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Short Communication

Cryptocurrency volatility and Egyptian stock market indexes: A note

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Abstract: This paper examines the effect of the riskiness of the top four cryptocurrencies on the riskiness of stock market indexes in Egypt, being recognized as a developing country. The analysis uses daily data on cryptocurrencies and the three stock market indexes covering January 2020 to January 2023. The risk is measured using the holding period Value at Risk (VaR). The GMM results show that (a) cryptocurrency volatility is negatively associated with the volatility of stock market indexes. That is, the higher the investors' interest in trading cryptocurrencies, the lower the volatility of stock market indexes as investors trade stocks less frequently, (b) cryptocurrencies can provide hedge and diversification benefits, and (c) the relationship between volatilities of cryptocurrencies and stock market indexes varies across indexes, therefore, contingent.

Keywords: value at risk, VaR; cryptocurrencies volatility; stock market index volatility; behavioral intention; EGX30; EGX70; EGX100; robustness; structural break; Egypt

1. Introduction

The introduction and broad use of cryptocurrencies have resulted in substantial shifts in the global financial environment in recent years. Due to their decentralized structure and potential for large profits, cryptocurrencies such as Bitcoin and Ethereum have piqued the interest of investors and scholars alike. As these digital assets acquire importance, concerns about their impact on traditional financial systems, particularly the stock market, arise (Baur et al., 2017).

Cryptocurrencies, with their distinct characteristics such as finite supply, cryptographic security, and peer-to-peer transactions, have created fresh investment opportunities for people and institutions. Their increasing popularity has resulted in greater integration with traditional financial markets, blurring the lines between the digital and traditional worlds. As a result, investors, politicians, and market players must all recognize the possible dangers of this integration (Aljamaan, 2018).

The relationship between cryptocurrencies and stock market risk has been the subject of much academic debate. While various studies have investigated the possible diversification benefits of cryptocurrencies in stock portfolios, a rising body of research suggests that the impact on stock market risk might be significant (Nadarajah & Chu, 2017). This negative association shows that including cryptocurrencies in investment portfolios may enhance rather than mitigate overall market risk. The underlying volatility of cryptocurrencies is one potential explanation for this unfavorable relationship. Cryptocurrencies are notorious for their wild price swings, frequently fueled by speculative trading, regulatory uncertainty, and technological advancements. As a result, incorporating these highly volatile assets into investing portfolios may introduce additional risk, increasing market volatility and stock market risk (Baek & Elbeck, 2015).

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The authors of the present paper are motivated by the understanding that cryptocurrencies' absence of government control and standardized valuation standards contributes to increasing uncertainty and risk. Because cryptocurrencies lack centralized authority and are decentralized, they are prone to market manipulation, fraud, and security breaches, which raise worries about the potential threats to financial markets at large and the stock market in particular (Nakamoto, 2008; Anisiuba et al., 2021).

This paper aims to fulfill two main objectives: (1) examine the relationship between the volatilities of cryptocurrencies and stock market indexes, and (2) examine the effect of an economic breakout on the relationship between the volatilities of cryptocurrencies and stock market indexes. The authors examine the daily returns for the four most popular cryptocurrencies to capture the time-varying volatility. The validity of the results requires an examination of different indexes in terms of composition.

The main results show a negative relationship between cryptocurrencies' volatility and stock market indexes' volatility. The main results of the paper are as follows. (a) cryptocurrencies can be used for hedging against equity volatility. This benefit can be further expanded if the indexes are offered as ETFs. The EGX30 is the only index offered as ETF; (b) the equity returns provide a hedge, although not perfect, against inflation; (c) money market interest rates provide a significant alternative investment to equity markets.

This paper contributes to the related literature examining the robustness of the relationship between the volatilities of cryptocurrencies and stock market indexes. In addition, the effect of a structural break is considered, which adds to the robustness of the results.

The remainder of this paper is organized as follows. Section 2 discusses the findings of previous studies regarding the relationship between cryptocurrencies and the advances in the underlying technology. Section (3) discusses the behavioral aspects of trading cryptocurrencies and the triad of Interest Rates, Inflation Rates, and Stock Returns. Section (4) discusses the Data, Methodology, and the results. Section (5) concludes.

2. Literature review

2.1. Cryptocurrencies and technological factors

Technology has a significant impact on how cryptocurrencies are developed and evolved. The underlying technology, especially blockchain, has been acknowledged as a significant force in developing cryptocurrencies. Blockchain technology's decentralized security and nature allow for transparent and tamper-resistant transactions, fostering peer-to-peer interactions and improving confidence in the Bitcoin ecosystem. Furthermore, consensus techniques like Proof-of-Work and Proof-of-Stake guarantee the integrity and consensus of transactions inside the network (Nakamoto, 2008; Buterin, 2014). The scalability issues posed by cryptocurrencies are addressed through scaling solutions, such as layer-two protocols and off-chain transactions, which enable higher transaction throughput and efficiency (Poon & Dryja, 2016). Additionally, the addition of smart contracts and programmable features has increased the potential of cryptocurrencies, encouraging the creation of decentralized apps. These technological developments improve the usability and usefulness of cryptocurrencies and help them gain popularity and remain viable over time. The landscape of digital currencies and their potential impact on financial systems and industries are thus shaped by technological factors, including blockchain technology, consensus mechanisms, scalability solutions, and innovative contract capabilities (Sagheer, et al., 2022).

2.2. Behavioral intention and cryptocurrencies

Many researchers have connected the behavioral intention of customers to adopt new technology to perceived factors in terms of ease of use and usefulness (Saadé & Bahli, 2005; Daud et al., 2018). Schaupp and Festa (2018) argue that perceived behavioral characteristics are the most important considerations when selecting cryptocurrencies for

electronic payments. People are more likely to use cryptocurrencies if they think they are easy. Shahzad et al. (2021) show that perceived factors significantly impact people's intentions to use cryptocurrencies. Therefore, it is crucial to consider these aspects for subsequent investigations (Mendoza et al., 2018). One of the leading forces influencing the development of cryptocurrencies is user adoption and demand. Furthermore, Yermack (2019) indicates that cryptocurrencies' development is aided by their capacity to address issues with financial inclusion and offer safe and practical payment methods. The behavioral intention was extended to the effect of social networks, knowledge, and awareness in promoting the adoption of cryptocurrencies (Böhme et al., 2015; Wang et al., 2020).

Matkovsky and Jalan (2019) indicated that a decline in equities markets was to blame for a drop of roughly 7% in Bitcoin prices. Ether, Litecoin, and the Bloomberg Galaxy Crypto Index all saw declines of roughly 10%, 11%, and 13%, respectively. Moreover, Umar et al. (2020) examined the integration between significant stock markets and cryptocurrencies, shedding insight into the qualities that differ internationally. Therefore, a hypothesis can be developed as follows.

H1: "There is a significant relationship between volatility of cryptocurrencies 'returns and volatility of stock market indexes."

2.3. Interest rates, inflation rates, and stock returns

The volatility of stock returns is an intrinsic factor that investors try to price, making benefits out of it (Hussainey et al., 2011). Birbil et al. (2009) state that the two main approaches for risk quantification are identified as the function of the deviation from a predictable value or as the function of absolute loss. Extended literature utilized the benefits of using VaR to quantify asset volatility. VaR considers the conventional standard deviation as a measure of risk in addition to a specific confidence interval. When using standard deviation as a measure of risk, it is assumed that all stocks' returns are symmetrical or have a bell-shaped curve, which is, in reality, very rare to occur; most stock returns are either skewed negatively or positively. Righi (2019) proved that using standard deviation as a measure of risk leads to the conclusion that it is unreliable when the investor aims to avoid risk. VaR extends the benefits of standard deviation, considering a confidence interval. Although there is no general economic solution or formal framework that variance was given as a risk proxy in terms of economic utility, the perception behind variance as a fundamental statistical concept makes its use easy (Fallon & Sabogal, 2004; Subing et al., 107).

Various studies have studied the relation between macroeconomic variables, financial stability, and the development of cryptocurrencies. Research has shown how economic conditions and financial crises influence interest in and acceptance of cryptocurrencies as substitutes for traditional forms of asset storage. For instance, Cheah et al. (2015) discovered evidence of an association between the demand for cryptocurrency and macroeconomic variables, including inflation and economic ambiguity. Similarly, (Dyhrberg, 2016) showed a positive association between Bitcoin returns and market volatility, indicating that cryptocurrencies might act as a safety net during periods of financial instability. Other significant elements driving the development of cryptocurrencies include trading volumes, liquidity, and the accessibility of cryptocurrency exchanges. The effect of Bitcoin exchange activity on its price and liquidity was explored by Grinberg (2011), who emphasized the significance of a solid exchange infrastructure. When Glaser et al. (2014) looked at why people use Bitcoin, they discovered that exchange functionality and liquidity were fundamental factors in adoption.

2.3.1. Interest rates

Hung et al. (2019) and Uddin et al. (2013) conclude that short-term interest rates hurt stock prices. However, Pantow et al. (2010) and Subing's (2017) study show that an increase in interest rates would make investors withdraw their money from stocks and

move it to deposits, which shows a negative relationship between increases in interest rates and stock prices. Udin and Mahmudul (2010) concluded that interest rates have a significant negative relationship with stock prices.

H2: "There is a negative and significant relationship between interest rates and volatility of equity index returns."

2.3.2. Inflation Rate

Several studies examined the effect of inflation on stock prices (Sathyanarayana & Gargesa, 2018). Rjoub (2011) tested the impact of inflation on stock returns in five MENA countries, concluding that unexpected inflation hurts stock market returns. Ahmad et al. (2011) showed a negative significant relationship between inflation and stock market returns. Murithi (2016) concludes that inflation is a good factor in explaining stock returns.

H3: "There is a negative and significant relationship between inflation rates and volatility of equity index returns."

3. Data and methods

This paper examines the relationship between the risks of the top 4 cryptocurrencies and three stock market indexes in Egypt. The authors use the Generalized Method of Moments (GMM) on cross-section time series panel data. Using GMM is justified by violating two assumptions: linearity and homoskedasticity. The risk is quantified using the $VaR_{99\%}$ that follows:

$$\text{VaR} = z_\alpha \times \sigma \times \sqrt{t}\,, \qquad (1)$$

where z_α one tail confidence interval 99% for standardized normal distribution; σ = standard deviation of the variable under consideration; t = holding period. This paper calculates VaR as time-varying for a window of 5 trading days being rolled down over the respective time horizon from January 2020 to January 2023.

In the early 1980's, the major US banks used the VaR as a methodology for market risk measurement in absolute (monetary) terms. As a result of the negative impact caused by the major international financial crisis in the 1990s on major financial institutions of the world, the Basle Committee further reinforced this methodology on Banking Supervision (Jorion, 2002). "VaR summarizes the worst expected loss over a target horizon within a given confidence interval" (Jorion, 1996). Linsmeier and Pearson (1996) also defined VaR as a measure of the downside risk and the chance to lose more than the amounts indicated by the measure is very low, as it depends on the confidence level used to calculate the VaR over a certain period (Berkelaar, 2002). Nevertheless, Shaik and Padmakumari (2022) conclude that using VaR in investment bank firms and significant banking corporations to mitigate risks has shown poor performance when used in periods of crisis. Bali et al. (2004) conclude that VaR can seize significant time-series variation in stock returns. Nevertheless, Fallon and Sabogal (2004) conclude that VaR and Coefficient of Variation (CV) were not statistically significant in the Colombian Market being characterized by thin trading.

3.1. Data

The author uses daily returns on cryptocurrencies and stock market indexes from Jan 2020 to Jan 2023. The data is available at investing.com.

3.2. Dependent variables

Three dependent variables are examined, including the daily returns for the three main indexes in Egypt, namely EGX30, EX70, and EGX100. These indexes play a vital role in the Egypt Stock Exchange. The evolution of the three indexes can be outlined as follows. The EGX30 was established in February 2003. This index includes the top 30 firms in terms of liquidity and activity. The adjusted free-floated market capitalization weights this Index. EGX100 was established in March 2009, and it is a price index offering more

diversification than EGX30. The Egyptian Exchange extended EGX70 to a broader price-based index, which EGX 100 was established in August 2009. EGX 100 includes the 100 active firms that combine those listed in EGX30 and EX70. The EGX 100 index considers closing prices without being weighted by the market capitalization.

3.3. Independent variables

- **Bitcoin (CR1):** Bitcoin is a decentralized digital currency that permits direct transactions between users without using intermediaries. The volatility of Bitcoin is one of the most significant hazards of investing in it (Nakamoto, 2008; Abrol, 2023). The market may be very unpredictable, and the price of Bitcoin can change drastically. Bitcoin's popularity has grown, becoming a viable investment alternative for many people. Bitcoin's current price is around $27,747, with a market capitalization of more than $535 billion as of March 2023, ranking it first in the top 10 cryptocurrencies.
- **Ethereum (CR2):** Ethereum is a Decentralized Blockchain platform, so no single entity has power over it. Because of its decentralization, the platform is safe and impervious to hacking, censorship, and other types of intervention. Because of this, Ethereum is the perfect platform for companies and people who value security and anonymity (Abrol, 2023). At this time, Ethereum has a market cap of more than $215 billion.
- **Binance (CR3):** The coin was introduced as a component of Binance's native Blockchain ecosystem, one of the biggest cryptocurrency exchanges in the world. One of the most well-known and valued cryptocurrencies. It was created by a known businessman in the blockchain -Changoeng Zhao- in 2017. Binance has a sophisticated trading platform and a user-friendly design. Intervention by the regulatory authorities is one of the primary concerns connected to Binance Coin. Regulators like the SEC (Securities and Exchange Commission) and FCA have started acting against cryptocurrency exchanges and businesses that break the rules, as we have seen in the past. After regulatory involvement in February 2023, Binance Coin dropped to its lowest level since mid-January. According to Forbes, regulatory worries caused Binance Coin's value to drop roughly 20% in 24 hours. This demonstrates investors' need to be abreast of regulatory changes in the cryptocurrency sector. (Abrol, 2023).
- **XRP (CR4):** Chris Larsen and Jed McCaleb formed the financial business Ripple Labs, which introduced XRP in 2012. Initially known as Open Coin, Ripple Labs sought to develop a decentralized payment system. The original version of Ripple was developed in 2004 by businessman and software engineer Ryan Fugger; it was then rebranded as XRP. With a market capitalization of over $21 billion, XRP is currently among the most widely used digital currencies. Financial institutions worldwide, like Santander, Standard Chartered, and American Express, use it, and it is consistently rated among the top 10 cryptocurrencies by market cap. The descriptive statistics of the dependent and independent variables are reported in the appendix.

3.4. Control variables

This paper includes the daily interest rates (as disclosed by the Central Bank of Egypt) and monthly inflation rates as control variables. The latter is converted into approximate daily estimates as follows.

$$\mathrm{Inf_M} = (\mathrm{Inf_d} + 1)^{30} - 1 \qquad (2)$$

Infm are the monthly inflation rates (as disclosed by the Central Bank of Egypt), and *Infd* are the daily inflation rates. The latter is obtained by rearranging equation (2) and the continuous compound (natural log) transformation.

$$\mathrm{Inf_d} = \mathrm{e}^{\frac{\ln(\mathrm{Inf_M}+1)}{30}} - 1 \qquad (3)$$

4. Results and discussion

This section discusses the results of regressing the VaR for four cryptocurrencies on the VaR of three different stock market indexes. The results are reported in Table 1. The dependent variables are the VaR of daily stock returns for three indexes, namely EGX30, EGX70, and EGX100. The independent variables are the VaR of daily returns for four common cryptocurrencies. Random vs. Fixed Effects are examined using the Hausman specification test (Hausman, 1978; Hausman & Taylor, 1981) under the following hypotheses.

$$H_0{:}\mathrm{cov}(x_{it}, \lambda_k) = 0; \qquad H_1{:}\mathrm{cov}(x_{it}, \lambda_k) \neq 0. \qquad (4)$$

The results [EGX30; χ^2 (4) = 2.35, Prob. = 0.6716); EGX70 (χ^2 (4) = 1.18; Prob. = 0.8813); EGX100(χ^2 (4) = 1.41; Prob. = 0.8424)] show that the best model for fitting both models is random effect model as the p-value associated with the tests is more than 5%. The linearity vs. nonlinearity Test is carried out using the Regression Equation Specification Error Test RESET (Ramsey, 1969; Thursby & Schmidt, 1977; Thursby, 1979; Sapra, 2005; Wooldridge, 2006) is employed to test the two hypotheses that follow.

$$H_0{:}\, \hat{\gamma}^2, \hat{\gamma}^3 = 0; \qquad H_1{:}\, \hat{\gamma}^2, \hat{\gamma}^3 \neq 0. \qquad (5)$$

The results [EGX 30: F(1, 1096) = 0.9851, Prob > F = 0.3211); EGX 70 (F(1, 1096) = 0.7452, Prob > F = 0.3881; EGX 100 (F(1, 1096) = 0.6549, Prob > F = 0.4185] show that the linear model fits the data. Heteroskedasticity is examined using the Breusch-Pagan/ Cook-Weisberg test. The results [EGX30 χ^2 (1) = 261.11, Prob > chi2 = 0.0000; EGX70 χ^2 (1) = 274.57, Prob > chi2 = 0.0000; EGX100, Prob > chi2 = 0.0000] show that the data is heteroskedastic, which requires the use of robust estimation. Multicollinearity is examined using the Variance Inflation Factor (VIF). The results show that cryptocurrencies across the three main indexes are associated with VIF less than or close to 5 (Appendix B).

The results in Table 1 show that the negative relationship between cryptocurrency volatility and index volatility is supported by previous literature that suggests using cryptocurrency as a hedging tool against the stock market. These results can be explained through previous findings, such as Just and Echaust (2024), concluding that cryptocurrencies can be used as a hedging tool to decrease the overall risk for a stock portfolio. In addition, other studies found that the price of Bitcoin increased during times of economic or financial turmoil (Blundell-Wignall, 2014; Urban, 2017), implying that Bitcoin could be used as a hedging tool. Mariana et al. (2020) and Melki & Nefzi (2022) show that, while cryptocurrencies exhibit a haven, Ethereum appears to be better than Bitcoin.

During the COVID-19 crisis, the relationship dynamics between stock market returns and crypto returns are changing in the short and long run. Dash and Ripple have been discovered to be a long-term haven for all five markets. During the financial crisis, however, cryptocurrencies have shown a sustainable haven for three emerging markets: the BVSP, SSE, and RTSI (Jeribi et al., 2021). In addition, Stensås et al. (2019) argue that cryptocurrencies protect investors against downturns in the equity and commodity markets. As a result, in times of extreme uncertainty, investors with exposure to equity and commodities may benefit from holding Bitcoin.

Corbet et al. (2019) explored the dynamic relationships between cryptocurrencies (Bitcoin et al.), showing that cryptocurrencies may offer diversification benefits for investors with short investment horizons. Moreover, the effects of geopolitical risks on Bitcoin returns and volatility have been analyzed by Aysan et al. (2019), Abdelmalek and Benlagha (2022), Bouri et al. (2021), and Chemkha (2021), showing that Bitcoin can be considered a hedging tool against global geopolitical risks.

Table 1. The effect of cryptocurrency VaR99% on stock market indexes

Variables	EGX30 Daily Returns	EGX70 Daily Returns	EGX100 Daily Returns
Constant	0.1654 *(0.984)*	0.328 *(2.594)***	0.296 *(0.7826)*
Cryptocurrency	-0.742 *(-3.674)***	-0.796 *(-2.632)***	-0.985 *(-2.784)***
Ethereum	-0.7863 *(-0.7843)*	-0.673 *(-1.133)*	-0.349 *(-1.0082)*
Cardano	0.7849 *(2.662)***	0.7522 *(1.983)**	0.3891 *(2.636)***
Binance	-0.7818 *(-4.863)****	-0.742 (-2.436)***	-0.6634 *(-2.7731)***
Inflation	2.964 *(5.741)****	3.632 *(6.161)****	3.673 *(5.341)****
Interest Rate	-0.682 *(-9.743)****	-0.682 *(-9.743)****	-0.682 *(-9.743)****
Time (Days)	Yes	Yes	Yes
Observations	1096	1096	1096
$\overline{R}^2$	0.411	0.572	0.499
F Stat	23.14***	134.72***	156.95***

*** Significant at 1%; ** Significant at 5%

4.1. Testing for Structural Break and Robustness

It is worth noting that structural economic events can interrupt the benefits of investing in cryptocurrencies and stock market indexes. In this sense, the Egyptian economy witnessed a significant EGP currency devaluation on 27 October 2022. Therefore, it is necessary to examine the extent to which this structural break has affected the relationship between the riskiness of cryptocurrencies and stock market indexes. The Chow (1960) test is employed, and the results are reported in Table 2.

Table 2. Testing the significance of the EGP devaluation on 27th October 2022 on major stock market indexes

	Chow Breakpoint Test: 27th October 2022		
Indexes	F-Statistic	Log Likelihood Ratio	Wald Statistic
EGX 30	2.57812**	12.95298**	12.8906**
EGX 70	1.711	8.625	8.559
EGX 100	1.999*	10.06452*	9.99652*

The asterisks ** and * denote significance at the significance at 5% and 10% levels, respectively.

The results in Table 2 show that only two indexes (EGX30 and EGX100) were affected by the EGP devaluation, while EGX70 was not affected, although the latter is as equally weighted as the EGX100. These results can be considered a straight test for robustness. The results show that the relationship between the volatility of cryptocurrencies and stock market indexes is contingent. That is, it is impossible to draw general implications about the effects of the volatility of cryptocurrencies on the volatility of stock market indexes.

5. Conclusion

This paper examined the effect of the top four cryptocurrencies' volatility on the volatility of the three main indexes in Egypt's stock exchange. The data covers daily returns for three years, from January 2020 to January 2023. Riskiness is quantified using $VaR_{99\%}$ for

the returns of the cryptocurrencies and stock market indexes. The general results reveal a negative association between the volatility of cryptocurrencies and the volatility of the returns of the stock market indexes. These results carry empirical implications that the volatility of cryptocurrencies deter their trading but trade more frequently the equity indexes. A further implication can be extended: investments in the cryptocurrencies examined in this paper and the stock market indexes are different asset classes. That is, the two asset classes can be combined in a single fund that, in this case, reflects the benefits of diversification. The latter is warranted under the condition that no structural breaks intervene. Nevertheless, the results of a robustness test reveal that the effects of the volatility of cryptocurrencies on stock market volatility are contingent.

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Appendix

Table (A). Descriptive Statistics

	EGX 30	*EGX 70*	*EGX 100 EWI*	*Binance USD*	*Cardano*	*Ethereum*	*Bitcoin*
Mean	0.00028	0.00131	0.00109	5.4E-07	0.00688	0.00585	0.00326
Median	0.00055	0.00345	0.0031	0	0.0034	0.0046	0.0023
Mode	0.0015	0.0065	0.004	0	0	-0.0153	0.0142
Skewness	-0.5865	-1.1353	-1.1101	1.18152	0.31735	-0.6129	-0.9597
Range	0.1526	0.1374	0.1228	0.0091	0.7472	0.7051	0.5859
Minimum	-0.0934	-0.0902	-0.0789	-0.0042	-0.4149	-0.4455	-0.3918
Maximum	0.0592	0.0472	0.0439	0.0049	0.3323	0.2596	0.1941
Count	1096	1096	1096	1096	1096	1096	1096

Table (B). The Results for the Multicollinearity test (Variance Inflation Factor, VIF)

Variable	EGX30	EGX70	EGX100
Cryptocurrency	2.321	3.461	4.561
Ethereum	3.782	2.442	3.983
Cardano	4.481	3.981	5.372
Binance	3.771	4.561	4.946

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