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Are Stable Coins Stable? Stable Coins' Exposure to Cryptocurrency and Financial Market Volatility

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Stable Coins' Exposure to Cryptocurrency and Financial Market Volatility

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Abstract

Stable coins are the nonvolatile assets that assist cryptocurrency investors in hedging from the volatility of the market. These coins have market capitalizations worth billions of US dollars and are relied on throughout the world to store funds without risk. However, there have been instances in the past of stable coins failing and wiping out billions from the market. In this analysis, I examine the exposure that the four largest stable coins have to market movements in both cryptocurrency markets and traditional financial markets. I find that one stable coin, DAI is the only coin that has no correlation or granger-causal relationships with either market. Tether is found to have a statistically significant correlation with the S&P 500, and the S&P 500 granger-causes price returns in USDC. Finally, there was a statistically significant correlation between cryptocurrency market price returns and the price returns of BUSD. These results show that DAI is the most trustworthy cryptocurrency in hedging from market risks. The research displays weaknesses that each coin has that investors should take into account when investing.

Introduction and Background

In this research paper, I will analyze the impact that the cryptocurrency market and traditional financial markets have on the price movements of stable coins. Stable coins are cryptocurrencies pegged to a constant value and are pillars that hold up the market in periods of volatility. Creators and users of these coins claim that they are stable and won't deviate from their pegged value, but it is necessary to test these assumptions. If stable coins are vulnerable to market changes in cryptocurrencies and the S&P 500, it could wipe out a considerable amount of investors' money and leave investors with no exit strategy. To test this relationship, I used OLS regressions and Granger-Causal tests to determine whether there is co-movement between stable coins, the cryptocurrency market, and the equity market.

Since its inception in 2009, Bitcoin has created waves that have rippled throughout financial markets. Bitcoin was the first cryptocurrency created and it led to a new form of technology and financial asset. To understand the motivation for this topic, it is important to first understand the technology that stable coins were built on.

A cryptocurrency is, "a digital or virtual currency secured by cryptography, which makes it nearly impossible to counterfeit or double- spend" (Investopedia, 2023). Cryptocurrencies act as the gas that makes blockchain technology run. Cryptocurrencies facilitate transactions, pay settlement fees, and clear software execution. The technology that facilitates this is blockchain. Blockchain is, "a distributed ledger enforced by a disparate network of computers"(Investopedia, 2023). In other words, Blockchain is a group of individual computers throughout the world, who confirm and process transactions that occur by users of the platform. They then each have a correct ledger of all transactions that have occurred on the platform and are able to verify each other's ledgers. These computers choose to participate in the blockchain because they get paid by

the native cryptocurrency on the platform. If they don't verify other transactions, or have a correct ledger of their own, they aren't allowed to participate in transaction settlement, thus removing their monetary incentive. This was the creation of a peer-to-peer financial network.

The creation of blockchain was in direct response to the 2008 financial crisis, in which bank failures caused waves of panic and distrust with large, centralized banks. The idea of blockchain was to remove a central intermediary to process transactions. This then created a trustworthy platform to transact or hold money without fear of losing your deposits. It erased the possibility of human error that people feared. Blockchain platforms had been theorized for some time prior to Bitcoin, but Bitcoin was the first real world use case. The innovation that was Bitcoin spurred more innovation and use cases for blockchain.

The large innovation in blockchain that followed Bitcoin was the new blockchain based platform, Ethereum. Ethereum is, "a decentralized blockchain platform that establishes a peer-to-peer network that securely executes and verifies application code, called smart contracts"(AWS Blockchain, 2023). The platform took the initial Bitcoin concept and instead of only facilitating transactions, Ethereum allowed applications to be built on its platform, and the blockchain would settle the executions of code. This step taken by Ethereum lead to an explosion in development in cryptocurrencies. New blockchains that mimicked or improved upon Ethereum developed, like Solana, Cardano, and Binance. Developers also began creating applications on Ethereum's platform. These applications would use their own tokens that they created to for use on their platform. For example, a cryptocurrency exchange, Uniswap, has distributed tokens to many people who provide staking for the platform. Uniswap is a financial exchange with no central authority, and relies on community members to lend, or "stake", their cryptocurrencies, so that users can trade with the pool of cryptocurrencies that are staked. Uniswap then created a token

and distributed it to the lenders, and like a stock, it gave users partial ownership of the platform. It allows Uniswap token holders to vote on future decisions for the platform, with weight given to how much they own. The Uniswap token is also traded on different exchanges now. This is one example of a token that has been created on Ethereum, but thousands of others have been developed for their own purposes. The explosion in tokens and new blockchains created many new cryptocurrencies that would be used, traded, and develop their own price on the open market.

As mentioned, the thousands of cryptocurrencies and tokens that were created began to be traded on the open market. Either investors who believed in projects, or from those who were trading the coins for quick profits, many people jumped into the market. The early days of cryptocurrency trading has many stories of investors who saw enormous gains, and others who dealt with devastating losses. This was because the market was incredibly volatile. This volatility appealed to some people but posed a problem to the legitimacy of cryptocurrency in the future. If cryptocurrencies wanted to be treated as true currencies, the markets needed to find a way to solve that problem.

The solution that eventually rose to solve these problems were stable coins. Stable coins are cryptocurrencies that are backed by fiat currencies and pegged to a certain value, typically the US dollar or the Euro. These stable coins provided a safe haven for investors within digital assets. Depending on the stable coin, because there are many, they maintain their peg in different ways. First, centralized stable coins are stable coins that are backed 1-to-1 with the fiat currency it lists at. Three of the stable coins I use in this study, Tether, USDC, and BUSD, are centralized stable coins. To maintain their peg, centralized stable coins rely on trader arbitrage. From Tether's website, "It has maintained its peg because every USDT is redeemable for dollars via

Tether, and as such any time the price goes below 1$ investors can earn a profit by buying USDT for a discount and redeeming it with Tether"(Tether, 2023). On the flip side, if USDT's value is higher than 1$ investors can purchase them from Tether at a discount. This arbitrage-based stability has been able to maintain the coins' pegs. The second type of stable coin we study are algorithmic stable coins. One stable coin within this study is algorithmic, DAI. As opposed to centralized stable coins that are collateralized by a business off the blockchain, algorithmic stable coins exist purely on the blockchain and are run by the smart contracts (code) that were mentioned before. DAI is created when investors provide the smart contracts with collateral, the DAI is then destroyed when the DAI is returned for the collateral. The DAI peg relies on both investor arbitrage and ownership of collateral provided, if the price of the collateral drops too far, DAI will auction off your collateral to protect the DAI price.

Having completed the descriptions and definitions of different aspects of the blockchain and cryptocurrencies, it is necessary to discuss stable coins' importance. Stable coins have facilitated growth and protected investors from market volatility. Investors trust in the value of these coins to maintain the value of their money. Even though these stable coins claim that they can maintain their peg, it is important to test this claim. If the tests were to find that stable coins were not in fact insulated from the greater cryptocurrency market and other financial markets, it would pose a serious problem for holders of the currencies. For example, if the price of Bitcoin were to significantly drop due to market worry, many investors would exit their Bitcoin positions and enter a stable coin to save their money, for the sake of example, say Tether. With a massive influx of funds, the natural progression would be for Tether to raise in price due to the increased demand, however, the stable coin should never move away from its given peg, and if it were to, it would lose investors trust. A stable coin losing its peg to market swings is something that

should not be able to occur, and the instances of a stable coin losing its peg in the past have been damaging to markets. It is necessary to test the assumption that stable coins can shield themselves from market volatility.

There have been instances in the past of a stable coin losing its peg. One that occurred recently was the Terra USD stable coin. To create an ecosystem that supported a native currency and a stable coin, the Terra Luna system was born. Luna was the native currency, and Terra (UST) was the stable coin. Terra was an algorithmic stable coin, but it was non-collateralized. Instead, it used complex algorithms and paired with Luna to maintain its 1$ peg price. As per the algorithm, one Terra was always redeemable for 1$ worth of Luna. The beginning of the crash for Terra started when a large holder of Terra sold hundreds of millions of Terra in an instant and depressed the price to 0.91$, then, many Terra holders began redeeming their Terra for Luna, as to arbitrage the system, but given the shakeup that the Terra sale had in the market, Luna prices started falling along with the greater market. The market capitalization for Luna soon fell below that of Terra, and thus, the exchange principle between Luna and Terra became null, and investors lost confidence in the coins. Luna was among the top ten cryptocurrencies in the world before the loss of peg, and in a short time, the combined coins lost 99.9% of their value, with UST collapsing from 1$ to 0.022$, and Luna collapsing from 80$ to a very small fraction of a cent. This loss of peg from Terra ultimately caused a 36-billion-dollar loss in the value of Luna, and an 18-billion-dollar loss in Terra. This is an example of why it is imperative that a stable coin cannot lose its peg. With the volatility that already exists within the crypto markets, billions of dollars can be wiped out within a week. Testing the current most popular stable coins against historical cryptocurrency and equity market data will provide us with an answer on how much the stable coins are affected by the larger market and if investors should place trust within them.

To test stable coins' trustworthiness, I tested the daily price returns of the coins against the daily price returns of two indicator indexes; the Bitwise 10 Cryptocurrency index, which weights the top ten cryptocurrencies excluding stable coins by market capitalization, and the S&P 500 Index as an equity markets indicator. Using regressions, the goal is to test if the main stable coins could be affected by the price swings of large cryptocurrencies and typical financial markets. If they can be affected by changes in those markets, it would be a deduction from the trustworthiness of the coin and be an indicator of risk in the future. If the stable coins are not affected by any price changes, then they are shielded well from the markets and provide a trustworthy hedge for investors from volatility.

To test this question, I took the daily price data for the majority of each stable coin's lifetime and the corresponding prices of the indexes. The daily price returns were calculated and used as the testing values for our variables. To test out are hypothesis that there is no correlation between the dependent and independent variables price returns, I used a time series OLS regression for same day price movements, and Granger-Causal tests to determine if previous price returns impacted future ones.

The results of the tests showed that Tether had a significant relationship with the third order lag of the S&P 500. It was also found that the S&P 500 granger-caused price returns in USDC. The Bitwise 10 Cryptocurrency index had a significant correlation with the price returns of BUSD, both in the original variable and the first order lag. And DAI was shown to have no significant correlation or granger-causal relationship with any of the independent variables.

What does this explain? The results show us that DAI is the most effective stable coin for shielding yourself from financial and cryptocurrency volatility, as they have no relationships with either of them. As for Tether and USDC, you would be exposing yourself to financial

market risk by using them, and in USDC's case, not just a correlation in price returns, but the S&P granger-causing price changes in the stable coin. Using BUSD would expose you to changes in the cryptocurrency market, in a way that other stable coins don't have. As an average investor, my recommendation would be to use DAI to have a true market hedge, if you are comfortable with the algorithmic stable coin that it is. As for the other stable coins, they are still usable, but I would acknowledge the risks that come with each of them before investing. Despite their claim of stability, these coins do face risks in the market.

For the rest of this research paper, I will begin by explaining the relevant literature in the field, including the details of what has been studied and how my research adds to it. From there, I will explain my data and how I will test it for my research. Next, I will move into the findings of the tests and their impact, while adding a conclusion at the end to discuss the value of the results.

Literature Review

My work focuses on the exposure stable coins face against the greater cryptocurrency market and financial markets. Within the field of study there are several sections that are relevant to my research topic. Much research has been done regarding the co-movement of cryptocurrencies. The assets have historically moved in similar directions and the market tends to act as a single unit. Because of this research, it has also been explored whether stable coins have moved in a similar direction, or whether the coins move against the market. This topic is relevant to my research because it tests similar aspects of the market. Along with this, research has been done testing if stable coins can maintain their peg, although the factors that are studied vary from paper to paper. Finally, much research and thought has been poured into the concept of algorithmic stable coins and if they are truly capable of creating a system of money purely from software. The following sections will provide more detail on said work.

As mentioned earlier, cryptocurrencies are a historically volatile asset, and that volatility isn't unique to one currency. In fact, not only do most cryptocurrencies face volatility, but they also face shared volatility as the movements in one cryptocurrency can affect price changes within many others. As the largest cryptocurrency in the world by market capitalization, Bitcoin has been shown to be a dominant contributor to market spillover effects, and Bitcoin price swings will affect the prices of other cryptocurrencies (Koutmos, 2018). Despite Bitcoin being the largest contributor to market spillover, it has been found that even smaller capitalized currencies are able to influence the prices of more substantial coins (Bouri et al., 2019). And that while investors hope that the growth in the number of currencies will decrease this effect, for now the currencies have become more interdependent on one and other(Koutmos, 2018).

This begs the question, if the stable coins that make up a large portion of the daily trading volumes are a part of this heavily connected market, will they move in a similar way to the other assets? And if they can be significantly impacted by the market, it could highlight a risk of failure. If a stable coin were to fail, it would cause distrust not only in that single coin, but within the market as a whole. When the failure of the Luna and Terra ecosystem occurred, the damage wasn't only financial, but also the trustworthiness of stable coins(Briola et al., 2023). Stable coins must be able to maintain their price throughout the sways of the market.

Even though stable coins have faced distrust, several papers have researched the value of stable coins for the market and why they are so necessary. The introduction of stable coins has increased overall liquidity in cryptocurrency markets and thus reduced the volatility of the asset class (Wei, 2018). This additional liquidity has provided a much more stable and safer environment for investors and traders (Kołodziejczyk & Jarno, 2020). This stability is the most important aspect stable coins have provided the market and investors trust in that stability and turn to the them when there is increased volatility in cryptocurrency markets(Łęt et al., 2023)(Baur & Hoang, 2021). This belief is reflected by survey participants on the Ethereum blockchain, in which 60% of them reported they prefer stable coins to the US dollar (Jin et al., 2023). Stable coins have proved to be a valuable asset on the blockchain, and determining the weaknesses they may face, to protect them against future failures is essential.

Different types of stable coins have been studied to determine which would be most effective in providing a trustworthy coin. Some research posits that tokenized 1:1 fiat backed stable coins; like Tether, USDC, and BUSD, are the most effective in maintaining their peg (Jarno & Kołodziejczyk, 2021). The simplicity of the asset is what makes it much more trustworthy in the long term as it doesn't face similar software risks that an algorithmic coin may

face. It should be noted, however, that tokenized stable coins like Tether must be paired with a market that is able to effectively arbitrage their prices. Tether struggled to maintain its peg initially, until they moved their distribution protocol to the Ethereum blockchain, which reduced deviations from the peg by half (Lyons & Viswanath-Natraj, 2023). It was also determined that tokenized stable coins are safer when pegged to a fiat currency like the dollar, rather than a commodity, like gold (Wang et al., 2020).

Despite the support that tokenized stable coins receive; others believe the future of currency to be algorithmic stable coins. Coins that use mathematics and coding to adjust for changes in supply and demand to maintain their peg (Cong et al., 2020). Those who believe in the idea of decentralization and the blockchain, believe that the only way forward is with algorithmic coins. And it has been shown that the coins have shown protocol similarities to that of a tokenized stable coin like Tether (Gadzinski et al., 2022). However, algorithmic stable coins have faced backlash from others, particularly non-collateralized ones. Some believe that algorithmic coins are fundamentally unable to achieve stability. They require demand to be operational, they require independent arbitragers, and reliable price information always; and without this they fail (Clements, 2021). Despite, the push back, many other researchers are continuing to study the field of algorithmic stable coins (Zhao et al., 2021). Due to the difference in opinions that parties on both sides of the stable coin sides make, it is important to use both tokenized stable coins and algorithmic ones in out testing process.

Despite the focus that we will be taking into the risk's stable coins face, there are many other factors that can impact their prices. Devaluation of a stable coin can stem from investor distrust in the company backing a coin or the underlying smart contracts (Lyons & Viswanath-Natraj, 2023). Macroeconomic, legal, and regulatory risk also pose a distinct threat to stable

coins' future, which was shown in the recent failure of Silicon Valley Bank and its effect on USDC (Sood et al., 2023). Others have shared in the belief that future regulatory changes or requirements pose the largest threat, not only to stable coins but to all cryptocurrencies (Arner et al., 2020). Unfortunately, it is impossible to weigh in every single potential risk into one study, however, it is important or keep in mind the other factors that can affect a stable coin peg outside of price swings.

This paper aims to add to the literature on the stability of stable coins. Other studies have looked at the ability of stable coins to maintain their peg. Using recent data, I have been able to further the research done on stable coin stability, using cryptocurrency and equity markets as the risk factors that could affect the price.

Data

For my regressions, I have gathered data from a variety of sources to provide the most accurate depiction of the digital asset landscape as possible. The data gathered is price and trading data from 12/10/2020 to 3/22/2023. The first date indicates the creation of the Bitwise 10 Cryptocurrency index, the youngest asset of the group, and the final date is the day that regressions were ran. My data was pulled from Yahoo Finance and CoinMarketCap.com. Because digital asset trading takes place on both centralized and decentralized exchanges and each asset can have a trading pair with hundreds of other digital assets, the data needs to be aggregated by Yahoo Finance and CoinMarketCap.com to be useable. They calculate the trading volume as the volume weighted average of all an asset's pairings, converted to USD. This aggregation provides us with accurate trading volume data that can be used within a regression.

My dependent variables are the four largest stable coins that exist on the digital asset market as of April 20th, 2023, and they were chosen for that reason. They are as follows: Tether (USDT), Circle (USDC), Binance (BUSD), and Dai (DAI). These different stable coins will provide us with a mix of both tokenized coins and algorithmic coins.

Tether (USDT) is the largest stable coin in the world as of April 20th, 2023, with a market capitalization of 81.45 billion dollars. As mentioned earlier, Tether is a tokenized stable coin that is controlled by a centralized company off the blockchain rather than a decentralized network on the blockchain. Tether initially began as Real Coin in 2014 but rebranded to Tether in 2017 and has since maintained that title. Their presence as the largest stable coin hasn't come without controversy though, as they have faced questions about their claims that every single USDT is backed by one USD. Despite this, Tether remains the premier stable coin issuer in the world.

USDC is the second largest stable coin in the world, and the fifth largest cryptocurrency in the world as of April 20th, 2023. USDC was created by the company Circle and is pegged to the dollar and their coin is backed fully by both US dollar reserves and short-term US treasury bonds. A unique aspect of USDC is that they have been compliant with regulatory firms and have a transparent accounting system. Recently, however, the coin came under scrutiny as it lost its peg in March of 2023. Circle held some of its assets within Silicon Valley Bank, and when that failed, investors lost faith and depressed the prices. Despite the worry investors had, USDC has since restabilized its peg and is operating on the blockchain.

Binance USD (BUSD) is the third largest stable coin in the world as of April 20th, 2023, with a market capitalization of 6.5 billion dollars. Binance created their 1:1 backed stable coin in 2019 and is regulated by the New York State Department of Financial Services. Binance holds all their collateral in the United States and is supported by cash and cash equivalents as well as US treasuries.

DAI is the fourth largest stable coin in the world as of April 20th, 2023, with a market capitalization of 4.9 billion dollars. DAI is the only algorithmic stable coin within our study and runs it smart contracts on the Ethereum blockchain. The DAI protocol was launched in 2019 by decentralized autonomous organization, which means that there is no owner or company backing it, but participants who make decisions within the protocol by voting on changes and executing smart contacts. DAI collateralizes its stable coin with 150% backing of a select few cryptocurrencies and has maintained its peg well. Despite this, DAI has faced scrutiny due to its algorithmic backing.

The independent variables used to evaluate the market will be two indices, the Bitwise 10 Cryptocurrency Index, and the S&P 500. These two indices will be indicators for both the

cryptocurrency market and traditional financial markets. The Bitwise 10 Index is the ten largest cryptocurrencies in the world, weighted by market capitalization and rebalanced monthly. The S&P 500 is an index for the largest companies off the blockchain and gives an indicator to how traditional markets are moving. These two indices will give us good markers to test our stable coins against. Exhibit 1 provides a summary table of the data gathered.

Exhibit 1: Data Summary

Summary	Observations	Mean	Std. Dev	Min	Max
Bitwise Return	573	-0.77%	6.34%	-48.60%	46.30%
S&P 500 Return	573	0.00%	0.10%	-3.36%	4.24%
Tether Return	573	0.00%	0.06%	-0.39%	0.31%
USDC Return	573	0.00%	0.06%	-0.30%	0.79%
BUSD Return	573	0.00%	0.08%	-0.35%	0.34%
DAI Return	573	0.00%	0.17%	-1.30%	1.74%

Methodology

The methods used in evaluating the currency will be two-fold, a time-series OLS regression, and a Granger-Causal test. The time-series OLS regression will look at the co-movement between the dependent and independent variables. The Granger-Causal test will determine whether past price changes in one of the variables can impact future price returns in other variables.

Due to the nature of stable coins being centered around the peg price of 1$, the data was transformed into their daily price returns. This helps the viewer see the true day to day change in price of both stable coins and cryptocurrency. Because cryptocurrencies exist on the blockchain, there is no open and close for their price data, like the stock market may have. Instead of the typical nine-to-five market hours, the open price is the price of an asset right at the beginning of a new day, so midnight, and the close is one second before midnight. The method of using daily price returns also removed any non-stationarity from the data.

Another factor necessary to consider with the data, is the presence of autocorrelation. Prior to running our regressions, the Breusch-Godfrey test was used as a general test for autocorrelation within our errors, with a null hypothesis of no autocorrelation. In the result I found that there was an autocorrelation problem in the residuals, as the p-value was below the significance level of 5%. To combat this, lagged variables were introduced to each regression. To determine the number of lagged variables necessary per regression, I used an AIC test. This test displayed that Tether and BUSD regressions should use three lags, and USDC and DAI should use four.

Finally, I tested for the presence of heteroscedasticity. Using the Breusch-Pagan-Godfrey test, I was able to determine whether the residuals were scattered or consistent. The test results

showed that two of our dependent variables faced heteroscedasticity problems, BUSD and DAI. To combat this, I used heteroscedastic consistent robust standard errors for these two regressions. After dealing with all the assumptions, I was able to move forward with the testing process.

Results

Using the regressions and procedures explained in the methodology section, we were able to test how well our chose stable coins held up to market pressures. This section will be broken down into four parts explaining each of the stable coins' results.

Tether

Exhibit 2: Tether OLS Regression Results

Equation:

$$\text{Tether Returns} = \beta_0 + \beta_1\text{Tether Returns (lag 1)} + \beta_2\text{Tether Returns (lag 2)} + \beta_3\text{Tether Returns (lag 3)} + \beta_4\text{Bitwise Return} + \beta_5\text{Bitwise Return (lag 1)} + \beta_6\text{Bitwise Return (lag 2)} + \beta_7\text{Bitwise Return (lag 3)} + \beta_8\text{SNP 500 Return} + \beta_9\text{SNP 500 Return (lag 1)} + \beta_{10}\text{SNP 500 Return (lag 2)} + \beta_{11}*\text{SNP 500 Return (lag 3)} + \varepsilon$$

Variable	Coefficient	Std. Err
L1 Tether Return	-0.235***	0.0699
L2 Tether Return	-0.191**	0.0764
L3 Tether Return	0.100	0.0693
Bitwise Return	3.98e-05	0.00065
L1 Bitwise Return	-0.000840	0.000534
L2 Bitwise Return	-0.000213	0.000616
L3 Bitwise Return	0.000752	0.000621
SNP 500 Return	-0.00245	0.00319
L1 SNP 500 Return	-0.00360	0.00332
L2 SNP 500 Return	0.00209	0.00371
L3 SNP 500 Return	-0.00789**	0.00400

*** p<0.01, ** p<0.05, * p<0.1

Tether shows a significant correlation with one variable at a 99% confidence level, the first lag of itself, and two variables at a 95% confidence level, the second lag of Tether and the

third lag of the S&P 500. The adjusted R-squared of the test estimates that 9.92% of movement in Tether prices can be explained by the movements in the Bitwise index and the S&P 500.

The presence of correlation in the lags of Tether price returns show that the returns for one day prior, and two days prior, have a correlation with Tether's price returns, both of which are negative relationships. Holding all covariates constant, a 1% increase in the price return of Tether's first lag has a corresponding decrease of -0.23% in the price return of Tether. And if all covariates are held constant, a 1% increase in the price returns of Tether's second lag, has a corresponding -0.19% decrease in Tether price returns. While this result isn't an indicator of the market on Tether, I believe that it is a demonstration of the arbitrage style of Tether's peg. Because this stable coin requires people to find profit when it moves from the peg, the fact that it has a negative correlation with itself from a day or two prior is evidence that the system is working. If the price were to exceed one dollar, the following day it would move down to stabilize, and vice-versa.

The next significant relationship discovered is that the S&P 500 had a significant correlation with Tether in its third lag. So, holding all other covariates fixed, if the S&P 500 price returns from three days prior increase 1%, Tether will decrease a corresponding -0.0078%. This displays that there is a significant relationship between the two assets. A potential explanation could be that if things are moving in a positive direction in equity markets, people are more liable to exit their cryptocurrency holdings. However, this could not be proven without more testing and data. Tether's relationship with a market force is not a favorable result. Despite the small amount of correlation displayed, a significant correlation displays that Tether can be impacted by forces outside of itself, which is what the coin relies on being able to avoid.

Exhibit 3: Granger-Causal Tests for Tether

Equations:

$$\text{Tether Return}_t = \alpha + \beta 1\text{Bitwise Return}_t + \beta 2\text{Bitwise Return}_{t-1} + \beta 3\text{Bitwise Return}_{t-2} + \beta 4\text{Bitwise Return}_{t-3} + \varepsilon_t$$

$$\text{Tether Return}_t = \alpha + \beta 1\text{SNP 500}_t + \beta 2\text{SNP 500}_{t-1} + \beta 3\text{SNP 500}_{t-2} + \beta 4\text{SNP 500}_{t-3} + \varepsilon_t$$

Equation	Excluded	Chi2	Prob > Chi2
Tether Return	Bitwise Return	4.032	0.258
Tether Return	SNP 500 Return	5.000	0.172

The Granger-Causality test results are displayed in exhibit 3. These results show that the Bitwise Index and the S&P 500 do not Granger-cause price changes in Tether, and vice versa. None of the p-values displayed a number below the 90% confidence level. This is a favorable result for Tether and its investors as it shows that price changes in those markets do not granger-cause any price changes in stable coins and thus Tether has been able to insulate itself from that risk.

USDC

Exhibit 4: USDC OLS Regression Results

Equation:

$$\text{USDC Returns} = \beta_0 + \beta_1\text{USDC Returns (lag 1)} + \beta_2\text{USDC Returns (lag 2)} + \beta_3\text{USDC Returns (lag 3)} + \beta_4\text{USDC Returns (lag 4)} + \beta_5\text{Bitwise Return} + \beta_6\text{Bitwise Return (lag 1)} + \beta_7\text{Bitwise Return (lag 2)} + \beta_8\text{Bitwise Return (lag 3)} + \beta_9\text{Bitwise Return (lag 4)} + \beta_{10}\text{SNP 500 Return} + \beta_{11}\text{SNP 500 Return (lag 1)} + \beta_{12}\text{SNP 500 Return (lag 2)} + \beta_{13}\text{SNP 500 Return (lag 3)} + \beta_{14}\text{SNP 500 Return (lag 4)} + \varepsilon$$

Variable	Coefficient	Std. Err
L1 USDC Return	-0.269**	0.108
L2 USDC Return	-0.186	0.115
L3 USDC Return	-0.141	0.142
L4 USDC Return	0.0107	0.0519
Bitwise Return	-0.000844	0.00118
L1 Bitwise Return	-0.000648	0.000915
L2 Bitwise Return	0.000972	0.000851
L3 Bitwise Return	-0.000731	0.000990
L4 Bitwise Return	-0.00178	0.00109
SNP 500 Return	-0.00105	0.00459
L1 SNP 500 Return	0.00446	0.00449
L2 SNP 500 Return	-0.00433	0.00489
L3 SNP 500 Return	0.00612	0.00527
L4 SNP 500 Return	0.00898	0.00577

*** p<0.01, ** p<0.05, * p<0.1

Exhibit 4 displays the OLS results, in which four lags were incorporated to account for autocorrelation. The adjusted R-Squared estimates that 6.23% of the movement in USDC Returns can be explained by the independent variables. The regression shows that only one independent variable had a significant correlation with the daily price returns, and it was the price returns of USDC from the day prior. So, holding all other covariates constant, a 1% increase in the price returns of USDC one day before, corresponds with a -0.268% decrease in the price returns of USDC. The fact that USDC showed no significant correlation with either index used is a positive result for investors in USDC and shows that they are protected from correlation with other markets.

Exhibit 5: USDC Granger-Causal Test Results

Equation:

$$\text{USDC Return}_t = \alpha + \beta 1\text{Bitwise Return}_t + \beta 2\text{Bitwise Return}_{t-1} + \beta 3\text{Bitwise Return}_{t-2} + \beta 4\text{Bitwise Return}_{t-3} + \beta 5\text{Bitwise Return}_{t-4} + \varepsilon_t$$

$$USDC\ Return\_t = \alpha + \beta 1 SNP\ 500\_t + \beta 2 SNP\ 500\_t\text{-}1 + \beta 3 SNP\ 500\_t\text{-}2 + \beta 4 SNP\ 500\_t\text{-}3 + \beta 5 SNP\ 500\_t\text{-}4 + \varepsilon\_t$$

Equation	Excluded	Chi2	Prob > Chi2
USDC Return	Bitwise Return	5.268	0.261
USDC Return	SNP 500 Return	8.011	0.091*

The Granger-Causal tests are shown in Exhibit 5, which displayed interesting results. While the Bitwise index did not granger-cause changes in USDC, the S&P 500 did at a 90% confidence level. This means that changes in the S&P 500 were the root of a change in the price returns of USDC, or a granger-causality. This result highlights one of the dangers that centralized stable coins hold that an algorithmic stable coin does not, the exposure to changes in the financial market. The drop in the stock market that led Silicon Valley Bank to default impacted USDC to the point of losing its peg. This is a risk that impacted only USDC but is one that is held by other centralized stable coins. Being a bridge between traditional finance and blockchain finance exposes these stable coins to both risks. And this is a problem that could become more prevalent, with recent economic downturn and regulatory changes looming, these centralized stable coins face challenges in the future that could be harmful to investors and the market.

BUSD

Exhibit 6: BUSD OLS Regression Results

Equation:

$$BUSD\ Returns = \beta_0 + \beta_1 BUSD\ Returns\ (lag\ 1) + \beta_2 BUSD\ Returns\ (lag\ 2) + \beta_3 BUSD\ Returns\ (lag\ 3) + \beta_4 Bitwise\ Return + \beta_5 Bitwise\ Return\ (lag\ 1) + \beta_6 Bitwise\ Return\ (lag\ 2) + \beta_7 Bitwise\ Return\ (lag\ 3) + \beta_8 SNP\ 500\ Return + \beta_9 SNP\ 500\ Return\ (lag\ 1) + \beta_{10} SNP\ 500\ Return\ (lag\ 2) + \beta_{11} * SNP\ 500\ Return\ (lag\ 3) + \varepsilon$$

Variable	Coefficient	Std. Err
L1 BUSD Return	-0.579***	0.136
L2 BUSD Return	-0.363***	0.0976
L3 BUSD Return	-0.109	0.0904
Bitwise Return	-0.00171**	0.000787
L1 Bitwise Return	-0.00106*	0.000628
L2 Bitwise Return	-0.000443	0.000857
L3 Bitwise Return	-0.00113	0.000708
SNP 500 Return	0.00819	0.00523
L1 SNP 500 Return	0.00139	0.00507
L2 SNP 500 Return	0.00474	0.00551
L3 SNP 500 Return	0.00453	0.00714

*** p<0.01, ** p<0.05, * p<0.1

Exhibit 6 shows the results of the OLS regression for BUSD. They displayed that BUSD has a significant correlation with two groups of variables, the lagged BUSD variables, and the Bitwise index variables.

BUSD displayed a significant correlation with the first and second order lags of itself. So, holding all other covariates fixed, a 1% increase in the price returns of BUSD one period prior, has a corresponding decrease in BUSD price returns of -0.57%. The second order lag returns are correlated with a corresponding decrease in -0.36% of BUSD price returns. This another result that is in line with the other stable coins returns that appear to be displaying the arbitrage peg nature of tokenized stable coins.

The other variable that BUSD displayed a significant correlation with was the daily price returns of the Bitwise index, and the first order lag of the same variable. Holding all other covariates fixed, a 1% increase in the return of the Bitwise index, has a corresponding decrease in the price return of BUSD of -0.0017%. In the case of the first order lag, there is a corresponding decrease of -0.00106%. This result shows that BUSD holds some exposure to the cryptocurrency market, which is an unfavorable result. Despite the correlation though, the coefficient is small and may not be economically significant. However, BUSD is the only stable

coin that has shown a correlation to other cryptocurrencies and I think that displays a weakness of the currency.

Exhibit 7: BUSD Granger-Causal Test Results

Equation:

$$\text{BUSD Return\_t} = \alpha + \beta 1\text{Bitwise Return\_t} + \beta 2\text{Bitwise Return\_t-1} + \beta 3\text{Bitwise Return\_t-2} + \beta 4\text{Bitwise Return\_t-3} + \varepsilon\_t$$

$$\text{BUSD Return\_t} = \alpha + \beta 1\text{SNP 500\_t} + \beta 2\text{SNP 500\_t-1} + \beta 3\text{SNP 500\_t-2} + \beta 4\text{SNP 500\_t-3} + \varepsilon\_t$$

Equation	Excluded	Chi2	Prob > Chi2
BUSD Return	Bitwise Return	3.434	0.329
BUSD Return	SNP 500 Return	1.0516	0.789

Exhibit 7 displays the results of the granger causality tests. The results of the test show that neither the S&P 500 Price returns, nor the price returns for the Bitwise index granger-cause changes in the returns of BUSD. This is a favorable result for BUSD as they only have correlation with the cryptocurrency market, but no Granger causation.

DAI

Exhibit 8: DAI OLS Regression Results

Equation:

$$\text{DAI Returns} = \beta_0 + \beta_1\text{DAI Returns (lag 1)} + \beta_2\text{DAI Returns (lag 2)} + \beta_3\text{DAI Returns (lag 3)} + \beta_4\text{DAI Returns (lag 4)} + \beta_5\text{Bitwise Return} + \beta_6\text{Bitwise Return (lag 1)} + \beta_7\text{Bitwise Return (lag 2)} + \beta_8\text{Bitwise Return (lag 3)} + \beta_9\text{Bitwise Return (lag 4)} + \beta_{10}\text{SNP 500 Return} + \beta_{11}\text{SNP 500 Return (lag 1)} + \beta_{12}\text{SNP 500 Return (lag 2)} + \beta_{13}\text{SNP 500 Return (lag 3)} + \beta_{14}\text{SNP 500 Return (lag 4)} + \varepsilon$$

Variable	Coefficient	Std. Err
L1 DAI Return	-0.474	0.377
L2 DAI Return	-0.212	0.438
L3 DAI Return	0.0928	0.232
L4 DAI Return	0.0931	0.221
Bitwise Return	0.00176	0.00328
L1 Bitwise Return	0.00102	0.00190
L2 Bitwise Return	-0.00251	0.00296
L3 Bitwise Return	-0.000831	0.00193
L4 Bitwise Return	0.00578	0.00427
SNP 500 Return	0.0109	0.0113
L1 SNP 500 Return	0.00516	0.0101
L2 SNP 500 Return	0.00345	0.0120
L3 SNP 500 Return	0.01000	0.0104
L4 SNP 500 Return	0.00944	0.0123

*** p<0.01, ** p<0.05, * p<0.1

The results of our DAI regression show that DAI has no significant relationship with any of the variables it was tested against. DAI's price movements are not correlated with the lags of itself, the Bitwise index, or the S&P 500 index. This shows that DAI doesn't typically co-move with any of the larger cryptocurrencies, or equity markets. Given that DAI exists solely on the blockchain, it isn't surprising that it doesn't share a significant relationship with the S&P 500, but I believed that it would be more strongly affected by the cryptocurrency market, but instead it has no significant relationship with either. This shows that DAI has been able to insulate itself from the market and not be affected my volatile swings in price. The lack of correlation with lags of itself, which all the other stable coins held, could be an example of the way that algorithmic stable coins and tokenized fund coins differ, however, it is challenging to tell whether or not this is a favorable aspect of the coin.

Exhibit 9: DAI Granger-Causal Test Results

Equation:

$$DAI\ Return_t = \alpha + \beta 1 Bitwise\ Return_t + \beta 2 Bitwise\ Return_{t-1} + \beta 3 Bitwise\ Return_{t-2} + \beta 4 Bitwise\ Return_{t-3} + \beta 5 Bitwise\ Return_{t-4} + \varepsilon_t$$

$$DAI\ Return_t = \alpha + \beta 1 SNP\ 500_t + \beta 2 SNP\ 500_{t-1} + \beta 3 SNP\ 500_{t-2} + \beta 4 SNP\ 500_{t-3} + \beta 5 SNP\ 500_{t-4} + \varepsilon_t$$

Equation	Excluded	Chi2	Prob > Chi2
DAI Return	Bitwise Return	6.540	0.162
DAI Return	SNP 500 Return	2.242	0.691

The results of the Granger-causality test are shown in Exhibit 9. Once again, DAI has shown no exposure to other markets, having no granger-causal relationships with either of the indices. This demonstrates that other price changes will not granger-cause an impact on the price returns of DAI. This is a positive sign for investors in DAI as it shows that DAI has been successful in fulfilling its claim of trustworthiness as an asset that stores a user's value, as far as its exposure to price movements in other markets.

Conclusion and Discussion

The goal of this paper was to ascertain whether stable coins were worthy of their "trustworthy" title given to them by blockchain market participants. Investors, traders, and participants of blockchain networks utilize these cryptocurrencies with the belief that they will maintain their peg and hold their value. Although there are many aspects that could impact the peg value of a stable coin, one major aspect of that is a stable coin's ability to maintain its price during times of market volatility. By using daily price returns of the largest stable coins and testing their correlation with the cryptocurrency market and equity markets, I was able to determine which stable coins faced exposure to the markets and which didn't.

The results show us that each stable coin is affected in different ways by the markets. All the coins we tested except for DAI displayed a significant correlation with their lagged price returns, whether the first order lag or the first and second order. I hypothesize that this isn't necessarily a significant relationship that they share, and that the relationship shown is a product of the arbitrage the coins use to maintain their price.

The S&P 500 displayed statistically significant relationships with two of the stable coins tested, Tether and USDC. The third order lag of the S&P 500 had a significant correlation with the price returns of Tether. And it was also found that the S&P 500 Granger-caused the price returns in USDC. The Tether results show that there is a statistically significant connection with traditional financial markets, and although the relationship is economically small, Tether does have some exposure to those markets. The Granger-causal relationship between the S&P 500 and the USDC was a significant one and it firmly shows that stable coins, specifically one's owned by centralized businesses, face exposure to the outside market. This highlights one of the biggest risks that centralized stable coins face.

The Bitwise 10 Cryptocurrency index displayed a statistically significant relationship with only BUSD, both as a primary variable and in its first order lag. The relationship highlights that BUSD can be affected by swings in the market. Although the relationships are small and work in opposite directions. This can be interpreted in two ways. First, the investors consistently use BUSD as a hedge against volatility, and they exit cryptocurrencies directly into DAI and vice versa. The second, is that BUSD is affected by the investors decisions to enter and exit, and this shades their trustworthiness as a coin that hedges against the market. I believe it is a combination of both. It is known that investors use stable coins as shields for when they dislike the volatility, but that applies to all the stable coins tested, but BUSD was the only one whose price returns had a significant relationship with it. This shows that BUSD can't completely hedge against market movements, and this should be noted for potential users.

Overall, the results display that each stable coin faces risks in one way or another. DAI was the only stable coin that completely hedged itself from market movements, which is a favorable indicator for investors. However, DAI's existence as an algorithmic stable coin is one that investors may be wary of, and one would need to address those risks before using. Although, if the only thing you are looking for is a hedge against outside markets, DAI would be the best option to use. USDC protected itself from the cryptocurrency market, but faced significant exposure to traditional financial markets, and it highlighted the potential risks of all centralized stable coins. It is important to address the risks of each stable coin before deciding which coin you are most comfortable using.

Although the result was important in determining stable coin risks, my research did face some limitations. First, cryptocurrency prices and traditional market prices move frequently throughout the day, and simply taken the opening and closing price ignores the changes that

occur throughout the day. It would be valuable to plot prices throughout the day and test those specific changes against changes in the market. Second, there are many external factors that can affect the prices of stable coins outside of swings in the market. Where centralized coins hold their funds or the regulations they may face in the future are both important factors. The underlying algorithms that run stable coins on the blockchain are important for the fully digital coins. Incorporating those aspects into research would assist in better understanding the vulnerability of stable coins.

Being able to shield itself from rises and falls in markets is the most important asset for a stable coin to maintain its peg. They must be able to do this no matter the circumstances in the market. The research done in this paper has shown that some are capable of it, and others face some exposure to the market. Despite their exposures, the stable coins tested have been able to maintain their pegs, with deviations here and there. Investors and blockchain users can utilize these coins as a low volatile asset while operating on the blockchain, without fear of a destabilization due to price change.

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