-0.673405	0.092565	-7.274970	0.0000
R-squared	0.536388		Adjusted R-squared	0.515783

Source: *Output EViews 10.*

R^2 is the coefficient of determination. It defines the proportion of total variations independent variable. In the above ECM model, the given value of R^2 is 0.54, which explains 54% of the goodness of fit. Thus, the model explains the INDV, while the value of the adjusted R^2, that is, 0.52, explains 52% of the goodness of fit.

Diagnostics test result: In this step, to ensure the suitability of the model used to measure the estimated elasticities in the long term, the estimation of the ARDL model has undergone several diagnostic tests to ensure the appropriateness of the model. We adopted the normality, heteroskedasticity, serial correlation LM, cumulative sum (CUSUM), and CUSUM square tests. Table 5 shows the results of the diagnostic tests conducted on the ARDL model (2, 0, 0, 0, 1, 0, 0, 0), the results indicate that this study has passed all the diagnostic tests indicating that residuals of the model are normally distributed, have no heteroskedasticity or serial Correlation.

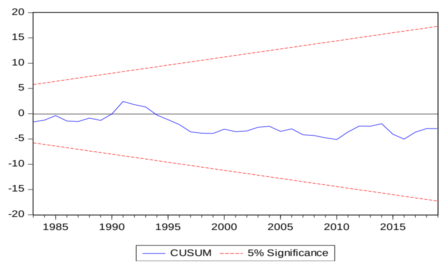
Table 5. *Diagnostic tests for the selected ARDL model (2,0,0,0,1,0,0,0)*

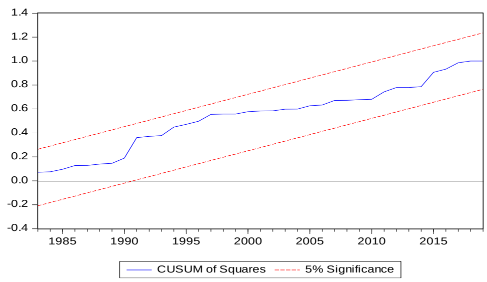
Test series	Coefficient	Prob.
Normality test (JarqueßBera test)	0.525884	0.768786
White heteroskedasticity	3.049290	0.0065
ARCH (Autoregressive conditional heteroskedasticity)	1.850052	0.1806
Serial correlation LM test	0.477549	0.6243

Source: *Output EViews 10.*

Stability test: After all the diagnostic tests, we proceed with the stability test to analyze the stability of the long-run coefficients together with the short-run dynamics, CUSUM, and CUSUM square. Figures 3 and 4 are graphical representations of CUSUM and CUSUMQ statistics, which are within the bounds and significant at the 5% level. Hence, the null hypothesis (i.e., the regression equation is correctly specified) cannot be rejected, which confirms the stability of the estimated coefficients of the ECM.

Figure 3. *CUSUM & CUSUM of Squares*





Source: *Own creation.*

4. Discussion and Conclusion

We empirically investigate the determinants of growth in the manufacturing sector of Egypt using annual data from 1970 to 2019. To do so, we apply the ARDL and ECM models. The results of this study contribute to the literature on the determinants of growth in the manufacturing sector.

Manufacturing activities are essential to economic development in Egypt. Since 1974, manufacturing has doubled in the country, yet this progress has not led to an industrial boom as expected, and the share of manufacturing to the total GDP has remained stable but stagnant, at 15-17%.

Through an econometric analysis, we reveal a long-run relationship of industry value added (INDV) with the variables of gross domestic product (GDP), the productivity of the total factors of production (TFP), gross fixed capital formation (GFCF), average energy consumption (AEC), number of workers (POP), trade volume (TRAD), and foreign direct investment (FDI). First, the results of the unit root test show that the growth rate of GDP, TRAD, and FDI are stationary at the I(0) level, and INDV, TFP, GFCF, AEC, and POP are stationary at the I(1) level, with constant. Second, the ARDL-ECM results prove the existence of a long-run relationship of INDV with the independent variables GDP, TRAD, FDI, TFP, GFCF, AEC, and POP. The optimal lag length for the selected error correction representation of the ARDL (2, 0, 0, 0, 1, 0, 0, 0) model is determined by the AIC.

Thus, we find a statistically significant positive relationship of INDV with GFCF, POP, and FDI, in agreement with economic theory, but a negative and insignificant relationship of INDV with GDP and TFP, in contradiction with economic theory. This result is explained by other sectors in the economy that contribute more to growth in domestic products.

Based on previous findings and the findings herein, this study recommends increasing GFCF and FDI in manufacturing, raising labor efficiency through more significant investments in human development (e.g., through more skill training and better healthcare), and enhancing high-tech innovation. Indeed, further research should explore the most productive Egyptian manufacturing industries. More investigations are needed to understand how the productivity of other sectors can be raised. Adopting economic policies that stimulate investment in manufacturing could increase economic growth and exports.

References:

Adebiyi, M.A., Dauda, R.O.S. 2004. Trade liberalization and industrial growth performance in Nigeria: An error-correction mechanism (ECM) technique. Challenges of Nigerian industrialization: A pathway to Nigeria becoming a highly industrialized country in the year 2015, 119-145.

Abul-Komasn, E. 2021. Industrial development in Egypt: lessons learned from the past and international experiences (in Arabic). ECES-WP215-A.

Aiyedogbon, J.O., Anyanwu, S.O. 2016. Macroeconomic Determinants of Industrial Development in Nigeria. Nile Journal of Business and Economics, 1(1), 37-46.

Ali, G. 2015. Gross Fixed Capital Formation and Economic Growth of Pakistan. Journal of Research in Humanities, Arts and Literature Applied, 1(2), 21-30.

Al-Shall, M.M. 2020. Policies and Mechanisms to Deepen the Egyptian Manufacturing Industries in Light of the Fourth Industrial Revolution (in Arabic). The Institute of National Planning.

Amaefule, J.N., Maku, E.O. 2019. National Domestic Savings, Inflation, Exchange Rate and Manufacturing Sector in Nigeria: ARDL Approach. EuroEconomica, 38(2).

Auzina, A. 2011. Export Dependency of Latvia's Manufacturing Sector. Economics & Business, 21.

Ayobami, O.T. 2019. Exchange Rate Volatility and the Performance of Manufacturing Sector in Nigeria (1981-2016). African Journal of Economic Review, 7(2), 27-41.

Begum, M., Chowdhury, M.B. 2017. Foreign Direct Investment and the Manufacturing Sector in Bangladesh. In Proceedings of the 1st International Conference on Business Research and Ethics (iCBRE), 20-22 November 2017, Sydney, Australia, 39-47.

Caglayan, M., Torres, R.I.M. 2011. The effect of the exchange rates on investment in Mexican manufacturing industry. Open Economies Review, 22(4), 669-683.

Cameron, G., Proudman, J., Redding, S. 1998. Productivity convergence and international openness. Bank of England.

Chandran, V.G.R. 2009. Trade openness and manufacturing growth in Malaysia. Journal of Policy Modeling, 31(5), 637-647.

Chen, S.W., Xie, Z., Liao, Y. 2018. Energy consumption promotes economic growth or economic growth causes energy use in China? A panel data analysis. Empirical Economics, 55(3), 1019-1043.

Chete, L.N., Adenikinju, A.F. 2002. Productivity growth in Nigerian manufacturing and its correlation to trade policy regimes/indexes (1962-1985). AERC.

Conti, J., Holtberg, P., Diefenderfer, J., LaRose, A., Turnure, J.T., Westfall, L. 2016. International energy outlook 2016 with projections to 2040 (No. DOE/EIA-0484). USDOE Energy Information Administration (EIA), Washington, DC. United States, Office of Energy Analysis.

Dastidar, S.G. 2015. Manufacturing and Trade Liberalisation of India: The Continuing Debate. Review of Development and Change, 20(2), 225-244.

Day, J., Ellis, P. 2013. Growth in Indonesia's manufacturing sectors: Urban and localization contributions. Regional Science Policy & Practice, 5(3), 343-368.

Dhanani, S., Hasnain, S.A. 2002. The impact of foreign direct investment on Indonesia's manufacturing sector. Journal of the Asia Pacific Economy, 7(1), 61-94.

Dijkstra, A.G. 2000. Trade liberalization and industrial development in Latin America. World Development, 28(9), 1567-1582.

Domar, E. 1947. Expansion and Employment. American Economic Review, March, 34-55.

Dutta, D., Ahmed, N. 2004. Trade liberalization and industrial growth in Pakistan: a cointegration analysis. Applied Economics, 36(13), 1421-1429.

Elhiraika, A.B., Aboubakar, O., Muhammad, K. 2014. Promoting manufacturing to accelerate economic growth and reduce growth volatility in Africa. The Journal of Developing Areas, 1-20.

Erol, U., Yu, E.S. 1987. On the causal relationship between energy and income for industrialized countries. The Journal of Energy and Development, 113-122.

Falaye, A.J et al. 2019. Impact of exchange rate on manufacturing sector in Nigeria. International Journal of Mechanical Engineering and Technology, 10(2), 1568-1583.

Fu, X. 2004. Exports, technical progress, and productivity growth in Chinese manufacturing industries. In Exports, Foreign Direct Investment and Economic Development in China, 97-119. Palgrave Macmillan, London.
Harrod, R. 1939. An Essay in Dynamic Theory. Economic Journal, 14-3.
Hawash, R. 2007. Industrialization in Egypt: Historical development and implications for economic policy. The German University in Cairo, Faculty of Management Technology, Working papers 1.
Hondroyiannis, G., Lolos, S., Papapetrou, E. 2002. Energy consumption and economic growth: assessing the evidence from Greece. Energy economics, 24(4), 319-336.
Hooper, P., Kohlhagen, S.W. 1978. The effect of exchange rate uncertainty on the prices and volume of international trade. Journal of International Economics, 8(4), 483-511.
Kaldor, N. 1957. A model of economic growth. The economic journal, 67(268), 591-624.
Kaldor, N. 1961. Capital accumulation and economic growth. In: The theory of capital, 177-222. Palgrave Macmillan, London.
Kaldor, N. 1966. Causes of the slow rate of economic growth of the United Kingdom: an inaugural lecture. Cambridge University Press.
Kaldor, N. 1968. Productivity and growth in manufacturing industry: a reply. Economica, New Series, Vol. 35, No. 140, 385-391. Wiley. https://doi.org/10.2307/2552347
Kenny, S.V. 2019. Determinants of Manufacturing Sector Performance and Its Contribution to Gross Domestic Product in Nigeria. MPRA, paper_93293.
Kiptui, M. 2007. Does the exchange rate matter for Kenya's exports? A bounds testing approach. In African Econometric Society 2007 Conference, Cape Town.
Kočenda, E., Černý, A. 2015. Elements of time series econometrics: An applied approach. Charles University in Prague, Karolinum Press.
Kwiatkowski, D., Phillips, P.C., Schmidt, P., Shin, Y. 1992. Testing the null hypothesis of stationarity against the alternative of a unit root. Journal of Econometrics, 54(1-3), 159-178.
Limao, N., Venables, A.J. 2001. Infrastructure, geographical disadvantage, transport costs, and trade. The world bank economic review, 15(3), 451-479.
Marin, D. 1992. Is the export-led growth hypothesis valid for industrialized countries? The Review of Economics and Statistics, 678-688.
Meyer, D.F., Sanusi, K.A. 2019. A Causality Analysis of the Relationships Between Gross Fixed Capital Formation, Economic Growth and Employment in South Africa. Studia Universitatis Babes-Bolyai Oeconomica, 64(1), 33-44.
Olayungbo, D., Yinusa, O., Akinlo, A. 2011. Effects of exchange rate volatility on trade in some selected Sub-Saharan African countries. Modern Economy, 2(04), 538.
Sallam, M.A. 2021. The Role of the Manufacturing Sector in Promoting Economic Growth in the Saudi Economy: A Cointegration and VECM Approach. The Journal of Asian Finance, Economics and Business, 8(7), 21-30.
Sallam, M.A., Neffati, M.R. 2019. Estimation and Analysis of the Output Gap for the Saudi Economy: Econometric Study (1970-2016). Asian Economic and Financial Review, 9(2), 267.
Sankaran, A., Kumar, S., Arjun, K., Das, M. 2019. Estimating the causal relationship between electricity consumption and industrial output: ARDL bounds and Toda-Yamamoto approaches for ten late industrialized countries. Heliyon, 5(6), e01904.
Sekkat, K., Varoudakis, A. 2000. Exchange rate management and manufactured exports in Sub-Saharan Africa. Journal of Development Economics, 61(1), 237-253.

Shuyun, Y., Donghu, Y. 2011. The causality between energy consumption and economic growth in China: Using panel method in a multivariate framework. Energy Procedia, 5, 808-812.

Soytas, U., Sari, R. 2007. The relationship between energy and production: evidence from Turkish manufacturing industry. Energy economics, 29(6), 1151-1165.

Szirmai, A. 2013. Manufacturing and economic development. Pathways to industrialization in the twenty-first century: New challenges and emerging paradigms, 53-75.

Szirmai, A., Verspagen, B. 2015. Manufacturing and economic growth in developing countries, 1950-2005. Structural change and economic dynamics, 34, 46-59.

Tregenna, F. 2009. Characterizing de-industrialization: An analysis of changes in manufacturing employment and output internationally. Cambridge Journal of Economics, 33(3), 433-466.

Umoru, D., Eborieme, M. 2013. Trade liberalization and industrial growth in Nigeria. Journal of Poverty, Investment and Development, 1(1), 148-156.

Vo, D.H., Zhang, Z. 2019. Exchange rate volatility and disaggregated manufacturing exports: Evidence from an emerging country. Journal of Risk and Financial Management, 12(1), 12.

Vukšić, G. 2005. Impact of foreign direct investment on Croatian manufacturing exports. Financial theory and practice, 29(2), 131-158.

Wang, M. 2009. Manufacturing FDI and economic growth: evidence from Asian economies. Applied Economics, 41(8), 991-1002.

Yamada, H. 1998. A note on the causality between export and productivity: an empirical re-examination. Economics Letters, 61(1), 111-114.

Zhang, J., Broadstock, D.C. 2016. The causality between energy consumption and economic growth for China in a time-varying framework. The Energy Journal, 37 (China Special Issue).