Virtual Currency Market Changes Based on The Information Resource Flow

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Abstract: Information resources are now the driving force behind all the resources available to human society. Bitcoin market, a new emerging digital currency market, is mainly dominated by information resources and also controls the flow of information resources. This article uses Google search volume as the information source, aiming to explore the relationship between information resources and the virtual currency market through information resource flow.

Keywords: Google search volume, Index investor attention, Bitcoin development

1 Introduction

Information resources play a crucial role in the virtual currency market. Since digital currency is not based on macroeconomic fundamentals, and its total supply amount is already fixed at the beginning. The demand side of the market is not driven by the traditional expected macroeconomic development, but by investors' expectation of holding the currency and selling the currency in the future. Therefore, the market is mostly intervened by noise traders, short-term investors and speculators. From this way, information resources influence virtual currency market greatly[1].

Since the bitcoin, an electronic digital currency, started trading in Japan, it has become the most attractive internet financial product. Under the wave of rapid development, bitcoin transactions have continued to be active after 2013, and transaction prices have shown an explosive growth trend. In China, the bitcoin transaction price increased rapidly from about 1,200 yuan to more than 80,000 yuan. Throughout 2013, the price of Bitcoin rose more than 90 times. From 2017 to 2018, the digital currency market experienced huge fluctuations. Bitcoins reached a maximum price of $20,000 in Dec. 2017, which yields 2000% return. After that, the market bounded to the bottom, the price decreased to $4,000 in Nov. 2018. The panic filled the market, which greatly impacted investors' sentiments. Many researchers point out that bitcoin's price trend cannot be explained by the fundamentals, like future cash flows[2][3]. There are many concerns about whether there is a price bubble in bitcoin transactions, and no consensus can be achieved.

In the bitcoin market, due to the volume of the bitcoin market and national policy issues, institutions don't have access to the market, so individual investors account for more than 90% of the total investors. A large number of investors participate in the investment in the Bitcoin market by searching relevant information through different network channels. When investors

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have high expectation, investors will get information through different channels, and they will always collect more information through search engine, the search frequencies can reflect the current information resource flow from this side.

In the research of this field, one of the problems is the measurement of information resource. Traditional measurements received criticisms of inaccuracy and outdated. In this thesis, we employ the Google Searching Volume Index as the proxy to measure information resource flow and investigate the potential relations behind the bitcoin market. Finding out whether one shock to searching queries will induce the response in bitcoin market. Also in a reversal direction, whether the change in bitcoin market will lead to a sprout of the engine searching volume, and how long time period the shock will maintain.

This article reconstructs a relative new proxy to quantify information resource flow applicable to the Bitcoin market, and explores the connection between Bitcoin and information resource, thereby intends to explain the relationship between information resource flow and Bitcoin development fluctuations, providing more evidence for the importance of information resources.

2 Materials and Methods

2.1 Hypothesis

From the previous studies, we hypothesize that there exist some bidirectional correlations between information resource flow and bitcoin related proxies.

Google is the most popular searching engine around the world. Google occupies over 70% of the searching market shares and catches almost 85% of mobile traffic. And Google Trends records the users' searching frequency of keywords[3]. From this perspective, when users search the specific keyword more frequently, it means the information resource flow in this field is relatively large. For example, When Bitcoin price skyrocketed, investors' interest drives them collecting bitcoin related information, bitcoin-related technologies, and bitcoin-related policies. Therefore, by collecting the corresponding data through a certain data mining technology, it's possible to quantify a measurement of information resource flow in specific field. Therefore, Google Search Volume Index (SVI) is employed as a direct proxy to measure the information resource flow in specific fields.

Based on these assumptions, we made the following hypothesis and models, adapting the formula in the specific regions, and test them in the following sections:

Hypothesis 1: The increase in Google SVI indicates an increase in Bitcoin price volatility, with a time lag.

$$Volatility_t = \alpha_0 + \sum_{i=1}^{4} \alpha_i Volatility_{t-i} + \sum_{i=1}^{4} \beta_i SVI_{t-i} + Return_t + \varepsilon_t \quad (1)$$

Hypothesis 2: The increase in Bitcoin price volatility indicates an increase in Google SVI, with a time lag.

$$SVI_t = \alpha_0 + \sum_{i=1}^{4} \alpha_i SVI_{t-i} + \sum_{i=1}^{4} \beta_i Volatility_{t-i} + Return_t + \varepsilon_t \quad (2)$$

2.2 Data collection and processing

In the thesis, we followed the method mentioned in previous researches, using weekly Google Search Volume Index in Google Trend to track the searching frequency of keyword 'Bitcoin'[4][5][6]. This is used in this article to measure the impact of information resource flow on the bitcoin market.

About the time period, the data time series range from 2017 to 2023. Here we use 7 whole years' statistics after 2017, And we use 7 whole years' data, dividedly by week. Seven whole years' data help to avoid the seasonality problem, and weekly data makes the interval more detailed. From the database, we get 320 observations.

Not alike stock market, the Bitcoin market cannot be divided into separate local markets. The Bitcoin has only one price within the whole world marketplace. We get the 2017 to 2023 Bitcoin price from Coindesk website. The Bitcoin return is calculated in the following way.

$$R_t = \ln(P_t/P_{t-1}) * 100\% \quad (3)$$

Rt is the return of Bitcoin, ln (Pt and Pt-1) is Bitcoin Price's natural logarithm form at Time t and Time t-1, as the log-log form postulates a constant elasticity model. Therefore, the outcome will be interpreted in the percentage way. We tested the Bitcoin Price and Google Search Index trend. And the log(Bitcoin price)'s pattern corresponds with the log(SVI)'s pattern.

Bitcoin price's volatility is calculated based on bitcoin's return, getting the standard deviation of bitcoin's daily return, and condensed it into the weekly return. ε_t assembles the idiosyncratic error. It's calculated in the following way.

$$\text{Volatility}_t = \sqrt{\sum_{t=1}^{n} R_t^2} \quad (4)$$

Various tests are done to test whether Google search volume index cause changes to Bitcoin price volatility. We use Dickey-Fuller test to examine whether the data is stationary. Vector Autoregressive Regression (VAR) is conducted to test the relationship among Google search volume index and Bitcoin price volatility.

To determine whether SVI influence the Bitcoin price volatility, and whether Bitcoin price volatility affect information resource flow in the same way, we conduct the following models to estimate our hypothesis mentioned before. Bitcoin market opens 7 working days a week. After getting the daily bitcoin return, we average numbers every 7 days and get the weekly bitcoin return. $Return_{t-I}$ is bitcoin's return on day t-i. SVI_{t-I} is the SVI number on day t-I, with different time lags.

3 Results and Discussion

3.1 Preliminary data inspection

To get a better understanding of the data, we run the descriptive statistical analysis to get a basic insight. Table 1 and Table 2 shows the statistical description outcome for Bitcoin price volatility and SVI outcome. The searching volume number from Google Trend is standardized

data, so the maximum volume is 100, higher SVI indicates higher information resource flow. As shown in the Table 1, Google SVI number reaches the highest limit.

Table 1. Statistical description for variables.

Variables	Mean	SD	Min
Google SVI	20.41292	16.77005	7
Bitcoin price volatility	0.0337993	0.0241526	0.0020002

Table 2. Correlation estimates of variables.

Variables	week	year	Google SVI	Bitcoin price volatility
week	1			
year	-0.1559	1		
Google SVI	0.0104	-0.1643	1	
Bitcoin price volatility	-0.0101	-0.0893	0.5483	1

To conduct the VAR model, we take the Dickey and Fuller test at first. The results are shown in Table 3, Google SVI and bitcoin return is significant, rejecting the null hypothesis at 1% level.

Table 3. The test of stationary by Dickey–Fuller.

Variables	t- statistics	Stationary/ Non-stationary
Google SVI	-4.185***	Stationary
Bitcoin price volatility	-11.702***	Stationary

Notes: *, ** and *** significant at 10%, 5% and 1% levels, respectively. D. means the first difference of original data.

Based on the Beyond Traditional Probabilistic Methods in Economics, we conduct the lag selection test as a pre-estimation, and get the optimal model by selecting lag variables, avoiding the missing critical explanatory variables.

Table 4 shows the result of the optimal lag length. Various information criteria are employed in the test. For Log-Likelihood and Likelihood Ratio, the greater value leads to better quality data sample. For Final Prediction Error, Akaike Information Criteria, Schwarz Bayesian Information Criteria, the smaller values denote better time lag lengths. Among multiple benchmarks, AIC is acknowledged as the most useful criteria. The AIC suggests that our models fit best with a time lag of 4. According to the optimal time lag, we will set the VAR model with setting four time weeks lag.

Table 4. The test of lag selection for global statistic.

Google Search Volume Index								
Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-485.502				0.000235	2.9939	3.0124	3.04026
1	460.097	1891.2	16	0	0.0000008	-2.69172	-2.59923,	-2.45992
2	501.005	81.816	16	0	0.00000068	-2.84407	-2.67758,	-2.42682
3	630.598	259.19	16	0	3.4E-07	-3.533882	-3.29834	-2.93614*
4	661.348	61.501*	16	0	3.1E-07*	-3.62904*	-3.31457*	-2.84091

3.2 Vector Autoregression Regression and Granger Test

Vector autoregressive Regression (VAR) and Granger Test are conducted to test the dynamic relationship between information resource flow and Bitcoin price volatility. The sample contains 356 observations. And time lag in the VAR model is set as 4. To avoid multicollinearity problem, in case bitcoin return and transaction volume proxies will be strongly correlated and interfered with each other, bitcoin return is controlled as exogenous factors in this regression.

The VAR and Granger test outcome for the relationship between Google SVI and Bitcoin Volatility is illustrated in the Table 5 and Table 6. The impulse-response function analysis is shown in Figure 1.

Table 5. Results of Vector autoregressive Regression of Global SVI and Bitcoin price volatility with four time lag periods.

Y(Return t)	Coef	Y (Google _SVI t)	Coef
Google _SVI t-1	0.000***[3.140]	Volatility t-1	-37.619[-1.574]
Google _SVI t-2	-0.000104[0.000183]	Volatility t-2	17.895[0.694]
Google _SVI t-3	0.000259[0.000191]	Volatility t-3	-86.115***[-3.538]
Google _SVI t-4	-0.000303*[0.000162]	Volatility t-4	37.743[1.582]
Volatility t-1	0.213***[0.0592]	Google _SVI t-1	0.743***[12.490]
Volatility t-2	0.148**[0.0639]	Google _SVI t-2	0.282***[3.824]
Volatility t-3	-0.0458[0.0603]	Google _SVI t-3	-0.0453[0.0772]
Volatility t-4	0.174***[0.0591]	Google _SVI t-4	-0.0469[0.0653]
Return t	-0.0879[0.0655]	Return t	103.4***[26.43]
Constant	0.0106***[0.00243]	Constant	3.411***[0.982]
R^2	0.3251	R^2	0.7812

Notes: *, ** and *** significant at 10%, 5% and 1% levels, respectively

Table 6. Granger causality Wald test of Global SVI and Bitcoin volatility.

Null Hypothesis	P-value	Result
Bitcoin price volatility does not indicate Granger Causality with Google SVI	0.000***	Reject
Google SVI does not indicate Granger Causality with Bitcoin price volatility	0.001***	Reject

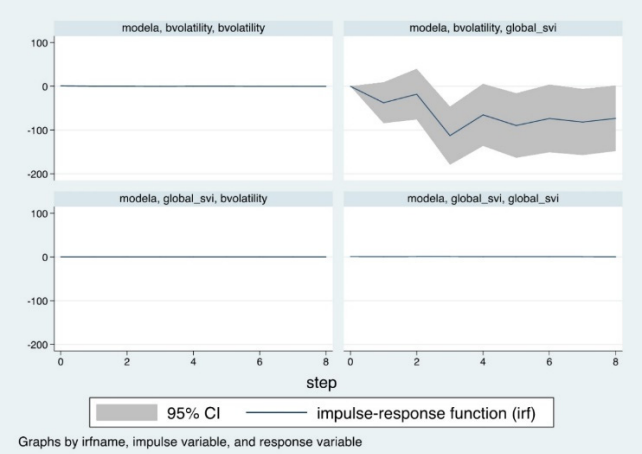

Figure 1. The impulse-response function analysis between Google SVI and Bitcoin volatility.

The Granger Test results in Table 6 shows that there exists a bilateral relationship between Bitcoin return and Google SVI, which means these two proxies predicate each other in the following time periods. Both causal relationships reach a significant 1% level.

Table 5 displays the result of Vector autoregressive Regression for two hypotheses. Although the SSR is only 0.32 for Hypothesis 1, which means the regression explains 32.51% of the Hypothesis 1 and the explanation power of employing information resource flow analyzing current bitcoin's price volatility is not strong, but we are more concerned about the dynamic relationship between the two parameters. The Sum of Squared Residuals of Hypothesis 2 is 0.7812, which means the regression explains 78% of the Hypothesis 2.

The table shows the significant estimates of the VAR parameter for the bitcoin price volatility for time lag 1 and 4. Google SVI at lag 1 has a significant relationship with current price volatility at 1% level while the relationship with SVI at lag 4 is only significant at 10% level. This suggests that the past one-week searching volume more accurately indicates the following week bitcoin price's volatility. But the coefficient of Google SVI at lag 1 is 0.00, which means when the Google SVI increases, it will cause almost no change to bitcoin price volatility in the following one week and generate a subtle decreasing trend of bitcoin transaction volume in one month. When looking into the past bitcoin price volatility, the past price volatility explains more about the current price variation. It shows that the past price volatility at lag 3 significantly provides information about the current price fluctuation.

The estimation outcome of Hypothesis 2 exhibits that the bitcoin price volatility at time lag 3 has a significant relationship at 1% level with current investors' attention, which means when current bitcoin price volatility is high, it will sharply decrease the Google SVI in the next third week.

The impulse-response graph displays the same trend. When bitcoin price volatility changes, it will not cause erratic fluctuation of investors' attention. But after two weeks, the Google SVI shows a strong negative trend, and remains the declining trend for one week. After that, the global attention back to the normal level in the long term.

In conclusion, information resource flow and bitcoin price volatility affect each other. But the relationship is much stronger when employing the past three -weeks statistics. The high bitcoin price volatility will lose investors' interests in the long term. Short term number can be a useful reference source, but the accuracy is not that high, and the relationship is not as strong as the long-term source.

4 Conclusions

This article selects the global data and uses the Google Searching Volume Index as a indicator to measure the information resource flow to study the impact of information resource on bitcoin proxies. After establishing several tests and regressions, the following outcome can be concluded.

First of all, current and previous information resource has influence on bitcoin development. At the same time, bitcoin development influences the information resource flow. For the Volatility, previous part certificates that the information resources can only exert significant

information for bitcoin price volatility, which proved by a statistically significant number. The coefficients of other parameters can be employed as a good reference source. But the result can be different in situations, as it lacks the significant number to support the findings. But in the reversal direction, the price volatility actually affects global information resource flow. When the price fluctuations are high, more public's attention is attracted.

Finally, based on the above research content and results, this article can provide some references for individual investors' future investments. For example, when individual risk-averse investors are trading bitcoin, they can sell bitcoin with fluctuated attention in the recent one month. And pay attention to bitcoin when it attracts greater attention and sells the bitcoin the next week, so that in most cases you can avoid losses and gain income.

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