MASTER OF MANAGEMENTS IN FINANCE AND INVESTMENTS

HEDGING EFFECTIVENESS OF CRYPTOCURRENCIES IN AFRICAN STOCK MARKETS

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Table of Contents

Abstract

The aim of this paper is twofold: first, to examine the hedging effectiveness of bitcoin for the biggest 7 African stock markets in bullish and bearish market conditions. Second, to contrast cryptocurrency to gold as a safe haven asset. To end, daily data from 2018 to 2022 were employed in an Autoregressive Distributive Lag (ARDL) framework. The findings have significant implications for investors, financial intermediaries and regulators.

1. Introduction:

1.1 Background

Cryptocurrency was established in 2009 post the Global Financial Crisis. Bitcoin was the first currency introduced and remains the most popular digital currency. Alternative cryptocurrencies were introduced subsequently and have grown in adoption namely, Ethereum and Ripple. In the past decade, the number of coins in circulation surpassed 1000 (Borgards & Czudaj, 2020). The spread of cryptocurrencies and blockchain related instruments such as tokens have experienced a global boom, with a peak total market value of $3 trillion in 2021 (Gambarelli, Marchi, & Muzzioli, 2023).

Portfolio risk diversification is one of the primary goals for investors and portfolio managers. Modern portfolio theory suggests that risk reduction is achieved by allocating funds to assets that have a low or negative correlations (Markowitz, 1952). The low correlations between cryptocurrencies and African stock markets can be explained by their different underlying fundamentals (Małgorzata & Echaust, 2024). Cryptocurrencies are blockchain related instruments with different price drivers. The inclusion of cryptocurrencies from an African investors' perspective, can expand on modern portfolio theory by shifting the portfolio investment frontier leftward, allowing investors to utilise higher returns for lower risk levels. Cryptocurrency has been compared to gold in some cases, in the sense that it might be considered as a safe store of value even in cases of economic distress (Baur & Hoang, 2021). In theory, cryptocurrency serves as a successful hedge when returns are negatively correlated with stock market returns during a market downturn.

Cryptocurrencies are suitable as a stock market hedge due to limited supply caused by its computational nature and is likely to show price robustness during bullish conditions (Sakurai & Kurosaki, 2023). Cryptocurrencies hedging ability is also reinforced through its absence of intermediaries and negligible counterparty risk boosting liquidity to the African investor

(Ahluwalia, Mahto, & Guerrero, 2020). The drivers of cryptocurrency prices are dissimilar compared to its traditional financial asset counterparts. Similar to gold, cryptocurrency prices are independent of the traditional banking system and lie outside the confines of sovereign politics and economics. This sparked interest in the literature to further investigate its hedging ability (Selmi, Mensi, Hammoudeh, & Bouoiyour, 2018).

Counterarguments against cryptocurrencies as a stock market hedge are that the values of major currencies are too volatile (Sakurai & Kurosaki, 2023). From an African investors' perspective, additional volatility may require diversification. Additional sources of fluctuations in cryptocurrencies are the high energy and power requirements needed to sustain the computer systems and servers to mine the units. Such energy requirements place strain not only on the cryptocurrency market, but real and international economies as a whole (Rehman & Vo, 2020). The inclusion of cryptocurrencies as a safe haven hedge brings rise to other issues such as cybercrimes and legal disorientation (Corbet, Meegan, Larkin, Lucey, & Yarovaya, 2018). African investors face other risks such as high inflation and poor banking infrastructure and hence it may be unrealistic for investors to take on additional risk sources (Kumah & Mensah, 2021).

The African demographic faces many socio-economic issues such as poverty, weak education systems and absence of technical skills (Adamolekun, Sakariyahu, Lawal, & Ahmed, 2023). Despite this Sousa (2019), shows that African investors have increased the incorporation of cryptocurrencies by 130% since 2018. This rise in adoption shows that African investors are willing to adopt cryptocurrencies to expand their portfolio endeavors.

The quest for an alternative safe-haven or hedging instrument in Africa is intensified during periods of economic distress. During the COVID-19 pandemic, global output plummeted thrice as much as the global financial crisis of 2007/2008 in half the time. As a result, financial markets globally experienced a shock. However, due to the under-development of African stock markets, the adverse impacts of the pandemic may persist even during economic recovery, while the impact on developed economies may be short lived. The pandemic introduced lockdowns, which constrained the movements of goods and people, disrupting supply chains globally. A critical source of revenue and stock market growth in African economies is linked to international trade. The restrictions imposed by the pandemic brought about a drop in financial performance due to business restructuring (Insaidoo, Ullah,

Dziwornu, Amoako, & Abdul-Mumuni, 2023). African investors as a result should look to cryptocurrencies as form of revenue generation during distressed periods.

Cryptocurrencies were developed as a medium of transaction governed by participants and not by third parties such as governments (Umar, Shahzad, Ullah, & Fanghua, 2023). The cryptocurrency market has emerged as a risk management tool for investors during times of elevated uncertainty due to its price robustness. During periods of economic distress, disinvestment occurred in the Chinese stock market, leading to investors pooling funds into cryptocurrencies. Emerging economies such as China have shown that during the COVID-19 pandemic when stock market prices were depressed, there is capacity for investors to hedge poor stock market performance through cryptocurrencies (Akhtaruzzaman, Boubaker, & Sensoy, 2021). Given that the pandemic had an equal impact on African stock markets, testing whether cryptocurrencies will provide a hedge for African investors will expand on this pool of knowledge.

The exporting of natural commodities drives growth in the African economies (Naeem, Agyemang, Chowdhury, Hasan, & Shahzad, 2022). The impact of the COVID-19 pandemic led to a depression of commodity prices due to reduced demand and excess supply. African economies rely heavily on developed counterparts as a source of international trade and Foreign Direct Investment and market integration (Bello, Guo, & Newaz, 2022). Cryptocurrencies provides investors with a source of revenues during a crisis.

The Russia-Ukraine war has led to natural resource scarcity globally. The crises have intensified in African markets increasing uncertainty and making asset allocation more difficult (Mensi, Vinh Vo , & Hoon Kang, 2023). Cryptocurrencies function independently of geopolitical events and can be used as a way for investors to protect themselves against excess natural resource volatility (Bello, Guo, & Newaz, 2022).

1.2 The research problem:

Africa possesses its own economic problems such as currency volatility, high inflation rates and poor banking infrastructure (Kumah & Mensah, 2021). Macroeconomic issues combined with the lack of availability of information have led to a neglect of African markets by researchers. The fragile banking infrastructure provides an opportunity for investors to

incorporate blockchain related instruments into their portfolios. African markets are undergoing stock market reforms pioneered by the African Monetary Union (AMU). The initiatives imposed by the AMU seek to reduce restrictions on foreign investment income repatriation. The AMU also seeks to improve the regulatory environment, increasing transparency and foreign investment flows into the region. France contributed 74% of the total foreign direct investment (FDI) into the Morocco stock market in 2011. The United States contributed 42% of Egypt's FDI into the stock market in 2012. The United States also contributed 59% of South Africa's FDI into the stock market in the same year (Naeem, Agyemang, Chowdhury, Hasan, & Shahzad, 2022).

Most African markets are primarily commodity exporters in contrast to the developed counterparts. More specifically, African markets export raw, unrefined commodities resulting in a risk exposure to fluctuating commodity prices. Additionally, African stock markets are likely to have large resource-based shares listed on their respective exchanges. Thus, a depreciation in commodity prices is likely to spill-over into the equity returns. (Naeem, Agyemang, Chowdhury, Hasan, & Shahzad, 2022). In the short term, cryptocurrencies have shown a price robustness during depressed commodity prices (Kyriasiz, 2020).

Studying whether Bitcoin and other cryptocurrencies provides a hedge and safe haven characteristics is especially meaningful during times of widespread financial crisis or economic turmoil. The recent COVID-19 pandemic and the Russia-Ukranian War (geopolitical emergencies) have affected stock prices. The COVID-19 pandemic led to a lockdown that restricted the movement of people and resulted in lower economic activity. Both crises led to financial difficulties for many markets around the world. Russia and Ukraine produce and export natural gas and special foods in large quantities. This conflict has led to a reduction in supply of conventional sources of energy leading to lower output and stock market returns throughout the world (Kumar , Reetika, Balli, & Billah, 2023). The volatility spill-over to commodity prices was higher during the war than the pandemic (Wang , Bouri , Fareed , & Dai, 2022). Naeem et al (2022), showed that African economies primary source of revenue arises through the exporting of commodities. African investors in the stock market are likely to bear additional volatility spillovers because of the war.

According to the Office of Financial Research in the United States (US), the financial stress index has been above zero since February 2022 (Xu & Kinkyo, 2023). This indicates that

geopolitical uncertainty is increasing volatility in global financial markets, making it essential for policymakers and investors to analyse risk and optimize their portfolios. While economic and financial fundamentals mainly drive traditional asset classes such as stocks, cryptocurrencies are essentially technological assets. Cryptocurrencies therefore poses as a significant contender to hedge investors risk during bullish environments. Studies involving the hedging abilities of cryptocurrencies around the COVID-19 pandemic and Russian-Ukranian War's in an African context is scarce. Due to poor stock market development in Africa, African investors are likely to diversify internationally in other developed market stock exchanges. Thus, investors are still exposed to sovereign and international market risks.

Evidence suggests that gold acts as both a hedge and, a safe haven for equity markets, especially during crisis periods. During the 2008/2009 global financial crisis, equity prices were at a depressed level, while the price of gold hit new highs (Beckmann, Berger, & Czudaj, 2015). This research seeks to extend the literature on the hedging and diversification qualities of cryptocurrencies in emerging African economies. Given that markets are likely to behave symmetrically during bullish conditions, the adoption of cryptocurrencies can reduce volatility in the short term. Due to its government and economic independence, cryptocurrencies have been compared to as "digital gold" (Sakurai & Kurosaki, 2023). Research on African markets has been conducted from a trading and speculative standpoint. The majority of studies conducted test the potential hedging ability of cryptocurrencies in developed economies with limited attention on developing African economies.

1.3 Research Objectives:

The aims of this research paper are twofold.

1. How to cryptocurrencies perform as hedging instruments in African stock markets?
2. What are the implications of cryptocurrency hedging strategies for portfolio risk management in an African context?

1.4 Importance and Benefits of the study:

Researchers have established that African investors have slowly adopted cryptocurrency into their portfolios. Given the strong correlation with stock markets and the volatile nature of traditional African currencies, cryptocurrencies pose as an attractive asset to hedge against stock market exposures.

The study expands on the pool of knowledge of alternative asset hedging strategies. It would be beneficial for investors to examine the hedging ability of cryptocurrencies in comparison to gold. African stock market underdevelopment means that shocks and bullish periods are likely to persist compared to the developed countries. Thus, investors are likely to face longer periods of distress.

1.5 Study Outline:

This research report will proceed with the literature review in Section 2, which discusses the past research conducted around the hedging ability of gold for various exposures and contrasting cryptocurrencies to gold as a safe haven asset. Thereafter the Methodology in Section 3 will discuss the Autoregressive Distributive Lag (ARDL) model employed. Section 4 discusses the results section. Finally, Section 5 is the conclusion.

1. Literature review

One established empirical concept, well defined in the literature, is that international diversification can generate substantial risk-return benefits for international investors. However, literature, largely suggests that stock market correlations are increasing over time (Frijns, Verschoor, & Zwubjeks, 2017). These correlations can be attributed to political, economic, and financial integration. The rapid growth in globalization suggests that profits are likely to influenced by global determinants (Frijns, Verschoor, & Zwubjeks, 2017). Financial market correlation and integration reduces diversification opportunities. Decisions made by policymakers can significantly impact others if market integration is present (Mensah & Premaratne, 2017). A substantial body of literature has emerged on the integration of African stock markets with global stock markets and other markets such as the commodity and the foreign exchange market. As a result, there are serious implication on asset pricing, risk reduction and diversification benefits (Mensah & Alagidede, 2017). Given that African stock markets are likely to mirror the behaviour of their global counterparts, international stock market diversification provides investors with little protection during bullish events. Alternative asset classes should provide investors with protection during market distress.

2.1 International Diversification and stock market correlations

African stock indices have high correlations with their global counterparts (Frijns, Verschoor, & Zwubjeks, 2017). Despite this, evidence suggests that stock market diversification is possible as a result of heterogenous segmentation between different industries. Investors should earn abnormal returns relative to the global asset pricing model by investing through industries indices. In addition, the international diversification potential of industries does not vanish through bullish conditions. The authors demonstrate this by using a global asset model and showing that investors can earn a significantly higher alpha by diversifying internationally in other industries outside the stock market. Thus, country diversification is far less superior than industry diversification. The authors also conclude that investors can obtain more efficient diversification by investing in segmented industries as part of their global portfolios (Umutlu, Yargı, & Zaremba, 2023). African stock markets movements mirror their global counterparts and international stock market diversification is unable to safeguard value. This research seeks to expand on this literature by examining cryptocurrencies as a potential store of value during different market conditions.

Mensi, Vo and Kang (2023) examined the relationship between spillovers and connectedness between oil and African stock markets under bearish, normal and bullish conditions. The authors employed the quantile connectedness model and showed that there are higher spill-over effect during bearish market conditions than any other time. The authors found that there was a maximum spillover effects from oil to the African stock market during the COVID-19 pandemic. The evidence from this paper suggests that the stock markets are subjects to movements in the oil price and thus cannot be the only source of diversification for investors. The authors disproved oil as a hedge against stock market movements. This research seeks to contribute to the pool of knowledge that tests whether alternative asset classes can provide African investors with safe-haven opportunities.

Bello, Guo and Newaz (2022) studied the effects of economic stress periods on the African stock markets. The authors use dynamic conditional correlations during the global financial crisis, BREXIT, the European debt crisis and the COVID-19 pandemic. During these periods of financial distress African stock markets exhibited high levels of correlation resulting in increased country-specific risk for the respective countries. The authors examined periods of relevance to the current study. International stock market diversification is unable to preserve the value of African investment practitioners. This research fills this gap by introducing cryptocurrencies as an expansion of portfolios.

2.2 Gold as a safe haven asset

Globalisation has grown to become a popular strategy in the modern era, gold has been frequently known to be uncorrelated with other assets. Gold can be referred to as a zero-beta asset, with little or no movement patterns to global stock markets. This makes gold is an ideal asset to hedge portfolio exposures. In contrast to other commodities, gold is seen to be durable, a stable store or value and well recognized in the market (Baur, 2013). The robustness of gold as a hedging tool has proved itself a worthy benchmark for all potential alternative safe haven assets.

2.1.1 Equity and Bond Market

Baur and Lacey (2010) clearly defined and tested the hedging ability of gold in reducing the stock and bond risk exposure. The definition formulated by the authors state that a hedge

(safe haven) is an asset that is uncorrelated or negatively correlated with another asset or portfolio during market stress or turmoil. An asset that does not exhibits an unrelated movement (0 correlation) is referred to as a diversifier. The study focused on the constant and time-varying frequency of the stock and bond market between the United Kingdom (UK), United States (US) and Germany. The period under investigation was 30 November 1995 to 30 November 2005. The study compared the MSCI stock and bond returns for the respective countries to gold over the period. The authors computed the coefficients for both a bullish and bearish period using an ordinary least squared (OLS) regression model. The coefficients indicated that gold was only able to provide a hedge for stocks during periods of heavy negative stock market shocks. Gold provided no protection for bonds in all three countries. The results showed that gold provided a hedge for stocks in the short term. Investors were only able to realise gold returns 15 days after the shock, subsequently, gold yielded no superior returns.

Baur and McDermott (2010), applied a related approach to test whether gold is a strong or weak hedge against stocks of major emerging and developing economies. The authors regressed gold returns on stock returns of various developed and emerging economies. To further refine the hypothesis, the authors apply confidence intervals of 90%, 95% and 99%. The authors used daily, weekly, and monthly data for the sample period 1979-2009. The results showed that gold did not act as a hedge for emerging economies and countries such as Australia, Canada and Japan. The authors classified extreme economic downturns as a large difference between average and actual stock returns. However, gold successfully acted as safe haven against daily extreme economic downturns for the United States and the United Kingdom.

2.1.2 Exchange rates

Ciner, Gurdgiev and Lucey (2013), investigated the United States (US) dollar fluctuations as a result of a movement in major asset classes in the United States (US) and the United Kingdom (UK). The authors expanded the selection beyond equities, and included bonds, oil and other currencies. The authors first conducted the conditional correlations test to determine if the assets can be used as a hedge for each other. Further, the authors then employed a quantile regression to determine whether there is a statistical difference between the asset classes during the extreme market conditions. The analysis determined whether gold

can be used as a hedge during exchange rate fluctuations. The results showed that gold provided investors with protection against exchange rate fluctuations, emphasing the role of gold as a monetary hedging tool.

2.2 Cryptocurrencies as an alternative asset

The recent addition to the pool of knowledge has been through alternative asset classes rather than traditional ones. Alternative asset classes are classified as blockchain derived, that recently make up a substantial portion of the global market capitalization. Blockchain investment technology comprises of plethora of cryptocurrencies. Cryptocurrencies resembles more of an equity investment rather than a fiat currency investment (Rehman & Vo, 2020).

2.2.1 Bitcoin:

Bitcoin is an emerging technological asset developed using blockchain. Bitcoin was the original cryptocurrency developed by Satoshi Nakamonto. Bitcoin has been widely accepted as a substitute for traditional currencies as a method of payment. In addition to its role in facilitating transactions, bitcoin possesses attractive properties from an asset allocation perspective. Bitcoin emerged during the aftermath of the global financial crisis in 2008 and has since been realized as an investment tool by researchers and practitioners. In times of financial distress, an asset that is uncorrelated with the market compensates for the loss caused by a price drop of other assets in the investment portfolio.

Li, Naqvi, Rizvi and Chang (2021), examined the hedging effectiveness of bitcoin from a portfolio optimisation perspective. The authors evaluated the role of bitcoin in an effort to boost portfolio efficiency that is risk-return trade-off. According to portfolio theory, the inclusion of bitcoin alongside other asset classes such as bonds, stocks, currencies leads to a leftward shift of the portfolio efficiency frontier and lowers unsystematic risk bourne by the investor. The results enforce this, by leading to a more concave and inclusive efficient frontier. Bitcoin only serves this purpose if short selling is permitted and is not sustainable in the medium or long term.

2.2.2 Commodities

A study conducted by Bouri, Shahzad, Roubaud, Kristoufek and Lucey (2020), compared the similarity or dissimilarity of gold to bitcoin and other commodities. Previous studies performed by Baur and Lacey (2010), stated that gold only provided protection in the short term. An asset is considered a hedge if it is uncorrelated with the market during the time of crisis. This statement is robust if it incorporates all time frequencies to capture heterogenous investment horizons. The authors built a wavelet analysis to test the diversification ability of the three assets (gold, bitcoin and commodities) with the stock index combining a Value-at-Risk (VaR) analysis. The crisis period under investigation was the Greece and Cypriot banking crisis. The authors results are congruent with the studies done by Baur and Lacey (2010), in stating that diversification benefits varies depending on the time frequency space. In this case, bitcoin proved to provide superior protection against stock market movements compared to gold and other commodities. Bitcoin provided protection against the Greek and Cypriot banking crisis while taking into account the heterogeneity in investors horizons.

Rehman and Vo (2020), examined the combination of cryptocurrencies in precious metal portfolios for investors to yield optimal returns. The relationship was examined through a correlation matrix using daily price data from March 2017 to August 2019. The authors then applied a cross spectural framework to investigate changing correlation patterns across quantile distributions over a short, medium and long term horizon. Additionally, the authors used a non-linear causality framework to determine spillover effects into other asset classes. The results showed that, in the short run, copper was the best diversifier with all cryptocurrencies. The medium and long term, precious metals showed extreme positive distributions are not integrated with the negative distributions of cryptocurrencies, indicating diversification is possible.

Bouri, Jalkh, Molnar and Roubaud (2017), studied the relationship between the prices of bitcoin and commodities around the bitcoin 2013 price crash. The authors focused on energy commodities, as energy commodities are key in maintaining the cryptocurrency infrastructure. Bitcoin proved to be a strong hedge and a safe haven against all commodity indices. During the bitcoin price plummet in 2013, bitcoin did not serve the same purpose as it did pre-crash. Post 2013, bitcoin simply serves as a diversifier, not a hedging instrument.

2.2.3 Additional Coins

Letho, Chelwa, and Alhassan (2021) documented the evidence to support diversification in a South African context. The authors demonstrated the benefits of cryptocurrencies using mean-variance tests, efficient frontier and risk-adjusted returns improvement. The authors broadend the foundation of knowledge brought about by Markowitz' Modern Portfolio Theory by utilising cryptocurrencies is emerging market portfolios. The paper utilised daily arithmetic returns of traditional asset classes such as stocks, bonds and currencies and alternative asset classes such as real estate and commodities. The paper employed a mean-variance analysis, the sharpe ratio and conditional value-at-risk (CoVAR). The study showed that cryptocurrencies provided a higher sharpe-ratio (higher return per unit risk) than traditional asset classes in a South African context. The authors also found CRIX, Bitcoin, Ethereum, Monero, Stellar, XRP, Litecoin, Tether, Dash, NEM and Dogecoin exhibited higher volatility compared to traditional asset classes. The traditional asset returns variables observed were the JSE All Share index, JSE Top 40 index, JSE Alternative Exchange index and South African government bonds while the alternative asset return variables consisted of JSE SA Listed Property, JSE SA Resources, gold, platinum, Brent Crude oil and the South African Rand. The returns on all cryptocurrencies are heavily skewed meaning that the risks increase sharply and decline gradually. This study illustrated that CRIX, Bitcoin, XRP, Ethereum, Dash, NEM, Stellar and Monero all individually improved the South African traditional and alternative investment portfolios whereas Litecoin, Dogecoin and Tether did not. Therefore, seven out of the ten cryptocurrencies and CRIX improved the South African traditional and alternative portfolios.

2.2.4 Crisis periods

The COVID-19 pandemic was declared a public health emergency of international concern by the World Health Organisation (WHO) on January 30, 2020. The pandemic infected more people than the SARS epidemic and the Ebola Virus. By July 2021, there was over 180 million cases with over 4 million recorded deaths worldwide. COVID-19 had adversely affected society and the global stock market. Global equity markets all experienced a similar continuous sharp decline followed by frequent fluctuations and slow recoveries. (Wu, Zhang, & Chen , 2022)

Wu, Zhang and Chen (2022), investigated the stock market tail risks caused by the COVID-19 pandemic and how it led to correlations among stock markets worldwide. The paper used the conditional autoregressive value at risk (CAViaR) model to test this phenomenon. The sample set involved 28 countries stock market. The results showed that the pandemic introduced several tail risks in most countries. The correlations between all countries stock markets intensified over the period of the pandemic. Risk was able to transfer from one market to the next. The increase in correlation and stock markets risk spillovers meant that investors were unable to diversify and protect their portfolio in international stock markets during the pandemic.

Stansas, Nygaard, Kyaw and Treepongkaruna (2019), categorised bitcoin as either a safe haven or diversifier during various periods of economic distress. The study focused on developed markets, emerging markets and includes portfolios of commodity stocks. The authors employed the GARCH dynamic conditional correlation (DCC) model. The sample set included 6 developed countries, 5 regional indices and 10 commodity series. Major economic events such as the US election, the BREXIT referendum in 2016 and the burst of the Chinese market bubble in 2015 were examined. During these periods, bitcoin protected all US and non US investors. Bitcoin proved to be a hedge for emerging economeies such as Brazil, Russia, India and South Korea, but only acts as a diversifier for developed and commodity counterparts.

2.2.4.1 Bitcoin vs Gold

Wen, Tong, and Ren (2022) compared gold to bitcoin as an asset of safe haven during the COVID-19 pandemic. The authors compared the dynamic spillover effects of the two potential safe havens to the oil and stock market. The time varying vector autoregressive model shows that, in-line with literature, gold provided sufficient safety for stocks and oil. Bitcoin, contrastingly was not found to be a safe haven for holders of stocks and oil. Moreover, the safe haven ability of gold intensified as the pandemic wore on. Gold showed a strong safe haven for stocks initially, and then exhibited correlations with the equity market, but proved to be a hedge for oil. Prior to the pandemic, bitcoin and gold proved to be safe havens. During the pandemic bitcoins protective ability fell away, while gold intensified as the pandemic wore on.

Al Nassar, Boubaker, Chiabi, and Makram (2022) investigated the hedging ability of several alternative investment assets including gold, bitcoin and oil. The studying aimed to test the hedging ability of these assets against movements in the Saudi Stock Market. The paper employed the same methodology as Stansas et al., (2019). The results were consistent with Wen et al., (2022) in the respect that gold provided the greatest protection as the pandemic progressed. The authors declared gold to be a flight-to-safety asset during the pandemic. The paper also reveals that both gold and oil served as feasible hedges during the early stages of the pandemic. The authors also stated the crisis period, bitcoin merely served as a diversifier rather than a hedging instrument.

Selmi, Mensi, Hammoudeh and Bouoiyour (2018), examined the role of bitcoin as a hedge for oil prices, in comparison to gold. The authors employed a quantile-on-quantile regression approach to test for independace between oil and bitcoin in comparison to gold, under different market conditions. The results showed that bitcoin and gold serve as a hedge against oil price movements. The results further confirmed that during US specific economic and political indicators, bitcoin, gold but not oil can provide investors with hedges. To add robustness, the authors employ the Conditional Value-at-Risk (CoVAR) to illustrate the downside risk reduction of the portfolio composing of gold and bitcoin.

2.3 Cryptocurrency as a hedging strategy

Cryptocurrency poses as an attractive hedge due to its unique underlying fundamentals compared to equities. Given the technological nature of the security, and its independence from sovereign politcs and economics further emphasises its need as a store of value against unfavourable stock market movements.

Gambarelli, Marchi, and Muzzioli (2023) tested the hedging effectiveness of cryptocurrencies in European stock markets during bullish and bearish periods. The authors also compared the hedging effectiveness of cryptocurrencies to gold. The authors utilized the Autoregressive Distributive Lag (ARDL) model due to its versatility and its ability to combine variables with different orders of integration. Versatility was emphasised as the model removes all endogeniety and autocorrelation amoung regressors and outpit variables. The authors used the Eurostoxx 50 index which covers the top 50 liquid blue chip stocks in eight eurozone countries. The authors found out that cryptocurrencies were able to provide short term

protection during bearish periods while gold showed resilance across all periods. The authors also recommended that gold and bitcoin used interchangably provided the greatest protection.

2. Data and Methodology

This section provides an overview of the analysis of the hedging effectiveness and asymetric correlations of cryptocurrencies and the African stock markets.

3.1 The Autoregressive Distributive Lag Model (ARDL)

The decision to use the Autoregressive Distributive Lag Model (ARDL) is based on two factors. Firstly, the ARDL is more flexible than other traditional econometric approaches such as cointegration and vector autoregression. The ARDL is able to categorise variables that have a different level of integration (Thampanya, Nasir, & Huynh, 2020). Secondly, the ARDL is able to deal with the endoginiety issue, that is, the correlation between the independant variable and the error term. Ignored hetrogeniety or explanatory variables can cause endoginiety leading to inaccurate results. The ARDL model properly addresses endoginiety issues by using an appropriate lag order (Ullah & Zaefarian , 2020). The ARDL model used in this study can be specified as followed:

$$yt = \alpha + \sum_{i=1}^{p} \gamma_i y_{t-i} + \sum_{j=1}^{k} \sum_{i=0}^{q_j} X_{j,t-i}\, \beta_{j,i} + \varepsilon_t \quad (1)$$

Where yt represents the returns of the African stock indices. Current and past values of the independent variables (in this case represents the returns of gold and cryptocurrencies) are represented by X_j . An ARDL is a least squared regression that includes lags of both the dependant and the independent variable. The number of lags of the dependant variable (African stock indices) is represented by *p,* while the returns of the independent variable is represented by q. Some of the explanatory variables may skip lagged terms, which are called fixed or static regressors. In the current model, cryptocurrency and gold returns act as dynamic regressors of the current value of the African stock market

3.1.1 Long run relationship:

The dynamic relationship between the African share price indices and the returns of cryptocurrencies and gold can estimated through an ARDL model and transformed into a long run relationship (Pesaran, 2001).

$$\theta_j = \sum_{i=1}^{j} \hat{\beta_{j,i}} / (1 - \sum_{i=1}^{j} y_i) \quad (2)$$

Where θ_j estimates long-run coefficients, indicating the dependant variable long run response to a change in the independent variable. Eq.2 represents the long run relationships between a movement in the African share price indices as a result of movements in gold and cryptocurrency prices.

3.1.2 The Bounds Test for a co integrating relationship:

Another important advantage of the ARDL model with respect to traditional econometric approaches its its ability to estimate a co integrating relationship without the need to specify the order or integration of variables. Unlike other variables, the ARDL representation does not need lag length symmetry, thus allowing for a different number of lags for each variable (Thampanya, Nasir, & Huynh, 2020). To test for cointegration we use the bounds testing approach within the ARDL framework (Adu & Marbuah, 2011). The Bounds test for a co-integrating regression of the ARDL model can be obtained by transforming Eq.(1) in terms of differences and replacing long-run coefficients from Eq.(2) as follows:

$$\Delta y_t = -\sum_{i=1}^{p-1} \gamma_{i*} \Delta y_{t-1} + \sum_{j=1}^{k} \sum_{i=0}^{q_{j-1}} \Delta X_{j,t-i}\, \beta_{j,i*} - \oslash^{E}\, C_{t-1} + \varepsilon_t \quad (3)$$

Where:

$EC_t = y_t - \alpha - \sum_{j=1} X_{j,t-i}\, \hat{\theta}_j$

$\oslash^{=} 1 - \sum_{i=1}^{p} r_i$

$\gamma_{i*} = \sum_{m=i+1}^{p} \gamma_m$

$\beta_{j,i*} = \sum_{qj} \beta_{j,m}$

Where ε_t is the disturbance term, which is assumed to have a zero mean, constance variance and zero correlation with the regressors. The coefficient of the African stock indices is expected to be negatively correlated with the returns of bitcoin in order for a suitable hedge to be achieved.

As discussed previously, the ARDL model is more flexible than other econometric approaches. However, positive and negative fluctuation of the independent variable have a symmetrical effect on the dependant variable. That is, changes in the returns of stock market returns will move bitcoin prices in the same direction. Most African stocks exhibit positive skewness with minimal countries showing negative skewness, indicating overall asymmetry. The kurtosis values signify leptokurtic market dynamics. This clarifies that all of the measured parameters diverge substantially from normality and that fat tails are evident.

The African markets chosen have shown a modestly higher yield on average compared to other African counterparts. Given that the 7 countries chosen are one of the largest exporters of minerals, the prices of these minerals have exhibited stability (Woode, Junior, & Adam, 2024).

3.3 The African dataset:

Very little emphasis is placed on African emerging markets due to the majority of studies focusing on the US and European-developed markets. To fill this gap, daily stock returns of 7 African countries (Ghana, Nigeria, Botswana, Egypt, Kenya, Morrocco and South Africa) were collected. Large commodity exporters are likely to have many listed commodity equities. This means that there is likely to be a direct connection between stock market volatility and commodity prices. (Naeem, Agyemang, Chowdhury, Hasan, & Shahzad, 2022). The daily equity prices was utlised from Equity All Share Indices equivalents of the 7 African countries. The dataset covers the period 1 January 2018 to 31 December 2022. This period under investigation covers both a bullish and bearish period. The conclusion of the Global Financial Crisis in 2012 led several African frontier markets most emerging economies fell into a deep depression. Subsequent stock market stability due to resource price stablity which extended through the periods 1 January 2018 to 31 December 2019 (Woode, Junior, & Adam, 2024).

Since the beginning of 2020, the price series of metals has dropped due to a decreased demand. The price series of stocks showed a significant downward spike during the period (Woode, Junior, & Adam, 2024). 1 January 2020-31 December 2022 covered the height of the COVID-19 pandemic and the Russia Ukraine War. This period under investigation highlights global economic strain, and eliminates the opportunity for international stock

market diversification outside Africa. The outcome of the war led to several trade sanctions imposed on Russia. Given that there is a global reliance on natural resources, mainly from Russia, the imposing of the sanctions impacted supply side factors negatively (Zhu, Zhao, & Liu, 2024). This period will also test the robustness of cryptocurrencies compared to gold as a safe haven hedging asset.

The cryptocurrency market was extremely volatile during these periods. Bitcoin is the largest and most popular cryptocurrency (by trade volume and market cap). Other coins grown in adoption and trade are Etherium, the US Dollar pegged coin Tether and Dogecoin. The studies conducted by Baur and Hoang (2021) suggest the price movement of bitcoin is likely to dictate the movements of other coins. A further study conducted by Liu (2019), investigated the diversification opportunities evident within cryptocurrencies. The author studied the price drivers of Bitcoin, Etherium, Ripple, Litecoin, Stellar, Monero, Dash, Tether, NEM and Verge. The paper found that given the common price drivers, there was a high correlation evident amoung the coins with minimal diversification opportunities. For the context of this study, Bitcoin was only taken into account as a potential hedging tool.

3. Results

This section examines the hedging effectiveness of return correlations between bitcoin, gold and African stock markets proxied by the equity indices of Ghana, Nigeria, Botswana, Egypt, Kenya, Morrocco and South Africa.

Table 1 Bearish Correlation Matrix

	BITCOIN	GOLD	BOTSWANA	EGYPT	GHANA	KENYA	MOROCCO	NIGERIA	SOUTH AFRICA
BITCOIN	1.000								
GOLD	-0.084	1.000							
BOTSWANA	0.083	0.039	1.000						
EGYPT	0.036	-0.026	0.025	1.000					
GHANA	-0.027	0.087	-0.020	0.035	1.000				
KENYA	0.018	0.004	-0.017	0.016	0.008	1.000			
MOROCCO	-0.010	-0.009	-0.003	0.206	0.051	-0.006	1.000		
NIGERIA	0.052	0.001	-0.174	-0.073	0.072	-0.012	0.066	1.000	
SOUTH AFRICA	0.127	-0.063	0.085	-0.052	0.042	0.025	-0.058	-0.017	1.000

Note: The bearish period under investigation refers to the period of low stock market volatility in the build up to the COVID-19 pandemic and the Russia-Ukraine War. The table shows the correlation between the series of daily returns.

Table 2 Bullish Correlation Matrix

	BITCOIN	GOLD	BOTSWANA	EGYPT	GHANA	KENYA	MOROCCO	NIGERIA	SOUTH AFRICA
BITCOIN	1.000								
GOLD	-0.004	1.000							
BOTSWANA	0.059	0.038	1.000						
EGYPT	0.003	0.029	0.049	1.000					
GHANA	-0.040	-0.070	-0.037	0.037	1.000				
KENYA	0.025	0.014	0.036	-0.109	0.006	1.000			
MOROCCO	-0.017	0.036	-0.047	0.014	0.048	-0.030	1.000		
NIGERIA	0.092	-0.031	0.010	0.049	0.123	0.056	-0.108	1.000	
SOUTH AFRICA	-0.059	0.032	0.231	0.003	0.024	0.052	-0.040	0.021	1.000

Table 1 and 2 show the correlation between the series of daily African stock market returns to Bitcoin and Gold for both periods under investigation. Bitcoin strengthens its diversification ability in Botswana and Ghana. This is due to the lower correlation coefficient as the volatility increases. Research suggests that the pandemic had the greatest impact on Ghana as compared to Botswana as certain economic sectors were harder hit than others (Amoah, Ofori-Boateng, Hughes, & Tetteh, 2022). Bitcoin, exhibited a mildly negative correlation coefficient and thus able to act as a mild hedge for Ghanaian equity investors. The greatest effect was evident in South Africa, as bitcoin served as a diversifier pre-pandemic and later became a mild hedge during the pandemic. Bitcoin and gold are both uncorrelated or marginally correlated with the returns of the equity indices (Baur & Lacey, 2010).

Gold serves as a stronger diversifier in Ghana only. Gold has seen a reduction in its protective ability in Egypt, Kenya, Morrocco, Nigeria and South Africa as it became a diversifier during the pandemic as opposed to a hedge pre-COVID (Wen, Tong, & Ren, 2022). Beladi, Trinh and Chao (2023), examined the potential price movements of gold during the pandemic. Consistent with the findings of this paper, the lower returns realised by investors was attributed to the low demand for gold during the pandemic, reducing its protective ability.

4.1 Bitcoin:

Bitcoin has been classified as a safe haven or hedge during various periods of financial distress (Stansas et al., 2019). Gold and Bitcoin are classified as alternative assets ideal for hedging and diversification purposes (Rehman et al., 2020). Both asset classes operate independently of sovereign politics and economics with the latter being blockchain derived. Literature has categorised Bitcoin as the “digital gold” (Sakurai & Kurosaki, 2023). The second part of the results section involves contrasting Bitcoin to gold as a hedging tool.

Table 3 Bounds test for cointegrating relationship during bearish period

Critical value bounds for the F-statistic: unrestricted constant and trend				
Test Statistic	**Value**	**Signif.**	**I(0)**	**I(1)**
		Asymptotic: n=1000		
F-statistic	57.208	10%	1.7	2.83
k	7	5%	1.97	3.18
		2.50%	2.22	3.49
		1%	2.54	3.91
Actual Sample Size	467	Finite Sample: n=80		
		10%	-1	-1
		5%	-1	-1
		1%	-1	-1

Table 4 Bounds test for cointegrating relationship during bullish period

Critical value bounds for the F-statistic: unrestricted constant and trend				
Test Statistic	**Value**	**Signif.**	**I(0)**	**I(1)**
		Asymptotic: n=1000		
F-statistic	85.875	10%	2.26	3.34
k	8	5%	2.55	3.68
		2.50%	2.82	4.02
		1%	3.15	4.43
Actual Sample Size	701	Finite Sample: n=80		
		10%	-1	-1
		5%	-1	-1
		1%	-1	-1

Note: k is the number of regressors, and the critical values are tested at a 5% statistical significance

Tables 3 and 4 represents the bounds test of cointegration between bitcoin and the returns of African equity indices for the bullish and bearish periods respectively. The output from the Bounds test shows that at a 95% confidence interval, there a long run equilibrium relationship between Bitcoin and the African stock markets both in the build-up and during the pandemic.

Table 5 Estimated long-run relationship between Bitcoin and African Equities for bearish period

Levels Equation Case 1: Unrestricted Constant and Unrestricted Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Botswana	1.202	0.737	1.631	0.104
Egypt	0.177	0.184	0.964	0.336
Ghana	-0.169	0.195	-0.866	0.387
Kenya	0.076	0.217	0.350	0.727
Morocco	-0.059	0.405	-0.146	0.884
Nigeria	0.379	0.261	1.456	0.146
South Africa	0.568	0.218	2.608	0.009

Note: ARDL (1,0,0,0,0,0,0,0) is selected based on the Schwartz Bayesian Criterion.

The results from the long-run bitcoin relationship during the lower volatility period is reflected in table 5. The returns of the Botswana market shows the most significant positive movements to the returns of Bitcoin. The JSE ALSI (South Africa) also indicates a significant positive relationship in the long run. Similarly, the correlation matrix in table 2 also inferes a positive relationship for these countries pre pandemic.

Table 6 Estimated long-run relationship between Bitcoin and African Equities for bullish period

Levels Equation Case 1: Unrestricted Constant and Unrestricted Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Botswana	0.553	0.299	1.848	0.065
Egypt	-0.009	0.100	-0.091	0.927
Ghana	-0.139	0.092	-0.150	0.133
Kenya	0.255	0.166	1.662	0.097
Morocco	-0.172	0.154	-1.186	0.236
Nigeria	0.518	0.145	2.064	0.039
South Africa	-0.015	0.181	-0.085	0.9326

Note: ARDL (1,0,0,0,0,1,1,4,4) is selected based on the Schwartz Bayesian Criterion.

Table 6 shows the output of the long run cointegrating relationship for bitcoin and the African stock market during the crisis period. Table 6 shows that bitcoin was able to act as a mild diversifier for Botswana, Kenya and Nigeria at a 90% confidence interval. This implies that the positive and statistically significant relationship will lead to similar comovements in the long run. The results show that there was a statistically insignificant relationship for Kenya and Nigeria before the pandemic and the war. However, a significant long run relationship between the variables emerged during the pandemic. Investors that held Nigerian and Kenyan equities can include bitcoin as a mild diversifier. The long run diverisifier relationship persists during the pandemic for Botswana Equity Indices. This is consistent with the findings of Gambarelli et al. (2023) whom also find that bitcoin neither serves as a strong hedge nor diversifer against stock market movements in the long run. Consistent with the findings of Bello et al. (2022), the results show that the returns of African stock markets are likely to mirror each other.

Table 7 Error correction representation between Bitcoin and African Equities during bearish period

ECM Regression				
Case 1: Unrestricted Constant and Unrestricted Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Cointegration Eq. 1	-0.983	0.046	-21.561	0.000
R-Squared	0.508			

Table 8 Error correction representation between Bitcoin and African Equities during bullish period

ECM Regression Case 1: Unrestricted Constant and Unrestricted Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.006	0.003	-1.928	0.054
Trend	0.000	0.000	2.969	0.003
Kenya	0.052	0.091	0.573	0.567
Morocco	-0.045	0.057	-0.802	0.423
Nigeria	0.365	0.124	2.946	0.003
Nigeria(-1)	-0.197	0.148	-1.333	0.183
Nigeria(-2)	-0.392	0.146	-2.680	0.008
Nigeria(-3)	-0.352	0.124	-2.848	0.005
South Africa	-0.113	0.070	-1.606	0.109
South Africa (-1)	-0.202	0.086	-2.365	0.018
South Africa (-2)	-0.265	0.086	-3.092	0.002
South Africa (-3)	-0.182	0.070	-2.573	0.010
Cointegration Eq. 1	-1.047	0.037	-27.963	0.000
R-Squared	0.542			

Note: ARDL (1,0,0,0,0,1,1,4,4) is selected based on the Schwartz Bayesian Criterion.

The short run results estimated within the ARDL framework is depicted in Table 8 and 9 for bearish and bullish periods respectively. In order to ensure the reliability of the estimated parameters in the error correction model, a series of diagnostic tests were applied. The estimated model shows congruence with the data and passes all of the specification tests applied. The model shows an absense of autocorrelation and hetroskedasticity. The Cointegration Eq.1 measures the speed of adjustment to equilibrium, it is statistically significant at 5%. The R-squared shows that the model has an adequate at predictive ability for both turbulent and stable volatility cycles.

Consistent with the long run results, the returns on the Nigerian stock market is close to small and almost unrelated to the movements in bitcoin returns and is highly significant. The movements of the Nigerian stock market and bitcoin suggest that bitcoin acts more as a

diversifer (Baur & Lacey, 2010). The results in table 5 and 6 indicate that bitcoin acts as a mild diversifer to Botswana and Kenya equities at a 10% significance. However, in the short term, these investors cannot seek any financial safety. The results are consistent with the findings of Al Nassar et al., (2022) and Gambarelli et al., (2023) whom state that bitcoin only acts as a partial store of value in the short run. The error correction coefficients are correctly negatively and statistically significant at 5% ensuring the attainment of long run equilibrium following the shock. The term CointEq(-1)* measures the speed of adjustment to equilibrium, it is statistically significant at 5%.

4.2 Gold vs Bitcoin:

Table 9 Bounds test for cointegrating relationship between Gold and African Equities for bearish period

Critical value bounds for the F-statistic: unrestricted constant and unrestricted trend				
Test Statistic	**Value**	**Signif.**	**I(0)**	**I(1)**
		Asymptotic: n=1000		
F-statistic	19.806	10%	2.38	3.45
k	7	5%	2.69	3.83
		2.50%	2.98	4.16
		1%	3.31	4.62
			Finite Sample: n=80	
Actual Sample Size	467	10%	2.504	3.631
		5%	2.885	4.111
		1%	3.728	5.16

Table 10 Bounds test for cointegrating relationship between Gold and African Equities for bullish period

Critical value bounds for the F-statistic: unrestricted constant and trend				
Test Statistic	**Value**	**Signif.**	**I(0)**	**I(1)**
		Asymptotic: n=1000		
F-statistic	77.518	10%	1.85	2.85
k	8	5%	2.11	3.15
		2.50%	2.33	3.42
		1%	2.62	3.77
Actual Sample Size	701	Finite Sample: n=80		
		10%	-1	-1
		5%	-1	-1
		1%	-1	-1

Note: k is the number of regressors, and the critical values are tested at a 5% statistical significance

Table 9 and 10 represents the bounds test of cointegration between bitcoin and the returns of African equity indices for the bullish and bearish periods respectively. The result from the Bounds test shows that the F-statistic is greater than the lower and upper bound. This clearly shows that there is a long run equilibrium relationship present between the returns on gold and the returns of the African stock market indices. The output from the Bounds test shows that at a 95% confidence interval, there a long run equilibrium relationship exists between bitcoin and the African stock markets both in the build up and during the pandemic. The results show that both bitcoin and gold exhibit a cointegrating relationship with African equities.

Table 11 Estimated long-run relationship between Gold and African Equities for bearish period

Levels Equation				
Case 2: Restricted Constant and Unrestricted Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Bitcoin	-0.010	0.007	-1.361	0.174
Botswana	0.110	0.107	1.031	0.303
Egypt	-0.023	0.026	-0.872	0.384
Ghana	-0.009	0.043	-0.205	0.837
Kenya	0.004	0.031	0.145	0.885
Morocco	-0.003	0.058	-0.059	0.953
Nigeria	0.006	0.038	0.152	0.880
South Africa	-0.044	0.031	-1.410	0.059

Note: ARDL(3,0,0,1,0,0,0) is selected based on the Schwartz Bayesian Criterion.

Table 11 examines the long run relationship present between gold and the various African Equity Indices. Gold was only able to act as a mild short term hedge against JSE ALSI (South Africa) movements. In contrast to bitcoin, gold was unable to provide any statitiscally significant protection for an investor holding Botswana equities in the short term. Gold and bitcoin can act as a mild diversifier for the JSE ALSI. From a practical standpoint, equity investors holding shares in the JSE ALSI would be indifferent between using bitcoin and gold as a store of value pre pandemic in the long run.

Table 12 Estimated long-run relationship between Gold and African Equities for bullish period

Levels Equation Case 2: Restricted Constant and Unrestricted Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Bitcoin	-0.028	0.015	-1.843	0.066
Botswana	0.730	0.127	5.759	0.000
Egypt	0.020	0.021	0.940	0.348
Ghana	-0.039	0.019	-2.010	0.045
Kenya	0.005	0.024	0.220	0.826
Morocco	0.016	0.018	0.907	0.365
Nigeria	-0.002	0.027	-0.080	0.937
South Africa	0.010	0.016	0.589	0.556

Note: ARDL (1,3,3,0,0,0,0,0,0) is selected based on the Schwartz Bayesian Criterion.

Table 12 represents the long run relationship between the gold returns and the returns of the African stock indices. The results show during the pandemic, gold showed a highly significant positive relationship with the returns of the Botswana stock index. Table 6 also indicates a mildly positive statistically significant relationship with Botswana. However, bitcoin was able to act as a milder diversifier due its lower coefficient compared to gold. Table 12 generates a low negative coefficient that is statistically significant for the Ghanaian stock exchange. Investors holding Kenyan shares could flock to gold as a long run mild hedge during the pandemic (Baur & Lacey, 2010). Bitcoin on the other hand, was unable to generate a statistically significant relationship at 10% for Kenya equities in the long run during the pandemic.

Interestingly to note, the returns of bitcoin and gold are uncorrelated but slightly negative in the long run during the bullish period. This similarity can be drawn to the different underlying fundamentals of both asset classes. Table 12 suggests that investors can include gold as a mild hedge against movements in bitcoin during high volatility periods. This alludes to the hypothesis that gold and bitcoin can be used complements to preserve value against stock market shocks in the long run (Oosterlinck, Reyns, & Szafarz, 2023).

Table 13 Error correction representation for the ARDL Model between Gold and African Equities for bearish period

ECM Regression Case 5: Restricted Constant and Unrestricted Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Gold (-1)	-0.012	0.071	-0.164	0.870
Gold (-2)	-0.070	0.046	-1.508	0.132
Ghana	0.052	0.021	2.503	0.013
Cointegration Eq. 1	-1.144	0.090	-12.688	0.000
R-Squared	0.592			

Table 13 shows that in the short run, gold acted as a diversifier for Ghana only, whereas bitcoin was unable to draw any significant relation pre-pandemic.

Table 14 Error correction representation for the ARDL Model between Gold and African Equities for bullish period

ECM Regression Case 5: Restricted Constant and Unrestricted Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Bitcoin	-0.002	0.007	-0.310	0.757
Bitcoin (-1)	0.027	0.008	3.402	0.001
Bitcoin (-2)	0.011	0.007	1.634	0.103
Botswana	0.063	0.057	1.104	0.270
Botswana (-1)	-0.475	0.070	-6.813	0.000
Botswana (-2)	-0.120	0.058	-2.058	0.040
Cointegration Eq. 1	-1.053	0.037	-28.024	0.000
R-Squared	0.539			

Note: ARDL (1,3,3,0,0,0,0,0,0) is selected based on the Schwartz Bayesian Criterion.

The error correction term represented as the CointEq(-1) is negative and statistically significant. This term indicates that the model possesses a high speed of adjustment from the

short run to the long run, that is, the model has a strong ability of removing disequilibrium. Emphasis can be placed on the models ability to generate accurate results using both asset classes during high volatility periods. Bitcoin was able to act as a short run diversifier for Kenyan equities during the pandemic, whereas gold was unable to draw any significant short term relationship. However, this relationship falls away in the long run as shown in Table 12.

4. Conclusion:

The financialisation of commodity markets has exposed commodity prices to market-wide shocks. Evidence exists that suggests that there has been a growing in dependance of financial markets on precious metals, thus the hedging ability of precious metals has weakened over the past years (Małgorzata & Echaust, 2024). Cryptocurrencies are digitally encrypted assets that are not affected by the same macroeconomic factors as other assets. This paper verifies this, as the inclusion of cryptocurrencies can reduce the overall equity volatility of an African investor. Market volatility cycles has made it essential for investors to identify alternative asset classes to hold value during turbulent cycles (Frijns, Verschoor, & Zwubjeks, 2017).

The literature has intensely emphasized gold as a store of value or a hedge. In the context of this paper, the hedging ability of bitcoin was tested and gold was used as a benchmark. As a reference for African stocks, the equity indices of Botswana, Egypt, Ghana, Kenya, Morocco, Nigeria and South Africa was used. The ARDL model allowed assess whether positive or negative returns of bitcoin may affect the stock market. The following results were obtained.

Bitcoin had a positive and statistically significant relationship to movements in the South African and Botwana equity indices during the bearish period pre-pandemic. Bitcoin acted as a weak long run diversifier against stock market movements in the two countries. During the pandemic however, the long run weak diversifier relationship with Botswana equities persisted. Mildly positive long run coefficients were determined for the Nigerian stock exchange indicating bitcoin as a poor store of value. While bitcoin established a stronger long run diversifier relationship to Kenyan stocks during the pandemic.

Consistent with the long run results, the returns on the Nigerian stock market was found to be small and almost unrelated to the movements to movements in bitcoin returns and is highly significant. This suggests that bitcoin was able to act as a safe store of value against stock market decline during the pandemic for Nigerian equities.

The paper then moved onto the comparison of bitcoin to gold as a potential hedging tool. Gold only provided mild safety for investors of the JSE ALSI as a mild short term hedge. In contrast to bitcoin, gold was unable to provide any statitiscally significant protection for an investor holding Botswana equities in the short term. Gold and bitcoin can act as a mild

diversifier for the JSE ALSI. From a practical standpoint, equity investors holding shares in the JSE ALSI would be indifferent between using bitcoin and gold as a store of value pre pandemic in the long run. In the short run, Bitcoin was to act as a diversifier against Kenyan stock market movements. Gold however drew no significant relationship regarding its hedging qualities to African equities during the pandemic.

The findings of this paper are of relevance to investors and traders whom may consider cryptocurrencies as a hedging tool. African investors may utilize cryptocurrencies to minimize stock market shocks which is essential for future decisions on risk management and asset allocation. The results of this paper can also be utilized by academics engaged in the investigation of potential safe haven instruments for African an international stock market. This paper infers that African equity investors are likely to have the greatest safe havens when gold and bitcoin are used concurrently in one's portfolio. Therefore, bitcoin was able to act as a "digital gold" and provide investors with protection when conventional gold could not (Sakurai & Kurosaki, 2023). This recommendation stems from the observed weak interdependencies between the assets. This awareness can equip investors with the knowledge needed to effectively diversify their portfolio and optimize returns. Given the variable interplay between risk and return, it is prudent for investors to recognize that, especially during a crisis, be able to identify which assets can act as a store of value.

Future research should consistently monitor the evolution and intercorrelations between cryptocurrencies and stock markets over time. For instance, researchers should analyse the implementation of cryptocurrency-based derivative contracts, to help mitigate the excessive risk surrounding these assets. The increased adoption of cryptocurrencies into investors portfolio will lead to a stronger connection between cryptocurrencies and traditional markets (Wang , Bouri , Fareed , & Dai, 2022).

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