

Bitcoin in the South African market: A safe haven or hedge?

Fortune Nhlanhla Mhlanga

Supervisor(s):

Dr. Yudhvir Seetharam



A research report submitted in partial fulfillment of the requirements for the
degree of Master of Science in the field of e-Science

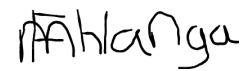
in the

School of Computer Science and Applied Mathematics
University of the Witwatersrand, Johannesburg

22 August 2022

Declaration

I, Fortune Nhlanhla Mhlanga, declare that this thesis is my own, unaided work. It is being submitted for the degree of Master of Science in the field of e-Science at the University of the Witwatersrand, Johannesburg. It has not been submitted for any degree or examination at any other university.



22 August 2022

Abstract

Crypto-currency has been growing rapidly since its inception and this development has led to increasing interest from investment portfolio managers to understand if crypto-currency can be used as a financial asset. One of the major objectives of these managers is to minimize losses and maximize profits on the investments they made. Loss in portfolio value is always possible. Consequently portfolio managers are always searching for new, uncorrelated, asset classes that can be used to hedge their existing positions. This study seeks to understand if Bitcoin can act as a hedge or a safe haven for stocks and bonds in South Africa. The principal regression model is used to probe the weekly, monthly, and quarterly Bitcoin, stocks and bonds historical data from 2012 to 2021. This study shows that Bitcoin can act as a hedge against bonds. Results from weekly and monthly historical data show that Bitcoin can act as a hedge against stocks and a safe haven for stocks and bonds. Quarterly historical data results do not support the latter results.

Acknowledgements

I would like to give great thanks to my supervisor Dr. Yudhvīr Seetharam for granting me the opportunity to do this work with him, and for guiding me in this research project. I would also like to thank National e-Science Postgraduate Teaching and Training Platform for providing me with financial support during this MSc degree. Lastly, I would like to thank the mother of my daughter kebuile Moseki for supporting and believing in me from the beginning when I started this MSc degree.

Contents

Declaration	i
Abstract	ii
Acknowledgements	iii
1 Introduction	1
1.1 Background	4
1.2 Problem Statement	4
1.3 Research Question	5
1.4 Research Aims and Objectives	5
1.4.1 Research Aims	5
1.4.2 Objectives	5
1.5 Overview	6
2 Literature Review	7
2.1 Hedges and safe haven studies	7
2.1.1 Bitcoin hedges and safe haven studies	8
3 Research Methodology	11
3.1 Data	11
3.2 Methodology	17
4 Results	19
4.1 Summary of Results	24
5 Conclusion	25
5.1 Future Work	26
Bibliography	27

A	Monthly and Quarterly Model Results	31
A.1	Monthly Historical Returns Results	31
A.2	Quarterly Historical Returns Results	33

Chapter 1

Introduction

Cryptocurrency is a peer-to-peer virtual or digital currency that takes advantage of advancements of cryptography for security [1]. The transaction process for cryptocurrency is such that it takes place without any central authority [2]. These transactions are verified to check if the seller owns the currency to ensure those currency units are not spent more than once [2]. The process of confirming and verifying transactions is generally termed "mining" [2]. Cryptocurrency is perceived by many people as a replacement for fiat currency, currently, it is very difficult to foresee the world that only uses cryptocurrency because fiat currencies are fundamentally different to cryptocurrency. One of the major differences is that cryptocurrency does not exist in physical notes or coins as it is done with fiat currencies. Another major difference is that cryptocurrency is very volatile meaning that the value of a single unit of cryptocurrencies can change significantly at any second which is contrary to fiat currency. In addition, cryptocurrency is not controlled or managed by any government entities while all fiat currencies are heavily regulated by the government. However, cryptocurrency is well protected since its value is presented digitally [1]. The value of fiat currency lies in the act of possession. This implies that the person who holds fiat currency assumes ownership while the validation of the cryptocurrency is in accordance with security protocols that are computerised [1].

Generally, the value of a cryptocurrency's is not associated with any given physical asset or the economic performance of any given country but is determined by security measures of the algorithm that monitors transactions [3]. Bitcoin, one of the most popular cryptocurrencies, had a value of more than \$1 trillion estimated market capitalisation [4] as of the 10th of April 2021. In addition to Bitcoin, there are more cryptocurrencies that are called altcoins. Some of these altcoins are Ethereum,

Binance coin, Lite coin, each with an estimated market capitalisation of \$250 billion, \$75 billion, \$4 billion respectively [4] as of the 10th of April 2021. There have been speculations that the ever-expanding competition in cryptocurrencies would drive the Bitcoin price down. However, this has not been the case as Bitcoin grew many folds over the years and as it stands each Bitcoin cost 30 times more than each Ethereum that follows Bitcoin in terms of market capitalisation [4] as of the 10th of April 2021.

Bitcoin's growth has led to large inflows of investments to newly found specialised funds called cryptocurrency funds. Trading of digital assets has mostly been done by individual investors, but recently, cryptocurrencies are becoming more accepted as a viable investment vehicle by institutional investors [5]. In the United States (US) of America, Fidelity conducted a study where they surveyed more than 400 US institutional investors and found that about half (47%) of these institutional investors would include digital assets in their investment portfolios [6].

In 2020, PricewaterhouseCoopers (PWC) estimated that total crypto-assets were less than 10 billion US dollars [7], with around 2 billion US dollars in the global crypto hedge funds (HF) in 2019 [7]. In 2020, it is estimated by PWC that almost 4 billion US dollars were managed by crypto HF [7], meaning that in 2021 the crypto HF probably grew. Several trends shown by the PWC, Elewood, and AIMA's recent report on the crypto hedge fund business show that it is growing faster [7]. Currently, there are more than 800 crypto funds that are operating in and around the world [8], these include HF and Venture Capitals (VC). In South Africa, about 11% of the population or 4.2 million people are holding cryptocurrency [9]. Due to government regulations institutions have found it difficult to participate in crypto investing as they can not solicit money from the public to make these investments [10].

The South African financial market is historically volatile because of factors such as political instability, policy uncertainty, strikes to name a few. To combat these challenges there is a need for new financial assets are not linked to the government, which Bitcoin is, in the South African financial market.

In 1887 just one year after gold was discovered in the Witwatersrand area, the Johannesburg Stock Exchange (JSE) was founded to raise capital to fund the rapidly

developing investments in the mining industry [11]. Since its creation, the JSE subsequently has earned its place as one of the most important stock exchanges on the African continent. The JSE is one of the twenty world's largest share markets [11], it is rated the sixth among the emerging economies [11], it is the largest stock market in Africa, with over 300 firms listed with a huge market capitalization as of January 2022 [12]. The ratio of market capitalization to the Gross Domestic Product (GDP) can be used as a gauge of a stock exchanges importance to its domestic market. This ratio for the JSE in South Africa is around 190% [11].

Firms generally issue debt instruments to investors to raise funds on JSE [13]. The issuer of a debt instrument which is commonly known as a bond agrees with the investor to pay back the borrowed amount with some interest upon the time agreed on [13]. For a company to be eligible to list on the JSE as a debt or bond issuer the company must attain credit rating from credit rating agencies such as Standard and Poor's, Fitch or Moody's [13]. The Bond Exchange of South Africa, also known as the JSE bond market, was only created in 2009 [13]. Historically, there was no bond market until the late 1980s in South Africa, during the 1970s and 1980's the bond market facilitated via the counter and it was made of government bonds and semi-government bonds [14]. After the inquiry of Jacob and Stals in 1987, it was recommended that the Bond Market Association (BMA) should be formed [13]. By the end of 2013 there were a total of 1600 listed debt instruments that whose nominal value totalled in excess of R1.8 trillion [15]. The South African government lists more than half of the debt listed on the JSE, while other debt issuers are the state-owned companies, corporates, banks and other African countries [15].

The South African Real Estate Investment Trusts (REIT's) association has indicated that their listed properties asset class has performed better than developed economies' REIT's from 2006 to 2016 [16]. Fast growth and good returns lead to an interest in domestic and foreign investors and increased positivity that the South African financial market has the potential to deliver good investment returns other than the South African REIT's listed asset class. Furthermore, the South African REIT's growth is similar to Bitcoin in South Africa, which has been fast growing in its adoption by users [17], which leads to a potential that Bitcoin may be an essential asset in the South African financial market. Hence, this study attempts to quantify the effects of Bitcoin in the South African financial market to assist domestic and foreign investors who may be interested in investing in the South African market.

1.1 Background

The Bitcoin success has attracted increased interest from the media, ordinary people and corporations have increasingly started treating Bitcoin and altcoins as valid payment instruments [18]. Nonetheless, amid this huge interest, there is negative media coverage that reflects the shortcomings of the wide use of Bitcoin as a new form of payment [18]. Some of the concerns raised are the lack of regulation and cyber security challenges, which means that the black-market activities flourish and individuals and organisations may face challenges as they make transactions in the cryptocurrency platforms [18]. The volatility of Bitcoin is a concern to users as the price of Bitcoin rose more than a thousand percent between 2011 and 2017 [3].

This growth of Bitcoin raises concerns to the government and policy-makers as it has the potential to replace money as we know it today. The demand for cryptocurrency has been increasing over the years. It has been shown that cryptocurrencies such as Bitcoin are mostly used as a speculative investment rather than a substitute currency [3]. Bitcoin has proved to be a multi-use asset as it has been seen being used for making payments or being used as a short term and long-term investment instrument. This has led to curiosity on how Bitcoin relates to other financial assets.

The relationship between Bitcoin, stocks and bonds is still yet to be probed into detail to understand the hedging capabilities of Bitcoin or its ability to act as a safe haven for South African stocks and bonds. An asset that is called a safe haven is an asset that is not correlated or inversely correlated with another asset specifically in market stress [19], while a hedge is an asset that is not correlated or inversely correlated with another asset generally in the market [19]. The relationship between cryptocurrency and financial assets is essential to investors since they need to find ways that can result in profits or avoid losses during times of instability in the financial market. The need to make profits and avoid losses has led investors to search for assets that they could use as safe haven, as these assets inversely correlate with traditional assets during times of instabilities in the market.

1.2 Problem Statement

Many studies have been conducted that show that adding Bitcoin to an investment portfolio improves the performance of that portfolio [20],[21]. In addition, there

are studies that have demonstrated that Bitcoin acts as a hedge and a diversifier [22],[23],[24]. A study done by Kein, et al [25] show that Bitcoin acted oppositely to gold as they found that Bitcoin had a positive correlation with S&P500 during the declining time in the market. Studies by Blundell-Wignall [26], Ticomb [27], and [28] suggest that Bitcoin is a safe haven as its prices are observed to surge during a financial crisis. There haven't been many studies that have been conducted to observe the Bitcoin effects to developing markets like the one found in South Africa. This is important to note because normally financial asset trading from developed countries is different to developing countries. A developing market like the one in South Africa is subjected to volatility due to various factors such as political uncertainties, strikes, and declining investment ratings as seen in the recent past. The decentralization and great transparency nature of Bitcoin trading provide reliability and easy access to investors all over the world who are seeking alternative financial assets to invest in [29]. This has helped Bitcoin to grow rapidly in developing countries [29] as it removes barriers to doing business. However, many studies have focused on Bitcoin's effects in developing countries. Hence, the need to study the benefits of Bitcoin in developing markets like the one found in South Africa.

1.3 Research Question

Do the properties of Bitcoin satisfy those of a hedge or a safe haven for stocks and bonds proxies in the context of South African financial markets?

1.4 Research Aims and Objectives

1.4.1 Research Aims

This study intends to determine if Bitcoin properties are that of a hedge or a safe haven in the South African stocks and bonds proxies.

1.4.2 Objectives

- To determine if Bitcoin properties satisfy those of a hedge asset.

- To determine if Bitcoin can provide a safe haven for South African stock and bonds proxies.
- To extend literature on hedges and safe-haven assets locally.

1.5 Overview

This document is structured as follows; [chapter 2](#) discusses the literature of this study to provide a view of previous relevant studies and their results. [chapter 3](#) characterises the method that is implemented in this study, a description of data that is used, detailed description of the method. [chapter 4](#) presents the results of this study and summarises them. [chapter 5](#) provides a conclusion of this study and discusses possible future studies in this subject..

Chapter 2

Literature Review

2.1 Hedges and safe haven studies

The past three decades have seen several financial crises such as the financial currency crisis that happened in Asia in 1997, the crisis that occurred between 1998 and 1999 in Russia and Brazil, the 2007 to 2008 global financial crisis and lastly the 2010 to 2011 debt crisis that happened in Europe. These crises have led to increased volatility in the stock market and the uncertainty that relates to portfolio investment. Hence, investors are looking to minimize the risk that is related to their investment. Hedges and safe-haven assets are tools that can be utilised by investors to minimize the risk associated with their investment.

This has led to increased studies in the field of hedges and safe haven assets. These studies seek to understand which assets can act as a hedge or safe haven for others. A study to ascertain if gold is a hedge or safe haven for US, UK and German stocks and bonds, found that gold hedges stocks on average and is also a safe haven for stocks during extreme market conditions [30]. Furthermore, it was shown that the safe haven attribute of gold is not permanent [30].

Another study looked at the inflation hedging attributes of gold, stocks, and real estate in the US, and found that real estates and stocks are good hedges against inflation, while gold defies Fisher's hypothesis [31]. In addition, it was found that the asset-inflation hedging association for the US is time-varying [31].

There is a study that examined the correlation between oil, gold, currency, bond and stock markets of the US and UK, and found that there is evidence that suggests the gold market can be regarded as a hedge for exchange rate fluctuations [32]. Furthermore, it is found that gold acts as a safe haven for exchange rates when they are dropping significantly for both countries [32].

Academics and practitioners have attempted to explore the topic of hedges and safe haven in the South African market. One of these studies used the quantile regression method and showed that gold can be used as a safe haven for strictly 15 days after a financial collapse [33]. In addition, it was found that gold shows properties of a hedge against South African bonds and equities [33]. Furthermore, it is shown that there is a positive return on gold on the day of severe negative impact in the stock market, but this return disappears following two days of trading [33].

2.1.1 Bitcoin hedges and safe haven studies

The volatility of asset classes is one of the major considerations during the investment portfolio construction process. Volatility is generally used as a measure of fear levels in the financial market [34]. Since security market prices can be easily seen in the markets, volatility is generally calculated from the security returns or inferred from market prices that are model-based for derivative instruments. In developing equity markets like the one that is found in the JSE, volatilities of past returns from equities generally end up acting as proxies for the market's forward-looking volatility projections. Measures of that nature usually provide equally weighted statistical deviations of how much returns deviate daily from the mean over time. There are times when the market volatility is constant and other times when the markets are experiencing turbulence and volatility increases and remain at those high levels for a longer period, this period is known as volatility clustering [34].

Historical, empirical evidence reviewing 16 asset returns against Bitcoin returns shows that Bitcoin returns have the highest returns, and the most volatile [35]. [Figure 3.1](#) shows the Bitcoin prices from late 2011 until the 1st of February 2022, this figure further supports that Bitcoin prices are extremely unpredictable. The volatility of Bitcoin makes it even more attractive to investors since there is a chance of profiting as it was established by [35] that Bitcoin had the highest returns and volatility compared to the 16 assets that were studied. Furthermore, the average monthly volatility of Bitcoin is found to be much higher than that of gold and foreign currency pairs against the US dollar [36].

This rise of cryptocurrency has not been probed into greater detail by academia to ascertain its impact on the financial markets [3]. This scarcity of research is due to the deficiency of Bitcoin to those that are outside the field of computing and

cryptography [37]. Secondly, is the scarcity of Bitcoin itself, the number and value of Bitcoin created thus far is relatively small to the global economy size [38]. Most of the studies that seek to understand the impact of cryptocurrency have focused on its dynamic prices [3].

In a study conducted by [23] to probe the hedging capabilities of Bitcoin, hedging capabilities of Bitcoin were explored by applying the asymmetric generalized autoregressive conditional heteroskedasticity (GARCH) method which is a method that has been widely used to study hedges across different financial assets. Results from [23] show that Bitcoin can act as a hedge against the United States (US) dollar for a shorter period, and the United kingdom (UK) stock market.

A study that probed the relationship between Bitcoin and currencies was performed using Bitcoin data hourly frequency since it was noted that Bitcoin experiences larger volatility during the day [3]. This study [3], employed the asymmetric dynamic conditional correlation (ADCC) model and found that Bitcoin can act as a hedge for the Swiss franc (CHF), European Euro (EUR) and British Pound (GBP) during the day. This study [3], further employs the non-temporal Hansen test to probe the safe haven properties of Bitcoin and it was found that Bitcoin can act as a safe haven for the Canadian dollar (CAD), CHF and GBP.

Bitcoin was examined if it was a medium of exchange or an asset, and what is the current use of Bitcoin to assess its future characteristics [35]. It was demonstrated that Bitcoin is uncorrelated to traditional asset classes such as equity and bonds during times of stability and times of commotion in the financial market [35]. In addition, it was shown by [35] that Bitcoin returns are negatively skewed and with a high kurtosis. The negative skewness returns of Bitcoin are comparable to the skewness of corporate bonds yield and gold returns [35].

In the US market, it is shown by [35] that Bitcoin is strongly correlated with the stocks that are represented by Standard and Poor's 500 (S&P500) and (S&P600) stock indices. This paper also evidenced Bitcoin's correlation with corporate bonds that have high yields and a negative correlation with the US Treasury Bond Index (tbi). Bitcoin was shown by [35] to be a weak safe haven for S&P500 since the Bitcoin returns were observed to be uncorrelated with S&P 500 returns during a market crash.

Given the studies above, there is still a gap in understanding Bitcoin's properties if are that of a hedge or if it can provide a safe haven for developing countries'

stocks and bonds. To conduct this assessment, market proxies are needed to conduct this study as using individual Bonds or Stocks is not feasible. Hence, this study aims to probe the Bitcoin properties against the South African stocks and bonds proxies to add to the literature on cryptocurrency, hedges and safe-haven assets locally.

Chapter 3

Research Methodology

For Bitcoin to be regarded as a hedge on average it must not have a positive relationship with the South African stocks and bonds [33]. If Bitcoin exhibits characteristics of a hedge during extreme times of volatility in the South African stocks and bonds market, then it can be considered a safe haven in South Africa [33]. Given the rich statistical theory, it is possible to test the hypothesis that Bitcoin's properties are that of a hedge for bonds and stocks in the local market. It is also possible to test the null hypothesis that Bitcoin does not have a relationship with South African stocks and bonds.

3.1 Data

To achieve the aim of this study, there is a need to know if a study of this nature in South Africa is possible or not. To address this feasibility concern, the Gross Domestic Product (GDP) data of South Africa contains some information about how the South African economy has performed for a selected period. South African GDP data covering the periods 2012 up to 2021, sourced from the University of the Witwatersrand IRESS, for this academic study. The period chosen is motivated by the fact that Bitcoin gained popularity around 2011 and has grown ever since. To conduct the study of hedges and safe havens it is important to know if there have been times when the economy contracted, which is important to address the question of safe haven assets. While studying hedges, it is not particularly important to know the specific times in the economy where it declined and recovered. [Figure 3.2](#) below shows, the South African GDP from 2012 to 2021. From [Figure 3.2](#) it is clear that this selected time frame suits this study as it can be seen that there are periods where the economy declined rapidly and recovered.



FIGURE 3.1: Bitcoin prices in U.S Dollars from 2012 to 2022 [39].

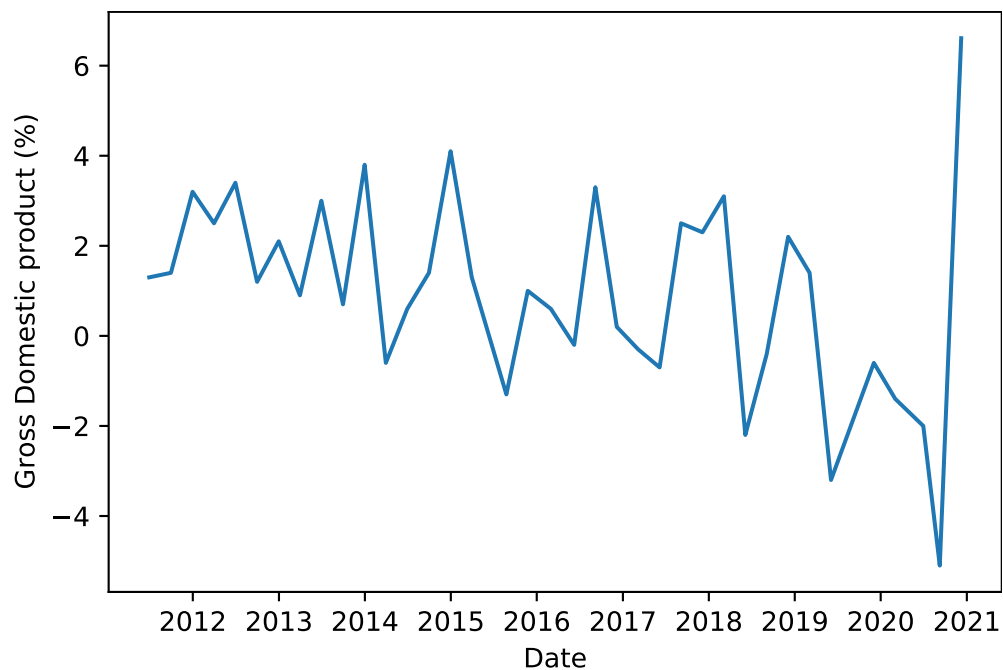


FIGURE 3.2: The Gross Domestic Product of South Africa between 2012 and 2021, examined on the 30th of April 2021.

Rather than using individual company stocks and bonds, All Share Index (ALSI) and the All Bond Index (ALBI) the popular domestic indexes as proxies for stocks and bonds respectively. ALSI is a market capitalisation-weighted index that represents 99% of the full market capitalisation of all eligible stock listed on the JSE main board [40]. The ALBI index is a concoction index that contains top 20 South African vanilla sovereign and non-sovereign bonds [15]. The historical data for the ALSI and ALBI used in this study is sourced from University of the Witwatersrand IRESS linked database. The historical daily prices of the ALSI and the ALBI excludes weekends and public holidays, since the JSE does not trade on those days. The weekends historical data is not recorded completely, while for public holidays the previous trading day closing price is used on that public holiday. For the remainder of this document stocks and bonds will be used interchangeable with ALSI and ALBI respectively to mean the same thing unless stated otherwise. The ALBI and ALSI dataset contains variables of interest like the Date and Closing daily prices in ZAR. These Close prices are averaged to weekly, monthly and quarterly prices.

The historical Bitcoin data prices were extracted from nomics.com. This dataset contains two variables namely: the Date and accompanying Closing prices of Bitcoin in US dollars. These prices are converted to ZAR using historical US dollar to the ZAR exchange rate of a corresponding day at which the data the Bitcoin price was collected. Daily prices are averaged to weekly, monthly and quarterly prices excluding weekends to smooth out large daily prices fluctuations. Then these weekly, monthly and quarterly returns are computed as follows:

$$Returns = \ln\left(\frac{P_t}{P_{t-1}}\right) \quad (3.1)$$

Where P_t is the closing price at time t and P_{t-1} is the weekly, monthly or quarterly previous price of P_t . The resulting weekly returns historical data has 467 data points, monthly historical data has 116 data points, and quartely returns historical data has 36 data points.

Handling data problems is one of the most critical steps in any data science project. The data problem encountered in this data was removing weekend historical Bitcoin prices in order to structure it so that it is compatible with ALSI and ALBI data, upon realising that public holidays data was not missing from stocks

and bonds historical data but those days are filled with previous trading closing prices a decision was made not to remove these days and assume this was a true trading day on JSE. After data handling, weekly, monthly and quarterly historical data prices were created by taking average aggregates of daily prices. Due to fewer data points, it was thought against creating bi-annual historical prices. It was then that now returns could be computed using [Equation 3.1](#), after those quantiles were computed using the method outlined in [section 3.2](#).

TABLE 3.1: Is the statistical description of weekly historical returns.

Weekly Returns Historical Statistics						
Variable Name	Mean	Standard Deviation	Minimum	Maximum	Skew	Kurtosis
ALBI	-0.000023	0.013509	-0.111656	0.065417	-2.142682	21.277626
ALSI	0.001255	0.055647	-0.297379	0.259457	-0.081799	3.563518
Bitcoin	0.020244	0.108551	-0.369725	0.500295	0.315824	2.491793

As it can be seen from [Table 3.1](#) that the mean of the returns is very close to zero, especially the ALBI which is slightly on the negatives. The minimum and maximum metrics show that Bitcoin lows are lower than both ALSI and ALBI, and its highs are also higher than both ALSI and ALBI. The standard deviation also supports the high volatility of Bitcoin returns as it is the highest. [Table 3.1](#) further shows that ALBI returns are the least volatile since its minimum and maximum values are the smallest amongst others which also shows that they are closer to each other, and this observation is further supported by the highest kurtosis which means that ALBI historical weekly returns distribution is tall and thin meaning that most of its values are near the mean.

[Figure 3.3](#) below shows the historical ALBI weekly returns. From 2012 to 2019 the ALBI returns seem to be consistent with very few outliers even though in 2015 it is visible that there were two extreme returns which one extremely negative while another is also very high compared to other years. In 2020, the ALBI returns shows to have been more volatile compared to other years, there are more weeks where there were positive returns compared to other years even though this was the time

where COVID-19 was prevalent in the world and the economies were being shut-down.



FIGURE 3.3: ALBI returns

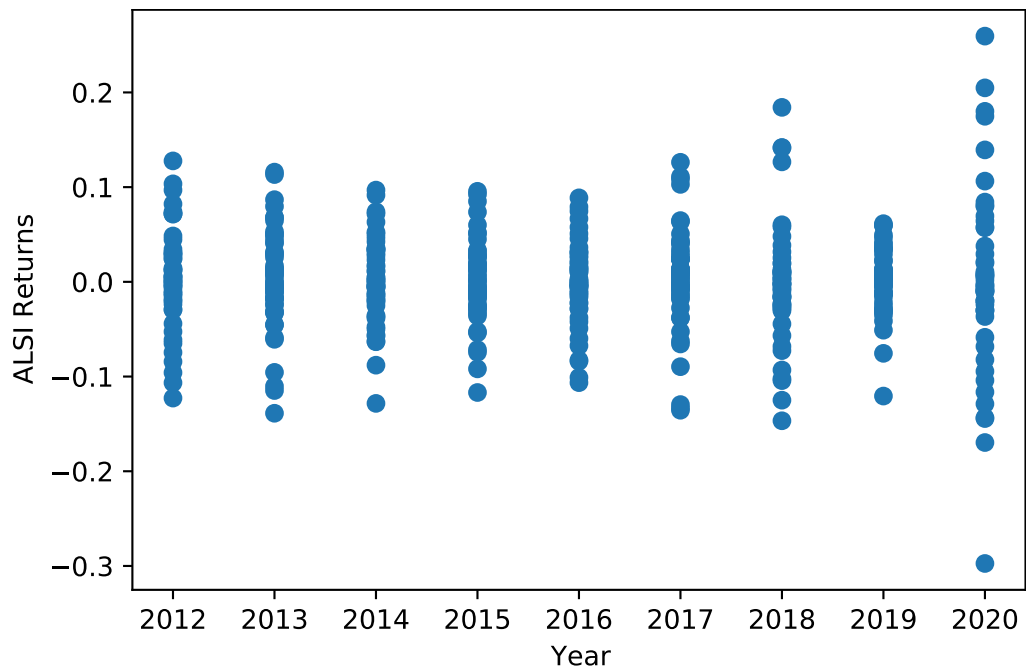


FIGURE 3.4: ALSI returns



FIGURE 3.5: Bitcoin returns

From [Figure 3.4](#), it is observable that from 2012 to 2019 the returns do not vary too much with a few exceptions in 2018 where the returns are seen to vary a bit more. While in 2020, similarly as in ALBI returns, the ALSI tends to vary more, it is this year that had the first lowest low and also the highest high returns.

In contrast, [Figure 3.5](#) shows that Bitcoin returns are not as regular as seen for ALBI and ALSI. In 2013 Bitcoin returns were very unstable with few weeks showing negative returns while many weeks showing positive returns. This historical data shows that 2013 had the highest highs and lowest lows of returns. The use of returns shows that as much as Bitcoin prices have been growing but their returns haven't been doing the same. In 2020, the Bitcoin returns did not vary as it was seen for stocks and bonds, Bitcoin appears to have had stable returns in 2020 compared to stocks and bonds which is interesting given that it was during the time of COVID-19.

3.2 Methodology

The principal regression model is a method that has been used to conduct hedges, and safe-haven studies, this method was demonstrated by Dirk G. Baur [30] to study if Gold can act as a hedge or safe haven for stocks and bonds. Regression is a way of learning the relationship between a set of independent input and the dependent output variables with the intention that given unseen input variables then the corresponding output can be computed. This study follows this method to study Bitcoin properties to ascertain if it can act as a hedge or provide a safe haven locally. The principal regression model [30] is defined as follows:

$$r_{Bitcoin,t} = a_1 + b_1 r_{stock,t} + b_2 r_{stock,t(q)} + c_1 r_{bond,t} + c_2 r_{bond,t(q)} + e_t \quad (3.2)$$

In Equation 3.2 [30], $r_{Bitcoin}$, r_{stock} and r_{bond} are the returns of Bitcoin, stock, and bonds prices, respectively. To account for asymmetries of positive and negative returns during extreme market shocks the terms $r_{stock,t(q)}$ and $r_{bond,t(q)}$ are included, to rigorously examine the role of Bitcoin during the periods of the extreme negative performance of the South African market. In addition, regressors that have stocks and bonds returns that are in the $q\%$ lower quantile, such as the 5%, 2.5% and 1% quantile are included. These ALSI and ALBI lower quantiles are meant to imply the times of extreme negative returns in the stock and bonds market. In practice, these lower quantiles are computed as follows: given all the bonds or stocks returns than the five, two and a half, and one percentile values are computed and then all returns that are less or equal to those values are kept and then rest are set to zero.

In this model, it is assumed that during times of uncertainty driven volatility in the stocks and bonds market, if investors buy Bitcoin rapidly, then its price will increase which is a consistent view of a safe haven hypothesis. This implies that if the price does not increase due to panic buying by investors then the investors are not buying nor selling during this time.

To study the Bitcoin properties against the behaviour of stocks and bonds, it is important that the price of Bitcoin does not impact the prices of stocks and bonds.

In Equation 3.2, if b_1 or c_1 has a value of zero or a negative value, then it means that Bitcoin act as a hedge for stocks and bonds since these assets are uncorrelated with each other. To examine if Bitcoin properties are that of a safe haven for stocks and bonds in the South African market, the parameters b_2 and c_2 are used. If the

sum of b_1 and b_2 for stocks and the sum of c_1 and c_2 is non-positive during the extreme times where stocks and bonds prices are falling then Bitcoin would be acting as a safe haven for these assets. For Bitcoin to be an asset that investors could rely on, it should have a negative correlation to stocks and bonds during times of volatility in the market meaning that Bitcoin price increases during this time and investors can gain profits compensating for losses that are encountered in stock or bond investments.

Chapter 4

Results

The results shown in this chapter are a result of probing weekly, monthly and quarterly returns historical data from 2012 up to 2021 using the principal regression model discussed the methodology extensively. The monthly and quarterly results are presented in the appendix below, but the implications of these results are discussed in this section.

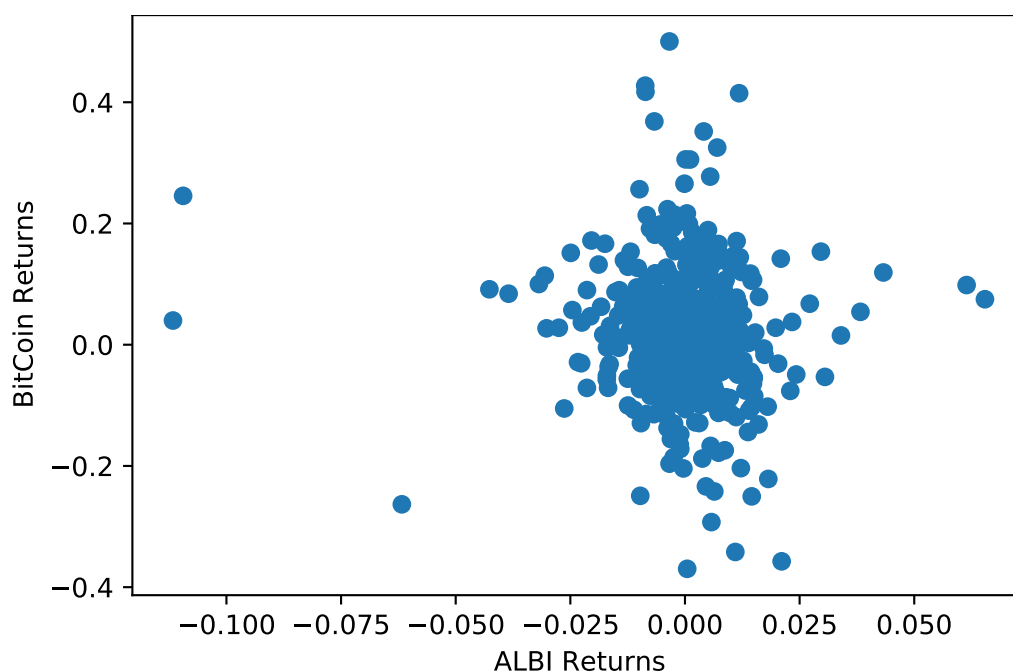


FIGURE 4.1: ALBI retrurns versus Bitcoin returns from 2012 to 2022

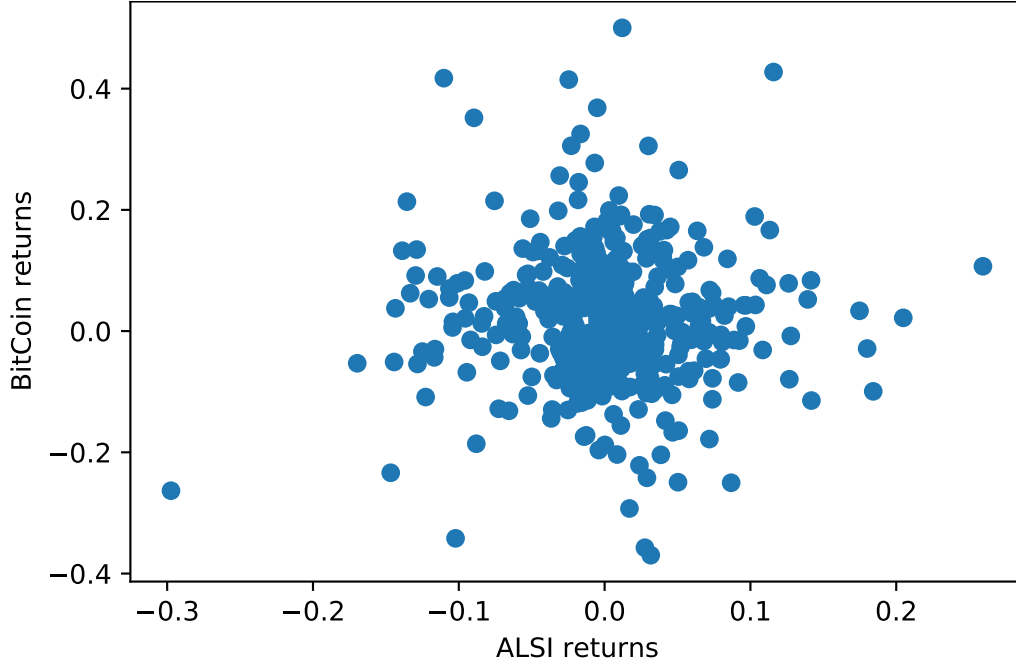


FIGURE 4.2: ALSI returns versus Bitcoin returns from 2012 to 2022

Figure 4.1 shows Bitcoin returns plotted against ALBI returns. This scatter plot shows a few points that are outliers, with the majority of points concentrated around the origin, with Bitcoin returns and ALBI returns showing a linear relationship. Similarly, Figure 4.2 most of the points are concentrated around the origin, with several outliers. The relationship between Bitcoin returns and ALSI returns is also linear.

Now fitting the principal regression model, quantiles are needed to fit Equation 3.2 into the data, therefore Equation 3.2 is initially fitted with $r_{stock,t(q)}$ and $r_{bonds,t(q)}$ capped at 5%, then at 2.5% and then lastly fitted at 1%.

Linear Regression Diagnostics				
	Coefficient	Standard Error	t-stat	p-value
Intercept	0.0227***	0.005	4.242	0.000
ALBI (c_1)	-0.8392*	0.531	-1.579	0.115
ALSI (b_1)	-0.1065	0.110	-0.965	0.335
ALBI $\leq$ 5% (c_2)	0.1104	0.774	0.143	0.887
ALSI $\leq$ 5% (b_2)	0.3211*	0.204	1.572	0.117

TABLE 4.1: Shows the principal regression model results when $r_{stock,t(q)}$ and $r_{bonds,t(q)}$ are equal or less than 5% of r_{stock} and r_{bonds} respectively. The significance level when the regression is run to obtain the coefficients, ***, **, * indicates 5% significance level, 10% significance level, 15% significance level, respectively.

Using R-squared, the results of fitting Equation 3.2 show that this model does not fit the data best as demonstrated by the 0.014 value of the R-squared which measures the goodness of the fit. From Table 4.1, it is evident that from Equation 3.2 b_1 and c_1 are negative implying that Bitcoin can act as a hedge for stocks and bonds. In addition, from Equation 3.2 the sum of b_1 (-0.1065) and b_2 (0.3211) is 0.2146 implying that Bitcoin is not safe haven for stocks. Furthermore, the sum of c_1 (-0.8392) and c_2 (0.1104) is -0.7288 meaning that Bitcoin does act as a safe haven for Bonds.

Linear Regression Diagnostics				
	Coefficient	Standard Error	t-stat	p-value
Intercept	0.0222***	0.005	4.308	0.000
ALBI (c_1)	-0.8974**	0.498	-1.804	0.072
ALSI (b_1)	-0.0966	0.102	-0.949	0.343
ALBI $\leq 2.5\%$ (c_2)	0.1586	0.766	0.207	0.836
ALSI $\leq 2.5\%$ (b_2)	0.4300**	0.228	1.886	0.060

TABLE 4.2: Shows the principal regression model results when $r_{stock,t(q)}$ and $r_{bonds,t(q)}$ are equal or less than 2.5% of r_{stock} and r_{bonds} respectively. The significance level when the regression is run to obtain the coefficients, ***, **, * indicates 5% significance level, 10% significance level, 15% significance level, respectively.

The results of fitting Equation 3.2 show that this model does not the best fit for the data as demonstrated by the 0.017 value of the R-squared which measures the goodness of the fit. From Table 4.2, it is evident that from Equation 3.2 b_1 (-0.0966) and c_1 (-0.8974) are negative implying that Bitcoin can act as a hedge for stocks and bonds. In addition, from Equation 3.2 the sum of b_1 (-0.0966) and b_2 (0.4300) is 0.3334 implying that Bitcoin does not act as a safe haven for stocks. Furthermore, the sum of c_1 (-0.8974) and c_2 (0.1586) is -0.7388 meaning that Bitcoin does act as a safe haven for Bonds.

Linear Regression Diagnostics				
	Coefficient	Standard Error	t-stat	p-value
Intercept	0.0222***	0.005	4.431	0.000
ALBI (c_1)	-0.8438**	0.465	-1.814	0.070
ALSI (b_1)	-0.1286	0.095	-1.347	0.178
ALBI $\leq 1\%$ (c_2)	-0.1270	0.786	-0.162	0.872
ALSI $\leq 1\%$ (b_2)	0.9930***	0.279	3.559	0.000

TABLE 4.3: Shows the principal regression model results when $r_{stock,t(q)}$ and $r_{bonds,t(q)}$ are equal or less than 1% of r_{stock} and r_{bonds} respectively. The significance level when the regression is run to obtain the coefficients, ***, **, * indicates 5% significance level, 10% significance level, 15% significance level, respectively.

The results of fitting Equation 3.2 show that this model does not fit the data best as demonstrated by the 0.036 value of the R-squared which measures the goodness of the fit. From Table 4.2, it is evident that from Equation 3.2 b_1 (-0.1286) and c_1 (-0.8438) are negative implying that Bitcoin can act as a hedge for stocks and bonds. In addition, from Equation 3.2 the sum of b_1 (-0.1286) and b_2 (0.9930) is 0.8644 implying that Bitcoin does not act as a safe haven for stocks. Furthermore, the sum of c_1 (-0.8438) and c_2 (-0.1270) would surely sum up to a negative value meaning that Bitcoin does act as a safe haven for Bonds when there is an extreme shock to the financial market.

The monthly historical returns also show similar results as in weekly historical returns presented above in this chapter. These results can be seen in section A.1, which shows that Bitcoin can act as a hedge for stocks and bonds, also it can act as a safe haven for bonds but not for stocks.

Model results obtained from running quarterly historical data are shown in section A.2 are somewhat different to the model results from weekly and monthly historical data. In section A.2, these results show that Bitcoin acts as a hedge for bonds which is in agreement with the already observed results, furthermore, these results do not show Bitcoin as a hedge for stocks. Regarding Bitcoin acting as a safe haven for stocks and bonds, quarterly historical data model results in section A.2 show

that Bitcoin does not act as a safe haven for bonds or stocks. These observed differences between quarterly, weekly and monthly data ran model results are discussed in the results summary with a possible explanation as to why these differences may exist.

The p-values observed in all the tables presented in this document show that the null hypothesis that b_1 , b_2 , c_1 and c_2 values are zero can not be rejected. The reason is that, generally, the significance value is 5% meaning that p-values less than the significance would be strong evidence to reject the null hypothesis. Since the p-values observed in this study are above the normally used significance this means there is a high likelihood that these coefficients are indeed zero in the population.

4.1 Summary of Results

The data cleaning procedure implemented for historical data was successful, the statistical description of this data supports the literature. The findings evidenced in [Table 3.1](#) supports the theory that ALBI is less volatile and that Bitcoin is extremely volatile, as the returns are also high for Bitcoin and lower for bonds. [Figure 4.1](#) and [Figure 4.2](#) show that plotting Bitcoin returns against ALBI and ALSI returns, the points are concentrated around the means of each variable plotted. The principal regression model results from weekly and monthly historical data agree with each other that Bitcoin acts as a hedge against stocks and bonds in South Africa, and additionally, Bitcoin also acts as a safe haven for bonds but does not act as a safe haven for stocks. The model results from quarterly historical data are only consistent with the model results from weekly and monthly historical data on Bitcoin acting as a hedge against bonds but does not support that Bitcoin acts as a hedge against stocks nor Bitcoin acting as a safe haven for stocks and bonds.

Chapter 5

Conclusion

This study probed Bitcoin to understand its uses as a hedge or a safe haven asset against South African stocks and bonds. Bitcoin is the cryptocurrency of choice due to its largest market capitalisation compared to other cryptocurrencies such as Ethereum, Binance, etc. Using a principal regression model to study the relationship between Bitcoin returns and South African securities, the results of this study suggest that Bitcoin is a hedge for bonds. This result was consistently observed amongst all the historical datasets that were studied. In addition, Bitcoin and bonds show to be inversely proportional to each other, satisfying the properties of a hedge. The results presented in this study are not entirely consistent in supporting the hypothesis that Bitcoin acts as a hedge against stocks, this is because the model results from weekly and monthly historical data support the hypothesis but the model results from quarterly historical data contradict this hypothesis. The hypothesis that Bitcoin acts as a safe haven for bonds or stocks is also not consistently supported, the model results from weekly and monthly historical data support this hypothesis but again the results from quarterly historical data do not support the hypothesis. The results from this study will form part of the literature on hedges and safe-haven assets in South Africa. These results are consistent with the study done by A. Stensens, M. Nygaard, K. Kyaw and S. Treepongkaruna [29], where they showed that Bitcoin was a hedge for developing markets. In addition, safe haven results presented in this document are also consistent with [29] as it is shown that Bitcoin acts as a safe haven for some markets but not all.

The findings of this study have implications for investors who may be interested in or investing in the South African market. These results show to some extent that there is a possibility of gain in holding Bitcoin during times of uncertainty or generally holding Bitcoin against stocks and bonds. Finally, the results of this study

should be an eye opener for the South African financial regulators to change their stance on cryptocurrencies being a financial asset as there is evidence that suggests cryptocurrencies can be used by investors.

5.1 Future Work

The importance of this study was demonstrated in the results presented above. Also in addition this study showed that more studies need to be done since the data sets explored in this study did not show a consistent result on Bitcoin's ability to act as a hedge against stocks and Bitcoin's ability to act as a safe haven for stocks and bonds. This disagreement may have been caused by fewer data points for the quarterly historical data since this dataset had only 36 data points. This problem could be solved by waiting a few years and accumulate around 116 quarters then redo this study and also studying bi-annual returns historical data. Another approach to this study could be to create an index of a weighted average for the top-performing cryptocurrencies as it was done to create the ALSI and ALBI. This cryptocurrency index could be less volatile and possibly have better hedging properties.

Bibliography

- [1] Edmund Mokhtarian and Alexander Lindgren. "Rise of the Crypto Hedge Fund: Operational Issues and Best Practices for an Emergent Investment Industry". In: *Stan. JL Bus. & Fin.* 23 (2018), p. 112.
- [2] Ujan Mukhopadhyay, Anthony Skjellum, Oluwakemi Hambolu, Jon Oakley, Lu Yu, and Richard Brooks. "A brief survey of cryptocurrency systems". In: *2016 14th annual conference on privacy, security and trust (PST)*. IEEE. 2016, pp. 745–752.
- [3] Andrew Urquhart and Hanxiong Zhang. "Is Bitcoin a hedge or safe haven for currencies? An intraday analysis". In: *International Review of Financial Analysis* 63 (2019), pp. 49–57.
- [4] *Today's Cryptocurrency Prices by Market Cap*. <https://coinmarketcap.com/>. Accessed: 2021-04-10.
- [5] Daniele Bianchi and Mykola Babiak. "On the performance of cryptocurrency funds". In: *Journal of Banking & Finance* 138 (2022), p. 106467.
- [6] *NEW RESEARCH FROM FIDELITY® FINDS INSTITUTIONAL INVESTMENTS IN DIGITAL ASSETS ARE LIKELY TO INCREASE OVER THE NEXT FIVE YEARS*. https://s2.q4cdn.com/997146844/files/doc_news/archive/59439969-390c-4354-94a9-772219d0b8b9.pdf. Accessed: 2022-07-25.
- [7] *3rd Annual Global Crypto Hedge Fund Report 2021*. [https://www.pwc.com/gx/en/financial-services/pdf/3rd-annual-pwc-elwood-aima-crypto-hedge-fund-report-\(may-2021\).pdf](https://www.pwc.com/gx/en/financial-services/pdf/3rd-annual-pwc-elwood-aima-crypto-hedge-fund-report-(may-2021).pdf). Accessed: 2022-07-26.
- [8] *List of Crypto Funds Included below are hedge funds and venture capital investing in crypto and blockchain. The list contains more than 800 crypto funds*. <https://cryptofundresearch.com/list-of-crypto-funds/>. Accessed: 2022-07-26.

- [9] *Report: South Africa ranks 21st in crypto ownership*. <https://www.itnewsafrika.com/2022/01/report-south-africa-ranks-21st-in-crypto-ownership/>. Accessed: 2022-07-28.
- [10] *New cryptocurrency regulations in South Africa*. <https://www.finglobal.com/2021/07/23/new-cryptocurrency-regulations-in-south-africa/>. Accessed: 2022-07-28.
- [11] Shakill Hassan et al. "South African capital markets: An overview". In: (2013).
- [12] *Today's JSE Market Cap*. <https://www.moneyweb.co.za/tools-and-data/click-a-company/JSE/>. Accessed: 2022-01-28.
- [13] Sinazo Guduza and Andrew Phiri. "Efficient Market Hypothesis: Evidence from the JSE equity and bond markets". In: (2017).
- [14] Rajeswari Sengupta and Vaibhav Anand. "Corporate debt market in India: Lessons from the South African experience". In: (2014).
- [15] *Debt Market*. <https://www.jse.co.za/trade/debt-market>. Accessed: 2022-01-31.
- [16] Omokolade Akinsomi, Mehmet Balcilar, Rıza Demirer, and Rangan Gupta. "The effect of gold market speculation on REIT returns in South Africa: a behavioral perspective". In: *Journal of Economics and Finance* 41.4 (2017), pp. 774–793.
- [17] *Bitcoin is growing in South Africa*. <https://www.bitcoinzar.co.za/bitcoin-is-growing-in-south-africa/>. Accessed: 2022-08-7.
- [18] Eng-Tuck Cheah and John Fry. "Speculative bubbles in Bitcoin markets? An empirical investigation into the fundamental value of Bitcoin". In: *Economics letters* 130 (2015), pp. 32–36.
- [19] Pengfei Wang, Wei Zhang, Xiao Li, and Dehua Shen. "Is cryptocurrency a hedge or a safe haven for international indices? A comprehensive and dynamic perspective". In: *Finance Research Letters* 31 (2019), pp. 1–18.
- [20] Alexander Eisl, Stephan M Gasser, and Karl Weinmayer. "Caveat emptor: Does Bitcoin improve portfolio diversification?" In: *Available at SSRN 2408997* (2015).

- [21] Jamal Bouoiyour and Refk Selmi. "Ether: Bitcoin's competitor or ally?" In: *arXiv preprint arXiv:1707.07977* (2017).
- [22] Nathaniel Popper. *Digital gold: The untold story of Bitcoin*. Penguin UK, 2015.
- [23] Anne Haubo Dyhrberg. "Hedging capabilities of bitcoin. Is it the virtual gold?" In: *Finance Research Letters* 16 (2016), pp. 139–144.
- [24] Elie Bouri, Peter Molnár, Georges Azzi, David Roubaud, and Lars Ivar Hagfors. "On the hedge and safe haven properties of Bitcoin: Is it really more than a diversifier?" In: *Finance Research Letters* 20 (2017), pp. 192–198.
- [25] Tony Klein, Hien Pham Thu, and Thomas Walther. "Bitcoin is not the New Gold—A comparison of volatility, correlation, and portfolio performance". In: *International Review of Financial Analysis* 59 (2018), pp. 105–116.
- [26] Adrian Blundell-Wignall. "The Bitcoin question: Currency versus trust-less transfer technology". In: (2014).
- [27] James Titcomb. "How bitcoin has become Zimbabwe's crisis currency". In: *The Telegraph* (2017).
- [28] Rob Urban. "Bitcoin is the new crisis currency". In: *Bloomberg November* 16 (2017).
- [29] Anders Stensås, Magnus Frostholt Nygaard, Khine Kyaw, and Sirimon Trepongkaruna. "Can Bitcoin be a diversifier, hedge or safe haven tool?" In: *Cogent Economics & Finance* 7.1 (2019), p. 1593072.
- [30] Dirk G Baur and Brian M Lucey. "Is gold a hedge or a safe haven? An analysis of stocks, bonds and gold". In: *Financial Review* 45.2 (2010), pp. 217–229.
- [31] Afees A Salisu, Ibrahim D Raheem, and Umar B Ndako. "The inflation hedging properties of gold, stocks and real estate: A comparative analysis". In: *Resources Policy* 66 (2020), p. 101605.
- [32] Cetin Ciner, Constantin Gurdgiev, and Brian M Lucey. "Hedges and safe havens: An examination of stocks, bonds, gold, oil and exchange rates". In: *International Review of Financial Analysis* 29 (2013), pp. 202–211.
- [33] Yudhvir Seetharam, Lauren Bodington, et al. "Gold in the South African market: A safe haven or hedge". In: *Applied Economics Quarterly* 61.4 (2015), pp. 331–352.

- [34] Katleho Makatjane and Ntebogang Moroke. "Predicting Extreme Daily Regime Shifts in Financial Time Series Exchange/Johannesburg Stock Exchange—All Share Index". In: *International Journal of Financial Studies* 9.2 (2021), p. 18.
- [35] Dirk G Baur, Kihoon Hong, and Adrian D Lee. "Bitcoin: Medium of exchange or speculative assets?" In: *Journal of International Financial Markets, Institutions and Money* 54 (2018), pp. 177–189.
- [36] Gerald P Dwyer. "The economics of Bitcoin and similar private digital currencies". In: *Journal of financial stability* 17 (2015), pp. 81–91.
- [37] Timothy B Lee. *Four reasons Bitcoin is worth studying*. 2013.
- [38] François R Velde. "Bitcoin: A primer, the federal reserve bank of chicago". In: *Chicago Fed Letter (Dec. 2013)* (2013).
- [39] *Bitcoin/U.S. Dollar*. <https://www.tradingview.com/chart/>. Accessed: 2022-02-01.
- [40] *Headline*. <https://www.jse.co.za/headline>. Accessed: 2022-02-01.

Appendix A

Monthly and Quarterly Model Results

A.1 Monthly Historical Returns Results

Linear Regression Diagnostics				
	Coefficient	Standard Error	t-stat	p-value
Intercept	0.0932	0.024	3.881	0.000
ALBI	-1.7691	1.494	-1.184	0.239
ALSI	-0.5191	0.731	-0.710	0.479
ALSI $\leq$ 5%	1.5531	1.490	1.042	0.299
ALBI $\leq$ 5%	1.2938	2.544	0.509	0.612
R ²	0.024			

TABLE A.1: Shows the principal regression model results when $r_{stock,t(q)}$ and $r_{bonds,t(q)}$ are equal or less than 5% of r_{stock} and r_{bonds} , respectively, for monthly historical returns.

Linear Regression Diagnostics				
	Coefficient	Standard Error	t-stat	p-value
Intercept	0.0876	0.023	3.770	0.000
ALBI	-1.3007	1.334	-0.975	0.332
ALSI	-0.3989	0.687	-0.581	0.563
ALSI $\leq 2.5\%$	1.4857	1.573	0.944	0.347
ALBI $\leq 2.5\%$	0.6162	2.770	-0.975	0.332
R ²	0.018			

TABLE A.2: Shows the principal regression model results when $r_{stock,t(q)}$ and $r_{bonds,t(q)}$ are equal or less than 2.5% of r_{stock} and r_{bonds} , respectively, for monthly historical returns.

Linear Regression Diagnostics				
	Coefficient	Standard Error	t-stat	p-value
Intercept	0.0847	0.023	3.682	0.000
ALBI	-1.2692	1.270	-1.000	0.320
ALSI	-0.2089	0.707	-0.295	0.768
ALSI $\leq 1\%$	0.8379	1.887	0.444	0.658
ALBI $\leq 1\%$	1.1243	3.516	0.320	0.750
R ²	0.012			

TABLE A.3: Shows the principal regression model results when $r_{stock,t(q)}$ and $r_{bonds,t(q)}$ are equal or less than 1% of r_{stock} and r_{bonds} , respectively, for monthly historical returns.

A.2 Quarterly Historical Returns Results

Linear Regression Diagnostics				
	Coefficient	Standard Error	t-stat	p-value
Intercept	0.2464	0.024	2.552	0.016
ALBI	-3.0950	3.821	-0.810	0.424
ALSI	3.1801	2.606	1.220	0.232
ALSI $\leq 5\%$	1.8978	6.737	0.282	0.780
ALBI $\leq 5\%$	5.7584	6.697	0.860	0.397
R ²	0.083			

TABLE A.4: Shows the principal regression model results when $r_{stock,t(q)}$ and $r_{bonds,t(q)}$ are equal or less than 5% of r_{stock} and r_{bonds} , respectively, for quarterly historical returns.

Linear Regression Diagnostics				
	Coefficient	Standard Error	t-stat	p-value
Intercept	0.2255	0.091	2.482	0.019
ALBI	-2.9283	3.496	-0.838	0.409
ALSI	3.8166	2.512	1.519	0.139
ALSI $\leq 2.5\%$	-0.9436	7.302	-0.129	0.898
ALBI $\leq 2.5\%$	7.7982	7.388	1.055	0.300
R ²	0.093			

TABLE A.5: Shows the principal regression model results when $r_{stock,t(q)}$ and $r_{bonds,t(q)}$ are equal or less than 2.5% of r_{stock} and r_{bonds} , respectively, for quarterly historical returns.

Linear Regression Diagnostics				
	Coefficient	Standard Error	t-stat	p-value
Intercept	0.2255	0.091	2.482	0.019
ALBI	-2.9283	3.496	-0.838	0.409
ALSI	3.8166	2.512	1.519	0.139
ALSI $\leq 1\%$	-0.9436	7.302	-0.129	0.898
ALBI $\leq 1\%$	7.7982	7.388	1.055	0.300
R^2	0.093			

TABLE A.6: Shows the principal regression model results when $r_{stock,t(q)}$ and $r_{bonds,t(q)}$ are equal or less than 1% of r_{stock} and r_{bonds} , respectively, for quarterly historical returns.