The impact of Foreign Direct Investment and infrastructure on boosting exports

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Abstract

The Foreign Direct Investment (FDI) impact on the performance of the exports of the host countries has been widely debated. Several theoretical and empirical studies propose the export-primitive dimension of FDI across different aspects. Such analysis spans from strengthening the host country's export diversification until more capital to invest in exports, technology transfer, and linking up with global distribution networks for selling its exports. This research paper aims to investigate the consequences faced by foreign direct investment and infrastructure on exports in Egypt between 1998 to 2022. The Egyptian Government is actively seeking to attract foreign direct investments by setting more attractive incentives in various economic sectors and has made significant investments in infrastructure. To achieve this aim, the Generalized Methods of Moment (GMM) approach is adopted, which supports the hypothesis stating that with FDI inflows, a positive impact is

shown in exports. The study also applies an alternative estimate using the Autoregressive Distributed Lag (ARDL) bound testing framework to estimate the long-run equilibrium relationship among the variables and the Error Correction Mechanism (ECM). The empirical results confirm the existence of a positive impact of FDI inflows on exports. The FDI coefficient is 0.078, stating that with an increase of 1% in FDI, the EXP will increase by 0.078. The hypothesis supported by the ARDL bound test approach says that in the short-run as well as in the long-run there is a statistically significant positive relationship between EXP and FDI.

Keywords: FDI, Exports, Infrastructure, GMM, ARDL.

الملخص

يُعد أثر الاستثمار الأجنبي المباشر (FDI) على أداء الصادرات في الدول المضيفة من القضايا التي أثارت اهتمامًا واسعًا في الأدبيات الاقتصادية، سواء النظرية أو التطبيقية .وتشير الدراسات التطبيقية إلى أن الاستثمار الأجنبي المباشر يسهم في تعزيز الصادرات من خلال عدة مسارات، منها تنويع قاعدة الصادرات، وزيادة رأس المال المتاح للاستثمار في القطاعات التصديرية، ونقل التكنولوجيا، والاندماج في سلاسل التوريد والتوزيع العالمية.

تهدف هذه الدراسة إلى تحليل أثر كل من تدفقات الاستثمار الأجنبي المباشر وتطوير البنية التحتية على أداء الصادرات في مصر خلال الفترة من 1998 إلى .2022 وقد كثفت الحكومة المصرية جهودها في جذب الاستثمار الأجنبي من خلال تقديم حوافز تنافسية في قطاعات متعددة، إلى جانب تنفيذ مشاريع بنية تحتية كبرى.

لتحقيق أهداف الدراسة، تم توظيف طريقة العزوم المعممة (GMM) لاختبار فرضية وجود علاقة إيجابية بين تدفقات الاستثمار الأجنبي المباشر والصادرات .كما تم اعتماد نموذج الانحدار الذاتي للفجوات الزمنية الموزعة (ARDL) لاختبار العلاقة التوازنية طويلة الأجل، إلى جانب استخدام آلية تصحيح الخطأ (ECM) لتحليل العلاقة قصيرة الأجل بين المتغيرات.

تشير النتائج التطبيقية إلى وجود علاقة طردية ذات دلالة إحصائية بين تدفقات الاستثمار الأجنبي المباشر والصادرات .إذ يُظهر معامل FDI البالغ 0.078 أن زيادة بنسبة 1% في الاستثمار الأجنبي المباشر تؤدي إلى ارتفاع الصادرات بنسبة 0.078%. كما تؤكد نتائج منهجيتي GMM و ARDL على قوة العلاقة الإيجابية بين الاستثمار الأجنبي المباشر وأداء الصادرات في الأجلين القصير والطويل.

الكلمات المفتاحية : الاستثمار الأجنبي المباشر ، الصادرات ، البنية التحتية ، GMM ، ARDL

1. Introduction

The foreign direct investment (FDI) impacting export growth in recipient countries was extensively debated. The previous studies on exports have considered both empirical and theoretical aspects to suggest that FDI promotes exports through mechanisms such as an infusion of extra capital for export production, technology transfer, extension and upgradation of existing product lines (Hymer 1976; Brundenius & Wise 1998), access to a larger global distribution network where the sales are in international markets, etc., enhancing technical as well as managerial skills- upgrading human resources within domestic

firms, upgrading host country's exporting structure (Zhang, 2006). A recent study by Kastratovic (2020) reviewed a wide range of analytical and factual studies and concluded that generally pieces of literature depict a favorable relationship between exports and FDI. Export spillover effects are favorable externalities from FDI on the exports of local businesses. Investment inflows may contribute to both, increasing the intensive export margins as well as extensive export margins. The intensive margin of exports refers to the rise in the average amount of goods each firm exports while the extensive margin of exports refers to the increase in exporting goods of the firm. Harding & Javorcik (2011).

Goh et al. (2017) and Ahmed et al. (2018) examined how trade was affected by Foreign Direct Investment (FDI), as this impact could vary based on the reasons why foreign industries invest in a country. Some investors invest to gain access to resources, increase market share, strategic possessions and assets, or efficient productivity. It is, hence of vital importance to test empirically the potential benefits of external investment in deepening exports for receptor countries which are crucial elements if we focus on the promotion of economic use through the "export-led-growth hypothesis". (Parida & Sahoo, 2007)

The research focuses on investigating the outcomes of foreign direct investment and infrastructure on Egypt's exports

from 1998 to 2022. Before scrutinizing the correlation between FDI, infrastructure, and exports, the situation and performance of the variables are highlighted in this section. Egypt's FDI flow has evolved over the decade, from 2013 to 2023, as the value of net Foreign Direct Investment reached about $66 billion.

Central Agency for Public Mobilization and Statistics in Egypt issued the data on the proceeds of Egypt's FDI during fiscal year 2013-2014 amounted to around 4.2 billion dollars. It jumped by 52.7% to about 6.4 billion dollars during the fiscal year 2014-2015. Moreover, the proceeds of Foreign Direct Investment during the fiscal year 2015-2016 flows to Egypt grew 8.7% to reach $6.9 billion. In the fiscal year 2016-2017, FDI continued to rise by 14.4% to record about $7.9 billion. While the fiscal year 2017-2018 witnessed a decline of 2.7% to record about $7.7 billion, it rose again during the fiscal year 2018-2019 to record a growth of 6.7% to reach $8.2 billion.

However, FDI decreased by 9.5% during the fiscal year 2019-2020 to about $7.5 billion and proceeded to decline by 30% to reach $5.2 billion during the fiscal year 2020-2021. Furthermore, the fiscal year 2021-2022 witnessed the most significant increase in Foreign Direct Investment inflows to Egypt after a rise of 71.4% to record about 8.9 billion dollars. The inflows continued in 2023 until they reached $10 billion, which comes at a time when the Egyptian government is seeking

to attract foreign direct investments by setting more attractive incentives in various economic sectors, which has helped raise the volume of Foreign Direct Investment recently.

Undoubtedly, the development of infrastructure is significant in achieving long-term growth in the economy and attracting FDI. Important infrastructure investments are framed by the Egyptian government, especially in the sectors of energy, roads, transit, power, natural gas and oil. The infrastructure of the nation has been greatly enhanced by this investment, and it has also improved the business climate for investors, which is probably going to attract additional capital to Egypt. As a result, Egypt's ranking in the Global Competitiveness Report infrastructure index advanced four places from 52nd to 56th in 2019 compared to 2018.

Internationally, Egypt's ranking in the value of exports has improved over the years. According to the Trade Map, which displays trade statistics, Egypt ranked 61st in 2021 compared to 65th in 2014. In addition, Egypt ranked third in Africa in terms of export value in 2021. It is vital to take into account that exports in Egypt reached about $43.9 billion in the fiscal year 2021-2022, which is a significant increase compared to the average Egyptian exports of $24 billion from 2013 to 2020. This increase represents a growth of up to 82%.

2. Literature Review

2.1 Theoretical background

Comprehensively, an ongoing argument regarding inflows of foreign capital plus international trades complement or substitute one another. The study by Mundell (1957) underscores the "*Hecksher-Ohlin* trade model and states that Foreign Direct Investment (FDI) and trade are substitutes". Within this framework, trade among countries is because of the diversity in comparative advantage. Initially, capital mobility is a tendency for capital to shift from countries abundant in capital to countries deficient in capital. This capital flow moves between the two countries until differences in comparative advantage and, consequently, the basis for trade gradually deteriorate. Therefore, trade diminishes as Foreign Direct Investment (FDI) inflows function as a substitute. Nevertheless, subsequent theories have emerged to tackle situations where Foreign Direct Investment (FDI) complements trade.

Some noteworthy theories regarding trade include the *New Trade Theory* models. As a result, these models permit intra-firm trade, growing returns, product differentiation, and imperfect competition. In addition, some critical models in this category were developed by Helpman (1984) and Markusen (1984). Furthermore, Ekholm et al. (2007) demonstrate how export platforms can be established in the host countries through foreign

investment. According to this model, trade is encouraged using FDI through the utilization of export platforms.

The outcome of FDI on trade is influenced by the nature of the FDI inflows. Production processes for vertical FDI are dispersed geographically and occur in several places according to their comparative advantages. For instance, the host nations export manufactured items back to the investment countries after receiving imports of intermediate goods and other inputs from the investing countries. As investment nations set up comparable production processes in host nations to investigate market circumstances, horizontal FDI varies greatly. To market the goods locally, production is done in the host nations, which lowers tariff and transportation expenses (Markusen, 1984). Thus, horizontal FDI substitutes trade, whereas vertical FDI typically has a complementary effect.

According to Moran (2011), market-seeking FDI may not necessarily result in an increase in exports, while efficiency-seeking FDI can enhance production efficiency by leveraging comparative advantage, ultimately boosting exports from the host country. Therefore, the purpose of FDI is crucial in determining its trade-related effects.

In developing countries, Foreign Direct Investment (FDI) can directly or inversely impact exports through multinational corporations (MNCs) and their affiliates. According to Zhang

and Song (2001), as foreign subsidies utilise MNC's extensive worldwide distribution networks, FDI can boost exports from host countries. This export increase is typically seen in industries that process raw materials, make labor-intensive items, like consumer goods and textiles, and assemble components. Additionally, inflows in foreign investment can indirectly boost exports by favorably influencing industries in the host nations. Raised capital, knowledge spillovers, technology transfers, skill development, improved managerial abilities, higher competitiveness, and upgraded transportation and infrastructure facilities are some advantages that domestic firms enjoy from FDI inflows. Furthermore, FDI paved the way for vertical linkages between foreign affiliates and domestic enterprises, which may spread the diffusion of skills and upgrade technologies throughout domestic manufacturing. "These elements have the potential to raise the productivity of local businesses, boost their output, and encourage other foreign markets exports as said by OECD, 2002; Zhang & Song, 2001; Zhang, 2006."

2.2 Previous Empirical Studies

Kim and Xin (2021) examined the impact of Foreign Direct Investment (FDI) on export spillover to both preceding and subsequent China's accession to the World Trade Organization (WTO). The study specifically focuses on the FDI source nation and industries ownership model, utilizing a panel

dataset of Chinese-producing industries between 1998 to 2007. The outcome shows the absence of spillover effects among state-owned enterprises (SOEs). Husain, U., Khan, Z. A., & Javed, S. (2021). The research's major objective is to examine the spillover effect of Foreign Direct Investment (FDI) in Oman's enterprises, precisely to evaluate connections within the framework of policies of FDI as well as Oman's net inflows of FDI. Furthermore, net inflows of FDI effects on Oman's creation of employment are also taken into account. Non-state-owned businesses from Hong Kong, Macao, and Taiwan (HMT), however, exhibit both positive vertical and negative horizontal spillovers correlated with FDI. Additionally, FDI of non-HMT, primarily focusing on the Organization for Economic Co-operation and Development (OECD) nations has both horizontal and vertical spillover effects and a statistically significant positive impact on Chinese private enterprises based on the performances of export. Positive forward spillovers occur just by following China's WTO accession, while positive backward spillovers exist before and after. Kim and Xin disclose that WTO accession in China amplified the forward linkage of production, indicating the export performance of domestic private companies has profited from the increased high-quality inputs accessibility made by non-HMT global multinational corporations.

"Szkorupová (2014) analyzed the correlation between Foreign Direct Investment, economic growth, and exports in

Slovakia from 2001 to 2010." The study focused on estimating the effects on economic growth. Szkorupová utilized the "co-integration method and vector error correction model with quarterly data". The findings confirmed the long-term causal links within selected variables in Slovakia. Research revealed a favourable impact linking FDI as well as the growth of the economy in the nation, as do exports on Gross Domestic Product (GDP), by the implementation of research methods as well as time series availability. Moreover, the generally accepted belief that FDI positively impacts a nation's growth in the economy is indeed true.

Goswami & Saikia (2012) examined the Indian FDI trends from 1991-92 to 2010-11 and "established a bi-directional causality between FDI and exports using the vector error correction model (VECM)". Furthermore, studies cover the discussion on the status of the North East Region (NER) through FDI as well as exports. It highlights the potential the government's Look East Policy (LEP) offers the region due to its strategic location. Despite the NER's natural supremacy for commerce with neighboring nations and the potential for industrial development due to its vast natural resources, the region needs help attracting substantial FDI due to infrastructure and other domains. The study's findings underscore the need for strategic intervention to remove the fundamental constraints that hinder FDI inflows to the NER, such as inadequate infrastructure.

The insights provided by this study would be valuable to policymakers and stakeholders keen on promoting economic growth and development in India through FDI.

Sunde (2017) empirically investigated the relationship between "South Africa's exports, Foreign Direct Investment (FDI), and economic growth". The research utilised the Autoregressive Distributed Lag (ARDL) model, ARDL bounds testing, to inspect the long-term correlation in between variables. The short-term oscillations were further analysed with the help of the Error Correction Model, addition to the direction of causality was ascertained through the VECM Granger causality approach. Their study verified the connections among exports, FDI, and growth in the economy. Furthermore, it revealed, contrary to some research that contends otherwise, exports stimulate development and economic growth. FDI and Economic growth are unidirectionally causally related, with foreign direct investment driving economic growth, as per the results presented by the VECM Granger causality test.

Similarly, it was seen as a unidirectional causality effect between FDI and exports, with FDI causing exports. Finally, a bidirectional causality effect was there in between exports and the economic upswing. For South Africa, this paper supports the FDI-led growth hypothesis. Regarding policy, the country's administration may amplify FDI by offering investors reasonable incentives, establishing a macroeconomic environment that is

favourable, as well as cautiously implementing insecure monetary policies to strengthen the economic system.

Farid et al. (2023) analysed the "effect of Foreign Direct Investment (FDI) inflows on Pakistan's exports of five major manufacturing industries from 2000 to 2020". The researchers established an export production function taking a base of endogenous growth theory, considering FDI as an additional export determinant to achieve this. Husain, U., Javed, S., & Araimi, A. A. (2021) studied the impact of FDI on Oman's production and manufacturing firms, using data from 1984-2018 and surveys of 410 respondents across nine sectors. FDI enhanced domestic market efficiency, productivity, and economic diversification, with significant technology and capital spillovers. The Error Correction Model (ECM) and the Pedroni residual-based co-integration test were used for short-term as well as long-term associations. The long-term autocorrelation of domestic capital, human capital, exports, foreign direct investment, and domestic sales was demonstrated by the Pedroni residual-based theory. The FDI coefficient has a statistically significant impact on exports and, over time, is trending positively, as per the ECM data.

Contribution to Foreign Direct Investment (FDI) in export broadening was only short-term. It is a long and gradual process for the changes in the sector's development patterns. Drawing from the endogenous growth theory theoretical framework, the

long-run coefficient of foreign direct investment (FDI) can be viewed as supporting evidence that FDI stimulates export development through exports. Therefore, when it comes to Pakistan, the "FDI-based endogenous growth theory" was applicable.

"Goh et al. (2017) examined whether exports, foreign direct investment (FDI), and gross domestic product (GDP) have a long-term relationship, particularly in Asian economies." The autoregressive distributed lag (ARDL), the recently developed test of cointegration is employed by researchers. For the ARDL test, the bootstrap method produces and applies critical values that are relevant to the particular sets of data. The bootstrap tests consider the possibility of endogeneity and feedback. Although empirical studies tend to overlook degenerate case possibilities, Pesaran et al. (2001) pointed out this concern. When GDP is a dependent variable, tests in the study do not show any integration of cointegration. It is found that no long-term forcing relationship between exports and FDI to GDP indicating exports with FDI were not the primary medium for growth in the economy and development for the chosen economies in Asian countries.

Majumder et al. (2022) study that there are very few researchers who talked about how "Bangladesh's export processing zones (EPZs) are affected by Foreign Direct Investment (FDI)". The majority of scholars have looked into how FDI affects Bangladesh's economic expansion. Moreover,

some academicians have also looked at the FDI effects on trade, domestic investment, and different economic sectors. However, according to our knowledge, there has been no investigation into the FDI effect on EPZs of Bangladesh. Taking the help of secondary data from the years 1997 to 2018, the paper investigates how inflows in FDI affect exports and employment in the boundaries of Bangladesh. "The research used the Auto Regressive Distributed Lag (ARDL) bound test approach and Generalized Method of Moments (GMM) model for employment creation and export EPZ respectively." Key explanatory variable is inward FDI. To solve the issues of omitted variables, there exist additional control variables.

The GMM estimate indicates the trade-offs between FDI and the growth of GDP are favourable in terms of accelerating EPZ exports. Exports of EPZ production will show an increment of 0.74% if inflows of FDI increase by 1%, according to the coefficient of FDI inflows, which stands at 0.74%. The ARDL findings demonstrate that there is a positive and favourable correlation between FDI inflows and employment in the EPZ in both the short-term as well in long-term. The country's policymakers and government delegates should underscore the essential operations of the single point of service in order to elevate domestic and foreign investors. If policymakers establish a one-stop service for the investors of foreign lands then many of

the investors will be motivated as well as enthusiastic to take part in the country's investments.

In their remarkable study, "Sahoo and Dash (2022) investigate the implementation of foreign direct investment in the exports of 93 developing countries from 2000 to 2017 through panel data analysis". Investigating the FDI varying effects for these various nations categories, the study additionally makes a distinction between emerging nations, lower-income countries (LICs), and lower- and middle-income countries (LMICs). These research conclusions showcase that exports and FDI complement each other and the complementary goods depend on the host country's degree of development. FDI is least effective for LICs while more effective for export promotions in emerging nations. As a result, the study suggests well-thought-out policies that give top priority to FDI directed towards strategic sectors and infrastructure, financial markets, and human capital quality improvements.

3. The Data, Methodology and Specification of Model

Analyzing the correlation between Exports and Foreign Direct Investment (FDI) of goods as well as services during the period year 1998 to year 2022. This paper adopts the "Generalized Methods of Moment (GMM) given by Hansen (1982)". Large sample properties of GMM estimators help in addressing comparative characteristics. In an empirical analysis, a persistent issue is Heteroscedasticity. In the existence of heteroscedasticity,

diagnostic tests will reveal inaccurate results. "GMM aids in the application of orthogonality criteria for efficient estimations when Heteroscedasticity of an unknown form is present (Baum et al., 2003)." The quantitative model is formulated based on the natural logarithm (ln) of six main variables as follows: goods and services export, Foreign Direct Investment (FDI), Final consumption expenditure, Inflation, Infrastructure index, and Financial Development Index. Information was retrieved from the World Bank's World Development Indicator Series and the Central Bank of Egypt. The model is expressed as Equation (1).

$$ln(EXP)_t = \beta_0 + \beta_1 ln(FDI)_t + \beta_2\, ln(DD)_t + \beta_3\, ln(INFD)_t + \beta_4\, ln(FIND)_t + \beta_5\, ln(INFL)_t + \varepsilon_t \quad (1)$$

Where:

EXP = Exports of goods and services (% of GDP).

FDI = Foreign direct investment (% of GDP).

DD = Final consumption expenditure (% of GDP).

INFD = Infrastructure index.

FIND = Financial Development index.

INFL = Inflation.

ε = The error term.

t = Represents time

β_0 = intercept

β_1,..., β_5 = regression coefficients.

For the robustness check, the study also applies an alternative estimate using the "Autoregressive Distributed Lag (ARDL) bound testing framework (Pesaran and Shin 1995 and 1999, Pesaran et al. 1996, Pesaran 1997) for the estimation of long-run equilibrium relationship among the different variables and the Error Correction Mechanism (ECM)". The ARDL model has one of the explanatory variables, the lagged values of the independent variables (distributed lag) and the lagged values of the dependent variables (autoregressive). The ARDL autocorrelation helps in maintaining the long-run equilibrium relationship among the variables under review when the variables are integrated of both order zero I(0) and order one I(1). "The benefit of implementing the ARDL technique in comparison with that of the conventional, Johansen (1998) and Johansen and Juselius (1990) cointegration approach is that the former employs only a single reduced form equation (Pesaran and Shin 1995) while the latter estimates the long-run relationships within the context of a system of equations." Furthermore, the ARDL approach circumvents the need to configure a greater number of specifications in the

standard cointegration test. These incorporate the conclusions of how to treat the deterministic elements as well as the inclusion concerning the number of exogenous as well as endogenous variables.

Additionally, unlike the standard cointegration test, the ARDL method permits the use of several optimal lags for the various variables. Since time series data can be susceptible to unit root issues, thus spurious regressions can be prevented and avoided by the implementation of Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests to the series. Unit root tests are first conducted to ascertain the stationarity of the variables, which must be a combination of I(0) and I(1) series. Equation (2) illustrates how the ARDL approach to cointegration is carried out by following Pesaran et al. (2001).

$$\begin{aligned}&\Delta ln(EXP)_t \\&= \beta_0 + \beta_1 \Delta ln(FDI)_t + \beta_2 \Delta ln(DD)_t + \beta_3 \Delta ln(INFD)_t \\&+ \beta_4 \Delta ln(FIND)_t + \beta_5 \Delta ln(INFL)_t + \beta_6 ln(EXP)_{t-1} \\&+ \beta_7 \Delta ln(FDI)_{t-1} + \beta_8 \Delta ln(DD)_{t-1} + \beta_9 \Delta ln(INFD)_{t-1} \\&+ \beta_{10} \Delta ln(FIND)_{t-1} + \beta_{11} \Delta ln(INFL)_{t-1} + ECT_{t-1} \\&+ \varepsilon_t \end{aligned} \quad (2)$$

A lag length test is carried out by estimating a single equation Vector Autoregressive (VAR) and using the lag length criteria in order to determine the ideal number of lags for each variable. Subsequently, an unrestricted Error Correlation (EC) model with a single equation is calculated, utilising the number of estimated lags indicated in Equation (3).

$$\begin{aligned}\Delta ln(EXP)_t = \beta_0 + \sum_{i=1}^{p} \beta_{1i}\Delta ln(EXP)_{t-i} \\ + \sum_{i=1}^{p} \beta_{2i}\Delta ln(FDI)_{t-i} + \sum_{i=1}^{p} \beta_{3i}\Delta ln(DD)_{t-i} \\ + \sum_{i=1}^{p} \beta_{4i}\Delta ln(INFD)_{t-i} \\ + \sum_{i=1}^{p} \beta_{5i}\Delta ln(FIND)_{t-i} \\ + \sum_{i=1}^{p} \beta_{6i}\Delta ln(INFL)_{t-i} + \beta_7 ln(EXP)_{t-1} \\ + \beta_8 ln(FDI)_{t-1} + \beta_9 ln(DD)_{t-1} \\ + \beta_{10} ln(INFD)_{t-1} + +\beta_{11} ln(FIND)_{t-1} \\ + \beta_{12} ln(INFL)_{t-1}\varepsilon_t \end{aligned} \quad (3)$$

Here, *p* is the optimal lag length, Δ is first difference operator, and all other variables stays constant. To get F-statistics, which helps to test for the presence of a long-run association, Wald tests on the coefficients of unrestricted ECT variables are performed. The number of regressors, the inclusion of I(0) or I(1) variables in the model, and the presence of an intercept and/or a temporal tendency of the model all affect the non-standard distribution of the F-test. At the 5% level of significance, the F-statistics are compared to Pesaran's critical value. Asymptotic critical value bounds apply to the test based on whether the variables are I(0) or I(1) or a combination of the two. The I(1) and I(0) series provide the upper and lower bound critical values respectively. Irrespective of the order in which the variables are integrated, we reject the null hypothesis as there is no co-integration among the variables when the F-statistic is above the upper bound value. Thus conclusions can be drawn that it is evident of a long-term relationship among the variables. The null hypothesis of no co-integration was not rejected when the F-statistic falls below the lower bound value whereas inconclusive results are shown when it lies between the bounds.

Disequilibrium may occur in the short-run when it is entrenched that variables are co-integrated (i.e., there is a long-run or equilibrium relationship between them). The disequilibrium is corrected with the employment of an error correction mechanism. Equation (4) illustrates how to estimate

the Error Correlation Term (ECT) using the specific lags to obtain the short-run dynamics.

$$\Delta ln(EXP)_t = \beta_0 + \sum_{i=1}^{p} \beta_{1i} \Delta ln(EXP)_{t-i} + \sum_{i=1}^{p} \beta_{2i} \Delta ln(FDI)_{t-i} + \sum_{i=1}^{p} \beta_{4i} \Delta ln(INFD)_{t-i} + \sum_{i=1}^{p} \beta_{4i} \Delta ln(INFD)_{t-i} + \sum_{i=1}^{p} \beta_{5i} \Delta ln(FIND)_{t-i} + \sum_{i=1}^{p} \beta_{6i} \Delta ln(INFL)_{t-i} + \lambda ECT_{t-1} + \varepsilon_t \quad (4)$$

Where is the error correction term, and λ is the symbol of the speed of adjustment; which represents the speed, after the short-run shock, at which the long-run disequilibrium from the past years is rectified in the current year. The p-value is less the 5% and the ECT must be negative (statistically significant).

3.1 INFD and FIND Indexes construction

By using Principal Component Analysis (PCA) we develop a composite Infrastructure Index (INFD) and Financial Development Index (FIND), in contrast to other research using single indicators for growth of the infrastructure and financial sector development. Three Infrastructure indicators are included

in the infrastructure index: (INFD1) telephone density (fixed lines and mobiles per 100 persons), (INFD2) Internet connection (fixed broadband connections per 100 persons), and (INFD3) Air transport (freight million tons per km). In a similar way, the Financial Development Index comprises three major financial variables: (FIND1) number of bank branches per one lakh population, (FIND2) Domestic credit by banks as a ratio to GDP, and (FIND3) Broad money ratio (M2 by GDP). PCA findings include Eigenvalues as shown in Table (1), Variance explained. Note that INFD1 and FIND1 negatively correlate with the other variables, we eliminated them from the Infrastructure Index and Financial Development Index, respectively.

Table (1): PCA results

	INFD	**FIND**
1st component Eigenvalue	1.889	1.465
2nd component Eigenvalue	0.111	0.535
Variance Explained (%)	94.463	73.255

Table (1) shows that:

1- The 1st principal component for **INFD** has an eigenvalue greater than one (1.889) and describes 94.643% of the total variance. There is a great difference between the eigenvalues of the 1st principal component and the next. Hence, we select the 1st principal component for making a composite index of the

combined variance of the different aspects of the Infrastructure Index captured by the two variables (INFD2 & INFD3).

2- The 1st principal component for **FIND** has an eigenvalue greater than one (1.465) and describes 73.255% of the total variance. There is a great difference between the eigenvalues of the 1st principal component and the next. Hence, we select the 1st principal component for making a composite index of the combined variance of the different aspects of the Financial Development Index captured by the two variables (FIND2 & FIND3).

3.2 Descriptive Statistics

Descriptive Statistics summaries Minimum Value, Maximum Value, Mean, and Standard Deviation of all variables are presented in below Table (2).

Table (2): Descriptive Statistics

Variables	Sample Size	Minimum	Maximum	Mean	Std. Dev.
Ln (EXP)	25	2.337	3.498	2.908	0.327
Ln (FDI)	25	0.000	2.356	1.184	0.562
Ln (DD)	25	4.417	4.561	4.484	0.044
Ln (INFD)	25	0.000	1.467	0.589	0.479
Ln (FIND)	25	0.000	1.396	0.816	0.445
Ln (INFL)	25	0.820	3.385	2.033	0.654

3.3 Correlation

The correlation coefficient is coded as r and ranges from -1 to +1, Pearson correlation coefficients are conducted (Table (3)) to ascertain whether there is any relationship between the dependent and independent variables. The larger the correlation between the variables irrespective of the sign, the closer the correlation value is to one. When the relationship between the variables is weaker, the correlation value is closer to zero. Contrary to this, whether the relationship is positive or negative is described by the correlation coefficient sign. The relationship between the two variables is direct indicating the positive correlation sign whereas the relationship between the two variables is indirect indicating the negative correlation sign.

Table (3): Correlation Matrix

Variables	Ln (EXP)	Ln (FDI)	Ln (DD)	Ln (INFD)	Ln (FIND)	Ln (INFL)
Ln (EXP)	1					
Ln (FDI)	0.487**	1				
Ln (DD)	-0.839***	-0.281	1			
Ln (INFD)	-0.671***	-0.071	0.715***	1		
Ln (FIND)	0.458**	0.242	-0.603***	-0.614***	1	
Ln (INFL)	0.112	0.418**	0.296	0.364*	-0.254	1

Note: ***, **, * **denote significant at 1%, 5% and 10% respectively.**

Table (3) shows that:

1- There is a statistically significant positive relationship between **EXP** and **FDI** at 5% significance level, whereas the correlation coefficient is 0.487 and the *p*-value is less than the significance *p*-value < α = 0.05.

2- There is a statistically significant negative relationship between **EXP** and **DD** at 1% significance level, whereas the correlation coefficient is -0.839 and the *p*-value is less than the significance *p*-value < α = 0.01.

3- There is a statistically significant negative relationship between **EXP** and **INFD** at 1% significance level, whereas the correlation coefficient is -0.671 and the *p*-value is less than the significance *p*-value < α = 0.01.

4- There is a statistically significant positive relationship between **EXP** and **FIND** at 5% significance level, whereas the correlation coefficient is 0.458 and the *p*-value is less than the significance *p*-value < α = 0.05.

5- There is no statistically significant relationship between **EXP** and **INFL** at 1% or 5% or 10% significance level, whereas the *p*-value is less than the significance.

3.4 Results of the GMM Model

The present research used data series from 1998 to 2022 for the estimation of the result of GMM estimation. Table (4) shows the result of the GMM model.

Table (4): GMM Model

Variable	Coefficient	Std. Error	t-Statistic	p-value
Constant	27.391	4.049	6.764	0.000
Ln (FDI)	0.078	0.033	2.379	0.028
Ln (DD)	-5.513	0.909	-6.068	0.000
Ln (INFD)	-0.241	0.055	-4.350	0.000
Ln (FIND)	-0.110	0.095	-1.161	0.260
Ln (INFL)	0.184	0.035	5.243	0.000
R-squared	0.903	Mean dependent var		2.908
Adjusted R-squared	0.877	S.D. dependent var		0.327
S.E. of regression	0.115	Sum squared residual		0.250
Durbin-Watson stat	1.360	J-statistic		8.22E-39
Jarque-Bera	0.236	Jarque-Bera *p*-value		0.889

Table (4) shows that:

1- **FDI**, **DD**, **INFD**, **INFL** had a statistically significant effect on **EXP** at 5%, where the *p*-value < 0.05. Overall, the model performs well in terms of goodness of fit: $R^2 = 0.903$ and Durbin-Watson (1.360).

2- The coefficient of FDI is 0.078, which states that with the increase of **FDI** by 1% the **EXP** will increase by 0.078.

3- The normality test has been calculated by implementing the Jarque-Bera statistics. The test states that the Jarque-Bera value is 0.236 and the *p*-value is more than 5% (*p*-value= 0.889 > 0.05) which declares the residual of the model has been normally distributed.

3.5 Results of the ARDL Model

3.5.1. Stationarity test (Unit root tests)

A stationarity test using the Augmented Dickey-Fuller (ADF) test is organized to ascertain the order of integration for each variable as shown in Table (5).

Table (5): Unit root tests

Variables	Dickey-Fuller (ADF) test		
	Level	1st Diff.	I(d)
Ln (EXP)	-1.328	-3.593**	I(1)

Ln (FDI)	--3.167**	------	I(0)
Ln (DD)	-1.394	-4.755***	I(1)
Ln (INFD)	-0.535	-5.873***	I(1)
Ln (FIND)	-1.537	-3.657**	I(1)
Ln (INFL)	-1.961	-4.602**	I(1)

Note: ***, **, * denote significance at 1%, 5%, and 10% respectively.

Since the stationarity test of the variables under consideration is a mixture of I(1) and I(0), the ARDL approach was deemed appropriate for estimation and testing our hypothesis.

3.5.2. Estimating the optimum lag length

To determine the optimum lag length for the variables, the first step is to conduct and estimate a lag length test. The optimum lag length to be included in the unrestricted ECM was found by applying the Akaike information criterion (AIC) to the ARDL choices, with a maximum order of lags of two, as indicated in Table (6). According to the results, the optimum lag length is one for **EXP** and **FIND** while two for **FDI**, **DD**, **INFD**, and **INFL** (e.g., ARDL (1, 2, 2, 2, 1, 2)).

Table (6): Estimating the optimum lag length for each variable

Variable	Coefficient	Std. Error	t-Statistic	p-value

Ln (EXP)$_{t-1}$	0.265	0.089	2.967	0.021
Ln (FDI)$_{t}$	-0.017	0.030	-0.570	0.586
Ln (FDI)$_{t-1}$	0.109	0.029	3.729	0.007
Ln (FDI)$_{t-2}$	-0.199	0.025	-7.835	0.000
Ln (DD)$_{t}$	-3.893	0.381	-10.212	0.000
Ln (DD)$_{t-1}$	-0.398	0.589	-0.675	0.521
Ln (DD)t-2	-1.319	0.372	-3.545	0.009
Ln (INFD)$_{t}$	-0.060	0.058	-1.035	0.335
Ln (INFD)$_{t-1}$	-0.019	0.058	-0.324	0.755
Ln (INFD)$_{t-2}$	0.144	0.061	2.386	0.048
Ln (FIND)$_{t}$	-0.296	0.037	-8.055	0.000
Ln (FIND)$_{t-1}$	0.322	0.044	7.286	0.000
Ln (INFL)$_{t}$	0.134	0.018	7.405	0.000
Ln (INFL)$_{t-1}$	0.067	0.027	2.515	0.040
Ln (INFL)$_{t-2}$	-0.101	0.032	-3.193	0.015
Constant	27.169	3.455	7.865	0.000

R-squared	0.998	Mean dependent var	2.922
Adjusted R-squared	0.993	S.D. dependent var	0.338
S.E. of regression	0.029	Akaike info criterion	-4.050
Sum squared resid.	0.006	Schwarz criterion	-3.260
Log likelihood	62.577	Hannan-Quinn criter.	-3.852
F-statistic	200.419	Durbin-Watson stat	2.972
Prob(F-statistic)	0.000		

The long-term relationships among the variables are determined in the next step. We derive an F-Bounds test for the joint

significance of lagged levels of the variables, as indicated in Table (7), by performing a Wald test on the coefficients of the unconstrained ECM variable.

Table (7): Cointegration testing

Test Statistic	Value	Sig. Level	I(0)	I(1)
F-statistic	34.443	10%	2.407	3.517
K	5	5%	2.910	4.193
		1%	4.134	5.761

Table (7) demonstrates that, when employing a restricted constant and no trend, the computed F-statistic of the Bounds test (34.443) is greater than the upper bound critical value (4.193) at the 5% level of significance. Therefore, the null hypothesis (H_0) of no cointegration among the series can be rejected. This suggests that all the variables are in a long-term relationship. In order words, in the long-term, the model variables co-move together. Additionally, Table (8) displays the estimated model and the long-run relationship between all variables.

Table (8): Long-run model

Variable	Coefficient	Std. Error	t-Statistic	*p*-value
Ln (FDI)$_{t-1}$	-0.145	0.054	-2.695	0.015
Ln (DD)$_{t-1}$	-7.629	0.518	-14.718	0.000
Ln (INFD)$_{t-1}$	0.089	0.067	1.325	0.203
Ln (FIND)$_{t-1}$	0.036	0.067	0.530	0.603
Ln (INFL)$_{t-1}$	0.137	0.046	2.939	0.009
Constant	36.948	2.310	15.995	0.000

Table (8) shows that **FDI**, **DD**, and **INFL** had a statistically significant effect on **EXP** in the long-run at 5%, where the *p*-value < 0.05. To estimate the model in the sort-run, ECM short-run dynamics are conducted as shown in Table (9).

Table (9): Short-run error correction model

Variable	Coefficient	Std. Error	t-Statistic	*p*-value
Ln (FDI)	-0.017	0.012	-1.435	0.175
Ln (FDI)$_{t-1}$	0.199	0.015	13.710	0.000
Ln (DD)	-3.893	0.200	-19.482	0.000
Ln (DD)$_{t-1}$	1.319	0.229	5.748	0.000
Ln (INFD)	-0.060	0.028	-2.129	0.053

Ln $(INFD)_{t-1}$	-0.144	0.028	-5.246	0.000
Ln (FIND)	-0.296	0.019	-15.787	0.000
Ln (INFL)	0.134	0.011	12.726	0.000
Ln $(INFL)_{t-1}$	0.101	0.011	9.118	0.000
ECT_{t-1}*	-0.735	0.035	-21.160	0.000

R-squared	0.993	Mean dependent var	0.000
Adjusted R-squared	0.988	S.D. dependent var	0.190
S.E. of regression	0.021	Akaike info criterion	-4.572
Sum squared residual	0.006	Schwarz criterion	-4.078
Log likelihood	62.577	Hannan-Quinn criter.	-4.448
F-statistic	194.838	Durbin-Watson stat	2.972
Prob(F-statistic)	0.000		

The conclusions of the ECM summarized in Table (9) demonstrate that all variables (**FDI**, **DD**, **INFD**, **FIND**, and **INFL**) had a statistically significant effect on **EXP** in the short-run, with a *p*-value of less than 0.05 (*p*-value < 0.05). Overall, the model works well in terms of goodness of fit: R^2 = 0.993 and Durbin-Watson (2.972). Findings also showcase a coefficient value for ECT_{t-1} of −0.735, implying rejection of the null hypothesis of no cointegration. This indicates the speed of adjustment from the short run equilibrium to the long run equilibrium and suggests that 74% of the error is rectified annually. This adjustment speed implies that it will take

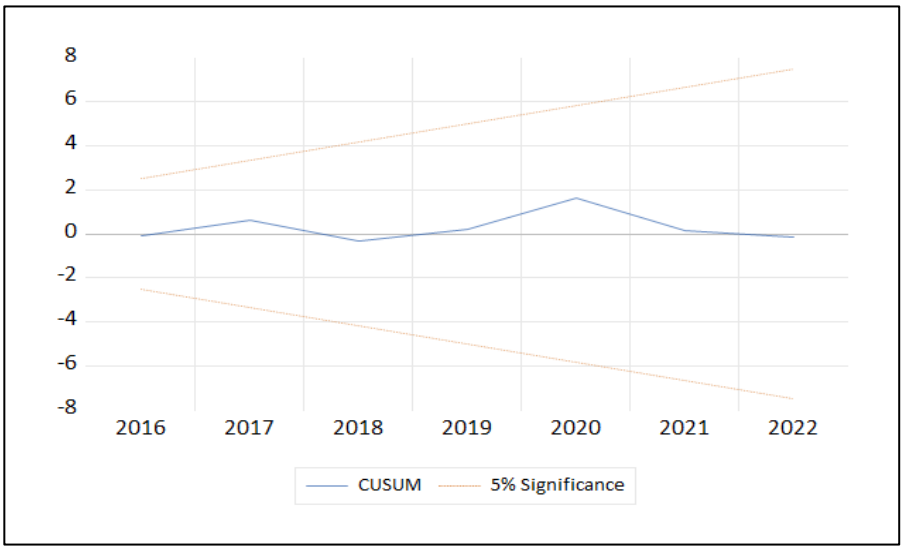
approximately 1.36 years to bring the economy back to equilibrium. Furthermore, the application of Breusch–Godfrey serial correlation LM test, Heteroskedasticity test and Jarque-Bera test shown in table (10).

Table (10): Heteroskedasticity and Serial Correlation tests

Heteroskedasticity Test (Breusch-Pagan-Godfrey)			Serial Correlation LM Test (Breusch-Godfrey)			Jarque-Bera test	
F	*df*	*p*-value	*F*	*df*	*p*-value	*JB*	*p*-value
0.995	(15,7)	0.535	3.327	(3,4)	0.138	1.326	0.515

Based on Table (10), the null hypothesis cannot be rejected if no Heteroskedasticity ($F_{(15,7)} = 0.995$, p-value = 0.535 > 0.05), and the null hypothesis cannot be rejected if no Serial Correlation ($F_{(3,4)} = 3.327$, p-value = 0.138 > 0.05) thus, this assumption is satisfied by the model. Additionally, Jarque-Bera states that the model's residual has been normally distributed (JB = 1.326, p-value= 0.515 > 0.05). Moreover, to guarantee the stability of the model, Figure (1) presents evidence from the Cumulative Sum Chart (CUSUM) stability test, which shows that the blue line never deviates beyond the critical red lines indicating the stability of the model at the 5% level.

Figure (1): Stability of the model



4. Conclusion

Based on the existing theoretical literature, Foreign Direct Investment (FDI) can inversely and directly complement exports of the host country through various spillover effects. The research aimed to explore the impact of FDI and infrastructure on exports. To reach the goals of the study, the Generalized Method of Moments (GMM) was applied whereas for the robustness check, the Autoregressive Distributed Lag (ARDL) bound testing framework was used. The GMM approach supports the hypothesis that FDI inflows have a positive impact on exports. FDI and exports show a statistically significant positive relationship between each other. The ARDL bound test approach also supports the hypothesis that there is a positive correlation

between FDI inflows and exports in the long run as well as in the short run. The primary objective of this research paper is to ascertain the impact of FDI inflows on exports. The empirical results confirm that there is a positive impact between exports and FDI inflows. The FDI coefficient is 0.078, which states that with the increase in FDI by 1%, the exports will increase by 0.078. The study also found that capital inflow has increased in recent years, and it is predicted to reach about 10 billion in 2023. Based on the study, some recommendations have been made. To increase exports, magnetize more and more FDI by giving priority to the policies. Infrastructure development is crucial for achieving long-term economic growth and attracting FDI. Therefore, investment can be made in human capital and financial development by the Government.

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