Portfolio effects of Cryptocurrencies during the Covid 19 Crisis

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Abstract

We investigate the performance of optimised three asset portfolios comprised of stocks, bonds and a cryptocurrency or gold for the period immediately before and during the Covid 19 financial crisis. We compare the performance of these portfolios with a two-asset cash portfolio comprised of stocks and bonds. Cryptocurrencies have the potential to control risk as most portfolios that include cryptocurrencies consistently experienced risk no greater than 50 basis points above the risk experienced by cash portfolios. However, there is no free lunch. While three asset portfolios can control risk, they also have a lower return per unit of risk.

Keywords: Portfolio Optimization, Bitcoin, Cryptocurrency, Altcoin, Gold

1. Introduction

On May 22, 2010, Laszlo Hanyecz reported that he bought two medium sized pizzas from Papa John's for 10,000 Bitcoins.[1] Ten years later, the price of a Bitcoin closed at $9,238 suggesting that this transaction would then be worth more than $92 million. Such a huge rise in value attracts speculative interest leading to the introduction of very many competing products and consequently to the development of a whole new asset class we now call cryptocurrencies. Nowadays, there are some 2,700+ cryptocurrencies with an overall market value of more than $250 billion.

As this market is in its infancy, many questions arise regarding the purpose, value, and use of cryptocurrencies. The academic literature notes the issues with governance and the association of cryptocurrencies with criminality, Corbet et al. (2019), while much of the literature examines the diversification, safe haven and hedging properties of cryptocurrencies using a variety of econometric techniques, Bouri et al. (2017), Shahzad et. al. (2020) and Baur and Hoang (2020) are examples. From this literature we understand that cryptocurrencies work best as safe havens and for portfolio diversification and less so for hedging strategies. González et al. (2020) examine the statistical connectiveness between Bitcoin and other popular cryptocurrencies finding substantial amounts of co-movements in the long and short run amongst the top ten largest cryptocurrencies. This chapter contributes by examining the role cryptocurrencies can play as an asset class added to traditional portfolios. More specifically, we examine the role cryptocurrencies can play in moderating the risk or enhancing the return of traditional cash portfolios comprised of stocks and bonds during the run up to and after the heart of the Covid 19 inspired financial crisis.

To accomplish this task, we first describe nine different cryptocurrencies. We then review the performance of cryptocurrencies from February 5, 2018 to May 15 2020 thereby incorporating the Covid 19 crisis. Recognising that the Covid 19 crisis presents an opportunity to discover if cryptocurrencies can play a role of either improving investment performance or controlling risk or both, we form portfolios of stocks and bonds as of January 1, 2019. We then measure the actual return and risk experiences of this portfolio and compare them to the actual return and risk once a cryptocurrency such as Bitcoin is added to the cash portfolio. We do this for the top nine cryptocurrencies, namely Bitcoin, Ethereum, Ripple, Bcash, Tether, Litecoin, Eos, Bfinance and Tezos. We also incorporate Gold into our analysis for comparison purposes. After discussing our results, we then draw conclusions.

2.0 Cryptocurrencies

As a class, cryptocurrencies perform all the basic functions of a currency, including representing a store of value, a medium of exchange and a common denominator to measure value of goods and services. In contrast to traditional currencies, cryptocurrencies are not issued by a central bank and so do not derive their value as being backed by the resources of the issuing authority's credit. Instead, the value is supported by technology that makes it impossible to create unauthorised units of a given cryptocurrency. For some cryptocurrencies, supply is determined by miners, traders who solve complex mathematical problems to earn new cryptocurrency coins. The interaction between the demand and supply of a given cryptocurrency determines its' value. All cryptocurrencies are convertible into traditional currencies on cryptocurrency exchanges at rates determined by open and transparent transactions. While the above is common to most types of cryptocurrencies, each

[1] See https://bitcointalk.org/index.php?topic=137.msg1195#msg1195

one has a different price as the technical structure of each cryptocurrency is different. Therefore, our first task is to describe Bitcoin and outline how each of the remaining cryptocurrencies in our sample are different.

2.1 The main type of cryptocurrencies.

Table 1 reports the nine cryptocurrencies we examine in this chapter. On May 15, 2020, Bitcoin, with a market capitalisation of nearly $175 billion and with a 24-hour trading volume of more than $50 billion, dominates the rest of our sample in terms of size and liquidity. Meanwhile Tezos has the smallest market capitalisation and the least liquidity with a market capitalisation of under $2 billion and a 24-hour trading volume of approximately $120 million.

Table 1 about here

Bitcoin is a digital currency. It is the original popular cryptocurrency and holds the market lead in size and acceptance for retail transactions. For example, Amazon accepts bitcoins as payment for gift cards. Since the development of Bitcoin there has been an explosion in the number of alternative coins (hereafter altcoins) that seek ways to improve on Bitcoin. Successful innovations include increasing the range of applications, increasing the volume, speed and reducing the cost of transactions and improving the security and governance of altcoin operating systems.

Ethereum moved beyond being a digital currency by allowing users to develop their own applications such as online betting and ticket sales via an open source platform. These decentralised applications also reduce the likelihood of being hacked by operating on decentralized networks instead of centralized servers. Like Ethereum, **EOS** uses a decentralised operating system and allows users to create their own commercial sized applications. However, EOS is also designed to alleviate the scalability issues of Bitcoin and Ethereum by being capable of handling millions of transactions per second without transaction fees. While **Tezos** is also an Ethereum style decentralised system, it distinguishes itself by improving the security and governance of the system. Tezos rewards coin holders for verifying transactions and contracts thereby reducing the likelihood of malicious attacks. Governance is improved by empowering coin holders to vote on proposed updates to the network.

Bcash and **Litecoin** are direct competitors of Bitcoin by making some technical adjustments to the block chain technology that drives cryptocurrency transactions thereby allowing for more transactions to be processed faster. **Ripple** is designed to aid financial institutions to settle global transactions more efficiently and more cheaply. For example, Ripple can settle up to 200 times more transactions a second than Bitcoin. Potentially, Ripple can replace the SWIFT system currently used by financial institutions as the facilitator of cross-border transactions between currencies. Ripple can handle millions of transactions per second, settles transactions in seconds (rather than days for SWIFT) with a transaction cost of less than $0.01.

Other altcoins seek to compete with Bitcoin by offering services to coin holders. **Bfinance**, while having its' own coin, is a Tokyo based cryptocurrency exchange designed to facilitate trading between cryptocurrency pairs. Like any other exchange, Bfinace offers limit, market, and stop limit orders as well as listing and delisting facilities. It has also proved to be a valuable venue for initial coin offerings for new cryptocurrencies. Meanwhile, **Tether** is a type of stable coin – meaning that the value of the coin is benchmarked against another asset. In the case of Tether, the value of one unit is calibrated to be one US dollar. Originally this was accomplished by being convertible to US dollars on a one to one basis. Since then however, Tether has been backed by a variety of assets and in practise the value can fluctuate from one dollar.

3.0 Investment potential of Cryptocurrencies

Our choice of beginning and ending dates for our study is dictated by the need to cover the heart of the Covid 19 crisis and the need to maximise the number of cryptocurrencies we can examine. We first selected the top 10 Cryptocurrencies ranked by market capitalisation from investing.com only to discover that Bitcoin SV did not commence trading until November 2018. As this will give us too few data points to reliably measure performance, we decided to drop Bitcoin SV. The next most recently issued altcoin, Tezos was issued on February 5, 2018 giving us 220 daily observations to measure starting values we need to measure investment performance quarterly from January 1, 2019. Accordingly, we collect daily stock, bond, gold and cryptocurrency prices from February 5, 2018 to May 15, 2020.

Daily cryptocurrency information is from investing.com. To represent the stock, bond and gold markets we collect the Wiltshire 5000 total return index, the Wiltshire global bond total return index and gold prices from the Federal Reserve Database FRED. The Wiltshire 5000 is a market weighted index of more than 3,000 US stocks that is intended to be a very broad indicator of US stock performance. Similarly, the Wiltshire Global Bond index has a very broad coverage of all types of taxable US dollar denominated bonds that reflects the actual holdings by US institutional investors. Finally, gold prices are the London daily 15:00 price fixing.

Figures 1a to 1e report daily returns of cryptocurrencies and Figures 2a and 2b report the daily returns of stocks, bonds and gold from February 5, 2018 to May 15, 2020. Figure 1 clearly shows that cryptocurrencies can suffer catastrophic daily loses. Notice that the daily (not annualised) gains and losses range from plus and minus 40% prior to the Covid 19 period whereas the corresponding range in Figure 2 is a much more modest plus or minus three percent. Figure 2 clearly illustrates that uncertainty related to Covid 19 began to be incorporated into the cash markets about the third week of February 2020. During this heightened period of uncertainty, unannualized daily stock returns were sometimes greater than 5% and losses were greater than 10%. On Covid 19 day March 12, 2020, most cryptocurrencies lost approximately one half of their value whereas equity lost a little more than 10%. Despite a strong rebound the following day a further catastrophic loss was experienced on Monday March 16 where most cryptocurrencies lost 10% of their value and equities 13%.Given these wild gyrations in the financial markets, it is interesting to determine if we can moderate the risk of investing in cash assets by adding a cryptocurrency to a cash portfolio.

All Figures about here

Our testing strategy is as follows. We first measure expected returns and risk as inputs to determine what portion of each asset should be included in a three-asset portfolio comprising of stocks, bonds and an alternative asset such as gold or a cryptocurrency. Using these inputs, we set a target risk level and then optimise by changing the portions invested in each of the three component assets to obtain the highest possible return given the target risk level on January 1, 2019. This optimisation is accomplished via the solver function in Excel. Using these optimized portions, we then measure the return, the risk (portfolio standard deviation) and the ratio of return to risk (hereafter Sharpe ratio) three months later on March 31, 2019 and compare these actual values to what was promised initially. We then repeat by rebalancing our initial portfolio using updated risk measures – the variances and covariances amongst included assets in the portfolio - on March 31 2019, but retain the initial target returns and portfolio target standard deviation and then measure the second quarterly returns, risk and the Sharpe ratio on June 30, 2019. We continue rebalancing the portfolio at the beginning of each quarter to compare to the actual performance at the end of the quarter until March 31, 2020. To capture the rapid bounce back after March 31, 2020 we rebalance the portfolio on March 31 and measure the performance of this portfolio seven weeks later May 15, 2020.

We use the five-year average, from January 1, 2014 to December 31, 2018, to calculate the expected value for the mean returns of stocks, bonds and gold. We use the annualised daily averages over the 220 daily observations from February 5, 2018 to December 31, 2018 to calculate expected values for the variances and covariances for all assets. However, the five year (or part thereof) return of the nine cryptocurrency returns were incredible and using a similar five-year average would result in portfolios dominated by cryptocurrencies. This would defeat the purpose of this study as we wish to examine how cash portfolios can be improved by including cryptocurrencies as an additional rather than a substitute asset class in the portfolio. Therefore, we arbitrarily chose 4% as the target return, which is part way between the average target return for stocks, bonds and gold at 8, 3.5 and 0.5% respectively.[2]

Once chosen, the starting values will be used to form a portfolio with a controlled level of risk by minimising risk to a chosen level. We chose an overall portfolio standard deviation of 9.9% as the target risk. This is the average five-year standard deviation for the Wilshire 5000 index up to December 31, 2018, the idea being that investors are willing to invest some portion of their wealth in cryptocurrencies provided this does not result in an expected major increase in risk. Using our chosen expected values, we now optimise portfolios by finding the portions invested in each asset that in combination obtains the highest possible portfolio expected return based on the expected values, consistent with an overall portfolio standard deviation of 9.9%.[3] Short selling is not allowed so the minimum investment in any given asset is zero.

The initial allocations are reported in Table 2. Based on the expected returns, variances and covariances, these allocations are optimal as they give the highest possible returns given the target of holding the overall standard deviation of the portfolio to 9.9%. The portion invested in Gold and Cryptocurrencies do vary substantially. For example, the initial allocation for the first quarter has 20.2% invested in gold and 1.4% invested in Tezos. It is interesting to note that only Gold and Tether regularly enter the rebalanced portfolios with allocations of between 15 to 30%. All other cryptocurrencies have allocations of less than 10%. Also, for the part quarter from April 1 to May 15, when the markets bounced back from the heart of the Covid 19 crisis, six cryptocurrencies do not even enter the rebalanced portfolios as clearly based on past data, they were “too risky”. Including them would results in a rebalanced portfolio with a standard deviation greater than 9.9%.

Table 3 reports the mean, standard deviation and the Sharpe ratios for the twelve portfolios formed quarterly between January 1, 2019 to May 15, 2020. Recalling that all portfolios were calibrated to have an expected standard deviation of 9.9%, we can see that the actual risk experienced by these portfolios were sometimes far higher than expected based on the prior data. For all of 2019, the cash portfolio realised a standard deviation that was the same as expected or lower, but in the part 2020 calendar year, up to May 15, 2020, the cash portfolio had a much higher realised standard deviation clearly reflecting the heighted risk associated with Covid 19.

First, looking at the 2019 calendar year, with few exceptions, the risk of a cash portfolio is not materially increased by the inclusion of a third asset. In fact, there are only four out of a possible 36 instances where risk increase by more than 100 basis points and eight of 36 instances where risk increased by more than 50 basis points over the cash portfolio. Meanwhile, in nearly half, 17 of 36 instances, risk is less, sometimes by substantial amounts, than the risk experienced by the cash portfolio. Bitcoin seems to create the most excess risk, followed by Litecoin and Tezos. In contrast,

[2] We experimented with a range of values for the target cryptocurrency target return from 0.5% to 5%. Using lower values resulted in very little investment in cryptocurrencies whereas using a value greater than 4% lead to portfolios with more than 50% invested in cryptocurrencies. As shown in table 2, the use of a 4% target return allowed is to form portfolios with a significant, but not dominant investment in in cryptocurrencies.

[3] We initially set the investment in Equity as 100% and zero for the remaining assets and then optimise.

Bcash and Tether consistently realise risk no great than 50 basis points than that experienced by cash portfolios and Ethereum and Bfinance consistently have a realised risk lower than the risk of the cash portfolio.

For the Covid 19 period from January 1, 2020 to March 31 2020, we find that including a cryptocurrency asset increases risk only in the case of Bcash, the remaining cryptocurrencies reduced risk sometimes by substantial amounts. The worst performing asset was gold as inclusion of gold resulted in a 150 basis point increase in risk whereas the corresponding figure for Bcash was 90 basis points. It is difficult to draw any conclusions regarding the bounce back period as it includes only seven weeks of information and six of the nine cryptocurrencies do not even enter the portfolios as they were too risky based on data from the covid 19 period. However, we do observe that the three cryptocurrencies that did enter the portfolios all have a lower risk than the cash portfolio.[4]

Finally, we examine the trade-off between risk and return by examining the Sharpe ratio where the higher the ratio the greater the reward for taking risk. Here we see that in 21 out of a possible 36 instances inclusion of a cryptocurrency results in a lower Sharpe ratio. For the Covid 19 period the Sharpe ratio is always higher or the same as the cash portfolio and all ratios are negative.

4.0 Conclusions

We conclude that cryptocurrencies have the potential to control risk as most cryptocurrencies consistently experienced risk no higher than 50 basis points of the risk experienced by cash portfolios comprised of stocks and bonds. However, some cryptocurrencies appear to control risk less well than others. In particular, Bitcoin appears to be the least stable followed by Litecoin and Tezos. On the other hand, two cryptocurrencies, Ethereum and Bfinance combined with cash assets result in portfolios that have a realised risk that is less than the risk of the corresponding cash portfolio. However, there is no free lunch as clearly while risk can be controlled it comes at the expense of a lower Sharpe ratio suggesting that the reward for taking on risk is higher when we ignore cryptocurrencies in forming portfolios. More specifically, the two cryptocurrencies that best control risk, Ethereum and Bfinance, also often have Sharpe ratios that were lower than the corresponding Sharpe ratio for cash portfolio.

These results add to the literature by finding that while cryptocurrencies can control the risk of well diversified cash portfolios, not all cryptocurrencies are able to do this during the run up to and during the Covid 19 financial crisis. Our findings implies that investors seeking to control the risk of well diversified cash portfolios should consider altcoins, particularly Bfinance and Tether, rather than Bitcoins but all the while realising that a reduction in risk is likely to be accompanied by a lower return. In contrast, the literature mostly concentrates on Bitcoin finding some evidence that bitcoins can effectively diversify cash portfolios in the case of extreme events (Bouri et al. (2017) but gold appears to have more stable diversification properties than Bitcoin (Shahzad et. al. (2020). In contrast, we find Gold did not control risk well during the height of the Covid 19 financial crisis and

[4] It is interesting to speculate whether an investment in gold or a cryptocurrency would form a hedge during the heart of the Covid 19 financial crisis from Thursday March 12 to Monday March 16, 2020. We note that except for Gold and Tether, all cryptocurrencies moved in the same direction during these three working days as the stock market experienced losses on Thursday and Monday and an increase on Friday. This suggests that during this critical period most cryptocurrencies could form a hedge had the investor short sold the corresponding cryptocurrency. To confirm this a study of hedge portfolios formed of long bonds and stocks with a short position in the candidate cryptocurrency designed to minimise portfolio variance needs to be conducted- a task beyond the scope of this chapter.

there were better performing altcoins than Bitcoin. Perhaps the variation in diversification effectiveness can be traced to the structure of an altcoin. Altcoins designed to attract the interest of professional investors by incorporating the altcoin to the trading on an exchange – Bfinance – or tied to another asset – Tether or provide ancillary services – Ethereum lead to more rational trading and less speculation resulting in more effective diversification than other alternatives.

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Name	Ticker	Market Cap (Billions)	Price	Volume (24h - Billions)	Circulating Supply
Bitcoin	BTC	$174.72	$9,507.28	$50.24	18,378,018 BTC
Ethereum	ETH	$22.09	$199.13	$17.94	110,938,751 ETH
Tether	USDT	$8.83	$1.00	$56.06	8,798,069,379 USDT
Ripple	XRP	$8.82	$0.20	$2.07	44,112,853,111 XRP
Bcash	BCH	$4.38	$237.94	$3.33	18,407,919 BCH
Litecoin	LTC	$2.80	$43.21	$4.51	64,735,081 LTC
Binance Coin	BNB	$2.50	$16.07	$0.35	155,536,713 BNB
EOS	EOS	$2.39	$2.59	$4.19	922,646,994 EOS
Tezos	XTZ	$1.78	$2.51	$0.12	710,520,732 XTZ
Total	M/A	$228.32	N/A	$138.80	N/A

Table 1: This table reports the market capitalisation as a measure of the size and 24-hour trading volume and circulating supply as indicators of liquidity of nine top cryptocurrencies as on May 15, 2020.

Q1	Cash	Gold	Bitcoin	Ethereum	Ripple	Bcash	Tether	Litecoin	Eos	Bfinance	Tezos
Equity	60.3	58.4	44.4	36.5	57.4	59.2	58.4	23.8	33.7	54.2	59.4
Bonds	39.7	21.4	47.2	56.4	40.7	39.2	21.7	67.4	60.4	42.6	39.2
Alternative	0.0	20.2	8.3	7.0	1.9	1.6	19.9	8.8	5.9	3.2	1.4
Q2											
Equity	62.4	60.6	43.8	45.4	34.8	60.6	60.6	26.1	35.1	52.2	29.2
Bonds	37.6	20.3	46.6	48.4	57.9	37.5	20.6	65.2	58.7	43.4	64.7
Alternative	0.0	19.1	9.6	6.2	7.3	1.9	18.8	8.7	6.1	4.4	6.1
Q3											
Equity	65.1	63.4	49.7	27.1	65.1	64.3	63.3	29.6	35.1	53.9	59.2
Bonds	34.9	18.8	41.6	64.0	34.9	34.2	19.2	61.8	58.4	41.4	37.7
Alternative	0.0	17.8	8.7	8.9	0.0	1.6	17.5	8.6	6.5	4.8	3.0
Q4											
Equity	65.8	64.3	55.3	29.4	65.8	64.7	64.0	30.0	36.0	53.9	48.3
Bonds	34.2	18.1	37.5	61.7	34.2	33.6	18.9	61.3	57.4	41.0	46.7
Alternative	0.0	17.5	7.3	8.9	0.0	1.8	17.1	8.7	6.6	5.0	5.0
Q5											
Equity	68.6	67.4	57.9	31.9	68.6	67.4	67.0	31.8	37.0	51.3	48.6
Bonds	31.4	16.5	34.7	58.8	31.4	30.8	17.3	59.1	55.9	42.5	46.0
Alternative	0.0	16.1	7.4	9.3	0.0	1.8	15.7	9.1	7.0	6.3	5.4
Q6 (Part)											
Equity	40.6	32.9	20.9	40.6	40.6	30.9	40.6	40.6	40.6	40.6	40.6
Bonds	59.4	36.3	70.6	59.4	59.4	65.3	30.1	59.4	59.4	59.4	59.4
Alternative	0.0	30.8	8.5	0.0	0.0	3.9	29.3	0.0	0.0	0.0	0.0

Table 2: This table reports the initial percentage allocations, expected returns, variances and covariances from Q1 the first quarter of 2019 to Q6 the second part quarter of 2020 ending on May 15 based on information prior to the date portfolios are formed. All figures are in percent

Q1	Cash	Gold	Bitcoin	Ethereum	Ripple	Bcash	Tether	Litecoin	Eos	Bfinance	Tezos
Mean	39.6	36.5	36.0	31.7	37.2	39.8	35.4	50.4	41.2	41.2	42.9
SD	7.8	7.9	9.9	7.4	7.6	7.9	7.9	8.8	7.4	7.4	8.2
Sharpe	5.1	4.6	3.6	4.3	4.9	5.0	4.5	5.7	5.6	5.6	5.3
Q2											
Mean	18.0	22.4	58.2	36.7	27.7	26.0	13.8	45.1	27.9	32.5	18.8
SD	7.1	7.2	7.7	6.7	7.8	6.7	7.4	9.0	7.6	6.7	7.7
Sharpe	2.5	3.1	7.5	5.5	3.5	3.9	1.9	5.0	3.7	4.8	2.5
Q3											
Mean	4.0	4.7	-9.0	-11.6	4.0	-0.1	3.3	-18.9	-12.3	-9.5	3.2
SD	9.9	9.8	10.2	9.0	9.9	9.9	9.7	9.1	8.7	9.4	10.0
Sharpe	0.4	0.5	-0.9	-1.3	0.4	0.0	0.3	-2.1	-1.4	-1.0	0.3
Q4											
Mean	22.2	22.3	14.7	-0.9	22.2	20.5	21.5	-0.5	8.8	15.6	25.7
SD	6.1	5.8	6.6	5.6	6.1	6.1	5.9	6.3	5.5	6.0	6.0
Sharpe	3.7	3.8	2.2	-0.2	3.7	3.4	3.6	-0.1	1.6	2.6	4.3
Q5											
Mean	-64.0	-59.9	-57.2	-27.1	-64.0	-62.4	-63.1	-30.0	-37.6	-49.4	-40.4
SD	39.6	41.1	39.4	30.5	39.6	40.5	38.4	29.1	29.4	36.8	35.7
Sharpe	-1.6	-1.5	-1.5	-0.9	-1.6	-1.5	-1.6	-1.0	-1.3	-1.3	-1.1
Q6 (Part)											
Mean	55.6	77.1	72.3	55.6	55.6	54.2	48.8	55.6	55.6	55.6	55.6
SD	16.3	15.1	12.4	16.3	16.3	13.4	15.8	16.3	16.3	16.3	16.3
Sharpe	3.4	5.1	5.8	3.4	3.4	4.1	3.1	3.4	3.4	3.4	3.4

Table 3: This table reports the mean, standard deviation SD and Sharpe ratio quarterly from Q1 the first quarter of 2019 to the end of the part second quarter of 2020 on May 15, 2020. The means and standard deviations are annualised percent rates.

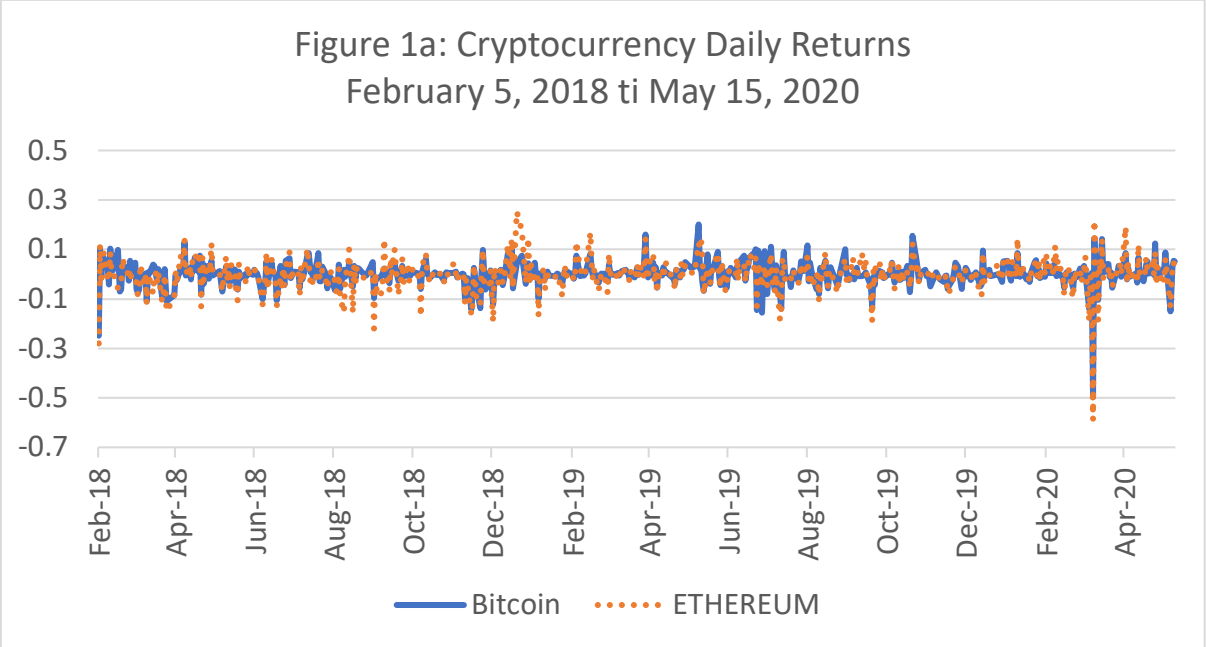


Figure 1a: Cryptocurrency Daily Returns
February 5, 2018 ti May 15, 2020
0.5
0.3
0.1
-0.1
-0.3
-0.5
-0.7
Feb-18
Apr-18
Jun-18
Aug-18
Oct-18
Dec-18
Feb-19
Apr-19
Jun-19
Aug-19
Oct-19
Dec-19
Feb-20
Apr-20
Bitcoin
ETHEREUM

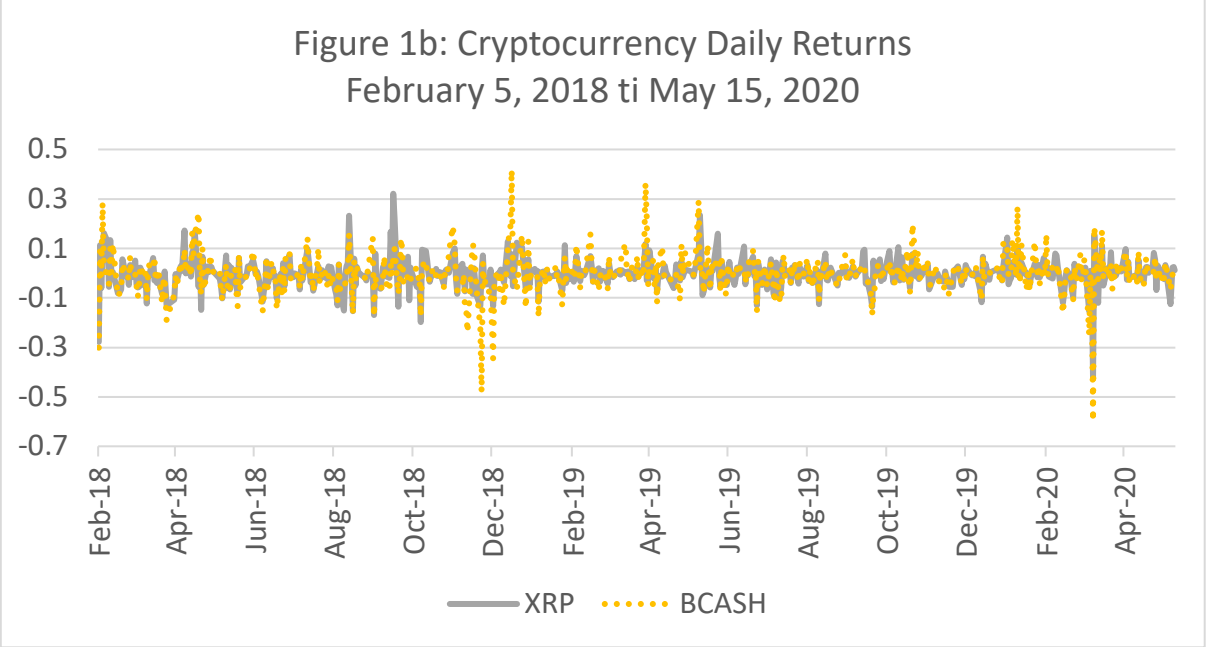


Figure 1b: Cryptocurrency Daily Returns
February 5, 2018 ti May 15, 2020
0.5
0.3
0.1
-0.1
-0.3
-0.5
-0.7
Feb-18
Apr-18
Jun-18
Aug-18
Oct-18
Dec-18
Feb-19
Apr-19
Jun-19
Aug-19
Oct-19
Dec-19
Feb-20
Apr-20
XRP
BCASH

Figure 1c: Cryptocurrency Daily Returns
February 5, 2018 ti May 15, 2020

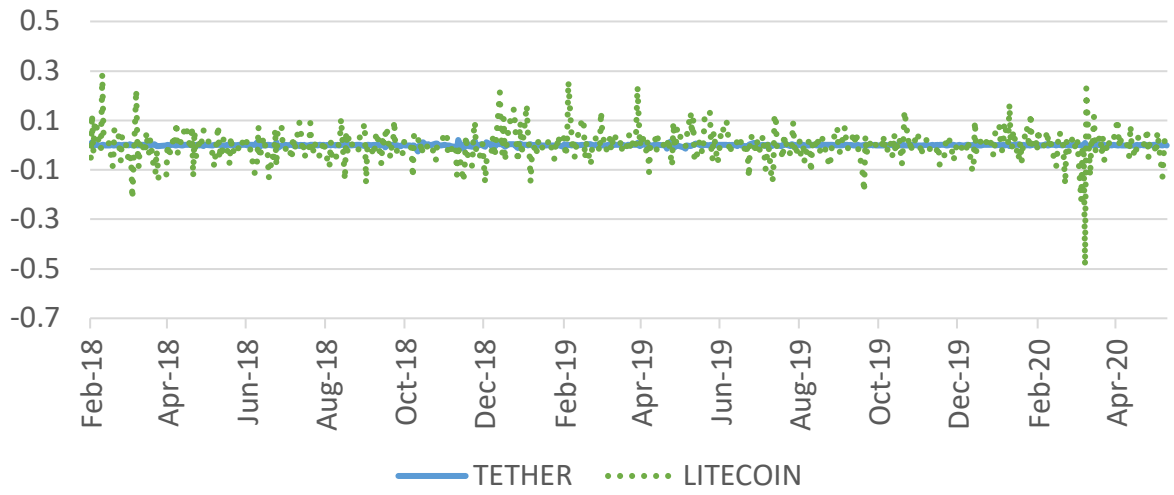
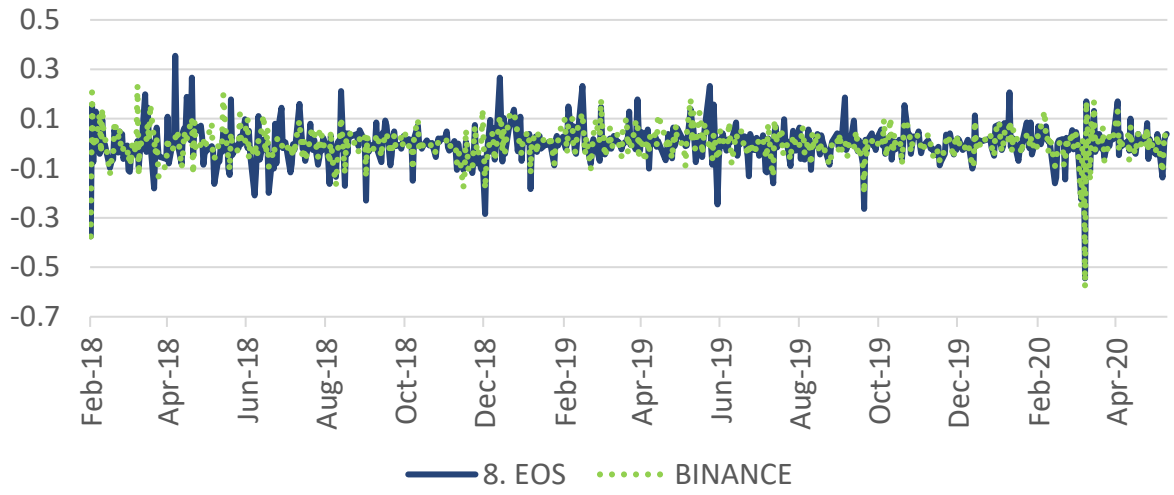


Figure 1d: Cryptocurrency Daily Returns
February 5, 2018 ti May 15, 2020



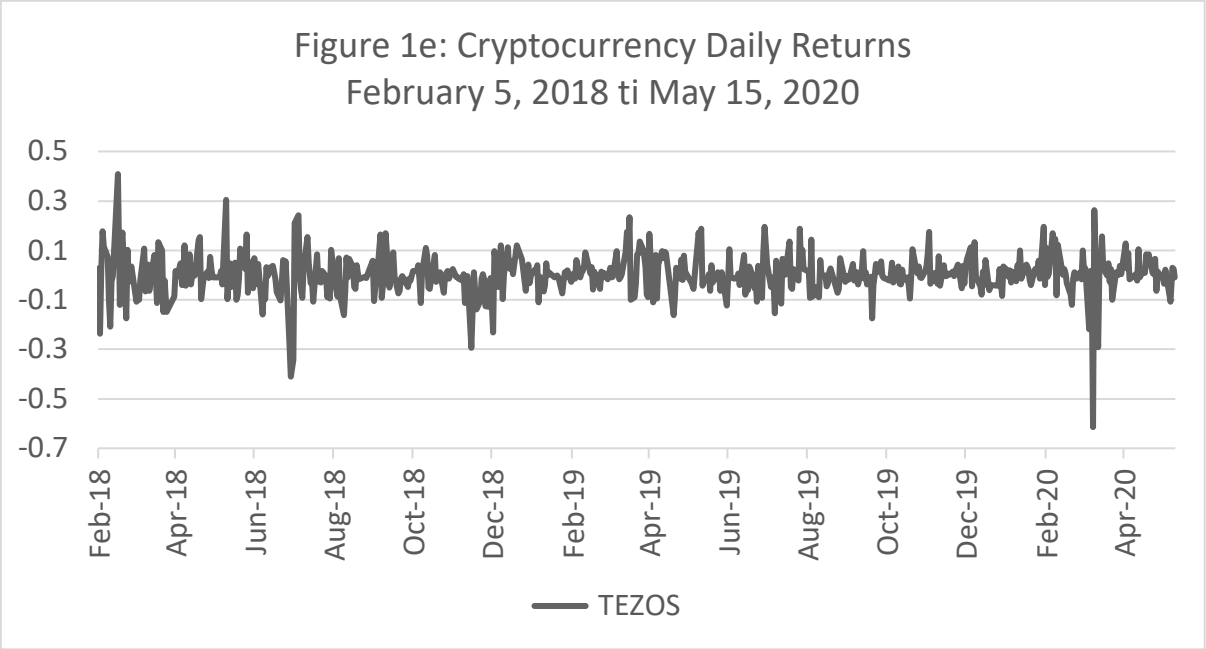


Figure 1e: Cryptocurrency Daily Returns
February 5, 2018 ti May 15, 2020
0.5
0.3
0.1
-0.1
-0.3
-0.5
-0.7
Feb-18
Apr-18
Jun-18
Aug-18
Oct-18
Dec-18
Feb-19
Apr-19
Jun-19
Aug-19
Oct-19
Dec-19
Feb-20
Apr-20
TEZOS

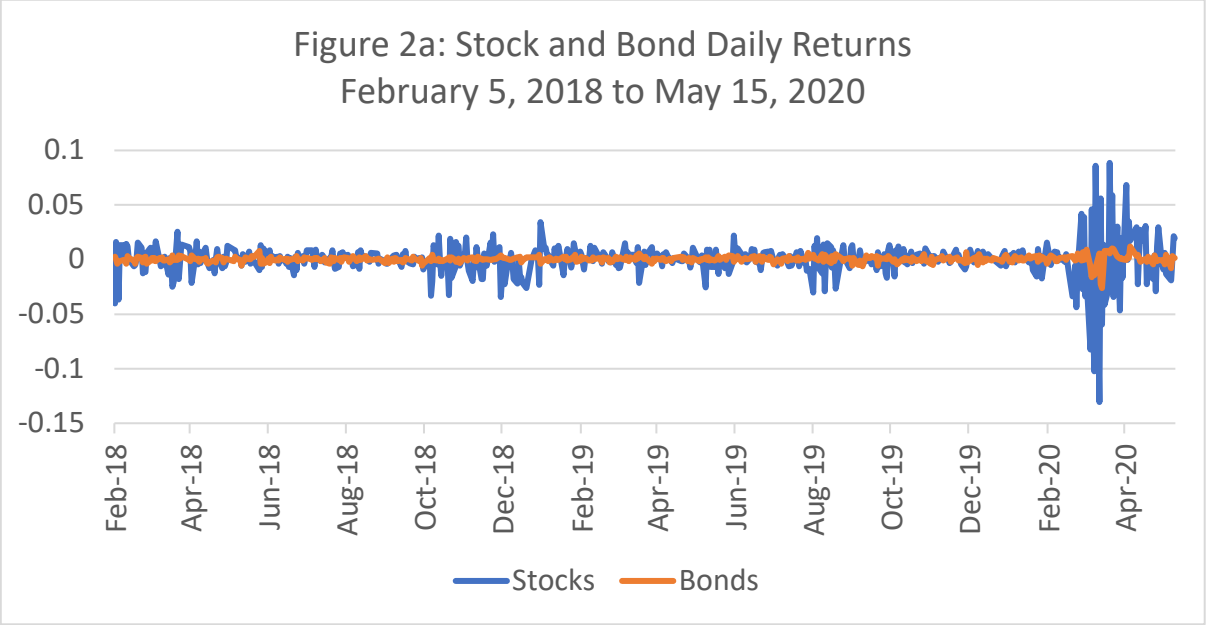


Figure 2a: Stock and Bond Daily Returns
February 5, 2018 to May 15, 2020
0.1
0.05
0
-0.05
-0.1
-0.15
Feb-18
Apr-18
Jun-18
Aug-18
Oct-18
Dec-18
Feb-19
Apr-19
Jun-19
Aug-19
Oct-19
Dec-19
Feb-20
Apr-20
Stocks
Bonds

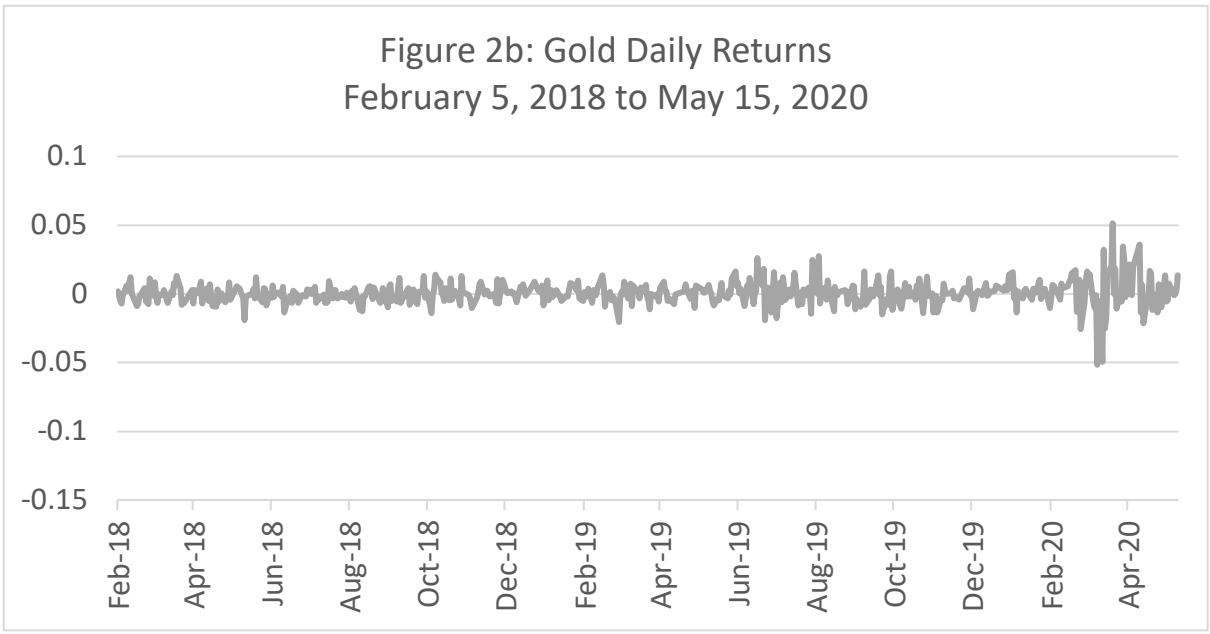


Figure 2b: Gold Daily Returns
February 5, 2018 to May 15, 2020
0.1
0.05
0
-0.05
-0.1
-0.15
Feb-18
Apr-18
Jun-18
Aug-18
Oct-18
Dec-18
Feb-19
Apr-19
Jun-19
Aug-19
Oct-19
Dec-19
Feb-20
Apr-20