European Journal of Business and Management Research
Vol 9 | Issue 5 | September 2024
ISSN 2507-1076

RESEARCH ARTICLE

The Dynamic Relationship Between Exchange Rate Volatility and Stock Prices in the Egyptian Real Estate Market and the Moderating Effect of Interest Rates

Ahmed Rady, Farah Essam*, Habiba Yahia, and Maram Shalaby*

ABSTRACT

Among different channels of the financial market, the exchange rates and stock markets play a vital role in the domestic and international markets. This study aims to explore the dynamic relationship between the exchange rate (USD/EGP) and the real estate sector listed companies of the Egyptian Stock Exchange (EGX) from 2013 to 2023. Additionally, the study examines the moderating effect of interest rates on the relationship. To achieve this, the study employs several econometric methods such as Augmented Dicky Fuller (ADF) test, Granger Causality test to determine the direction of the relationship, Vector Autoregressive (VAR) model, and more. The results demonstrate that a long-run relationship exists between the variables. Furthermore, there is a significant unidirectional causality that runs from the exchange rate to real estate stock prices; thus, fluctuations in the exchange rate can significantly affect the profitability of investments in real estate stocks. Therefore, investors should closely monitor the movements in the exchange rate level to predict changes in real estate stock prices. When including the interest rate as a moderator, the outcome changes to bidirectional causality, meaning that the exchange rate and real estate stock price movements affect each other at a 1% significance level. Hence, interest rate could be used as an instrument to control demand in both the stock market and foreign exchange market. Finally, it is recommended that policymakers use the monetary policy while considering this bidirectional relationship in the presence of interest rate as a moderating variable.

Keywords: Exchange rate, Granger causality, Real estate, Stock price.

Submitted: December 03, 2023

Published: September 11, 2024

10.24018/ejbmr.2024.9.5.2230

Investment & Finance Department, Egypt Japan University of Science & Technology, Egypt.

Corresponding Authors:
e-mail: farah.essam@ejust.edu.eg;
e-mail: maram.ashraf@ejust.edu.eg

1. Introduction

In the increasingly globalized markets, movements in the foreign exchange market tend to have serious implications for the stability and growth of the overall economy. On the other hand, the vibrant stock exchange market could be noticeably responsive to macroeconomic variables, including exchange rate, particularly in sectors with high exposure to international trade, such as the real estate sector. Hence, governments attempt to maintain effective exchange rate regimes, taking into consideration the interdependence of financial markets, as no market operates in isolation from another.

Throughout the recent economic challenges, starting from the year 2013 till 2023, the Egyptian government altered its exchange rate regimes to mitigate the impact of the economic crisis. Initially, the Egyptian government intervened in the FOREX market and carried out Egyptian Pound devaluations. Nevertheless, Egypt had to adopt a flexible exchange rate system on November 3, 2016, replacing the fixed exchange rate system that had been in place since 1960 (IMF, 2016). Under the fixed exchange rate system, the Central Bank of Egypt (CBE) had been setting the exchange rate for the Egyptian pound against the US dollar and intervening in the foreign exchange market to maintain the peg (Ahmed, 2020). However, due to significant pressures on the country's foreign exchange reserves and balance of payments, the CBE decided to float the Egyptian pound and allow the exchange rate to be

determined by market forces (IMF, 2016). This led to a significant devaluation of the Egyptian pound against the US dollar, with the exchange rate dropping from around 8.8 pounds per dollar to around 18 pounds per dollar following the floatation. Since then, the exchange rate has continued to be determined by market forces, with the CBE intervening only to smooth out excessive volatility or to build up foreign exchange reserves (IMF, 2018).

The flexible exchange rate system adoption in Egypt was driven by the conditions of a loan agreement with the International Monetary Fund (IMF, 2016). In August 2016, Egypt secured a $12 billion loan from the IMF as part of a broader economic reform program aimed at stabilizing the economy and restoring fiscal sustainability (IMF, 2016). One of the conditions for the loan was the adoption of a more flexible exchange rate regime, which would allow the exchange rate to be determined by market forces and reduce the pressure on foreign exchange reserves (IMF, 2016). The devaluation of the Egyptian pound that occurred following the adoption of the flexible exchange rate regime led to a rise in inflation and a decline in the purchasing power of Egyptian households (Khalil & Ghandour, 2018). However, the flexible exchange rate regime has helped to stabilize the foreign exchange market, reduce pressure on foreign exchange reserves, and restore fiscal sustainability (IMF, 2022). Due to the increase in foreign inflows, foreign reserves increased from $19 bn in October 2016 to $32 bn in November 2017 (Saleh, 2017). Additionally, according to the International Monetary Fund, the liberalization of the currency has made Egyptian exports more competitive by making them cheaper in foreign markets, which has helped to boost export earnings and support economic growth. However, Egypt devalued its currency three times since the Russian-Ukraine war. It was evaluated twice in 2022 and lost around half of its value. Additionally, the Egyptian pound was devaluated again in January 2023 to reach around 31 EGP for each USD. Moreover, the inflation reached 31.9% in February, according to the Central Bank of Egypt, as Egypt relies heavily on importing grains from Ukraine, and the war affected the prices and exerted extra pressure on the Egyptian need for foreign currencies.

In addition, the real estate sector needs to be thoroughly studied as a significant driver of economic growth. The real estate sector is one of Egypt's economic engines that contributed to approximately 20% of GDP in 2021 (American Chamber of Commerce, 2022). Moreover, the Minister of Planning and Economic Development reported that Real estate business received the majority of public investments, amounting to EGP 157.9 billion, or 53.7% of all public investment made in urban development in FY 2022/2023 (El-Said, 2022). Furthermore, according to the General Authority for Investment (GAFI), the real estate sector has attracted 545.4 million USD, contributing 3.9% of total FDI inflows in the Egyptian economy in the year ended 2021.

However, the sector still possesses the potential for further growth. According to the World Bank, the Egyptian population increased by 1.7% in 2021. This percentage accounts for 1,797,004 million people (World Bank Open Data, 2022), with 880,041 marriages published by the Central Agency for Public Mobilization and Statistics (2022). Also, as of 2021, around 43% of the Egyptian population lived in urban cities. In addition, about 99% of Egypt's population is concentrated in an area of about 6.8% of the total area of Egypt in a narrow strip of the Nile Valley and the Delta (National Population Council, 2022). Such an increase in the population could generate vast opportunities in the real estate industry due to the increased demand and relieve the high congestion in Cairo and major cities. Egypt started to build new cities such as New Administrative Capital, New Alamein City, Galala City, and more (Hafez, 2022).

Not only does the real estate sector contribute to the public investment sector, but it also contributes to the Egyptian Stock Exchange. For instance, with 8.73% of the total Egyptian market capitalization and 30 public companies listed in the Egyptian stock exchange, the real estate sector represents a crucial building block in the future of the Egyptian stock market, in particular, and the Egyptian Economy, in general. The recent fluctuations in the Egyptian economy, especially the increase in the exchange rate (USD/EGP), affected all sectors of the Egyptian market, including real estate, as the increase in dollar prices led to higher costs of transportation, iron, cement, and other materials required for the building process. Thus, the prices of properties are expected to keep growing in relation to the exchange rate. At the beginning of 2023, steel prices increased by EGP 2500 per ton to reach between EGP 23,300 and EGP 27,360, cement's prices increased to a range between EGP 1,600 and EGP 1750, while white cement's prices rose to EGP 2800 (Al-Shahry, 2023). However, investors still perceive real estate as a safe choice for investment despite the great uncertainty in other sectors recently. Moreover, the Egyptian government passed a group of regulations that facilitated real estate development in 2023. For instance, it reduced the interest imposed by the Ministry of Finance to 1% after it was 2%, extended delivery deadlines by 20%, decreased the accepted project completion from 90% to 85%, and more.

In light of the foregoing, the paper aims to examine the impact of exchange rate volatility on the real estate sector performance in the Egyptian stock market from April 2013 to April 2023. In that event, the paper attempts to answer a crucial question: Given the high demand in the real estate industry, how does the exchange rate volatility affect the real estate sector performance in the Egyptian stock market?

Moreover, the study seeks to investigate the moderating effect of interest rates on the relationship between exchange rates and stock market performance in the real estate industry in an attempt to conduct a thorough comparison between the available investing opportunities for investors in the Egyptian market.

The study contributes to the existing literature through various approaches. First, an in-depth analysis that focuses solely on the real estate market response to the exchange rate volatility. There was a recent study on the interrelation between exchange rate and stock market prices in Egypt (Kamal, 2022) that used the EGX 30 index as an indicator of the stock market performance. However, no literature can be found investigating the Egyptian real estate market

response to the exchange rate volatility. Second, the paper utilizes an additional variable, which is the interest rate, as a moderating variable in the Exchange Rate and Stock Market dynamic to reflect the various channels in which investors decide to invest their funds. These channels can be divided into four main categories: investing in real estate, capital market constituents, bond and stock markets, financial institutions receiving an interest rate as a return on the investment, and trading in the eurocurrency market. All of which are covered in this study to be able to present a viable recommendation for both investors and policymakers.

To answer the research question, the paper uses the Granger Causality Model as the main statistical approach to test whether the panel dataset of a time series of Exchange Rates can be used to forecast another time series of real estate stock prices in the Egyptian market for a period of 10 years from 2013 to 2023. The Granger Causality test is used in many studies of the existing literature investigating the causal relationship between Exchange rate and Stock Market performance in emerging markets, North African countries, the MENA region, and the Egyptian Market context. Most recently, Kamal (2022) used Granger Causality to examine the dynamic relationship between exchange rate fluctuations and stock market returns for the period (2012–2022).

Granger causality is employed using monthly data for both the independent variable represented by the exchange rate (ER) and the dependent variable represented by stock Prices (SP) in the Egyptian real estate market. This paper uses Interest Rate (IR) as a moderating variable in the ER-SP dynamic to test how the causal relationship changes with the presence of the moderator. Thus, a more insightful conclusion could be drawn, considering the significance of the interest rate variable in the Egyptian economy and the shift in investor behavior that follows CBE's decisions to increase or lower the interest rate.

2. Literature Review

2.1. *Theoretical Framework*

Numerous pieces of literature have been published on the relationship between exchange rates and stock prices. Classical Economic theory hypothesizes that exchange rates and stock prices interact (Richards *et al.*, 2009). However, the direction of the interaction between the two variables cannot be explained by a unidirectional theory. A review of the literature reveals two leading theories that explain the relationship between the stock price and the exchange rate: the flow-oriented model by (Dornbusch & Fischer, 1980) and the stock-oriented model (Branson, 1983; Frankel, 1983). This section of the literature review will examine the key features and the applicability of the two models.

One of the approaches explaining this causal relationship is the flow-oriented model, suggesting that exchange rate movements affect stock prices through the flow of funds in the economy (Dornbusch & Fischer, 1980) because exchange rates affect the multinational firms' value by affecting foreign operations and thus reflect on its stock price depending on whether the firm is export or import oriented (Bala Sani & Hassan, 2018a).

The theory argues that changes in exchange rates can have a significant impact on stock prices, both directly and indirectly. Directly, changes in exchange rates can affect the profitability of companies that operate in international markets. For example, if the value of a country's currency depreciates, it will make the country's exports cheaper and its imports more expensive. This can lead to an increase in exports and a decrease in imports, which can boost the company's profits (Phylaktis & Ravazzolo, 2005). Indirectly, changes in exchange rates can also affect stock prices through their impact on investor sentiment. When exchange rates are volatile, investors may become more risk-averse, which can lead to a decline in stock prices. This theory also suggests that when there is a net inflow of capital into a country, the demand for that country's currency increases, leading to an appreciation of the domestic currency. This, in turn, can lead to an increase in stock prices as investors become more optimistic about the country's economic prospects. The flow-oriented model theory also highlights the importance of investor sentiment in driving capital flows. According to this theory, investors are more likely to invest in countries with strong economies and political stability, leading to an inflow of capital a decrease in the exchange rate, and an increase in stock price.

On the other hand, the stock-oriented models are other approaches to determining the direction of the relationship between the exchange rate and stock price and articulate that the financial assets can determine the exchange rate through changes in the supply and demand of financial assets transactions (Branson, 1983 and Frankel, 1983). This approach incorporates components of the portfolio balance model and the monetary model. It considers stock market factors such as stock prices and indices of the stock market to be variables impacting exchange rates. According to the stock-oriented models, changes in stock prices can alter expectations for investors, risk preferences, and portfolio allocations, influencing the flow of capital as well as exchange rates.

The portfolio balance model, also known as the asset market model, considers several assets and combines the examination of exchange rate volatility with other types of financial assets, such as stocks and bonds. It explains how portfolio investment can determine the exchange rate through capital account transactions. It implies a negative relationship between exchange rates and stock prices, and the causality runs from the stock prices. For instance, this model is based on the idea that investors allocate their funds among different assets in different countries according to the expected risk and return. When a country's stock market prices increase, and investors expect it to deliver higher returns relative to the other markets, investors aim to acquire more domestic assets. Therefore, investors liquidate their foreign assets to obtain domestic currency to purchase domestic assets. The rise in investors' wealth because of rising domestic asset prices stimulates them to seek additional stocks, and the increase in demand for domestic currency increases domestic currency value. Thereupon, expected stock prices granger cause the exchange rate (Branson, 1983; Frankel, 1983).

Regarding the monetary approach, it assumes that the equity market's efficiency can alter the supply and demand of the domestic currency. Accordingly, share price fluctuations impact aggregate demand by means of wealth, liquidity effects, and the exchange rate (Dornbusch, 1976). When the stock price increases, the investors' wealth increases, increasing consumption and aggregate demand. Consequently, the rise in stock market prices will attract foreign investors, and the need for the local currency will increase; thus, the local currency will appreciate (Adjasi *et al*., 2011). Therefore, exchange rates depend on future expected currency movements. Liquidity effects refer to the impact of stock prices on the firm's cost of borrowing. To illustrate, companies can use their equity holdings as borrowing collateral. Therefore, as companies' equity holding increases, they can access loans at a lower cost due to the increased collateral (Gavin, 1989). Comprehensively, the link connecting share prices and aggregate demand is complicated, and other factors besides share prices might influence aggregate demand.

Besides, the relationship between interest rates and exchange rates has been a topic of extensive research in international finance. The exchange rate is the value of one currency in terms of another, while the interest rate is the cost of borrowing or the return on investment. Changes in interest rates can have a significant impact on the value of currencies in foreign exchange markets, as the increase in interest rates can lead to an increase in the demand for a currency, causing its value to appreciate.

Interest rate parity (IRP) theory offers the fundamental explanation for the relationship between interest rate and exchange rate. IRP suggests that the exchange rate between two currencies should equal the ratio of the two countries' nominal interest rates. According to this theory, if interest rates are higher in one country than in another, investors will shift their investments to the country with higher interest rates, leading to an appreciation of that country's currency. This can lead to a decrease in interest rates in the country with the appreciating currency, as investors are willing to accept a lower return on their investment in exchange for an appreciation of the currency. Nevertheless, IRP assumes that there are no transaction costs, no capital controls, and no risk premiums. However, these factors can influence the relationship between interest rates and exchange rates. Furthermore, Mundell-Fleming Model explains how movements in exchange rate influence interest rates. The theory, which was developed by Mundell (1960) and J. Marcus Fleming in the early 1960s, suggests that in an open economy, interest rates are influenced by three main factors: fiscal policy, monetary policy, and exchange rates. Mundell-Fleming Model suggests that changes in exchange rates can impact interest rates through capital flows and central bank policy. When a country's currency appreciates, it leads its assets to attract more foreign investors, indicating an increase in capital inflows. This increase in capital inflows drives growth in the demand for domestic currency, which can cause it to appreciate further. As a result, a decrease in interest rates may occur since investors are willing to accept a lower return on their investment in exchange for an appreciation of the currency. Additionally, central banks can use exchange rate policy as a tool to influence interest rates. For example, if a central bank wants to reduce interest rates, it may choose to intervene in the foreign exchange market by selling its currency to reduce its value.

Similarly, the relationship between interest rate and stock prices has been theoretically explained through several literature. The efficient market theory is one of the most influential theories in describing this relationship. The primary premise is that stock prices reflect all available information in the market, including information on changes in interest rates. When interest rates rise, investors may become more cautious and less willing to accept risks, leading to a decrease in stock prices. Moreover, the relationship between stock prices and interest rates can be described through the present value model, as long-term interest rates affect the discount rate, thus the stock prices, Fama (1981; 1990).

Alternatively, stock prices tend to impact interest rates, according to the wealth effect theory. The wealth effect theory is an economic, behavioral theory suggesting that as stock prices increase, investors of these stocks could feel more confident to raise their consumption levels, causing inflationary pressures, which can cause shifts in monetary policies, forcing interest rates to increase (Pigou, 1943).

2.2. Prior Research

2.2.1. The Dynamic Relationship Between Exchange Rate and Stock Prices

Research into the relationship between exchange rates and stock prices has a long history, yet no consensus has been found. Many research investigations have been conducted to study the causal relationship between stock prices and exchange rates utilizing diverse methodologies, data sources, markets, and time intervals. Some studies have identified a positive or negative relationship between stock prices and exchange rates; however, other studies have found no correlation or a nonlinear interaction.

To illustrate, researches were conducted to study the relationship between exchange rates and stock prices in developing countries for example, Patro *et al*. (2009) performed a cross-sectional study to investigate the relation between the returns on the local stock market during currency depreciations against the nation's major macroeconomic indices. The paper examined 125 devaluation incidents from 41 countries between 1979 and 2011, including Egypt. The researchers discovered that stock returns are much lower for larger devaluation and developing countries. Alternatively, other researchers have examined the relationship's short-term and long-term dynamics for developed countries. A study by Nusair and Olson (2022) of the G7 countries examined the dynamic relationship between stock prices and exchange rates. In their implementation of linear and nonlinear ARDL models, both the portfolio balance approach and the flow-oriented approach were supported in the short run. On the one hand, the linear ARDL models did not support either approach in the long run. Otherwise, in four G7 countries, the nonlinear ARDL model supported the portfolio balance approach. The paper employed VAR models to check for robustness and the Granger Causality test to examine the relationship between exchange rates and stock prices.

The results revealed that, in six of the G7 countries, there is unidirectional causality from stock prices to exchange rates.

Regarding the Middle East and North Africa (MENA) region, research showed that there is a significant relationship between stock and exchange rate movements. In particular, it was found that stock prices and exchange rates tend to move together during periods of economic stability. However, during periods of economic instability, they move in opposite directions (Trabelsi & Bahloul, 2022).

Other papers studied the impact on specific markets like Suriani *et al*. (2015) studied the relationship between the exchange rate and stock price in Pakistan using monthly data from January 2004 to December 2009. The paper employed the Granger causality and the ADF test to examine the stationarity of the data at the level. According to the study's outcomes, there is no relationship between the variables.

Recent research was done by Mkhize (2022) for the fifteen largest financial sector companies in terms of market capitalization listed on the Johannesburg Stock Exchange. The study incorporated the interest and inflation rates as control variables and employed various methods to achieve the research's aims. For instance, the GARCH model, the Granger Causality test, the descriptive statistics test, the correlation test, the Heteroscedasticity test, and the Augmented Dickey-Fuller test. The study's major finding indicates a bi-directional causality.

Similarly, studies were made on the Egyptian market as the dynamic relation between the exchange rate and stock market in Egypt, using data between 2009 and 2017, was studied by Micheal (2018). The Granger causality test was utilized, and the result indicated a unidirectional causality that the exchange rate granger causes the stock prices. Focusing only on one sector, namely tourism, Abdallah (2019) studied the impact of exchange rate volatility on the share price of tourism sector companies in the Egyptian Stock Exchange. To achieve this, Granger causality and the ARCH/GARCH models were implemented using monthly data from June 2010 to December 2019. The result indicated a significant unidirectional relationship between the exchange rate volatility and to stock prices.

Another study specific to the Egyptian market by Kamal (2022) indicated the presence of a significant positive relationship between the exchange rate fluctuations measured by the EGP/USD exchange rate and the Egyptian stock market returns, supporting the flow-oriented model theory.

Focusing on the real estate sector, Quy and Loi (2016) studied the causal relationship between chosen economic variables and real estate stock price using a sample from 2009 to 2015. The study discovered that inflation rate, GDP growth rate, and exchange rate all had significant effects on real estate stock values. Furthermore, Endri *et al*. (2021) studied several factors that affect real estate stock prices as exchange rate, interest rates, return on assets, and others. The findings indicate a positive and significant relationship between the interest rate and stock returns, while the exchange rate has the most significant impact on stock returns. Conversely, a study on the same stock market found that the rate of exchange has a positive and significant impact on real estate corporations and property stock returns. The findings indicate that considering all other variables are constant, a ten percent rise in the exchange rate will result in a 16.48% rise in the firm's stock return (Bustami & Heikal, 2019). As for Egypt, no literature was found on the relationship between the real estate sector prices and the exchange rate.

Thus, based on the previous discussion we hypothesis the following:

H1: Exchange Rate fluctuations Granger-causes Stock Market prices.

H2: Stock Market Prices Granger-causes Exchange Rate fluctuations.

2.2.2. The Relationship Between, Interest Rates, Exchange Rates, and Stock Prices

On the other hand, empirical studies also examined the relationship between stock prices, exchange rates, and interest rates particularly in other developing markets:

In Nairob, Ouma and Anyago (2016) studied the moderating effect of interest rates on the relationship between stock prices and interest rates. The research used Johanesn's test for co-integration to detect the long-term relationship between exchange rates and price index from one side and between interest rates and price index from the other side. The results found that stock market performance can be affected by the average lending rates and average deposit rates. Furthermore, the study findings suggested that interest rates moderate the relationship between securities market performance and exchange rate volatility.

Another study by Kganyago and Gumbo (2015) in Zimbabwe examined the relationship between interest rate and stock market performance and found an existing long-term relationship between interest rate and stock market performance. Results showed a significant and inverse relationship between interest rates and stock market prices.

Furthermore, a study in Sri Lanka investigated the dynamic relationship between stock market performance and short-term interest rates by Pallegedara (2012). The methodology relied on Unit-root tests, cointegration tests, Vector Auto-Correction Model (VECM) analysis, and Granger-causality tests. The study concluded an inverse long-term relationship between short-term interest rates

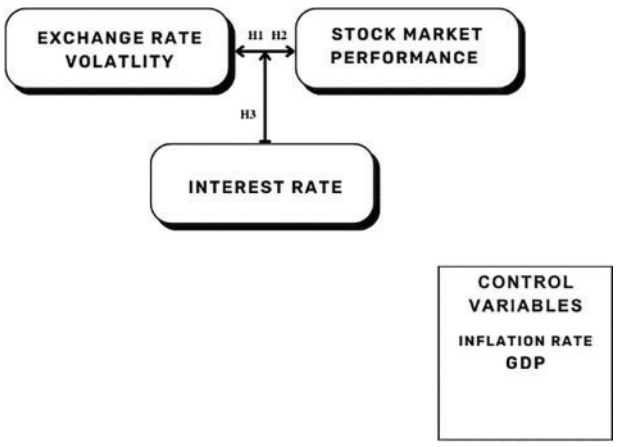

Fig. 1. Model framework and hypotheses.

TABLE I: List of Study Variables

Variable name	Symbol	Measurement	Data source
Exchange rate	ER	The CBE published official rate of USD/EGP	Central Bank of Egypt (CBE)
Real estate market prices	SP	Monthly closing price	The Egyptian Exchange
Interest rate	IR	Average EGP deposit and lending rates	Central Bank of Egypt (CBE)
Inflation rate	INF	Consumer Price Index (CPI)	World Bank
Gross domestic product	GDP	Monetary value of all goods and services in EGP	World Bank

and stock market performance but no short-term causal relationship between short-term interest rates and stock market performance. The study shows that the central bank adjusts interest rates to maintain stability in prices. Thus, in the long term, investors can predict future stock market performance through interest rate policies.

Liu and Lee (2020) tested the relationship between interest rate and exchange rate in both the Chinese market and the USA using VAR and dynamic stochastic general equilibrium (DSGE) model, with the assumption of operating in an open economy. Results showed that US monetary policies regarding interest rates have a significant impact on the exchange rate between China and the USA, while exchange rate volatility appears to have more impact on interest rates in the USA than interest rates in Hacker *et al*. (2009) studied the relationship between exchange rate and interest differential in seven different countries to find a negative relationship between the two. The methodology relied on a regression analysis model and on the following simple equation to represent the inverse relationship between the two variables. Furthermore, results showed that the significance of the relationship varied from one country to another. Therefore, prior research and established theories indicate the existence of a relationship between interest rate and exchange rate, as well as another relationship between interest rates and stock prices. Accordingly, this paper uses the interest rate as a moderator variable, which can interfere with the dynamic relationship between the exchange rate and stock prices. Consequently, based on the former argument we hypothesize:

H3: Interest rates moderates in the dynamic relationship between exchange rates and stock prices.

3. Research Design and Methodology

3.1. Research Design

3.1.1. Research Framework Model

Fig. 1 shows the research framework model that represents the research hypothesis and how the model variables interact with each other.

3.1.2. Measurements Table

Table I summarizes the variable list in the study framework model along with their symbol throughout the research, how they are measured, and the source from which they are collected.

3.2. Methodology

The data set entails monthly data for all variables from April 2013 to April 2023. This period witnessed volatility in the exchange rate (ER) and stock prices (SP); hence, it was chosen. The data for the exchange rate, the Gross Domestic Product growth rate (GDP), inflation rate (INF), and interest rate (Lending_IR) were sourced from the Central Bank of Egypt (CBE), and the stock prices from the Egyptian Exchange (EGX). The GDP data was available quarterly; therefore, it was transformed into monthly data via the quadratic match sum conversion method, guided by Borjigin *et al*. (2018) using the Eviews 12 interface. The exchange rate is proxied to the USD/EGP value by the last day of the month rate.

TABLE II: Descriptive Statistics and Correlation Matrix

Variable	SP	ER	GDP	INF	Lending_IR
Mean	5.047	14.281	0.014	0.010	0.134
Median	2.640	15.740	0.015	0.007	0.122
Minimum	0.000	6.887	−0.008	−0.023	0.093
Maximum	78.420	30.915	0.033	0.081	0.199
Standard deviation	7.064	5.694	0.007	0.013	0.032
Sample variance	49.906	32.422	0.000	0.000	0.001
Kurtosis	15.659	0.293	1.261	8.400	−0.953
Skewness	3.245	0.434	−0.171	2.357	0.560
Jarque-Bera	35,065.370	35.764	208.495	11,100.940	256.585
Probability	0.000	0.000	0.000	0.000	0.000
Correlation matrix					
SP	1.000				
ER	0.148***	1.000			
GDP	0.018	0.274***	1.000		
INF	0.017	0.404***	0.058***	1.000	
Lending_IR	−0.041**	0.363***	0.176***	0.110***	1.000

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

3.2.1. Descriptive Statistics

The descriptive statistics provide insights of the used sample. Table II contains the descriptive statistics for the sample as Ahmed (2019), Aimer (2019), and Ahmed (2020). There are several observations that we can draw as all variables show positive means and medians. Furthermore, the ER has a 5.694 standard deviation from the sample mean, reflecting the exchange rate volatility for the USD/EGP rate. Kurtosis and skewness values are varied among the variables, and overall results indicate that the variables are not normally distributed. To further prove this, the Jarque-Bera test for normality was used, and the null hypothesis states that the distribution is normal. With a p-value of less than the 5% significance level, the null hypothesis is rejected; consequently, all variables are not normally distributed. Since the Jarque-Bera test indicated an absence of the normal distribution, applying the co-integration test became essential. Data summary is shown in Table II.

TABLE III: ADF Test Results

Integration level	With intercept and trend	With intercept	Without intercept and trend	Station-ary level	Variable
I (1)	−4.849	−4.516	0.482	Level	SP
	0.000***	0.000***	0.685		
	−25.562	−27.426	−44.907	1st difference	
	0.000***	0.000***	0.000***		
I (1)	2.992	6.523	8.436	Level	ER
	0.998	1.000	1.000		
	−22.729	−25.085	−29.554	1st difference	
	0.000***	0.000***	0.000***		
I (1)	−14.764	−15.990	2.666	Level	GDP
	0.000***	0.000****	0.996		
	−17.119	−19.661	−23.592	1st difference	
	0.000***	0.000***	0.000*		
I (1)	−17.065	−19.258	−0.755	Level	INF
	0.000***	0.000***	0.225		
	−29.246	−30.923	−44.343	1st difference	
	0.000***	0.000***	0.000***		
I (1)	−1.320	−5.973	3.907	Level	Lending_ IR
	0.093*	0.000***	1.000		
	12.551	−2.544	−7.987	1st difference	
	1.000	0.0055***	0.000***		

Note: *** is p<0.01, ** is p<0.05, * is p<0.1.

3.2.2. *Unit Root Test*

The unit root test is essential to test whether the variables are stationary. To illustrate, it aids in determining if a set of data has a trend or a stable mean over a period of time. Any tested variable that is found nonstationary should be transformed into stationary to avoid spurious regression issues. The study uses Augmented Dicky-Fuller (ADF) was presented by Dickey and Fuller (1979 and 1981) to test for unit root, as followed by Adjasi *et al*. (2011), Mkhize (2022), Ahmed (2019), and Kamal (2022). In this study, the ADF test was conducted on the panel dataset without trend nor constant, with constant, and wish trend and constant (Mkhize, 2022). The results of the ADF are in Table III.

According to the ADF Test, the outcomes reveal that the variables are not stationary by observing the p-value at level without including a constant and a trend, confirming the null hypothesis of a Unit root presence. However, some variables were found stationary when including a constant as GPD, INF, and IR. Nevertheless, all variables became stationary when differenced at the first level at a 1% significant level. The optimal lag length was obtained using the automatic Akaike Information Criterion (AIC), as used across various literature, for example, ElMasry and Badr (2020). To reach a consensus among different tests, the Phillips-Perron (PP) test was used, which was introduced by Phillips and Perron (1988). The PP unit root tests confirmed the ADF results that all variables are first-order integrated I(1). The results of the ADF test on the first differenced variables in Table II showed that they were all stationary. Each variable ER, SP, Lending_IR, INF, and GDP were transformed into D_ER, D_SP, D_IR, D_INF, and D_GDP, respectively.

TABLE IV: Johansen Fisher Panel Test

Hypothesized no. of CE(s)	Fisher stat. (From trace test)	Probability	Fisher stat. (From max-eigen test)	Probability
None	1179	0.000	1039	0.000
At most 1	869.2	0.000	640,8	0.000
At most 2	737.3	0.000	402.6	0.000
At most 3	622,1	0.000	622.1	0.000

TABLE V: Pedroni Cointegration Test

H0: No cointegration	Number of panels = 24	
Ha: All panels are cointegrated	Avg. number of periods = 117.29	
Cointegrating vector: Panel specific	Kernel: Bartlett	
Panel means: Included	Lags: 4.00 (Newey–West)	
Timetrend: Included AR parameter: Panel specific	Augmented lags: 6 (AIC)	
	Statistic	p-value
Modified Phillips–Perron T	−5.7529	0.0000
Phillips–Perron T	−7.5925	0.0000
Augmented Dickey–Fuller T	−8.7204	0.0000

TABLE VI: Variance Inflation Factor (SP Dependent)

Variable	VIF	1/VIF
D ER1	1.576	0.634
D IR1	1.358	0.736
D INF1	1.197	0.836
D GDP1	1.009	0.991
Mean VIF	1.285	.

3.2.3. *Co-Integration Test*

To test for co-integration among the variables, the Johansen fisher panel test was used (Seshaiah & Tripathy, 2018). It indicates a long-run equilibrium between variables, as followed by Aimer (2019). It shows a combined behavior of several variables and determines if they reveal a consistent long-term relationship. The null hypothesis states "No co-integration"; after performing the test, the null hypothesis was rejected at the 5% significance level, confirming that the variables have a long-run relationship. The Pedroni cointegration test (Engle-Granger based) was used to verify the result; moreover, its p-value was significant, rejecting the null hypothesis at a 5% significant level, as pursued by Odhiambo *et al*. (2019). Cointegration results are shown in Tables IV and V.

3.2.4. *Multicollinearity Test*

Two multicollinearity tests were performed on the data. The results of the first test, with D_SP as the dependent variable, show a Mean-Variance Inflation Factor (VIF) equal to 1.285, indicating low multicollinearity between the variables in the regression model. Additionally, the results of the second test with D_ER being the dependent variable show a similar output of low multicollinearity that averages among the independent variables to 1.007. Test results are shown in Tables VI and VII.

TABLE VII: Variance Inflation Factor (ER Dependent)

Variable	VIF	1/VIF
D INF1	1.011	0.989
D IR1	1.011	0.989
D GDP1	1.006	0.994
D SP1	1.002	0.998
Mean VIF	1.007	

TABLE VIII: Breusch-Pagan/Cook-Weisberg Test for Heteroskedasticity

SR as dependent variable	ER as dependent variable
Assumption: Normal error terms	**Assumption:** Normal error terms
Variable: Fitted values of D_SR	**Variable:** Fitted values of D_ER
H0: Constant variance	**H0:** Constant variance
$chi^2(1) = 352.60$	$chi^2(1) = 930.16$
Prob > $chi^2 = 0.0000$	Prob > $chi^2 = 0.0000$
Assumption: Normal error terms	**Assumption:** Normal error terms
Variables: All independent variables	**Variables:** All independent variables
H0: Constant variance	**H0: Constant variance**
$chi^2(4) = 459.59$	$chi^2(4) = 1229.30$
Prob > $chi^2 = 0.0000$	Prob > $chi^2 = 0.0000$

TABLE IX: Standard Error and Coefficient of Robust and OLS

Independent variables	Robust model b/se	OLS model b/se
D_SR1	−0.0121801	−0.0121801
	0.0091249	0.013236
D_IR1	42.18671***	42.18671***
	7.373736	4.673591
D_INF1	6.301051**	6.301051***
	1.983703	1.856194
D_GDP1	12.95278	12.95278
	7.349955	8.760823
_cons	0.1867321***	0.1867321***
	0.0199362	0.0209009

Note: ***means (P ≤ 0.001) and **means P ≤ 0.01.

3.2.5. *Heteroskedasticity Test*

To test for heteroskedasticity in the linear regression model, Breusch-Pagan/Cook-Weisberg test was used followed by Amirova and Ismailova (2021).

The test assumes that the errors of the regression model are homoscedastic, having constant variance. The resulting p-value is less than the significance level of 0.05. This means that we can reject the null hypothesis and conclude that there is evidence of heteroscedasticity, as shown in Table VIII.

To correct the presence of heteroscedasticity in the data, a robust regression method is implemented, which was introduced by (White, 1980). Table IX shows the standard error (se) difference between the Ordinary Least Square (OLS) and the Robust regressions. The Robust model maintains the same coefficients and significant relationships while reducing the standard error.

TABLE X: Wooldridge Test Results

D_SP as dependent variable	D_ER as dependent variable
F(1, 23) = 12.811	F(1, 23) = 48.430
Prob > F = 0.0016	Prob > F = 0.0000

TABLE XI: Resulting Standard Error and Coefficient of Prais-Winsten Estimation (D_SP Dependent Variable)

Independent variables	Coefficient (b)	Standard error (se)
D_ER1	−0.0113953	0.0321183
D_IR1	2.664814	7.941761
D_INF1	−2.171932	2.767352
D_GDP1	−36.6357**	13.34016
_cons	0.045981	0.0341719

Note: **means P ≤ 0.01.

TABLE XII: Resulting Standard Error and Coefficient of Prais-Winsten Estimation (D_ER Dependent Variable)

Independent variables	Coefficient (b)	Standard error (se)
D_SP1	−0.0062107	0.0124422
D_IR1	58.6278***	4.183928
D_INF1	15.70442***	1.873642
D_GDP1	−0.817691	7.603793
_cons	0.1799539***	0.0170382

TABLE XIII: Hausman (1978) Specification Test (D_SR Dependent Variable)

Value	Coefficient
Chi-square test value	0.007
P-value	1

TABLE XIV: Hausman (1978) Specification Test (D_ER Dependent Variable)

Value	Coefficient
Chi-square test value	0.001
P-value	1

3.2.6. *Serial Correlation Test*

The serial correlation was tested by the Wooldridge test for autocorrelation in panel data. The test results in Table X show a p-value less than the significance value ($p < 0.05$). Thus, we can reject the null hypothesis that there is no first-order autocorrelation and conclude that there is evidence of first-order autocorrelation presence.

To correct the presence of serial correlation in the data, Prais-Winsten estimation was used, as shown in Tables XI and XII.

3.2.7. *Choosing Between Fixed and Random Effects Models*

Using the Hausman test to compare the fixed effects estimator and the random effects estimator, the results show that the p-value is 1.00 > 0.05, suggesting that the Random Effects Model (REM) is a better fit for the data. The same result is obtained for both models (D_ER as the dependent variable and D_SR as the dependent variable), as shown in Tables XIII and XIV.

TABLE XV: Regression Results (SR as Dependent Variable)

D_SP	Coef.	St. Err.	t-value	p-value	95% Conf	Interval	Sig
D_ER1	−0.0571	0.0307	−1.86	0.0633	−0.1076	−0.0065	*
D_IR1	3.8837	5.25	0.74	0.4595	−4.7518	12.5192	
D_INF1	−2.4457	1.0073	−2.43	0.0152	−4.1026	−0.7889	**
D_GDP1	−37.9759	20.0811	−1.89	0.0586	−71.006	−4.9455	*
c	3.5	1.6692	2.10	0.036	0.7544	6.246	**
Constant	0.0464	0.0143	3.24	0.0012	0.0228	0.0699	***
Mean dependent var		0.042		SD dependent var		1.580	
Overall r-squared		0.004		Number of obs		2795	
Chi-square		18.770		Prob > chi^2		0.002	
R-squared within		0.004		R-squared between		0.001	

Note: ***p < 0.01, **p < 0.05, *p < 0.1.

TABLE XVI: Regression Results (ER as Dependent Variable)

D_ER	Coef.	St. Err.	t-value	p-value	95% Conf	Interval	Sig
D_SR1	−0.0131	0.0076	−1.72	0.086	−0.0256	−0.0005	*
D_IR1	41.0271	1.5631	26.3	0	38.456	43.598	***
D_INF1	6.1092	.22	27.8	0	5.7474	6.471	***
D_GDP1	12.8072	1.5276	8.38	0	10.2945	15.32	***
c	6.2831	5.3802	1.17	0.243	−2.5666	15.133	
Constant	0.1858	0.0024	78.0	0	0.1819	0.1898	***
Mean dependent var		0.201		SD dependent var		1.121	
Overall r-squared		0.037		Number of obs		2795	
Chi-square		29135.513		Prob > chi^2		0.000	
R-squared within		0.037		R-squared between		0.184	

Note: ***p < 0.01, **p < 0.05, *p < 0.1.

3.2.7.1. *Random Effects Model Estimation*

The Random Effects Model is estimated using the following equations to test for the dynamic relationship in the panel data under study. The regression results of the random effects model are shown in Tables XV and XVI.

$$D\_SP = \beta_0 + \beta_1 D\_ER1 + \beta_2 D\_INF1 + \beta_3 D\_GDP1 + \beta_4 D\_IR1 D\_ER1 + \varepsilon$$

$$D\_ER = \beta_0 + \beta_1 D\_SP1 + \beta_2 D\_INF1 + \beta_3 D\_GDP1 + \beta_4 D\_IR1 D\_SP1 + \varepsilon$$

where D_SP is the first difference of the real estate listed companies' stock prices, D_IR is the first difference of the lending interest rate, D_ER is the first difference of the exchange rate, D_INF is the first difference of the inflation rate, D_GDP is the first difference of the gross domestic product, β_0 is the intercept term, β_1, β_2, β_3, and β_4 are the regression coefficients, ε is the error term.

3.2.7.2. *Vector Auto Regressive Test (VAR)*

A Vector Auto Regression model (VAR) was utilized to examine the response of stock prices and exchange rates to changes in each one VAR, which was introduced by Sims (1980), is a multivariable linear model where each variable is predicted by its previous (lagged) values in addition to the current and past values of the other variables in the model. However, since the model is usually implemented with time series data in prior literature, our study mainly followed the panel var model developed by Abrigo and Love (2016), which is a k-variate homogeneous panel VAR. The outcomes of the VAR model are highly impacted by lag selection. Therefore, we used an automatic optimal lag selection, also developed by Abrigo and Love (2016), based on Andrews and Lu (2001) model that suggests moment and model selection criteria (MMSC) for generalized methods of moments (GMM) models similar to other commonly used criteria, such as the Akaike information criteria (AIC) (Akaike, 1969), the Bayesian information criteria (BIC) (Schwarz, 1978; Rissanen, 1978; Akaike, 1977), and the Hannan–Quinn information criteria (HQIC) (Hannan & Quinn, 1979). They used the following equations:

$$MMSCBIC, n\,(k,p,q) = J_n\,(k_2 p, k_2 q) - (|q| - |p|)\,k_2 lnn$$

$$MMSCAIC, n\,(k,p,q) = J_n\,(k_2 p, k_2 q) - 2k_2\,(|q| - |p|)$$

$$MMSCHQIC, n\,(p,q) = J_n\,(k_2 p, k_2 q) - R_{k2}\,(|q| - |p|)\,lnlnn$$

where $Jn\,(k, p, q)$ is the J statistic of overidentifying restriction for a k-variate panel VAR of order p and moment conditions based on q lags of the dependent variables with sample size n, Abrigo and Love (2016).

Optimal lags of 12 were selected, according to $MAIC$ criterion, since Akaike information criteria (AIC) was used by most of the previous literature, like ElMasry and Badr (2020) and Ahmed (2019).

After that, the Var model was implemented three times with and without the moderating effect using 12 lags for each variable, while considering GDP and INF exogenous variables (Table XVII). In the beginning, the model tested the relationship between D_ER and D_SR for a 12-month period. The results showed a pattern of negative coefficients between the two variables, meaning they move in opposite directions at a confidence level of 95%. The second time, the study integrated the interactive term MODS (D_SR ∗ D_IR) to examine how the relationship is affected if interest rate entered the model as a moderating variable. The results also indicated a common pattern of negative coefficients. The third time was employed with the interactive term MOD (D_ER ∗ D_IR), also to test the effect of interest rates on the relationship between the variables. Another pattern of negative coefficient was also perceived. Thus, in the three cases stock prices of the real estate sector and exchange rates tend to move in opposite directions, as the price of dollar increase the real estate sector prices may decrease. However, direction of the relationship is sensitive to the number of lags used, and positive coefficients were also observed in different lags, although they were not common.

TABLE XVII: VAR Model

MQIC	MAIC	MBIC	J p value	J	CD	lag
3.758	104.711	−172.744	1.41E−20	200.711	−0.233	1
18.341	110.881	−143.452	1.43E−21	198.881	−0.223	2
36.63	120.757	−110.455	2.77E−21	200.757	−0.212	3
31.355	107.07	−101.022	6.89E−21	179.07	−0.176	4
46.417	113.719	−71.251	4.00E−22	177.719	−0.166	5
57.531	116.42	−45.428	9.94E−23	172.42	−0.183	6
68.269	118.746	−19.981	2.41E−23	166.746	−0.181	7
76.483	118.547	2.941	1.43E−23	158.547	−0.182	8
79.941	113.593	21.108	5.76E−23	145.593	−0.219	9
64.014	89.253	19.889	1.36E−18	113.253	−0.203	10
54.309	71.134	24.892	1.77E−15	87.134	−0.2	11
5.98	14.393	−8.728	0.00017	22.393	0.165	12

TABLE XVIII: Granger Causality Without Moderator

Equation\Excluded		chi^2	df	Prob > chi^2
D_ER	D_SP	11.705	12	0.47
	ALL	11.705	12	0.47
D_SP	D_ER	23.912	12	0.021
	ALL	23.912	12	0.021

3.2.7.3. *Granger Causality*

Followed by the VAR test, Granger causality Wald test was also employed three times to test for the dynamic relationship between Exchange rates and stock prices, assuming two scenarios in which each variable is dependent and vice versa. The Granger model by Granger (1969) generates outcomes based on the results of VAR analysis, as it tests the correlation between the current value of one variable and the lagged values of the other variables in the model. Several studies also used the Granger model to test the causality between exchange rate and stock prices such as Adjasi *et al.* (2011).

Granger analysis was implemented with the following assumptions:

- The null hypothesis(H0) that *D_ER* doesn't granger cause *D_SR* and *D_SR* doesn't granger cause *D_ER*.
- Inflation and GDP are used as control variables in the model.
- Significance level is 5.

The first scenario test results without the moderating effect are presented in Table XVIII. The test flows in two directions, in which each variable is assumed to be dependent. Assuming ER is the dependent variable, the null hypothesis that SR doesn't guarantee cause ER is accepted at a significant level of 5% (p > 0.05), as p = 0.470. However, when SR is the dependent variable, the null hypothesis that ER doesn't granger cause ER is rejected at significance level of 5% (p < 0.05), since p = 0.02. Therefore, there is a unidirectional causality from the exchange rate to the stock prices of real estate companies listed in EGX.

Granger causality was employed another two times to integrate interest rate (IR) into the model as a moderator variable to test its effect on the direction and strength of the relationship between exchange rates (*ER*) and Stock Prices (*SP*).

Also, two scenarios are assumed to be represented in the following equations.

$$D\_ER = \beta_0 + \beta_2 D\_SP1 + \beta_3 D\_INF1 + \beta_4 D\_GDP1 + \beta_1 D\_IR1 D\_SP1 + \varepsilon \quad (1)$$

where *SP* is the dependent variable, the moderator (*D_IR*) is multiplied by the exchange rate (*D_ER*) to create an interactive term named MOD.

$$D_{SP} = \mathrm{D\_ER1} + \beta_3 \mathrm{D\_INF1} + \beta_4 \mathrm{D\_GDP1} + \beta_1 \mathrm{D\_IR1D\_ER1} + \varepsilon \quad (2)$$

where *ER* is the dependent variable, the moderator (*D_IR*) is multiplied by the stock prices (*D_SP*) to generate another interactive term called MODS.

Tables XIX and XX show the results of the new granger test. In the first scenario based on (1), we use the interaction term MODS to represent (*D_IR* ∗ *D_SP*), when exchange rate (*D_ER*) is the dependent variable. In this case, the table shows that when interest rate is integrated in the model, p-value of 0.003 at 5% sginifacnce level (p < 0.05) indicating a rejection of the hypothesis that the independent variables doesn't granger cause *ER*. In the second scenario represented in (2), we used the interaction term (MOD) Implying (*D_IR* ∗ *D_ER*), as Stock prices (*D_SP*) is the dependent variable. The results display a p-value of 0.004 at a 5% significance level (p < 0.05), leading to the rejection of the null hypothesis. Thus, the study can assume that lagged values of exchange rates affect stock prices and lagged values of stock prices affect exchange rates under the moderation effect of interest rates. Therefore, when interest rate enters the granger causality model as a moderator it doesn't only change the strength of the relationship, but it also changes the nature of the relationship into a bidirectional icerelationship.

TABLE XIX: Granger Causality with Moderator Term MODS

Equation/Excluded	chi^2	df	Probability > chi^2
D_ER			
D_SP	20.022	12	0.067
ModS	30.695	12	0.002
ALL	47.756	24	0.003

TABLE XX: Granger Causality with Moderator Term MOD

Equation/Excluded	chi^2	df	Probability > chi^2
D_SP			
D_ER	16.7	12	0.161
Mod	18.025	12	0.115
ALL	46.842	24	0.004

4. Results and Discussion

To test the validity of the study's three hypotheses, VAR and Granger test results were used. According to the results at confidence interval of 95% and significance level of 5%, the correlation coefficient between exchange rate and stock prices is negative. Furthermore, only two hypotheses can be accepted at p-value > 0.05. The first hypothesis implies causality from exchange rate to stock prices. However, causality from stock prices to exchange rates represented in H2 is rejected at p-value > 0.5. On the other hand, H3 is accepted indicating that interest rate moderates in the relationship between stock prices and exchange rate, as it changes the strength and the direction of the relationship.

5. Study Limitations

The limitation of this study regarding the causal and dynamic relationship between stock prices and exchange rate lies in the inadequate number of Egyptian-market-focused studies in general and regarding the real state sector of EGX in particular. Therefore, there was not a clear reference for guidance or comparison. Moreover, most studies used time series data by focusing on one market or index; thus, there was limited access to studies that used panel data in this field. In addition, the small number of real estate companies listed on EGX affects the sample size. Additionally, numerous factors affect the exchange rate and stock prices; however, the study is limited only to a few of them. Furthermore, the study period from 2013 to 2023 witnessed severe economic and political circumstances on the domestic and global levels that may affect the reliability of results. Lastly, the inconsistency of data as it is subject to missing data, omitting companies due to their short life, and finally, the quality, different frequency, and availability of the data. Moreover, the study examines the potential moderation effect of interest rates on the relationship between exchange rate volatility and stock prices. However, it is important to note that moderation effects depend on the context and vary across different markets, economic conditions, and timeframes.

The study findings regarding the moderation effect of interest rates in the Egyptian real estate market may not be applicable to other sectors or countries. Further research could investigate the moderation effects of other variables and examine their implications in different markets and sectors. Despite the limitations presented, the study contributes to the literature and provides insights for further research. The findings of this research could be used by investors and policymakers to make more informed decisions based on the dynamics within the real estate sector.

6. Conclusion

The interdependence of financial markets and their prominent impact on the overall economy creates an urgent need to study the relationship between the different economic variables to gain a better understanding of optimal investment strategies. Hence, this paper focused on studying the dynamic relationship between exchange rates and stock prices in the Egyptian economy as a part of the two most influential markets in the economy. The particular choice for these two variables stemmed from the recent fluctuations in the forex market, which led the Egyptian government to alter its exchange rate regimes several times over the past ten years. Also, we focused on the real state sector, considering its significance in the Egyptian stock market, in addition to its sensitivity to exchange rates due to the high impact of importing building equipment and materials on the prices of buildings prices. Furthermore, to make the study more holistic, in the model we've tested the moderation effect of interest rate on the dynamic relationship between exchange rate and stock prices, while also taking into consideration GDP and inflation rates as control variables. We've conducted a theoretical analysis extracted from previous literature, followed by empirical testing on the exchange rates and stock market prices data collected from EGX and CBE.

The paper attempted to produce a thorough empirical analysis by doing several diagnostic tests on the study's panel data, such as unit root testing, co-integration testing, Multicollinearity Test, Heteroskedasticity Test, and more. Moreover, to generate results on the dynamic relationship between exchange rates and stock prices, we've used the Var model and Granger causality model two times. For the first time, we tested the dynamic relationship without integrating interest rates.

The results showed a unidirectional relationship from the exchange rate side to stock prices. In other words, the stock price of real estate companies listed on EGX can witness changes due to fluctuations in exchange rates. Once again, the model is tested with the addition of interest rates to measure the moderation effect. The outcomes implied a bidirectional relationship between the exchange rates and stock prices. Thus, the first hypothesis that exchange rate fluctuations impact stock prices can be accepted. However, the second hypothesis, which is that changes in stock prices impact exchange rates, is rejected. Finally, the third hypothesis, which is that the interest rate moderates the dynamic relationship between exchange rates and stock prices, is accepted.

7. Study Recommendations

The findings of this study suggest a unidirectional relationship between the exchange rate and stock prices as well

as a bidirectional relationship between the two variables when the moderation effect of interest rate is accounted for. These results suggest several insightful recommendations for investors, policymakers, and researchers.

Firstly, the unidirectional relationship between exchange rate volatility and stock performance suggests that fluctuations in the exchange rate can significantly affect the profitability of investments in real estate stocks. Thus, it is recommended that investors diversify their portfolios as well as closely monitor the movements in exchange rate level to use these movements to predict changes in real estate stock prices. The study findings indicate that exchange rate and stock prices move in opposite directions; therefore, the depreciation of the Egyptian Pound can cause lower stock returns for real estate investors.

Secondly, the study findings indicate that policymakers should adopt measures to stabilize the exchange rate due to its significant impact on the stock market. Additionally, it is recommended that policymakers use the monetary policy while taking into account the bidirectional relationship between exchange rate and stock prices in the presence of interest rate as a moderating variable. This means that interest rates could be used as an instrument to control demand in both the stock market and FOREX market.

Finally, the results obtained in this study open an opportunity for further research, given the limited literature in the Egyptian market context. In light of the bidirectional relationship investigated in this research, it is important to carry the investigation further and look into the driving factors of this dynamic, such as the investor behavior, flow of Foreign Direct Investments, and fundamental analysis of the companies under study. Furthermore, researchers could increase the reliability of the results by examining the variables over longer time periods as well as investigating the significance of the relationship between stock performance and exchange rate using different moderating and mediating variables.

Conflict of Interest

The authors declare that they do not have any conflict of interest.

References

Abdallah, N. (2019 February 1). Exchange rate volatility and tourism stock prices. https://jaauth.journals.ekb.eg/article_91944_ade345d91abdff663561a1449c69d583.pdf.

Abrigo, M., & Michael, I. L. (2016). Estimation of panel vector autoregression in stata—sage journals. Accessed July 20, 2023.

Abrigo, M. R., & Love, I. (2016). Estimation of panel autoregression in stata. https://journals.sagepub.com/doi/10.1177/1536867X1601600314.

Adjasi, C., Nicholas, B., & Kofi, O. (2011). Stock prices and exchange rate dynamics in selected. https://www.researchgate.net/publication/241708530_Stock_prices_and_exchange_rate_dynamics_in_selected_African_countries_A_bivariate_analysis.

Ahmed, H. S. N. (2019). Exchange rate volatility and tourism stock prices: Evidence from Egypt. *Journal of Association of Arab Universities for Tourism and Hospitality*. https://jaauth.journals.ekb.eg/article_91944.html.

Ahmed, W. M. A. (2020). Asymmetric impact of exchange rate changes on stock returns: Evidence of two de facto regimes. *Review of Accounting and Finance*, *19*(2), 147–173. https://doi.org/10.1108/RAF-02-2019-0039.

Aimer, N. M. (2019). The impact of exchange rate volatility on stock prices: A case study of Middle East countries. *Asian Development Policy Review*, *7*(2), 98–110. Retrieved 8 June, 2023. https://archive.aessweb.com/index.php/5008/article/view/233/442.

Akaike, H. (1969). Fitting autoregressive models for prediction Ann. *Inst. Stat. Math.*, *21*, 243–247.

Akaike, H. (1977a). On entropy maximization principle. In *On Entropy Maximization Principle*, https://pascal-francis.inist.fr/vibad/index.php?action=getRecordDetail&idt=PASCAL7830254164

Al-Shahry, I. (2023). Inflation, high-interest Cds could slow down Egyptian real estate market in Q1. [Online]. Invest-Gate. Available at: 2023. https://invest-gate.me/features/inflation-high-interest-cds-could-slow-down-egyptian-real-estate-market-in-q1-2023/.

American Chamber of Commerce (2022 April). High-end homes. AmCham. Retrieved May 2, 2023. https://www.amcham.org.eg/publications/industry-insight/issue/51/high-end-homes.

Amirova, A.K., & Ismailova, R. A. (2021). Cost-effectiveness analysis of new remuneration project towards accountable civil service. , 3. Retrieved August 25, 2023. https://www.researchgate.net/profile/Aderemi-Adebayo/publication/358582179_Factors_Influencing_Internet_Financial_Reporting_Among_Non-financial_listed_firms_in_Nigeria/links/62dff1883c0ea878875c27e7/Factors-Influencing-Internet-Financial-Reporting-Among-Non-financial-listed-firms-in-Nigeria.pdf#page=3.

Andrews, D. W. K., & Lu, B. (2001). Consistent model and moment selection procedures for GMM estimation with application to Dynamic Panel Data models. *Journal of Econometrics*, https://www.sciencedirect.com/science/article/abs/pii/S0304407600000774.

Bala Sani, A. R., & Hassan, A. (2018a). Exchange rate and stock market interactions: Evidence from Nigeria. *Arabian Journal of Business and Management Review*, *8*(1), 334. Retrieved 20 May, 2023. https://www.researchgate.net/profile/Sani-Bala-2/publication/363121226_Arabian_Journal_of_Business_and_Management_Review/links/630eb2431ddd4470212139f9/Arabian-Journal-of-Business-and-Management-Review.pdf.

Bala Sani, A. R., & Hassan, A. (2018b). Exchange rate and stock market interactions: Evidence from Nigeria. *Arabian Journal of Business and Management Review*, *8*(1), 334. Retrieved May 22, 2023. https://www.researchgate.net/profile/Sani-Bala-2/publication/363121226_Arabian_Journal_of_Business_and_Management_Review/links/630eb2431ddd4470212139f9/Arabian-Journal-of-Business-and-Management-Review.pdf.

Borjigin, S., Yang, Y., Yang, X., & Sun, L. (2018). Econometric testing on linear and nonlinear dynamic relation between stock prices and macroeconomy in China. *Physica A: Statistical Mechanics and Its Applications*, *493*, 107–115. https://www.sciencedirect.com/science/article/pii/S0378437117310439.

Branson, W. H. (1983, November 1). Macroeconomic determinants of real exchange rates. *NBER*, https://www.nber.org/papers/w0801.

Bustami, F., & Heikal, J. (2019). Determinants of return stock company real estate and property located in Indonesia stock exchange. *International Journal of Economics and Financial Issues*, *9*(1), 79. https://www.proquest.com/openview/03412cd5aaa9beb7e1199fcdff9316ae/1?pq-origsite=gscholar&cbl=816338.

Central Agency for Public Mobilization and Statistics (2022 August 23). Slight increase of marriage contracts in 2021—capmas.gov.eg. Central Agency for Public Mobilization and Statistics Press Release. Retrieved May 1, 2023. https://capmas.gov.eg/admin/news/PressRelease/2022823122131_666%20e.pdf.

Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association*, *47*, 427–431. https://www.scirp.org/reference/referencespapers?referenceid=1855675.

Dickey, D. A., & Fuller, W. A. (1981). Likelihood ratio statistics for autoregressive time series with unit root. *Econometrica*, *49*, 1057–1072. https://doi.org/10.2307/1912517.

Dornbusch, R. (1976). Expectations and exchange rate dynamics. https://www.mit.edu/~14.54/handouts/dornbusch76.pdf.

Dornbusch, R., & Fischer, S. (1980). Exchange rates and the current account. *The American Economic Review*, *70*(5), 960–971. Retrieved May 22, 2023. https://www.jstor.org/stable/pdf/1805775.pdf?refreqid=excelsior%3Abcf2f5f894b333598ca095ba79d5882e&ab_segments=&origin=&initiator=&acceptTC=1.

Egypt Chanels 21% of Public Investments to Urban Development: Planning Minister—Economy—Business (25 C.E., August 22). Ahram Online. Retrieved May 2, 2023. https://english.ahram.org.eg/NewsContent/3/12/473825/Business/Economy/Egypt-chanels--of-public-investments-to-urban-deve.aspx.

ElMasry, A., & Badr, O. (2020). (PDF) stock market performance and foreign exchange market in Egypt: Does 25th January

revolution matter? Research gate. https://www.researchgate.net/publication/342134225_Stock_market_performance_and_foreign_exchange_market_in_Egypt_does_25th_January_revolution_matter.

El-Said, H. (2022). Planning Ministry Eyes EGP 294.2 BN Investments for Urban Development in FY. [Online]. Invest-Gate. Available at: 2022/2023. https://invest-gate.me/news/planning-ministry-eyes-egp-294-2-bn-investments-for-urban-development-in-fy-2022-2023/.

Endri, E., Amrullah, D. F., Suparmun, H., Mary, H., Sova, M., & Indrasari, A. (2021). Determinants of stock return of property and real estate companies in the developing market. *Corporate Governance and Organizational Behavior Review*, *5*(2), 184–193. https://virtusinterpress.org/Determinants-of-stock-return-of-property-and-real-estate-companies-in-the-developing-market.html.

Fama, E., (1981 February 14). Stock returns, real activity, inflation, and money. https://www.jstor.org/stable/1806180.

Fama, E. (1990, September 1). Stock Returns, Expected Returns, and Real Activity. https://www.jstor.org/stable/2328716.

Frankel, J. (1983). Monetary and Portfolio-Balance Models of Exchange Rate Determination. In *Economic Interdependence and Flexible Exchange Rates*. MIT Press, https://www.sciencedirect.com/science/article/abs/pii/B9780124442818500386

Gavin, M. (1989). The stock market and exchange rate dynamics. *Journal of International Money and Finance*, *8*(2), 181–200. https://www.sciencedirect.com/science/article/abs/pii/0261560689900223.

Granger, C. W. J. (1969). Investigating causal relations by econometric models and cross-spectral methods. *Econometrica*, *37*, 424–438.

Hacker, S., Kim, H., & Mansson, K. (2009). The relationship between exchange rates and interest. https://www.researchgate.net/publication/46470120_The_Relationship_between_Exchange_Rates_and_Interest_Rate_Differentials_A_Wavelet_Approach.

Hafez, T. (2022 May). In depth-calling new cities home. AmCham. Retrieved May 2, 2023. https://www.amcham.org.eg/publications/business-monthly/issues/317/May-2022/4168/calling-new-cities-home.

Hannan, E. J., & Quinn, B. G. (1979). The determination of the order of an autoregression. *Journal of the Royal Statistical Society*, *41*, 190–195. https://www.scirp.org/reference/referencespapers?referenceid=2257006.

ichards, N., John, S., & John, E. (2009). The interaction between exchange rates and stock. https://www.researchgate.net/publication/42386599_The_Interaction_between_Exchange_Rates_and_Stock_Prices_An_Australian_Context.

IMF. (2016 November 11). IMF executive board approves US$12 billion extended arrangement under the extended fund facility for Egypt. Retrieved May 4, 2023. https://www.imf.org/en/News/Articles/2016/11/11/PR16501-Egypt-Executive-Board-Approves-12-billion-Extended-Arrangement.

IMF. (2018). International monetary fund. *Annual Report on Exchange Arrangements and Exchange Restrictions*, [Online] [Retrieved May 4, 2023]., https://www.imf.org/~/media/Files/Publications/AREAER/areaer-2018-overview.ashx.

IMF. (2022 December 16). Frequently asked questions on Egypt and the IMF. https://www.imf.org/en/Countries/EGY/Egypt-qandas.

Kamal, A. L. M. (2022). Interrelation dynamics between exchange rate and stock market returns in Egypt. *Archives of Business Research*, *10*(9). Retrieved May 29, 2023. https://www.researchgate.net/profile/Abdelmonem-Lotfy-Mohamed-Kamal/publication/367591346_Interrelation_Dynamics_between_Exchange_Rate_and_Stock_Market_Returns_in_Egypt/links/63ed3b1651d7af054028d7da/Interrelation-Dynamics-between-Exchange-Rate-and-Stock-Market-Returns-in-Egypt.pdf.

Kganyago, T., & Gumbo, V. (2015). An empirical study of the relationship between money market interest rates and stock market performance: Evidence from Zimbabwe (2009–2013). *International Journal of Economics and Financial Issues*, *5*(3). Accessed September 6, 2023. http://www.econjournals.com/index.php/ijefi/article/view/1202.

Khalil, A., & Ghandour, Y. E. (2018). The Egyptian devaluation—One year later. *Infomineo, Value Added Business Research*. Retrieved June 1, 2023. https://infomineo.com/egyptian-devaluation-one-year-later/.

Liu, T. Y., & Lee, C. C. (2020). Exchange rate fluctuations and interest rate policy. *International Journal of Finance & Economics*, *27*(3), 3531–3549. https://doi.org/10.1002/ijfe.2336.

Micheal, J. (2018). The dynamic relationship between stock prices and exchange rate—An Egyptian experience. *International Journal of Research in Economic and Social Sciences*, *8*(2), 1–7. https://doi.org/10.2139/ssrn.3106574.

Mkhize, B. (2022). The effect of exchange rate volatility on share prices of the JSE top 40. *Research portal*, https://ujcontent.uj.ac.za/esploro/outputs/graduate/The-effect-of-exchange-rate-volatility/9915309807691.

Mundell, R. (1960). The monetary dynamics of international adjustment under fixed and flexible exchange rates. *The Quarterly Journal of Economics*, *74*(2), pp. 227–257. https://econpapers.repec.org/article/oupqjecon/v_3a74_3ay_3a1960_3ai_3a2_3ap_3a227-257.htm.

National Population Council (2022 April). *The Role of the State in Demographic Dislocation*. National Population Council. Retrieved May 2, 2022. http://npc.gov.eg/media/4jcbglx0/%D8%AF%D9%88%D8%B1-%D8%A7%D9%84%D8%AF%D9%88%D9%84%D8%A9-%D9%81%D9%89-%D8%A7%D9%84%D8%AE%D9%84%D8%AE%D9%84%D8%A9-%D8%A7%D9%84%D8%B3%D9%83%D8%A7%D9%86%D9%8A%D8%A9-_%D8%A7%D8%B5%D8%AF%D8%A7%D8%B1-%D8%A7%D8%A8%D8%B1%D9%8A%D9%84-2022.pdf.

Nusair, S. A., & Olson, D. (2022). Dynamic relationship between exchange rates and stock prices for the G7 countries: A nonlinear ARDL approach. *Journal of International Financial Markets, Institutions and Money*, *78*, 101541. https://reader.elsevier.com/reader/sd/pii/S1042443122000312?token=48A6E2F70B6B1FC6E142617B9C7C65B53AE2BBD8EFA4A794712640B2BBC83BE69C81AA83880998AFC7773CAB87516137&originRegion=eu-west-1&originCreation=20230512114347.

Nyasha, S., & Odhiambo, N. M. (2019). Does remittance inflow granger-cause economic growth in South Africa? A Dynamic Multivariate Causality Test. *The Review of Black Political Economy*, *47*(1), 86–103. https://doi.org/10.1177/0034644619885348.

Ortega, J. T., De La Rosa, J. O., & Isaza, Y. I. (2022). Panel data approach: Macroeconomic variables and first enrollment in private higher education institutions in Colombia. *Procedia Computer Science*, *203*, 610–614. https://www.sciencedirect.com/science/article/pii/S1877050922006937/pdf?md5=2f7f2eea171f4850e548b904d61399a1&pid=1-s2.0-S1877050922006937-main.pdf.

Ouma, J., & Anyango, C. (2016). Performance of Nairobi securities exchange market—Researchgate. https://www.researchgate.net/profile/Johnmark_Ouma/publication/346989505_Moderating_Effect_of_Interest_Rates_on_Relationship_between_Foreign_Exchange_Rate_Fluctuation_and_Performance_of_Nairobi_Securities_Exchange_Market/links/622b594c3c53d31ba4bacfc4/Moderating-Effect-of-Interest-Rates-on-Relationship-between-Foreign-Exchange-Rate-Fluctuation-and-Performance-of-Nairobi-Securities-Exchange-Market.pdf.

Pallegedara, A. (October 3, 2012). Dynamic relationships between stock market performance and short term interest rate—Empirical evidence from Sri Lanka. SSRN. https://deliverypdf.ssrn.com/delivery.php?ID=177005005066088064091101066100005007009025023051035024067125124026003126011107095081043118057101052027117103016073117013123110021057038082085065015125076018066108089093050038114125119118026090027071114022101094005096094071117126008120085078103116107105&EXT=pdf&INDEX=TRUE.

Parsva, P., & Tang, C. F. (2017). A note on the interaction between stock prices and exchange rates in Middle-East economies. *Economic Research-Ekonomska istraživanja*, *30*(1), 836–844. Retrieved 20 May, 2023. https://hrcak.srce.hr/file/269196.

Patro, D. K., Wald, J. K., & Wu, Y. (2009). Currency devaluation and stock market response: An empirical analysis. *Social Science Research Network*. https://doi.org/10.2139/ssrn.1459491.

Phillips, P. C. B., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, *75*, 335–346. https://doi.org/10.1093/biomet/75.2.335.

Phylaktis, K., & Ravazzolo, F. (2005). Stock prices and exchange rate dynamics. *Journal of International Money and Finance*, *24*(7), 1031–1053. Retrieved May 27, 2023. https://doi.org/10.1016/j.jimonfin.2005.08.001.

Pigou, A. C. (1943, December 1). The classical stationary state. https://www.jstor.org/stable/2226394.

World Bank Open Data. (2022). *Population Growth (Annual %)—Egypt, Arab Rep*. World Bank Open Data. Retrieved April 20, 2023. https://data.worldbank.org/indicator/SP.POP.GROW?end=2021&locations=EG&start=2008.

Quy, V. T., & Loi, D. T. N. (2016). Macroeconomic factors and stock prices–A case of real estate stocks on Ho Chi Minh stock exchange. *Ho Chi Minh City Open University Journal of Science-Economics and Business Administration*, *6*(1), 63–75. https://journalofscience.ou.edu.vn/index.php/econ-en/article/view/111.

Richards, N. D., Simpson, J., & Evans, J. (2009). The interaction between exchange rates and stock prices: An Australian context. *International Journal of Economics and Finance*. https://www.researchgate.net/publication/42386599_The_Interaction_between_Exchange_Rates_and_Stock_Prices_An_Australian_Context.

Rissanen, J. (1978). Modeling by shortest data description. *Automatica*, *14*, 465–471. https://doi.org/10.1016/0005-1098(78)90005-5.

Rossi, B., & Wang, Y., Vector autoregressive-based Granger causality test in ... -sage journals. Accessed July 25, 2023. https://journals.sagepub.com/doi/10.1177/1536867X19893631.

Saleh, H. (2017 December 12). *Egypt Fights Inflation After its Currency Devaluation*. Financial Times. https://www.ft.com/content/dc2871fe-d4f9-11e7-8c9a-d9c0a5c8d5c9.

Schwarz, G. (March, 1978). Estimating the dimension of a model. *Ann Statist*, *6*(2), 461–464. https://doi.org/10.1214/aos/1176344136.

Sims, C. A. (1980a, January 1). Macroeconomics and reality. Econometrica. https://ideas.repec.org/a/ecm/emetrp/v48y1980i1p1-48.html.

Suriani, S., Kumar, M. D., Jamil, F., & Muneer, S. (2015). Impact of exchange rate on stock market. *International Journal of Economics and Financial Issues*, *5*(1), 385–388. https://dergipark.org.tr/en/pub/ijefi/issue/31972/352308?publisher=http-www-cag-edu-tr-ilhan-ozturk.

Trabelsi, M., & Bahloul, S. (2022). Stock and exchange rate movements in the MENA countries: A markov switching-VAR model. *Economic Journal of Emerging Markets*, *14*(2), 218–230. Retrieved May 28, 2023. https://journal.uii.ac.id/JEP/article/download/25504/14270.

Venkata Seshaiah, S., & Tripathy, T. (2018). GDP purchasing power parity per capita and its determinants: A panel data analysis for BRICS. *Theoretical Economics Letters*, *8*, 575–591. https://doi.org/10.4236/tel.2018.83040.

White, H. (1980). A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica: Journal of the Econometric Society*, *48*(4), 817–838.