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Stock Prices and Bitcoin Prices: A VAR Model

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Abstract: The rapid rise of Bitcoin, a decentralized digital currency, has attracted significant attention from investors, researchers, and policymakers alike. The relationship between traditional stock prices and Bitcoin prices has garnered considerable attention in recent years. This research paper aims to explore the interconnections and dynamics between stock prices and Bitcoin prices by employing a Vector Autoregression (VAR) model. The study utilizes a comprehensive dataset spanning a specific time period, encompassing daily or monthly observations of stock prices and Bitcoin prices. The VAR model allows for the analysis of the joint behavior of these variables, capturing both short and long-term relationships, showing the effects of stocks on Bitcoin, but not the other way around. The research also underscores the necessity for continuous monitoring and analysis as the cryptocurrency landscape evolves rapidly. It highlights the significance of understanding the intricate dynamics between traditional financial markets and emerging digital assets, such as Bitcoin, in order to make informed investment decisions and mitigate potential risks.

Keywords: Bitcoin, VAR model, stock & stock prices

1. Introduction

The rapid rise of Bitcoin, a decentralized digital currency, has attracted significant attention from investors, researchers, and policymakers alike. With its unique characteristics and potential to disrupt traditional financial systems, Bitcoin has emerged as a subject of great interest in the field of finance[1-3]. In recent years, there has been growing curiosity about the relationship between Bitcoin prices and the prices of traditional financial assets, particularly stocks. This research paper aims to investigate the interconnections and dynamics between stock prices and Bitcoin prices, shedding light on their relationship using a Vector Autoregression (VAR) model. By employing the VAR model, we can analyze the joint behavior of stock prices and Bitcoin prices, capturing both short-term fluctuations and long-term trends.

To conduct this analysis, we utilize a comprehensive dataset encompassing a specific time period, comprising daily or monthly observations of stock prices and Bitcoin prices. The inclusion of such a diverse dataset allows us to examine the dynamics between these two asset classes from various angles and timeframes. One of the key motivations for studying the relationship between stock prices and Bitcoin prices lies in the potential investment opportunities and risk management strategies that may arise from their interdependence. Understanding how changes in Bitcoin prices can impact stock prices, and vice versa could provide valuable insights for investors seeking to diversify their portfolios or hedge against market volatility[4-7].

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Moreover, this research underscores the importance of continuous monitoring and analysis as the cryptocurrency landscape evolves rapidly. The emergence of new cryptocurrencies, regulatory developments, shifts in investor sentiment, and macroeconomic factors all contribute to the intricate dynamics between traditional financial markets and emerging digital assets, such as Bitcoin. Therefore, it is crucial to gain a comprehensive understanding of these dynamics to make informed investment decisions and effectively manage risks. By employing the VAR model and analyzing the interconnections between stock and Bitcoin prices, this study aims to add to the preexisting studies on this subject. The results will provide empirical evidence on the relationship between these two asset classes, highlighting the factors that influence their dynamics. Ultimately, this research aims to facilitate the development of investment strategies and risk management techniques in the context of evolving financial landscapes, thereby enhancing our understanding of the relationship between stock prices and Bitcoin prices.

This study showed that Bitcoin prices, both current and historical, have very little effect on the price of stocks, as seen from the results of the Granger causality test and the VAR model. Arbitrage can help investors generate profits, but Bitcoin prices will inevitably be impacted by future variations in stock values.

2. Data

This article takes its data from the NASDAQ stock index, as well as Bitcoin prices for a full year, from May 15, 2021- May 15, 2023, to help evaluate the correlation between Bitcoin and stock prices. Figure 1 illustrates how the price of Bitcoin fluctuates more quickly than the price of stocks. However, there is still a link between them.

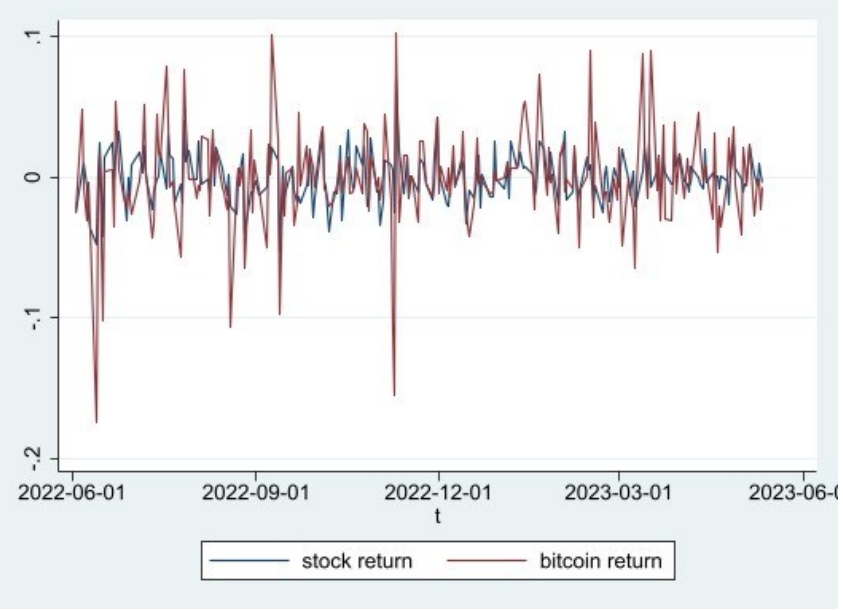

Figure 1: Return of stock and Bitcoin.

Table 1 presents descriptive information on stock price and Bitcoin price returns. In this investigation, it is discovered that the typical return on Bitcoin prices is negative. The highest stock return is 0.03 less than the highest Bitcoin return, while the stock price's average rate of return is negative.

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Table 1: Descriptive statistics.

Variable	Obs	Mean	Std. dev.	Min	Min
stock	237	-.000011	.0170198	-.0529697	.0709264
bitcoin	237	-.0005963	.034278	-.1740526	.1020374

3. Methods and Analysis

In 1980, a non-structural equation model known as the vector autoregressive model(VAR Model) was first presented by Sims. This model, instead of relying on economic theory, utilizes a multi-equation simultaneous method [8-10]. Through the regression of lagged data in all the independent endogenous variables, it estimates the dynamics of said variables in its equations. These relationships are very often used in linked time series, as well as the effects of random shocks.

There are two major advantages presented by this model. First, the endogenousness or externality of a variable is irrelevant, as the VAR model already has all of the endogenous variables. Furthermore, it also is more capable of handling multiple data pieces. As well, it can convert a univariable model into a vector model, complete with multivariable time series. This is achieved by letting a variable depend on not only its own lag but that of other variables as well.

The primary goal of this article Is to be able to help investors in their investing ventures, especially through the usage of the VAR model to discover and analyze the relationship between stock return and Bitcoin return. The model is as follows:

$$Bit_t=d_1+B_1Bit_{t1}+d_1Stock_t+d_1Stock_{t1}+\varepsilon_t \quad (1)$$

In order to find the best lag order, we used the Stata program in order to take into account the FPE, AIC, HQIC, and SBIC. Our analysis showed that three orders of lag are best for this set of data. Due to this, we used a third order lag for this (Table 2).

Table 2: The best lag order.

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	187.956				3.1e-0.7*	-9.2978*	-9.26727*	-9.21336*
1	188.169	.42554	4	0.980	3.8e-07	-9.10844	-9.01685	-8.85511
2	191.61	6.8823	4	0.142	3.9e-07	-9.0805	-8.92784	-8.65828
3	192.941	2.6623	4	0.616	4.5e-07	-8.94706	-8.73333	-8.35595
4	200.83	15.778*	4	0.003	3.7e-07	-9.1415	-8.86671	-8.3815

After this, we utilized a unit root test on the regression results, as shown in figure 2. This confirms the stability between our coefficients, as all the points are within the unit circle, which furthermore confirms the validity of our results

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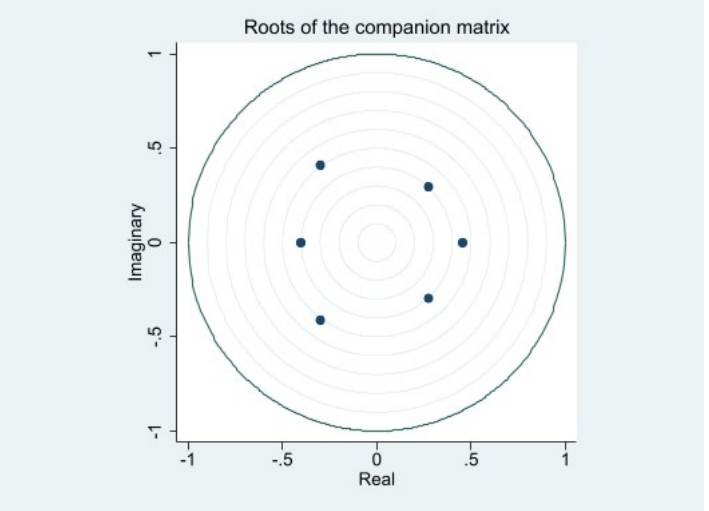

Figure 2: Unit Root Test.

Table 3 presents the investigation's results. Our investigation shows that the stock's own 1, 2, or 3 order lags do not significantly affect the return rate. It shows that subsequent stock values are not significantly impacted by earlier prices. However, the first-order price lag of the stocks has a major impact on the Bitcoin return rate. The Bitcoin return is increased by first-order lagging stock prices while it is decreased by second-order lagging stock prices.

In addition, we discovered that Bitcoin prices will respond to the first-order lag of stocks, whereas Bitcoin returns have no effect on stock prices in terms of how Bitcoin prices affect them. To further affirm the validity of the results, we applied the Granger causality test.

Table 3: Regression result.

	Coefficient	Std. err.	z	P>|z|	[95% conf. interval]	
Stock						
Stock						
L1	.0731623	.1412453	0.52	0.604	-.2036733	.349998
L2	.059043	.153345	0.39	0.700	-.2415077	.3595937
L3	-.038916	.1601146	-0.24	0.808	-.3527348	.2749029
Bitcoin						
L1	-.0703172	.0757469	-0.93	0.353	-.2187783	.0781439
L2	-.0347752	.077642	-0.45	0.654	-.1869508	.1174004
L3	.0263979	.0724841	0.36	0.716	-.1156683	.1684641
Cons	.0001167	.002036	0.06	0.954	-.0038738	.0041071

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Table 3: (continued).

Bitcoin						
Stock						
L1	-.0170576	.2489283	-0.07	0.945	-.504948	.4708329
L2	.1478395	.2702526	0.55	0.584	-.3818459	.6775249
L3	.1366033	.2821832	0.48	0.628	-.4164657	.6896723
Bitcoin						
L1	-.0734657	.133495	-0.55	0.582	-.335111	.1881796
L2	.0275211	.136835	0.20	0.841	-.2406706	.2957128
L3	.1049091	.1277447	0.82	0.412	-.1454659	.3552841
Cons	-.0000301	.0035882	-0.01	0.993	-.0070628	.0070026

Table 4: Granger causality Wald tests.

Equation	Excluded	chi2	df	Prob > chi2
stock	bitcoin	1.4482	3	0.694
stock	ALL	1.4482	3	0.694
bitcoin	stock	.56271	3	0.905
bitcoin	ALL	.56271	3	0.905

A method of hypothesis testing for statistics is known as the Granger casualty test, which helps to find whether or not one set of time series actually has an impact on another such series. Since the VAR is a type of regression analysis, it can typically only find the correlation of one variable before and after another, while the Granger casualty test helps find the distinctions. Time-drop relationships exist between the different variables. According to Table 4, while stock returns are unaffected by changes in Bitcoin prices, Bitcoin prices are heavily affected by stock prices.

The results of our subsequent impulse response study, which looked at the enduring effects of stock returns and Bitcoin returns on the dependent variable, are shown in Figure 3. The graph demonstrates that after five periods, the effect of the stock price and the price of Bitcoin will be negligible.

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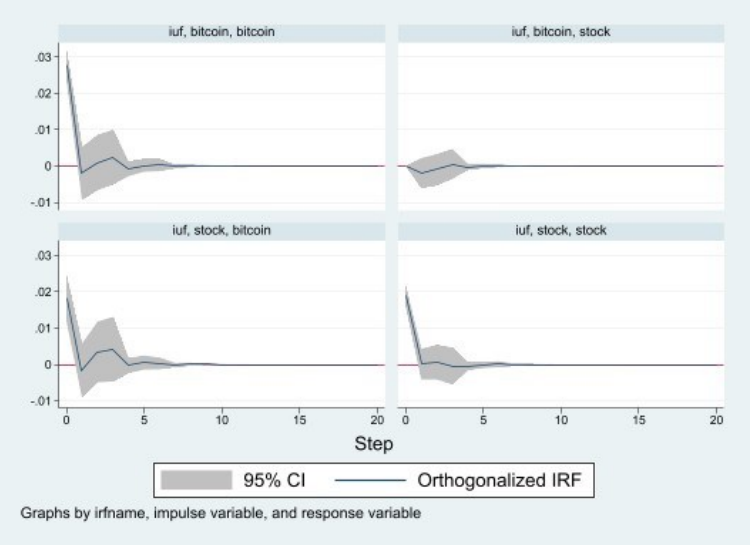

Figure 3: Impulse response for stock and Bitcoin.

4. Conclusion

In this study, we used the VAR model to find the relationships between stock return and Bitcoin return, and while it demonstrated that Bitcoin return had little impact on stock return, the opposite was true and that stock has a lot of impact on Bitcoin prices. This was further verified by the Granger casualty test, as shown above. Even though arbitrage may allow investors to make additional gains, future volatility in the price of stocks will unavoidably have an impact on Bitcoin prices as well.

While this paper analyzed the quantitative relationship between both stock prices and Bitcoin, there was still much more left unexplored. For example, theoretical methods were seldom used, and economic concepts and ideas were similarly seldom employed.

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