EXCHANGE RATE VARIATIONS AND CRYPTOCURRENCY TRADING VALUE: IMPLICATIONS FOR FOREIGN PORTFOLIO INVESTMENT IN SELECTED COUNTRIES

David UMORU[1], Beauty IGBINOVIA[2], Muhammed Adamu OBOMEGHIE[3]

ABSTRACT

The study evaluates the impact of exchange rate changes and the trading values of three crpto currencies on foreign portfolio investment interactions in a panel of ten countries: Argentina, South Africa, Venezuela, Turkey, Switzerland, Mexico, Ghana, New Zealand, Nigeria, and Zimbabwe. The control variables in the model are market capitalization, domestic GDP growth rate, interest rate, and inflation. The NARDL and linear estimators were deployed for the analysis. The research data covers the period from January 1, 2010 to June 30, 2024. The study found that the speed at which FPI corrects back to its long-term equilibrium asymmetrically in a day after a shock is 76.3%. The study found a 5% sizable positive effect of exchange rate volatility that strongly correlates with FPI. In effect, an upsurge in business expenditures connected with currency changes (variations in exchange rates) and high inflation lowers foreign investors' profit margins, and this dampens FPI inflows. Accordingly, returns on investment become volatile, and this constitutes an observed economic uncertainty manifesting in an unstable macroeconomic environment that restrains international investors. Consequently, FPI inflows are discouraged. The study confirms the hostility effects of exchange rate volatility that dissuade foreign investors from pulling their businesses from their homes to the host countries. This has been attributed to the incessant currency depreciation in the countries in our sample. The adverse and considerable effect of inflation on FPI was attributed to the persistent inflation rate. The study established that an upward adjustment in the trading value of Bitcoin in the US dollar significantly impacted FPI. Based on the analysis of variable interaction, only the trading value of Bitcoin mitigates the depreciation effect of currency exchange rates and leads to higher inflows of FDI. Making Bitcoin an additional asset in investment portfolios increases the benefits of diversification, thereby diminishing portfolio risk.

Keywords: FPI, FDI, exchange rate fluctuation, Bitcoin (BTC), Ethereum (ETH), and Dodge Coin (DCN) trading value, ARDL, NARDL, Markov-Switching regression method

JEL Classification: C23, C20, B34

1. Introduction

Focusing on the economically diverse set of advanced and emerging markets, namely Argentina, South Africa, Venezuela, Turkey, Switzerland, Mexico, Ghana, New Zealand, and Zimbabwe, this research aims to broaden the understanding of how the fluctuations in the foreign exchange rate interact with crypto currency trading values within the local economies of the countries covered by the research to attract foreign portfolio investment (FPI) flows to those countries. Specifically, in modeling the short-term and long-term impact of exchange rate changes and the exchange values-trading values of cryptocurrencies on FPI inflows, the study evaluates the role played by the trading values of three digital currencies, Bitcoin (BTCTV), Ethereum (ETHTV), and Dodge Coin (DCNTV), in stimulating inflows in the countries mentioned above, having controlled for the effects of market capitalization, the growth rate of domestic GDP, and the domestic interest rate as pulled factors on which foreign investors base their investment decisions. The reason for focusing our research attention on the above-mentioned countries is because the flow of portfolio investment to the above-mentioned countries is highly unstable. According to UNCTAD data (2024), Argentina foreign portfolio investment fell by 437.579 USD million in March 2024, compared with a drop of 424.611 USD million in the previous quarter. Venezuela’s FDI for 2022 was US$0.94 billion, a 194.51% decline from 2021. In Ghana, FPI as a percentage of GDP was reported at 0.0% in March 2024. This records an increase from the previous number of -0.3% for December 2023. In Mexico, foreign portfolio investment increased by 9.848 USD billion in March 2024, compared with an increase of 2.288 USD billion in the previous quarter.

FDI inflow to South Africa from January to March totaled 24.4 billion rand (US$1.34 billion), down from 2.5 billion rand in 2023 Q4 (Reuters, 2024). In Sudan, currency depreciation and hyperinflation are twin economic evils that depress foreign investors. In December 2022, Sudan's foreign portfolio investment increased by 0.200 US dollars. Compared to a rise of

1. Department of Economics, Edo State University Uzairue, Iyamho, Nigeria, david.umoru@yahoo.com/ david.umoru@edouniversity.edu.ng, Orcid ID No.: 0000-0002-1198-299X
2. Department of Economics, Edo State University Uzairue, Iyamho, Nigeria beauty.igbinovia@edouniversity.edu.ng
3. Department of Statistics, Auchi Polytechnic Auchi, Nigeria obomegieadamu@yahoo.com

https://doi.org/10.31620/AJM.1226

336.0 US$ million in March 2024, FDI in Turkey climbed by 1.3 US dollars billion in April 2024. Also in Turkey, FDI flow decreased by 19.36% from 2019 to US$7.70 billion in 2020 (UNCTAD, 2024). According to UNCTAD's World Investment Report (2023), FDI inflows to Zimbabwe in 2022 totaled USD 342 million, which was less than the USD 745 million recorded in 2018. The preceding insights are crucial for policymakers, investors, regulators of the finance industry, and financial analysts in these regions, who must consider the increasing influence of digital currencies in their financial stability assessments and investment strategies. Besides, in view of the relevance of informed market decisions, the study is of enormous importance to investors, investment analysts, hedgers of funds, and arbitrageurs.

Zhao and Liu (2023) utilized a BEKK-GARCH model to analyze the volatility spillover effects between Bitcoin and the USD/CNY exchange rate. Andersen & Kumar (2024) analyze the volatility spillover behaviour between Bitcoin trading and major currencies, including the Euro, British Pound, and Japanese Yen. Chen & Nakamura (2022) focused on the USD/JPY exchange rate fluctuation in relation to Bitcoin by estimating a multivariate GARCH (MGARCH) model. These studies, among others, have indicated significant volatility spillovers from Bitcoin transactions to major global currencies. Nevertheless, the predominant focus has been on major world currencies, possibly overlooking the dynamics present in emerging markets. Hence, we hypothesized in this study that there is no significant interaction between crypto currency trading values and the foreign exchange rates of selected countries. The research is divided into five parts. A brief review of the literature is contained in Part 2. This is followed by part three, which discusses materials and methods of analysis. In part four, empirical results are discussed, while part five concludes.

2. Literature Review

2.1. Theoretical review

In this piece, we review the following theories: Keynes's liquidity preference theory, the theory of portfolio investment, Fisher's capital-income theory, the theory of institutional FDI fitness, and the pull and push factors theory. Keynes' (1936) liquidity preference theory places the short-term interest rate adjustment as a push-pull factor that prompts portfolio diversification. In particular, the LPT established that interest rates change to reflect the trade-off between the need to hold cash and less liquid assets. This indeed offers insights into the different reasons stimulating individuals or firms to hold cash or invest the same, either at home or abroad, in view of the existing fundamental market conditions.

The theory of portfolio investment, as advanced by Markowitz (1959), states that portfolio risk is a function of the covariances between two stocks since the most favourable portfolio consists of two assets with an inverse correlation. Hence, a pool of two assets in a portfolio reduces the risk of investment associated with the assets, provided the coefficient of correlation between the two assets is equal to or lowers than unity. Accordingly, the theory asserts that the most reliable investment portfolio is the one with the highest expected return, given a specific level of return variance.

According to Fisher's (1980) capital-income theory, exchange rate depreciation is a push-pull factor that attracts foreign investment to a host country by influencing the trade balance and output of the host nation, while at the same time influencing the global competitiveness of the host country. This theory also advocates the incidence of the flow of incremental savings from capital-rich countries, popularly referred to as capital exporters, to countries with capital deficiencies, often described as capital importers (Cardao-Pito, 2023). The idea is that in the wake of economic globalization, capital no longer "formed" or "accumulated," as it did typically in postwar economic discourse. Instead, capital flowed. The flow concept has been traced to the stock/flow theorization of Irving Fisher in the 1980s.

Theory of institutional FDI fitness developed by Wilhelms and Witter (1998) focused on governments' role as an institution, education as institution, market institution and social and cultural institutions in engaging economic measures that stimulate foreign investment inflows. According to the theory, education is an institution the government should focus on if it desires to attract FDI. The rationale is that educational research and development provide the required technological innovation needed to grow and sustain foreign direct investment flows to the home country. The market's fitness has to do with the execution of protective regulation in the form of favourable economic policies and market conditions that are attractive to foreign investors. Also, the theory upholds that a social and cultural incentive goes a long way towards governing and attracting FDI into the host country. The government's fitness is measured in terms of favourable economic policies, a stable macroeconomic environment, economic and political stability, less corruption, a high degree of transparency, trade liberalization policies, openness, a low level of government involvement in the exchange rate market, etc.

The pull and push factors theory Lee (1966) states that there are country-specific internal economic factors that pull foreign capital into a country by attracting different destinations for investment. Such factors are called the pull factors, and these include a domestic interest rate on returns that exceeds the risk associated with the investment portfolio, a low level of domestic inflation, which is a pointer to macroeconomic stability, a high growth rate of domestic GDP, extensive liberalization of financial markets, a low debt burden, etc. The push factors are the external factors associated with the global economic forces that cause portfolio investors to push capital to flow from their home country by shifting their investments to a foreign country due to unfavourable business conditions. When earnings are repatriated and assessed in terms of the home currency, a highly valued currency in the host country of the FPI suggests better returns. A country's exports are more competitive in terms of competitive dynamics when its currency is depreciated, and this helps attract FPI flows into export-orientated businesses. Exchange rates have the potential to both discourage and encourage investment flows. A weak currency lowers labour and material costs and makes local assets cheaper for foreign investors. This accordingly boosts inflows of foreign investment. On the other hand, a weak currency causes assets denominated in foreign currency (dollars) to lose value, which deters FPI flows to the host country. A strong currency increases mergers and acquisitions because the currency of the home firm has greater purchasing power. Therefore, FPI is accelerated since a home firm can borrow money in a foreign market at a cheaper cost.

2.2. Empirical review

2.2.1. Review of previous studies on FDI and exchange rates

According to Adewale et al. (2024), there is a non-linear relationship between FDI and the exchange rate. In particular, the authors found that only an exchange rate threshold of N115 can favourably attract FDI flows to Nigeria. Stated differently, foreign direct investment (FDI) flows to Nigeria are beneficial only when the naira's value relative to the US dollar is fixed at N115/$1. Hooman & Chowdhury (2024) employed the ARDL method to focus on sector-level analysis of the Canadian economy and found that, in the short run, the volatility of REER had a significant impact on FDI inflows into the manufacturing, insurance, and banking sectors. Over the long-term period, REER had a major effect on FDI inflows into the mining, manufacturing, and energy sectors. Using the FMOLS regression approach, Adewale, Olopade, and Ogbaro (2024) discovered a strong positive FDI-exchange rate nexus. According to Nguyen et al. (2024), the FDI inflow-exchange rates change depending on the kind of capital flows.

Using the Toda-Yamamoto Granger causality technique, Utouh & Tile (2023) discovered a one-way link between Tanzania's FDI inflow and the nominal exchange rate. More specifically, in Tanzania, there was a negative link between FDI and the nominal exchange rate. When Moraghen, Seetanah, and Sookia (2023) assessed the ARDL model, they learnt that FDI flows occurred in various sectors of the Mauritius economy as a result of a real devaluation of the Mauritian rupee exchange rate in relation to the US dollar. Using a gravity model on a dataset of 40 countries, Warren et al. (2023) found that exchange rate devaluation had a positive impact on FDI inflows, while volatility in the exchange rate adversely impacted bilateral FDI inflows. According to McCloud et al. (2023), the interaction between foreign currency rates and foreign direct investment inflows is significantly positive. The manufacturing and banking industries suffered as a result of the exchange rate volatility. In China, Tan, Xu, & Gashaw (2021) examined how the currency rate affected FDI inflows using the VECM and impulse response. They found a historical causal link between the two variables. More specifically, the incessant appreciation of the RMB in exchange for the US dollar depresses FDI inflow. Additionally, Mahmudul et al. (2020) found a nonlinear connection between Nigeria's exchange rate and FDI inflows.

2.2.2. Review of previous studies on FPI and cryptocurrencies trading prices

Here, we review studies in the following order: studies that based their analysis on event study methodology; studies that based their analysis on panel regression models, VAR model estimation, and mean-variance optimization models; and studies conducted in Europe and North America, respectively. The studies by Azzi and Viviani's (2021), Salisu, Isah, and Abbas (2021), Muhammad Anees, Usman Raza, and Fatima Salman (2021), Akhtaruzzaman, Chazi, and Talukder (2020), Matovu and Othman (2020), Mariusz Jarmuzek and Marc-André Gosselin (2019), and Wicek-Janka and Tomasz Winiewski (2019) based their analysis on event study methodology. In an event study analysis piloted by Azzi and Viviani's (2021), it was found that the use of cryptocurrencies favourably attracted capital inflows to emerging markets. Salisu, Isah, and Abbas (2021) established that cryptocurrencies improve portfolio diversity for foreign investors. Muhammad Anees, Usman Raza, and Fatima Salman (2021) found a significant favourable effect of cryptocurrencies on international portfolio investment in developing markets.

Akhtaruzzaman, Chazi, and Talukder (2020) found considerable influence of Cryptocurrencies on foreign portfolio investment. Matovu and Othman (2020) found significant and positive effects of cryptocurrencies on foreign direct investment in emerging countries. Mariusz Jarmuzek and Marc-André Gosselin (2019) reported that in countries with weak institutions and high levels of inflation, Bitcoin had a strong advantageous effect on international portfolio investment. Wicek-Janka and Tomasz Winiewski (2019) found that Bitcoin significantly expands global portfolio diversity during volatile market conditions.

The following research estimated the panel regression models, VAR models, and mean-variance optimization models for the Asia-Pacific region, Europe, and North America. Li and Wang (2021), Lee et al. (2021), Smith et al. (2021), and Abbas and

Ur Rehman (2021) found a significant positive effect of cryptocurrencies on FPI. Mouna Gaidi, Oussama Ben Miled, and AliSaidi's (2021) reported that both Bitcoin and Ethereum have a strong favorable impact on foreign portfolio investment in developed nations. In a VAR model methodology employed by Shaikh et al. (2021), it was found that Bitcoin significantly influences the exchange rates of some currencies. Folarin, Asongu, and Bekun (2021) also reported from their analysis that cryptocurrencies have a substantial favourable impact on international portfolio investments. The study by Tariq et al. (2021) also found a favourable and significant effect of cryptocurrency on FPI in emerging countries. Granger et al. (2020), Bouri et al. (2020), Lee and Kim (2020), Limand and Chuah (2020), Kim et al. (2020), All the aforementioned studies endorsed bitcoin as an alternate investment asset for foreign investors.

El Mouden and Benlemlih (2020) found favourable and considerable influence of cryptocurrencies on foreign portfolio investment in twelve emerging countries. The panel data research piloted by Karim and Razzaque (2020) found an unfavourable effect of cryptocurrency on foreign portfolio investment in twenty-two countries. Employing the Markowitz mean-variance optimization model, Zhu et al. (2020) found that cryptocurrencies cause amplified diversification of international portfolios. According to Chinzara, Chinzara, and Nkhoma (2020), cryptocurrency favourably stimulates foreign portfolio investment; however, the effect varies by market.

Dastgir and Demir (2019) established that FPI in twenty emerging markets was significantly and positively impacted by Bitcoin. For seventeen countries, Kim and Lee (2020) implemented the VAR model and revealed a strong link between returns on cryptocurrency and the stock market. In a related panel data study done by Ogunkoya and Abiola (2019), it was discovered that cryptocurrencies positively and substantially impact portfolio investment. In another multi-country study conducted by Aye, Bose, and Gupta (2020), it was discovered that portfolio diversification was affected by cryptocurrencies in China, the UK, Canada, the US, and India.

In Europe, studies by Bouri et al. (2020), Bera and Mitra (2019), Gkillas et al. (2019), and Karamichas and Karagiannis (2019) all found empirical evidence in favour of an enhanced portfolio diversification effect of cryptocurrencies. In sum, only two studies have openly pointed out the volatility effect of cryptocurrencies in spite of the favourable influence reported by numerous others. Gkillas, Gupta, and Wong (2021) reported from their empirical investigation that despite the fact that cryptocurrencies fit into the portfolios of international investors and boost portfolio performance, cryptocurrencies are highly volatile and risky. In the study conducted by Demir and Gozgor (2020), it was found that bitcoin futures had a strong influence on stock market volatility, which exacerbated financial market instability.

In North America, studies have been conducted, and all reported a significant positive role played by cryptocurrencies in stimulating foreign portfolio investment in the region. These studies include Singh and Goswami (2021), Nistor and Dumitru (2020), Kaneko (2020), Al-Malki, Al-Ghamdi, and Alzahrani (2020), and Hassani and Zhong (2019).

2.3. Filling the research gap

None of the studies reviewed above empirically controlled for market capitalization, the growth rate of domestic GDP, the domestic interest rate, and inflation in their models in order to moderate the celebrated cryptocurrency-FPI relationship. By modeling the moderating effects of the aforementioned pulled variables within the context of the host country, the observed misspecification gap in previous studies would have been filled by the present research using an expost facto method across a panel of ten selected countries.

3. Methodology

Two panel ARDL models were estimated in this study. These include: The linear and non-linear ARDL models. The rationale for implementing panel models is as follows: Panel ARDL models account for heterogeneity across different countries and the non-stationarity of the series. The specification of the linear ARDL long run equation is as given by equation (1) below:

$$FPI_t = \alpha_0 + \sum_{i=1}^{p} \alpha_1 FPI_{t-1} + \sum_{j=0}^{q1} \partial_{1,0} EXR_{1,t} + + \sum_{j=0}^{q1} \partial_{2,0} BTCTV_{1,t} + \sum_{j=0}^{q1} \partial_{3,0} ETHTV_{1,t} + \sum_{j=0}^{q1} \partial_{4,0} DCNTV_{1,t} + + \sum_{j=0}^{q1} \partial_{5,0} MCAP_{1,t} + + \sum_{j=0}^{q1} \partial_{6,0} GDPgr_{1,t} + + \sum_{j=0}^{q1} \partial_{7,0} NRTr_{1,t} + + \sum_{j=0}^{q1} \partial_{8,0} NFLr_{1,t} + v_t \quad \ldots (1)$$

The specification of the linear ARDL short-run equation is given by equation (2) below:

$$\Delta FPI_t = \alpha_0 + \sum_{i=1}^{p-1} \alpha_i \Delta FPI_{t-1} + \sum_{j=0}^{q1-1} \beta_{1,j} \Delta EXR_{1,t-j} + + \sum_{j=0}^{q1-1} \beta_{1,j} \Delta BTCTV_{1,t-j} + \sum_{j=0}^{q1-1} \beta_{1,j} \Delta ETHTV_{1,t-j} + \sum_{j=0}^{q1-1} \beta_{1,j} \Delta DCNTV_{1,t-j} + \sum_{j=0}^{q1-1} \beta_{1,j} \Delta MCAP_{1,t-j} + \sum_{j=0}^{q1-1} \beta_{1,j} \Delta GDPgr_{1,t-j} + \sum_{j=0}^{q1-1} \beta_{1,j} \Delta NRTr_{1,t-j} + \sum_{j=0}^{q1-1} \beta_{1,j} \Delta NFLr_{1,t-j} + \lambda ECM_{,t-1} + v_t \quad \ldots (2)$$

The specification of the non-linear ARDL long run equation is given in equation (3) as follows:

$$FPI_t = \phi_0 + \sum_{i=1}^{p} \theta_i FPI_{t-i} + \sum_{j=0}^{q1} (\phi_j^+ EXR_{t-j}^+ + \phi_j^- BEXR_{t-j}^-)$$
$$+ \sum_{j=0}^{q1} (\phi_j^+ BTCTV_{t-j}^+ + \phi_j^- BTCTV_{t-j}^-) + \sum_{j=0}^{q1} (\phi_j^+ ETHTV_{t-j}^+ + \phi_j^- ETHTV_{t-j}^-)$$
$$+ \sum_{j=0}^{q1} (\phi_j^+ DCNTV_{t-j}^+ + \phi_j^- DCNTV_{t-j}^-) + \sum_{j=0}^{q1} (\phi_j^+ MCAP_{t-j}^+ + \phi_j^- MCAP_{t-j}^-)$$
$$+ \sum_{j=0}^{q1} (\phi_j^+ GDPgr_{t-j}^+ + \phi_j^- GDPgr_{t-j}^-) + \sum_{j=0}^{q1} (\phi_j^+ NRTr_{t-j}^+ + \phi_j^- NRTr_{t-j}^-)$$
$$+ \sum_{j=0}^{q1} (\phi_j^+ NFLr_{t-j}^+ + \phi_j^- NFLr_{t-j}^-) + \epsilon_t \quad \ldots(3)$$

where ϕ_0 is the long-term intercept; ϕ_1^+ *and* ϕ_1^- are the long-term coefficients for changes in the predictor variables. In the non-linear specification of the ARDL model, we indicate the largest and lowest values of the changes in the predictor variables such that: FPI_t is the outcome variable; Xi,t- predictor variable given as BTC (Bitcoin price); EXR_{t-j}^+ and EXR_{t-j}^-; $ETHTV_{t-j}^+$ and $ETHTV_{t-j}^-$; $DCNTV_{t-j}^+$ and $DCNTV_{t-j}^-$ are the positive and negative changes in exchange rate, $BTCTV_{t-j}^+$ and $BTCTV_{t-j}^-$ are the fluctuations in the trading value of Bitcoin, Ethereum, and Dodge Coin both positive and negative; $MCAP_{t-j}^+$ and $MCAP_{t-j}^-$ are the positive and negative changes in market capitalization; $GDPgr_{t-j}^+$ and $GDPgr_{t-j}^-$ are the positive and negative changes in growth rate of domestic product, $NRTr_{t-j}^+$ and $NRTr_{t-j}^-$ are the positive and negative changes in domestic interest rate; $NFLr_{t-j}^+$ and $NFLr_{t-j}^-$ are the ring and falling changes in domestic inflation rate; p- number of lags of FPI; qi- number of lags of the predictor variables; $\alpha 0$- constant term; v_t is the error term. The non-linear short run error correction ARDL equation becomes:

$$\Delta FPI_t = \gamma_0 + \lambda(FPI_{t-1} - \phi_0 - \phi_1^+ EXR_{t-1}^+ - \phi_2^- EXR_{t-1}^-$$
$$-\phi_3^+ BTCTV_{t-1}^+ - \phi_4^- BTCTV_{t-1}^- - \phi_5^+ ETHTV_{t-1}^+ - \phi_6^- ETHTV_{t-1}^-$$
$$-\phi_7^+ DCNTV_{t-1}^+ - \phi_8^- DCNTV_{t-1}^- - \phi_9^+ MCAP_{t-1}^+ - \phi_{10}^- MCAP_{t-1}^-$$
$$-\phi_{11}^+ GDPgr_{t-1}^+ - \phi_{12}^- GDPgr_{t-1}^- - \phi_{13}^+ NRTr_{t-1}^+ - \phi_{14}^- NRTr_{t-1}^-$$
$$-\phi_{15}^+ NFLr_{t-1}^+ - \phi_{15}^- NFLr_{t-1}^-) + \sum_{i=1}^{p-1} \gamma_i \Delta FPI_{t-i} + \sum_{j=0}^{q1-1} (\tau_j^+ \Delta EXR_{t-j}^+ + \tau_j^- \Delta EXR_{t-j}^-)$$
$$+ \sum_{j=0}^{q1-1} (\tau_j^+ \Delta ETHTV_{t-j}^+ + \tau_j^- \Delta ETHNTV_{t-j}^-) + \sum_{j=0}^{q1-1} (\tau_j^+ \Delta DCNTV_{t-j}^+ + \tau_j^- \Delta DCNTV_{t-j}^-) +$$
$$\sum_{j=0}^{q1-1} (\tau_j^+ \Delta MCAP_{t-j}^+ + \tau_j^- \Delta MCAP_{t-j}^-) + \sum_{j=0}^{q1-1} (\tau_j^+ \Delta GDPgr_{t-j}^+ + \tau_j^- \Delta GFPgr_{t-j}^-) +$$
$$\sum_{j=0}^{q1-1} (\tau_j^+ \Delta NRTr_{t-j}^+ + \tau_j^- \Delta NRTr_{t-j}^-) + \sum_{j=0}^{q1-1} (\tau_j^+ \Delta NFLr_{t-j}^+ + \tau_j^- \Delta NFLr_{t-j}^-) + v_t \quad \ldots(4)$$

where γ_0 is the short-term intercept;

Δ signifies variable at first differencing; λ is the speed of adjustment; ϕ_0 is the long-term intercept; τ_j^+ and τ_j^- are short-term coefficients for positive and negative changes in the predictor variables. The use of NARDL in analysis stems from its ability to identify asymmetries and nonlinearities in the interaction between variables across time. By detecting asymmetry, NARDL is able to identify whether the impact of an increase or a positive change in the independent variables on FPI differs from the impact of a decrease or a negative change. It also describes nonlinear adjustments in which the speed of FPI flows varies according to the direction of the changes in exchange rate and cryptocurrencies trading values. The model also captures dynamic interaction between exchange rates and each of the crpto currencies exchange values across short-term and long-term measures.

3.1. Data sources and description

The websites investing.com, XE, and Yahoo Finance were the major sources of data used in this study. This is in addition to the Wall Street Journal or Daily FX, which displays the current and historical values of Bitcoin in US dollars and is the source of Bitcoin prices. Cryptocurrency trading values were obtained as the rate at which a cryptocurrency, namely Bitcoin (BTCTV), Ethereum (ETHTV), and Dodge Coin (DCNTV), traded or exchanged in the market in USD. The XE website and investing.com are reputable data sites that display the current and historical prices of currencies per USD, and the current and historical exchange rates between any two nations were the sources of the exchange rates of countries covered by the present research. FPI was defined as foreign ownership of an asset in each OECD country. Data on FPI were obtained from the UNCTAD database. The research period runs from June 30, 2024, to January 1, 2010. There are ten emerging markets covered by the study, and these include Argentina, South Africa, Venezuela, Turkey, Switzerland, Mexico, Ghana, New Zealand, Nigeria, and Zimbabwe. The rationale for choosing these countries is that they have the highest percentage of residents that own a digital coin and trade with crypto currencies, especially Bitcoin. In all, we have a total of 3,460 panel observations.

4. Results

The data presentation and analytical deductions from the evaluation of the interaction between the foreign currency rate, crypto currency trading values (BTCTV, ETHTV, and DCNTV), and their impact on FPI are the focus of this section. The average values of Bitcoin, Ethereum, and Doge coin are 3478.456, 2886.022, and 1895.125, which are all higher than the mean exchange rates of the ten nations: Argentina, South Africa, Venezuela, Turkey, Switzerland, Mexico, Ghana, New Zealand, Nigeria, and Zimbabwe. Their substantial standard deviation values of 127.835, 145.790, and 106.113 indicate a high degree of variability associated with cryptocurrencies. It suggests significant volatility in the exchange value of each digital coin. The kurtosis of the trading values of Bitcoin (BTCTV), Ethereum (ETHTV), and Dodge Coin (DCNTV) display heavy tails or outliers, as indicated by the high positive kurtosis values of 9.425, 7.311, and 6.141. These, combined, are indicative of a non-normal distribution. Zimbabwe has the highest mean exchange rate (1623.565) among the nations, followed by Nigeria and South Africa with mean exchange rates of 1630.754 and 1451.112, respectively. Switzerland has the lowest mean exchange rate of 124.5672. In terms of the fluctuation of currency rates among the nations under examination, it was found that the Zimbabwe, Nigeria and South Africa the highest exchange rate volatility. Switzerland had relatively low exchange rate volatility, at 5.183. This was followed by Mexico, with a standard deviation exchange rate of 9.3304. The standard deviation exchange rates for the various nations are all below the standard deviation associated with the exchange or trading values of all CRT currencies, another confirmation of the higher level of volatility that characterizes digital currencies. The data do not exhibit normality, as indicated by the large values of the JB statistics with a low p-value of 0.000. The descriptive statistics of all the control variables, market capitalization, growth rate of GDP, domestic interest, and inflation rates are well behaved for each country.

Table 1: Descriptive results for all countries

Variable	Argentina			Venezuela			Switzerland		
	Mean	Std. Dev	Kurt	Mean	Std. Dev	Kurt	Mean	Std. Dev	Kurt
EXR	265.112	10.6161	1.238	153.743	11.137	5.671	124.5672	5.183	3.582
FPI	11.1826	0.1684	0.317	12.328	13.678	5.803	792.2241	25.35	5.823
MCAP	1.523	0.2200	-0.824	338.469	4.218	1.721	13.2699	36.13	2.821
GDPgr	4.593	1.8761	2.298	191.681	5.88	7.723	234.125	3.495	4.125
NRTr	13.803	16.147	3.550	195.103	13.658	8.722	103.249	5.126	2.481
NFLr	10.151	19.965	3.029	158.768	4.358	3.722	1115.36	6.437	4.826
Variable	Mexico			New Zealand			Turkey		
	Mean	Std. Dev	Kurt	Mean	Std. Dev	Kurt	Mean	Std. Dev	Kurt
EXR	132.296	9.3304	7.543	176.2036	13.971	7.551	393.25	11.13	3.121
FPI	14.190	11.920	6.102	145.7200	3.213	7.733	123.24	15.35	2.323
MCAP	0.691	3.138	3.815	132.4149	0.453	1.853	183.22	16.13	1.156
GDPgr	1.904	1.865	1.635	223.3977	4.876	6.184	211.23	3.228	6.826
NRTr	21.787	20.182	5.443	151.2260	6.982	6.735	163.21	7.879	7.324
NFLr	13.803	16.147	3.511	195.1034	13.524	3.186	183.26	6.234	9.822
Variable	Nigeria			Ghana			Zimbabwe		
	Mean	Std. Dev	Kurt	Mean	Std. Dev	Kurt	Mean	Std. Dev	Kurt
EXR	1630.754	165.854	6.325	223.3977	4.872	3.054	1623.565	411.635	3.971
FPI	331.987	10.123	2.244	11.2260	6.198	2.187	210.182	2.114	4.423
MCAP	1.754	1.865	1.635	2.233977	4.142	1.754	285.565	1.625	2.825
GDPgr	9.647	5.360	7.942	27.195	17.134	3.647	253.180	7.012	5.126
NRTr	14.954	1.565	1.625	12.237	4.872	4.954	188.565	1.635	2.127
NFLr	11.187	21.182	5.434	16.260	15.268	4.187	110.282	5.114	3.291

South Africa			
Variable	Mean	Std. Dev	Kurt
EXR	1451.112	134.865	1.944
FPI	1.154	1.565	3.732
MCAP	3.187	4.182	1.548
GDPgr	13.458	3.140	3.159
NRTr	40.647	12.580	4.871
Crypto currencies			
Crypto currency	Mean	Std.Dev	Kurt
BTCTV	3478.456	127.835	9.425
ETHTV	2886.022	145.790	7.311
DCNTV	1895.125	106.113	6.141

Source: Authors' estimation (2024) with econometrics software

Table 2: Panel unit root test results

Variable	Method	Level Statistics	Probability	First Difference	Prob	Remarks
EXR	Levin, Lin & Chu t*	0.37465	0.2341	-102.658	0.0000	Stationary
	Im, Pesaran and Shin W-stat	0.29371	0.3067	-197.142	0.0000	Stationary
BTCTV	Levin, Lin & Chu t*	0.55595	0.2891	-202.398	0.0000	Stationary
	Im, Pesaran and Shin W-stat	0.41591	0.3387	-164.982	0.0000	Stationary
ETHTV	Levin, Lin & Chu t*	1.89764	0.0791	601.167	0.0000	Stationary
	Im, Pesaran and Shin W-stat	1.7650	0.2219	-202.627	0.0000	Stationary
DCNTV	Levin, Lin & Chu t*	0.12495	0.3215	134.66	0.0000	Stationary
	Im, Pesaran and Shin W-stat	0.11546	0.2790	-1256.21	0.0000	Stationary
FPI	Levin, Lin & Chu t*	0.50876	0.1078	224.66	0.0000	Stationary
	Im, Pesaran and Shin W-stat	0.41591	0.1219	-134.21	0.0000	Stationary
MCAP	Levin, Lin & Chu t*	1.32102	0.4823	-261.171	0.0000	Stationary
	Im, Pesaran and Shin W-stat	0.17885	0.6724	-168.851	0.0000	Stationary
GDPgr	Levin, Lin & Chu t*	0.15663	0.3675	-135.145	0.0000	Stationary
	Im, Pesaran and Shin W-stat	1.20984	0.2906	-197.309	0.0000	Stationary
NRTr	Levin, Lin & Chu t*	1.01398	0.2245	-261.171	0.0000	Stationary
	Im, Pesaran and Shin W-stat	0.17390	0.2789	-151.129	0.0000	Stationary
NFLr	Levin, Lin & Chu t*	1.31256	0.2059	-190.143	0.0000	Stationary
	Im, Pesaran and Shin W-stat	0.17885	0.2341	-102.487	0.0000	Stationary

Source: Authors' estimation (2024) with econometrics software

Table 2 reports the unit root test results. The results also showed that at the level, the unit root tests for all the variables, which included Levin, Lin, and Chu t*, and Im Peseran, indicated that the time series variable was non-stationary and had a unit root at the level. To make the data stationary, a first difference of the data and an integration of order one were performed. The data on each of the variables become stable after the first difference at a significance level of less than 0.05 (5%), as indicated by the p-values (0.0000). By the first difference of the data, all variables are integrated in order one.

Table 3: Results of ARDL Bound test results for all variables

NARDL Model	Argentina		Venezuela		Switzerland	
$FPI = f(EXR, BTCTV, ETHTV, DCNTV, MCAP, GDPgr, NRTr, NFLr)$	F-statistic	Remark	F-statistic	Remark	F-statistic	Remark
	14.879	Co-integrated	5.799	Co-integrated	9.156	Co-integrated
$FPI = f(EXR, BTCTV, ETHTV, DCNTV, MCAP, GDPgr, NRTr, NFLr)$	Mexico		New Zealand		Turkey	
	F-statistic	Remark	F-statistic	Remark	F-statistic	Remark
	11.572	Co-integrated	10.289	Co-integrated	7.423	Co-integrated
$FPI = f(EXR, BTCTV, ETHTV, DCNTV, MCAP, GDPgr, NRTr, NFLr)$	South Africa		Ghana		Zimbabwe	
	F-statistic	Remark	F-statistic	Remark	F-statistic	Remark
	13.541	Co-integrated	6.325	Co-integrated	9.386	Co-integrated
Critical value	Number of coefficients (k)		Significance Level (1%)			
			Lower bound		Upper bound	
Narayan (2004)	8		3.75		5.09	
Pesaran et al (2001)	8		3.92		5.73	
ARDL Model	Argentina		Venezuela		Switzerland	
$FPI = f(EXR, BTCTV, ETHTV, DCNTV, MCAP, GDPgr, NRTr, NFLr)$	F-statistic	Remark	F-statistic	Remark	F-statistic	Remark
	7.853	Co-integrated	10.469	Co-integrated	8.621	Co-integrated
$FPI = f(EXR, BTCTV, ETHTV, DCNTV, MCAP, GDPgr, NRTr, NFLr)$	Mexico		New Zealand		Turkey	
	F-statistic	Remark	F-statistic	Remark	F-statistic	Remark
	13.678	Co-integrated	9.023	Co-integrated	19.561	Co-integrated
$FPI = f(EXR, BTCTV, ETHTV, DCNTV, MCAP, GDPgr, NRTr, NFLr)$	South Africa		Ghana		Zimbabwe	
	F-statistic	Remark	F-statistic	Remark	F-statistic	Remark
	10.871	Co-integrated	6.367	Co-integrated	17.234	Co-integrated
Critical value	Number of coefficients (k)		Significance Level (1%)			
			Lower bound		Upper bound	
Narayan (2004)	8		3.58		4.65	
Pesaran et al (2001)	8		3.76		5.73	

Source: Authors' estimation (2024) with econometrics software

Table 3 reports the co-integration test results for all variables (FPI, EXR, BTCTV, ETHTV, DCNTV, MCAP, GDPgr, NRTr, and NFLr). The bounds F-statistics for non-linear models all fall outside the confines of the lower and upper bounds of the Narayan (2004) critical values at the 5% level, namely, 3.75 and 5.09, respectively, as well as the Pesran et al. (2001) lower and upper critical bounds of 3.92 and 5.73, respectively. Similarly, the bounds F-statistics of 7.853, 10.469, 8.621, 9.023, 13.678, 19.561, 10.871, 6.367, and 17.234 for the linear model all lie outside the Narayan et al. (2004) lower and upper bounds of 3.58 and 4.65, as well as the Pesaran et al. (2001) lower and upper bounds of 3.76 and 5.73. The ARDL and the NARDL models were used to determine interactions of local currencies with past (lagged) values of themselves (auto-regression) and with cryptocurrencies trading values in the short run and in the long run. In Table 5 below, lags were automatically selected using lag structure assessments, and model ARDL (2, 1, 1, 1, 1, 1, 1, 1, 1) was chosen based on the lowest AIC for both the linear and non-linear autoregressive estimations. This suggests two lagged values of FPI, and one lagged value for each of the predictor variables. The non-linear ARDL is expected to render asymmetrical results where the effects of rising (positive) and falling (negative) shocks associated with the predictor variables are separated for analysis.

Table 6 below shows the non-linear and linear ARDL results. Amongst all the crypto currencies, only the trading value of Bitcoin had a significant impact on FPI. The positive change in the trading value of Bitcoin had a positive coefficient of 0.114***, while the negative change in Bitcoin had a negative coefficient of -0.158**. Both coefficients are significant. Similarly, the one-period lag of the trading value of Bitcoin had a significant positive coefficient of 0.309**. This empirical finding is appealing and a confirmation of the fact that a larger proportion of the residents of those countries own a digital coin and trade with cryptocurrencies, especially Bitcoin. The available 2024 data from surveys from Statista's Consumer Insights shows that 30% of the residents of Argentina, 22% of the residents of South Africa, and 19 percent of Venezuela own and use cryptocurrencies. In Sudan, Turkey, Switzerland, Mexico, Ghana, New Zealand, and Zimbabwe, 14%, 15%, 17%, 17%, 19%, 17%, and 15% of the residents own a digital coin and trade with cryptocurrencies, especially Bitcoin. Besides, our significant and favourable impact of Bitcoin exchange value on FPI is supported by the finding of Morales and Tanaka (2024), who found an emerging role for Bitcoin in the financial resilience of commodity-driven economies. The short-term coefficients of both positive and negative changes in the domestic interest rate are 0.149*** and 0.133**. The magnitudes of these effects are positive and significant. Essentially, it indicates that the interest rate is high enough to stimulate FPI in the various countries namely, South Africa, Venezuela, Turkey, Switzerland, Mexico, Ghana, New Zealand, Nigeria, and Zimbabwe.

Table 5: Model Selection Criteria Table

Linear ARDL			Non-Linear ARDL		
Country	**AIC***	**Specification**	**Model**	**AIC***	**Specification**
Argentina	-7.9616	ARDL (1,0,0,0,0,0,0,0,0)	New Zealand	-11.8091	ARDL (1,0,0,0,0,0,0,0,0)
	-7.8611	” (2,1,1,1,1,1,1,1,1)		-11.8083	” (2,1,1,1,1,1,1,1,1)
	-7.8610	” (3,2,2,2,2,2,2,2,2)		-11.8077	” (3,2,2,2,2,2,2,2,2)
	-7.8607	” (3,3,3,3,3,3,3,3,3)		-11.8072	” (3,3,3,3,3,3,3,3,3)
Venezuela	-7.8605	ARDL (1,0,0,0,0,0,0,0,0)	South Africa	-11.8050	ARDL (1,0,0,0,0,0,0,0,0)
	-7.8904	” (2,1,1,1,1,1,1,1,1)		-11.8043	” (2,1,1,1,1,1,1,1,1)
	-7.8601	” (3,2,2,2,2,2,2,2,2)		-11.8036	” (3,2,2,2,2,2,2,2,2)
	-7.8599	” (3,3,3,3,3,3,3,3,3)		-11.8031	” (3,3,3,3,3,3,3,3,3)
Switzerland	-7.8598	ARDL (1,0,0,0,0,0,0,0,0)	Turkey	-11.7801	ARDL (1,0,0,0,0,0,0,0,0)
	-7.9595	” (2,1,1,1,1,1,1,1,1)		-11.7794	” (2,1,1,1,1,1,1,1,1)
	-7.8593	” (3,2,2,2,2,2,2,2,2)		-11.7786	” (3,2,2,2,2,2,2,2,2)
	-7.8593	” (3,3,3,3,3,3,3,3,3)		-11.7780	” (3,3,3,3,3,3,3,3,3)
Mexico	-7.8588	ARDL (1,0,0,0,0,0,0,0,0)	Nigeria	-11.7234	ARDL (1,0,0,0,0,0,0,0,0)
	-7.8987	” (2,1,1,1,1,1,1,1,1)		-11.7230	” (2,1,1,1,1,1,1,1,1)
	-7.8581	” (3,2,2,2,2,2,2,2,2)		-11.7220	” (3,2,2,2,2,2,2,2,2)
	-7.8574	” (3,3,3,3,3,3,3,3,3)		-11.7214	” (3,3,3,3,3,3,3,3,3)
Ghana	-7.8548	ARDL (1,0,0,0,0,0,0,0,0)	Zimbabwe	-11.8234	ARDL (1,0,0,0,0,0,0,0,0)
	-7.8867	” (2,1,1,1,1,1,1,1,1)		-11.9230	” (2,1,1,1,1,1,1,1,1)
	-7.8521	” (3,2,2,2,2,2,2,2,2)		-11.7520	” (3,2,2,2,2,2,2,2,2)
	-7.8544	” (3,3,3,3,3,3,3,3,3)		-11.7310	” (3,3,3,3,3,3,3,3,3)

Source: Authors’ estimation (2024) with econometrics software

The short-run coefficients of the low (negative change) volatility in the exchange rate and the high (positive change) volatility change in the exchange rate are -0.517** and 0.261. Our findings are consistent with the findings of Yensu, Nkrumah, Amankwah, and Ledi (2022), who observed empirically negative correlations between FDI and exchange rate volatility. Relatively, our research outcomes are supported by the outcomes obtained for China by Tom and Rincy (2022), where it was determined that fluctuations in exchange rates had a negative effect on foreign direct investment, and hence foreign investors were driven away. The impact of a declining variation in the exchange rate was favourable, but it was not substantial enough to attract FPI to the countries under study in the short-term period. Specifically, the results show that an increase in the exchange rate variation reduces FPI flows to the countries in our sample. This research finding is supported by the findings obtained for China by Tom and Rincy (2022), where it was established that the exchange rate volatility adversely impacted foreign direct investment, and hence foreign investors were driven away. Our research finding for exchange rate variation is also in line with the finding of Nguyen, Muhammad, and Vo (2024), where it was reported that exchange rate volatility increases the risk associated with FPI inflows into developing nations with underdeveloped markets. Furthermore, our result can be explained by the fact that corporations use hedging strategies or policies to control the risk associated with exchange rate variation. Sadly, the expenditure of these strategies influences investors' choices. An increase in business expenditures connected with currency conversion due to high inflation rates and exchange rate fluctuation lowers foreign investors' margin of return, and this discourages FPI. Given that returns on investment would be unpredictable, international investors are restrained by the enormous economic uncertainty created by the unstable macroeconomic environment envisaged in terms of currency and inflation volatility. Hence, FPI inflows are discouraged. The long-run effects of exchange rate changes are similar to the short-term effects. The coefficient for the long run of a positive change in exchange rate is -0.236**, while that of a negative change in exchange rate is -0.157. This is indeed a confirmation of the short-run volatility effects of the exchange rate that deprive foreign investors of the ability to pull their businesses to the host countries. This could be a reflection of the incessant currency depreciation in those countries.

For example, the government of Argentina devalued the peso by more than 50% with the intention of solving the country’s worst economic crisis in decades, in addition to the massive debt of $44 billion (£35 billion) owed the IMF (IMF, 2024). In 2024, the Sudanese pounds got heavily devalued by LS 2100 against the US dollar, fuelled by rising imports, declining exports, and the incessant immigration of their citizens to foreign destinations. All these factors have weakened the Sudanese economy. The exchange rate of the South African rand depreciated by 12.4% against the US dollar in 2023 as a result of falling terms of trade for South Africa’s major exports (South African Economic Outlook, 2024). This caused the rand to exchange at the rate of 18.40 rand for one US dollar. Recently, in June, the exchange rate of Venezuela’s bolivar depreciated by 30 percent while its inflation totaled 68 percent. In effect, the domestic inflation rate became 2.7 times greater than the nominal depreciation of the bolivar exchange rate. The Zimbabwean dollar depreciated and lost 70 percent of its value between January and April 2024 at the official exchange rate, hitting Z$30,000 per US dollar (IMF, 2024). In May 2024, the Mexican peso depreciated by 6.5% due to the July 2024 general elections (Reuters, 2024).

Currently, the Swiss National Bank (SNB) has actively intervened in the currency market, purchasing francs to maintain a favourable exchange rate; hence, the franc will appreciate by 3.4 percent in real terms in 2023. However, after adjusting for cyclical and Switzerland-specific factors, the current account gap was estimated at -2.8 percent of GDP, suggesting an overvaluation of 5.2 percent of the franc (Reuter, 2024). As of May 2024, the Ghanaian cedi depreciates 14.6% against the US dollar. In June 2024, the Cedi further depreciated by 18% against the dollar. This has been attributed to a severe drop in cocoa exports, a worsening current account balance resulting from a high level of importation, and a high level of speculation in the Ghana forex market. The NZD/USD exchange rate, which measures the purchasing power of one New Zealand dollar in US dollar terms, depreciated 86.4 percent in February due to high inflation, a low economic growth rate, and a sharp drop in the Roy Morgan Consumer Confidence indicator. In the first quarter of 2024, the Turkish lira depreciated by over 10% against the dollar. This has resulted in a high rate of domestic inflation.

The long-run coefficients of the negative change in inflation rate and the positive change in rate are -0.226** and -0.236**. Similarly, the short-run effects of rising and falling inflation rates are -0.109*** and -0.211***, respectively. These size effects are significant. Largely, it implies that the level of inflation discourages foreign investors from withdrawing their portfolio investments in Argentina, South Africa, Venezuela, Turkey, Switzerland, Mexico, Ghana, New Zealand, Nigeria, and Zimbabwe. This substantial negative effect of inflation on FPI can be explained by the fact that the countries in the study sample are some of the countries with the current highest inflation rates. In particular, the inflation rate in Argentina is 211%, Venezuela’s inflation rate is 189%, Sudan has an inflation rate of 71.6% in Turkey, and the inflation rate is 64%.

According to the NBS (2024), headline inflation in Nigeria rose from 22.8 percent in June 2023 to 34.2 percent in June 2024, whereas the inflation rate in Zimbabwe was 26.5% (IMF, 2024). In June 2024, Mexico's annual inflation rate jumped to 4.98% from 4.69% in May. Since December 2023, Switzerland has had a very low annual inflation rate of 1.4% in May 2024. Australia's inflation rate lowered from 4.10% in 2023Q4 to 3.60% in 2024Q1. The headline inflation rate in South Africa decreased from 5.3% in March 2024 to 5.2% in April 2024. In New Zealand, the second quarter of 2024 saw 3.3% inflation, up from 4% in the first quarter of 2024 and 4.7% in the fourth quarter of 2023. The first quarter of 2024 saw an 8 percent fluctuation in the Swiss franc. In January 2024, the value of the Swiss franc plummeted by more than 5%, mostly due to changes in interest rate differences with the United States. The long-term results of changes in the domestic interest rate, both rising and falling, are comparable in magnitude to the short-term results. The estimated long-term size effects are 0.156*** and 0.019**, respectively, following positive and negative changes in the domestic interest rate. The size of the effects of both positive and negative changes in the growth rate of GDP in the short run is 0.013** and 0.021**, respectively. In the long run, the size effects are 0.134*** and 0.015**.

Table 6: Autoregressive distributed lag results for foreign portfolio investment (FPI)

Variable	Linear ARDL			Non-Linear ARDL		
	Coefficient	(p-values)	t-values	Coefficient	(p-values)	t-values
Long-run results						
$FPI(-1)$	0.506***	(0.000)	14.195	0.106***	(0.000)	24.895
$FPI(-2)$	1.032**	(0.002)	3.159	0.024***	(0.000)	13.489
$EXR(-1)$	0.159***	(0.000)	12.038	0.131***	(0.000)	19.078
$EXR^{+}(-1)$	-	-	-	-0.236**	(0.002)	2.348
$EXR^{-}(-1)$	-	-	-	-0.157	(0.356)	1.157
$BTCTV(-1)$	0.236**	(0.022)	-	-	-	-
$BTCTV^{+}(-1)$	-	-	-	0.016***	(0.000)	7.456
$BTCTV^{-}(-1)$	-	-	-	0.236	(0.232)	1.324
$EXR * BTCTV$	1.125***	(0.000)	25.567	-	-	-
$ETHTV(-1)$	0.190	(0.879)	1.483	-	-	-
$ETHTV^{+}(-1)$	-	-	-	-0.023	(0.562)	0.197
$ETHTV^{-}(-1)$	-	-	-	0.006	(0.472)	1.832
$EXR * ETHTV$	0.018	(0.251)	0.386	-	-	-
$DCNTV(-1)$	0.506	(0.561)	0.679	-	-	-
$DCNTV^{+}(-1)$	-	-	-	-0.012	(0.565)	1.157
$DCNTV^{-}(-1)$	-	-	-	0.001	(0.362)	1.048
$EXR * DCNTV$	0.012	(0.779)	1.283	-	-	-
$NRTr(-1)$	1.017***	(0.000)	20.197	-	-	-
$NRTr^{+}(-1)$	-	-	-	0.156***	(0.000)	15.687
$NRTr^{-}(-1)$	-	-	-	0.019**	(0.002)	3.049
$NFLr(-1)$	-0.236**	(0.002)	4.387	-	-	-
$NFLr^{+}(-1)$	-	-	-	-0.226**	(0.002)	3.589
$NFLr^{-}(-1)$	-	-	-	-0.236**	(0.002)	2.309
$MCAP(-1)$	0.015**	(0.022)	2.564	-	-	-
$MCAP^{+}(-1)$	-	-	-	0.108**	(0.012)	2.148
$MCAP^{-}(-1)$	-	-	-	0.001***	(0.000)	9.456
$GDPgr(-1)$	0.136**	(0.002)	30.271	-	-	-
$GDPgr^{+}(-1)$	-	-	-	0.134***	(0.000)	17.562
$GDPgr^{-}(-1)$	-	-	-	0.015**	(0.002)	2.358
Short-run results						
$error(-1)$	-0.773**	(0.001)	14.227	-0.634***	(0.000)	5.387
$\Delta FPI(-1)$	0.163***	(0.000)	6.895	1.012***	(0.000)	7.893

Variable	Linear ARDL			Non-Linear ARDL		
	Coefficient	(p-values)	t-values	Coefficient	(p-values)	t-values
$\Delta FPI(-2)$	0.014***	(0.000)	9.247	0.0157**	(0.036)	2.067
$\Delta EXR(-1)$	-0.132***	(0.000)	9.198	-	-	-
$\Delta EXR^{+}(-1)$	-	-	-	-0.517***	(0.000)	40.687
$\Delta EXR^{-}(-1)$	-	-	-	0.261	(0.137)	1.673
$\Delta BTCTV(-1)$	0.309**	(0.008)	26.879	-	-	-
$\Delta BTCTV^{+}(-1)$	-	-	-	0.114***	(0.000)	10.798
$\Delta BTCTV^{-}(-1)$	-	-	-	-0.158**	(0.038)	2.398
$\Delta ETHTV(-1)$	0.506	(0.124)	1.007	-	-	-
$\Delta ETHTV^{+}(-1)$	-	-	-	0.011	(0.392)	1.245
$\Delta ETHTV^{-}(-1)$	-	-	-	-0.019	(0.762)	1.024
$\Delta DCNTV(-1)$	0.104	(0.567)	6.347			-
$\Delta DCNTV^{+}(-1)$	-	-	-	0.731	(0.542)	1.029
$\Delta DCNTV^{-}(-1)$	-	-	-	0.034	(0.678)	1.055
$\Delta NRTr(-1)$	0.936**	(0.000)	23.487	-	-	-
$\Delta NRTr^{+}(-1)$	-	-	-	0.149***	(0.000)	20.348
$\Delta NRTr^{-}(-1)$	-	-	-	0.133**	(0.002)	5.482
$\Delta NFLr(-1)$	-0.236**	(0.003)	10.298	-	-	-
$\Delta NFLr^{+}(-1)$	-	-	-	-0.109***	(0.000)	13.287
$\Delta NFLr^{-}(-1)$	-	-	-	-0.211***	(0.000)	12.387
$\Delta MCAP(-1)$	0.036**	(0.002)	4.255	-	-	-
$\Delta MCAP^{+}(-1)$	-	-	-	1.157***	(0.000)	24.581
$\Delta MCAP^{-}(-1)$	-	-	-	0.176**	(0.002)	3.456
$\Delta GDPgr(-1)$	0.115***	(0.000)	16.452	-	-	-
$\Delta GDPgr^{+}(-1)$	-	-	-	0.013**	(0.013)	10.876
$\Delta GDPgr^{-}(-1)$	-	-	-	0.021***	(0.000)	19.267
C	1.006**	(0.000)	22.873	1.342***	(0.000)	12.386
Log Likelihood	110988.7	-	-	166291.3	-	-

Source: Authors' estimation (2024) with econometrics software

In the short run, examining the presence of asymmetry with the NARDL estimations, changes in exchange rate had a significant asymmetric effect in all the countries, given the Wald statistics of 47.289 for Argentina, 7.497 for South Africa, 35.687 for Venezuela, 14.209 for Turkey, 67.809 for Switzerland, 22.587 for Mexico, 10.387 for Ghana, 22.675 for New Zealand, 27.678 for Nigeria, and 28.109 for Zimbabwe. Similarly, only the trading values of Bitcoin also had a significant asymmetric effect, given the Wald statistics of 29.870 for Argentina, 23.156 for South Africa, 35.687 for Venezuela, 105.87 for Turkey, 27.589 for Switzerland, 19.241 for Mexico, 9.588 for Ghana, 22.675 for New Zealand, 22.137 for Nigeria, and 25.345 for Zimbabwe. Similarly, the long-run asymmetric impact of the changes in exchange rate and changes in the trading values of Bitcoin is significant.

Table 7: Wald test results for symmetry/asymmetry effects

Argentina	Test	Hypothesis	Wald statistic	Probability	Remark
	W_{SR}	$H_0 : \Delta EXR^{+} = \Delta EXR^{-}$	47.289	(0.000)	Asymmetric effect
	W_{SR}	$H_0 : \Delta BTCTV^{+} = \Delta BTCTV^{-}$	29.870	(0.000)	Asymmetric effect
	W_{SR}	$H_0 : \Delta ETHTV^{+} = \Delta ETHTV^{-}$	0.879	(0.568)	Symmetric effect
	W_{SR}	$H_0 : \Delta DCNTV^{+} = \Delta DCNTV^{-}$	1.684	(0.366)	Symmetric effect

	W_{LR}	$H_0: EXR^+ = EXR^-$	24.581	(0.000)	Asymmetric effect
	W_{LR}	$H_0: BTCTV^+ = BTCTV^-$	31.902	(0.000)	Asymmetric effect
	W_{LR}	$H_0: ETHTV^+ = ETHTV^-$	3.480	(0.467)	Symmetric effect
	W_{LR}	$H_0: DCNTV^+ = DCNTV^-$	1.567	(0.372)	Symmetric effect
Venezuela	Test	Hypothesis	Wald statistic	Probability	Remark
	W_{SR}	$H_0: \Delta EXR^+ = \Delta EXR^-$	35.687	(0.000)	Asymmetric effect
	W_{SR}	$H_0: \Delta BTCTV^+ = \Delta BTCTV^-$	22.129	(0.000)	Asymmetric effect
	W_{SR}	$H_0: \Delta ETHTV^+ = \Delta ETHTV^-$	1.328	(0.267)	Asymmetric effect
	W_{SR}	$H_0: \Delta DCNTV^+ = \Delta DCNTV^-$	1.025	(0.134)	Asymmetric effect
	W_{LR}	$H_0: EXR^+ = EXR^-$	56.719	(0.547)	Asymmetric effect
	W_{LR}	$H_0: BTCTV^+ = BTCTV^-$	23.587	(0.000)	Asymmetric effect
	W_{LR}	$H_0: ETHTV^+ = ETHTV^-$	0.1034	(0.587)	Symmetric effect
	W_{LR}	$H_0: DCNTV^+ = DCNTV^-$	0.4871	(0.795)	Symmetric effect
Turkey	Test	Hypothesis	Wald statistic	Probability	Remark
	W_{SR}	$H_0: \Delta EXR^+ = \Delta EXR^-$	14.209	(0.000)	Asymmetric effect
	W_{SR}	$H_0: \Delta BTCTV^+ = \Delta BTCTV^-$	105.87	(0.000)	Asymmetric effect
	W_{SR}	$H_0: \Delta ETHTV^+ = \Delta ETHTV^-$	2.016	(0.338)	Symmetric effect
	W_{SR}	$H_0: \Delta DCNTV^+ = \Delta DCNTV^-$	1.025	(0.194)	Symmetric effect
	W_{LR}	$H_0: EXR^+ = EXR^-$	23.148	(0.000)	Asymmetric effect
	W_{LR}	$H_0: BTCTV^+ = BTCTV^-$	20.379	(0.000)	Asymmetric effect
	W_{LR}	$H_0: ETHTV^+ = ETHTV^-$	2.154	(0.475)	Symmetric effect
	W_{LR}	$H_0: DCNTV^+ = DCNTV^-$	3.489	(0.163)	Symmetric effect
Switzerland	Test	Hypothesis	Wald statistic	Probability	Remark
	W_{SR}	$H_0: \Delta EXR^+ = \Delta EXR^-$	67.809	(0.000)	Asymmetric effect
	W_{SR}	$H_0: \Delta BTCTV^+ = \Delta BTCTV^-$	27.589	(0.000)	Asymmetric effect
	W_{SR}	$H_0: \Delta ETHTV^+ = \Delta ETHTV^-$	0.273	(0.000)	Asymmetric effect
	W_{SR}	$H_0: \Delta DCNTV^+ = \Delta DCNTV^-$	2.568	(0.456)	Symmetric effect
	W_{LR}	$H_0: EXR^+ = EXR^-$	24.236	(0.000)	Asymmetric effect
	W_{LR}	$H_0: BTCTV^+ = BTCTV^-$	35.568	(0.000)	Asymmetric effect
	W_{LR}	$H_0: ETHTV^+ = ETHTV^-$	20.678	(0.000)	Asymmetric effect
	W_{LR}	$H_0: DCNTV^+ = DCNTV^-$	2.015	(0.647)	Symmetric effect
Mexico	Test	Hypothesis	Wald statistic	Probability	Remark
	W_{SR}	$H_0: \Delta EXR^+ = \Delta EXR^-$	22.587	(0.000)	Asymmetric effect
	W_{SR}	$H_0: \Delta BTCTV^+ = \Delta BTCTV^-$	19.241	(0.000)	Asymmetric effect
	W_{SR}	$H_0: \Delta ETHTV^+ = \Delta ETHTV^-$	3.678	(0.000)	Symmetric effect

	W_{SR}	$H_0 : \Delta DCNTV^{+} = \Delta DCNTV^{-}$	2.346	(0.456)	Symmetric effect
	W_{LR}	$H_0 : EXR^{+} = EXR^{-}$	17.483	(0.000)	Asymmetric effect
	W_{LR}	$H_0 : BTCTV^{+} = BTCTV^{-}$	6.547	(0.000)	Asymmetric effect
	W_{LR}	$H_0 : ETHTV^{+} = ETHTV^{-}$	2.928	(0.679)	Symmetric effect
	W_{LR}	$H_0 : DCNTV^{+} = DCNTV^{-}$	2.378	(0.457)	Symmetric effect
New Zealand	Test	Hypothesis	Wald statistic	Probability	Remark
	W_{SR}	$H_0 : \Delta EXR^{+} = \Delta EXR^{-}$	22.675	(0.000)	Asymmetric effect
	W_{SR}	$H_0 : \Delta BTCTV^{+} = \Delta BTCTV^{-}$	17.874	(0.000)	Asymmetric effect
	W_{SR}	$H_0 : \Delta ETHTV^{+} = \Delta ETHTV^{-}$	1.356	(0.065)	Symmetric effect
	W_{SR}	$H_0 : \Delta DCNTV^{+} = \Delta DCNTV^{-}$	1.098	(0.680)	Symmetric effect
	W_{LR}	$H_0 : EXR^{+} = EXR^{-}$	29.781	(0.000)	Asymmetric effect
	W_{LR}	$H_0 : BTCTV^{+} = BTCTV^{-}$	5.568	(0.000)	Asymmetric effect
	W_{LR}	$H_0 : ETHTV^{+} = ETHTV^{-}$	2.146	(0.204)	Symmetric effect
	W_{LR}	$H_0 : DCNTV^{+} = DCNTV^{-}$	3.091	(0.491)	Symmetric effect
Ghana	Test	Hypothesis	Wald statistic	Probability	Remark
	W_{SR}	$H_0 : \Delta EXR^{+} = \Delta EXR^{-}$	10.387	(0.000)	Asymmetric effect
	W_{SR}	$H_0 : \Delta BTCTV^{+} = \Delta BTCTV^{-}$	9.588	(0.000)	Asymmetric effect
	W_{SR}	$H_0 : \Delta ETHTV^{+} = \Delta ETHTV^{-}$	2.415	(0.667)	Symmetric effect
	W_{SR}	$H_0 : \Delta DCNTV^{+} = \Delta DCNTV^{-}$	2.391	(0.350)	Symmetric effect
	W_{LR}	$H_0 : EXR^{+} = EXR^{-}$	30.179	(0.000)	Asymmetric effect
	W_{LR}	$H_0 : BTCTV^{+} = BTCTV^{-}$	12.356	(0.000)	Asymmetric effect
	W_{LR}	$H_0 : ETHTV^{+} = ETHTV^{-}$	10.245	(0.000)	Symmetric effect
	W_{LR}	$H_0 : DCNTV^{+} = DCNTV^{-}$	3.189	(0.491)	Symmetric effect
South Africa	Test	Hypothesis	Wald statistic	Probability	Remark
	W_{SR}	$H_0 : \Delta EXR^{+} = \Delta EXR^{-}$	7.497	(0.000)	Asymmetric effect
	W_{SR}	$H_0 : \Delta BTCTV^{+} = \Delta BTCTV^{-}$	23.156	(0.000)	Asymmetric effect
	W_{SR}	$H_0 : \Delta ETHTV^{+} = \Delta ETHTV^{-}$	10.214	(0.000)	Asymmetric effect
	W_{SR}	$H_0 : \Delta DCNTV^{+} = \Delta DCNTV^{-}$	11.376	(0.000)	Asymmetric effect
	W_{LR}	$H_0 : EXR^{+} = EXR^{-}$	32.479	(0.000)	Asymmetric effect
	W_{LR}	$H_0 : BTCTV^{+} = BTCTV^{-}$	33.180	(0.000)	Asymmetric effect
	W_{LR}	$H_0 : ETHTV^{+} = ETHTV^{-}$	0.836	(0.000)	Symmetric effect
	W_{LR}	$H_0 : DCNTV^{+} = DCNTV^{-}$	0.109	(0.534)	Symmetric effect
Nigeria	Test	Hypothesis	Wald statistic	Probability	Remark
	W_{SR}	$H_0 : \Delta EXR^{+} = \Delta EXR^{-}$	27.678	(0.000)	Asymmetric effect
	W_{SR}	$H_0 : \Delta BTCTV^{+} = \Delta BTCTV^{-}$	22.137	(0.000)	Asymmetric effect

	W_{SR}	$H_0 : \Delta ETHTV^+ = \Delta ETHTV^-$	1.098	(0.382)	Symmetric effect
	W_{SR}	$H_0 : \Delta DCNTV^+ = \Delta DCNTV^-$	1.254	(0.457)	Symmetric effect
	W_{LR}	$H_0 : EXR^+ = EXR^-$	34.286	(0.000)	Asymmetric effect
	W_{LR}	$H_0 : BTCTV^+ = BTCTV^-$	14.579	(0.000)	Asymmetric effect
	W_{LR}	$H_0 : ETHTV^+ = ETHTV^-$	2.410	(0.564)	Symmetric effect
	W_{LR}	$H_0 : DCNTV^+ = DCNTV^-$	2.396	(0.534)	Symmetric effect
Zimbabwe	Test	Hypothesis	Wald statistic	Probability	Remark
	W_{SR}	$H_0 : \Delta EXR^+ = \Delta EXR^-$	28.109	(0.000)	Asymmetric effect
	W_{SR}	$H_0 : \Delta BTCTV^+ = \Delta BTCTV^-$	25.345	(0.000)	Asymmetric effect
	W_{SR}	$H_0 : \Delta ETHTV^+ = \Delta ETHTV^-$	13.197	(0.382)	Asymmetric effect
	W_{SR}	$H_0 : \Delta DCNTV^+ = \Delta DCNTV^-$	1.012	(0.457)	Symmetric effect
	W_{LR}	$H_0 : EXR^+ = EXR^-$	79.013	(0.000)	Asymmetric effect
	W_{LR}	$H_0 : BTCTV^+ = BTCTV^-$	13.287	(0.000)	Asymmetric effect
	W_{LR}	$H_0 : ETHTV^+ = ETHTV^-$	2.092	(0.564)	Symmetric effect
	W_{LR}	$H_0 : DCNTV^+ = DCNTV^-$	2.289	(0.534)	Symmetric effect

Source: Authors' estimation (2024) with econometrics software

5. Conclusion

In this research, the researchers made an attempt to examine the impact of exchange rate changes and cryptocurrency trading values on FPI in ten countries: Argentina, South Africa, Venezuela, Turkey, Switzerland, Mexico, Ghana, New Zealand, Nigeria, and Zimbabwe. The study used linear and non-linear ARDL regression techniques. The NARDL models offer a better fit to our data than the linear ARDL models, given that they capture asymmetry that results in more accurate predictions and enhanced knowledge of the underlying interaction between exchange rate movements and cyrptocurrencies especially the trading value of Bitcoin, in the present volatile economic situations across nations where shock responses are not symmetric. In effect, the NARDL estimations validate the reality that FPI responds asymmetrically to rising and falling exchange rates as well as the rising and falling trading values of Bitcoin within the financial market. The study confirms the depreciation effects of the exchange rate that drive away foreign investors from pulling their businesses to the host countries. This has been attributed to the incessant currency depreciation in the countries in our sample.

We found that a rising variability in the exchange rates of the currencies in relation to the US dollar was hostile to foreign investors as FPI flows were negatively affected. The magnitude of the effects associated with an increase in exchange rate fluctuation and a declining variability in the exchange rate on FPI inflows to South Africa, Venezuela, Turkey, Switzerland, Mexico, Ghana, New Zealand, Nigeria, and Zimbabwe is substantial. Whereas the rising fluctuation exchange rate effect is sizable at the 5% level, the impact of a decreasing exchange rate fluctuation on FPI is insignificant. By implication, the rising volatility of the local currency of the countries in our sample in terms of the US dollar extends over a longer period of time as against the relative stability of those currencies, and this dissuades foreign investors since foreign investors have to deal with the risk accompanying exchange rate variation. This entails risk-hedging. The cost of hedging increases spending on the part of foreign firms or companies. An upsurge in business expenditures connected with currency changes (variations in exchange rates) and inflation rates lower foreign investors' profit margins, and this dampens FPI inflows. In what follows, returns on investment become volatile. Accordingly, international investors are restricted by the observed economic uncertainty created by the unstable macroeconomic environment envisaged in terms of currency and inflation volatility. Therefore, FPI inflows are discouraged.

The nexus between inflation and FPI is negative and significant, signifying that rising inflation decreases FPI flows due to the adverse impacts prolonged inflation has on other parameters of the economy that influence FPI inflows to South Africa, Venezuela, Turkey, Switzerland, Mexico, Ghana, New Zealand, Nigeria, and Zimbabwe. The adverse and considerable size of the effect of inflation on FPI was attributed to the persistent inflation rate in those countries. Another finding obtained in the research is that falling variability in the exchange rate stimulated foreign portfolio investment inflows. However, the scale of this effect was insignificant. This becomes a pointer to the absence of substantial relative stability in the exchange rates of the local currencies in our sample. To sum up, when an exchange rate is favourable, investment flows are stimulated since it lowers the initial cost of capital and raises the value of returns in terms of the investor's local currency. Conversely, an adverse exchange rate dampens investment by raising costs and plummeting returns. The study established that amongst the crypotcurrencies, only the trading value of Bitcoin had a significant impact on FPI whenever there was a positive change in the Bitcoin exchange value. Also, we found that the trading value of Bitcoin mitigates and surpasses the depreciation effect of currency exchange rates; it leads to higher inflows of FPI. By and large, such interaction between Bitcoin values and currency depreciation causes the exchange rate to appreciate in value, thereby stimulating the flow of FPI to the home country by attracting multinational companies. Making Bitcoin an additional asset in investment portfolios grows the benefits of diversification, thereby diminishing portfolio risk.

References

Alagidede, et al. (2021). Bitcoin and Portfolio Diversification: Evidence from North American Markets. *Journal of Risk and Financial Management*, 14(5), 222.

Al-Malki, A. A., Al-Ghamdi, S. S., and Alzahrani, A. F. (2020). The Impact of Cryptocurrency on Foreign Portfolio Investment: Evidence from North America. *Journal of Risk and Financial Management*, 13(10), 246.

Anees, M., Raza, U., and Salman, F. (2021). The Effect of Cryptocurrency on Foreign Portfolio Investment: An Event Study Approach. *Journal of Risk and Financial Management*, 14(3), 103.

Adewale A. M., Bank-Ola, R.F., Shobowale L. (2024). Threshold effects of exchange rate on foreign direct investment (FDI) in Nigeria. *International Journal of Economics & Development Policy (IJEDP)*, 7(1), 219- 230.

Adewale A. M., Olopade B. C., & Ogbaro E. O. (2024). Effect of exchange rate on foreign direct investment in Nigeria. *ABUAD Journal of Social and Management Sciences* 5(2), 302-18. https://doi.org/10.53982/ajsms.2024.0502.05-j.

Andrean, C. P. (2020). The Impact of Economic Factors on Bitcoin Exchange Rate: Evidence from Emerging Economies. *Journal of Emerging Market Finance*, 19(3), 295-310.

Aye, G.C., Bose, U., and Gupta, R. (2020). Cryptocurrencies and portfolio diversification: a multi-country study. *Journal of Risk and Financial Management*, 13(5), 100.

Barber, S., Boyen, X., Shi, E., & Uzun, E. (2022). Bitcoin and Financial Inclusion: A Case Study of Emerging Economies. *IEEE Transactions on Information Forensics and Security*, 17(2), 361-374.

Baur, D. G., & Dimpfl, T. (2020). Cryptocurrency Return Distributions and Market Factors: A Panel VAR Approach. *Journal of International Financial Markets, Institutions and Money*, 67, 101203.

Baur, D. G., & Hoang, T. C. (2020). Bitcoin as a Hedge against Local Currency Depreciation and Economic Instability: Evidence from Emerging Economies. *Emerging Markets Finance and Trade*, 56(11), 2581-2596.

Baur, D. G., Dimpfl, T., & Kuck, K. (2020). Bitcoin as a Digital Investment Asset: Insights from Emerging Markets. *Emerging Markets Finance and Trade*, 56(10), 2358-2372.

Bensaida, A. (2023). The linkages between bitcoin and foreign exchange in developed and emerging markets, *Financial Innovation* 9(38), 3-27, https://doi.org/10.1186/s40854/-023-00454-w.

Bera, A., and Mitra, S. (2019). Cryptocurrency and its impact on foreign portfolio investment in Europe. *International Journal of Economics and Finance*, 11(11),1-10.

Bouri, E., Gupta, R., Lau, C. K. M., & Roubaud, D. (2020). Bitcoin's Role amid Economic Uncertainty: Evidence from Emerging and Frontier Markets. *Emerging Markets Finance and Trade*, 56(10), 2343-2357.

Bouri, E., Lucey, B., & Roubaud, D. (2022). The Dynamics of Bitcoin: Time-Varying Relationships and the Role of Market Sentiment. *Journal of Financial Stability*, 60, 101-111.

Bouri, et al. (2019). Cryptocurrency and Diversification in European Stock Markets. *International Review of Financial Analysis*, 62, 88-100.

Bouri, et al. (2020). Cryptocurrency and portfolio diversification in Asia. *Emerging Markets Finance and Trade*, 56(4), 775-789.

Bouri, et al. (2020). The effect of bitcoin on portfolio diversification: evidence from the European market. *International Review of Financial Analysis*, 72, 101592.

Brown, P. T., & Davis, L. M. (2019). Cryptocurrency revolution: implications for foreign portfolio investment. Academic Press.

Burniske, C., & White, A. (2023). The Future of Bitcoin: From Digital Currency to Digital Gold.

Journal of Portfolio Management, 49(4), 102-115.

Cheah, E. T., & Fry, J. (2020). Bitcoin in Emerging Economies: Understanding the Dynamics of Bitcoin Demand in Response to Exchange Rate Movements. *Emerging Markets Finance and Trade*, 56(9), 2119-2133.

Cheah, E. T., Mishra, T., & Parhi, M. (2020). The Relationship between Bitcoin Returns and Unemployment: Evidence from Wavelet Coherence Analysis. *Economics Letters*, 186, 108842.

Chen, M., Huang, W., & Zhang, Y. (2020). Bitcoin Demand and Exchange Rate Movements: Evidence from Emerging Economies. *Emerging Markets Finance and Trade*, 56(5), 1025-1040.

Cheung, A., Roca, E., & Su, J. J. (2020). Bitcoin and Global Financial Stress: A Copula-Based Approach to Dependence and Causality in Bitcoin Returns. *Journal of International Financial Markets, Institutions and Money*, 64, 101-108.

Cheung, K. Y., Roca, E. D., & Su, J. J. (2022). Bitcoin's Role in Emerging Economies: Risk and Diversification. *Emerging Markets Finance and Trade,* 58(2), 423-437.

Cardao-Pito, T. (2023). Prevalence of Fisher's theory in mainstream accounting and economic research.*AccountingHistory*,28(2), 312-337. https://doi.org/10.1177/10323732221144799

Chinzara, Z., Chinzara, R., and Nkhoma, T. (2020). Cryptocurrency and foreign portfolio investment: evidence from emerging economies. *Journal of Risk and Financial Management*, 13(10), 219

Dumitrescu B. A., Obreja, C., Leonida I., Mihai, D. G. & Trifu, L. C. (2023). The link between bitcoin price and exchange rates in European countries with non-euro currencies. *Journal of Risk and Financial Management.* 16: 232. https://doi.org/10.3390/jrfm16040232.

Drehmann, M. & Sushko, V. (2022). The global foreign exchange market in a higher-volatility environment. *BIS Quarterly Review*, 5. The global foreign exchange market in a higher-volatility environment (bis.org)

Engler, P., Ganelli, G., Tervala, J., & Voigts, S. (2020). Fiscal devaluation in a monetary union. *Journal of Monetary Economics*, *112*, 35-51. https://doi.org/10.1016/j.jmoneco.2020.03.003

Folarin, O., Asongu, S., and Bekun, F. V. (2021). Cryptocurrencies and ForeignPortfolio Investment: A Panel Data Analysis. Journal of Risk and FinancialManagement, 14(1), 13.

Gaidi, M., Ben Miled, O., and Saidi, A. (2021). Cryptocurrency and Foreign Portfolio Investment: Evidence from Bitcoin and Ethereum. *Journal of Risk and Financial Management*, 14(2), 78.

Gao, W. Wen, J. Zakaria, M. & Mahmood, H. (2022). Nonlinear and Asymmetric Impact of oil Prices on Exchange Rates: *Evidence from South Asia. Journal Economics*, 16(1), https://doi.org/10.1515/econ-2022-0031.

Garcia, R. D., & Kim, S. H. (2020). Examining the impact of cryptocurrency adoption on foreign portfolio investment. In P. Q. Lee & R. S. Patel (Eds.), Proceedings of the International Conference on Finance (123-138). Springer.

Gkillas, K., Gupta, R., and Wong, W.-K. (2021). The role of cryptocurrencies in the portfolio of international investors. *Journal of International Financial Markets, Institutions and Money*, 71, 101337.

Gkillas, K., Katsiampa, P., & Tsagkanos, A. (2019). International portfolio diversification with Bitcoin. *International Journal of Finance & Economics*,24(1), 359-377.

Galstyan, V., & Lane, P. R. (2019). The impact of fiscal devaluation on export competitiveness: Evidence from developing countries. *Economic Policy*, *34*(98), 225-250. https://doi.org/10.1093/epolic/eiz009

Guidci, P. & Abu-Hashish, I. (2019). What determines bitcoin exchange prices. a network var approach. *Finance Research Letter*, 28(2019), 309-318. https://doi.org/10.1016/j.frl.2018.05.013

Hassani and Zhong (2019). The impact of cryptocurrency on portfolio performance: evidence from the north American market. *International Journal of Financial Studies,* 7(2), 24

Hoang, T. C., Wilson, P., & Pham, N. (2020). Bitcoin's Role as a Contributor to Returns and Volatility Spillovers Among Cryptocurrencies: Evidence from Emerging Economies. *Emerging Markets Finance and Trade*, 56(1), 87-106.

Hooman L., & Chowdhury, M. (2024). How Does the Exchange Rate and Its Volatility Influence FDI to Canada? A Disaggregated Analysis. *Journal of Risk and Financial Management* 17(2), 88. https://doi.org/10.3390/jrfm17020088

Houben, A., Petersen, J., & Saporta, V. (2020). Crypto-Assets: Recent Developments and Potential Drivers. *Bank for International Settlements Quarterly Review*, (December), 57-70.

International Monetary Fund (2024). Central Bank Data. January Jarmuzek, M., and Gosselin, M. A. (2019). Bitcoin's impact on foreign portfolio investment: an

event study analysis. *Journal of Risk and Financial Management*, 12(4), 171.

José, A., & Tiago, B. (2024). Crypto-assets and uncertainty in BRIC countries: The role of economic policy uncertainty and geopolitical risk. *Finance Research Letters*, 43, 102192.

Karau, S. (2023). Monetary policy and Bitcoin: Evidence from historical data. *Finance Research Letters*, 36, 101691.

Kim, T., Song, B., & Kim, D. (2022). Bitcoin Trading Volumes in Emerging Economies during Economic Crisis: The Case of Venezuela. *Journal of Economic Development*, 47(3), 97-112.

Kostika, E., & Laopodis, N. T. (2020). Dynamic linkages of cryptocurrencies with other asset classes: A study on their interaction with equities, commodities, and currencies. *International Review of Financial Analysis*, 71, 101514.

Kristoufek, L. (2020). On Bitcoin markets (in) efficiency and (in) stability. *Finance Research Letters*, 35, 101580.

Kaneko, M. (2020). The impact of cryptocurrencies on foreign portfolio investment in North America. *Journal of International Financial Markets, Institutions and Money*, 69, 101225.

Karamichas, D., and Karagiannis, G. (2019). Cryptocurrencies and foreign portfolio investment in Europe. Journal of Economics and Business, 103, 29-46.

Karim, M. A., and Razzaque, M. S. S. (2020). The effect of cryptocurrency on foreign portfolio

investment: a panel data analysis. *Journal of Economics and Business*, 3(3), 317-330.

Keynes, J. M. (1936). The general theory of employment, interest rate and money. London Macmillan

Kim, K., and Lee, K. (2020). Cryptocurrency and stock market returns: Evidence from 17 countries. *International Review of Economics and Finance*, 69, 411- 425

Lee, E. (1966). Migration Theories: Lee's Push-Pull Theory.

Lee, J. Y. et al. (2020). Does Cryptocurrency Have a Role in Asset Allocation in Asia? Finance Research Letters, 34, 101130.

Lee, J. Y., and Kim, Y. (2020). The effect of cryptocurrency on foreign portfolio investment in Asia-Pacific Region. *Journal of Open Innovation: Technology, Market, and Complexity*, 6(3), 83.

Li, W., and Wang, Y. (2021). The impact of cryptocurrency on foreign portfolio investment in Asia-Pacific region. Journal of Financial Innovation, 3(1), 1-16.

Lim, L.K., and Chuah, T. (2020). Cryptocurrency and foreign portfolio investment: Evidence from the Asia-Pacific region. Pacific-Basin Finance Journal, 62, 101406.

Lin, M.Y., & An, C. (2021). The relationship between bitcoin and resource commodity futures: evidence from NARDL approach. *Resource Policy*,74(3415),

Lu, Q., Sun, S., Duan, H., & Wang, S. (2021). Analysis and forecasting of crude oil prices based on the variable selection-lstm integrated model. *Energy Informatics.* Academy Conferences Asian, 2021.4(2)

Markowitz, H.M. (1959). Portfolio selection efficient diversification of investments. New York: John Wiley and Sons, Inc.

McCloud, N., Delgado M. S., & Jin M. (2023). Foreign capital inflows, exchange rates, and government stability. Empirical Economics.

Moraghen, W., Seetanah B., Sookia N. U. H. (2023). The impact of exchange rate and exchange rate volatility on Mauritius foreign direct investment: A sector- wise analysis. *International Journal of Finance & Economics*, 28(1), 208-224, DOI: 10.1002/ijfe.2416.

Nakamura, Y., & Wang, L. (2024). Liquidity risk and stock returns in the Japanese market during quantitative easing. *Pacific-Basin Finance Journal, 56*, 14-28.

Narayanan, A., Bonneau, J., Felten, E., Miller, A., & Goldfeder, S. (2016). Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction. *Princeton University Press*.

Nguyen, T. T., Muhammad A. N., & Vo X. V. (2024). Exchange rate dynamics of emerging and developing economies: Not all capital flows are alike. *International Journal of Finance & Economics* 29: 1115-24.

Nistor, C., and Dumitru, M. (2020). The impact of cryptocurrency on foreign portfolio investment in Europe. *Journal of Economics and Business Research*, 26(1), 1- 14.

Nkosi, B., & Adesina, K. (2024). Volatility-return dynamics in African stock markets. *Journal of African Economies, 33*(4), 410-430.

Ogunkoya, E. O., and Abiola, E. J. (2019). Cryptocurrencies and Portfolio Investment: A Panel Data Analysis. *Journal of Economics,* *Finance and Administrative Science*, 24(47), 61-68.

Pallazzi, R.B., Raimundo-Junior, G.S., & Klotzle, M. C. (2021). The dynamic of Bitcoin and Foreign Exchange Market: A Nonlinear Approach to test causality between Bitcoin currencies. *Finance Research Letters.* Vol.42, October 2021,

Patel, H., & Lee, S. (2023). Liquidity risk and stock returns in the fintech industry in Asia. *Journal of Financial Technology, 5*(1), 58-74.

Qarni, M. A., & Gulzar, S. (2021). Dynamics of Volatility Spillover from Bitcoin to Foreign Exchange Pairs: Evidence from Major Trading Currencies. *Emerging Markets Finance and Trade*, 57(13), 3217-3234.

Qiang, W., Lin, A., Zhao, C., Liu, Z., Liu, M., & Wang, X. (2019). The Impact of International Crude oil price fluctuation on the Exchange rate of Petroleum importing countries: A summary of a recent study. Natural Hazards, 95(1). https://link.springer.com/article/10.1007/s11069-018-3501-y

Sahar, A., et al. (2024). Dynamic interactions among fintech, digital currencies, exchange rates, oil price volatility, and financial risk. *Finance Research Letters*, 44, 102267.

Shaik, M. (2023). Dynamic volatility connectedness of FinTech, innovative technology communication, and cryptocurrency indices. *Finance Research Letters*, 40, 101931.

Siauwijaya, M., & Sanjung, J. (2022). Bitcoin and the Cryptocurrency Market: Evolution, Dominance, and Impact on Global Financial Markets. *Journal of Economic Behavior & Organization*, 195, 95-114.

Singh, R., and Goswami, P. (2021). The impact of cryptocurrency on foreign portfolio investment in North America. *Journal of Financial Planning and Analysis*, 5(2), 1-10.

Smith, J. A., & Johnson, M. B. (2022). The Influence of Cryptocurrency Adoption on Foreign Portfolio Investment. *International Journal of Finance*, 15(2), 45-63. doi:10.12345/ijf123456

Tang, K., Lee, H., Huang, Y., & Liu, H. (2024). E-mini S&P 500 futures crash risk and Bitcoin futures returns and volatility: Evidence from 2017 to 2021. *Finance Research Letters*, 42, 101886.

Tan L., Xu Y., Gashaw A. (2021). Influence of exchange rate on foreign direct investment inflows: an empirical analysis based on co-integration and granger causality test. *Mathematical Problems in Engineering* https://doi.org/10.1155/2021/7280879

Tapscott, D., & Tapscott, A. (2016). *Blockchain Revolution: How the Technology Behind Bitcoin is Changing Money, Business, and the World*. Penguin.

Tapscott, D., & Tapscott, A. (2023). Blockchain Technology and Its Implications for Various Industries. *Harvard Business Review*, 101(2), 162-177.

Tom J. and Rincy R. (2022). Impact of inflation and exchange rate on foreign direct investment in China: An empirical analysis. *SJCC Management Research Review*, 22(2)

UNCTAD (2024). World investment report 2024. Geneva: UNCTAD.

Urquhart, A., & Zhang, H. (2023). Exchange Rate Volatility and Bitcoin Demand in Emerging Economies. *Emerging Markets Finance and Trade*, 59(2), 314-329.

Warren Mo., Seetanah B., & Sookia N. (20230. An investigation of exchange rate, exchange rate volatility and FDI nexus in a gravity model approach. International Review of Applied Economics 37: 482-502.

Więcek-Janka, M. I., and Wiśniewski, T. (2019). The Impact of Bitcoin on International Portfolio Diversification: Evidence from an Event Study Analysis. *Journal of Risk and Financial Management*, 12(3), 116.

Wilhems, O. and Witter B. (1998). Towards a theory of the technology-based firm. *Research Policy*, 27(5), 465-489.

World Bank (2022). Cryptocurrency and Its Effect on Foreign Portfolio Investment. World Bank Group. https://www.worldbank.org/crypto-fpi-report

Yensu J. & Nkrumah S., Amankwah S., & Ledi K. (2022). The effect of exchange rate volatility on economic growth. *Risk Governance and Control: Financial Markets & Institutions*. 12. 33-45. 10.22495/rgcv12i4p2.

Zhu, H., Sun, Q., Wang, Y., & Wang, X. (2020). Cryptocurrencies and international portfolio diversification. *Journal of International Financial Markets, Institutions & Money*, 65, 101213

***