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ARTICLE

# Currency Volatility Risk, VIX and Equity Market Performance of Developed Countries: Quantile and Markov Regressions Analysis

David UMORU[1†]*; Salisu S. UMAR[1†]; Beauty IGBINOVIA[1†]; Rafat HUSSAINI[1†]

[1] Department of Economics, Edo State University Uzairue, Iyamho, Nigeria.
[†] Authors contributed equally.
* Corresponding Author: david.umoru@yahoo.com

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## Abstract

The susceptibility of financial markets to macroeconomic variables and other risk factors globally raises the need for this research. The focus of the study is to analyze the impact of exchange rate policy regime shifts and the outbreak of pandemics on stock market returns and prices in developed countries. The study used the Markov switching model. Quantile regressions were also estimated to substantiate the credibility of the results. The study found that exchange rate risk caused significant reductions in stock values. Since the VIX index served as the switching predictor variable; the results suggest that in the state of falling expectations as regard market uncertainty, there was a corresponding upward adjustment in stock market prices while rising market expectations of volatility and uncertainty, stock prices jumped up. These portray downward adjustments in the prices of equities and consequently return whenever there was a percentage rise in the interaction index. Stressful market circumstances made evident in market sentiments, embrace algorithmic trading and high-frequency traders, magnify price swings and exacerbate instantaneous market reactions to news or events regardless of the regime. This amplifies uncertainty about the market and significantly discourages stock returns. Volatility lowers business performance, weakens investors' market engagements, and lowers firm share returns. Accordingly, the findings support earlier research that a rise in VIX heightens investors' anxiety over the significant suspense of volatile stock market price swing and declining returns. The research outcomes are significant for use by market traders, investors and policy makers. Investors should use volatility risk projections to inform their investment choices, such as options or volatility-based trading. Financial regulation may be required to monitor and control excessive volatility, since extended periods of volatility destabilizes financial markets and damage investor trust.

**Keywords:** Stock returns, stock price**s,** exchange rate risk, volatility index (VIX), developed equity markets
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## 1. Introduction

Financial market volatility frequently causes investors to get disturbed and deter them from making reliable investment choices (**Kirci et al., 2024**). An immediate market index that shows the market's anticipations of volatility risk over the next 30 days is called the Volatility Index (VIX). While traders use the VIX for pricing futures and trading a range of options and exchange-traded products, investors use the VIX to measure market fear and risk levels when making investment choices. The degree of uncertainty and anxiety risk based on volatility expectations increases with the size of the VIX index's price movements, and vice versa. Hence, it is widely acknowledged that turbulent periods are characterized by amplified equity return volatilities (**Mensi et al., 2023**). Accordingly, in this era of financial globalization that has been bedeviled by incessant volatilities that spread across equity markets, it becomes increasingly desirous for investors to evaluate the risks associated with market investments across different regimes of low and high volatilities.

The currency exchange rate risk has become a fundamental measure for managing businesses and investments. Research by **Lilley & Rinaldo (2020)** and **Stavrakeva & Tang (2021)** have all investigated the significance of the risk premium as a factor in exchange rate movements. Perceived risk and negative sentiments tend to intensify in the early phases of a market crisis, as individuals react to news, social media reports, and interactions (**Ilzetzki, Reinhart, & Rogoff, 2020b**). Hence, the impact of changes in the exchange rate risk on the stock market has sparked extensive debate. This issue is particularly significant for nations transitioning from a fixed to a floating exchange rate system due to the increased unpredictability associated with flexible exchange rates. This transition engenders an environment where exchange rates are prone to greater fluctuations, driven by a reduced level of government intervention. The resultant exchange rate volatility emerges as an initial forerunner of economic hazard, entailing substantial consequences for a country's international trade dynamics (**Stavrakeva & Tang, 2021**).

In view of the preceding, the study seeks to evaluate the regime effects of currency volatility risk, and VIX index on equity markets. The research is significant to the government as it will enable them to adopt policies that will prevent the volatility risk and adopt the exchange rate policy regime appropriately. The study is of significance to policymakers, especially the monetary authorities and other players in the financial markets of both developed and developing countries, because knowledge of the relationship between financial markets, pandemics, and exchange rate policy regime shifts will enable the relevant authorities to formulate proactive and preventive responses to likely effects that might arise. The research assists traders and investors seeking to invest in domestic and international financial markets. For stock market practitioners, the findings provide awareness of the dynamics of stock markets that are adversely affected by volatility risk in order to identify the best market alternatives. Finally, the study has added to the existing literature and provided a robust basis for the intended research. Section two reviews the literature, while three provides the methodology and model specification together with sources of data. Section four provides the interpretations of the regression results. The final section is the conclusion.

## II. Prior Research Evidence on Equity Markets

### *A. Relationship between VIX and Stock Markets' Performance*

According to **McFarlane et al. (2023)**, investors and market experts utilize VIX, a volatility index, as the primary metric to gauge stock market uncertainty. It serves as a tool for gauging market perceived risk of uncertainty. As noted by **Prasad et al. (2023)**, **Aharon & Dimpfl (2022),** and **Nasution et al. (2020)**, the VIX index is frequently referred to as the "fear index" since it represents expectations of short-term stock market volatility. To comprehend how volatility indexes represent investor expectations of market risk, especially in times of uncertainty, the VIX has proven essential.

**Pati, Rajib, and Barai (2019)** demonstrated that volatility indices give useful information for pricing assets and managing market risk as regards the Indian stock market. According to **Qadan et al. (2019)**, a rise in the VIX could indicate that investors are becoming more risk averse and may encourage them to improve diversification to balance their portfolios. The research's implications support earlier findings that the VIX is the investor fear gauge, highlighting the function of volatility indices as predictive measures of market emotion. In their study of the volatility risk premium in Indian options prices, **Garg & Vipul (2015)** emphasized the significance of using volatility metrics in derivatives pricing models.

### *B. Relationship between Exchange Rate Risk and Stock Markets' Performance*

Concerning studies on exchange rate risk on stock markets, exchange rate instability had no discernible detrimental effects on the quantity of stock transactions of industrial firms on the Nigerian exchange, according to the empirical findings of **Ani, Nzewi & Abere (2024)**. Duruechi, **Ojiegbe, & Ekweozor's (2023)** analysis found a long-term nexus, albeit a marginal one, between Nigerian stock market performance and foreign exchange rate dynamics. The financial returns of holdings in real estate stocks of companies listed on the Egyptian Stock Exchange (EGX) were greatly impacted by variations in the exchange rate, according to **Rady *et al*. (2024)**. A two-way causal interaction between exchange rate changes and the prices of real estate stocks was demonstrated when interest rate was included in the model as a moderator. **Adekunele (2023)** conducted an empirical study which demonstrated a weak negative link between exchange rate volatility and the capitalization and volume of transactions in Nigeria's stock market. **Baeriswyl *et al*. (2023)** empirically determined an amplification of the sensitivity of domestic stock prices to exchange rate fluctuations. By this empirical result, the law of one price was supported.

**Trabelsi & Bahloul (2022)** assert that currency rates and stock prices move in tandem when the economy is stable and in opposition during times of economic turbulence.By using the ARCH/GARCH model estimation on monthly data from June 2010 to December 2019, **Abdallah (2019)** empirically discovered a considerable impact of exchange rate volatility on the share price of companies in the tourist sector listed on the Egyptian Stock Exchange. According to **Bustami & Heikal's (2019)** research, real estate companies and property stock returns benefited greatly from exchange rate fluctuations. Specifically, stock returns increased by 16.48% for every 10% increase in the fluctuating exchange rate. **Frankel *et al.* (2019)** present a study where they develop a novel database characterizing the de facto exchange rate regime for 145 countries throughout the entire post-Bretton Woods era. Using this comprehensive database, the study first examines the global shifts in de facto ERRs over time. Subsequently, the research delves into the relationship between ERR and economic growth. The study's findings challenge two prevailing notions: the *corner hypothesis* and the *fear of floating*. Contrary to these ideas, the results demonstrate that intermediate ERRs are positively associated with economic growth, and this relationship holds the greatest level of significance. Furthermore, the study reveals that this relationship varies across countries with different income levels, emphasizing that the choice of ERR appears to have more substantial implications for low-income countries compared to their high-income counterparts. These findings provide valuable insights into the intricate dynamics of exchange rate regimes and their impact on economic growth, particularly considering the diverse economic contexts of different countries. The review of literature so far has shown an empirical relationship between the exchange rate and stock markets, and between the volatility risk and equity markets. Yet, this research improved on the literature by evaluating the regime effects of the volatility index and exchange rate risk, as well as the interaction between VIX and currency risk on stock markets of developed countries. On the above promise, this study remains invaluable to academics, policymakers, stakeholders, and international business owners.

## III. Data and Methodology

### *A. Data Measurement and Sources*

Secondary data for study variables were retrieved from institutional sources. This study uses the stock markets of Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Singapore, South Korea, Spain, Sweden, Switzerland, the United Kingdom, and the United States of America as its sample. The list of stock market indices utilized in this research are the ASX200 index of the Australian stock market, the ATX index of Austria market, the BEL20 index of Belgium market, the TSX index of the Canadian stock market, the Denmark OMX Copenhagen 20 index, Helsinki 25 index of the Finland Stock market, the FR40 index of France which is made up of 40 of the most prominent listed companies in the France, DAX stock index traded on the Frankfurt Stock Exchange, the Athens General index of the Athens Stock Exchange. Also, we have the ISEQ-20 All-Share index of the Irish Stock Exchange, the FTSE MIB (Milano Indice di Borsa) index traded on the BorsaItaliana, JP Nikkei 225 index of the Japanese stocks, the AEX Index traded on the Amsterdam Exchange, the NZX 50 listed on the New Zealand Exchange, the OSEAX index traded securities on the Oslo Stock Exchange, the Portuguese Stock Index (PSI-20) that trade on Euronext Lisbon, the Straits Times Index (STI) index of the Singapore Exchange, the KOSPI index of the South Korean Exchange, IBEX 35 index of the Bolsa de Madrid Stock Exchange, the Stockholm 30 Index traded on the Stockholm Stock Exchange of Sweden, the Swiss Market Index (SMI) listed in the Swiss Exchange. The FTSE 100 index traded at the London Stock Exchange (LSE), the Standard & Poor's 500 (S&P) 500 tracks the 500 largest companies by market cap in the U.S. These stock market indices are all free-floating adjusted market capitalization price-weighted weighted indices.

As reported in Trading Economics, since January, 2024; the ASX200 index of the Australian stock market increased 586 points or 7.72% in January 2024. The ASX is the leading share market index and contains the top 200 ASX listed companies. The ATX index rose 176 points or 5.13% since January 2024. The BEL20 is a weighted capitalization index of as it tracks the performance of 20 most capitalized and liquid stocks traded in Belgium. The Canada TSX index reached an all-time high of 24922.92 in October of 2024, it rose 3427 points or 16.35%. The OMX Copenhagen 20 index consists of the 20 most actively traded shares on the Copenhagen Stock Exchange. The index increased 235 points or 10.31%. According to Trading Economics, the Australian stock market's ASX200 index rose by 7.72%, since January 2024. The top 200 ASX-listed firms are included in the ASX, the most prominent share market index. Since October 2024, the ATX index has increased by 5.13%. The performance of the highest 20 capitalized equities traded in Belgium is tracked by the BEL20, a weighted capitalization index. The 20 shares that are traded the most on the Copenhagen Stock Exchange make up the OMX Copenhagen 20 index. The index rose 10.31%. The Finland market's Helsinki 25 index rose by 2.19%. In September 2024, the France stock exchange's FR40 index closed at 7,635.8 points, down from 7,630.9 points at the end of August 2024. Forty of the largest and most liquid German firms that trade on the Frankfurt Stock Exchange are represented by the DAX stock index. One significant stock market index that monitors the performance of Greek stocks listed on the Athens Stock Exchange is the Athens General index.

The ISEQ 20 is made up of the 20 overall Index businesses with the largest market capitalization and trading volume. The ISEQ 20 index rose by 12.21%. The performance of 40 of the most prominent and liquid firms listed on the BorsaItaliana is tracked by the FTSE MIB index, a significant stock market index. The average of Japanese stocks that is most frequently quoted is the Nikkei225 index. One important stock market index that monitors the performance of the top stocks traded on the Amsterdam Exchange is the AEX Index. The NZX 50 is a leading stock market index that follows the performance of 50 of the biggest and most liquid businesses listed on the New Zealand Exchange based on their free float market capitalization. Based on a six-month turnover rating, the OSEAX index is a leading stock market index that monitors the performance of the most traded securities on the Oslo Stock Exchange. The OSEAX index rose 9.81% in August 2024. In the Lisbon exchange, the PSI-20 monitors the prices of the twenty listings with the highest market capitalization and share turnover. The PSI 20 rose 5.62% in September 2024. The performance of the top 30 businesses listed on the Singapore Exchange is closely tracked by the STI, a significant stock market index. One significant stock market index that monitors the performance of big South Korean firms is the KOSPI. As of August 2024, the KOSPI index's most current value is 131.65 points, which is lower than its prior value of 139.68 points.

The benchmark index of the Bolsa de Madrid stock market, known as the IBEX 35, tracks the collective performance of the 35 most traded companies in the Spanish stock market, following a technical advisory committee analysis, most appropriate in terms of capitalization, liquidity, and trading volume among those listed on the Electronic Stock Market Interconnection System (SIBE) in the four (4) Spanish stock exchanges (Madrid, Barcelona, Bilbao, and Valencia). After closing at 11,065.0 points at the end of July 2024, the index closed at 11,401.9 points in August 2024. The performance of 30 stocks with the highest trading volume on the Stockholm Stock Exchange in Sweden is tracked by the Stockholm 30 index. The SMI is a prominent stock market index that monitors the performance of the top 20 most liquid and notable stocks listed on the Swiss Exchange. The top hundred firms listed on the LSE by market capitalization are listed in the FTSE 100 index. The S&P 500 index tracks the 500 biggest American corporations by market capitalization.

The VIX for the U.S equity market is taken from the Refinitiv Eikon database. The index is a measure of 30-day projected volatility of the U.S. stock market, computed from mid-term quote prices of S&P 500 Index (SPX) call and put options. The VIX for other stock markets was computed using the options pricing on each market's underlying asset throughout the course of the preceding 30 days. The price of options, which are derivatives, was determined by the likelihood that the current price of a specific stock will move sufficiently to reach a level known as the striking price. As a result, we chose options that had 23–37-day expiration dates. An option must expire between 23 and 37 days in order to be included in the VIX index.

The *mid-term* options are those with an expiration date of 23 to 37 days, which is a period that is neither weekly nor extremely long, with many months till expiration. In order to profit from impending news events or earnings releases while maintaining a certain degree of freedom in the event that the market direction shifts, traders employ mid-term options. The adjusted price of each option is then determined. The pricing of mid-term options is heavily influenced by the underlying asset's volatility since greater volatility can raise the possibility of more substantial price swings over the period. To be able to determine the 30-day variance, we interpolated the two variances and determined the total variance for the first and second expirations. The volatility as a standard deviation was then obtained by taking the square of the root of the 30-day variance. To calculate stock market returns, the logarithmic initial differences of stock market prices were taken.

### *B. Methodology*

The relevance of the arbitrage pricing theory (APT), due to **Ross (1976)** in modeling market dynamics was evaluated by **Yadav & Hegde (2021)**. The APT serves as the methodological foundation for this research. According to Ross, the theory takes into account risk factors that affect asset returns as well as macroeconomic variables. As a result, the model indicates that the independent variables in the study namely, the exchange rate regime as a macroeconomic variable and pandemics as a risk factor may have an impact on the stock market, which helps the theory of arbitrage pricing achieve its goals.

$$\mathrm{E}(StReturns_{it}) = StReturns_{it-1} + \vartheta_1 risk_1 + \vartheta_2 risk_2 + \cdots + \vartheta_n risk_n \quad (1)$$

$$\mathrm{E}(StPrices_{it}) = StPrices_{it-1} + \theta_1 risk_1 + \theta_2 risk_2 + \cdots + \theta_n risk_n \quad (2)$$

where $StPrices_{it}$ is stock prices of i[th] stock at time t; $StReturns_{it}$ is the returns on the ith stock at time t that captures the sensitivity of expected returns and stock prices. The Markov switching regression model, and quantile regression model were utilized in the statistical analysis. The Markov-Switching regression model is specified as follows:

$$StReturns_{it} = T_{st} + \Phi_1(EVOL_{it} - T_{st} - 1) + \Phi_2(VIX_{it} - T_{st} - 2) + +\Phi_2(VIX.EVOL_{it} - T_{st} - 2) + \varepsilon_t, \varepsilon_t \sim i.i.dN(0, \sigma_t^2) \quad (3)$$

$$StPrices_{it} = D_{st} + \Phi_1(EVOL_{it} - D_{st} - 1) + \Phi_2(EVIX_{it} - D_{st} - 2) + +\Phi_2(VIX.EVOL_{it} - D_{st} - 2) + \varepsilon_t, \varepsilon_t \sim i.i.dN(0, \sigma_t^2) \quad (4)$$

where D, and T are the regime-specific regression coefficients, and s(t) represents regime at time t. Each regime has its own set of regression coefficients. Focusing on regime specifics, the research recognizes two economic states, namely, the low volatility and high volatility periods. The following specified panel quantile regression model was estimated for this study:

$$StReturns_{it} = \beta_{0d}^{(\rho)} + \beta_{d1}^{(\rho)} EVOL_{it} + \beta_{d2}^{(\rho)} VIX_{it} + \beta_{d3}^{(\rho)} VIX.EVOL_{it} + e_{it} \quad (5)$$

$$StPrices_{it} = \delta_{0d}^{(\rho)} + \delta_{d1}^{(\rho)} EVOL_{it} + \delta_{d2}^{(\rho)} VIX_{it} + \delta_{d3}^{(\rho)} VIX.EVOL_{it} + e_{it} \quad (6)$$

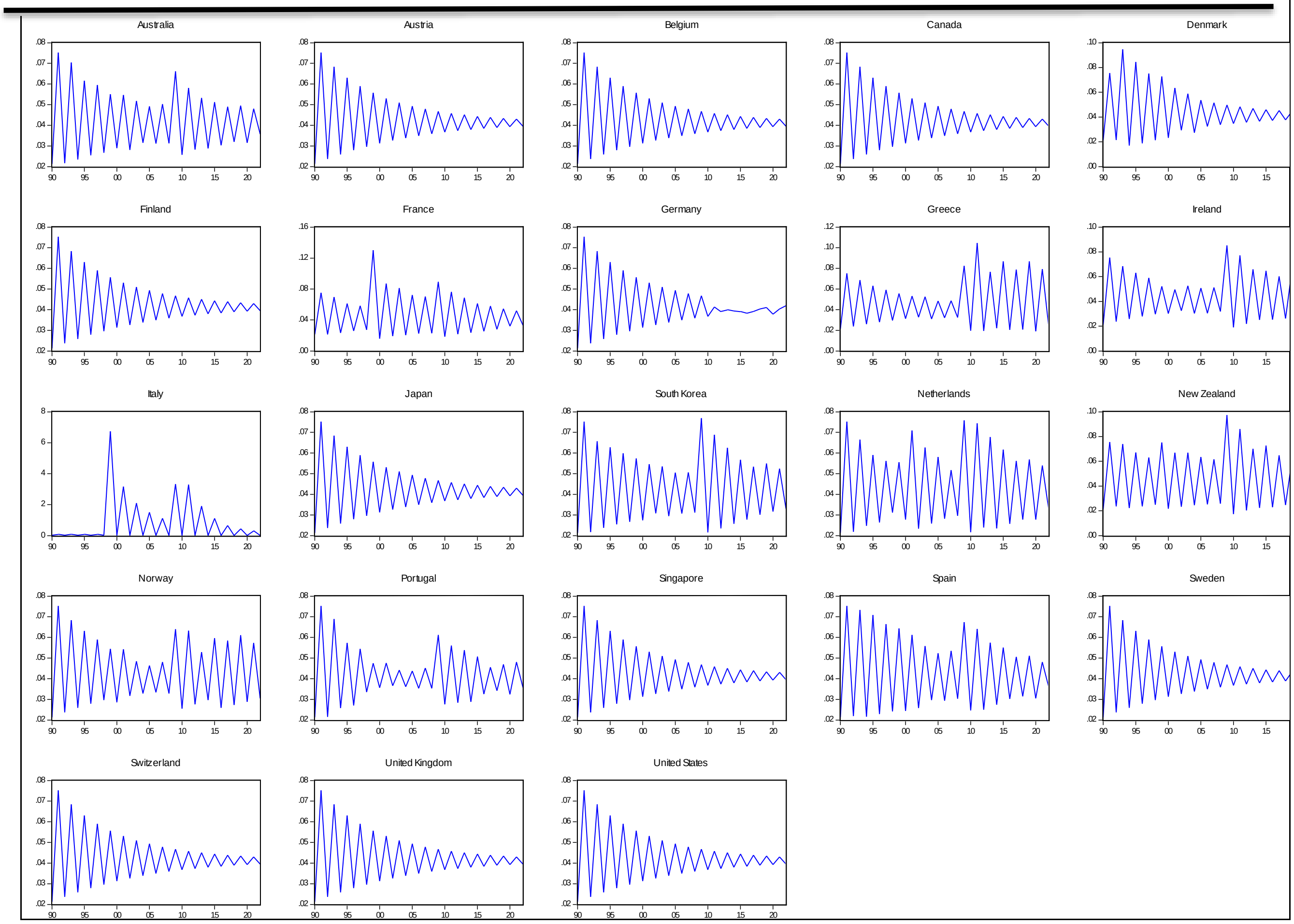
where $EVOL_{it}$ is the exchange rate risk, that is, the risk associated with the i[th] exchange rate at time t, $VIX_{it}$ is the market volatility index, i.e., the volatility index of the i[th] equity market at time t, $VIX.EVOL_{it}$a is the interaction variable for volatility risk and exchange rate risk – a measure of market uncertainty, and $\rho$ is the quantile.

## IV. RESULTS AND DISCUSSIONS

### *A. Descriptive Analysis of Variables*

The graph depicted in Figure 1 shows the pattern of volatility risk expectation of stock markets' participants for each country researched. The volatility graphs in Figure 3 show high volatility clustering and persistence in turbulence across the sampled countries, with large undulating movements confirming the persistence found in the numerical outputs. The persistence found shows that large volatilities are followed by large volatilities, and smaller volatilities are followed by small volatilities. The implication of the foregoing is that market players can predict, to a large degree of accuracy, future stock prices from current volatility. The charts also show numerous spikes in different periods for most of the stock markets in developed countries. For Poland, Switzerland, the United Kingdom, the United States, Sweden, Japan, Belgium, Canada, Austria, and Germany, spikes were at peaks in earlier periods before adjusting to more stable fluctuations in later periods. Other countries had a broader distribution of spikes across the early and mid-periods.

**Figure 1: VIX Graphs of Equity Markets Indices**

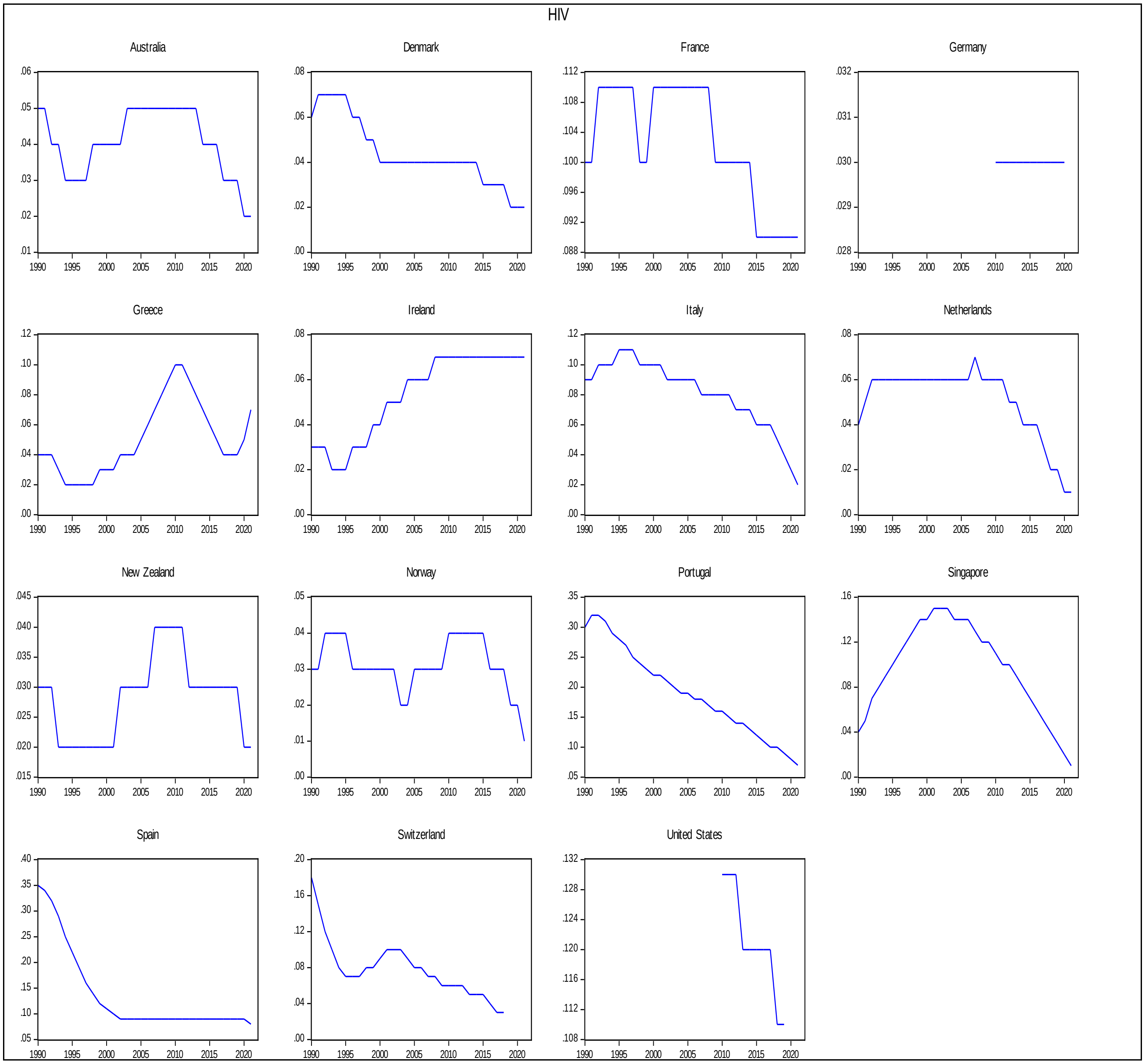



Source: Authors' E-Views 13 estimation results

Figure 2 depicts a plot of exchange rate risk measured as exchange rate risk in Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Singapore, South Korea, Spain, Sweden, Switzerland, the United Kingdom, and the United States of America. According to the Figure, the VIX index exhibits varying trends across different countries. Generally, however, the study finds latter years following a declining pattern for most of the years.

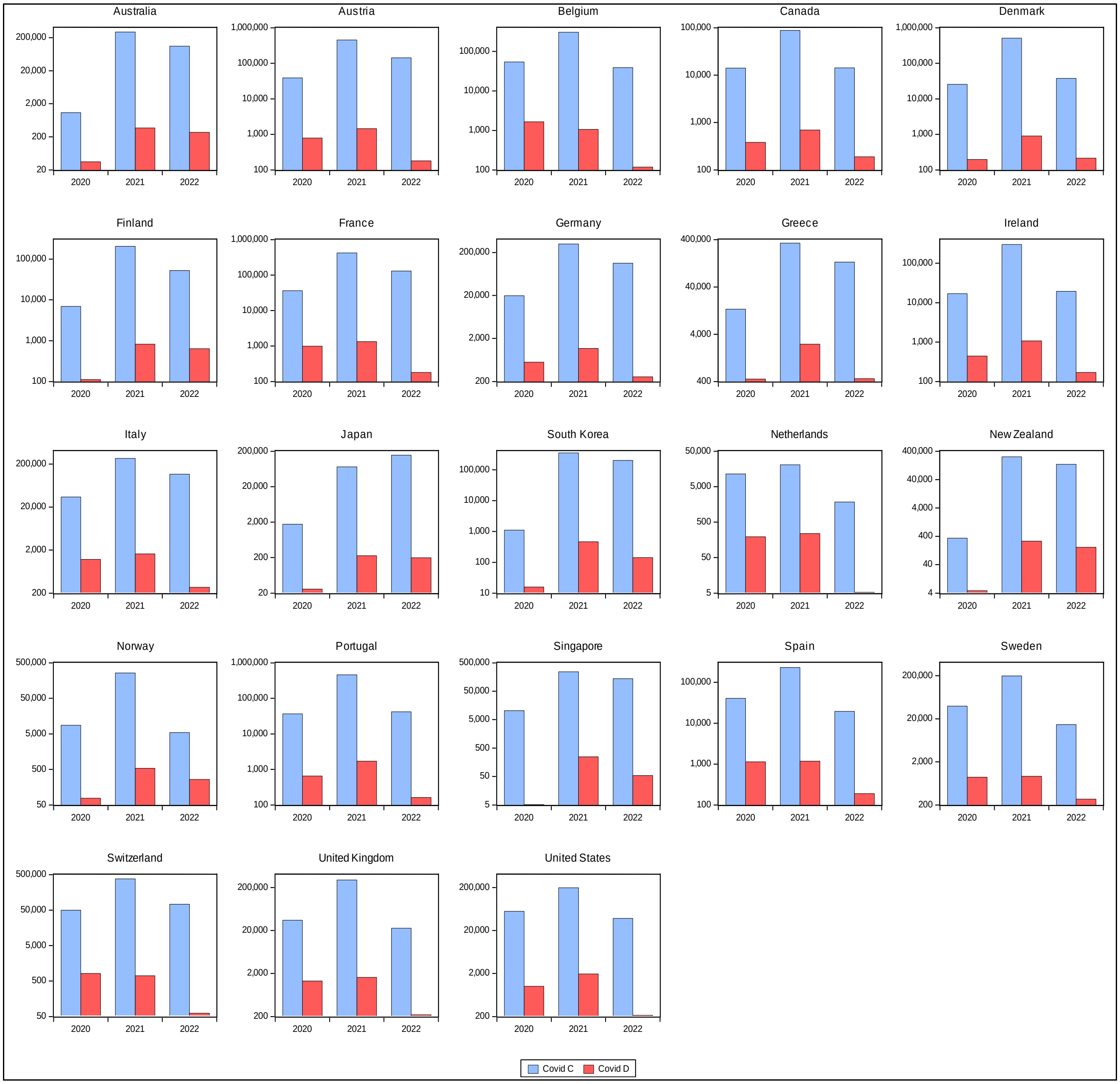
The graph in Figure 3 shows the stock prices and returns in Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Singapore, South Korea, Spain, Sweden, Switzerland, the United Kingdom, and the United States of America.

**Figure 2: Exchange Rate Risk Charts for Developed Countries**




Source: Authors' E-Views 13 estimation results

**Figure 3: Stock Markets' Prices and Returns Charts for Developed Stock Markets**




Source: Authors' E-Views 13 estimation results

Table 1 shows the description of stock prices in developed countries. For stock prices, log values were resorted to for all the countries because capitalization values were very large, and logarithm transformation reduces the values by placing them in a common base for clearer understanding. The United States had the largest market capitalization, with values in trillions of dollars. The least it had been for the time is also the largest at hundreds of billions of dollars, and the distribution is platykurtic. The Japanese minimum value comes close to that of the United States in hundreds of billions of dollars as well. However, the statistics show a lower level of growth in the Japanese market given that average and maximum values still remain within the hundreds of billions of dollars range. Canada, France, and Germany also have average values within the category, although the minimum values for these three fall to values showing tens of billions of dollars. Finland had the least mean value of market capitalization in the tens of billions range, although the least value ever recorded was in the Italian market, valuing figures in the hundreds of millions range. Finland and France maintained a normal distribution, while others tilted from platykurtic to leptokurtic distributions.

**Table 1: Description of Stock Prices**

| Country | Mean | Maximum | Minimum | Std. Dev. | Kurtosis |
|---|---|---|---|---|---|
| Australia | 812 | 1720 | 108 | 524 | 1.423 |
| Austria | 81 | 236 | 3 | 57 | 3.029 |
| Belgium | 230 | 438 | 64 | 120 | 1.727 |
| Canada | 1400 | 2640 | 458 | 681 | 1.628 |
| Denmark | 78 | 151 | 33 | 35 | 2.317 |
| Finland | 32 | 97 | 12 | 21 | 6.790 |
| France | 1420 | 2750 | 151 | 799 | 1.779 |
| Germany | 1250 | 2280 | 329 | 585 | 2.022 |
| Greece | 88 | 265 | 34 | 60 | 5.261 |
| Ireland | 101 | 170 | 49 | 38 | 1.866 |
| Italy | 488 | 1070 | 0 | 288 | 2.279 |
| Japan | 3810 | 6720 | 2070 | 1230 | 2.763 |
| Netherlands | 546 | 1100 | 120 | 249 | 2.469 |
| New Zealand | 46 | 132 | 9 | 31 | 3.499 |
| Norway | 152 | 355 | 18 | 106 | 1.558 |
| Portugal | 69 | 132 | 39 | 21 | 5.155 |
| Singapore | 367 | 787 | 34 | 271 | 1.387 |
| South Korea | 706 | 2180 | 42 | 588 | 2.384 |
| Spain | 701 | 1800 | 111 | 433 | 2.647 |
| Sweden | 204 | 373 | 78 | 97 | 1.748 |
| Switzerland | 941 | 2000 | 158 | 522 | 2.009 |
| United Kingdom | 2360 | 3950 | 850 | 957 | 1.920 |
| United States | 16800 | 40700 | 3090 | 9490 | 2.834 |
| All | 1610 | 40700 | 0 | 4220 | 36.38 |

Source: Authors' E-Views 13 estimation results

The descriptive statistics for stock returns are displayed in Table 2 below. The variable's distributional attributes were essentially established on the basis of this description. In advanced economies, stock returns varied widely across countries, as shown in Table 2 below. Austria's losses at -0.929 were the lowest, followed by France's at -0.776 and South Korea's at -0.698. All-time high values have Austria with the highest value of 1170%. This is followed by South Korea and Singapore at 173.6% and 171%, respectively. Japan's returns had an average of 5.4%, a peak of 82.6%, and a low of -30.94%. Greece also had 5.57% mean returns, with a maximum of 84%. Belgium, Finland, Germany, Ireland, Spain, and the United Kingdom all have average returns across the period of less than 10%, taking annual data into consideration. Denmark, Finland, Germany, Greece, Norway, Portugal, Spain, and Sweden satisfied normality assumptions in the panel distribution.

**Table 2: Description of Stock Returns**

| Country | Mean | Maximum | Minimum | Std. Dev. | Kurtosis | Skewness |
|---|---|---|---|---|---|---|
| Australia | 0.124592 | 0.845243 | -0.473262 | 0.252699 | 4.232251 | 2.387 |
| Austria | 0.462671 | 11.70026 | -0.929381 | 2.150245 | 26.62289 | 3.274 |
| Belgium | 0.096301 | 0.782153 | -0.566290 | 0.282909 | 3.440300 | 5.328 |
| Canada | 0.093927 | 0.622821 | -0.527268 | 0.253139 | 3.348974 | 1.273 |
| Denmark | 0.124092 | 0.584901 | -0.274684 | 0.226810 | 2.902615 | 1.586 |
| Finland | 0.092335 | 0.967961 | -0.578113 | 0.491377 | 2.084730 | 4.938 |
| France | 0.357025 | 8.943400 | -0.775875 | 1.702428 | 24.86585 | 2.864 |
| Germany | 0.091318 | 0.572894 | -0.472458 | 0.233529 | 2.902814 | 3.380 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Greece | 0.055695 | 0.840477 | -0.659572 | 0.400681 | 2.164072 | 1.679 |
| Ireland | 0.093644 | 0.795531 | -0.656094 | 0.328612 | 3.053458 | 2.468 |
| Italy | 103.2340 | - | -0.999146 | 504.9982 | 22.04346 | 2.291 |
| Japan | 0.054851 | 0.826300 | -0.309419 | 0.247918 | 4.328546 | 3.083 |
| Netherlands | 0.114762 | 0.438552 | -0.593455 | 0.226882 | 4.633957 | 2.715 |
| New Zealand | 0.122974 | 0.671944 | -0.490169 | 0.267946 | 3.152226 | 2.268 |
| Norway | 0.128038 | 0.557391 | -0.588903 | 0.283007 | 2.700061 | 2.927 |
| Portugal | 0.061321 | 0.616133 | -0.479153 | 0.291134 | 2.261125 | 2.135 |
| Singapore | 0.169028 | 1.711181 | -0.508557 | 0.439823 | 6.452834 | 3.083 |
| South Korea | 0.208807 | 1.736141 | -0.698959 | 0.522996 | 5.492521 | 3.189 |
| Spain | 0.094595 | 0.573456 | -0.473089 | 0.245798 | 2.451031 | 3.289 |
| Sweden | 0.126314 | 0.618364 | -0.279664 | 0.283945 | 1.905112 | 1.354 |
| Switzerland | 0.104880 | 0.437325 | -0.334412 | 0.185016 | 3.173502 | 3.893 |
| United Kingdom | 0.084241 | 0.496903 | -0.514319 | 0.206172 | 4.376702 | 2.879 |
| United States | 0.104393 | 0.353129 | -0.418225 | 0.169564 | 4.341078 | 2.134 |
| All | 4.335100 | 11.70026 | -0.999146 | 101.9355 | 586.9508 | 5.381 |

Source: Authors' E-Views 13 estimation results

Table 3 below shows the description of VIX index in developed countries. Portugal had the highest mean proportion of 0.191 for the VIX index. Spain and the United States had the second and third highest average values, with 0.137 and 0.121 respectively. Spain had the all-time high VIX index. Only Argentina, Brazil, and Norway had a normal distribution of VIX indices with a kurtosis value approximately equal to 3.

**Table 3: Description of VIX Index**

| Country | Mean | Max | Min. | Standard Deviation | Kurtosis | Skewness |
|---|---|---|---|---|---|---|
| Australia | 0.041 | 0.05 | 0.02 | 0.009 | 2.271 | 3.245 |
| Denmark | 0.044 | 0.07 | 0.02 | 0.015 | 2.387 | 3.157 |
| France | 0.103 | 0.11 | 0.09 | 0.008 | 1.750 | 3.022 |
| Germany | 0.030 | 0.03 | 0.03 | 0.000 | NA | 1.149 |
| Greece | 0.050 | 0.1 | 0.02 | 0.024 | 2.318 | 3.094 |
| Ireland | 0.053 | 0.07 | 0.02 | 0.019 | 1.675 | 3.564 |
| Italy | 0.081 | 0.11 | 0.02 | 0.023 | 3.381 | 3.289 |
| Netherlands | 0.050 | 0.07 | 0.01 | 0.016 | 3.663 | 3.042 |
| New Zealand | 0.028 | 0.04 | 0.02 | 0.007 | 2.134 | 3.098 |
| Norway | 0.031 | 0.04 | 0.01 | 0.008 | 3.413 | 3.671 |
| Portugal | 0.191 | 0.32 | 0.07 | 0.074 | 1.984 | 3.038 |
| Singapore | 0.096 | 0.15 | 0.01 | 0.042 | 2.030 | 3.546 |
| Spain | 0.137 | 0.35 | 0.08 | 0.083 | 4.025 | 3.037 |
| Switzerland | 0.078 | 0.18 | 0.03 | 0.033 | 5.056 | 2.903 |
| United States | 0.121 | 0.13 | 0.11 | 0.007 | 2.040 | 1.267 |

| | | | | | | |
|---|---|---|---|---|---|---|
| All | 0.075 | 0.35 | 0.01 | 0.058 | 8.816 | 4.583 |

Source: Authors' E-Views 13 estimation results

**Table 4: Unit Root Tests Results**

| Variables | Order | Im, Pesaran and Shin W-Statistic | ADF-Fisher Chi-Square | PP-Fisher Chi-Square | Breitung t-Statistic | Levin, Lin & Chu t* Statistic |
|---|---|---|---|---|---|---|
| EVOL | I(I) | -9.672** | 116.92*** | 94.10*** | -1.975 | -2.567** |
| StockP(prt) | I(I) | -4.392** | 103.84*** | 88.56*** | -1.554 | -2.243** |
| StockR(ret) | I(I) | -16.36*** | 303.64*** | 440.84*** | -1.843 | -16.40*** |
| VIX | I(1) | -8.7539*** | 43.412*** | 26.24*** | 5.196 | -2.746** |

Source: Authors' E-Views 13 estimation results

### *B. Unit Root and Co-integration Analysis*

The examination of the stationarity of variables within the cohort of developed countries is elucidated by the data presented in Table 4. Specifically, unit root tests employed showed that exchange rates at level possessed unit root. In other words, the series were non-stationary across panels, implying that modelling with the series will result in unreliable forecasts. Consequently, further investigation was conducted through second differencing. The results of the second differencing process indicated significant p-values across all five tests, leading to the rejection of the null hypothesis of unit root and the acceptance of the alternative hypothesis, suggesting that the differentiated data are stationary. Thus, upon first differencing, it was established that the fluctuations in exchange rates among these countries around their mean values are transitory and lack a discernible stochastic trend. Additionally, the examination extended to share prices and share returns, revealing stationarity only at the first differencing stage across all tests. This observation suggests that the fluctuations in stock prices are transient and tend to revert to a stable level over time. Furthermore, investigations were conducted on variables related to all of which were found to be first-differenced stationery. This conclusion was drawn from the acceptance of the alternate hypotheses across the tests ($p < .05$). Consequently, it can be inferred that the trends observed in the data pertaining to VIX indices exhibit predictable patterns, facilitating their accurate modeling and forecasting.

The panel co-integration test results, covering both individual and group test methods, are shown in Table 5 for each of the variables. Table 5 reports the panel co-integration test results. Co-integration statistics with common autoregressive coefficients had statistically significant outcomes ($p < .05$), and these revealed the existence of a prolonged equilibrium relationship among the study variables, indicating their collective movement over time regardless of short-term fluctuations. The significance of the statistical measures linked to panel co-integration assessments illuminate both the strength and nature of these relationships. Therefore, the four variables on which the test was conducted do not exhibit purely random behaviour but rather share a common underlying trend that binds them together over the long term. However, this long-term relationship was observed only when all cross-sections are assumed to have common roots. In consideration of the uniqueness of each cross-section, panel co-integration tests yield contradictory results. The results also spell complexity in the interactions of study variables in the long term, although potential short-term relationships are likely to exist.

**Table 5: Co-integration Test Results**

| Measure | Statistic |
|---|---|
| Panel v-Statistic | 2.204597** |
| Panel rho-Statistic | -1.135158 |
| Panel PP-Statistic | -3.671974** |
| Panel ADF-Statistic | -3.269229** |
| Group rho-Statistic | 1.589268 |
| Group PP-Statistic | -0.877169 |
| Group ADF-Statistic | -0.934775 |

Source: Authors' E-Views 13 estimation results

**Table 6: Ramsey Reset Test Results for Stock Prices**

| | | |
|---|---|---|
| Log(stock prices), VIX.EVOL, VIX, EVOL, C | QLR L-statistic<br>QLR Lambda-statistic | 2.8891 (0.19)<br>2.8772 (0.19) |

Source: Authors' E-Views 13 estimation results

### *C. Quantile Regression (QR) Analysis*

The QR analysis for the estimation results for stock prices were pre-diagnosed using the Ramsey RESET test, as reported in Table 6. The Ramsey RESET test yielded values of 2.8891 and 2.8772, both of which were considered insignificant (p > 0.05). Acceptance of the null hypothesis in this context suggests that the selected functional form adequately represents the relationship between variables across various quantiles. Consequently, the quantile regression model demonstrates stability without any evidence of functional misrepresentation.

The QR results for stock prices as the dependent variable are presented in Table 7; the probability values are enclosed in parenthesis, and the cryptograms *, **, and *** indicate that the variable is significant at the 10%, 5%, and 1% levels for the respective variables. Table 9 reveals the quantile estimates for stock prices in developed countries' stock markets. The quantile distribution estimates consistently show negative and significant interaction effect between VIX index and exchange rate risk. This signifies a considerable level of market uncertainty that is associated with falling stock prices.

The VIX index passed significance in the 10$^{th}$ to 60$^{th}$ percentiles of the distribution. The outcome shows that 10% to 60% quantiles of stock prices declined significantly following a rise in the VIX index. These stock prices also rise when the VIX index of market expectations of volatility falls in relative terms. The considerable effect of the VIX index is only prominent during the immediate period. For exchange rate risk, all the percentiles had negative coefficients significantly decreasing stock prices in developed markets. Regarding the post-estimation exercise, the quantile slope equality test was conducted to explore whether coefficients vary across different quantiles of the dependent variable. Results indicate that the coefficients of independent variables vary largely across various segments of the developed population (Wald statistic = 165.06, p<0.05), suggesting that the effects of both regimes and pandemics are changing across these segments.

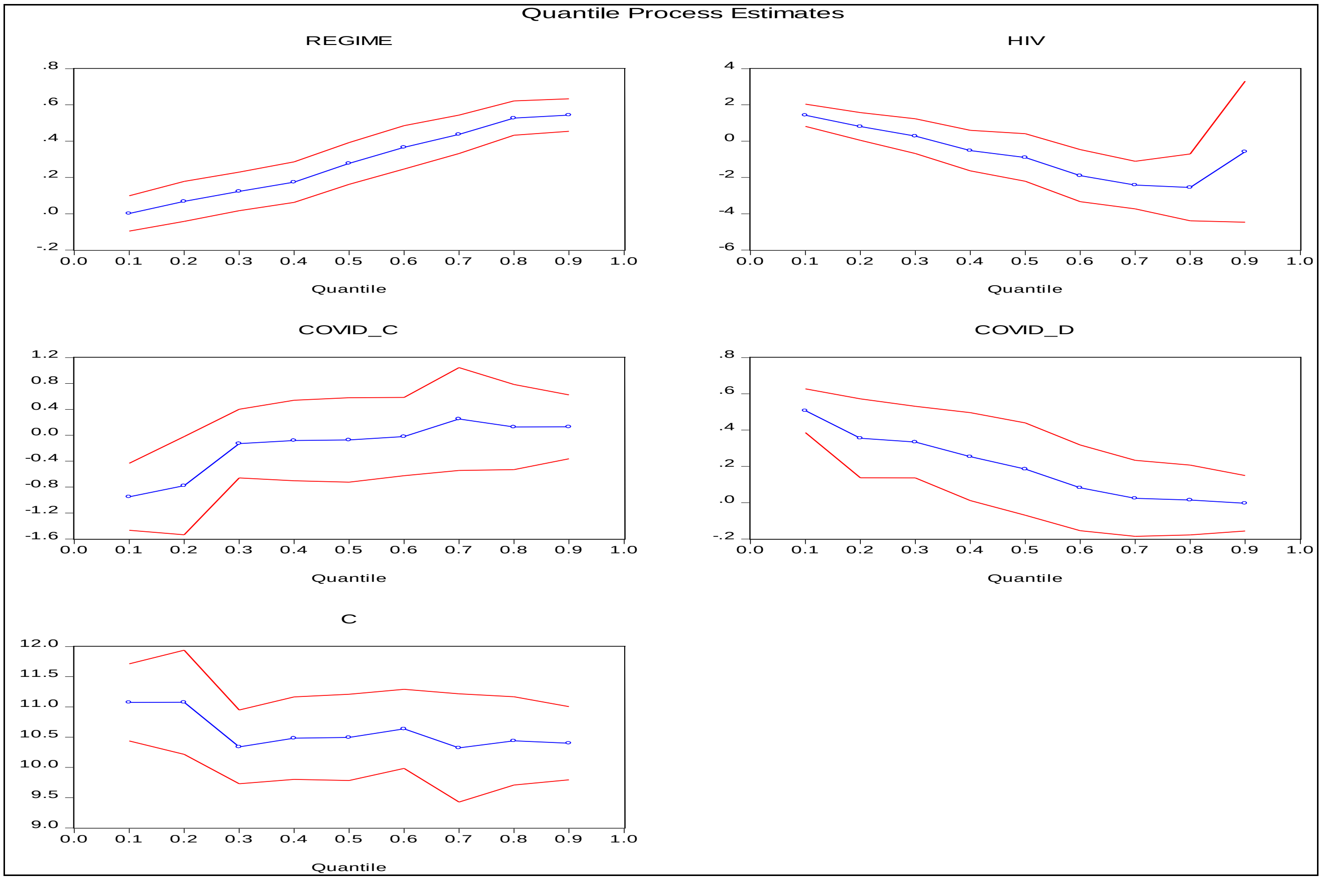
Figure 4 illustrates the conditional distributions of stock prices with respect to the variables. The Figure represents graphical representations of the adjustments in magnitudes of the impact of each model term on stock prices. The study finds the chart plotted for exchange rate regimes is continuously sloping upwards from left to right, confirming the rising impact as the percentiles progress. The VIX index offer a contrary pattern, sloping upwards from right to left, confirming a continuous recline in its impact on stock market indices as percentiles progresses. The exchange rate risk and the regression intercept values have rolling adjustments across quantiles.

**Table 7: Quantile Estimates for Stock Prices**

| Quantile | VIX.EVOL | VIX | EVOL | C |
|---|---|---|---|---|
| **0.1** | -0.017*** (0.000) | -1.027***(0.017) | -0.949**(0.004) | 0.5068*** (0.0615) |
| **0.2-** | -0.061***(0.000) | -0.214***(0.3912) | -0.777**(0.007) | 0.3547** (0.111) |
| **0.3** | -0.123**(0.042) | -0.134**(0.001) | -0.1275***(0.006) | 0.3339** (0.1006) |
| **0.4** | -0.142*** (0.000) | -0.0017***(0.5687) | -0.0809**(0.009) | 0.2536** (0.1237) |
| **0.5** | -0.132**(0.089) | -0.0092**(0.0016) | -0.0716***(0.000) | 0.1852 (0.1297) |
| **0.6** | -0.159** (0.009) | -1.899**(0.001) | -0.0195 (0.081) | 0.0817 (0.1206) |
| **0.7** | -0.176***(0.000) | -0.012 (0.978) | -0.2509 (0.005) | 0.0237 (0.1068) |
| **0.8** | -0.224** (0.003) | -0.049 (0.173) | -0.1270 (0.001) | 0.0146 (0.098) |
| **0.9** | -0.098** (0.007) | -0.129(0.453) | -0.1298 (0.009) | -0.0034 (0.0781) |
| | | Quantile Slope Equality Test (Wald): 165.06*** | | |
| | | Symmetric Quantiles Test (Wald): 19.3114 | | |

Source: Authors` E-View 13 estimation results

**Figure 4: Quantile Estimate Plots for Stock Prices of Developed Countries**




Source: Authors' E-Views 13 estimation results

**Table 8: Ramsey Reset Test Results for Stock Returns of Developed Countries**

| Variables | Statistic | Value |
|---|---|---|
| Log(stock returns)- VIXEVOL, VIX, EVOL, C | QLR L-statistic | 1.4114(0.23) |
| | QLR Lambda-statistic | 1.4114(0.23) |

Source: Authors' E-Views 13 estimation results

The quantile regression analysis for the estimation model for stock returns was pre-diagnosed using the Ramsey RESET test, as reported in Table 8 below. The Ramsey RESET test returned values of 1.4114 and 1.4114, which were deemed insignificant (p > 0.05). Acceptance of the null hypothesis in this situation implies that the chosen functional form appropriately captures the association between variables across quantiles. As a result, the quantile regression model is stable and shows no indication of functional misrepresentation.

Table 9 displays results of quantile estimation with stock returns as the dependent variable. The probability values are contained in parenthesis and *, **, and *** imply that the variable is significant at the 10%, 5%, and 1% levels respectively. For stock return estimation, as reported in Table 10, the interceptive values indicate the expected values of exchange rates when regimes and pandemics are non-existent. Values across the quantiles vary, with a negative value of -0.0015 at the first conditional distribution and rising continuously to 0.269 in the ninth quintile. The VIX indices had both negative and positive coefficients confirming a heterogeneous pattern of effects. The effects are highly substantial at the 1% and 5% levels respectively. The interaction variable shows strong interaction between VIX and exchange rate volatility that signifies declining effect on stock returns. All quantiles of equity market returns show significant and hostile effect of the interaction between exchange rate risk and VIX index of market's expectations of volatility over the next 30 days. This suggests that developed countries with strong incidence of market uncertainty have lower returns on their investments. The magnitude of influence of these effects across the quantiles fluctuates, with the least impact on the first quantile at -0.001, followed by the second quantile with -0.003.

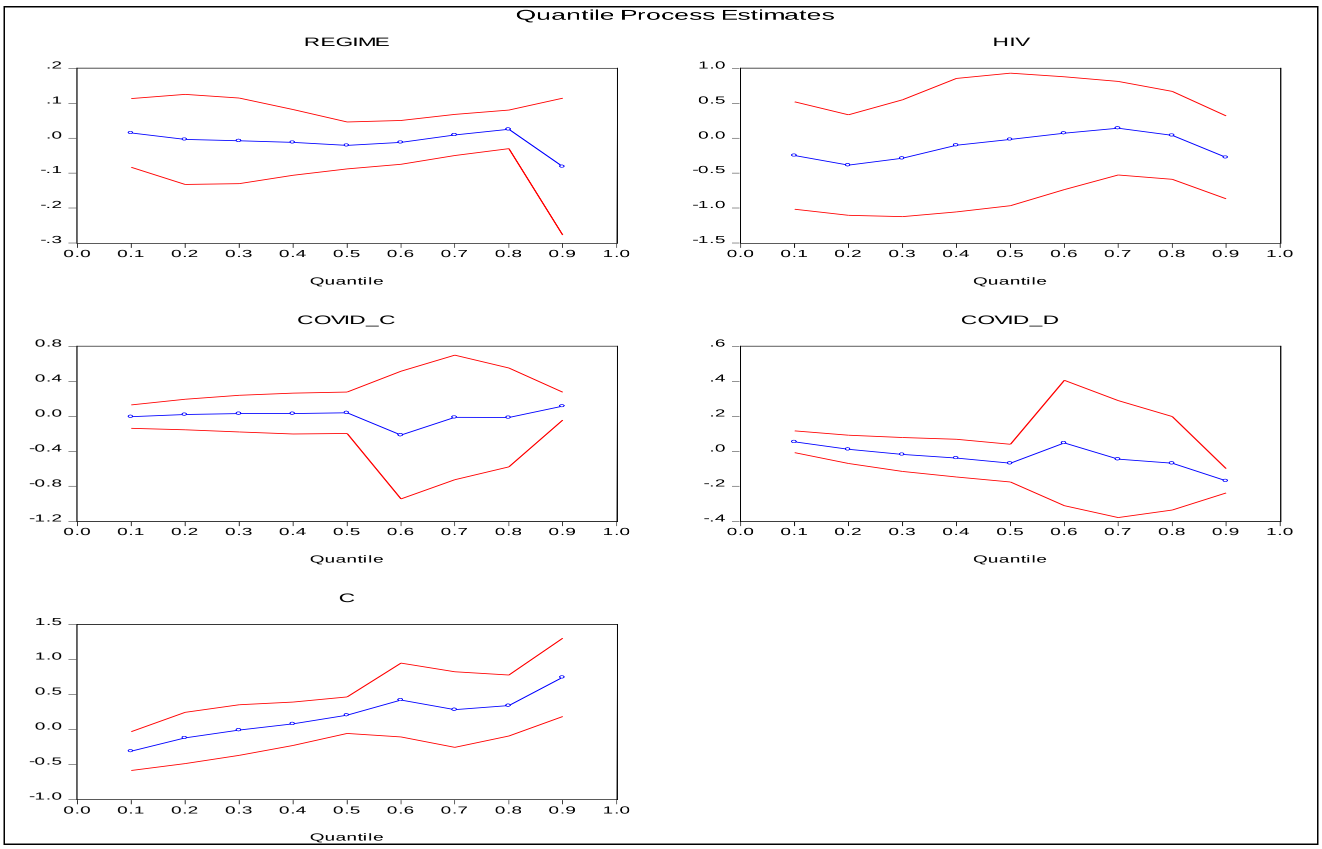
The volatility of the exchange rate is associated with declining stock returns as made evident by the negative quantile coefficients. All these coefficients of exchange rate risk are significant at various thresholds of 5% and 1%, confirming that exchange rate risk does exert significant influence on the returns of investors in the stock markets. For the post-estimation exercise, the quantile slope equality test was carried out to determine whether there is variation in coefficients across different quantiles of the dependent variable. The findings indicate that the coefficients of the independent variables remain changing across various proportions of the developed population (Wald statistic = 78.48, p < 0.05). This suggests that the impact of both regimes and pandemics significantly differs across different segments of developed nations. Additionally, the symmetric quantiles test was conducted, and it supports the null hypothesis that the conditional distribution of the dependent variable is symmetric around the median (Wald Statistic = 7.42, p > 0.05).

**Table 9: Quantile Estimates for Stock Returns in Developed Countries**

| Variable | VIX.EVOL | VIX | EVOL | C |
|---|---|---|---|---|
| **0.1** | -0.001***(0.002) | -0.2477*** (0.000) | -0.036*** (0.000) | 0.0542 (0.0318) |
| **0.2** | -0.003*** (0.005) | -0.3852**(0.0071) | -0.025**(0.004) | 0.0111 (0.0413) |
| **0.3** | -0.075** (0.025) | -1.069**(0.006) | -0.037**(0.013) | -0.0184 (0.0497) |
| **0.4** | -0.119** (0.048) | -0.125***(0.001) | -0.015**(0.091) | -0.0393 (0.055) |
| **0.5** | -0.207*** (0.003) | -0.017*** (0.015) | -0.049*** (0.000) | -0.0681 (0.0551) |
| **0.6** | -0.120**(0.032) | 0.026** (0.018) | -0.217**(0.006) | 0.0474 (0.1832) |
| **0.7** | -0.092*** (0.000) | 0.131*** (0.004) | -0.015***(0.000) | -0.0450 (0.1708) |
| **0.8** | -0.053** (0.021) | 0.0407*** (0.000) | -0.013**(0.006) | -0.0687 (0.1365) |
| **0.9** | -0.129*** (0.000) | -0.243***(0.002) | -0.162** (0.001) | -0.1688** (0.0355) |
| Quatile Slope Equality Test (Wald): 78.48*** | | | | |
| Symmetric Quantiles Test (Wald): 7.42 | | | | |

Figure 5 below illustrates the conditional distributions of stock returns with respect to the variables. In the line charts of Figure 5, the plots show graphically the magnitude of coefficients across different conditional distributions for each term in the model.

**Figure 5: Quantile Estimate Plots for Stock Returns of Developed Countries**




Source: Authors' E-Views 13 estimation results

### *D. Panel Regression for Stock Returns*

Table 10 illustrates the random panel regression for stock returns in developed stock markets. The probability values are contained in parenthesis and *, **, and *** imply that the variable is significant at the 10%, 5%, and 1% levels respectively. The VIX coefficients of -1.047 and -1.142 for stock prices and returns reveal a significant and inverse relationship between market expectations of risk and stock returns and prices in developed markets. The results demonstrate that higher market fear and risk levels cause declining stock returns. Exchange rate risk is similarly inversely related to stock returns with a coefficient of -0.3173; however, this effect was found to be insignificant within the

95% confidence interval for the price equation. For the returns equation, the exchange rate risk was significant at 5% level with a negative effect given by -1.021. The market uncertainty measure was negatively related to prices and returns with significant sizes of -0.162 and -0.895 respectively. From the statistics, it is revealed that the surge in the interactive effect heightens investors' sentiment in terms of fear and risk levels when making investment choices in developed markets. The explanatory power of the models as depicted by the adjusted R-squared values, confirming that the price model was responsible for 49% of the variation in stock returns in developed countries while the returns equation explained 63%.

**Table 10: Random Panel Regression for Stock Prices and Returns**

| Variables | Coefficients | |
|---|---|---|
| | **Prices** | **Returns** |
| Constant | 1.592***(0.000) | 1.029***(0.001) |
| VIX | -1.047***(0.000) | -1.142**(0.052) |
| EVOL | -0.317(0.465) | -1.021**(0.023) |
| VIX.EVOL | -0.162***(0.000) | -0.895***(0.000) |
| Hausman Test | 2.6752(0.613) | 2.1094(0.850) |
| Adjusted $R^2$ | 0.495 | 0.632 |
| F-statistic | 9.1753*** (0.000) | 10.1879***(0.000) |

Source: Authors' E-Views 13 estimation results

### *E. Markov-Switching Regression Results*

Table 11 reports the Markov-switching regime regression results for stock prices as the dependent variable. The probability values are contained in parenthesis and *, **, and *** imply that the variable is significant at the 10%, 5%, and 1% levels respectively. The results differentiate between two economic states, regime 1 and regime 2. Regimes were grouped into two groups guided by the major existing regimes: fixed and floating regimes. Examining the sigma values, regime 1 has a lower value than regime 2, revealing that regime 1 is a period of low volatility, as opposed to regime 2, which is marked as a state of high volatility. Analysis of the error variance for each regime highlights greater stability in models predicting countries with lower stock market prices (regime 1) compared to those in regime 2 since 0.5699 < 1.4372. The VIX index served as the switching predictor variable. The VIX index had significant coefficients of 1.114 and -1.058, respectively for regime 1 and regime 2. The VIX index had a positive impact on stock prices in the first regime, while it had an inverse effect on stock prices in the second regime. The results suggest that regardless of the conditions of the stock markets (the two regimes); VIX does significantly impact the pricing of stock markets in developed countries. The exchange rate risk given as volatility in the exchange rates of the countries in the study had significant negative coefficients of -1.052 and -1.379, respectively for regime 1 and regime 2. The results suggest that regardless of turbulent or calm market conditions, exchange rate risk does unfavorably impact the pricing of stock markets in developed countries. The results disclose significant negative interaction effects for regime 1 and regime 2 with coefficients given by -1.064 and -1.023. These show that whenever there was a percentage increase in the interaction index, the prices of stocks adjusted downward by 1.064% and 1.023%. Since the VIX index was used as the switching predictor variable, the results indicate that stock market prices adjusted upward in response to declining expectations regarding market uncertainty, while stock prices increased in response to rising market expectations regarding volatility and uncertainty.

The P11-C value of 4.2798, significant at 0.05, indicates a strong tendency for developed countries in low-volatility regimes to persist within that state rather than transitioning to high-volatility periods. This is supported by constant transition probabilities, with a 98.6% probability that developed economies in low-volatility states will remain in that state rather than moving to a period of extreme volatility (5%). The P21-C value of 12.459 with a constant transition probability of 99.9% suggests a reduced likelihood (1%) of developed countries in high volatility periods remaining in such periods. In other words, countries that experience high volatility periods will most likely try to switch to periods of low volatility compared with how they prefer to stay within their current regime (0.1%). Duration statistics provide insights into the expected time spent in each regime. In developed countries, countries will likely stay in a high stock-volatility era spanning an average of a year before transitioning to more stable periods. The same class of countries will uphold the low stock-price regime for an average of 73 years and 2 months before transitioning to the high stock-price era. The higher stability observed in regime 1, characterized by lower price fluctuations, indicates a more consistent and predictable behaviour of stock prices within that regime.

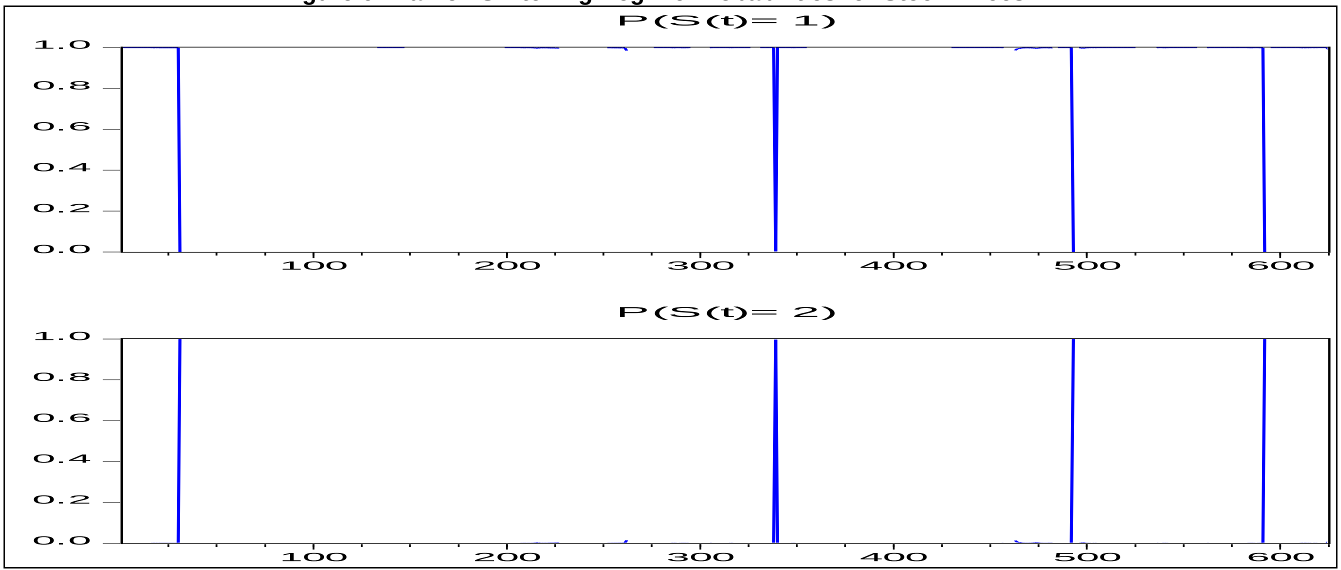
**Table 11: Markov-switching Regression Results for Stock Prices**

| Variables | Tranquil Regime 1 | Turbulent Regime 2 |
|---|---|---|
| Constant | 0.283** (0.072) | 2.947 (1.537) |
| Regime-Specific Error Variance | 0.569*** (0.000) | 1.432** (0.000) |
| Common | | |
| VIX.EVOL | -1.064*** (0.007) | -1.023*** (0.000) |
| VIX | 1.114** (0.006) | -1.058** (0.002) |
| EVOL | -1.052*** (0.000) | -1.379** (0.009) |
| P11-C | 4.298** (0.004) | 1.048** (0.005) |
| P21-C | 12.459 (0.442) | 3.482*** (0.000) |
| Auto/Partial Correlation test | p>0.05 | |
| Constant expected durations | 73.226 | 1.000 |
| Constant transition probabilities | | |
| Regime 1 | 0.9863 | 0.0136 |
| Regime 2 | 0.9999 | 0.0001 |

Source: Authors' E-Views 13 estimation results

Figure 6 demonstrates the Markov Switching regime charts for stock prices.

**Figure 6: Markov Switching Regime Probabilities for Stock Prices**




Source: Authors' E-Views 13 estimation results

Table 12 reports the Markov-switching regime regression results for stock return as the dependent variable. The probability values are contained in parenthesis and *, **, and *** imply that the variable is significant at the 10%, 5%, and

1% levels respectively. The Markov model estimations reveal that the VIX coefficients for both regimes 1 and 2 are -0.322 are -0.412, indicating that a percentage rise in the volatility expectations corresponds to a decline in equity returns of 0.322 percent and 412 percent. The variable of exchange rate risk for regimes showed negative effects as seen in the coefficients, -1.054 and -1.161. It implies that regardless of the regime in operation, exchange rate risk significantly influences stock returns. The uncertainty variable as measured by the interaction between VIX indices and exchange rate risks adversely impacted returns in the equity markets for both regimes. The calm regime discloses an interaction effect with a coefficient of -1.943 while the turbulent regime had -1.137, thereby revealing downward adjustments in stock returns by 1.9% and 1.14% given a percentage rise in the uncertainty index that the interaction effect represents.

Probability values reveal that the interaction is significant in the model across both switching states ($p < 0.05$). Regardless of the regime, uncertainty about the market significantly discourages stock returns. The logarithm of sigma (σ) values represents the error variance specific to each regime in the Markov model, reflecting the variability of residuals within each regime. For regime 1, the error variance was recorded at -2.419, whereas for regime 2, it stood at -0.408. These values indicate that the Markov model in periods of low volatility exhibits greater stability in explaining variability in exchange rates compared to those in highly volatile periods. Interpreting the switching regressor, in the highly volatile periods in developed countries, an adjustment in adopted exchange rate regimes will culminate in a significant, corresponding inverse change in stock returns of 0.0249 units, as represented by the coefficient figure of -0.0249.

The constant transition probability of regime 1 is valued at 0.8667, confirming an 86.7% chance of developed economies experiencing low volatility periods remaining in their current states rather than switching to more volatile periods. In other words, the probability that these countries will switch to more turbulent periods is 13.3%. On the other hand, countries with highly volatile or turbulent returns have a higher chance of remaining in periods of turbulence than moving to more tranquil regimes, as depicted by a 93.4% probability value as against a 6.6% chance of switching to more stable economic states. Duration statistics provide insight into the expected time spent in each regime, with developed countries forecasted to have highly volatile markets for up to 15 years and then maintain more stable markets for 7 years and 6 months.

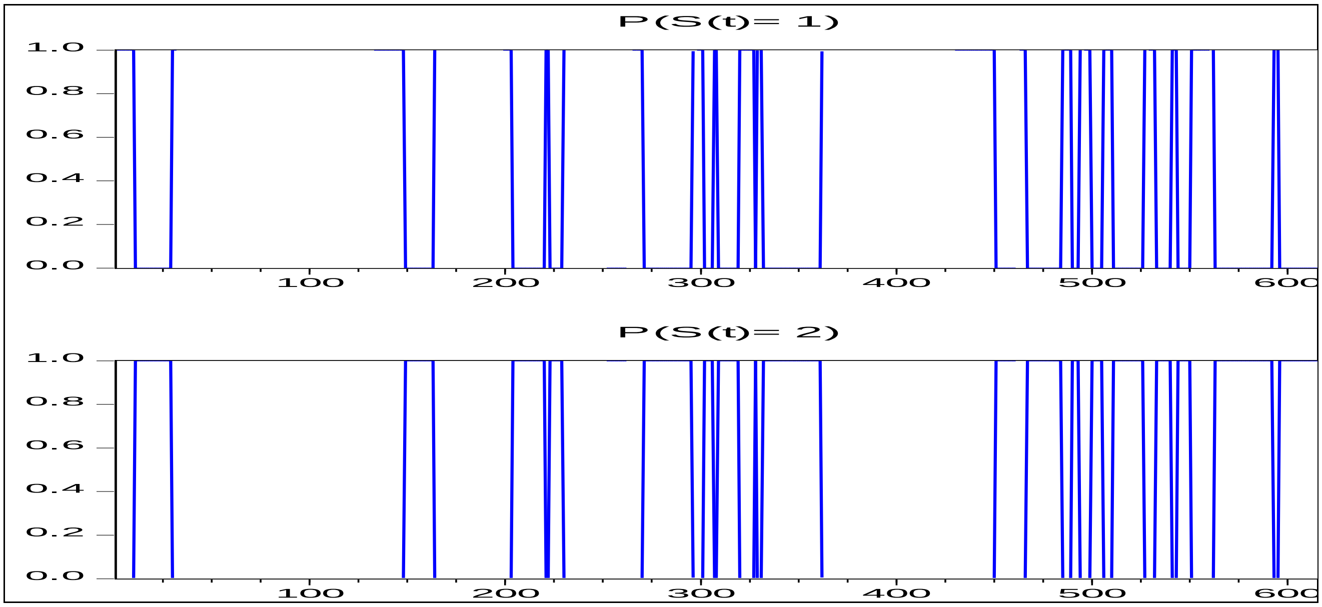
**Table 12: Markov-switching Regression Results for Stock Returns**

| **Variables** | **Tranquil Regime 1** | **Turbulent Regime 2** |
|---|---|---|
| Constant | 0.029***(0.002) | -0.127*(0.005) |
| Regime-Specific Error Variance | -2.419**(0.013) | -0.408***(0.000) |
| Common | | |
| VIX | -0.322***(0.000) | -0.412***(0.000) |
| EVOL | -1.054***(0.000) | -1.161(0.273) |
| VIX.EVOL | -1.943(0.001) | -1.137(0.000) |
| Auto/Partial Correlation test | p>0.05 | p>0.05 |
| Constant expected durations | 7.5048*** | 15.0809*** |
| Constant transition probabilities | | |
| Regime 1 | 0.8667 | 0.1332 |
| Regime 2 | 0.0663 | 0.9337 |

Source: Authors' E-Views 13 estimation results

Figure 7 demonstrates the Markov Switching regime charts for stock returns.

**Figure 7: Markov Switching Regime Probabilities for Stock Returns**




Source: Authors' E-Views 13 estimation results

### V. Results Discussion

The VIX coefficient is negative and significant during periods of turbulence, while it is still negative in sign but only marginally significant during the calm market period. This implies that both extremely low and high VIX have a negative impact that ultimately results in lower returns on the equities market, with no exceptions. Capital preservation takes precedence above profit maximization. As a result, the effect of VIX on equity markets could be reflected by market sentiment and risk aversion. Our findings are mostly consistent with those of **Kirci et al. (2024)** and **Khalfaoui et al. (2023)**, who observed that under different market situations, the VIX and returns function as net transmitters and receivers of shocks due to the connectedness structure. The results of this study support **Sarwar & Khan's (2017)** finding that the VIX had a negative and substantial influence on equity returns, suggesting that the market was extremely volatile, particularly during uncertain economic times. A rise in the VIX heightens investors' anxiety over the significant suspense of volatile stock market price swings. This is also consistent with the findings of **Asriani et al.'s (2024)** study, which found that investors tend to get out of the stock market when the VIX rises, which lowers stock prices. On the other hand, the equity market is anticipated to be steadier and calm when the VIX index declines.

High volatility (turbulent regime) in financial markets can cause quick and unpredictable price fluctuations across asset types. During such times, stock prices may be influenced by short-term trading tactics, market sentiment, and liquidity dynamics rather than exchange rate regimes. During moments of extreme volatility, investors may be more focused on central bank operations and government policies than on exchange rate movements. During times of high volatility, the impact of exchange rate regimes on stock prices may be overshadowed by changes in market sentiment and investor behavior. Negative sentiment can lead to indiscriminate selling across asset classes, while positive sentiment can drive broad-based rallies. Global factors, such as geopolitical events, may have a greater impact on stock prices than domestic exchange rate dynamics.

The study correlates with the observations presented by **Cheuathonghua et al. (2019)** who stated that investor mood is stronger during financial crises than tranquil periods, suggesting that even a minor shift in the VIX may profoundly affect global markets under stressful market circumstances. As a result, when market optimism and confidence indicate a low risk of uncertainty, investors make more substantial investments. This significantly raises stock values. Put differently, VIX gives investors a quick overview of market volatility expectations, which they can use to manage risk in their portfolios and make better investment decisions (**Prasad et al., 2023**). Given that the study sample period encompasses the coronavirus outbreak, the highly substantial unfavourable coefficient of VIX may indicate the incidence of the pandemic. This supports the findings of **Adedeji (2023)** that the uncertainty brought by volatility caused significant decline in equity market performance. This had been made manifest in stock price collapse (**Davis et al., 2022; Mujahida, 2021**). The implications of the foregoing are that equity markets are considerably impacted by market expectations about future corporate profitability and economic growth. Though, economic considerations, such as changes in monetary or fiscal policy can influence investor attitudes and market expectations; the VIX index had far-reaching consequences for investors' sentiments and hence decisions, the impacts may differ across markets. Preemptive efforts may mitigate bad investors' sentiment and reduce the impact on stock returns. Developed nations have many multinational firms with diverse income sources and global activities, making their equities appealing to investors seeking stability and robustness. The duration of the results of both regimes reveals that developed countries are more likely to have periods of low volatility persisting for extended periods, with occasional periods of higher volatility.

The performance of the stock market is also impacted by fluctuations in the exchange rate risk. Import-dependent businesses experience higher manufacturing costs, which reduces profit margins and stock returns, especially when the domestic currency rate declines. This study backs up the findings of **Raju et al. (2021)**, who found that exchange rates have a big impact on stock markets in emerging markets. Weak exchange rates usually result in lower stock values because they make imports more expensive and weaken purchasing power. Accordingly, exchange rates may more accurately reflect economic fundamentals, minimizing mismatches between stock prices and underlying realities. Central banks may have more flexibility to implement inclusive monetary policies, such as interest rate cuts or quantitative easing, to boost economic growth and calm financial markets. Lower interest rates can lower firm capital expenses, boost investment, and raise stock values. Highly volatile periods, on the other hand, had exchange rate regimes in developed countries that were insignificant in determining stock prices. Exchange rate risk plays an important role in the stock market. Companies that export goods or services may gain from lower home currencies, making their products more competitive in global marketplaces, but companies that import goods or rely on overseas markets may struggle with stronger domestic currencies. Changes in exchange rates (depreciation/appreciation) can have an influence on these firms' profits and increase or reduce stock values, depending on the direction of the change. Currency risk management becomes vital as investors need to modify their portfolios to reduce risk or profit from opportunities.

During periods of low volatility (calm regime), international investors may view countries with floating exchange rates (most developed countries adopt this regime) as appealing investment destinations due to decreased currency rate risks. This increased international investment may result in more demand for domestic equities and higher stock prices. This aligns with the findings of **Dua & Tuteja (2021)** where the behaviour of regime switching and dynamic linkages within currency and equity markets in the Eurozone, India, Japan, and the United States was investigated. Their analysis identified two distinct states: a *bull state*, characterized by high returns and low volatility, and a *bear state*, characterized by low returns and high volatility. In the Yen/USD market, the *bull state* corresponds to depreciation with excessive volatility. Through the MS-VAR model encompassing both stocks and currencies, they identify a tranquil regime marked by lower volatility and higher returns and a *turbulent regime* characterized by higher volatility and lower returns.

Periods of high volatility are followed by periods of comparable high volatility, and vice versa for low volatility. Stock prices within these developed stock markets react swiftly to new information, resulting in rapid changes and the possibility of volatility bundling. This phenomenon has core consequences for investors and other market players around risk management, portfolio growth, and financial market regulation. Price fluctuations are amplified and market reactions to news or events are made worse by market structure, which includes automated trading and high-frequency traders. Hence, forecasts of volatility risk should be used by investors to guide their decisions about options and volatility-based trading. Financial regulation may be required to monitor and control excessive volatility, since extended periods of high volatility can destabilize financial markets and damage investor trust. Central banks and regulatory bodies have implemented initiatives to reduce excessive volatility and promote market stability. Improving market transparency and strengthening risk management techniques can all help alleviate the negative consequences of volatility risk.

Symmetry in investors' reactions to favorable and unfavorable news as made evident by QR can also be attributed to the depth and liquidity of developed markets, which reduces the likelihood of supply-demand mismatches. The absence of asymmetry in developed markets aligns with the efficient market hypothesis in that developed markets usually have well-established regulatory frameworks and supervision procedures that promote market information, investors' confidence, transparency, and investor protection that support information being imbibed in share prices. The efficiency of the prices leaves the possibility for predictable patterns. Developed stock markets are frequently part of a global financial system characterized by interconnectedness and cross-border capital flows, which can result in volatility transmitted across assets and regions, offsetting any potential asymmetrical effects in stock volatility.

This research adds to the empirical understanding of the relationship between investor behavioral preferences and equity markets. The thrust of the research findings upholds the fact that investors are uneasy and deterred from making decisions about their investments by the high levels of volatility index. Therefore, linking findings to practical implications can be situated around the implication that behavioral tendencies such as risk aversion, and fear of losses are reflected in the adverse interaction between the VIX index and market returns. Increased volatility is an indicator of unpredictability, which makes risk-averse investors sell their holdings. Investors who wish to diversify their risk and increase their profits by investing in international portfolios must carefully evaluate the current volatility in financial markets. Besides, investors need to assess risks, create hedging plans, and pay attention to inter-market relationships because market volatility can affect other markets at the same time.

Understanding how currency volatility risk and panics brought on by volatility affect equity markets highlights for investors the value of keeping a variety of assets (portfolios) and taking a long-term investment stance. Investors can better manage market swings and steer clear of selling with anxiety when times are turbulent by elucidating the ways in which adverseness to losses can affect decision-making. When assessing investment prospects, this market knowledge becomes essential for investors and governments to make refined choices that result in profit-oriented investment choices. The results of research can also be used by policymakers to create focused measures to address the concerns and uncertainties of equities investors that provide threats to stock market returns. The results of the study also help financial market regulators implement policies that reduce volatility risks and improve market stability. In essence, the study gives financial authorities a useful step towards combining investment plans and risk prevention procedures to better determine and reduce risks caused by rising volatility.

Our findings also improve the capacity of regulatory authorities to react to market dynamics that are impacted by the sentiment, and fear of investors. This aligns with the findings of **Zhang et al (2024)** who reported that when investors are making choices about investments in the face of persistent market and economic circumstances, the volatility index that represents market expectations of future volatility, offers significant perspectives into market conditions and investors' sentiment in terms of fear, risk of uncertainty, or -tension in the market. Consequently, a change in stock prices is mainly influenced by market sentiment. A drop in stock prices results from investors pulling out of the stock market when they are afraid or unsure about the direction of the economy. And so, during times of market stress, VIX frequently rises, indicating increased investor anxiety (**McFarlane et al., 2022; Zhang et al., 2023**).

## VI. CONCLUSION

This study evaluated empirically the effect of exchange rate risk, and VIX market expectations on stock markets of developed countries of developed countries stock markets. The Quantile regressions and Markov regressions were conducted. Exchange rate risk creates uncertainty about future market returns, prices and the overall market condition, monetary policies and economic conditions, increasing volatility in stock markets as investors modify their expectations and portfolios. Abrupt changes in exchange rates therefore had a substantial effect on investors' currency risk exposure, causing stock market volatility as investors assess the trade-return trade-off. Exchange rate risk impacts on trade competitiveness since changes in relative pricing alters the financial viability and competitiveness of domestic enterprises. For example, a depreciation of the local currency under a floating exchange rate regime may boost export competitiveness while increasing import costs, resulting in sectoral swings in stock market performance. Exchange rate regimes can have an impact on capital flows and speculative activity in financial markets. Changes in exchange rate regimes may attract foreign investment, resulting in capital inflows that affect stock market liquidity and volatility. Speculative actions related to exchange rates can also increase stock market turbulence. Exchange rate policies and actions have an impact on policy trustworthiness and market expectations. Modification of policies, credibility, or dedication to preserving stable economic circumstances can erode investor confidence and create uncertainty, resulting in sustained volatility in stock markets as investors respond to policy regime changes. This study has added to the existing body of research by employing multiple analytical models to investigate the nexus between exchange rate regimes and stock market indices in the midst of pandemic incidents. The research work was able to juxtapose the effects of highly volatile periods with those of less volatile periods. The impact of pandemics on stock return volatility may vary across different sectors. Hence, a focus on the extractive industry, technology, healthcare, and manufacturing may reduce generalization biases that may be present in this study. Other external factors, such as government interventions, monetary policies, investor sentiment, and global economic conditions, can also influence stock return volatility during pandemics. Researchers should consider the interplay of these factors and their potential confounding effects on the relationship between pandemics and volatility.

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