“Cryptocurrencies and traditional assets: Decoding the analogy from emerging economies with crypto usage”

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CRYPTOCURRENCIES AND TRADITIONAL ASSETS: DECODING THE ANALOGY FROM EMERGING ECONOMIES WITH CRYPTO USAGE

Abstract

This paper investigates the relationship of cryptocurrencies with four traditional assets: equity, fiat currencies, crude oil, and gold in Nigeria, Vietnam, the Philippines, Turkey, and Peru. According to Statista's 2020 Cryptocurrency Adoption Survey, these five countries showed high levels of crypto usage and ownership. Emerging economies attract the attention of portfolio managers due to the high returns associated with assets originating from these countries. The paper explores the possibility of creating a multi-asset portfolio, including cryptocurrencies. Vector Autoregression Granger causality and Johansen Cointegration tests are conducted to study the relationship between each traditional asset and cryptocurrencies. The study period is from October 2017 to June 2021. The composite Crypto Index was created using the top seven cryptocurrencies based on market capitalization. The Granger Causality test results reveal no causality between Nigeria's chosen traditional assets and the cryptocurrency index. In the case of the Philippines, there is a unidirectional causality relationship from crypto returns to currency returns; and gold returns to crypto index returns. In Vietnam, stock index returns cause crypto returns; in Peru, gold returns cause crypto returns; and in Turkey, crypto returns cause currency returns. None of the countries has exhibited a bidirectional relationship between traditional assets and the crypto index. The robustness of the causality relations is checked using the Johansen Cointegration test. All the assets taken under study, country-wise, are cointegrated with one another. Hence, when building a multi-asset portfolio covering these five emerging nations, cryptocurrencies do not offer investors diversification, hedging, or haven benefits.

Keywords cryptocurrencies, traditional assets, diversification, emerging nations, causality, cointegration

JEL Classification C22, D53, G11

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INTRODUCTION

The drivers of the adoption of cryptocurrencies have been linked to increased e-commerce productivity and enhancement in global fund transfer time, resulting in lower transaction costs (Dandapani, 2017). While most financial transactions typically require a minimum of three business days to be completed, a cryptocurrency takes only seconds to be recorded globally and, at the most, ten minutes to get included in the blockchain (Krause, 2016). The fluctuating price of this digital currency and the business model provided by these virtual currencies has driven exponential growth, enticing investors to utilize this speculative asset for early windfall gain (Shirakawa et al., 2019). Research on cryptocurrency is needed because investors are still divided about whether crypto assets are financially viable investments or just speculative asset classes (Corbet et al., 2019b); whether bitcoin is a currency, digital gold, commodity, or synthetic commodity (Selgin, 2015), and disagreement in considering bitcoin as money (Yermack, 2013). Past studies have exhibited the purpose of emerging economies adopting cryptocurrencies as legal tender (Schwartz, 2022; Casanova & Ninia, 2022; Handagama, 2022).

Spreading investments across asset classes and countries reduces portfolio risk and increases diversification benefits. A diversifier is an asset that has a weak positive correlation with another asset on average. An asset is a weak hedge if it is uncorrelated with another asset on average. Conversely, an asset is a strong hedge if negatively correlated with another asset. An asset is said to exhibit strong (weak) haven properties if it has a negative correlation (uncorrelated) with another asset on average during financial stress (Bouri, Molnár et al., 2017). Assets allocated to multi-asset strategies of portfolio construction have increased, making it one of the growing investment approaches in the United States (Baghai et al., 2021). Multi-asset portfolios bring the advantages of greater liquidity, improved diversity, reduced volatility, ability to fit readily alongside a variety of investment approaches and asset class categories (Peskin, 2018). Therefore, a test of the relationship dynamics between crypto-assets and other financial assets – stocks, commodities, and fiat currencies – becomes pertinent in understanding the diversification benefits cryptocurrencies can bring to individual investment portfolios.

Recently, there have been extensive studies on the movement of cryptocurrencies with other financial asset classes. For example, Corelli (2018) found a statistically significant effect of Asian currencies on cryptocurrencies: the Thai Baht, Taiwan Dollar, and Yuan. In addition, Adebola et al. (2019) found a long-run relationship between gold and bitcoins. On the other hand, Gil-Alana et al. (2020) found no long-run relationship between cryptocurrencies and stock indices.

These studies raise a primary question, "Are cryptocurrencies worthwhile in a multi-asset portfolio comprising equities, commodities (like gold and crude oil), and fiat currencies?" Statista Global Consumer Survey of 2020 has revealed that Nigeria, Vietnam, the Philippines, Turkey, and Peru are the top five nations that use and own cryptocurrencies. For international portfolio managers, cryptocurrencies can be included in a multi-asset portfolio to bring diversification benefits and leverage in portfolio construction. The multi-asset portfolio may include cryptocurrencies, equities, crude oil, gold, and fiat currencies, from these five emerging nations. Most studies have conducted an empirical investigation to check the relationship between financial assets and bitcoins, chiefly in the UK (Tiwari et al., 2019); the US (Dyhrberg, 2016; Conlon & McGee, 2020); and China markets (Feng et al., 2018). In this paper, an attempt has been made to investigate the relationship of cryptocurrencies with traditional assets in a few emerging countries, which have shown high cryptocurrency adoption, per the Statista 2020 consumer survey.

1. LITERATURE REVIEW

The advantages of international portfolio diversification are documented quite extensively in Levy and Sarnat (1970), Lessard (1973), and Solnik (1974). Therefore, a test of the relationship dynamics between crypto-assets and other financial assets – stocks, commodities, and fiat currencies – becomes pertinent to understanding the diversification benefits cryptocurrencies can bring to individual investment portfolios. Deniz and Teker (2020) observed that in recent years, cryptocurrencies have gained popularity and been discussed as an essential component of portfolios for investors. This is because they lack dependence on a central authority. A multi-asset portfolio can be created if no interrelationship is found between cryptocurrencies and other traditional assets. For example, this portfolio may comprise equity indices of the five nations, the fiat currency of the nations under study, and gold and crude oil. This portfolio may give diversification benefits to investors who desire investments in emerging developing nations. However, diversification opportunities exist only if the financial assets are not cointegrated in the long run (Talwar & Gupta-Bhattacharya, 2017).

Various researchers have investigated the relationship between bitcoins and financial variables: bitcoins and FTSE stocks (Dyhrberg, 2016), monetary systems (Rogojanu & Badea, 2014), fiat currencies (Baur et al., 2017; Dyhrberg, 2016), macroeconomic news (Al-Khazali et al., 2018; Zhang et al., 2019), commodities (Bouri, Jalkh et al., 2017; Baur et al., 2015), and global uncertainty (Bouri, Gupta, et al., 2017; Bouri et al., 2018). The following studies have found hedging

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benefits brought by bitcoins to various financial assets. Bouri, Jalkh et al. (2017) studied the bitcoin price debacle of December 2013. Their study revealed that bitcoins could be a hedge and haven compared to commodities and energy commodities. However, this property exists only in the pre-crash period. In the post-crash period, Bitcoin acted as a diversifier. Dyhrberg (2016) found that bitcoin might hedge the US Dollar in the short term.

Bhullar and Bhatnagar (2020) tested the relationship of Bitcoins with the Indian stock market. They found a unidirectional relationship between Sensex and bitcoin between 2015 and 2019. Their study implied that Sensex caused price movement in bitcoins, but bitcoins did not impact the price movements of Sensex. Kang et al. (2021) found that the cryptocurrency market after November 2017 is not as efficient as those created before November 2017. Gil-Alana et al. (2020) discovered the possibility of Bitcoin and Ethereum in investor portfolios providing diversification benefits to investors. The study by Akhtaruzzaman et al. (2020) has presented inverse correlations of bitcoins with industry portfolios and bond index exchanges, thereby providing substantial diversification benefits. Studies conducted by Liu (2019), Selmi et al. (2018), and Corbet et al. (2018) recognized portfolio gains from the inclusion of cryptocurrency with other financial assets. When explicitly examining the relationships between bitcoin and other traditional financial assets, Bouri, Gupta et al. (2017) found bitcoins suitable for diversification purposes. However, bitcoin acts as an imperfect hedge for stock and bond indices. Tiwari et al. (2019) generated similar results for the S&P500 exchange and Eurostoxx 50, and Feng et al. (2018) found similar results for the Shanghai stock exchange.

Studies investigating the relationship of cryptocurrencies with gold have found that the former developed a long-term and short-term asymmetric reaction to gold returns during the COVID-19 period (González et al., 2021). Guesmi et al. (2019) found that including bitcoin in a portfolio comprising gold, crude, and emerging market stocks significantly reduces portfolio risk. Klein et al. (2018) found that bitcoin positively correlates with gold returns in downtrends in developed markets. Thereby not providing hedging benefits due to its positive correlation with gold. Kurka (2017) studied the asymmetric volatility spillover between bitcoins with foreign exchange, stocks, and commodities. He found an abrupt disruption triggered a stream of negative spillovers of considerable scale from bitcoin to gold. Finally, Bouri et al. (2018) found that return spillovers from the world and emerging markets to bitcoin are positive in bull markets but negative in bear markets.

Few contrasting studies have rejected the benefits of bitcoins to portfolios. Conlon and McGee (2020) found that bitcoin is neither a haven nor a hedge against the extreme bear market in the S&P500 elicited by the COVID-19 pandemic. Corbet et al. (2020) found that cryptocurrencies act as amplifiers of contagion in severe financial and economic disturbances. Finally, Bouri et al. (2018) found that spillovers from the world and emerging markets to bitcoins are positive in bull markets, but negative in bear markets.

Recent studies evaluating the inclusion of cryptocurrencies in multi-asset portfolios of developed countries found that cryptocurrencies bring benefits to a portfolio. Ankenbrand and Bieri (2018) created a cryptocurrency index and explored the possibility of this index in a portfolio comprising the S&P 500, Bloomberg bond index, commodity index, and US dollars. They found that cryptocurrencies enhance portfolio return. Andrianto and Diputra (2018) investigated the addition of cryptocurrencies in a portfolio comprising commodities, currencies, stocks of US companies, and ETFs. They found that cryptocurrencies enhance portfolio returns by 5-20%. Guesmi et al. (2019) found that adding bitcoin to a multi-asset portfolio comprising gold, crude, and stocks of emerging countries reduces portfolio risk. Glas (2019) found that most cryptocurrencies have a low correlation with US equities and global FX. Hence, they are included in multi-asset portfolios. Liu et al. (2021) included cryptocurrencies among six other traditional assets from mainstream countries covering 2014 to 2020. They found that cryptocurrencies enhance portfolio returns. Juškaitė and Gudelytė-žilinskienė (2022) found that the addition of

Bitcoin, Ethereum Dogecoin, and Terra in the investment portfolio of developed countries' indices – from the US, UK, Germany, and France, offers diversification benefits. Koziuk (2022) has observed an exciting finding. He found that countries with worsened inflation and institutional performance tend to hold more cryptocurrencies in their investment portfolios.

Most studies have investigated the inclusion of cryptocurrencies in portfolios of developed countries. This paper investigates the possibility of including cryptocurrencies in a portfolio comprising assets of emerging countries with high cryptocurrency usage (as per Statista cryptocurrency adoption survey of 2020). As per the literature review, no previous study has investigated the inclusion of cryptocurrencies among the chosen emerging economies.

This study provides an argument to justify the choice of the five countries taken in the study. Each of these five nations has high cryptocurrency usage, according to the Statista Consumer Global Survey reported. The report presented at World Economic Forum showed the statistics given by Statista in 2020 for 74 countries. It featured Nigeria as the most prominent bitcoin user, with 32% of the people using or owning cryptocurrencies. The study justified the popularity of cryptocurrencies, as they are cheaper for sending money across borders. The same study indicated the following percentage of the population using cryptocurrencies: 21% in Vietnam, 20% in the Philippines, 16% in Turkey, and 16% in Peru.

Ayomikun and Omowunmi (2019) proposed that the Nigerian Government considers cryptocurrency to be legalized as a means of exchange. Once that is done, the threat of its misuse in crime-related activity can be minimized. Franco (2014), through his study, added the low risk that crypto users might face in case of cyber-attack and losses. Hayes (2016) compared the transaction cost of cryptocurrency with credit cards in Nigeria. He found that credit cards are 5.5 times costlier in operations over a similar value. Finally, Salawu and Moloi (2018) studied chartered accountants' views regarding cryptocurrency usage in Nigeria. They suggested that cryptocurrencies need to be legislated by the Federal Government of Nigeria, which would bring desirable protection to the economy. These studies and the survey finding of the Statista survey justify the choice to include Nigeria in the current study.

All crypto assets were banned in Vietnam given their side effect of creating financial fraudulence triggering the risk of money laundering, terrorism financing, and tax evasion. This led to a decline in capital raised through Initial Coin offerings (OECD report 2019). Nam (2019) highlighted the trend of people not recognizing and abiding by the ban. On the other hand, Hang et al. (2020) highlight the acceptance of cryptocurrencies among citizens. Hence, cryptocurrencies should be adopted with regulatory guidelines. Vietnam News of May 2020 stated that the Finance Ministry decided to form a research group to evaluate and propose policies to manage virtual assets. The cyber-currency market is expected to touch USD 80 billion by 2024 (Nam, 2019). This opportunity has motivated Vietnam to adopt the initiative of establishing the first state-authorized digital currency. Given the controversy of cryptocurrency usage and the survey findings of Statista, Vietnam is included in this study.

According to bitcoin.com, the Philippines' Government has permitted crypto exchanges to operate as payment companies. The Philippines has the largest foreign working population overseas and needs many remittances; hence, cryptocurrency is widely accepted. Jennings (2019) observed that Filipinos generally prefer traditional investments, and young start-up companies target cryptocurrency to attract foreign investment and raise capital through ICO. His study further revealed that 70% of Filipinos do not have bank accounts, so virtual currency has become another payment method option. Evaluating its attractiveness among citizens, the Philippine government announced Cayagan Economic Zone Authority (CEZA), owned and controlled by the Government. Given the Government's affirmative steps taken in the Philippines to accept cryptocurrencies as a legal means of exchange, and due to the survey of the Statista findings, the Philippines is included in the current study.

Since 2017, which is considered the golden era of cryptocurrencies, Turkey has remained one

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of the most significant users. The reason being studied by Saka (2020) states that there was a positive correlation observed between investing in cryptocurrencies and economic restraints. The shift towards virtual currency happened in the fall of 2018 when the Turkish Lira radically lost its value. Within no time, cryptocurrencies became a household name and penetrated "Istanbul's old Grand Bazaar." To attract global financers, the 11th developmental plan, published on July 23, 2019, proposed to adopt a robust institutional structure in the financial sector and came up with its Technology center in Istanbul. This helped Turkey to evolve as a favorable environment toward blockchain and cryptocurrencies. The Financial Stability Committee also announced the establishment of regulations on cryptocurrency (Keskin et al., 2019). Developing its digital currency with national capabilities would lead to an enhanced digital economy for Turkey, as the head of the Informatics Association of Turkey stated in May 2021(Bicer, 2021). Turkey is included in this study due to the wide acceptance of cryptocurrencies as payment.

No studies were found in the context of Peru. However, Latin America is a region where cryptocurrencies are gaining wide usage. Peru has a 16% adoption of these virtual currencies, per the Statista Global Consumer Survey conducted in 2020. Hence, the study includes Peru as the fifth country in the analysis.

After a comprehensive study of the results of the literature cited above, it is evident that cryptocurrencies may have a relationship with traditional assets. This relationship may be short or long-term. This is the stepping-stone to the creation of a multi-asset portfolio. If a long-run relationship, as measured by the cointegration test, is found, constructing a multi-asset portfolio ceases. In that case, cryptocurrencies should not be added to a multi-asset portfolio. Previous studies have focused primarily on bitcoins rather than composite indices. In addition, they have investigated developed countries. The current study introduces a cryptocurrency index based on the highest market capitalization of the seven top cryptocurrencies. This index may be included in a multi-asset portfolio for diversification benefits. Thus, the paper endeavors to achieve the following research goals:

1. Investigating the relationship of the index of cryptocurrencies created in the current research paper with traditional assets of the five emerging nations that have embraced cryptocurrencies as a payment medium.

2. Suggesting the creation of a multi-asset portfolio in case no relationship is found between cryptocurrencies and traditional assets.

In the realm of multi-asset portfolio construction, this study hypothesizes the following:

H01: No interrelationship exists between cryptocurrencies and other traditional assets in Nigeria.

H02: No interrelationship exists between cryptocurrencies and other traditional assets in Vietnam.

H03: No interrelationship exists between cryptocurrencies and other traditional assets in the Philippines.

H04: No interrelationship exists between cryptocurrencies and other traditional assets in Turkey.

H05: No interrelationship exists between cryptocurrencies and other traditional assets in Peru.

2. METHOD

The daily data of financial variables of five nations – Nigeria, Vietnam, the Philippines, Turkey, and Peru – is analyzed from October 1, 2017 to June 21, 2021. The variables include: stock indices, the currency value of the respective country to the US dollars; gold prices in the respective market multiplied by the fiat currency value; Brent crude futures prices multiplied by the fiat currency value in the respective markets. In addition, daily prices of the top seven cryptocurrencies are taken as per market capitalization (as of June 28, 2021). All data were extracted from www.yahoofinance.com.

Table 1 recapitulates the ten extensively traded cryptocurrencies by market capitalization.

Table 1. Top traded cryptocurrencies

Source: Author's calculations, using https://coinmarketcap.com/. As of June 28, 2021, the market cap of cryptocurrency is 1.37 trillion.

S. No	Name of Cryptocurrency	Short Name	Market cap (as of June 28, 2021)	% of Total Market Cap (as of June 28, 2021)
1	Bitcoin	BTC	$645,521,558,588	47.08%
2	Ethereum	ETH	$230,336,290,675	16.79%
3	Tether	USDT	$62,565,345,544	4.56%
4	Binance Coin	BNB	$44,032,474,667	3.21%
5	Cardano	ADA	$42,140,975,640	3.07%
6	Dogecoin	DOGE	$33,273,492,430	2.41%
7	Ripple	XRP	$29,529,423,797	2.15%
8	USD Coin	USDC	$25,943,335,119	1.89%
9	Polkadot	DOT	$14,245,429,325	1.04%
10	Binance USD	BUSD	$10,013,585,979	0.73%

A market index of cryptocurrencies does not exist. Therefore, a new index using the top seven cryptocurrencies is created using a value-weighted methodology. The value-weighted methodology uses market capitalization as weight. The index's value is calculated as the total value of the weightage of each security multiplied by each security's closing price. As in the case of cryptocurrencies, the number of shares outstanding is not available; the circulating volumes are multiplied by the adjusted closing prices to get a proxy for market capitalization.

The analysis focuses on those cryptocurrencies that have existed from 2017 onwards and are within the top 10 currencies by market capitalization. These are Bitcoin, Ethereum, Tether, Binance coin, Cardano, and Dogecoin, Ripple. Together these seven cryptocurrencies constitute more than 80% of the market capitalization as of June 28, 2021, according to www.coinmarketcap.com.

First, the base period is set as October 1, 2017, when the top seven cryptocurrencies' data are available at the earliest. Market capitalization of the top seven cryptocurrencies was assumed 100 at that time. The subsequent index is calculated with daily market capitalization data of the seven cryptocurrencies for the market capitalization from October 1, 2017 to June 21, 2021. The selection of the seven cryptocurrencies is similar to Osterrieder et al. (2017) and Gil-Alana et al. (2020). The crypto index is created using the following equation:

Generally, financial time series witnesses non-stationarity and trending behavior. When one wants to establish an equilibrium relationship in the long run among time series variables using cointegration techniques, it becomes necessary to test for unit roots. This is the stepping-stone in the modeling of cointegration (Hatanaka, 1995). Augmented Dickey-Fuller (ADF) test is conducted to check the stationarity of all the time series data used in the study. First, non-stationary time series data sets are differenced, so their linear combination becomes stationary. Then, the series are cointegrated, making the variables hover around a constant value (Mitra, 2018). As per the ADF test results, all the datasets are stationary at their first differences.

Clive Granger first proposed whether one-time series data could forecast the cause of another time series in 1969. This test is popularly known as the Granger Causality Test. This paper uses the Granger causality test for all five countries to understand the cause-and-effect relationship between cryptocurrencies and other traditional assets.

Cointegration is essential for establishing a long-run association among the chosen time series variables. All variables are taken country-wise and tested to check the presence of cointegration. The test helps to identify whether datasets are moving together so that their linear combination results in a stationary time series. The Johansen cointegration test has been carried out using both maximum eigenvalue and trace statistics.

$$Crypto\ Index = \frac{\sum_{k=1}^{7} Daily\ Price \cdot Daily\ Circulating\ volume\ of\ each\ seven\ crytocurrency}{\sum_{1}^{7} Price \cdot Circulating\ volume\ of\ each\ seven\ cryptocurrencies\ of\ base\ date} \cdot 100. \quad (1)$$

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3. RESULTS

All the log-normal returns of the variables are taken as the time-series data for the Granger causality test. Next, a causality test using the Vector Autoregression (VAR) method is conducted. First, the VAR model is run to determine the lag, and then the causality test is used. Table 2 depicts the significant causality between the crypto index and other financial variables. The null hypothesis taken for all the tests is as follows:

Ho = series x does not Granger cause the series y (as the case may be).

If the null hypothesis is rejected, it is concluded that causality exists between the two variables. If the null hypothesis fails to get rejected, it is concluded that the series has no causality with other concerned series. Both series may have bi-directional, unidirectional, or no causality between them.

Table 2 shows no causality between crypto index return and the other four variables selected for Nigeria. For Philippines, two unidirectional causality relationships are found. The crypto index return Granger causes the return of fiat currency (unidirectional), and the gold returns Granger causes the crypto index return (unidirectional). In Vietnam, the return from the stock market Granger causes the crypto index return, but vice versa is not valid. Hence, the relationship is unidirectional. No causality was found between the crypto index return and the return of the other three variables (gold, currency, and crude) in Vietnam. In Peru, gold returns Granger causes the crypto index return, but vice versa is not valid, so unidirectional causality exists. However, no causality is found between crypto return and the return of other variables like the stock market, gold, and crude prices. In Turkey, the crypto index return Granger causes the fiat currency returns. This relationship is unidirectional. The return from the crypto index is not found to have any form of causality with the return of other variables in Turkey.

A simple way of testing the risk reduction possibility through diversification is investigated using correlations. However, there are shortcomings of correlations as it provides information about the short-run and fails to provide the long-run dynamics between the return of assets.

Cointegration emphasizes the long-run dynamics between the returns of assets providing a better measure of the linkages between the returns from assets. So a direct impact on diversification opportunities can be derived through cointegration in returns of financial assets as the long-run relationship is established between them. In that case, it shows that the availability of common factors may limit the intensity of independent variation among the returns series. Wilson and Okunev (1999) discussed that risk reduction in a portfolio through diversification benefits could be achieved by holding such assets jointly in the short and medium term. However, the same benefits cannot be derived in a long-term scenario.

The robustness of the Granger causality tests is checked through Johansen cointegration test results using Trace statistics and Max Eigenvalue. First, the Johansen cointegration test is conducted to find whether a long-run equilibrium prevails be-

Table 2. Summary of significant causality relationships

Source: Author's calculations.

Country-wise Null Hypothesis	F TEST Result	P-Value	Null	Causality Result
Nigeria (no significant causality found between any variable pairs)				
Philippines				
Crypto Index return does not Granger cause currency return	3.0887	0.0262	Reject Null	Causality Exists
Gold price return does not Granger cause Crypto index return	2.7614	0.0408	Reject Null	Causality Exists
Vietnam				
Stock market return does not granger cause crypto Index return	3.2846	0.0201	Reject Null	Causality Exists
Peru				
Gold price return does not Granger cause Crypto Index returns	4.4935	0.0114	Reject Null	Causality Exists
Turkey				
Crypto Index return does not Granger cause currency return	2.7883	0.0393	Reject Null	Causality Exists

tween the return of five variables taken for consideration country-wise. Further, the Max-Eigenvalue cointegration rank test is performed to check the long-run equilibrium relationships between the variables. Finally, a VAR model is used to identify the appropriate lag length using AIC criteria. The following hypotheses were framed in general for all the variables taken into consideration country-wise:

H0: No cointegration is there among the variables (r = 0).

H01: At the most, one pair of cointegration exists among the variables (r <= 1).

H02: At the most, two pairs of cointegration exist among the variables (r <= 2).

H03: There are at most three pairs of cointegration among the variables (r <= 3).

H04: There are at most four pairs of cointegration among the variables (r <= 4).

In Table 3, the country statistics of Peru can be observed. The max eigenvalue statistics are greater than the critical value at a 5% significance level. Therefore, it can be concluded that the null hypothesis H0 is rejected. Hence, cointegration is present between all the return variables in Peru. Similar observations can be made if one checks the values of cointegration for other countries like Nigeria, the Philippines, Vietnam, and Turkey. Hence, it can be concluded that cointegration is present among all the return variables in all these countries.

Further investigation suggests that in Peru, all null hypotheses (from H01 to H04) can be rejected if the eigenvalue statistics are compared with the critical value at the 5% level. Hence, based on the cointegration test's output, all the variables, i.e., returns from the crypto index, stock index, currency price, gold price, and crude price for Peru, are cointegrated. Similar results were found when the table for the other four countries was checked. Hence, each country taken for the study finds a long-run equilibrium relationship among the chosen variables.

Furthermore, trace statistics find a long-run association between all the variables country-wise. Table 4 presents the results of the same test using the trace statistics method.

Table 3. Johansen co-integration test results country-wise: maximum eigen value statistics, without linear trend and constant in cointegration

Source: Author's calculations.

Particulars	Peru		Nigeria		Philippines		Vietnam		Turkey	
Hypothesized no. of CE(s)	MES	CV @5%	MES	CV @5%	MES	CV @5%	MES	CV @5%	MES	CV @5%
r <= 4	88.37	9.24	79.28	9.24	105.175	9.24	125.67	9.24	117.12	9.24
r <= 3	172.25	15.7	165.97	15.67	151.105	15.7	136.95	15.7	131.13	15.67
r <= 2	188.14	22	207.64	22.01	179.089	22	203.42	22	165.27	22.01
r <= 1	211.38	28.1	375.6	28.14	188.101	28.1	331.45	28.1	190.49	28.14
r = 0	305.69	34.4	383.64	34.41	229.291	34.4	369.76	34.4	220.7	34.41
MES**	Max-Eigen Statistics									
CV @5% *	Critical Value @5% Significance									

Table 4. Johansen co-integration test results country-wise: trace statistics without linear trend and constant in cointegration

Source: Author's calculations.

Particulars	Peru		Nigeria		Philippines		Vietnam		Turkey	
Hypothesized no. of CE(s)	TS	CV @5%	TS	CV @5%	TS	CV @5%	TS	CV @5%	TS	CV @5%
r <= 4	88.37	9.24	79.28	9.24	105.18	9.24	125.67	9.24	117.12	9.24
r <= 3	260.91	20	245.25	19.96	256.28	20	262.62	20	248.25	19.96
r <= 2	449.05	34.9	452.89	34.91	435.37	34.9	466.04	34.9	413.52	34.91
r <= 1	660.43	53.2	828.49	53.21	623.47	53.2	797.49	53.2	604.01	53.21
r = 0	966.12	76.1	1212.13	76.07	852.76	76.1	1167.25	76.1	824.71	76.07
TS**	Trace Statistics									
CV @5% *	Critical Value @5% Significance									

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Both methods of Johansen Cointegration – Max eigenvalue and trace statistics confirm the cointegration between cryptocurrencies and traditional assets in each country. The results of this paper are compared with the findings of previous research.

4. DISCUSSION

This study provides an insightful understanding of the chosen cryptocurrencies and their dynamism with other assets. From a long-run perspective, it also tells how cryptocurrencies can be suitably paired with gold, currencies, and stock markets to reduce financial risk. Dirican and Canoz (2017) examined the relationship between the US and Chinese stock market indices with the bitcoin prices. They found that cointegration exists between stock market indices and bitcoin prices. Finally, Sami and Abdallah (2021) discussed the effects of cryptocurrencies on stock markets and stated that there is a statistically significant relationship between these two markets.

Contrary to that, Gil-Alana et al. (2020) analyzed the relationships between six stock market indices and six cryptocurrencies and found that no cointegration exists among cryptocurrencies and between cryptocurrencies and stock markets. Adebola et al. (2019) examined the relationship between gold prices and cryptocurrencies and found a small degree of cointegration between gold prices and bitcoin. Corelli (2018) examined the relationship between six cryptocurrencies and eleven exchange rates and stated that the Thai Baht, Taiwan Dollar, and Yuan have a strong statistically significant effect on cryptocurrencies. Mokni and Ajmi (2021) focused on the causality relationships between cryptocurrencies and the US dollar. They emphasized a strong causal relationship between these two markets. In this study, a long-run equilibrium relationship is found country-wise among these variables for all the countries. Therefore, all the assets taken under study, country-wise, are cointegrated with one another. This study is in line with the research of Dirican and Canoz (2017), Sami and Abdallah (2021), Adebola et al. (2019), and Mokni and Ajmi (2021). However, the results of the current study conflict with that of Gil-Alana et al. (2020), where a lack of cointegration between cryptocurrencies and stock market indices was found. Some more studies have revealed that cryptocurrency can be used to reduce portfolio risk and for hedging (Katsiampa, 2017; Baur et al., 2018; Guesmi et al., 2019). Again, it has been found by some researchers that cryptocurrencies cannot be used as a tool for decreasing portfolio risk (Klein et al., 2018). The results found in this study point towards the long-run relationship between cryptocurrencies and other portfolios; hence, decreasing the risk of portfolios by using cryptocurrencies becomes difficult.

Since this study aligns with the other studies for the most part, it is concluded that a multi-asset portfolio covering these five emerging nations will ensure the presence of common factors that will reduce the quantum of diversification among assets in a portfolio. This research work can be extended to explore the dynamic connectedness among different assets and how cryptocurrencies can work in a multi-asset portfolio. The current study can be further extended method-wise and period-wise to include more turbulent periods such as the Ukrainian crisis, global inflation increase, and interest rates during recent times. It can also provide fruitful implications for investors and policymakers in optimal hedging processes or investment strategies while accounting for heterogeneity, which can positively affect investment portfolio returns.

CONCLUSION

Several stylized facts about the dynamic relationship between the seven large cryptocurrency users with the equity market returns, crude oil returns, gold price returns, and currency value returns are exhibited. The study used an empirical analysis of daily asset closure data from the five nations that traded the maximum number of cryptocurrencies. In addition, the study employed a series of econometric tests to investigate the effect of these currencies on other financial assets – stocks, commodities, and fiat currencies – to establish the pertinence of the diversification benefits cryptocurrencies can bring to individual investment portfolios.

In the Philippines and Turkey, cryptocurrency returns Granger cause fiat currency returns. Additionally, in the Philippines, gold returns cause cryptocurrency returns. Stock returns Granger cause cryptocurrency returns in Vietnam. Gold returns Granger cause cryptocurrency returns in Peru. Through the Johansen Cointegration test using max eigenvalue and trace statistics, a long-run equilibrium relationship is found country-wise for all the countries among these variables. This means all the variables taken under study, country-wise, cointegrated with one another. Long-term cointegration will ensure the presence of common factors that will reduce the quantum of independent variations between the series of return variables. Therefore, cryptocurrencies offer investors no diversification, hedging, or haven benefits in constructing a multi-asset portfolio covering these five emerging nations.

The study results do not recommend including cryptocurrencies to international portfolio managers who wish to construct a multi-asset portfolio using stock indices, fiat currencies, and commodities of global significance – gold and crude oil.

AUTHOR CONTRIBUTIONS

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