Revisiting The Relationship Between Exchange Rate Market And The Egyptian Stock Market: An Analysis Based On Usd/Egp Forward Exchange Rates

Esam Aldin M. Algebaly
Associate Professor, Business Administration Department, Faculty of Commerce, Tanta University, Egypt
ORCID ID: http://orcid.org/0000-0002-6602-8917
Currently working as a teaching staff in the Finance and Economics Department, College of Business Administration, Taibah University, Saudi Arabia.

Abstract

The purpose of this research is to examine the bidirectional relationship between the non-deliverable forward (NDF) exchange rates of the US dollar against the Egyptian pound (USD/EGP) and the Egyptian stock market, proxied by the EGX30 index. It also examines the asymmetry of the effects of positive and negative shocks in each market on the conditional volatility of returns in the other market over the period from November 2016 to July 2024 mainly based on daily data. The Asymmetric BEKK-GARCH model is employed to achieve the purpose of research. A significant bidirectional relationship between the forward USD/EGP exchange rate market and the Egyptian stock market is documented, with asymmetrical effects of positive and negative at least from the Egyptian stock market to forward exchange rate market. These results are still robust after using different model specifications, considering structural breaks, and employing different NDF maturity dates. In addition, an evidence of significant volatility spillover is found from the forward exchange rate market to the Egyptian stock market when real exchange rates are used instead of nominal ones using monthly data. The findings of this study are useful for portfolio managers, prospective investors, and policymakers, and several ideas for future research are suggested.

Article Classification – Original scientific paper.

Keywords:. Non-deliverable forward contracts, US dollar/ Egyptian Pound (USD/EGP) exchange rate, Egyptian pound devaluation, The Egyptian stock market, Asymmetric BEKK-GARCH model.

JEL classification – G10, G11,

إعادة دراسة العلاقة بين سوق سعر الصرف وسوق الأسهم المصري:تحليل معتمد على أسعار الصرف الآجلة للدولار مقابل الجنيه المصري

د. عصام الدين محمد علي الجبالي

أستاذ مساعد بقسم إدارة الأعمال، كلية التجارة، جامعة طنطا

الغرض من هذا البحث هو دراسة العلاقة التبادلية بين أسعار الصرف الآجلة غير القابلة للتسليم (NDF) للدولار الأمريكي مقابل الجنيه المصري (USD/EGP) وسوق الأسهم المصري، ممثلة بمؤشر .EGX30 كما يفحص البحث عدم التماثل في تأثير الصدمات الإيجابية والسلبية في كل من السوقين على التقلبات الشرطية للعوائد في السوق الآخر خلال الفترة من نوفمبر ٢٠١٦ إلى يوليو ٢٠٢٤، وذلك بالاعتماد بشكل أساسي على البيانات اليومية. يتم استخدام نموذج-Asymmetric BEKK GARCH لتحقيق هدف البحث. وتوصلت الدراسة إلى وجود علاقة ثنائية الاتجاه ذات دلالة إحصائية بين سوق العقود الآجلة غير القابلة للتسليم لسعر الصرف (USD/EGP) وسوق الأسهم المصري، مع تأثيرات غير متماثلة للصدمات الإيجابية والسلبية، على الأقل من سوق الأسهم المصري إلى سوق العقود الآجلة للصرف. وتظل هذه النتائج قوية حتى بعد استخدام نماذج مختلفة، وأخذ الانكسارات الهيكلية في الاعتبار، واختبار تواريخ استحقاق مختلفة للعقود الآجلة غير القابلة للتسليم. بالإضافة إلى ذلك، تم التوصل لدليل على انتقال كبير للتقلبات من سوق العقود الآجلة لسعر الصرف إلى سوق الأسهم المصري عند استخدام أسعار الصرف الحقيقية بدلاً من الاسمية، وذلك بالاعتماد على البيانات الشهرية. وتوفر نتائج هذه الدراسة معلومات قيمة لمديري المحافظ الاستثمارية والمستثمرين المحتملين وصناع السياسات، كما تطرح عدة أفكار للأبحاث المستقبلية.

الكلمات المفتاحية: العقود الآجلة غير القابلة للتسليم؛ سعر صرف الدولار الأمريكي الجنيه المصري؛ تخفيض قيمة الجنيه المصري؛ سوق الأسهم المصري؛ نموذج BEKK-GARCH غير المتماثل

Introduction

The relationship between exchange rates and stock markets has been a central topic in international finance and macroeconomic theory for many years. With the increasing interconnectedness of global financial markets, understanding the dynamics between exchange rates and stock market performance has become ever more critical. This relationship is inherently complex, influenced by a multitude of factors including trade balances, capital flows, and investor sentiment, all of which can significantly affect the behavior of exchange rates and stock prices. The traditional perspective, supported by models such as Dornbusch's (1976) overshooting model, posits that exchange rate fluctuations can directly influence a country's stock market by altering the competitiveness of its exports and the value of foreign earnings when repatriated. In addition, the direction of relationship could be from stock market to exchange rate market according to as the Stock-Oriented Model.

However, empirical evidence on this relationship has been mixed, with studies yielding varying results, some researchers have identified a positive relationship between exchange rates and stock prices (Vajrapatkul, 2023; Yang et al., 2024), while others have found a negative relationship (El-Masry & Badr, 2020; Sreenu, 2023).

The inconsistencies in empirical findings have prompted scholars to explore the possibility of asymmetries and nonlinearities in the exchange rate-stock market relationship (Bahmani-Oskooee & Saha, 2018; Effiong & Bassey, 2019). The impact of exchange rates on stock prices may vary depending on the direction and magnitude of exchange rate movements, as well as the broader economic context. Additionally, the influence of exchange rates on stock markets may differ between developed and emerging economies due to variations in market structure, capital mobility, and investor behavior (Sokhanvar et al., 2024; Vajrapatkul, 2023).

In the Egyptian context, existing literature on the relationship between exchange rates and stock markets presents a heterogeneous set of findings. Some studies, such as those by El-Masry & Badr (2020), suggest a significant causal relationship between these markets during periods of political stability. Conversely, other research, like that of Aimer (2019), reports no significant relationship, particularly in the post-revolutionary period. Moreover, the study by Algebaly & Abd Elmoghny (2024) finds bidirectional relationship between exchange rate and stock markets. These divergent findings highlight the necessity for a more nuanced analysis that considers the asymmetric effects of both positive and negative shocks on these markets.

This study seeks to contribute to the understanding of the relationship between the USD/EGP exchange rate and the Egyptian stock market by pursuing several key objectives. First, it aims to examine the impact of returns and volatilities in forward USD/EGP exchange rates on the performance of the Egyptian stock market. Second, the research investigates the reverse relationship, analyzing how the returns and volatilities of the Egyptian stock market influence the forward USD/EGP exchange rate market. Finally, the study explores the asymmetric effects of positive and negative shocks in the forward USD/EGP exchange rate market on the Egyptian stock market, and vice versa.

A significant contribution of this research lies in its focus on Egypt, a country characterized by substantial volatility in the USD/EGP exchange rate, particularly with regard to forward exchange rates. The selection of Egypt as a case study is especially pertinent given the frequent and often dramatic fluctuations in its exchange rate, which can have profound implications for the country's financial markets. Another innovative aspect of this study is its reliance on forward USD/EGP exchange rates rather than the more commonly examined spot exchange rates. To the best of our knowledge, this is the first study to employ forward exchange rates in the analysis of the Egyptian market. Forward prices are believed to more accurately reflect the true value of the exchange rate, aligning more closely with rates observed in the parallel (black) market, and differing significantly from the spot prices reported by the official banking system. This approach facilitates a more precise examination of the exchange rate's impact on the stock market. Furthermore, the study is comprehensive in its scope, encompassing all major devaluations of the Egyptian Pound from 2016 to 2024. It also accounts for the impact of significant global and regional events during this period, including the COVID-19 pandemic, the Russia-Ukraine war, and the Gaza conflict.

Literature Review

In exploring the relationship between stock market performance and foreign exchange markets, various studies have produced diverse findings across different regions and time periods, providing valuable insights into these complex interactions. This section is divided into two parts. The first part reviews literature that examines the relationship between exchange rates and the stock market in Egypt, or in studies including Egypt in their samples. The second part encompasses studies on exchange rates and stock market interactions in countries other than Egypt.

The study by Eissa et al. (2010) is one of the earlier related studies that explored the relationship between exchange rate changes and stock returns at both aggregate and sectoral levels in Egypt, Morocco, and Turkey from 2001 to 2007. Using a Multivariate GARCH model with daily data, they found no general relationship between overall stock index returns and nominal exchange rates. However, at the sectoral level, there were significant reciprocal relationships between exchange rate volatility and stock returns, especially in Egypt and Turkey. In Egypt, the study found bidirectional spillovers between exchange rate changes and stock returns in sectors like basic materials, construction, and telecommunications, while exchange rate changes influenced returns in the financial and consumer services sectors.

The relationship between exchange rates and stock prices was also investigated by Aimer (2019) in a sample from MENA region, including Egypt. Using the GARCH model, the study indicated no significant relationship between exchange rate fluctuations and stock prices in the Egyptian market, which contrasts with the significant relationships observed in other Middle Eastern markets such as Dubai and Saudi Arabia. In addition, Abouwafia & Chambers (2015) analyzed the effects of monetary policy and real exchange rate shocks on stock market performance in five Middle Eastern countries—Egypt, Kuwait, Oman, Saudi Arabia, and Jordan—over the period from November 2003 to December 2012. Utilizing a Structural Vector Autoregressive model, they found that real exchange rates had a notable impact on stock prices in Egypt and Kuwait, with the effect varying depending on whether the firms were exporters or importers.

The causal relationship between stock prices and exchange rates was examined in six Middle Eastern countries: Egypt, Kuwait, Jordan, Oman, Saudi Arabia, and Iran by Parsva & Lean (2017) from January 2004 to September 2015. Using monthly data and employing Granger Causality Test, VAR, and VECM models, they found that exchange rate volatilities significantly impact stock prices in the Middle Eastern financial markets. For Egypt, the causality direction was from the Egyptian stock prices to exchange rates in both the short and long term. Auwal & Sulaiman (2017) also investigated the impact and nature of exchange rate volatility on stock returns in five emerging African markets: Egypt, Mauritania, Nigeria, South Africa, and Tunisia, from May 2, 2007, to November 30, 2015. Using the MGARCH and DCC models with daily data, they found that exchange rate and stock market volatilities were persistent across all countries in the sample. Significant volatility spillovers were observed in only two countries, with a negative conditional correlation between exchange rates and stock returns in Egypt and a positive one in South Africa.

Moreover, Živkov et al. (2021) examined the nonlinear bidirectional volatility spillover between stock markets and exchange rates in Egypt, South Africa, Morocco, and Nigeria from January 2005 to December 2019 (January 2012 to December 2019 for Nigeria). Using wavelet decomposition, MS-GARCH, and quantile regression, they found that volatility spillovers were generally stronger from exchange rates to stock markets. The impact of the Egyptian stock market index (EGX30) on the Egyptian pound was minimal, except during extreme events like the 2016 devaluation, where the effect remained modest. Furthermore, Moussa & Delhoumi (2022) examined the asymmetric effects of exchange rate and interest rate fluctuations on stock market returns across five MENA countries, including Egypt, from June 1998 to June 2018, using a nonlinear ARDL model. Their study revealed that stock returns are sensitive to changes in both interest rates and exchange rates. They observed asymmetric effects where stock returns in Egypt and Tunisia were more negatively impacted by depreciation of the local currency compared to appreciation. The findings suggest that maintaining relatively low real interest rates and strengthening the local currency against the dollar could enhance market returns in the MENA region.

In contrast to the previously discussed studies, which examined the relationship between exchange rates and stock returns in a group of countries including Egypt, the studies of Elhendawy (2017), Ahmed (2020), El-Masry & Badr (2020), Kamal (2022), and Algebaly & Abd Elmoghny (2024), among others, are only applied on Egypt. More specifically, Elhendawy (2017) investigated the volatility spillover between Egypt's stock market and exchange rates from January 2003 to June 2016. Using a GARCH (1, 1) model and Granger causality tests, the study found a significant inverse relationship between stock prices and the USD/EGP exchange rate, with the effect flowing primarily from the stock market to the exchange rate.

Similarly, Ahmed (2020) explored the impact of exchange rate fluctuations on stock prices in Egypt across two different exchange rate regimes from January 6, 2014, to August 9, 2018, using a nonlinear ARDL model. The study revealed that during the soft peg period, both positive and negative changes in the EGP/USD exchange rate affected stock returns, with currency depreciation having a more pronounced impact than appreciation. However, in the free float period, short-term asymmetries in exchange rate effects diminished, although long-term asymmetries persisted.

El-Masry & Badr (2020) undertook an analysis of the causal relationship between stock market performance and the foreign exchange market in Egypt during 2009–2016, with a division of the period into pre- and post-January 25th Revolution phases. Based on co-integration, Vector Autoregression (VAR) techniques, and Granger causality tests, they concluded that while significant causal relationships existed between the foreign exchange market and stock market indices before the revolution, these relationships dissipated post-revolution. The study suggests that political instability may disrupt previously established market linkages.

Kamal (2022) investigated the interactions between exchange rates, stock returns, inflation rates, and economic growth in Egypt from 2012 to 2022 using ARDL and Granger causality tests. His research revealed that there are significant long-term relationships among these variables. Specifically, stock market returns were found to drive fluctuations in exchange rates, indicating that a strong stock market positively influences the stability of the local currency. Additionally, exchange rate volatility was shown to affect both economic growth and inflation rates. This suggests that the performance of the stock market plays a crucial role in shaping economic conditions and exchange rate stability in Egypt.

In a more recent and related study, Algebaly & Abd Elmoghny (2024) examined the bidirectional relationship between the USD/EGP exchange rate market and the Egyptian stock exchange market. The research also explored whether positive and negative shocks in one market have asymmetric effects on the volatility of returns in the other market. The study identified two structural breaks in the exchange rate series during this period. To address these complexities, the researchers employed the Asymmetric BEKK-GARCH model with structural breaks. The findings revealed a significant bidirectional relationship between the exchange rate market and the Egyptian stock market, with asymmetric volatility responses in one market to shocks in the other. These results were consistent across different model specifications. However, the relationship did not hold when the real exchange rate was used instead of the nominal exchange rate.

The second group of studies examines the relationship between exchange rate market and stock market in countries other than Egypt. The following studies are some selected related studies to our study. Mahmoudinia & Mostolizadeh (2023) explored the asymmetric effects of exchange rates and stock market prices on Iran's housing inflation using ADRL and NARDL models. Their findings indicated a significant co-integration relationship, with both positive and negative changes in stock prices and exchange rates exerting distinct effects on housing prices, demonstrating the importance of considering asymmetric relationships in economic modeling.

Similarly, Vajrapatkul (2023) investigated the dynamic interplay between the Baht/USD exchange rate, the US discount rate, and the Stock Exchange of Thailand index. Using a vector error correction model, the study revealed long-run relationships between these variables and identified bidirectional short-run relationships. Moreover, Sreenu (2023) focused on the impact of exchange rate and inflation rate on market returns volatility in India, using ARDL and GARCH models. His findings revealed significant long-term relationships between market returns and exchange rates, while short-term relationships were found to have negative effects on stock market returns.

Other researchers have broadened the scope of this inquiry to various international contexts. For instance, Kaur et al., (2024) examined the long-term association between stock market indices and exchange rates for BRICS economies using Johansen co-integration tests and VECM models. Their analysis confirmed the presence of long-term associations among these indices and highlighted the significance of understanding these relationships for economic policy and international capital budgeting decisions.

Sokhanvar et al., (2024) also offered a comparative analysis of the exchange rate-stock market nexus in four advanced economies, particularly before and during the war in Ukraine. The study employed time-varying Granger causality and DS-ARDL techniques, finding that the causality predominantly flowed from stock market indices to exchange rates, regardless of whether the economy was a commodity exporter or importer. This consistency suggests that stock market performance may play a leading role in shaping exchange rate dynamics in advanced economies during periods of geopolitical stress.

Furthermore, Yang et al., (2024) explored the relationship between the offshore RMB exchange rate and stock index futures in China. By employing Granger causality tests and constructing a GARCH conditional volatility model, the study found that changes in the offshore RMB exchange rate had a significant impact on stock index futures, highlighting the critical role of investor sentiment and market liquidity in shaping these interactions.

In conclusion, based on the reviewed studies, whether those conducted on Egypt or those applied on other countries, there is a noticeable lack of consensus in the findings, and no definitive conclusion has been reached regarding the relationship between exchange rate and stock markets. This inconsistency is not only across different studies but also within a single study that includes samples from multiple countries. This divergence in results can be attributed to several factors: variations in the exchange rate systems applied during the study periods, differences in the time horizons each study targets—whether short-term or long-term—and discrepancies based on the sector type and the nature of companies within those sectors. Additionally, the varying characteristics of stock markets in each country, such as whether the dominant companies in the market are exporters or importers, play a role.

The main contributions of the current study are crystallized in several key points. First, using forward exchange rates instead of spot ones to examine the relationship exchange rate and stock markets. Considering the significant difference between the spot and forward exchange rates, which at times exceeded 20 Egyptian pounds. The disparity between these rates can reflect market expectations of future currency movements, hedging strategies, or speculative activities, all of which can have profound implications for the relationship between exchange rates and stock market returns. Second, the novelty of the time period, extending from November 2016 to July 2024. This period encompasses crucial global and local developments, such as the COVID-19 pandemic in 2020 and the war initiated by Russia against Ukraine in 2023. The study also covers five devaluations of the Egyptian Pound over the period of study. Third, the study employs a statistical model that aligns with the research objectives, namely the asymmetric BEKK-GARCH model used in a few related studies such as the study by Algebaly & Abd Elmoghny (2024). Furthermore, the nominal exchange rate is commonly used in literature, with only a few studies using the real exchange rate (such as the studies by Abouwafia & Chambers, 2015; Moussa & Delhoumi, 2022; Algebaly & Abd Elmoghny, 2024). While the current study measures forward exchange rate returns based on nominal exchange rates as is common, real exchange rates will also be used to check the robustness of the results.

Hypotheses Development:

In this section, hypotheses are developed based on the theoretical framework, supported by relevant previous studies. We will begin by presenting models, justifications, and studies that support the impact of exchange rate market changes on the stock market. This will be followed by a theoretical rationale and studies that support the reverse relationship, demonstrating the effect of stock market changes on the exchange rate market. This section concludes with an interpretation and explanation of studies that support the asymmetric impact of positive and negative shocks from one market on the volatility of returns in the other market.

The Expected Impact of Exchange Rate Changes on the Stock Market:

Several theories are adopted to justify the impact of exchange rate market on stock exchange market. The theories of Purchasing Power Parity (PPP) and Interest Rate Parity (IRP) could be used to examine the complex relationship between exchange rates and stock prices. Both PPP and IRP illustrate the interconnectedness between exchange rates and stock prices. PPP highlights the need for exchange rate adjustments to address inflation disparities, which impacts the competitiveness and profitability of companies engaged in international trade, thereby affecting stock prices. IRP, on the other hand, shows how interest rate differentials influence capital flows and exchange rates, impacting stock market performance through changes in investment attractiveness and returns (Willett, 2024; Ali et al., 2021; Witte, 2012).

The impact of exchange rate fluctuations on stock returns can be interpreted through the Arbitrage Pricing Theory (APT), introduced by Stephen Ross in 1976. APT is a multi-factor asset pricing model that predicts asset returns based on macroeconomic factors reflecting systematic risks. The theory does not specify the number or nature of these factors. Since exchange rates are a significant macroeconomic variable, studying their impact on stock returns is an application of this theory.

Additionally, the effect of exchange rate changes on the stock market can be explained by the Flow-Oriented Model, proposed by Dornbush and Fisher in 1980, known also as the Goods Market Approach or the Traditional Approach. This model assumes that exchange rates indirectly influence the stock market through the goods market. It posits that exchange rates affect trade balances and international competitiveness, as well as borrowing costs for companies using foreign financing sources. Consequently, changes in exchange rates impact current and future cash flows of companies, influencing their profitability and stock prices (Algebaly & Abd Elmoghny, 2024).

In addition, exchange rate fluctuations affect macroeconomic indicators and have varying impacts depending on whether a company is an exporter or importer. For exporting companies, a depreciation of the local currency is expected to have a positive impact, as it attracts foreign investors to local exports, increasing demand, revenue, and profits, thereby raising stock prices. Conversely, for companies operating solely in the domestic market or relying on imported inputs, a depreciation of the local currency raises input costs, reduces profits, and negatively affects stock prices (Abowafia, 2015). Therefore, it is expected that a depreciation of the local currency will have a positive effect on stock markets dominated by exporting companies and a negative effect on markets dominated by importing companies. This indicates that exchange rate movements produce asymmetric effects between exporting and importing companies (Algebaly & Abd Elmoghny, 2024).

Furthermore, exchange rate changes also influence the values of accounts payable and receivable. If a company has debts in a foreign currency and the exchange rate for that currency increases, the debt burden rises. Conversely, if the company has receivables in a foreign currency and the exchange rate increases, the value of those receivables increases (Elhendawy, 2017).

Regarding the direct impact of exchange rates on the stock market, a depreciation of the local currency, assuming other factors remain constant, can attract foreign investors who find local stock prices favorable, leading to increased demand and higher stock prices. For local investors holding cash in the local currency, they might seek alternative investments to offset currency depreciation, potentially increasing demand for stocks and raising their prices. Conversely, local investors might reduce their investments in local stocks in favor of foreign currency investments, leading to lower stock prices and further depreciation of the local currency. Exchange rate fluctuations can also affect stock prices through their impact on the discount rate or the required rate of return on investments. Significant exchange rate fluctuations can lead investors to demand higher returns to compensate for increased investment risk, which may result in reduced company investments and lower stock prices. Additionally, changes in the discount rate, influenced by interest rates and inflation expectations affected by exchange rate movements, can also impact stock prices (Algebaly & Abd Elmoghny, 2024).

Studies have supported both the Flow-Oriented Model and the Arbitrage Pricing Theory, showing that the relationship flows from the exchange rate market to the Egyptian stock market. For instance, Eissa et al. (2010) confirmed the impact of exchange rate changes on various sectors of the Egyptian stock market, while Živkov et al. (2021) found that fluctuations move more strongly from the exchange rate market to the stock market rather than vice versa. El-Masry & Badr (2021) observed that exchange rate changes affect the Egyptian stock market mainly before the revolution. In addition, volatility spillover from exchange rate market to the Egyptian stock market is documented in the study of Algebaly & Abd Elmoghny (2024).

Based on the theoretical justifications and previous empirical studies, and using forward exchange rate instead of the spot one, the first hypothesis of the study can be formulated as follows:

H1: *" There are significant shocks and volatility spillovers of forward USD/EGP exchange rate returns to the volatility of the Egyptian stock market returns".*

This primary hypothesis can be broken down into the following sub-hypotheses:

H1a: There is significant shocks spillover of the forward USD/EGP exchange rate returns to the volatility of the Egyptian stock market returns".

H1b: "There is significant volatility spillover of the forward USD/EGP exchange rate returns to the volatility of the Egyptian stock market returns".

The Expected Impact of Stock Returns Changes on the Exchange Rate Market:

The relationship may also move in the opposite direction, from the stock market to the exchange rate market. Stock price fluctuations can provide insights into exchange rate fluctuations, as outlined in the Portfolio-Balance Approach, also known as the Stock-Oriented Model. This theory suggests that the relationship flows from the stock market to the exchange rate market. When the stock market is booming, it leads to higher local stock prices, attracting foreign capital inflows and increasing demand for the local currency, thereby raising its value. Conversely, if the stock market is declining due to increased pessimism about the macroeconomic outlook, foreign investments may exit the market, putting pressure on the local currency and causing its value to fall. For this effect to occur and for stock markets to influence exchange rates, the stock market must be large, liquid, and actively traded (Auwal & Suliman, 2017; Chamber & Abouwafia, 2015).

Studies supporting the impact of stock market fluctuations on the value of the Egyptian pound include Elhendawy (2017) and Parsva & Lean (2017). Additionally, Agyei et al. (2022) found a positive effect of stock returns on the value of the Egyptian pound during the COVID-19 pandemic. Kamal (2022) concluded also in his study that stock market returns are the primary driver of exchange rate fluctuations in the Egyptian market, rather than the reverse. In addition, significant shocks and volatility spillovers of the Egyptian stock market returns to the volatility of the USD/EGP exchange rate returns were found in the study of Algebaly & Abd Elmoghny (2024).

Based on the above, the second hypothesis of the study is formulated as follows:

H2: *There are significant shocks and volatility spillovers of the Egyptian stock market returns to the volatility of the forward USD/EGP exchange rate returns*."

This second main hypothesis can be divided into these two hypotheses:

H2a: "There is significant shocks spillover of the Egyptian stock market returns to the volatility of the forward USD/EGP exchange rate returns".

H2b: "There is significant volatility spillover of the Egyptian stock market returns to the volatility of the forward USD/EGP exchange rate returns

If both the first and second hypotheses are accepted, this indicates a bidirectional relationship between the exchange rate market and the stock market. This bidirectional relationship has been confirmed by Eissa et al. (2010) in sectors such as basic materials, construction, and communications. Additionally, this bidirectional relationship has been supported by Auwal & Sulaiman (2017) in both Egypt and South Africa, by El-Masry & Badr (2021) using aggregate sample data, and by Algebaly & Abd Elmoghny (2024). Therefore, the third hypothesis is as follows:

H3: *There are significant bidirectional spillovers of shocks and volatility of returns between the Egyptian stock market and the forward USD/EGP exchange rate market."*

The Asymmetric Effect of Positive and Negative Shocks from One Market on the Volatility of Returns of the Other Market:

Examining the asymmetric impact of positive and negative shocks from the exchange rate market or the stock market on the volatility of returns in the other market is another important aspect explored by a few studies on the relationship between these markets. Behavioral explanations for the asymmetry in the impact of positive and negative exchange rate shocks on stock prices suggest that investor reactions are often exaggerated in response to negative news compared to positive news. This results in stock returns being more affected by currency depreciations than by appreciations. Additionally, the asymmetry might arise from the different ways a country responds to currency appreciation versus depreciation, leading to varying effects on stock prices and returns. Studies of Ahmed (2020), Moussa & Delhoumi (2022), and Algebaly & Abd Elmoghny (2024) have confirmed the asymmetry in the impact of positive and negative exchange rate changes on the returns of the Egyptian stock market, indicating a nonlinear relationship between exchange rate changes and stock returns. Moreover, the study by Algebaly & Abd Elmoghny (2024) has also confirmed the asymmetric impact of the positive and negative shocks in the other direction from exchange rate market to the Egyptian stock market. Therefore, the current study tests the following hypothesis:

H4: *Positive and negative shocks of stock market returns (forward USD/EGP exchange rate market returns) on the returns volatility of the USD/EGP forward exchange rate market returns (stock market returns) are asymmetric.*

This main hypothesis includes two hypotheses:

H4a: "Positive and negative shocks of stock market returns on the returns volatility of the USD/EGP forward exchange rate market returns are asymmetric.

H4b: "Positive and negative shocks of forward USD/EGP exchange rate market returns on the returns volatility of the stock market returns are asymmetric.

In light of the theoretical framework presented, it is evident that there is a lack of consensus regarding the direction of the relationship—whether it is positive or negative—between exchange rates and their fluctuations on one hand, and the stock market and its fluctuations on the other, both theoretically and empirically. Consequently, the hypotheses have been formulated in their alternative form, without specifying the direction of the relationship, in line with the uncertainty surrounding the direction of this relationship.

Data and Sample

This section discusses data used in the study and their sources, as well as identifying the samples used in the study. Afterwards, research methods are discussed at the end of this section.

This study is conducted on Egypt because of the high volatility of the Egyptian Pound values; particularly in the non-deliverable forward outright contracts (NDF). This volatility is coincided with the series of the Egyptian Pound recent devaluations from 2016 to 2024. Moreover, the Egyptian stock market ranks among the largest in the MENA region in terms of the number of listed firms and market capitalization and. Egypt is also consistently included in studies that examine stock markets in the MENA region and Arab countries.

The Central Bank of Egypt announced five devaluations of the Egyptian Pound over the period from 2016 to the last available data in July 2024. These devaluations are in November 2016, March 2022, October 2022, January 2023, and in March 2024. Following the study of Algebaly & Abd Elmoghny (2024), which is the most related and recent study to our study, daily Egyptian pound and EGX30 values are collected from the 6th of November 2016; which has the first available data after the first devaluation in 2016. Unlike the study by Algebaly & Abd Elmoghny (2024) which uses spot exchange rates and ends at the 30th November 2023, the present study relies on forward exchange rates and ends at the 15th of July 2024.

Whereas data related to exchange rates are collected from Bloomberg database, the values for the EGX30 index are gathered from the Egyptian Stock Exchange website. The Consumer Price Index (CPI) values for both the Arab Republic of Egypt and the United States of America are obtained from the World Bank (under the title "Headline Consumer Price Index") to calculate the real exchange rate on a monthly basis from November 2016 to the most recent data available in 15 July, 2024.

Variables Measurement and Descriptive Study

Variables Measurement:

The forward USD/EGP exchange rate returns, and stock market returns are the variables of interest in this study. Since the bidirectional relationship is examined, both of these two variables could be a dependent or an independent variable. Regarding the forward USD/EGP exchange rate, the Egyptian three-month non-deliverable forward outright (NDF) rates are used. The one-month and three-month maturities are popular due to their alignment with standard business cycles and liquidity considerations in the foreign exchange markets. In addition, the three-month maturity, in particular, is often highlighted in studies and market reports as a benchmark period for NDF contracts. Thus, three-month maturity is chosen.

EGX30 Index is the main market index in the Egyptian stock exchange. In addition, Algebaly & Abd Elmoghny (2024) find that there is no significant difference when either using EGX30 data or using other alternative Egyptian stock indices such as EGX30 TR index and EGX30 Capped index. Therefore, the EGX30 index is used as the proxy of the Egyptian stock market in this study.

To Calculate the real exchange rate, which considers the relative prices in the USA and Egypt, the nominal exchange rate is divided by the ratio of CPIs in the USA and Egypt, respectively. Monthly data are required to obtain real exchange rates because CPI data are available monthly, not daily. Table (1) presents the variables of study and their measurements. Following Algebaly & Abd Elmoghny (2024) among others, the returns of exchange rates and EGX30 values are expressed in the logarithmic form.

Table (1): The measurement of study variables

Variable	Symbol	Variable Definition
Nominal spot USD/EGP exchange rate	EX	The value of the nominal spot USD/EGP exchange rate
Nominal spot USD/EGP exchange rate return	EXR	The logarithmic return of the spot USD/EGP rates
Nominal forward USD/EGP exchange rate	M3	The value of the nominal forward USD/EGP exchange rate
Nominal forward USD/EGP exchange rate return	M3R	The logarithmic return of the three-month non-deliverable forward outright (NDF) USD/EGP rates
EGX30 return	EGX	The value of the EGX30 Index
EGX30 return	EGXR	The logarithmic return of the EGX30 values

Descriptive Study

Table 2 presents the descriptive statistics of variables of interest with daily frequency. The definitions of the variables in these three tables are shown in Table 1. It is evident that the mean, median and standard deviation values of exchange rates are greater in the forward market (M3) compared to those of the spot market (EX). Additionally, the mean daily returns of spot exchange rates, forward exchange rates, and the EGX30 returns are nearly the same (0.06%). Although the maximum values of forward exchange rates are greater than those of spot exchange rates by EGP 4.55 based on daily data (by EGP 12.98 based on monthly data), the mean or the median differences are less than EGP 2. That is because the variability of spot and forward exchange rates and the difference between these two rates varies across time. To illustrate, daily forward exchange rates are greater than daily spot exchange ones by at least EGP 5 from the 26th of October 2023 till the date of the fifth Egyptian Pound devaluation since 2016 on the 6th of March 2024.This difference ranges from EGP 5.1 to EGP 23.3 during this period with a mean of EGP 11.9 and a median of EGP 10.8.

Table (2): Descriptive Statistics

Variable	EX	M3	EGX	EXR	M3R	EGXR
Mean	20.73	22.2	14649.61	0.06%	0.06%	0.06%
Median	17.72	18.17	13630.44	0.00%	0.00%	0.06%
SD	7.75	9.36	4692.12	1.39%	1.05%	1.42%
Min	15.24	15.8	8657.50	-5.62%	-6.88%	-9.81%
Max	49.53	54.08	33382.51	47.27%	16.05%	10.17%
Skewness	2.097	1.789	1.702	23.886	4.416	-0.274
Kurtosis	6.987	5.050	5.540	768.529	64.312	8.819
JB (P. Value)	2489 (0.000)	1264 (0.000)	1341 (0.000)	43707019 (0.000)	285073 (0.000)	2538 (0.000)
N	1784	1784	1784	1783	1783	1783

The skewness (4.416) and kurtosis (64.312) of the three-month NDF forward USD/EGP exchange rate returns (M3R) are different from 0 and 3, respectively. The kurtosis (8.819) of the EGX30 index returns (EGXR) is also different from 3. Thus, it is expected that these two variables are not normally distributed. This result is confirmed by rejecting the null hypothesis of

Jarque-Bera (JB) test at the 1% significance level, which assumes that returns are normally distributed.

In order to test the residuals serial correlation, Breusch-Godfrey (BG) test is used at 6 and 12 lags. The null hypothesis which assumes no serial correlation of residuals is rejected for both variables M3R and EGXR at the 1% significance level. In addition, Breusch-Pagan (BP) test is employed to check the heteroskedasticity problem. It is found that residuals are heteroskedastic at the 1% significance level relying on 6 and 12 lags**.** These results show that the linear regression model is not suitable for this study. Therefore, the non-linear BEKK GARCH (1, 1) is suitable for achieving the study objectives, and will be used in this study.

The correlation coefficient between the values of the forward USD/EGP exchange rates (M3) and the values of EGX30 index (EGX) is nearly 88%. It nearly equals 84% when using Spot exchange rates (EX) instead of the forward ones. This high correlation between exchanges rates and the stock market index predicts significant relationship between these two variables. Additionally, the correlation between the values of the forward and spot exchange rates is very high (96%). Thus, similar results are expected when using forward exchange rates instead of spot ones. Moreover, both augmented Dickey-Fuller (ADF) and Pillips-Perron (PP) unit root tests are employed to conduct unit root tests. They share the same null hypothesis of unit root. Thus, data series are stationary if the null hypothesis of unit root is rejected. The results of these two tests are presented in three cases, namely with intercept only, with intercept and trend, and without neither intercept nor trend "none". All t-statistics are significant at the 1% significance level. That is, returns series of both forward exchange rates and EGX30stock market returns are stationary.

Research Methods

The Asymmetric BEKK GARCH (1,1) model will be applied in the current study. This model helps achieve the study's objectives by examining the spillover of shocks and volatility between the exchange rate and stock markets. The BEKK-GARCH model was introduced by Baba, Engle, Kraft, and Kroner, with BEKK representing the initials of the researchers who developed it. In 1998, Kroner and Ng further developed the model to study the asymmetric conditional volatility of positive and negative shocks (Engle & Kroner, 1995; Kroner & Ng, 1998). This developed version is referred to as the Asymmetric BEKK GARCH Model. The model also allows for testing the efficiency of the exchange rate and stock markets under study.

Several studies have applied the BEKK-GARCH model in the same area as the current study. For example, Eissa et al. (2010) studied the volatility spillover between stock returns and exchange rate changes in three MENA countries: Egypt, Morocco, and Turkey. In addition, Algebaly & Abd Elmoghny

(2024) applied the asymmetric BEKK-GARCH model in Egypt. The Asymmetric BEKK-GARCH model begins with the VAR(1)-GARCH(1,1) model as shown in Equation (1):

$$R_t = \alpha + \beta R_{t-1} + \epsilon_t$$ **Equation (1)**

Where:

- R_t and R_{t-1} are 2x1 vectors representing the returns of the stock and exchange rate markets at time t and the previous time period (t-1), respectively.
- α is a 2x1 vector representing the constant in the equations of stock returns and exchange rate returns.
- β is a 2x1 diagonal matrix of autoregressive coefficients.
- ϵ_t is a 2x1 vector of error terms with a conditional variance-covariance matrix Ht.

The BEKK-GARCH (1,1) model is represented as shown in Equation (2) (Engle & Kroner, 1995; Brooks, 2009; Algebaly & Abd Elmoghny, 2024):

$$H_t = C'C + A'\epsilon'_{t-1}\epsilon_{t-1}A + B'H_{t-1}B$$

Equation (2)

Where:

- H_t represents a 2x2 conditional variance-covariance matrix of the error terms at time t, and H_{t-1} represents this matrix for the previous period (t−1).
- C is a lower triangular matrix of constants, ensuring that the covariance matrix is positive definite.
- A is a 2x2 matrix of coefficients that captures the effect of past shocks (squared residuals) on current conditional volatility, with diagonal parameters representing the effect of past own shocks of return series ε_{t-1} on its current conditional volatility H_t, while off-diagonal parameters representing the spillover effects between the return series of forward exchange rates and EGX30 stock market index.
- B is a 2x2 matrix of coefficients that captures the impact of past volatility on current conditional volatility, with diagonal parameters measure the impact of past volatility in the return series H_{t-1} on its current conditional volatility H_t , while off-diagonal parameters representing the volatility spillover effects between the return series of forward exchange rates and EGX30 stock market index.

The Asymmetric BEKK GARCH (1, 1) model, which considers the asymmetric impact of positive and negative shocks on conditional volatility, is represented by Equation (3) (Kroner & Ng, 1998; Algebaly, 2019; Algebaly & Abd Elmoghny, 2024):

$$H_t = C'C + A'\epsilon'_{t-1}\epsilon_{t-1}A + B'H_{t-1}B + D'\zeta'_{t-1}\zeta_{t-1}D$$

Equation (3)

Where:

- D is a 2x2 matrix with diagonal parameters measure the impact of own negative shocks ζ_{t-1} on its current conditional volatility Ht, while off-diagonal parameters measure the market's response to negative shocks from the other market.
- ζt equals ϵt when ϵt is negative, and zero otherwise.

Results and Discussion

Empirical Results

The first part of Table (3) presents the results of the mean equation. It shows that EGX30 returns are significantly affected by their lagged returns for 1 period with a positive sign. This gives evidence that the Egyptian stock market is not efficient in the weak-efficiency form. The results of the variance equation are presented in the second part of Table (3), from row 7 to the end. The efficiency of the Egyptian exchange and stock markets in the weak form can also be evaluated by examining the significance of the diagonal elements of matrices A and B. All A (1,1), A (2,2), B (1,1), B (2,2) are significant at least at the 5% significance level. These findings indicate a lack of efficiency in both the Egyptian pound forward exchange rate against the US dollar and the Egyptian stock market in its weak form.

Table (3): The Asymmetric BEKK-GARCH (1,1) Model Outputs for Daily Returns of 3-Month Nominal Forward USD/EGP Exchange Rates and EGX30 Index from Nov. 6, 2016, to Jul. 15, 2024, Using Lags in the Mean Equation

MV-GARCH, BEKK - Estimation by BFGS
Convergence in 71 Iterations. Final criterion was 0.0000082 <= 0.0000100

Usable Observations 1782
Log Likelihood 12039.0342

Variable	Coeff	Std Error	T-Stat	Signif
Mean Model(M3R)				
1. Constant	-0.000072883	0.000051268	-1.42160	0.15514186
2. M3R{1}	-0.014059333	0.026348603	-0.53359	0.59362570
3. EGXR{1}	-0.008288516	0.005365395	-1.54481	0.12239224
Mean Model(EGXR)				
4. Constant	0.000312655	0.000253139	1.23511	0.21678942
5. M3R{1}	0.032912450	0.035175076	0.93568	0.34944039
6. EGXR{1}	0.161690713	0.023061836	7.01118	0.00000000
7. C(1,1)	-0.000277343	0.000068111	-4.07193	0.00004662
8. C(2,1)	0.002987321	0.000242566	12.31548	0.00000000
9. C(2,2)	0.000000009	0.001212510	7.38104e-06	0.99999411
10. A(1,1)	0.442003520	0.029112836	15.18243	0.00000000
11. A(1,2)	-0.168181953	0.028946534	-5.81009	0.00000001
12. A(2,1)	-0.010752540	0.006321759	-1.70088	0.08896590
13. A(2,2)	-0.099520122	0.039438540	-2.52342	0.01162185
14. B(1,1)	0.916578356	0.006623078	138.39159	0.00000000
15. B(1,2)	0.061455472	0.010640394	5.77568	0.00000001
16. B(2,1)	0.006850481	0.002281269	3.00293	0.00267398

17. B(2,2)	**0.923130373**	**0.010619550**	**86.92744**	**0.00000000**
18. D(1,1)	**0.369864807**	**0.058748493**	**6.29573**	**0.00000000**
19. D(1,2)	**0.017179002**	**0.082601246**	**0.20798**	**0.83524841**
20. D(2,1)	**-0.042643515**	**0.009619854**	**-4.43287**	**0.00000930**
21. D(2,2)	**0.369222483**	**0.031786804**	**11.61559**	**0.00000000**

What is important for testing the first three hypotheses of the study are the values and significance of the off-diagonal coefficients in matrices A and B. To test the first hypothesis related to the impact of the forward exchange rate market returns (M3R) on the stock market returns (EGXR), we look at the values and significance of coefficients A (1,2) and B (1,2). While coefficient A (1,2) indicates the effect of shocks in forward exchange rate market returns on the conditional volatility of stock market returns, coefficient B (1,2) shows the effect of volatility in forward exchange rate returns on the conditional volatility of stock market returns,

Since the prices are expressed using direct quotation, the interpretation of the results will be different. In direct quotation, the exchange rate of the Egyptian pound against the US dollar is determined based on the number of Egyptian pounds per one US dollar. Therefore, when the exchange rate increases, it means a decrease in the value of the Egyptian pound (i.e., the dollar becomes more expensive), and vice versa.

While the value of coefficient A (1,2) is negative (-0.168), the value of coefficient B (1,2) is positive (0.061), and both coefficients are significant at the 1% significance level. It means that the effect of shocks in forward USD/EGP exchange rate market returns on the conditional volatility of stock market returns is negative, which means that the conditional volatility of stock market returns is positively affected by the shocks in the returns of the Egyptian Pound value in the forward market. In addition, the effect of volatility in forward USD/EGP exchange rate returns on the conditional volatility of stock market returns is positive, which means that the conditional volatility of stock market returns is negatively affected by the volatility in the returns of the Egyptian Pound value in the forward market.

Thus, **the first hypothesis of the study (H1)**, **and its two sub-hypotheses (H1a & H1b)** which highlights the impact of forward exchange rate returns shocks and volatility on stock market returns volatility, **is accepted.** This supports the Purchasing Power Parity (PPP) and Interest Rate Parity (IRP) theories, the arbitrage pricing theory and the flow-oriented model (the traditional approach). Studies that have supported the direction of the relationship from the exchange rate market to the Egyptian stock market include, among others, Eissa et al. (2010), Abouwafia & Chambers (2015), Ahmed (2020), Živkov et al. (2021), El-Masry & Badr (2021), and Moussa & Delhoumi (2022).

The second hypothesis of the study requires examining the values and significance of coefficients A (2,1) and B (2,1). The value of coefficient A (2,1), which reflects the impact of stock market return shocks on the conditional volatility of forward exchange rate returns is significantly negative (-0.011) at the 10% significance level. Additionally, the value of coefficient B (2,1), which reflects the impact of stock market return volatility on the conditional volatility of forward exchange rate returns, is significantly positive at the 1% significance level. Therefore, there is a significant positive (negative) impact of shocks (volatility) in stock market returns on the conditional volatility in the returns of the Egyptian Pound value in the forward market. Consequently, **the second hypothesis (H2)** of the study, **and its two sub-hypotheses (H2a & H2b)** which suggests that changes and volatility in stock market returns affect forward exchange rate return volatility, **is accepted.** This supports the stock-oriented model (the Portfolio Balance Approach). The findings of this study are consistent with several other studies that have shown a relationship from the Egyptian stock market to the exchange rate of the Egyptian pound (e.g., Elhendawy, 2017; Parsva & Lean, 2017; Agyei et al., 2022; Kamal, 2022).

With the acceptance of the first and second hypotheses of the study, **the third hypothesis**, which posits a bidirectional relationship between the shocks and volatility of returns in the forward exchange rate and the conditional volatility of returns in stock markets, **is** also **accepted**. This bidirectional relationship between the exchange rate and stock markets has been confirmed in previous studies, such as those by Eissa et al. (2010), Auwal &

Sulaiman (2017), El-Masry & Badr (2021), and Algebaly & Abd Elmoghny (2024).

The diagonal parameters D (1,1) and D (2,2) are significantly positive at the 1% significance level. This indicates a significant positive effect of negative shocks specific to each market's return series on the current conditional volatility of that market's returns. To test the fourth hypothesis of the study, it is essential to examine the values and significance of the off-diagonal parameters in matrix D, which concerns the asymmetry in the impact of positive and negative shocks from one market on the conditional volatility of the other market. Although the coefficient of D (1,2) is insignificant, the coefficient of D (2,1) is significantly negative (-0.043) at the 1% significance level, indicating that the conditional volatility of the forward USD/EGP exchange rate returns negatively responds to negative shocks from the stock market. These results confirm the asymmetry in the impact of positive and negative shocks only from the stock market to the forward exchange rate market. Therefore, **the fourth hypothesis (H4) is partially accepted, because only its second sub-hypothesis (H4b) is accepted**. Although the asymmetry in the effect of positive and negative changes of the exchange rate returns on the Egyptian stock market returns has not been supported in this study, it has been confirmed in previous studies by Ahmed (2020) and Moussa & Delhoumi (2022). Moreover, the study by Algebaly & Abd Elmoghny

(2024) supported the asymmetry of the effect of positive and negative shocks from one market (spot exchange rate market or stock market) to the conditional volatility of the other market.

By comparing the results of our study to the study by Algebaly & Abd Elmoghny (2024), which is most related to ours, but they use spot exchange rates instead of forward ones, the results are similar but not identical. This similarity was expected because of the very high correlation coefficient between spot and forward exchange rates (96%) and for Whereas the coefficients A (2,1), B (2,1) and D (2,1) are significant and have the same signs as in our study, the remaining coefficients are different. To clarify, the coefficient A (1,2) is not significant in their study and significantly negative in our study. Although the coefficient B (1,2) is significant in both studies, it has negative sign in their study and positive sign in ours. Finally, the coefficient of D (1,2) is significant and positive in their study but is not significant in our study.

In conclusion, all hypotheses of the study are accepted at least partially, as in the case of the asymmetry hypothesis presented in the fourth hypothesis.

Robustness Checks

To confirm the results of this study, the robustness of results are checks by three approaches. The first approach involves using different model specifications. The second is by using other forward contracts with different maturity dates. The last involves using real exchange rates instead of nominal ones. The focus in the analysis will be on the values of the off-diagonal parameters in matrices A, B, and D related to the hypotheses of study.

Using different model specifications:

Using the model without lags in the mean equation[1]: The same conclusions are obtained after running the model without lags in the mean equation. In addition, the significance of coefficient A (2,1) improved from 10% to 1% significance level.

Considering Structural Breakpoints:

By examining the fluctuations in the returns of the main index of the Egyptian stock market, EGX30, (EXGR) it is found that the maximum fluctuation occurred on day 818, corresponding to March 15, 2020. This coincides with the onset of the COVID-19 pandemic. To confirm the presence of a structural break on that day, the Chow Breakpoint Test was conducted. The null hypothesis of this test suggests that there are no structural breaks in the data series. F-statistic of Chow test is 0.742 with 0.476 P-value, which indicates that there is no structural breaks at the specified breakpoint.

In addition, the highest fluctuations in the forward USD/EGP exchange rate returns (M3R) occurred on day 1238

[1] The related BEKK-GARCH models have not been provided here for the sake of brevity, but they are available from the researchers upon request.

(March 21, 2022), day 1679 (January 31, 2024), and day 1704 (March 6, 2024). The fluctuations on days 1238 and 1704 coincide with the devaluations announced by the Central Bank of Egypt in 2022 and 2024, respectively. To verify the presence of structural breaks on these dates, the Chow Breakpoint Test was applied. F-statistic of Chow test in these three breakpoints equals 10.621 0. with 0.000 P-value, which indicates that there are three structural breaks at days number 1238, 1679, and 1704.

Following Ewing & Malik (2013) and Harrathi & Almohaimeed (2015), dummy variables are inserted into the variance equation to reflect structural breaks.

Table (4): The Asymmetric BEKK-GARCH (1,1) Model Outputs for Daily Returns of 3-Month Nominal Forward USD/EGP Exchange Rates and EGX30 Index from Nov. 6, 2016, to Jul. 15, 2024, Using Lags in the Mean Equation and 3 Breakpoints in Days number 1238, 1679, and 1704.

MV-GARCH, BEKK - Estimation by BFGS
Convergence in 96 Iterations. Final criterion was 0.0000054 <= 0.0000100

Usable Observations 1782
Log Likelihood 12116.5528

Variable	Coeff	Std Error	T-Stat	Signif
Mean Model(M3R)				
1. Constant	-0.000101818	0.000063388	-1.60627	0.10821410
2. M3R{1}	-0.001914353	0.027950739	-0.06849	0.94539537
3. EGXR{1}	-0.010727413	0.005451378	-1.96784	0.04908701

	Mean Model(EGXR)			
4. Constant	**0.000166524**	**0.000240906**	**0.69124**	**0.48941492**
5. M3R{1}	**0.018400964**	**0.036818975**	**0.49977**	**0.61723809**
6. EGXR{1}	**0.157523369**	**0.022109788**	**7.12460**	**0.00000000**
7. C(1,1)	**0.002256514**	**0.000419804**	**5.37516**	**0.00000008**
8. C(2,1)	**0.002209484**	**0.000930524**	**2.37445**	**0.01757510**
9. C(2,2)	**0.000000025**	**0.001314360**	**1.86474e-05**	**0.99998512**
10. A(1,1)	**0.468795915**	**0.036453300**	**12.86018**	**0.00000000**
11. A(1,2)	**-0.069040845**	**0.045233225**	**-1.52633**	**0.12692761**
12. A(2,1)	**-0.026904196**	**0.007586049**	**-3.54654**	**0.00039033**
13. A(2,2)	**-0.006211112**	**0.036866826**	**-0.16847**	**0.86621018**
14. B(1,1)	**0.847616399**	**0.012480389**	**67.91586**	**0.00000000**
15. B(1,2)	**-0.002115522**	**0.025855318**	**-0.08182**	**0.93478864**
16. B(2,1)	**0.005501314**	**0.004056669**	**1.35612**	**0.17506224**
17. B(2,2)	**0.936737470**	**0.009211747**	**101.68945**	**0.00000000**
18. D(1,1)	**0.512396589**	**0.066465132**	**7.70925**	**0.00000000**
19. D(1,2)	**0.164672928**	**0.057628996**	**2.85747**	**0.00427038**
20. D(2,1)	**-0.046616745**	**0.012421847**	**-3.75280**	**0.00017487**
21. D(2,2)	**0.329953326**	**0.030021648**	**10.99051**	**0.00000000**
22. DM1(1,1)	**-0.001575911**	**0.000404029**	**-3.90049**	**0.00009600**
23. DM1(2,1)	**-0.003044396**	**0.000931828**	**-3.26712**	**0.00108647**
24. DM1(2,2)	**0.002543448**	**0.001342106**	**1.89512**	**0.05807694**
25. DM2(1,1)	**0.002555333**	**0.000551163**	**4.63626**	**0.00000355**
26. DM2(2,1)	**-0.000317873**	**0.000979316**	**-0.32459**	**0.74549353**
27. DM2(2,2)	**0.003624114**	**0.001355302**	**2.67403**	**0.00749466**
28. DM3(1,1)	**0.022980956**	**0.005289250**	**4.34484**	**0.00001394**
29. DM3(2,1)	**-0.012781684**	**0.003917743**	**-3.26251**	**0.00110430**
30. DM3(2,2)	**0.005380087**	**0.005472596**	**0.98310**	**0.32556017**

Three dummy variables are inserted in the variance equation, namely DM1 (equals 1 for returns number 1-1237, and zero otherwise), DM2 (equals 1 for returns number 1238-1678, and zero otherwise), and DM3 (equals 1 for returns number 1679-

1703, and zero otherwise). By comparing the results of this model with the basic model presented in Table (3), the coefficients of A (2,1) and B (2, 1), which show the effect of shocks and volatility of the Egyptian stock market returns on the conditional volatility of the forward exchange rate returns, still significant with the same signs. The coefficient D (2.1) also has the same significant negative sign. However, the effect of shocks and volatility of the forward exchange rate returns on the conditional volatility of the Egyptian stock market returns become insignificant. Moreover, the coefficient D (1,2) become significant with positive sign. Therefore, based on the results after considering breakpoints, the first hypothesis (H1) and its sub-hypotheses (H1a & H1b) is rejected, the second hypothesis (H2) and its sub-hypotheses (H2a & H2b) is accepted, and the third hypothesis which states bidirectional relationship is rejected accordingly. Moreover, the fourth hypothesis (H4) and its related sub-hypotheses (H4a & H4b) related to the asymmetry of positive and negative shocks of one market on the conditional volatility of the other market is accepted.

Using Forward Exchange Rates with Other Maturity dates:

Table (5): The Main Results of Asymmetric BEKK-GARCH (1,1) Models with Lags in the Mean Equation Based on Different Maturity Dates.

Maturity Date	A (1,2)	A (2, 1)	B (1,2)	B (2,1)	D (1,2)	D (2,1)
1-Month NDF	**-0.119*****	**-0.003**	**0.067*****	**0.003***	**-0.008**	**-0.047*****
2-Month NDF	**-0.124*****	**0.002**	**0.051*****	**0.002**	**-0.134****	**0.006**
3-Month NDF	***-0.168******	***-0.011****	***0.061******	***0.007******	***0.017***	***-0.043******
6-Month NDF	**-0.112*****	**-0.036*****	**0.095*****	**0.000**	**0.133*****	**-0.014***
9-Month NDF	**-0.176*****	**-0.029*****	**0.101*****	**0.008*****	**0.035**	**-0.043*****
12-Month NDF	**-0.086*****	**-0.027*****	**0.080*****	**0.004**	**0.113**	**-0.032****

Note: This table shows the values of coefficients and their significant levels, where ***, **, and * denote significance at the 1%, 5%, and 10% significance levels, respectively.

The three-month NDF exchange rate is used in the previous models. The main results of 1, 2, 3, 6, 9, and 12-month NDF exchange rates are presented in Table (5) to check the robustness of results to NDF maturity dates, using 3-month NDF as the benchmark. It is evident from this table that the same conclusion of the 3-month model is obtained from the 9-month model. Additionally, the first hypothesis (H1) related to the impact of shocks and volatility of forward exchange rate returns on the conditional volatility on the EGX30 stock market returns is accepted at all maturity dates at the 1% significance level. More specifically, all A (1,2) coefficients are significantly negative, and all B (1,2) coefficients are significantly positive at the 1% level.

The second hypothesis (H2) is also supported in most models. To illustrate, the shocks of stock market returns affect the conditional volatility of the forward exchange rate returns in 4 out of the 6 maturity date models, because the values of coefficient A (2,1) are significant (with negative sign) in the models of 3-month maturity date or greater. In addition, the volatility of stock market returns affect the conditional volatility of the forward exchange rate returns in models of 1, 3, and 9-month maturity date, as indicated in the significant (positive) values of their B (2,1) coefficients. Therefore, the third hypothesis (H3) is accepted.

Although the asymmetry of positive and negative shocks of 3-month NDF exchange rate market on the conditional volatility of the stock returns market is not significant, this asymmetry is significant based on 2 and 3-month maturity dates as shown in the values of coefficient D (1,2). Furthermore, the asymmetry from the stock market to the forward exchange rate market is significant based on all maturity dates models except the 2-month NDF model, because the values of coefficient D (2,1) is significant in these five models (with negative sign). Therefore, the model is robust to changing the maturity date of the NDF exchange rate contracts.

Using Real Forward Exchange Rates:

Real forward exchange rate (Sr) is measured in this study by dividing the value of nominal forward USD/EGP exchange rate by the ratio of CPIs in the USA and Egypt, respectively. Afterwards, the logarithmic return of real forward exchange rate is calculated to get the real forward exchange rate return. Monthly data should be used, instead of daily data, because CPIs are not available on daily basis.

The results obtained from utilizing real forward exchange rates document a significant positive values of B (1,2) coefficient in all NDF maturity dates, with the exception when using 12-month maturity date. That is, the volatility of real forward exchange rat returns affects the conditional volatility of EGX30 stock market returns (with positive sign). This result contradicts the findings of the study by Algebaly & Abd Elmoghny (2024) which found no support to the study hypotheses when using real spot exchange rate returns instead of nominal spot ones

Summary and Conclusions

The relationship between the exchange rate market and the stock market remains a topic of ongoing debate and analysis, as both theoretical and empirical results yield mixed outcomes. Theoretical models suggest varying effects, with some positing a significant link from the exchange rate market to the stock market, such as the theories of Purchasing Power Parity (PPP), Interest Rate Parity (IRP), Arbitrage Pricing Theory (APT), and the flow-oriented model (known as the commodity market approach or the traditional approach). Conversely, the relationship from the stock market to the exchange rate market can be justified using the stock-oriented model (known as the portfolio balance model). These discrepancies highlight the complexity of the interaction between exchange rates and stock markets, suggesting that the relationship is not uniform and may be influenced by a range of factors including economic policies, investor behavior, and external shocks. This confirms the need for continued research on this topic to understand their interactions.

The most related and recent studies to ours is the study by Algebaly & Abd Elmoghny (2024). The current study employs the sample asymmetric BEKK GARCH (1,1) model and tests the relationship between both the nominal and real exchange rate returns, and the Egyptian stock market returns proxied by the returns of EGX30 index. However, in our study exchanges rates are obtained from the forward market, by collecting 3-month non-deliverable forward (NDF) exchange rates, instead of exchange rates obtained from the spot market as in the study by Algebaly & Abd Elmoghny (2024). In addition, our study covers more recent period till 15 July 2024, which covers the fifth Egyptian Pound devaluation since 2016 in March 2024.

The four hypotheses of this study have been accepted based on the forward exchange data. More specifically, shocks in one market (the forward USD/EGP exchange rate market or the Egyptian stock market) have significant negative impact on the conditional volatility of the other market. Moreover, returns volatility in one market (the forward USD/EGP exchange rate market or the Egyptian stock market) has significant positive impact on the conditional volatility of the other market. Therefore, a bidirectional relationship is documented between forward exchange rate market and stock market. Furthermore, the positive and negative shocks have asymmetric impact on the conditional volatility at least from the Egyptian stock market to the forward exchange rate market.

By comparing the results of our study to the study by Algebaly & Abd Elmoghny (2024) based on daily data, the results are similar but not identical. This similarity was expected because of the very high correlation coefficient between spot and forward exchange rates (96%). More specifically, shocks and volatility spillovers from the Egyptian stock market to the conditional volatility of the USD/EGP exchange rate market is found with the same signs in both studies. In addition, the asymmetry of positive and negative stock market shocks on the conditional volatility of USD/EGP exchange rate market returns is detected with same negative sign in both studies. However, the impact of shocks and volatility spillover from the USD/EGP exchange rate market to the Egyptian stock market is different in these two studies

The results of this study are robust to using other model specifications and other forward contracts with different maturity dates. In addition, real exchange rates are used instead of nominal ones using monthly data. An evidence of significant volatility spillover is found from the exchange rate market to the Egyptian stock market. This evidence is not documented in the study by Algebaly & Abd Elmoghny (2024).

It is important for investors to understand the details of this relationship to reduce risks and achieve optimal allocation of their investment portfolios. Foreign investors and exporters should hedge against exchange rate fluctuations to maintain the expected returns on their investments denominated in Egyptian pounds. Forward USD/EGP exchange rates contracts could be used to achieve this hedging. In addition, the results of this research are valuable for investors, portfolio managers, and policymakers. Investors and portfolio managers should pay attention to the relationship between the foreign exchange and stock markets and how volatility is transmitted from one market to another when making capital allocation decisions. Policymakers should also consider this relationship when developing policies aimed at achieving financial and economic stability and enhancing the stock market.

Recommendations for future research is to conduct comparative studies involving multiple countries facing similar economic challenges as in some Arab countries or in some countries the MENA region. The relationship between exchange rate market and specific stock market sectors could also be examined instead of applying it to the overall market. This could reveal sector-specific weaknesses and opportunities. Additionally, event studies could be employed to analyze the impact of recent devaluations of the Egyptian Pound on the Egyptian stock market and its sectors, which could yield insights into investor behavior and market efficiency. Finally, Future research could also consider incorporating additional macroeconomic variables, such as interest rates, inflation rates, and GDP growth, to assess their combined impact on the exchange rate and stock market dynamics.

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