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NEXUS BETWEEN FINANCIAL INCLUSION AND EXCHANGE RATE: EMPIRICAL EVIDENCE FROM BANGLADESH ECONOMY

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Abstract

Financial Inclusion (FI), defined by the engagement and involvement of people with formal financial institutions, has become a buzzword nowadays. The authors have tried to investigate an alluring problem statement considering the nexus between FI and Exchange Rate (ER). The authors have collected data from the Financial Access Survey (FAS) of the International Monetary Fund (IMF) and the World Development Indicator (WDI) of the World Bank (WB) covering the years 2004 to 2020. The study has administered Unit root test, Johanson co-integration test, Vector Error Correction Model (VECM), and Granger Causality Test (GCT) to address the study objective. In accordance with analysis results, ER and Trade Openness (TO), ER and FI, and TO and FI have bidirectional associations which expose that they cause each other, for instance, ER↔TO, ER↔FI, and TO↔FI. On the other hand, Foreign Direct Investment (FDI) and TO have a unidirectional relationship which implies that FDI causes TO (FDI →TO). However, the authors did not find any relationship between ER and FDI, and FI and FDI. According to the study findings, there is a positive long-term bi-directional nexus between ER and FI, which implies that both factors affect each other because of the increasing transaction demand for money over the periods. Policymakers can take financial inclusion as a phenomenon by increasing the involvement of people taking financial services from formal financial institutions for producing export-oriented and import substitution goods for earning foreign currency to maintain the trade balance as the economy remains in the trade deficit over the time period.

Keywords: Financial inclusion, Exchange rate, Foreign direct investment, Trade openness, Bangladesh economy

Introduction

Financial inclusion (FI), also known as inclusive finance or financial inclusivity/inclusiveness, is a relatively new concept. It has emerged as a remarkable occurrence within the current worldwide plan for comprehensive and enduring economic progress. FI has multidimensional accepted definitions (Sarma, 2008; Solo, 2008). Therefore, the definition of financial inclusion differs. It is considered a multi-dimensional concept because it is defined and measured by individuals and enterprises on the basis of dichotomous classification. Mbutor & Uba (2013) analyzed that a formal financial service is defined as ensuring access at a cost in a clear way. Demirgtic-Kunt et al. (2012) conceptualized FI as an institutional service (Anarfo et al., 2019) from financial institutions (Sarma, 2016). It generally dealt with different groups, and its benefit spilled over to many individuals' welfare. Amidzic et al. (2014) also described FI as an economic phenomenon. There is no one who has not confessed access to financial services in terms of primary. Lagarde (2014) considered the term as simply the 'banked'. A definition in the 2014 Global Financial Development Report (GFDR) by the WB described FI in the way, as the share of households and entities involved in financial sectors and use services (World Bank, 2014). Sahay et al. (2015) characterized financial inclusion as consisting of three dimensions for instance, access (penetration), usage, and operation of financial services and it emphasized the vulnerable segments of society at affordable cost, while Sarma (2016) explained FI as a process only. It mainly ensures accessibility, (Sahay et al., 2015) availability, and use of formal financial services (Demirgtic-Kunt et al., 2012) for all sectors of the country.

FI is used as a composite indexing value for mitigating several macroeconomic indicators and uses as enhancing economic development or growth, sustainability, and stability, creation of employment, reduction of

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income inequality and reduction of poverty in terms of developed countries, as well as emerging and developing economies (Chibba, 2009). On the perspective of the level of FI, it consists of three dimensions for instance: credit of penetration, deposit of penetration and branch of penetration (Kesavan, 2015). Many rural households (Mandiwa, 2014) have to use informal channels (Gupta, 2015) to reach their financial services (Mandiwa, 2014) because the formal sector of finance does not work them well (Kesavan, 2015). FI, thus, gained considerable worldwide momentum. It is a concept and policy solution that helps to enhance the economic status of marginalized people in a considered country. On the other hand, income asymmetry (Hills et al., 2002) goes on social exclusion (Muffels et al., 2002) from the mainstream sector of an economy and it creates inequality in the context of income in the society as well as the economy.

The measurement of FI is accomplished mainly in two ways pointed out by scholars in their previous research via the formulation of a composite FI index. They are: the nonparametric approach of FI that Sarma (2016) used and the parametric approach of FI that Camara and Tuesta (2018) used in their research applying by the principal component analysis (PCA) method. The nonparametric method mainly defines the importance of factors by selecting the weights exogenously in accordance with scholars' willingness. Lockwood (2004) used indices that are important to subjective weight selection because of a slight changing in choosing weights altering the results correctly. Therefore, Camara and Tuesta (2018) tried to sort out that problem through developing FI index on the basis of principal component analysis which is commonly known the PCA approach for the measurement of financial inclusion.

Lapukeni (2015) found that money supply and inflation increases simultaneously. That means there is a positive association between these two variables. Exchange rate (ER) is an important variable of macroeconomics. Rate of Inflation associated with the ER is used as a key factor of macroeconomic policies and interest rate is also considered for the formulation of country policy especially in the central bank policy. ER variation can affect the payment system of taking foreign debt revenue. The purpose of taking debt is to invest in economic activities for enhancing economic development making sufficient funds to pay the debt money (Saheed et al., 2015). Draz et al. (2019) investigated the dynamic influence of macroeconomic factors on ER in South-Asian countries. However, results show that the macroeconomic factors significantly affected the exchange rate.

Furthermore, Lenka & Bairwa (2016) look at the relationship between ER and FI in South Asian Association for Regional Cooperation (SAARC) nations. According to outcomes, the exchange rates of countries are significantly impacted by financial inclusion. Increased financial inclusion results in more stable exchange rates, which lowers currency volatility. Financial inclusion also makes it easier for people to participate more in international financial markets, which enhances the management of exchange rates. The study comes to the conclusion that financial inclusion policies in SAARC nations can help preserve stable exchange rates, boost economic stability, and promote sustainable economic growth.

Likewise, the nexus between FI and ER in Nigeria is the main topic of Mbutor & Uba (2013). It demonstrates how important financial inclusion is in affecting exchange rates. The stability of ER and decreased volatility of currencies are benefits of greater financial inclusion. Financial inclusion also makes it possible for people and businesses to engage in the market dealing with foreign currency exchange more actively, improving the impact of monetary (central bank) policy interventions. In addition, it is emphasized that promoting financial inclusion in Nigeria can help to stabilize the exchange rate, increase economic stability, and improve the efficiency of monetary policy measures (Mbutor & Uba, 2013). Similarly, the study emphasized the link between FI and ER in Nigeria. More financial inclusion encourages exchange rate stability by lowering currency volatility, which helps to create an environment that is favorable for economic diversification and long-term economic growth (Adeola & Evans, 2017). In addition, Matsebula & Sheefeni (2022) examined the connection between South Africa's exchange rates and financial inclusion. It demonstrates how important financial inclusion is to preserving currency stability, lowering currency volatility, and fostering macroeconomic stability in the nation (Matsebula & Sheefeni, 2022).

In the previous empirical paper, the importance of FI and the exchange rate for economic development is discussed thematically. These two are crucial in fostering economic growth, investment decision, employment generation, trade balance, FDI inflow, and so on. Financial inclusion helps to increase savings leading to enhance investment decision helping to increase economic growth (Babajide et al., 2015; Ayoola & Omowunmi, 2018; Erlando et al., 2020), and to attract foreign investors (Anthony-Orji et al., 2023) to do their business in the home

country for getting a strong exchange rate (Errunza, 2001; Chen et al., 2023). Economic growth, monetary policy as well as investment decisions, may be the outcomes of exchange rate and financial inclusion (Lenka & Bairwa, 2016).

Moreover, FI can reduce instability and poverty (Adeola & Evans, 2017) by giving access to credit facilities and formal financial support to the people and accordingly they invest and spend their money to produce goods and services (Mbutor & Uba, 2013). It also helps to increase trade by providing financial services with lower interest rates (Ashraf et al., 2021) and by adjusting and controlling inflation, exporting goods and services, and establishing import-substitution industries helping to maintain trade balance (Irwin, 2021). In addition, it minimizes exchange rate volatility attracting foreign investors helping them produce goods and services at lower prices, and get cheaper to buy goods and services from the domestic country, and it finally grows economic resilience through export-led (Chen et al., 2023) goods and services and stabilizes economy of the host country by the helping of FDI inflow generating employment, ensuring to earn foreign currency, introducing new technology, and so forth, and it takes blessing for the home country (Anthony-Orji et al., 2023). In addition, FI improves transparency by providing formal financial services to the investors by making it easier to track their finances helping to lessen illegal activities such as corruption, tax evasion, nepotism, and so on, it motivates foreign investors (Barik, & Lenka, 2023) to invest in the economy by getting and ensuring financial security (Refakar & Cárdenas, 2023).

Whereas, an exchange rate can help the domestic economy by importing goods and services leading to lower prices for investors, buyers, and consumers. Furthermore, with a weaker exchange rate, it is easier to deal with the world market, and by competing with other economies, the economic growth of home economy can foster and reduce trade deficit through exporting goods and services and increase FDI inflow in the domestic country (Goldberg, 2009). Moreover, Anarfo et al. (2019) defined financial inclusion as formal inclusion with two dimensions: supply and demand sides which consist of six factors. Additionally, based on the entire sample, Anarfo et al. (2019) have revealed that the previous year of the real effective ER is a minor positive determinant of FI.

From the prevailing literature, the one-way impact and direction are evident. Whereas, this research expects that the exchange rate's lag will be positively associated with FI and that there will be a positive bidirectional nexus between the two variables simultaneously. The statistical significance of the relationship will depend on the data. Financial inclusion promotes financial market participation and economic stability, which in turn has a positive effect on exchange rates by lowering currency volatility. Hence, it is anticipated that an increased amount of FI will lead to a positive impact on the ER and vice versa.

In the literature, a study addressing the association between exchange rates and financial inclusion is hardly available. Furthermore, especially in terms of developing and emerging countries, covering the direction of Granger causality, and demand-side and supply-side factors of FI, there is little research work in association with FI and ER.

It is significant and rationale to understand the impact of FI on ER fluctuations and the reverse. The negative impact of ER on FI can affect to access formal financial services for individuals from financial institutions. It might lead to domestic investment decision reduction leading to export reduction, decreasing FDI inflow, increasing unemployment and poverty, and finally negatively affecting economic growth. Conversely, if FI has a positive effect on the ER, which makes it easier and accessible for people to take decisions and access services, it may help to increase domestic investment, exports of goods and services, FDI inflow, employment, and economic growth. Financial inclusion and exclusion may depend on the ER. Intending to address this rationality, this study has formulated three research questions for instance, 'What are the patterns of exchange rate and financial inclusion over the years?', 'How financial inclusion and exchange rate are associated with each other?' and 'What policies might be recommended?'

In order to answer the aforementioned three research questions, this study attempts to empirically investigate an alluring problem statement considering the nexus between FI and ER in Bangladesh economy by using WB and IMF datasets for Bangladesh. Through this research, financial inclusion and exchange rate can help to increase FDI inflow and trade balance. This study may contribute to policymakers, businesses, and investors. Therefore, now it is important to know the association of ER and FI in Bangladesh's economy. The following sections illustrate materials and methods, empirical results, discussion as well as conclusion.

Materials and Method

Data source and study area: The authors have collected data from the Financial Access Survey (FAS) of the International Monetary Fund (IMF) and the World Development Indicator (WDI) of the World Bank (WB) covering the years 2004 to 2020. For this research, the authors have selected one country of south-Asia namely Bangladesh as the study area.

Study variables and measurement: ER is measured by local currency units relative to the US$ (Dollar) collected from the WDI of the WB (Anarfo et al., 2019; Maher, 2022; WB, 2022). FI consists of supply-side and demand-side factors whose data have been gathered from the FAS of the IMF (Anarfo et al., 2019; IMF, 2022). In addition, FDI is considered as net inflows (yearly percentage of GDP) taken from the WDI of the WB (Dutta et al., 2017). TO is calculated by the sum of exports and imports of goods and services considered as a percentage of GDP and its data source is the WDI of the WB (Omar and Inaba, 2020; Dutta et al., 2017).

Analytical strategy: For answering the research questions of the study aforementioned in the introduction part, some empirical tools and techniques are used. These analytical strategies should be used thoroughly for getting a better understanding for the research questions' answer. To illustrate the overall condition of financial inclusion of Bangladesh's economy, the authors apply PCA and the results finally reveal FI's condition of the country with the use of the normalization method whose range varies from zero i.e. it is less financial inclusion to one i.e. it is more financial inclusion. Furthermore, zero indicates the lower-end degree of the country of FI and one represents the upper-end degree of the country's FI (Le et al., 2019; Yorulmaz, 2018). Six criteria make up the FI index (Anarfo et al., 2019). Equation 1 shows how the index is specified:

$$FI = f(ATMSPHTA; BBPHTA; CBBPHTA; BAPHTA; BCBPHTA; DCBPHTA) \quad (1)$$

Here, six components of Financial Inclusion are enlisted as follows (Anarfo et al., 2019**):**

Supply side factors: ATMSPHTA stands for Automated Teller Machines Per Hundred Thousand Adults; BBPHTA stands for Bank Branches Per Hundred Thousand Adults; CBBPHTA stands for Commercial Bank Branches Per Hundred Thousand Adults;

Demand side factors: BAPHTA stands for Bank Accounts Per Hundred Thousand Adults; BCBPHTA stands for Borrowers from Commercial Banks Per Hundred Thousand Adults; DCBPHTA stands for Depositors with Commercial Banks Per Hundred Thousand Adults.

Mehry et al. (2021) applied the normalization method for formulating the Financial Inclusion Index (FII) which is outlined in equation 2:

$$Zi=(X-Xmin)/(Xmax-Xmin) \quad (2)$$

Where, X is the first value of the determined variable; Xmin is the minimum value of X variable; Xmax is the maximum value of X variable; Zi is the normalization indexing value of i country. In addition, this abovementioned method is also known as Min-Max normalized method. To analyze the pattern of exchange rate of Bangladesh economy over the last 17 years, the authors use line chart. This research mainly wants to see the nexus between FI and ER of Bangladesh economy. For the time series analysis, dynamic method is generally used. From these viewpoints, stationary test (unit root test), co-integration test, VECM, GCT, and diagnostic tests are formulated on the basis of literature. In the following sections, all are described sequentially.

Unit Root Test (URT): To examine the stationary, not changeable over the time period, and non-stationary, changeable over the time period, of the yearly time series data, unit root test is widely used. The significance of stationary test is vast because of executing statistical models and analysing time series data. There are several methods to check stationary of time, among them this study considers Augmented Dicky-Fuller test and Phillips-Perron unit test (Gujrati et al., 2009). Generally, to test for a unit root, there are three channels, for instance, Augmented Dicky-Fuller (ADF), Dickey-Fuller Generalized Least Squares (DF-GLS), and Phillips-Perron (PP) unit root test for the time series data.

Johnson Co-integration Rank Test (JCRT): The maximum likelihood method is used to determine if the model is co-integrated by the Johansen co-integration test, a multivariate extension that permits the model to contain more than one co-integration vector. The long-term connection of the dependent and independent variables is investigated by the co-integration test. If the variables are stationary at difference I(1) but not level I(0), the co-integration test is administered (Al-Masbhi & Du, 2021).

Vector Error Correction Model (VECM): To investigate the long run causality among the variables, the authors use VECM model. The study uses this VECM model to test long run causality among ER, FI, TO, and FDI. Granger (1988) narrated, most probably; causality may happen from error correction term (ECT) and lagged difference. However, if the authors want to analyze long term (run) causal relationship among time series variables of ER, FI, TO, and FDI, the following equation need to be estimated.

$$\Delta ER_t = \alpha_1 + \Sigma_{j=1}^{k-1}\alpha_{11}\Delta ER_{t-j} + \Sigma_{j=1}^{k-1}\alpha_{12}\Delta FI_{t-j} + \Sigma_{j=1}^{k-1}\alpha_{13}\Delta TO_{t-j} + \Sigma_{j=1}^{k-1}\alpha_{14}\Delta FDI_{t-j} + \lambda_1 ECT_{t-1} + e_t \ldots\ldots (3)$$

Here, all short forms of the above variables = defined in study variables and measurement section; K-1 = Optimal lag length is reduced by 1; $\boldsymbol{\lambda}_1$ = Speed of Adjusted Parameter with negative value; $\boldsymbol{\lambda}_1 EC_{t-1}$ = Error Correction Term contains long-run information derived from the long-run co-integrating relationship; e_t = Disturbances or residuals in the Equation.

Granger Causality Test (GCT): The existence of unidirectional/bidirectional causality between FI and ER is to be tested using the Granger causality. Following the completion of the co-integration test, the Granger causality test is performed to see if the availability of co-integration is due to its error correction model. As a result, if two variables are present and the trend remains normal, there is a causality minimum in one direction: bidirectional or unidirectional (Granger, 1988). This model contains the estimate of the provided regression equation (4) as well as the estimation of the supplied regression equation (5).

$$y_t = \beta_0 + \Sigma_{i=0}^{n} \alpha_i\, x_{t-i} + \Sigma_{j=0}^{n} \beta_j\, y_{t-i} + u_{1t} \ldots\ldots (4)$$

$$x_t = \delta_0 + \Sigma_{i=0}^{m} \lambda_i\, x_{t-i} + \Sigma_{j=0}^{m} \delta_j\, y_{t-i} + u_{2t} \ldots\ldots (5)$$

Where, equation (4), in the regression of y_t and variables $x_{(t)}$ (also including its lag values i.e., x_{t-i}) and other lagged values of y_t promotes the approximations of the dependent variable (y_t) significantly, then only it can be defined that x_t (Granger) causes y_t. In the other equation of (5) the same statement applies in the case y_t (Granger) causes x_t. In equation (4) the given hypothesis is tested on the dependence of F-statistics at a selected level of significance.

Where,

Null Hypothesis = = $H_0: x_{(t)}$ does not Granger cause $Y_{(t)}$;

Alternative Hypothesis == $H_1: x_{(t)}$ Granger causes$Y_{(t)}$.

Also in equation (5), the given hypothesis to examine the causality term:

Where,

Null Hypothesis = $H_0: Y_{(t)}$ does not Granger cause $x_{(t)}$;

Alternative hypothesis= $H_1: Y_{(t)}$Granger cause $x_{(t)}$.

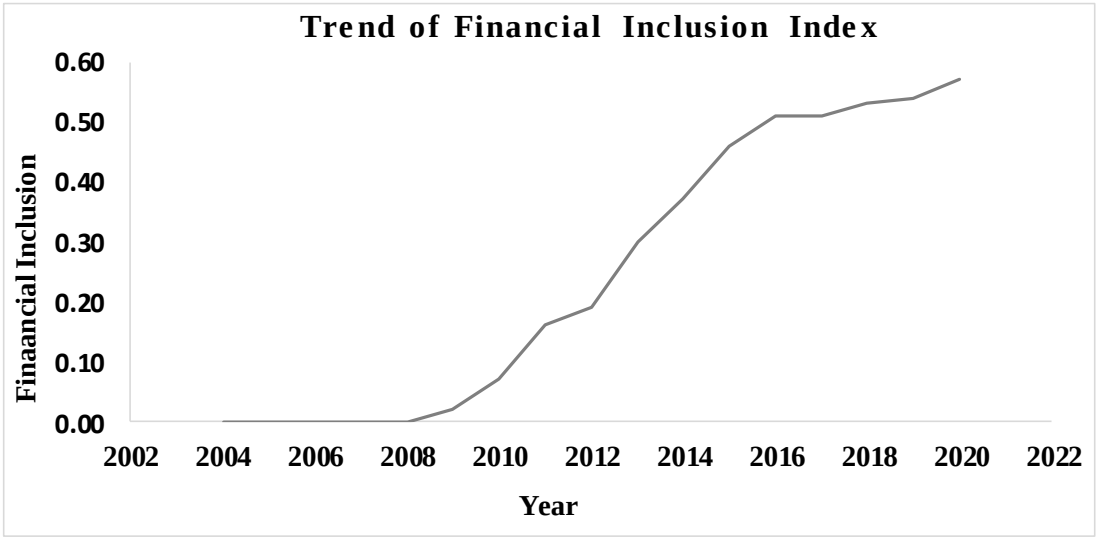
The variables such as ER, FI, TO, and FDI are considered simultaneously as $x_{(t)}$ and $Y_{(t)}$, and also, null hypothesis in equation (4) and (5) are applied against their similar alternative hypothesis (for details, Table 6).

Diagnostic checking/inspection: To be able to conduct the optimum regression approach, multicollinearity, heteroscedasticity, and autocorrelation should be validated before undertaking regression analysis. The Variance Inflation Factor (VIF) is used to check for multicollinearity, Brusch-Godfrey LM test are used to check for autocorrelation, and the White test must be used to check for heteroscedasticity. Before implementing the model, the ADF test, URT, stationary test, and co-integration test are examined. To assess the model's suitability, diagnostic tests including the heteroscedasticity, Jarque Bera, and Breusch-Godfrey tests are used.

Results

Overall condition of FI

From 2004 to 2020, the annual FI indexing value is displayed in Figure 1 as a line graph. The range of indexing value of financial inclusion is 0 to 1. Here, 0 means less financial inclusion or lower end scale of financial inclusion, and 1 means perfectly or fully top end degree of financial inclusion. From the Figure 1, it is clear that from 2004 to 2008, the indexing value of financial inclusion is perfectly zero which means, in those years, the economy stayed at lower financial inclusion. After that, from 2009 to 2016, the indexing value changed sharply. From 2009, the economy was going on upper end of financial inclusion up to 2020. In addition, from 2016 to 2017, the indexing value was unchanged. Then, after 2017, the inclusion indexing value increased progressively up to 2020. In conclusion, evident from the graphical line, the highest indexing value of financial inclusion was 0.57 in 2020 which indicate moderate level financial inclusion. On the contrary, the lowest indexing score of FI was 0.00 from 2004 to 2008. Finally, it can be commented on the line graph that the financial inclusion in the determined economy is improving from year to year over the last twelve years and also it shows a rising trend line which depicts increasing financial inclusion.



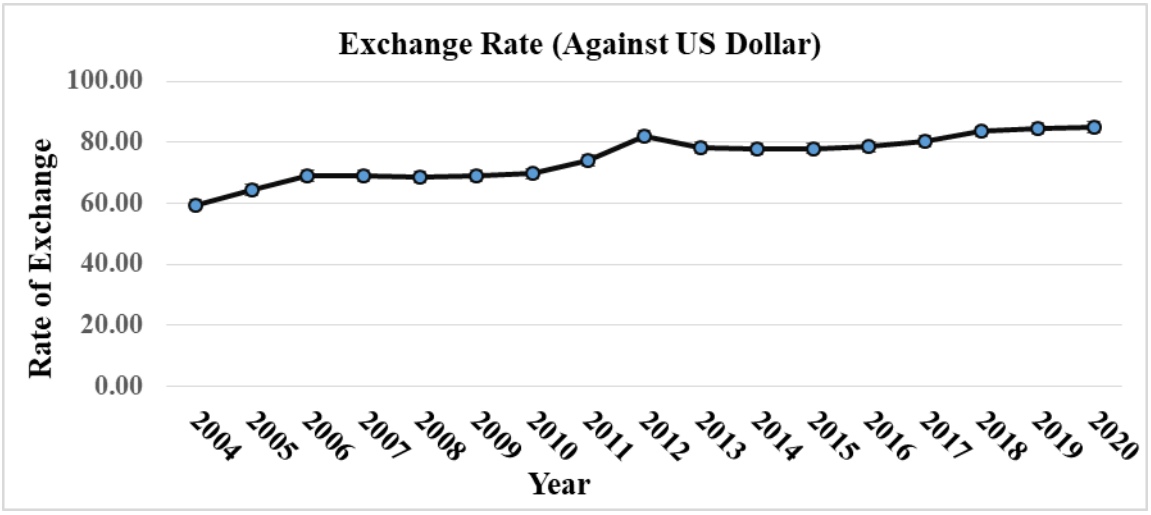
Source: Authors' Estimation Based on IMF (2022) Data

Figure 1. Performance of Financial Inclusion in Bangladesh

Overview of exchange rate

To get the pattern of exchange rate, a trend line is shown in Figure 2. The Figure demonstrates the pattern of the exchange rate of the Bangladesh economy from 2004 to 2020. Figure 2 gives information on the exchange rate. In 2004, the exchange rate was approximately 60.00 taka against a dollar. In 2005 and 2006, it increased slightly and reached about 70 taka against a dollar. The exchange rate remained almost unchanged up to 2010. In 2011, it arose a little and jumped to above 81 taka against a dollar in 2012. In 2013, it went down slightly and came below 80 taka. From 2013 to 2016, the exchange rate was almost the same. In 2017, it touched 80 taka against a dollar. From 2017

to 2020, it increased gradually and went near to 85 taka against a dollar. Nevertheless, as is illustrated by the graph, the lowest exchange rate was almost 60 in 2004 and the highest exchange rate was 85 taka in 2020 against per dollar. In conclusion, the exchange rate of the economy shows an upward trend from the beginning to ending year and in the middle year, it oscillated and remained static for some years. But, overall it demonstrates a pattern of increasing exchange rate over the period of time.

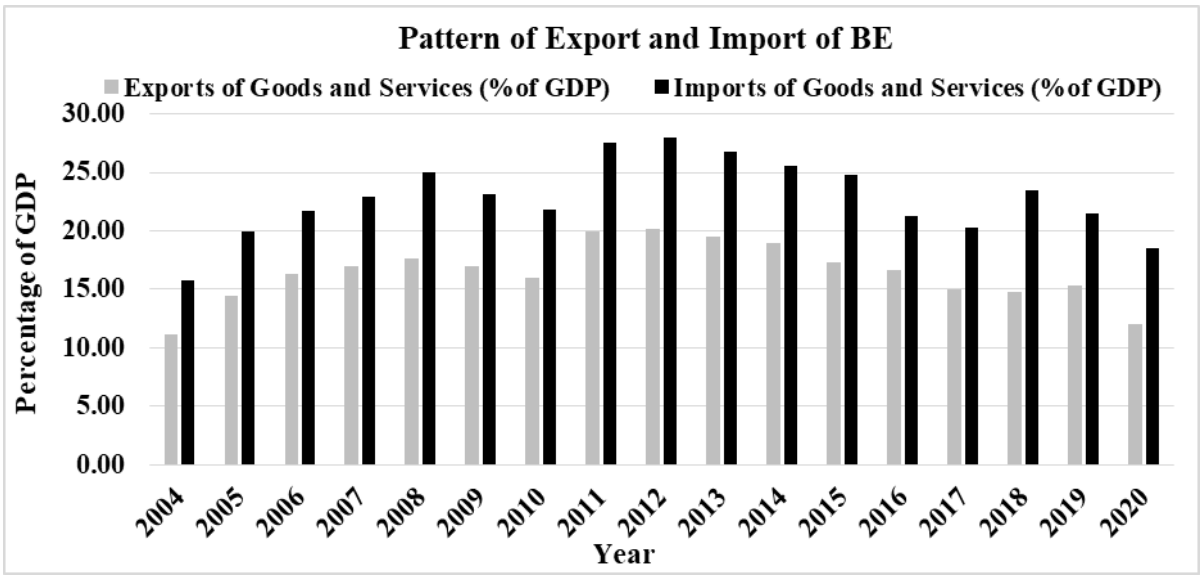


Source: Authors' Calculation Based on WB (2022) Data

Figure 2. Pattern of Exchange Rate of Bangladesh Economy over the Years

Overview of export and import (TO)

The pattern of TO of the Bangladesh economy is exhibited in Figure 3 considering the years from 2004 to 2020. Figure 3 depicts the trend of export and import (Trade Openness). As is seen on the graph in every year, exports of goods and services in the context of the percentage of GDP are lower than imports of goods and services in the context of the percentage of GDP. Therefore, the concerned economy is an import-oriented country and shows a trade imbalance. In terms of trade openness, it is the combination of export and import. From 2004 to 2020, the economy of Bangladesh always imports more than exported. Because of more import of luxuries, raw materials and capital-intensive goods by the government of Bangladesh and limited export of goods, this economy always stays in deficit trade (trade imbalance). Therefore, the policy makers have to think in this regard to diversify exported goods and services as well as to motivate Bangladeshi investors to produce goods which are imported and also institutions must focus on making skilled technicians and labors. That means; concerned policy makers must prioritize national and international investors to produce import substitution goods and services instead of imports these, and have to give them securities and facilities.

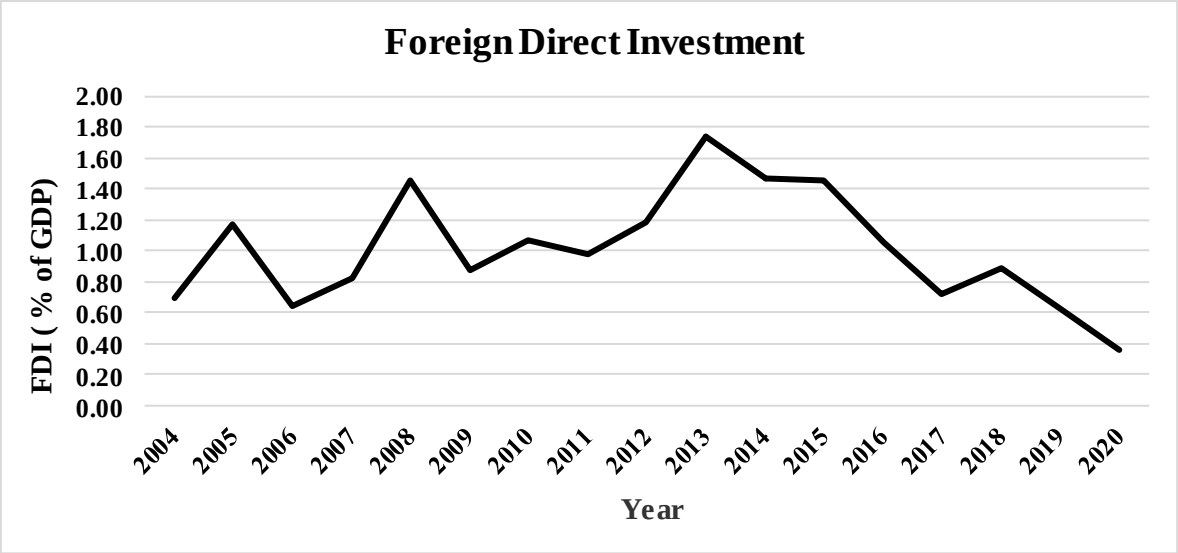


Source: Authors' Estimation Based on WB (2022) Data

Figure 3. Pattern of Export and Import of Bangladesh Economy (BE)

Overview of foreign direct investment in Bangladesh

Figure 4 illustrates the performance of FDI in the economy of Bangladesh from 2004 to 2020. Figure 4 explains FDI based on the percentage of GDP in terms of the Bangladesh economy. In 2004, the FDI was 0.69 percent. It increased radically in 2005 and reached 1.17 percent. Then it plummeted to 0.64 percent in 2006. It increased slightly in 2007 and came to 0.82 percent. In 2008, it jumped dramatically and arrived at 1.45 percent. Again, it fell radically and came to 0.88 percent in 2009. From 2009 to 2012, it fluctuated and it was 1.9 percent in 2012. There was a dramatic rise in FDI in 2013. The FDI reached its peak and was 1.74 percent in 2013. In 2014, FDI went down by 0.27 percent and remained almost constant in 2015. From 2016 to 2020, it decreased rapidly from 1.05 percent to 0.35 percent with a slight rise in 2018. However, it is clearly evident from the chart that the highest FDI was 1.74 percent in 2013 and the lowest FDI was 0.35 percent in 2020. The difference between the highest and lowest FDI was 1.39 percent of GDP. To conclude, from the starting year to the terminating year, the graph has shown a trend of decreasing FDI in this economy.



Source: Authors' Calculation Based on WB (2022) Data

Figure 4. Performance of Foreign Direct Investment in Bangladesh

Summary statistics of study variables

Table 1 contains the descriptive statistics of Official ER (USD), Exports, Imports, TO, FDI, FI, and FII.

Table 1. Summary Statistics of Macroeconomic Indicators

Variable with Unit of Measurement	Mean	Std. Dev.	Min	Max
Official Exchange Rate (Against Per USD)	74.73	7.53	59.51	84.87
Exports of Goods and Services (% of GDP)	16.43	2.54	11.15	20.16
Imports of Goods and Services (% of GDP)	22.81	3.26	15.71	27.95
Trade Openness (% of GDP)	39.24	5.73	26.86	48.11
Foreign Direct Investment (% of GDP)	1.02	0.37	0.35	1.74
Financial Inclusion	-0.01	2.17	-3.00	3.38
Financial Inclusion Index	0.25	0.24	0.00	0.57

Source: Authors' Calculation Based on WB and IMF (2022) Data

Note: *Std. Dev., Min, and Max stand for Standard Deviation, Minimum, and Maximum respectively.*

Table 1 represents the overall condition of the selected variables from 2004 to 2020. The table shows that the mean of the exchange rate of 2004-2020 is 74.73 taka and the standard deviation, minimum, and maximum of ER are 7.53 taka, 59.51 taka and 84.87 taka respectively against one dollar calculated on the basis of total 17 years. Besides, the mean, standard deviation, minimum, and maximum of exports and imports are 16.43 percent, 2.54 percent,11.15 percent, 20.16 percent, and 22.81 percent, 3.26 percent, 15.71 percent, and 27.95 percent of GDP sequentially. Here, it is important to clarify the TO. That means that the summation of the export and import of goods and services is trade openness. Its mean, standard deviation, minimum, and maximum value are 39.24 percent, 5.73 percent, 26.86 percent, and 48.11 percent of GDP corresponding. In addition, the mean, standard deviation, minimum, and maximum of foreign direct investment (% of GDP) are 1.02 percent, 0.37 percent, 0.35 percent, and 1.74 percent individually. On the other hand, the mean, standard deviation, minimum, and maximum value of financial inclusion and financial inclusion indexing value are -0.01, 2.17,-3.00, and 3.38 for per hundred thousand adults and 0.25, 0.24, 0.00, and 0.57. The country exists in financial inclusion on the basis of the average value estimated according to out of seventy years from 2004 to 2020.

Description of Unit Root Tests

The outcomes of Table 2's URT of ER, TO, FDI, and FI with and without intercept and time trend on the level series show that researchers accept the null hypothesis at a level of 5% because the absolute value of test statistics for time series variables is less than the 5% critical value, for example, ER, TO, FDI, and FI are all less than 5% and they are non-stationary. Conversely, the outcomes of the concerned variables on the first difference series indicate that the researchers cannot reject the alternative hypothesis at the 5% level because the time series variables ER, TO, FDI, and FI are stationary at the first differential form and their absolute values of test statistics exceed the 5% critical value. As a result, the researchers come to the conclusion that ER, TO, FDI, and FI are integrated with order one, i.e. I(1).

Table 2. Results of ADF Test and Others for Unit Root Tests

Variable Name	Without Dirft and Trend	With Drift and Trend	With Drift and Without Trend	DC, LS
ER	1.34	-3.48	-1.13	I(0)
ΔER	-3.02***	-3.61**	-3.82***	I(1)
TO	-0.52	-1.36	-1.32	I(0)
ΔTO	-2.85***	-3.88**	-2.66**	I(1)
FDI	-0.84	-0.899	-1.03	I(0)
ΔFDI	-3.23***	-3.98***	-3.12 ***	I(1)
FI	-0.57	-2.01	0.17	I(0)
ΔFI	-0.31	-3.06	-3.32***	I(1)
ΔFI	-2.15 ** based on DF-GLS Test		I(1)	
ΔFI	-20.09*** bssed on PP Test			I(1)

Source: Authors' Estimation Based on WB and IMF (2022) Data

Notes: *All variables are in general value. *, **, and *** denote significance at the 10 percent level, at the 5 percent level, and at the 1 percent level. I(0) and I(1) denote the integrated order for the time series data. DC stands for Decision Criteria and LC stands for Lag Selection.*

The results of the ADF test are represented in Table 2, and none of the variables within them attain stationary at their level form. This indicates that the absolute values are below the critical value of 5% in their level form. According to this stance, the authors accept the null hypothesis while rejecting the alternative. These time series variables are non-stationary at the level form as a result. Therefore, they are not integrated at order zero, for instance, I(0) because p-values are not significant for each variable in the level form (MacKinnon, 1996). However, the mentioned test is applied further to their first differences and their outcomes are also summarized in Table 2. The results show that these time series variables are stationary at the five percent significant level. These results are applicable for all concerned time series variables except FI on the perspective of ADF test. Here, with drift and trend of FI are not significant in ADF test but it shows significance in PP unit root test in the first difference indicating stationary. In addition, DF-GLS is applied to check stationary and also robustness of the FI represented in the above table. Therefore, it can be said that time variables are not stationary in level series that the authors justified in the above table for the four variables being applicable. But, in first difference series, the four variables are stationary and the authors accept the alternative hypothesis. Thus, the concerned four variables are first-ordered integrated shown as like I(1) in the mentioned table and subject to JCT, unrestricted co-integration rank test.

Outcome of Co-integration Test

The cointegration test must be carried out since it is determined that the four variables under consideration are integrated in the first order, which shows that there is a long-run or equilibrium link between them. The authors use JCT to determine the order of cointegration. The results of the Johansen cointegration test's equations, trace statistics and maximum statistics, or eigenvalue, are reported in Tables 3 and 4.

When a 90 percent confidence interval is used, the interval range is widened, which improves the likelihood that the null hypothesis is accepted. It is advised to use 95 or 99 percent confidence level. For this, the 95 percent confidence interval is used by the authors to test the hypothesis which is appropriate. The null hypothesis (r=0) of no co-integrating vectors in the relevant four time variables is likely to be rejected since the value of the trace statistics ($\boldsymbol{\lambda}_{\text{trace}}$) $(0)^2$ is 77.59, which exceeds the trace statistics' 5 percent critical value. In the second instance of trace statistics ($\boldsymbol{\lambda}_{\text{trace}}$), $(1)^3$ indicating the third eigenvalue, the authors compare the alternative hypothesis of two co-integrating vectors (r = 2) with the null hypothesis ($r \leq 1$).

Table 3. Trace Statistics

Null Hypothesis	Alternative Hypothesis	Trace Statistics ($\boldsymbol{\lambda}_{trace}$)	5%CV
r = 0	**r = 1**	77.59***	47.21
r ≤ 1	**r = 2**	30.94***	29.68
r ≤ 2	**r = 3**	9.64	15.41
r ≤ 3	**r = 4**	0.02	3.76
r ≤ 4	**r = 5**	-------	------

Source: Authors' Estimation Based on WB and IMF (2022) Data

Notes: *r represents the co-integration vector. *** shows the rejection of the null hypothesis at a one percent level. CV stands for Critical Value.*

The null hypothesis cannot be accepted since the ($\boldsymbol{\lambda}_{trace}$) statistics 30.94 exceeds the crucial value at the 95 percent confidence range. The authors compare the alternative hypothesis (r = 3) of two co-integrating vectors to the null hypothesis (r≤2) in the third case of trace statistics ($\boldsymbol{\lambda}_{trace}$), (2) representing two co-integrating vectors. The alternative hypothesis can be ruled out because the ($\boldsymbol{\lambda}_{trace}$) statistics 9.64 is less than the critical value at a 95 percent confidence range. In the fourth instance of trace statistics ($\boldsymbol{\lambda}_{trace}$), (3) representing three co-integrating vectors, the authors compare the alternative hypothesis of two co-integrating vectors (r = 4) to the null hypothesis (r ≤3). It is possible to accept the null hypothesis because the ($\boldsymbol{\lambda}_{trace}$) statistics' 0.02 value is lower than the crucial value at a 95% confidence interval. Trace statistics at the 95 percent confidence level clearly confirm no more than two co-integrating vectors from the perspective of the above results based on Table 3.

Table 4. Maximum Eigen Value

Null Hypothesis	Alternative Hypothesis	Max Statistics ($\boldsymbol{\lambda}_{max}$)	5% CV
r = 0	**r = 1**	46.65***	27.07
r ≤ 1	**r = 2**	21.30***	20.97
r ≤ 2	**r = 3**	9.62	14.07
r ≤ 3	**r = 4**	0.02	3.76
r ≤ 4	**r = 5**	-------	-------

Source: Authors' Estimation Based on WB and IMF (2022) Data

Notes: *r represents the co-integration vector. *** shows the acceptance of the alternative hypothesis at a one percent level. Max denotes maximum. CV stands for Critical Value.*

The greatest eigenvalue result in the Table 4 shows that the null hypothesis that there is no co-integrating vector (r = 0) is clearly rejected in favor of the particular alternative hypothesis. From the viewpoint of outcomes, in the same way it is clear that at the 95 percent confidence level, max statistics verifies no more than two co-integrating vectors. Therefore, it becomes clear that the time series variables, which are ER, TO, FDI, and FI, contain two co-integration vectors from the perspectives of trace statistics and maximum eigenvalue or statistics.

Outcome of VECM

Since the JCT reveals that there are two co-integrated equations of the time data of ER, TO, FDI, and FI, which means that they show long-term associations among them, the unconstrained co-integration rank test has also disclosed this. The VECM approach is vital for establishing and supporting associations with them, and it has also demonstrated a long-term relationship. As a result, the predicted VECM performs well, and the results of the model are shown in Table 5.

Table 5. Outcome of VECM

Variable Name	Co-efficient	Standard Error	Z	P>|Z|
ER	1.00	----------	------	-----
TO	0.17	0.05	2.96	0.00
FDI	-2.15	0.84	-2.55	0.01
FI	-3.33	0.08	-40.18	0.00
_cons	-78.90	----------	-------	-----
ECT	-0.82	0.26	-3.12	0.00

Source: Authors' Estimation Based on WB and IMF (2022) Data

Understanding the significance of the variable's coefficient sign is crucial. In the VECM analysis, a variable's negative coefficient denotes a positive result, while a variable's positive coefficient denotes a negative result. ER is

the model's dependent/ outcome variable, while TO, FDI, and FI are independent/explanatory variables incorporated in Table 5. The first variable's (TO) coeffient is 0.17, indicating that TO has a strong long-run negative impact on ER at one percent significant level. Additionally, the ER is strongly and positively influenced over the long term by the other two variables FDI and FI, whose coefficients are 2.15 and -3.33 respectively. These two variables have significant levels of 5% and 1%, respectively. Therefore, the authors come to the conclusion that FDI and FI show a long-term influence on ER of Bangladesh economy but the consequences of TO have a long-term negative impact. At the 5% and 1% levels, each result is statistically significant. Long-term adjustment speed is adequately represented by the ECT coefficient with 1% level.

Outcome of GCT

The results of the GCT test are presented in Table 6.

Table 6. Outcomes of GCT

Null Hypothesis (NH)	Alternative Hypothesis (AH)	Decision on NH	F Statistics	Indication of Direction (Causality)
ER does not Granger cause TO.	ER Granger causes TO.	Rejected	3.80*	ER↔TO
TO does not Granger cause ER.	TO Granger causes ER.	Rejected	6.48**	
ER does not Granger cause FDI.	ER Granger causes FDI.	Not Rejected	0.39	-------
FDI does not Granger cause ER.	FDI Granger causes ER.	Not Rejected	0.08	
ER does not Granger cause FI.	ER Granger causes FI.	Rejected	13.99***	ER↔FI
FI does not Granger cause ER.	FI Granger causes ER.	Rejected	9.14**	
TO does not Granger cause FDI.	TO Granger causes FDI.	Not Rejected	1.08	
FDI does not Granger cause TO.	FDI Granger causes TO.	Rejected	8.99**	FDI⟶TO
TO does not Granger cause FI.	TO Granger causes FI.	Rejected	6.55**	TO↔FI
FI does not Granger cause TO.	FI Granger causes TO.	Rejected	6.80**	
FDI does not Granger cause FI.	FDI Granger causes FI.	Not Rejected	1.52	-------
FI does not Granger cause FDI.	FI Granger causes FDI.	Not Rejected	0.31	

Source: Authors' Estimation Based on WB and IMF (2022) Data

***Note:** *, **, and *** denote significance at the 10 percent level, at the 5 percent level, and at the 1 percent level.*

Table 6 contains the outcomes of Granger Causality using the previously computed stable value of the VECM with two lags. The outcomes ensure the existence of a causal association among the selected variables in both unidirectional and bidirectional forms. Based on the Table 6, the first hypothesis is that ER does not Granger cause TO and this has not been accepted at 10 percent level of significance.

At a 10% level of significance between ER and TO, the alternative hypothesis can be adopted. Besides, the null hypothesis, which is that TO does not Granger induce ER, can be rejected at a 5 percent significant level. The computed F-value is statistically significant, and the results of ER and TO have bidirectional causality, for example, from ER to TO and TO to ER. This indicates that the results demonstrate that Granger induces both ER and TO (ER↔TO).

The second one is that the causal relationship between ER and FDI and the results show that they have no causal association which means ER does not Granger cause FDI and FDI does not Granger cause ER. Hence, they are statistically insignificant and they do not have any unidirectional or bidirectional association.

The next finding is that ER Granger causes FI, which is statistically significant at 1 percent level, and FI Granger causes ER, which shows significant at a 5 percent level. That means they have bidirectional association (ER↔FI).

The next alternative hypothesis is that TO Granger causes FDI that is insignificant but the reverse shows that an FDI Granger cause TO that is significant at a 5 percent level. That means, only a unidirectional form (FDI ⟶TO) exists in them.

The prior hypothesis of the last one, which is not accepted at the 5% level of significance, is that TO does not Granger induce FI. The alternative hypothesis can be accepted if there is a 5% level of significance between TO and FI. Additionally, at a significance level of 5%, the null hypothesis that FI does not Granger produce TO that can be rejected. The findings demonstrate that there is a bidirectional causal relationship between FI and TO

because obtained F-value is statistically significant. This means that the findings show Granger to cause in both FI and TO (TO↔FI).

The final one is that they have no causal association which means FDI does not Granger cause FI and FI does not Granger cause FDI. Hence, they are statistically insignificant and they have no unidirectional and bidirectional association.

Therefore, it is clear that ER and TO, ER and FI, and TO and FI have bidirectional associations which reveal that they cause each other, for instance, ER↔TO, ER↔FI and TO↔FI. On the other hand, FDI and TO have unidirectional relationship which indicates that TO is caused by FDI (FDI →TO). Besides, ER and FDI, and FI and FDI have no association revealed.

Outcome of diagnostic tests

These obtained results, which incorporate the JCT and VECM mechanisms, recognize two co-interacting vectors and a long-term relationship in the time variables. The VECM result is thus determined to be stable or not shown by applying these tests.

Table 7-A. Diagnostic Tests of VECM

		ΔER	**ΔTO**	**ΔFDI**	**ΔFI**
Adjusted R^2		0.752	0.160	0.612	0.881
Serial Residual Correlation Test for the Model					
Null Hypothesis, H_0 : No Serial Correlation					
Alternative Hypothesis, H_1 : Serial Correlation					
LM (1), x^2 =24.407, p-value =0.081					
LM (2), x^2 =14.754, p-value =0.542					
Normality Test for the Model					
Null Hypothesis, H_0: Residuals are multivariate normal.					
Alternative Hypothesis, H_1: Residuals are not multivariate normal.					
Skewness	x^2 =4.653			p-value =0.324	
Kurtosis	x^2 =0.513			p-value =0.972	
Jarque-Bera	x^2 = 5.166			p-value =0.739	

Source: Authors' Calculation Based on WB and IMF (2022) Data

According to Stata, the authors reject the null hypothesis if the P-value is less than the significant level of 1 and 5 percent. Table 7-A demonstrates that the p values exceed the significant threshold of five percent. Because the model does not exhibit problems with heteroscedasticity, the authors accept the null hypothesis. The p-value for the Jarque-Bera test, which is 0.739, is greater than the significant five percent, indicating that all residuals are normally distributed. Serial correlation, which does not exist in this model, is also explained by the Breusch Godfrey test and Lagrange Multiplier (LM) test.

From Table 7 (A-F) and Figure 5, the results show that the datasets are free from all diagnostic problems namely, multicollinearity, heteroscedasticity, and autocorrelation. Therefore, the study results are accurate. In short, the diagnostic inspections applied by the authors imply that all results are legitimate and accurate.

Table 7-B. Result of Brusch-Godfrey LM test for Autocorrelation

H0:	No Serial Correlation		
H1:	Serial Correlation		
1	0.202	1	0.6529
2	0.626	2	0.7313

Source: Authors' Calculation Based on IMF and WB Data (2022)

Table 7-C.Result of White's Test for Homoscedasticity

H0:	Homoscedasticity		
H1:	Unrestricted Heteroscedasticity		
		13.83	0.1285

Source: Authors' Calculation Based on IMF and WB Data (2022)

Table 7-D. Result of Breusch-Pagan / Cook-Weisberg test for Heteroskedasticity

H0:	Constant variance		
H1:	Not Constant/ Unequal variance		
		0.00	0.9802

Source: Authors' Calculation Based on IMF and WB Data (2022)

Table 7 –E. Result of Cameron & Trivedi's decomposition of IM-Test

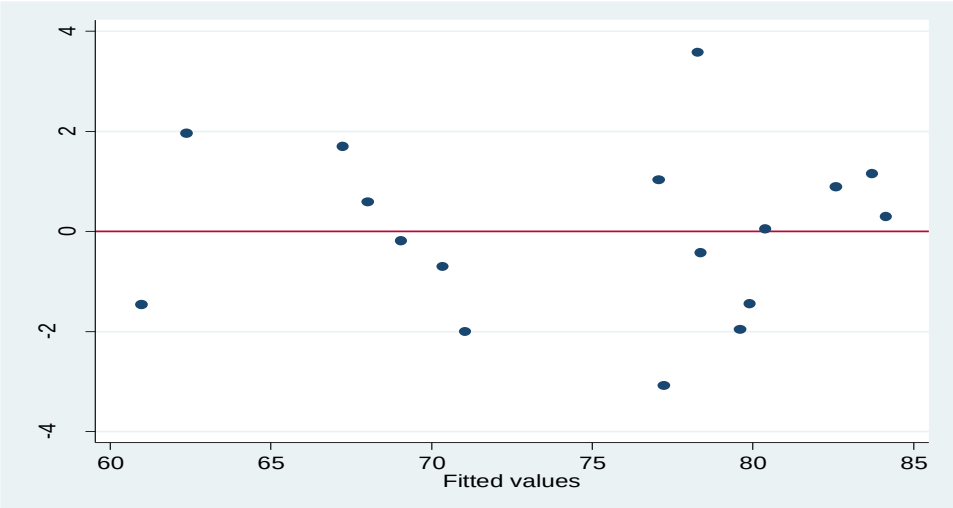
Heteroskedasticity	13.83	9.00	0.12
Skewness	0.61	3.00	0.89
Kurtosis	0.29	1.00	0.59
Total	14.73	13.00	0.32

Source: Authors' Calculation Based on IMF and WB Data (2022)

Table 7-F.Outcomes of VIF: Multicollinearity

FDI	1.92	0.52
TO	1.89	0.52
FII	1.04	0.96
Mean VIF	1.62	

Source: Authors' Calculation Based on IMF and WB Data (2022)



Source: Exhibition Based on IMF and WB Data (2022)

Figure 5.Homoscedasticity

Discussion

This part deals with a discussion on the present study related to the other empirical literature. FI, defined by the two indicators with seven factors, for instance, access indicators: and usage indicators which indicate the increasing trend of the FI index over the years of 2000 to 2017, the result is calculated by applying PCA, which is consistent with the implementation of several programs to increase the involvement of all sectors of Egyptian society throughout the institutional financial system (Elsherif, 2019). Moreover, there are several studies concluded in the same direction (Nguyen et al., 2020) that FI increases over the years throughout the world (Mehry et al., 2021; Tram et al., 2021).

From the perspective of the authors' study, the trend of inclusion index value calculated by using PCA and the normalization method also demonstrates a rising trend over the years of 2004 to 2020. Elsherif (2019) used ADF for the URT. The result shows that almost all the series are unstable at their levels. The ADF test indicates that one variable is stable at its level form while the rest remain unstable. Hence, all the series are expressed at first differencing to attain a trend stable level. The result, therefore, suggests that the series are integrated to order 1, shown as I(1). The application of the presence of a unit root indicating non-stationary meaning that the mean, variance, and covariance are different is the likelihood that a series will be consistently affected by outside shocks and disturbances on the variables, which, if unchecked, could produce a spurious/nonsensical/over-fitted result. On the other hand, the authors' study is not exceptional to the previous results of the URT. Therefore, all series are integrated with the first order, represented as I(1). That means that all variables are stationary and the results of the study are far from spurious regression.

In the course of JCT, Elsherif (2019) used it not to uncheck for the existence of cointegrating relationships among the concerned variables. The result shows that Johansen test ensures that there is more than one cointegration vector (Trace test indicates cointegrating equation (s) at the 0.05 level and Max-eigenvalue test indicates cointegrating equation (s) at the 0.05 level) among the determined variables and it suggests that the existence of one (or more) long-run associations within the set variables as well as the authors' result shows that there are two cointegrating vectors considering the significant level at the 5% among four variables and they have long run association among the set of variables.

In the context of VECM, the calculation of the VECM applies; both short-term variations in the variables and departures from long-term equilibrium (Elsherif, 2019) must be adjusted in this process. It explains the effects of FI, ER, interest rate, and money supply on inflation in order to comprehend the VECM results, which are used for effective and sound monetary policy (Elsherif, 2019). From the viewpoint of the authors' study, the outcomes of VECM are slightly different because the set of variables is not the same. But, the impact of FI on macro-variable has exposed the existence of long-run relationships.

The efficiency of monetary policy and FI are causally linked in both directions, according to the GCT. The p-value is less than 5% in both directions. In a nutshell, the empirical findings show that, over time, financial inclusion and monetary policy efficacy are related by a series of long-run correlations. Exchange rate shocks, on the other hand, have a positive and statistically significant long-term influence on the degree of monetary policy effectiveness.

In addition, in the dimension of the authors' study, ER and TO have a positive long-run bidirectional association. Moreover, ER and FI, and TO and FI show the same association of ER and TO. There is positive and negative relationship between trade openness (TO) and exchange rate (ER) in terms of short run and long run with statistical significance that can be unidirectional, bidirectional, and no relationship. A study of 101 countries found that TO has a statistically significant negative influence on the ER (Gantman & Dabos, 2018) and this negative impact is consistent with authors' study and the bidirectional association between them has been found in authors' study. Besides, some literatures have found that long-term effects of TO on ER are favorable but it has a negative short-run impact, and the impact of TO is weaker under a floating ER regime (Zakaria & Ghauri, 2011; Yusoff & Febrina, 2014).

Furthermore, ER and FDI have a complex relationship between them. A positive exchange rate refers to a weaker exchange rate for the domestic country helping to lead the increase of the FDI inflow because of getting goods and services along with assets cheaper and affordable from home country in comparisons with other countries for the international investors. In the literature, some studies have found that they have positive association. Goldberg (2009) has revealed that a weaker exchange rate leads positively FDI, as it makes home

country's assets cheaper and reasonable for outside investors and it can attract to increased FDI and other factors influence more FDI for instance, the political condition, skilled labor, fiscal policy as well as economic stability (Lily et al., 2014). This positive impact of FDI on ER is similar direction, consistent, and aligned with authors' study. On the other hand, Zhang & Zhang (2018) has illustrated that a stronger exchange rate helps to decrease carbon emissions because of decreasing FDI inflow and there exits negative relationship between ER and FDI.

Additionally, there exists a unidirectional (Liargovas & Skandalis, 2012) and positive relationship between FDI and TO (Biglaiser & DeRouen 2006) in the long run (Chakrabarti, 2001). There is a direct causality and positive association between FDI, and TO (Seyoum et al., 2015). Thus, TO helps positively to the increasing FDI in developing countries (Liargovas & Skandalis, 2012). In addition, Goldberg and Klein (1999) suggested that foreign direct investment affects trade openness. Whereas, Seim (2009) uncovered that a negative association between FDI inflows and TO exists. Conversely, the association between TO and FDI inflows differs and explains complex explanations depending on the country's case. Theoretically and empirically, the impact of TO on the FDI (Markusen & Maskus 2002) differs based on involving in FDI inflow activities (Dunning 1994). From the discussion, the authors' study reveals the same almost that they have positive association. In accordance with Hajilee & Niroomand (2019), FI plays an important role in the short run. The effect of it on the trade openness exists in many developing countries. On the other hand, the authors find that TO and FI have long run association. FDI significantly and positively affect exchange rate and a long-run relationship (Zakaria & Ghauri, 2011) exists between them. The same conclusion is evident in the author's study. Gantman & Dabos (2018) found that an upward in TO shows a depreciation of the real ER. It was conducted with some developing economies (Yusoff & Febrina, 2014). The authors' result reveals the same. Contrarily, a study shows a significant positive effect of TO on ER (Zakaria & Ghauri, 2011). Therefore, the association between ER and TO shows empirically mixed. Nevertheless, other empirical studies did not find any relationship between ER and TO (Elbadawi & Soto, 1994).

In Sub-Saharan Africa, the real effective ER has a substantial impact (Anarfo et al., 2019) on interest and inflation rates. The negative ER co-efficient in the panel VAR model has demonstrated this. It means that when the REER rises, the interest rate in Sub-Saharan Africa falls. There has been evidence of a negative association between monetary policy (Lenka & Bairwa, 2016) and the real effective ER (Anarfo et al., 2019). In addition, Anarfo et al. (2019) have shown that the FI index and the ER variables that are integrated of first order, I(1) as well as the author's study shows that the ER and the FI, which are integrated of order one symbolically demonstrated as I(1).

In addition, Anarfo et al. (2019) have disclosed that the lag of the real ER rate is a minor positive determinant of FI based on the large sample. And, the authors' study reveals the lag of the ER is positively associated with financial inclusion and they have a positive bi-directional association and this outcome is statistically significant. On the other hand, factors of macroeconomics are important drivers of the FI index in the sub-Saharan African sample. The real effective ER lag and the FI index are both important factors and also the lag of FI index FINDEX are drivers of the real effective (Anarfo et al., 2019) exchange rate in sub-Saharan Africa that shows the negative short-run bi-directional relationship and viewed from a 1% level, it is statistically significant. But the authors' study exposes the opposite of it that the lag ER and the lag FI have a positive long-run bi-directional association with each other and its relationship is statically significant at 1% and 5% level.

Conclusion

This paper's primary goal is to empirically investigate an alluring problem statement considering the nexus between FI and ER. The authors have garnered data from secondary source namely the FAS of the IMF and the WDI of the WB covering the years 2004 to 2020. Using time series yearly data with the aim of getting balanced data, the authors have applied some tests for example Augmented Dicky Fuller test, DF-GLS test as well as Phillips-Perron test commonly and formally known as unit root test for assessing stationary, Johanson Co-integration inspection for understanding long run nexus among variables, VECM and GCT to finally address the core objective of the study. For getting FI value, the researchers have applied Principal Component Analysis (PCA). The diagnostic results of PCA show that the overall KMO and Alpha values are 0.74 and 0.93 respectively meaning that the FI score is applicable for the data analysis.

The study has revealed that each and every variable is stationary and also all series are integrated at the first-order difference, I(1), and long-term relationships exist among the variables with two co-integrated vectors and the

maximum lag value is two in accordance with AIC and BIC criteria. The analysis result of Exchange Rate (ER) and FI shows a rising pattern over the years. In addition, the outcomes of the VECM diagnostic test disclose that the interpreted results are free from the problems of heteroscedasticity and auto-correlation.

Furthermore, in order to address the aim of the study, the outcomes of GCT have demonstrated bi-variate, uni-variate, and no causality. From the GCT outcomes, Exchange Rate (ER) and Trade Openness (TO), ER and FI, and TO and FI have bidirectional associations that expose that they cause each other, for instance, ER↔TO, ER↔FI, and TO↔FI. On the contrary, FDI and TO have a unidirectional relationship which implies that FDI causes TO (FDI ⟶TO). Moreover, the authors did not get any relationship between ER and FDI, and FI and FDI.

According to the study findings, a long-term positive bidirectional nexus exists between exchange rate and financial inclusion, which implies that both factors affect each other because of increasing transaction demand for money over the periods. When financial inclusion increases, the devaluation of home currency also increases. By affecting the demand and supply of foreign currency, financial inclusion can affect exchange rates. As more people and companies conduct cross-border business or invest in foreign markets, for instance, a higher level of FI may result in an increase in the demand for foreign currency. As a result, there may be pressure on the local currency, which could cause the ER to depreciate. The demand for foreign currency may be constrained and the local currency's susceptibility to outside shocks or speculation may be diminished, additionally, if FI is less widespread.

Promoting inclusive financial systems, enhancing access to banking services, promoting financial literacy, and fostering economic stability are some of the policy implications for the connection between FI and ER. The recommendation of this paper may increase the involvement of people and companies with formal financial institutions. Side by side, our policymakers can take into consideration promoting financial inclusion for the increase in exports of goods and produce import substitution goods to maintain trade balance through giving government support and facilities to make and foster businesses for the national and international investors.

The main limitation of this study is the difficulty to get balanced data before 2004 and after 2020 of financial inclusion for the country. The other shortcomings are that some variables for instance economic growth, real interest rate, money supply, and so on, can be included to associate with exchange rate and financial inclusion but they have not complied with the model's requirements in this study. However, this study may help to make macroeconomic policy to reduce economic instability via enhancing financial inclusion for the expansion of exports to maintain trade balance for the concerned economy.

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Conflict of Interest

The authors declare no conflicts of interest.

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