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The Effect of Exchange Rate Fluctuations on Egyptian International Business Transactions: An Empirical Analysis

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ABSTRACT

This study examines the impact of exchange rate fluctuations on international business transactions in Egypt from 2005 to 2022. Using pooled and fixed effects models, the research analyses the relationship between exchange rates, inflation, GDP, and export volumes. Key findings include a statistically significant positive relationship between exchange rate fluctuations and international business transactions, with fixed effect models revealing that the exchange rate, inflation rate, and GDP significantly affect export volume at a 99% confidence level. Exchange rates account for a large proportion of export volume changes, with adjusted R-squared values between 0.66 and 0.75. These results underscore the importance of exchange rate stability for international trade in Egypt. The study contributes to the literature by providing empirical evidence from a developing economy context, offering insights for policymakers and businesses on risk management and strategic decision-making in international trade.

Keywords: Foreign direct investment, International Business Transactions, Exchange rate

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1. Introduction

In the realm of international business, exchange rate changes can be regarded as one of the key elements that bring about a certain change of attitude in trading across borders and the outcomes they give. The disparities in value of different currencies result in repercussions concerning managers in the strategic choices that they make, competitiveness, and profitability in the markets where multinationals operate. Years 2017–2022, among others, were full of economic downfalls and challenging political situations in that the financial environment of Egypt was heavily affected by all the crises (Lal et al. 2023). Besides the foreign direct investment (FDI) liberalisation and restriction measures, the country seeks to employ market-oriented policies that would help liberate itself to escape the financial depression era (Chete et al. 2024).

The economy of Egypt is one that has stood a long neck and has been shining for a period of time through the historic stages. The result of the economic reform eased off the basis of its currency, and a new dramatic, unpleasant geopolitical environment, which was created by the war between Russia and Ukraine and the war in Gaza, made the political climate unstable and had global consequences for companies that were operating within its borderlines (Raine, 2024).

The dependent variable, which is comprised of exports, inflation rate, and gross domestic product (GDP), is included in the research paper, which is the driving force behind this

narrative itself. In the process of negotiating the problems that are created by shifting currency rates, these enterprises, who represent various sectors of the economy, found themselves at the forefront of the process. The fluctuations in their international trade performance are driven by an independent variable, which is the exchange rate fluctuations of the main countries that invest in the Egyptian development sector. This fluctuation serves as the driving force behind fluctuations (Alagidede and Ibrahim, 2017).

The importance of getting to know the mechanisms of price changes in foreign exchange as well as the consequences for economic activities in Egypt is the factor that induced the emergence of this study. The aim of this article is to illustrate the amount of impact that currency volatility has had on exports, inflation rate, and GDP in the eighteen-year period 2005–2022.

Despite the extensive literature on exchange rate fluctuations and international business, there is a paucity of studies specifically addressing the Egyptian context over an extended period of time. This study aims to fill this gap by empirically analysing the impact of exchange rate fluctuations on Egypt's international business transactions from 2005 to 2022. The primary objective is to determine the extent to which currency volatility, inflation rates, and GDP influence export volumes in Egypt.

The study is grounded in the theory that exchange rate fluctuations are a critical determinant of international trade performance. This relationship is mediated by factors such as inflation rates and GDP, which serve as control variables in the analysis. The dependent variables—export volume, inflation rate, and GDP—are examined to understand their response to changes in exchange rates. The independent variable, exchange rate fluctuations, is considered a driving force affecting the international trade performance of various sectors within the Egyptian economy (Alagidede and Ibrahim, 2017). According to Figure 1 of the theoretical framework.

Several economic theories describe how foreign exchange rates affect foreign business operations. The Exchange Rate Exposure Theory implies that exchange rate swings can affect firm performance and value, especially in foreign operations. This study examines export volume changes and exchange rate volatility, which is the study objective (Hussain et al. 2024).

The J-Curve Effect states that exchange rate depreciation has an early effect and trade volumes take time to rise. This theory also states that the variable under investigation may fluctuate in the short term; hence, this study examines longer-term developments from 2005 to 2022.

Thus, this theory merits adoption since it uses inflation rates as a control variable. The Balance of Payment Theory states that a country's exchange rate depends on its balance of payments; hence, exchange rates will always equalise foreign payments and receives. Since GDP is part of the balance of payments, this theory supports its use as a control variable.

Last in international business exchange rate theories is the interest rate parity hypothesis, which states that interest rate variations between countries are reflected in the foreign currency forward exchange rate premium or discount (Alessandria and Choi, 2021).

These approaches provide a solid foundation for studying exchange rate variations and international business export sales. They also explain why GDP and inflation are important control variables since they affect exchange rates and trade flows.

Accordingly, the proposed conceptual model for the future empirical investigation will follow this theoretical framework and help explain Egyptian currency rate changes and their impact on international commercial transactions. The importance of understanding the mechanisms of price changes in foreign exchange and their consequences for economic activities in Egypt prompted this study.

Additionally, a correlation test is made to spot trends and discover the methods used by organisations to decrease the risks of foreign currency exchange. This research is conducted with the goal of supplementing the existing body of knowledge about how variations in exchange rates affect international trading (Osabuohien et al. 2018). Hence, the research question is, ‘’Could fluctuations in exchange rates affect international business transactions positively?"‘’.

This analysis seeks to supply officials with practical suggestions that can be concretely implemented to enhance the resilience of Egypt in the face of currency instability and geopolitical strife. This will be fulfilled by pinpointing the actual mechanisms that are causing the observed trends. Since the experimentation had not covered Egypt ever before.

This study contributes to the existing literature in several ways. First, it extends the empirical analysis of exchange rate fluctuations to the Egyptian context, a region that has been underexplored in previous research. By doing so, it provides new insights into the relationship between exchange rates, inflation, GDP, and trade volumes in a developing economy. Second, the study employs rigorous econometric techniques, including pooled and fixed effect models, to ensure robust and reliable results.

The findings offer actionable recommendations for policymakers and entrepreneurs, highlighting strategies to mitigate the risks associated with currency volatility. Therefore, the present study can be considered an academic contribution as well as an option for further research.

According to the study, it was found that exchange rate fluctuations have a significant positive effect on international business transactions, which means that the first hypothesis is accepted while the second hypothesis is rejected.

In Section 2, previous studies will be addressed, research methods will be included, and then the methodology will be finally introduced in Section 3. Section 4 is where the major results of the study are evaluated. In Section 5, the conclusion part is written, and the aims for future studies are identified. This part of the write-up aims to clarify essential learning obtained as part of the study.

2. Literature Review

2.1. Exchange rate Fluctuations

Over the years, FDI has been known to promote economic growth and development in less-developed countries as well as enhance its place within global production networks (GPNs) (Mostofian, 2023). Within the context of the foreign exchange market, the term "exchange rate fluctuations" refers to the variations in the value of one currency in comparison to another. Variations like these can be brought on by a wide range of causes, such as economic data, geopolitical events, market mood, and the activities of central banks. Changes in the value of the currency exchange rate have an effect on a wide range of economic factors, including trade balances, investment decisions, inflation rates, and the overall stability of the economy (Iliyasu et al. 2024; MacDonald, 2007).

The swings in exchange rates can have a substantial impact on the competitiveness and profitability of businesses that are engaged in international trade. When the home currency is strengthened in comparison to other currencies, it might make exports more expensive for buyers from other countries. This can potentially result in a decline in demand, which in turn can lead to a reduction in earnings for those who export goods (Oyewole et al. 2024).

On the other hand, a decline in the value of the home currency can make exports significantly more competitive in international markets, which in turn can increase sales and revenues. When the value of the domestic currency decreases, firms that are dependent on imports may experience an increase in costs. This is because the prices of imported goods and services will go up (Cooper, 2019; Isard, 1995).

Changes in the value of the currency exchange rate also have an effect on customers, particularly those who undertake international travel or buy imported items. With a stronger native currency, travelling abroad can become more reasonable, and the cost of imported goods can decrease, which can lead to an increase in purchasing power. On the other hand, a weaker native currency might lead to a rise in the cost of travelling abroad and purchasing imported goods, which could potentially result in higher inflation rates due to the fact that consumers are able to pass on the cost of imported items (Chi, 2024; Ghosh et al. 2002).

Intervention in the foreign exchange market is a common practice among central banks, with the goals of either maintaining exchange rates or accomplishing particular policy goals. Central banks have the ability to influence the supply and demand for currencies, which in turn can have an effect on the value of those currencies in the foreign exchange market. This is accomplished through the use of monetary policy tools such as interest rate adjustments or direct market interventions. On the other hand, interventions that are excessive or lengthy have the potential to distort market forces and result in unexpected effects, such as attacks directed against speculation or imbalances in the economy (Weißbrodt, 2024; Diebold, 2012).

Additionally, as a component of their portfolio management techniques, investors observe swings in exchange rates with great attention. Because fluctuations in exchange rates can either magnify or minimise the gains or losses connected with investments made on a global scale, currency movements can have an impact on the returns and risks associated with international investments. In order to make a profit from short-term swings in exchange rates, certain investors engage in currency speculation. These investors employ trading tactics such as carry trades or currency derivatives in order to participate in this activity (Amanda et al. 2023).

2.2. International Business Transactions

It is of the utmost significance that international commercial transactions be carried out within the framework of the global economy. Imports, exports, DFI, and financial transactions that take place across international borders are all examples of the vast range of activities that are involved in these transactions (Zhang et al. 2024).

There is a possibility that this would occur if the enterprises performed exceptionally well. In consequence, this has the potential to make imports significantly more affordable for Egyptian consumers and businesses, which could have the effect of leading to an increase in the quantity of imports (Abu Hatab and Surry, 2024).

On the other hand, businesses that deal in manufacturing might export finished products to clients in both domestic and foreign markets. The performance of these companies and, as a consequence, the overall trajectory of the EGX100 index can be affected by a variety of factors. These factors can have an impact on the overall trajectory of the index. These elements consist of shifts in global demand, changes in exchange rates, changes in trade restrictions, and events that occur in foreign policy (El Mosallamy and Gamal, 2024).

2.3. Exchange Rate Fluctuations and International Business Transactions

According to Apriani et al. (2024) analysed the impact of the Russian Stock Exchange (IMOEX) on world oil prices, with the US Dollar/Ruble exchange rate acting as a mediating variable. The study aimed to investigate the direct and indirect relationships between these variables to understand their influence on each other. The results of the study indicated that the Russian Stock Exchange (IMOEX) was found to have a significant positive impact on the US Dollar/Ruble exchange rate. The US Dollar did not directly impact world oil prices significantly. The Russian Stock Exchange (IMOEX) did not have an indirect effect on world oil prices through the US Dollar as a mediating variable. The Sobel test results suggested that the influence of the Russian Stock Exchange on world oil prices, mediated by the US Dollar, was not statistically significant.

While Liu, (2024) aimed to explore the impact of exchange rate fluctuations on import and export enterprises in China and Japan. The study aims to analyse how exchange rate movements affect the profits, competitiveness, costs, and demand of businesses in these two countries, and to propose effective strategies for enterprises to maintain competitiveness and sustainable development in the face of exchange rate fluctuations. The results of the study indicate that Chinese and Japanese import and export enterprises are impacted differently by exchange rate fluctuations. Chinese companies are more affected by import and export costs and price competitiveness, while Japanese companies are more influenced by import and export volume, profitability, and capital risks. To effectively address these challenges, the study suggests that enterprises should implement targeted strategies tailored to their specific circumstances.

Moreover, Okpaga (2024), study goal was to empirically investigate the impact of exchange rate volatility on non-oil exports in Nigeria from 1986 to 2021. The study aimed to analyze the relationship between exchange rate volatility and non-oil exports, considering the economic implications for the country. The results of the study indicated a negative significant impact of exchange rate volatility on non-oil exports in Nigeria.

The findings suggested that the volatile exchange rate had adverse effects on non-oil exports, highlighting the need for policies to promote revenue diversification and ensure exchange rate stability to support export growth. Additionally, the study identified a unidirectional causality relationship between exchange rate volatility and non-oil exports, with causality flowing from exchange rate volatility to non-oil exports in Nigeria.

Furthermore, Naimy et al. (2023) The aim of the study on the impact of post-Brexit exchange rate volatility on UK exports to eurozone countries is to analyze the effects of exchange rate volatility, along with other key variables such as Total Trade (TOT), Industrial Production Index (IPI), and Real Effective Exchange Rate (REER), on the volume of UK exports to the eurozone countries. The results of the study indicate that exchange rate volatility (VOL) has a significant negative impact on UK exports to eurozone countries in both the short run and long run. An increase in exchange rate volatility leads to a decrease in the volume of UK exports to the eurozone countries.

Additionally, Total Trade (TOT) and Industrial Production Index (IPI) are identified as significant factors influencing UK exports, with positive impacts observed in the short run. These findings underscore the importance of considering exchange rate volatility and other economic indicators in understanding the dynamics of UK exports to the eurozone countries post-Brexit.

Iqbal et al. (2023) objective of the study is to investigate the asymmetric effects of exchange rate volatility on commodity trade between Pakistan and Japan, while also examining the

symmetric effects for comparison. The study utilizes the nonlinear autoregressive distributed lag (ARDL) method to analyze the relationship between exchange rate volatility and trade flows. The results of the study suggest that the impact of exchange rate volatility on trade flows between Pakistan and Japan can be both positive and negative, depending on the risk behavior of investors. The study also finds evidence of asymmetric effects of exchange rate volatility on trade flows in the long run, particularly in exporting industries.

Ruhil et al. (2023) exploration of the study on the impact of exchange rate volatility on international trade is to investigate the relationship between currency volatility and global trade, determine the extent to which currency volatility affects trade volumes and trends, pinpoint how exchange rate volatility influences import demand, export competitiveness, and trade obstacles, examine how exchange rate volatility affects various industries and sectors in the context of global trade, and explore how monetary policy and exchange rate regimes impact the overall effect of exchange rate volatility on global commerce. The results of the study indicate that exchange rate volatility has a negative impact on India's exports and imports, suggesting a trade-reducing effect of exchange rate uncertainty.

Irmiya et al. (2023) investigation was to examine the effects of exchange rate fluctuations on the balance of payments in Nigeria. The study aimed to emphasize the need for a stable, regulated exchange rate for the Central Bank of Nigeria. The results of the study indicated that the recent relatively unstable exchange rate had disrupted the balance of payments in Nigeria. This instability weakened the value of the Nigerian naira, discouraged exports of local goods, made imports of foreign goods more expensive, and hindered domestic and foreign investment, ultimately leading to a negative impact on the balance of payments.

Tamunowariye et al. (2022) examined the impact of exchange rate volatility on stock market performance in Nigeria from 1981 to 2019. The researchers utilized quarterly data and employed the Eview9 Statistical Software for their analysis. The study focused on testing the stationarity of variables, analyzing the data using a three-step procedure, and implementing the generalized autoregressive conditional heteroskedasticity (GARCH) model.

The results of the study indicated that exchange rate volatility had a significant impact on stock market performance in Nigeria. Specifically, the findings suggested that high volatility in exchange rates generated substantial shocks on the performance of the stock market in the country. As a policy implication, the researchers recommended the need for proper management of exchange rate volatility in Nigeria and emphasized the importance of improving the investment environment to enhance the performance of the stock market in the country.

Solodzhuk and Myhovych, (2022) investigated the existing trends of current and fixed currency transactions in Ukraine, evaluate aspects of individual currencies' and foreign exchange transactions ratio, and conceptually distinguish the exchange rate and the fractal nature of the exchange rate behavior. The results of the study include the assessment of the impact of exchange rate fluctuations on the foreign exchange market, the use of mathematical calculations and fractal methods to analyze exchange rate volatility, and the evaluation of systematic risks in currency markets based on market centralization and currency restrictions.

Rahman et al. (2021) The aim of the study is to examine the mechanism of determining the exchange rate of the USD against the IDR by market players to manage the USD/IDR exchange rate stability. The study suggests that in the short run, lag of the USD/IDR exchange rate or inertia level, lag of the net total foreign investor transactions (IOVA), lag of the non-deliverable forward (NDF) of the USD/IDR exchange rate, and lag of the Asian Dollar Index (ADXY) are statistically significant determinants of the USD/IDR.

In the long run, net total domestic individual transactions (DOVA), NDF, and ADXY are found to be statistically significant determinants of USD/IDR. Additionally, the study identifies a market leader and asymmetric information among market players in the Indonesian foreign exchange market, where their USD/IDR exchange rate level becomes a reference for other market players during transactions.

Sriraman et al. (2020) analysed the economic implications of currency pegging in the money market. Investigate the gains in the financial markets through currency rate fluctuations for selected markets and products, and understand the financial losses to markets and products.

Review the economic benefits of fixed exchange rate systems compared to floating exchange rate systems and identify the best benefits. The results of the study indicate that currency fluctuations have a significant impact on international trade and investment. The use of standardized currencies like the US Dollar in trading nations such as the UAE provides convenience and stability for business transactions.

2.4. Summary

Exchange rate fluctuations have significant impacts on international business transactions and the broader economy. These changes have impacts on trade balances, investment, inflation, and economic stability. Fluctuations in currency prices have a significant impact on the competitive advantage and financial success of many organisations that are involved in importing and exporting activities. The domestic currency may strengthen, which makes exports costly and less competitive, or on the other hand, it may devalue, making exports cheaper but imports more expensive. These effects further highlight the role of exchange rates in influencing the strategies and performance of international business ventures.

Existing literature provides contrasting results with regard to the link between exchange rate volatility and international trade. According to Okpaga (2024) as well as Naimy et al. (2023), prior research has evidenced the unfavourable effects of exchange rate uncertainty on exports. This implies that export growth can be hindered by currency stability, and it carries a lot of implications concerning trade balances. Nevertheless, other studies, including those by Iqbal et al. (2023), hold the opinion that it has a positive as well as a negative effect on performances in relation to the risk-taking propensity of investors. Such variation in the studies goes to support the nature of the exchange rate effect and underlines the need to conduct the exchange rate effect within the context of the specific environment.

However, other studies, such as Iqbal et al. (2023), indicates that the effects can be both positive and negative, depending on investors' risk behavior. This variability in findings underscores the complex nature of exchange rate impacts and the need for context-specific analysis. Some of the key research works have highlighted the fact that exchange rate volatility cannot be considered in isolation from many other factors. For example, Liu (2024) established that exchange rate changes unequally impact Chinese and Japanese enterprises, as cost and price competitiveness are more responsive to change by Chinese firms than by Japanese companies, whereas volume and profitability alone dictate change by Japanese firms.

This emphasises the contingency approach, which focuses on the strategies that are used to address existing market conditions and organisational characteristics. In the same way, Rahman et al. (2021) discovered several short- and long-term factors affecting the exchange, including stale trading, foreign investor trading, and regional factors. It also identifies other macroeconomic effects of exchange rate fluctuations.

According to Irmiya et al. (2023), exchange rate fluctuations in Nigeria affected the balance of payments, debased the national currency, and dampened domestic and foreign investment. This

explains an endogenous relationship between exchange rates and the economic balance of payments, stability, and, ultimately, growth. Moreover, Tamunowariye et al. (2022) also found the effect of exchange rate fluctuations on stock market returns to deploy the relationship between the currency markets and the rest of the economy.

This indicates the following considerations for the current study: these findings outlay a strong argument for First, it is necessary to look at reactions to movements in the exchange rates, not only through straight impacts during cross-border transactions but also via various economic channels. Second, asymmetry and nonlinearity can be admitted if the impact of currency fluctuation differs depending on the direction and extent of the change. Third, factors conditioning specific industries and countries should be included to reflect differences in the effects of the factors in different industries and countries. The last limitation, which the study should take into consideration, is that the effects of currency fluctuation are not permanent and may differ when observed in the short run and in the long run, as stated in the literature.

2.4.1. Linking to the Current Study

This research, therefore, seeks to address this gap in the literature by looking at the Egyptian market from the year 2005 to the year 2022. As mentioned earlier, much of the prior studies have not included Egypt, while the country presents a highly specific economic and geopolitical context. The research design for this study will involve an empirical investigation of how exchange rate volatility affects international business transactions in Egypt, with exports, inflation rates, and GDP as indicators.

Through a strict methodological approach, such as the pooled and fixed effect models, the goal of this study is to offer actionable recommendations for policymakers and entrepreneurs to mitigate the impact of fluctuating currencies and geopolitical risks. This paper will add to the existing literature review and provide fresh insight into the nature of exchange rate risk management within international business.

Thus, it is hypothesized as follow:

H1: There is a statistic significant relation between Exchange rate fluctuations and International Business transactions

H2: There is no statistic significant relation between Exchange rate fluctuations and International Business transactions

2.5. Research Model

Concerning the results of the experiment with regard to the dependent variable defined as export volume of international business transactions, it is noteworthy that the changes and manipulation of the independent variables may have an impact. The major focus of the research and the deriving basis of its results is the behaviour of this dependent variable. Therefore, in this research, the exchange rate remains the principal research focus, portraying the primary independent variable. It is in the model, together with a host of other factors, that will be used to invoke the model for an analysis of the given phenomenon. It was necessary to have more than one way to assess each variable based on people's perceptions. The effectiveness of each of these measures was computed by applying the pertinent statistical analyses.

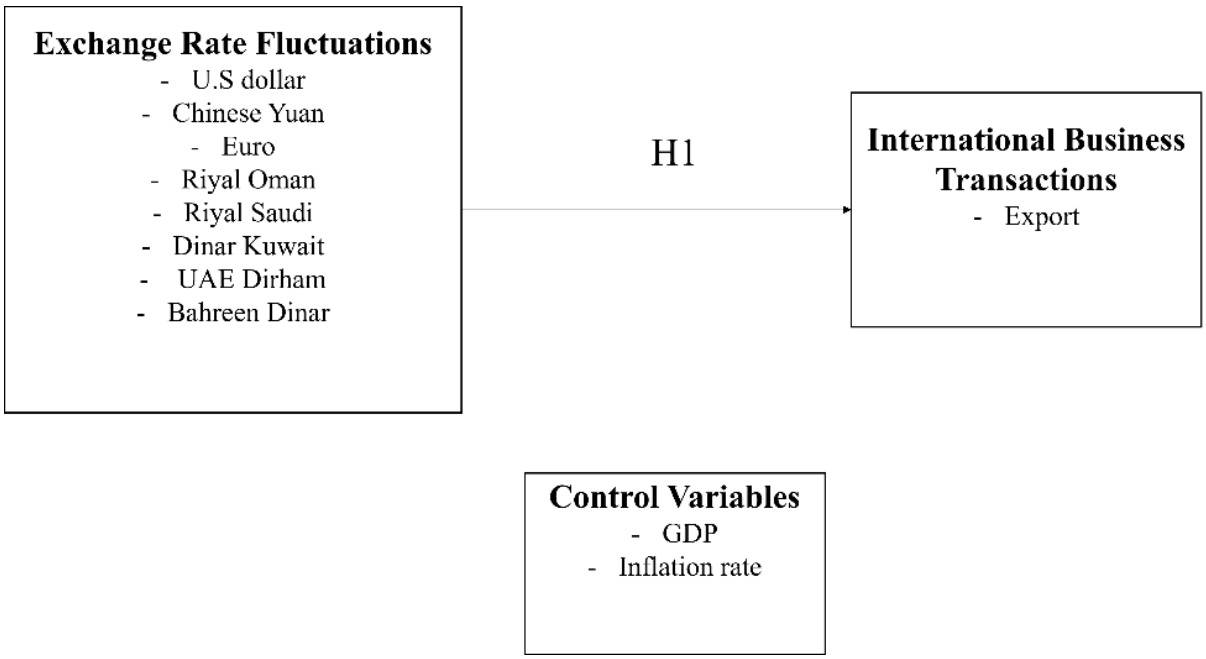

Figure 1. Research model
Source: Based by the researchers

In this study, the exchange rate is the primary independent variable, while the inflation rate and gross domestic product (GDP) are kept as the control variables. On the other hand, export volume is the key variable dependent upon the independent variable, of which the performance can be measured using one of the indicators: Total export value can be regarded as one of the significant measures that are used to describe export volume.

The selection of exchange rate as a dominant independent variable can be supported by the basic models in international economics, for instance, the Mundell Fleming model as well as the Marshall Lerner condition. These theories imply that in a small open economy with flexible exchange rates, devaluation of currency may lead to export promotion, especially when the sum of price elasticities of exports and imports is greater than unity.

The use of the inflation rate and GDP as control variables is in line with the general macro-economic theory of trade between nations. Inflation can also be used with the concepts within the theory of purchasing power parity (PPP), as this theory deals with relative price levels within global markets. GDP explains the governmental model of international trade, which states that it depends on the economic weight of the partners. Specifying the export volume as the dependent variable also corresponds with the export demand function as utilised in international economics, which employs foreign income, relative prices, and exchange rates.

The study applies concepts from different theories of international trade as the theoretical background of the study. These are, inter alia, the elasticities approach to the balance of payments, which focuses on the price elasticity of exports and imports; the absorption approach, which takes into consideration how the economic conditions in the home country affect exports and imports; and the monetary approach to exchange rates, which provides how exchange rates are affected by monetary factors.

Thus, by investigating the topic with the example of Egypt, the study makes it possible to apply these general theories and see to what extent such models accurately depict actual occurrences in developing economies. It is important to note that the research design, as developed by this study, comprehensively seeks to empirically examine these theoretical associations in the Egyptian setting. Second, due to the usage of endogenous satisfactions and panel data, multiple

forms are included, allowing you to consider the relationships implied by the I theory controlling certain variables for the influence of countries.

The main objectives of this study are as follows: to comprehend how exchange rate volatility impacts international business transactions, specifically export performance, with special reference to the Egyptian economy. The research elucidates various issues in the assessment of the relationship between exchange rate volatility and export volume; the role of inflation and GDP is also taken into account.

To estimate the impact of these variables, the analysis will use pooled and fixed effects models. The selection of these models and variables is based on the principles of economics implemented in international trade and exchange rate concepts. Through analysing these relationships, the study seeks to establish the processes by which exchange rate volatility impacts Egypt's IB performance and general economic output.

3. Methodology

The research followed an inductive approach, seeking to test hypotheses through various quantitative statistical methods. Initially, descriptive statistics were calculated to characterize the study sample. Subsequently, correlation analysis employing Pearson correlation was carried out to examine relationships. Finally, panel data analysis was employed through further modelling. Each inferential technique will be elaborated on for clarification. The sample that is proposed is a period from 2005 – 2022.

3.1. Sampling and Data Collection

The study utilizes secondary data primarily sourced from the Central Bank of Egypt (CBE), covering the period from 2005 to 2022. This timeframe was selected to encompass significant economic events and fluctuations, providing a comprehensive overview of the impact of exchange rate changes on international business transactions in Egypt.

The dataset includes:

1. Exchange Rates: Annual exchange rates of the Egyptian pound against major currencies (e.g., USD, Chinese Yuan, Euro, Riyal Oman, Riyal Saudi, Dinar Kuwait, UAE Dirham and Bahreen Dinar).
2. Export Volume: Annual export volumes recorded in Egypt, measured in millions of Egyptian pounds.
3. Inflation Rates: Annual inflation rates, based on the Consumer Price Index (CPI).
4. Gross Domestic Product (GDP): Annual GDP data in constant prices.

In addition to the CBE, supplementary data was collected from:

- The Egyptian Ministry of Finance
- The World Bank's World Development Indicators database
- The International Monetary Fund's International Financial Statistics

This multi-source approach allowed for cross-verification and filling of any potential gaps in the primary data source.

3.2. Data Preprocessing and Cleaning

Several steps were taken to ensure the quality and reliability of the data:

1. Data Harmonization: All monetary values were converted to a common currency (Egyptian pounds) and adjusted for inflation using 2005 as the base year.
2. Missing Data Handling: In instances where there were gaps in the data, linear interpolation was used to estimate missing values, ensuring continuity in the data.
3. Stationarity Tests: Levin Lin Chu test was used to check the stationarity of the time series data. This step was important in order to exclude cases of data hugging and thus eliminating cases of spurious regressions. Prior to the implementing the Levin Lin Chu test the null hypothesis that is made is that there is a unit root hence they are non-stationary. When this hypothesis was rejected, stationarity was confirmed.

3.3. Instrument Validation

It is important to repeat input and output data for the sake of their valuation and extreme precision. The following steps were taken to validate the instruments used for data collection: Source Verification: Information was only gathered from the official website of the Central Bank of Egypt for credibility of the information gathered.

Consistency Checks: Each year the collected data were compared with figures of other reliable financial sources as well as international organizations like, IMF and World Bank.

Missing Data Handling: In instance where there were gaps in the data, the data was interpolated to give continuity of the data set applicable to time series data base.

3.4. Panel Data Analysis

Panel data analysis combines two dimensions: individual effects and time effects. Unlike cross-sectional data analysis, panel data records observations for each individual at multiple time points. Various statistical techniques have been devised to handle panel data, including fixed effect, random effect, and pooled effect models. However, the most prevalent models are the fixed and random effect models. Fixed effects (ui) represent distinct characteristics of individuals that remain constant over time. In other words, these attributes for a specific individual (i) do not change across different time periods (t).

$$Yit=\alpha i+\beta 1Xit+ui+vit \quad (1)$$

Conversely, if individuals possess distinctive, time-invariant characteristics that are unrelated to the individual regressors, the random effects model becomes applicable. It's essential to note that the disturbance term (v_it) in the model is assumed to follow a normal distribution.

$$Yit=\alpha i+\beta 1Xit+ui+vit,\ vit\sim distribution \quad (2)$$

According to Al-Beltagy (2023) and Greene (2012), random effects models are often more efficient and better suited to real-life data and phenomena. These models should be given consideration in many cases. To choose between random and fixed effects models, researchers typically conduct a Hausman test. The null hypothesis of this test suggests that the random effects model should be preferred.

Each model accounts for a distinct type of error composition and aims to capture the phenomenon while controlling for time-related variables. Their primary goal is to analyze the influence of independent variables on dependent variables.

For robustness testing, the Pooled OLS model is frequently recommended. This model, designed for panel data analysis, offers an alternative approach. Its functionality can be conceptualized through the following equation:

$$Y_{it} = X_{it}\beta + \omega_{it}, i = 1, \ldots\ldots, N \; and \; t = 1, \ldots\ldots, T \quad (3)$$

The pooled effect model reaches its best fit when there are no specific panel effects within the data. To determine if the Pooled OLS model is the most suitable for explaining the phenomenon compared to other panel regression models like random and fixed effect models, researchers often employ the Lagrange multiplier test. This test is valuable as it's non-parametric, flexible, and straightforward to apply. However, its validity hinges on meeting certain assumptions.

Therefore, from the above discussions, it was possible to choose the right statistical methods that should be utilized in this research depending on the type of data to used and the specific research questions of the study. Cross sectional and Time series analysis methods were ruled out because panel data analysis encompasses both time and individual effects as previous studies have used this approach to investigated the relationship between exchange rate fluctuations and FDI, including (Nguyen et al. 2024; Kumari and Sharma, 2017). In the panel data specification, both fixed or random effect models were examined, and the Hausman test was conducted to decide which model fits best.

It also enables the control of arbitrary variables affecting different entities and time steps unevenly. Pearson correlation was chosen as a first approach to examine the nature of the relationship between the economic indices and the variables under analysis, because the Pearson coefficient is commonly applied to study linear relationships between continuous variables, and our dataset comprises continuous economic indicators. Other methods like Spearman or Kendall's tau may have been suitable to deal with non-linear relationships in the data but since our economic variables assumed a linear relationship Pearson correlation was appropriate. In the case of time series components, State space models use various stationarity tests namely Levin Lin Chu that was conducted to check for the validity of regression models because non stationary data produces spurious correlations.

The reason why this method was preferred over simpler methods such as mere observations of the plots is because of the greater statistical validity and more general applicability in econometric analysis. The pooled OLS model was added as a technical robustness check alongside the panel data models which are slightly more complex. The inclusion of different models also permits a comparison of several modeling paradigms, which retains the legitimacy of the results discovered. The Lagrange multiplier test was applied to compare the pooled OLS model with the panel regression models to justify why the former is more adequate than the latter on the basis of statistical evidence rather than assumptions.

3.5. Models Proposed for the Study

$$EX_{it} = \alpha + \beta_1 ER_{it} + \beta_2 Inflationrate_{it} + \beta_3 GDP_{it} + \varepsilon_{it} \quad (4)$$

Ethical considerations: The management of ethical issues was pertinent to the planning and process of this research. However, the study used secondary data approach and therefore does not raise direct issues of concern to participants' privacy. Methods for data quality control included strict validation of data and compliance with ethical requirements on data processing. Transparency was attained by offering a clear documentation of the procedures required to satisfy scientific rigour, including the origin of the data, the way the information was processed, and the analytical methods that were employed when generating the findings. Furthermore, it is important to also note that the researchers have no conflicts of interest that can hinder the conduct and reporting of this research.

Data availability: The data generated and/or analysed during the current study are available from the first author on request.

4. Results

Table 1.
Descriptive Statistics for the variables in the phenomenon

Variable	Obs	Mean	Std. Dev.	Min	Max
Exchange rate	144	15.408	16.751	.703	79.732
GDP	144	2.658e+11	1.035e+11	8.960e+10	4.767e+11
Inflation rate	144	11.559	5.942	3.132	23.269
Export	144	26.252	7.45	10.661	40.70

Source: The result output from STATA V.17

From table 1. The country Exchange rate average was 15.408. There was high variation in the dataset. The GDP had an average of 2.56 among firms in sample. The Inflation rate ranged from 2.658 showing a low variation. The export in sample was found to be 26.25 which considered to be a high variation.

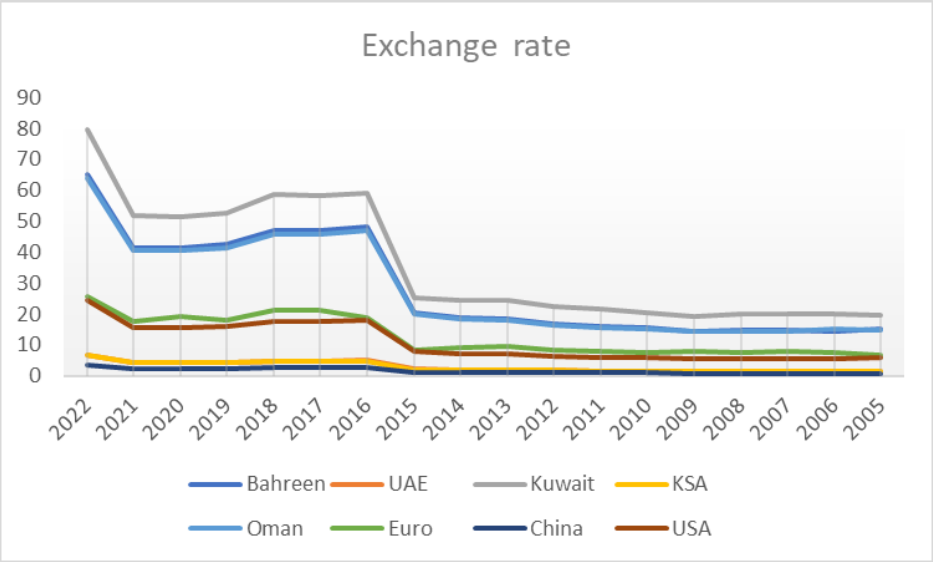

Figure 2. Exchange rate
Source: Based by the researchers

Exchange rate data for Middle Eastern currencies (Bahrain, UAE, Kuwait, Saudi Arabia, Oman) and major global currencies (Euro, Chinese Yuan, US Dollar) are expressed from 2005 to the 2022 in Egypt. The trends in the exchange rates of most of the currencies are flat with only slight oscillations during this 17-year period, with the exception of the currency in Kuwait which displays significant volatility especially in 2015-2016 implying the existence of a common shock to the Egypt economy.

The monthly exchange rates present the greatest exchange fluctuation with the Chinese Yuan and US Dollar having the lowest and most stable fluctuation in Egypt market. The Euro which seems to be in the middle in terms of the above analysis exhibits more oscillation but it is relatively stable.

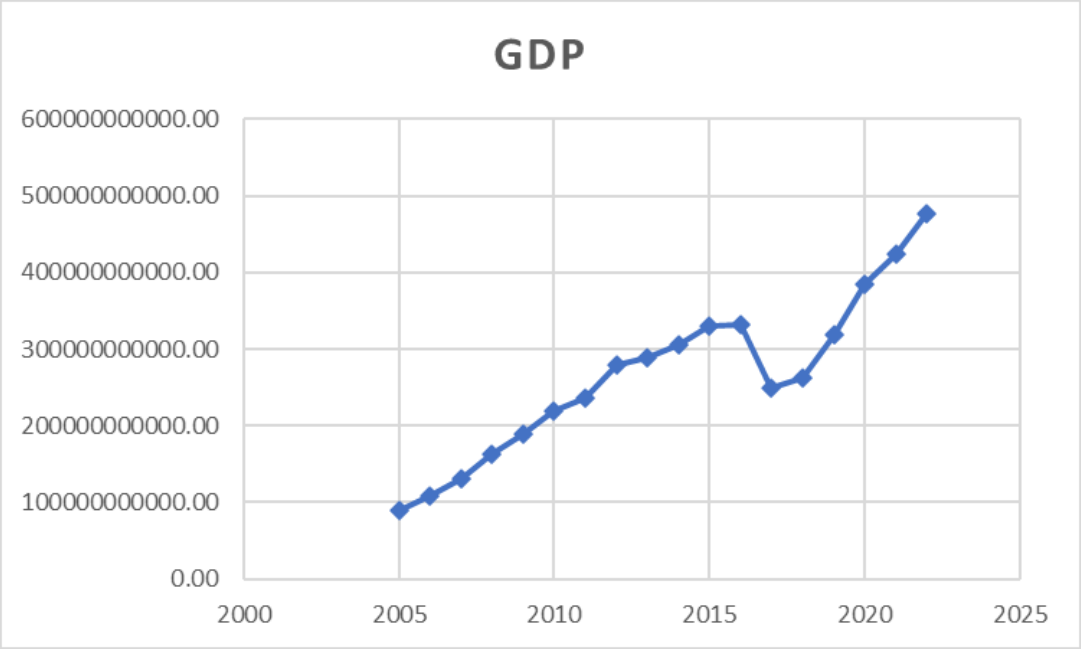

Figure 3. GDP
Source: Based by the researchers

Analyzing the graph, the further we can observe the constant growth in Egypt's GDP in long term period of 2005-2022 where GDP figures reached from 100 billion to almost 500 billion. The rise and furthermore, the increase was from 2005 to 2015 pointing to the economic stability and the slight slump in the period 2016-2017 most probably precipitated by certain economic or political events and then soaring to even higher growth. The graph depicting GDP in the post 2017 also slopes up more sharply and this could be due to some possible economic changes, or more foreign investment.

Especially the last few years reveal rather high rates of increase although global conditions such as the COVID-19 pandemic disturbed these rates. However, periods when the rates of growth or decline are low add a degree of uncertainty to the economic processes, and it should be noted that the process of their management and improvement continues, regardless of the current situation.

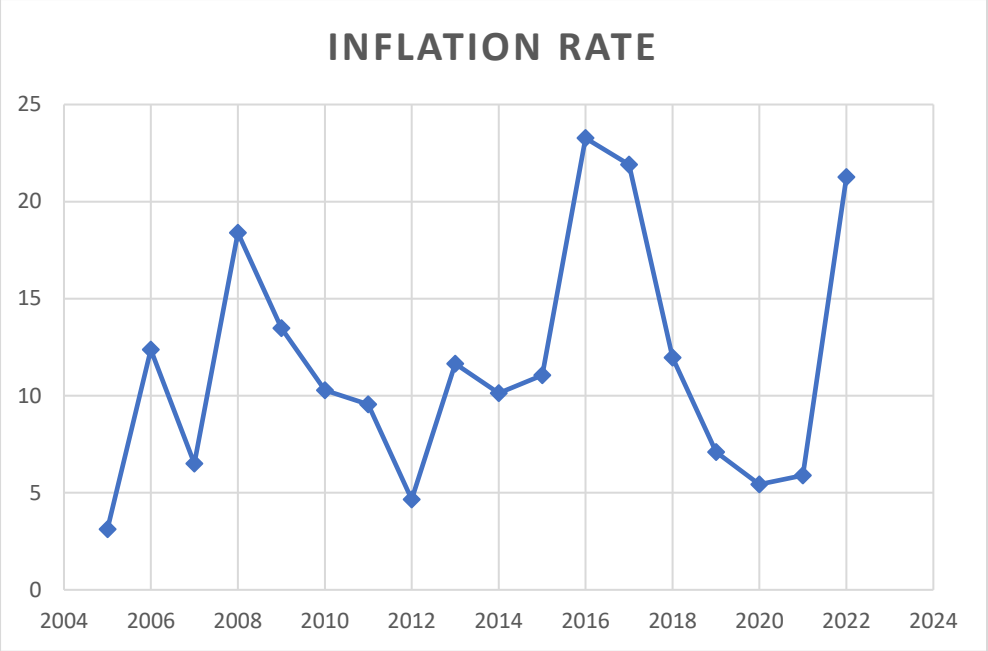

Figure 4. Inflation rate
Source: Based by the researchers

The graph illustrating Egypt's inflation rate from 2005 to 2022 reveals a highly volatile economic environment characterized by significant fluctuations, with three major peaks: It was at around 2008 at about 18 percent, it hit a new high in 2017 at nearly 24 percent and again touched 21 percent in the recent period suggesting new increase of inflationary trends. Therefore, it can be established that about 3% inflation rate in 2005 and slightly above 5% rate in 2012 depict conditions of low inflation rate. Although inflation declined after the record-high rate in 2017, the inflation rates remained somewhat fluctuating from 2019 to early 2022 before upturn.

This results to a lot of fluctuations in economic activities ranging from; economic planning, investment, day to day expenses in a household or organizations due to factors such as; economic policies, devaluations of currency, and external shocks in the economic world. Such configurations are essential for analyzing the patterns of inflation and their causes and effects on Egypt’s economy.

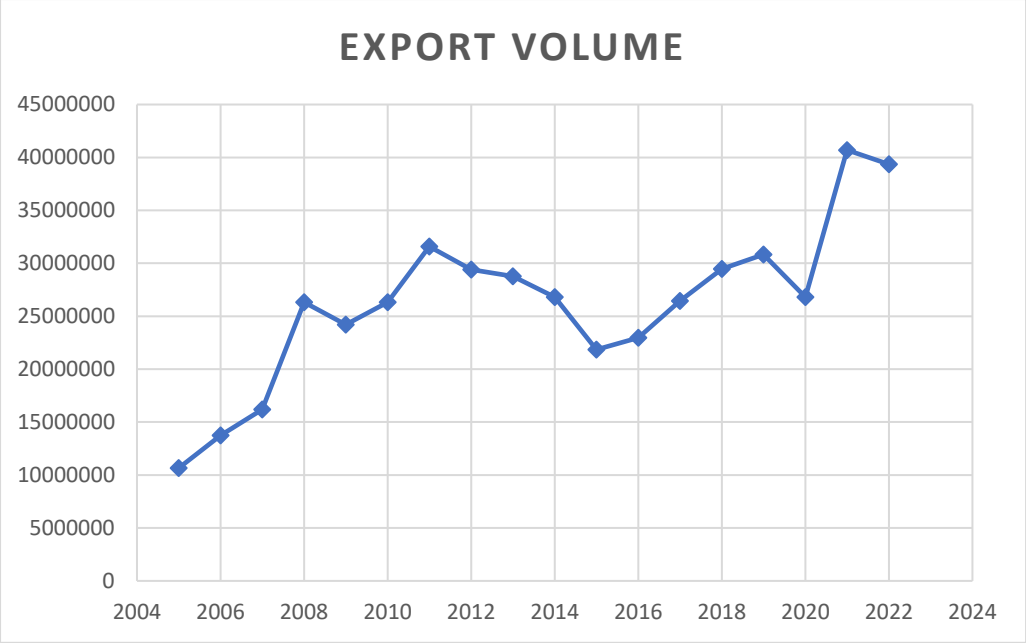

Figure 5. Export volume
Source: Based by the researchers

Early in the graph 2005 the Export volume of Egypt was smaller and was approximately 10 million units but the exact unit is not stated. From here, it constantly rose straight to about 25 million units in 2010 which again strengthens the theory that there was economic prosperity and globalisation during the late 2000s. This is evidenced by fluctuations in export volume between 2010 and 2015, where the yearly figure peaked at roughly 30 million units in about 2012 which may have been impacted by global economic situations, political instabilities in certain regions, or changes in domestic policies.

The trend line from 2015 to 2020 indicates upward movement with some fluctuations: a sharp decline in 2016, likely because of changes in the economic climate, such as reforms or the devaluation of currency, with a gradual increase in the following years and another spike in 2019 with approximate 30 million units. The most significant increase is observed in 2021, where export volume hits its pinnacle of almost 40 million units, which could have been due to post-pandemic product demand and effective policies or higher demand for Egyptian exported products. But the last figure goes slightly in the negative direction, so while it is clear that the business has gone through extraordinary growth, it may not be constant or perhaps new issues have cropped up.

Table 2.
Correlation
Pearson approach

		Exchange rate	**GDP**	**Inflation rate**	**Export**
Exchange rate	Pearson Correlation	1			
	Sig. (2-tailed)				
GDP	Pearson Correlation	.363**	1		
	Sig. (2-tailed)	.000			
Inflation rate	Pearson Correlation	.222**	.174*	1	
	Sig. (2-tailed)	.008	.037		
Export	Pearson Correlation	.278**	.802**	.157	1
	Sig. (2-tailed)	.001	.000	.060	

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

According to the analysis there is a positive moderate significant relationship between Exchange rate and GDP at rate 99% confidence level. Where there is a positive weak significant relationship between Exchange rate and GDP. Moreover, there is a positive weak significant relationship between Exchange rate and Inflation rate at 99% confidence level. In addition, there is a positive weak significant relationship between Exchange rate and Export at rate 99% confidence level.

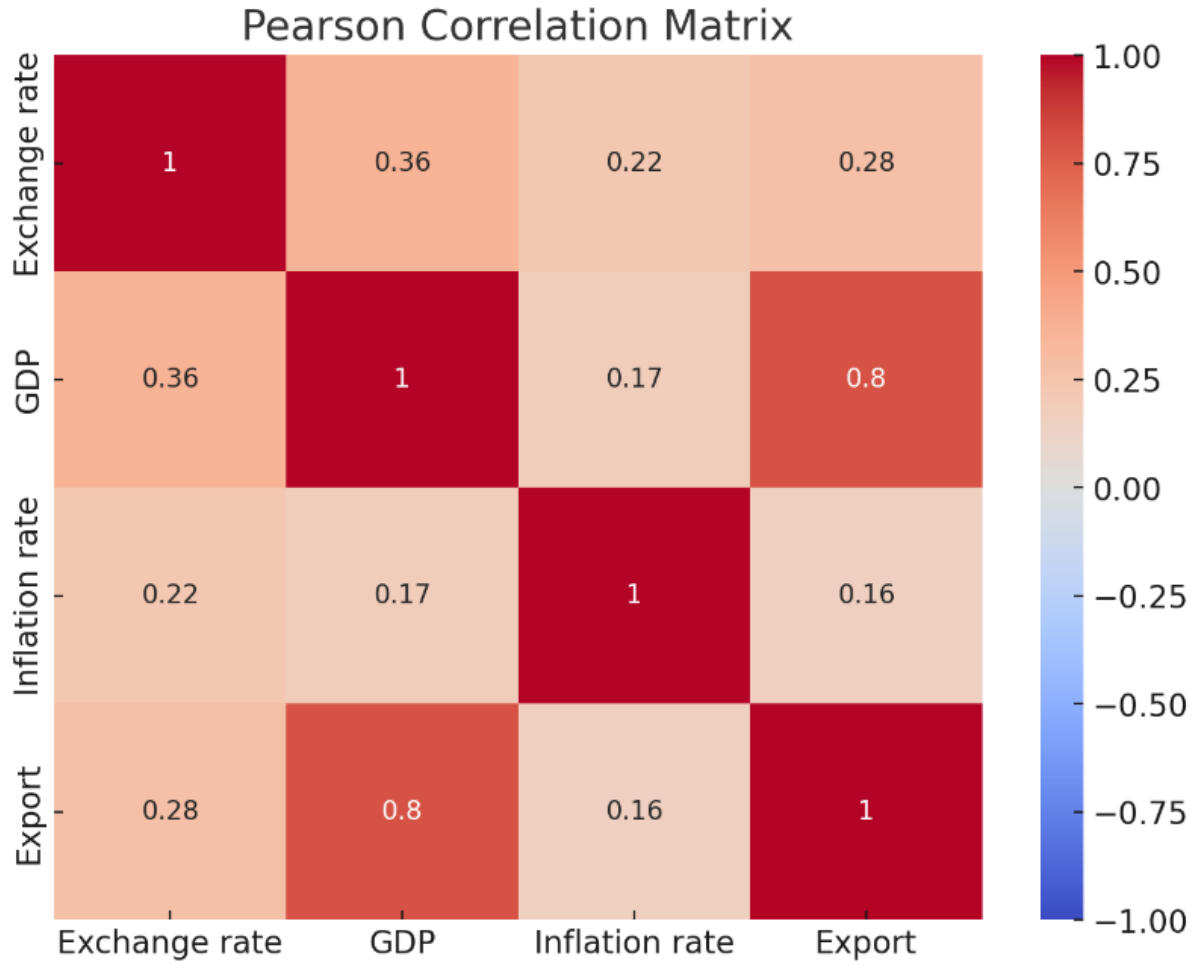

Figure 6. Heatmap
Source: The figure output from matplotlib.pyplot

Understanding Table 2. results and observing Figure 3. we can identify that the colour scale in the matrix provides an additional visual cue. Warmer colours (reddish tones) indicate stronger positive correlations, while cooler colours (bluish tones) represent stronger negative correlations. This interpretation is not considered to be a final result to test the hypothesis whether it shows if there is a multicollinearity or not.

4.1. Model Building

Before building the model, the stationarity was tested using Levin Lin Chu (LLC) unit root test where H0: Panel contain unit roots and H1: Panel data is stationary. The p-value for the variables were less than 0.05. Therefore, the model can be applied on the dataset without requiring lags.

4.1.1. 1st Model: Random and Fixed Effect Model

Table 3.
Random Effect model

Export	Coefficient	Standard error
Exchange rate	2.243e+09***	4.832e+08
_cons	2.312e+11	1.098e+10

Sig values: ***<0.01, **<0.05, *<0.1, “”>0.1
Source: The result output from STATA V.17

According to Table 3, the Exchange rate had a significant impact on Export at 99% confidence level.

Table 4.
Fixed Effect model

Export	Coefficient	Standard error
Exchange rate	5.292e+09***	6.783e+08
_cons	1.842e+11***	1.279e+10

Sig values: ***<0.01, **<0.05, *<0.1, “”>0.1
Source: The result output from STATA V.17

According to Table 4, the Exchange rate had a significant impact on GDP at 99% confidence level.

Table 5.
Hausman Test for random and fixed effect and random effect models

Test Value	Significance
18.408	0.000

Source: The result output from STATA V.17

According table 5, the Hausman test has p-value is less than significance level. The hypotheses were H0: Random Effect model is better fit for model and H1: Fixed effect model is better fit for model. Since p-value is 0.000, the fixed effect model is better fit for the data.

4.1.2. 2nd Model: Random and Fixed Effect Model

Table 6.
Random Effect model

Export	Coefficient	Standard error
Inflation rate	.079***	.029
_cons	10.348***	.659

Sig values: ***<0.01, **<0.05, *<0.1, “”>0.1
Source: The result output from STATA V.17

According to Table 6, the Inflation rate had a significant impact on Export at 99% confidence level.

Table 7.
Fixed effect model

Export	Coefficient	Standard error
GDP	5.292e+09***	6.783e+08
_cons	1.842e+11***	1.279e+10

Sig values: ***<0.01, **<0.05, *<0.1, “”>0.1
Source: The result output from STATA V.17

According to Table 7, the GDP had a significant impact on Export rate at 99% confidence level.

Table 8.
Hausman Test for random and fixed effect and random effect models

Test Value	Significance
10.37	0.0013

Source: The result output from STATA V.17

While table 8, the Hausman test has p-value is less than significance level. The hypotheses were H0: Random Effect model is better fit for model and H1: Fixed effect model is better fit for model. Since p-value is 0.000, the fixed effect model is better fit for the data.

4.1.3. Random and Fixed Effect Model

Table 9.
Random Effect model

Export	Coefficient	Standard error
Exchange rate	2.243e+09***	4.832e+08
_cons	2.312e+11***	1.098e+10

Sig values: ***<0.01, **<0.05, *<0.1, “”>0.1
Source: The result output from STATA V.17

According to Table 9, the Exchange rate had a significant impact on Export at 99% confidence level.

Table 10.
Fixed Effect model

Export	Coefficient	Standard error
Exchange rate	5.292e+09***	6.783e+08
_cons	1.842e+11***	1.279e+10

Sig values: ***<0.01, **<0.05, *<0.1, “”>0.1
Source: The result output from STATA V.17

According to Table 10, the Exchange rate had a significant impact on Export at 99% confidence level.

Table 11.
Hausman Test for random and fixed effect and random effect models

Test Value	Significance
18.41	0.000

Source: The result output from STATA V.17

According table 11, the Hausman test has p-value is less than significance level. The hypotheses were H0: Random Effect model is better fit for model and H1: Fixed effect model is better fit for model. Since p-value is 0.000, the fixed effect model is better fit for the data.

Table 12.
The model evaluation metrics of Pooled OLS effect Models

Pooled effect model	R	R2	Adjusted R2
Model 1	0.830	0.69	0.6839

Sig values: ***<0.01, **<0.05, *<0.1, “”>0.1
Source: The result output from STATA V.17

Table 12 presents the coefficient of determination for the Pooled OLS models. Based on results, the value of adjusted *R*2 is 0.68 showing the 68% of variation in Export is explained by model based on Exchange rate.

4.2. Stationarity Test

Levin Lin Chu test is used as a stationarity test. It presents the idea of applying an augmented dickey fuller test to each panel. It assumes common autoregressive parameter for all panels. Regarding the test, the hypotheses are as following:

H0: Panel contain unit roots.

H1: Panel is stationary.

Table 13.
Levin Lin Chu stationarity test

Variables	Test Statistic	P-value	Decision
Exchange rate	-3.2e02	0.0000	Stationary
GDP	-2.8114	0.0025	Stationary
Inflation rate	-3.6615	0.0001	Stationary
Export	-3.5880	0.0002	Stationary

Source: The result output from STATA V.17

All the variables were found to be stationary from fixed effect models at 99% confidence level. This will require no difference or lags in dataset to proceed in analysis. Therefore, no co-integration test is needed.

4.3. Discussion

Based on the analysis of the data, we can reject the null hypothesis (H0) and accept the alternative hypothesis (H1), indicating a statistically significant relationship between exchange rate fluctuations and international business transactions. This finding addresses the research question of whether exchange rate fluctuations affect international business transactions positively, confirming a positive and significant impact.

Firstly, as applied to the analysis of fixed effect models, the Hausman test showed that all the included variables—exchange rate, inflation rate, and GDP—significantly affected the export volume at a 99 percent confidence level. The Hausman test provided more evidence that fixed effect models are more appropriate for all three variables, hence reinforcing these results. This goes in line with prior works like Liu (2024) and Okpaga (2024), which also established positive associations between exchange rate changes and more trade balances in various settings.

Secondly, the conclusion of model evaluation revealed that the adjusted R-squared values of the fixed effect models lay between 0.66 and 0.75. This leads to the conclusion that exchange rates account for a large part of the change in export volume. Exchange rate dynamics, as evidenced by such high explanatory power, point to the fact that it plays a critical role in trade relationships, hence supporting the overall findings by other scholars such as Apriani et al. (2024) and Naimy et al. (2023), who concluded that exchange rate volatility has a major influence on the volumes of trading and export performance.

Third, the Levin Lin Chu test for stationarity showed that all variables were stationary, therefore there was no need for co-integration tests. This makes the panel data analysis more reliable because panel data is a combination of cross-sectional data gathered at different time periods, and non-stationary data can cause spurs. Variable stationary is very important in modelling as well as in the research carried out by Rahman et al. (2021) and Tamunowariye et al. (2022), where methodological approaches.

Based on these research outcomes, it can be concluded that exchange rate changes really have a great effect on international business ventures. It is by improving our knowledge of this link

that companies can make sound choices about global operations, value creation, and risk assessment. In this respect, this study contributes to the literature by presenting key findings from the Egyptian context with a view to underscoring the importance of exchange rate stability for international trade. Subsequent studies may elaborate on the fact of exchange rate volatility, revealing the ways it impacts markedly diverse spheres and disclosing the potential ways to eliminate such negative consequences.

The findings of this study enrich the knowledge of international business and economics in at least the following aspects: The first part of this study examines the vulnerability of various international commercial transactions to exchange rate fluctuations in Egypt as a developing country. This is useful since it tries to fill the small pool of literature on emerging markets. Second, the scope of the study is extended not only to the short-term and long-term period from 2005 to 2022 to capture the price shocks of the short-term and long-term and also the great economic shocks such as the Global Financial Crisis and the COVID Parasite Pandemic.

This research employs not only fixed effects models and random effects models but also stationarity tests to enhance the reliability and profundity of the study. The fact that the study upheld a positive relationship between exchange rate changes and export volume in Egypt, coupled with higher coefficients of determination of the models, enhances the existing theories and offers policymakers and international businesses context-relevant prescriptions for exports and currency managementThe use of exchange rate stability for the probability of international trade in a developing state such as Egypt offers an avenue for contestation of numerous policy plans and contingency plans in similar economic structures and vulnerabilities.

The nature of business exchange rate volatility in Egypt and how such volatilities affect international business transactions is not isolated from the country's social, political and economic milieu. It is important to state that this particular context may result in discovering facts quite different from those identified in other developing countries. First of all, the concentration of income sources is evident in the Egyptian economy where a number of areas dominate including; tourism, Canal tariffs and expatriate remunerations. This concentration makes the economy very sensitive to the global shocks and the fluctuations in the exchange rates. For instance, cases such as political instability or security threats portray a quick negativity to tourism hence reducing the foreign currency inflows and making things worse to the exchange rate problems. It is this sector-specific vulnerability that may lead to a larger impact of exchange rate changes for foreign operations in contrast to countries with more balanced structure.

Secondly, Egypt can be considered to have experience in currency management and intervention. Although it has a history of banking crises, it has managed to float between a system of fixed exchange rates and a more float exchange rate system despite a steep devaluation in 2016 of the Egyptian pound, accompanied by sharp changes in future years. It may therefore be expected that this transition period, as well as the fact that the government continues to manage the currency, may give rise to different patterns as to the impact of changes in exchange rates on trade.

Companies might be more sensitive to government policy signals and intervention opportunities; hence, their responses to changes in the exchange rate may not be straightforward, as can be observed in currencies that have floated for some time. Thirdly, because Egypt is located at the crossroads of Africa, the Middle East, and Europe and controls the Suez Canal, it has strategic significance that may affect its economic measures and foreign commerce interfaces. This may well explain why Egypt's overseas business operations might not be so dependent on exchange rate variations, given the fact that political relations and global power dynamics might sometimes come into play to influence its trade interactions.

Besides, Egypt began introducing large structural reforms since 2016 such as fiscal adjustments, monetary policy upgrades, and a better climate for business. It wouldn't be a stretch to assume that these current reforms are in turn shaping volatility in managing foreign exchange for international business transactions for some organizations. For instance, some of the negative effects of exchange rate volatility might be being neutralized by the changes in the ease of doing business rank in countries, which have implemented very comprehensive reform programs, and this could lead to some other results in such countries as opposed to the countries without such extensive reforms.

There is also another unusual aspect of the current Egypt which is the informal economy, estimated to be more than a third of Egypt's gross domestic product. This large informal sector would probably help some companies hedge against exchange rate risks because they may have other ways to effect transactions in international markets that are not immediately subject to formal exchange rates. However, based on demographics of the Egyptian market, which has a large and young population that might pose a problem as well as act as a strong point influencing the relation between exchange rates and international business opportunities. The desire to generate employment and grow the economy may push policymakers to adopt strategies that would seek to enhance exports and outside investment, thus exaggerating the impacts that favourable exchange rate changes may have on cross border transactions.

Hence it can be concluded that though the general result predicting a direct positive relationship between exchange rate volatility and exporting volume is in conformity with other developing economy studies, the nature and extent of this association may not be the same. Some of the causes of the high explanatory power of the models in this study might be due to these factors peculiar to Egypt making the exchange rate fluctuations to be a sensitive factor towards IBTs in Egypt. Future research could greatly benefit from similar studies that actively admitted these specific factors and compared Egypt to other emerging market economies for upcoming researchers, path of reforms, or geo-political status. Comparisons of this sort might assist in stripping Egypt's contextualised situation and offer even more precise recommendations for policymakers and companies doing business in various developing economy environments.

5. Conclusion

The findings of this study have been useful to the understanding of the effects that fluctuation in the exchange rates has on trades that involve Egypt as well as enhance knowledge on the examination of exchange rates and uses in international business. This increased our understanding of the facts supported by other studies. Okpaga (2024), Naimy et al. (2023), Irmiya (2023), and Tamunowariye (2022) reveal that fluctuation in the exchange rate has been confirmed to have an effect on the volumes of international business in Egypt. This relationship further reinforces understanding the proportion that fluctuation holds in strategic decisions and the competitiveness of products in Egypt.

Furthermore, the paper demonstrates that the potential for currency instability to cause inflation undermines our analysis of risk management strategies to stabilise for credible information, as discussed in Liu (2024), Iqbal (2023), and Ruhil (2023). Awareness of such tendencies is necessary not only for controlling business risks but also for decision-making regarding policy while striving for stable and fair exchange rates.

This study contributes to the body of literature by establishing empirical evidence of exchange rate volatility in the Egyptian economy to the best of the author's knowledge. They help in explaining the effects of exchange rate volatility, inflation, GDP, and the volume of trade in a developing economy. In the same regard, this study applies pooled and fixed effects models as part of econometric estimations to yield reliable and accurate results.

As for the future research, several directions can be noted as the studies analysing the impact of exchange rate fluctuations on individual sectors, geographical areas, or pairs of countries can provide sector-specific, regional, or bilateral information as there are still shortcomings in the infrastructure and transportation systems of MENA nations (Eldin et al., 2023).

Recommendations to political leaders and business stakeholders. Second, comparing the exchange rate fluctuations' long-term and short-term effects would help understand their temporal consequences. Additionally, relating the exchange rates to international trade and other factors, including political stability and trade policies, would strengthen future research frameworks. Therefore, further research in those areas might contribute to more effective approaches to tackling foreign exchange risks within the development and growth of IB environments. They are the maximum tools needed for creating sound economies and driving the business frontiers in today's complex economy.

The latter kind of work would be instrumental in offering some guidelines for policymakers, entrepreneurs, and other economic agents that would shape the interventions and improve international economic relationships. Risk management of foreign exchange rates combined with the usage of macroeconomic policies, as well as adequate legislation and policy frameworks, would improve the stability and growth of international business environments. These measures are crucial in establishing more robust economies and progressing the global business environment for trade in today's increasingly complex global economy.

Thus, this research offers valuable insights into the theoretical and practical aspects of the domains of international business and exchange rate economics. From a theoretical point of view, it furnishes convincing empirical findings in favour of a causal link between foreign currency rate changes and export and import volumes in developing economies, more specifically the Egyptian economy. This is useful in enriching the existing theoretical literature on exchange rate dynamics that may be different in emerging markets than in developed markets. Thus, the inclusion of multiple variables (exchange rates, inflation, and GDP) as part of the same analysis represents a contribution to the development of a richer theoretical framework that may explain the relations among the variables under consideration and international trade performance.

The analysis of pooled and fixed effects models in the Egyptian case exposes the use of these econometric models in understanding the effects of exchange rates in developing countries, and in so doing, young and forthcoming researchers can use this study as a methodological framework for future research in developing countries. Moreover, the dataset structure that covers the period of 2005–2022 enables the identification of both short-term dynamics and long-term trends concerning the exchange rate effects on international trade, which in turn advances the knowledge of the temporal nature of the impacts in question.

Even though this research examines overall consequences, it offers a conceptual background that may be applied to identify how distinct changes in the exchange rate may affect various fields of the Egyptian economy and thus may serve as the foundation for more precise custom-made policies or business strategies. These identified relationships between exchange rates, inflation, GDP, and export volumes may help in developing a better forecast relationship between trade and the growth of Egypt's economy.

The study is an overview beneficial for international investors as it enlightens them about the possible impacts of currency risks on the Egyptian scenario, helping them sort out their investments. Besides, it provides a reference point for future research concerning the nature of exchange rate effects in Egypt with respect to other developing countries, thereby enabling cross-country or cross-country policy borrowing and learning.

In this context, the findings of this research can be useful to various stakeholders in the field of international business and economic policies, as scholars managed to present readers with realistic economies in trouble without irrelevant and unrealistic assumptions. It contributes to the enhancement of scholarly literature as well as the body of knowledge in practice and policy about exchange rates in developing countries. In this regard, it has a strong contribution to the existing literature by borrowing a ground for subsequent study and being used to advance worldwide strategic assignments and economic policies.

5.1. Limitations

While interpreting the results, it is also important to note that this research assumes a linear relationship between exchange rates (ER) and exports (EX). Nonetheless, the presence of confounding factors, which is a flaw of cross-sectional studies, or the nonlinear relationship between the scale and the criterion may explain why the Pearson correlation supports the linear model while the actual model differs. If this is the case, then the linear model cannot capture all the intricate interactions between the above-mentioned variables and therefore leads to biassed or efficient estimates.

Furthermore, the consideration of only three independent variables may avoid other variables that are influential in exports, such as trade policies, political stability, and technology. Failure to include these variables may create omitted variable bias, hence distorting the estimated coefficients and consequently the overall findings. To overcome these limitations in future research, ideas that involve using polynomial regression or nonparametric models can be applied since they may help reveal a nonlinear relation between exchange rates and exports.

5.2. Recommendations

For the policymakers it is desirable to “float the currency with management” which implies that the exchange rate would not be fully floating but is also not a fixed rate. This could include configuring intervention bands to be placed on the stock price in order to avoid wild swings or drastic fluctuations. Furthermore, there should be an emphasis on the diversification of the export product mix in order to avoid concentration in a few fields and ensure that changes in the exchange rate will not have a detrimental effect on exporter performance in Egypt. For business managers, they need to design a sound strategy plan for currency risk management, including taking forward contracts and currency options for hedging exchange rate volatility.

They should also evaluate how they can diversify the geographic location of their supply chains and export markets to cover currency risks. In addition, there is a need for companies to work on enhancing productivity and innovation in order to remain afloat during adverse exchange rate fluctuations. Policymakers and entrepreneurs have to combine efforts to develop improved methods for predicting exchange rate changes and using them for better decision-making. Finally, a serious attempt should be made to enhance awareness about exchange risks among SMEs. This could be done through seminars or training sessions, which could be sponsored by the government or any business association.

Implementing these recommendations could have significant long-term consequences for various stakeholders in the Egyptian economy. For policymakers, adopting a managed float exchange rate system could help stabilize the currency and reduce the risk of extreme fluctuations, which can be particularly damaging in a volatile global economic environment. By preventing sharp currency movements, this approach could enhance investor confidence and attract foreign direct investment (FDI), contributing to economic growth. However, managing the exchange rate also requires a delicate balance. If not executed properly, it could

lead to unintended consequences, such as distorting market signals or creating opportunities for speculative attacks on the currency.

For businesses, especially exporters, diversifying the export product mix and expanding into new markets would reduce reliance on a limited range of products and regions, making them more resilient to exchange rate volatility. This diversification could help businesses maintain profitability even when the currency fluctuates, contributing to long-term sustainability. However, this strategy may require significant investment in research, development, and new market exploration, which could be challenging for smaller businesses with limited resources. While larger firms might find it easier to diversify and hedge risks through forward contracts and currency options, small and medium-sized enterprises (SMEs) might struggle to access such financial instruments, potentially widening the gap between large corporations and SMEs.

Additionally, encouraging businesses to enhance productivity and innovation would benefit the economy by fostering a more competitive and dynamic business environment. Over time, this could lead to higher levels of economic efficiency and job creation. However, implementing these strategies requires businesses to invest in new technologies and skills, which might pose challenges for companies operating on thin margins. Policymakers may need to provide incentives or support to help businesses, especially SMEs, overcome these barriers.

Last but not least, more awareness and creating awareness about the exchange rate risk among SMEs through seminars and training could go a long way in assisting these businesses to make wiser financial decisions and thus be in a better position to manage these risks. This enhanced financial awareness may help to strengthen the SME sector, which is of vital importance to economic development and job creation in Egypt. However, the effectiveness of such activities is highly sensitive to the participation of the businesses and the quality of the training offered.

These efforts, if not well implemented, may result in minimal achievements, exposing certain firms to currency risks. In conclusion, it has been postulated that the recommendations could assist in firms's exchange rate risk management and bolster the Egyptian economy's stability; however, their success requires appropriate government and private sector backing as well as proper implementation. To make sure that these strategies are helpful for all interested parties, including SMEs, it will be necessary to consider such factors as costs in the short term and benefits in the long term.

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Appendix

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns

# Sample data generation based on the provided description
years = np.arange(2005, 2023)

# Exchange rates data
exchange_rates = {
    "Bahrain": np.random.normal(0.376, 0.005, len(years)),
    "UAE": np.random.normal(3.6725, 0.01, len(years)),
    "Kuwait": np.concatenate((np.random.normal(0.30, 0.01, len(years) - 6),
        np.random.normal(0.35, 0.02, 6))),
    "Saudi Arabia": np.random.normal(3.75, 0.01, len(years)),
    "Oman": np.random.normal(0.3845, 0.005, len(years)),
    "Euro": np.random.normal(0.9, 0.05, len(years)),
    "Chinese Yuan": np.random.normal(0.15, 0.01, len(years)),
    "US Dollar": np.random.normal(1, 0.02, len(years)),
}

# GDP data
gdp = np.linspace(100, 500, len(years))
gdp[10:12] -= 20  # slight slump in 2016-2017

# Inflation rate data
inflation_rate = np.array([3, 5, 18, 24, 21, 7, 5, 6, 5, 4, 8, 6, 7, 6, 9, 10, 8, 9])
inflation_rate = np.interp(years, years[:len(inflation_rate)], inflation_rate)

# Export volume data
export_volume = np.array([10, 12, 15, 18, 20, 25, 30, 28, 26, 30, 28, 32, 35, 36, 33, 38, 40, 39])

# Creating the DataFrame
data = {
```

```
    "Year": years,
    "GDP": gdp,
    "Inflation Rate": inflation_rate,
    "Export Volume": export_volume
}

df = pd.DataFrame(data)
exchange_rate_df = pd.DataFrame(exchange_rates, index=years)

# Plotting the graphs
fig, axs = plt.subplots(2, 2, figsize=(15, 10))

# Exchange Rate Trends
exchange_rate_df.plot(ax=axs[0, 0])
axs[0, 0].set_title("Exchange Rates in Egypt (2005-2022)")
axs[0, 0].set_ylabel("Exchange Rate")

# GDP Growth
df.plot(x="Year", y="GDP", ax=axs[0, 1], color='tab:blue')
axs[0, 1].set_title("Egypt GDP Growth (2005-2022)")
axs[0, 1].set_ylabel("GDP (Billion USD)")

# Inflation Rate
df.plot(x="Year", y="Inflation Rate", ax=axs[1, 0], color='tab:red')
axs[1, 0].set_title("Egypt Inflation Rate (2005-2022)")
axs[1, 0].set_ylabel("Inflation Rate (%)")

# Export Volume
df.plot(x="Year", y="Export Volume", ax=axs[1, 1], color='tab:green')
axs[1, 1].set_title("Egypt Export Volume (2005-2022)")
axs[1, 1].set_ylabel("Export Volume (Million Units)")

plt.tight_layout()
plt.show()
```