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# Cryptocurrencies and Exchange Rates: A Relationship and Causality Analysis

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Received: 29 August 2018; Accepted: 3 October 2018; Published: 8 October 2018



**Abstract:** The paper analyzes the relationship between the most popular cryptocurrencies and a range of selected fiat currencies, in order to identify any pattern and/or causality between the series. Cryptocurrencies are a hot topic in Finance due to their strict relationship with the Blockchain system they originate from and therefore are normally considered as part of the ongoing, world-wide financial revolution. This innovative study investigates this relationship for the first time by thoroughly investigating the data, their features, and the way they are interconnected. Results show very interesting results in terms of how concentrated the causality effect on some specific cryptocurrencies and fiat currencies is. The outcome is a clear and possibly explainable relationship between cryptocurrencies and Asian markets, while envisioning some kind of Asian effect.

**Keywords:** cryptocurrency; fiat currency; causality; regression; relationship

## 1. Introduction

Cryptocurrencies are designed to complement and, in some cases, act as substitutes of, fiat currencies, in that they are backed not by governments but by the trust and faith of participants in the value assigned to that currency. The fact that these currencies are based on an algorithm is also an important decision factor for investors.

Using a decentralized control system, the cryptocurrencies implement blockchain technology to assess, confirm, and record all transactions happening with the use of these currencies.

The decentralized control of supply ensures that no government can act on the modification of offer of quantities of any cryptocurrency, since the pace of new issue of that currency is already planned at inception.

There are over a thousand of cryptocurrencies currently available on the market. While most of them derive from the well-known Bitcoin currency, some of them present some features that distinguish them from the others.

What all cryptos have in common is the fact that safety and integrity are guaranteed by a community of individuals and computers. These entities validate and timestamp each transaction through the mining process.

This does not mean the total absence of cybersecurity risk related to Bitcoin and others. Expert hacking would result in cryptocurrencies being stolen like any fiat currencies deposited in a bank account.

[Houben and Snyers \(2018\)](#) report that criminals use cryptos for illicit activities, including money laundering and tax evasion. Misuse of virtual currencies seems to be in the order of \$8 billion.

[Bauer and Ahmad \(2017\)](#) analyze the presence of social engineering attacks that can address social media of potential victims. They also describe how ransomware can affect the activities of a company. They also mention that hacking is sometimes performed to gain possession of someone else's computing power in order to run mining with the resources of the victim.

One common form of cyber-attack against cryptocurrencies is the phone-porting attack, a form of monitoring of social media conversations related to cryptocurrencies, aimed at stealing contact information of people involved in such conversations.

The relationship between cryptocurrencies and fiat currencies is a topic that has not been deeply explored by academia yet. Many online websites and magazines contain short articles that describe the main differences between the various types of currencies, but almost no scientific study exists about their relationship.

Berentsen and Schar (2018) introduce cryptocurrencies focusing on Bitcoin at first and then extend their analysis to generic blockchain-based systems. Similarly, Carrick (2016) analyzes the use of Bitcoin as a complement to emerging market currencies.

His results suggest that the features of Bitcoin make it a good complement and that the risk of investing in Bitcoin can then be minimized.

Chiu and Koepl (2017) develop a general equilibrium monetary model, based on Bitcoin, to analyze the optimal design of a system for cryptocurrency. They manage to relate the value of cryptocurrency systems to the volume of transactions.

Hileman and Rauchs (2017) perform a study to systematically investigate the cryptocurrency industry sector, by using non-public data, and find out that the sector is on an expansion trend.

D'Alfonso et al. (2016) compare Bitcoin and Ethereum from an investor perspective. They come to the conclusion that Bitcoin can leverage the user base, for a five-year period forecast, and Ethereum should be included in investment portfolios.

Cryptocurrency comes with several advantages over fiat money. First, it is a decentralized type of currency, meaning that the underlying system is based on a complex network of interconnected users, which are therefore not possible to control for any entity or government, at any point in time.

Another advantage is that, unlike fiat money, cryptocurrency is not subject to manipulation efforts, especially due to the feature of having a fixed supply, which does not allow for any manipulation in terms of overprinting.

However, there are issues related to the liquidity of crypto markets. Lack of proper liquidity sometimes hinders market participants from closing their position at the right price. The subsequent reluctance of investors to put the coins back to the market may result in a general flooding of the market that has an impact on volatility and efficiency.

Cryptocurrency also has no circulation costs. As opposed to fiat money, which is subject to printing and production costs, virtual currencies are only virtually produced, thereby saving production costs.

In recent times, the above cost convenience has considerably reduced to the point that many miners decided not to participate anymore due to the highly increased requirement of resources, in terms of energy and computing power.

One should recall in fact that, as the supply of cryptocurrencies increases overtime towards the maximum supply, the mining required to generate new coins increases, involving much more computing power. Mining therefore has become a much lengthier and more resource-consuming process in recent years.

Another important aspect that plays in favor of cryptocurrency is the level of security it offers compared to any fiat money. The use of blockchain for verification and the acknowledgment of the legitimacy of each transaction protects against any fraud attempt.

Does this make the crypto markets totally fraud-free? There have been some episodes in recent years that seem to contradict the hypothesis that security is bullet proof for coins. One can think about investment frauds that generate billions of losses in US dollars in the last few years.

In addition, with cryptocurrency the need of intermediaries is eliminated, being the dissemination of the currency assigned to a peer-to-peer distribution system, which excludes any centralized intervention. This system substantially cuts the transaction costs.

However, there are also disadvantages in the use of cryptocurrency. At the moment most people are not using it, and they still rely on fiat money, with the fair projection that this will keep lasting in

the near future. For most people, the value of their assets is still linked to the adoption of fiat money by central governments.

Another disadvantage is that the world is not ready technologically for a large dissemination of cryptocurrency, which requires new infrastructures. The only solution seems to be a gradual transition, which indeed would cause volatility to slowly increase and uncertainty to invade the expectations of the investors.

Moreover, the disruptive effect of cryptocurrency seems to threaten the traditional banking and financial system. The world cannot afford to lose the entire sector of financial institutions.

Investors are currently asking the following questions: Will cryptocurrencies be able in a short or long period to fully replace fiat money? What will the immediate and later consequences of such a takeover be?

One should recall that any currency is valuable as long as investors trust it as a vehicle of value transfer and as an asset. This is what led to the booming of Bitcoin prices in 2017.

However, we also observed a rapid decline afterwards, which generated huge volatility, showing that indeed the system of cryptocurrencies is not mature enough yet to guarantee stability in value.

While the reader is entertained by this section, more and more individuals, corporations, institutions, and governments are accepting Bitcoin and other cryptocurrencies as a means of payment.

There will be a point in the future when the adoption of cryptocurrency will be a standard and values and exchange rates with fiat currency will probably be stabilized. The main reason for such a statement is the fact that currently there are also local and federal entities around the world that are adopting cryptocurrencies for payment, thereby setting a standard for an institutionalized use of cryptos.

The purpose of this paper is indeed to assess what the current situation is in terms of the relationship between cryptocurrencies and fiat money, with regard to the correlation and causality effects.

The first part of the paper is dedicated to the introduction of the models and variables used in the analysis, with a specific focus on the role that correlation and causality play in disclosing the relationship between the variables involved.

The second part of the paper presents the dataset and a description of the data used for the analysis. Section three covers the results of the analysis with comments on the findings. The final section gives conclusions and hints that further research needs to be done in the field.

## 2. The Models and Variables

The variables included in the analysis are six cryptocurrencies and eleven currencies. More specifically, the exchange rate of each cryptocurrency and fiat currently with US dollar is taken into consideration.

The cryptocurrencies and fiat currencies used in the model are summarized in Table 1 below:

**Table 1.** Variables used in the model.

Cryptocurrency	Fiat Currency
Bitcoin	Euro
Ethereum	Australian Dollar
Ripple	Indian Rupee
Litecoin	Swiss Franc
Monero	Malaysian Ringgit
Dash	Thai Baht
	Taiwan Dollar
	South African Rand
	New Zealand Dollar
	Chinese Yuan
	Japanese Yen

The first multivariate linear regression involves the cryptocurrencies as the dependent variable, and all the exchange rates included in the dataset, for each country in the dataset, are calculated, in order to have a preliminary idea of the correlation between the data.

The multivariate regression formula for each cryptocurrency takes the form:

$$e_{Crp_i,USD} = \alpha + \beta_1 e_{Crr_1,USDt} + \beta_2 e_{Crr_2,USDt} + \beta_3 e_{Crr_3,USDt} + \beta_4 e_{Crr_4,USDt} + \beta_5 e_{Crr_5,USDt} + \beta_6 e_{Crr_6,USDt} + \beta_7 e_{Crr_7,USDt} + \beta_8 e_{Crr_8,USDt} + \beta_9 e_{Crr_9,USDt} + \beta_{10} e_{Crr_{10},USDt} + \beta_{11} e_{Crr_{11},USDt} + \varepsilon_t \quad (1)$$

in which

$e_{Crp_i,USD}$  is the natural logarithm of the exchange rate between the  $i$ -th cryptocurrency ( $i = 1, 2, \dots, n$ ) and US dollar.

$e_{Crr_i,USDt}$  is the natural logarithm of the exchange rate between the  $i$ -th fiat currency ( $i = 1, 2, \dots, n$ ) and US dollar.

The second part of the analysis involves selecting the coefficients that are significant and passing the corresponding variables to another stage, where causality is checked, to understand more deeply the relationship between the selected cryptocurrencies and the significantly related fiat currencies.

The analysis proceeds with the test of presence of a unit root for the time series of the cryptocurrencies taken to the second stage. The model used for that is an Augmented Dickey Fuller test (Dickey and Fuller 1979) and Said and Dickey (1984) for unit roots, in order to confirm or reject the hypothesis of stationarity of the time series of each of the cryptocurrencies. The model takes the form

$$\Delta \mathbf{v}_t = \alpha_i + \beta_i \sum_{i=1}^p \Delta \mathbf{v}_{t-i} + \varepsilon_t \quad (2)$$

in which

$\mathbf{v}$  is the vector of the two variables

$\alpha_i$  is the vector of intercepts

$\beta_i$  is the vector of regression coefficients

$p$  is the number of lags considered

$\varepsilon_t$  is the vector of error terms

It is always important to check for the stationarity of time series, especially of financial type, in order to exclude that trends observed in the time series are disconnected from any underlying correlation.

Checking for the stationarity of the cryptocurrency exchange with the US dollar is therefore very important to support the assumption that considers them distributed as an autoregressive process of order 1.

After checking for the stationarity of the time series for the single variables, the analysis concludes by analyzing the causality relationship between the cryptocurrencies and the fiat currencies, in order to identify possible relationships between them and, based on the findings, elaborate on the possible rationale behind such a relationship.

The analysis is carried on by running the test in the form of Granger's measure (Granger 1969). The null hypothesis that one variable causes the other variable is tested by the Granger method with an F-statistic that rejects the hypothesis when the associated probability is lower than 5%.

The Granger test takes the form:

$$z_t = \lambda_t + \sum_{i=1}^p \alpha_i z_{t-i} + \sum_{i=1}^p \beta_i y_{t-i} + \varepsilon_t \quad (3)$$

in which

$\lambda_t$  is the vector of intercepts

$\alpha_i$  and  $\beta_i$  are the regression coefficients

$p$  is the number of lags considered

$\varepsilon_t$  is the error term

The  $F$ -test is on the null hypothesis that  $\beta_1 = \beta_2 = \dots = \beta_p = 0$  and the hypothesis of causality is rejected for values of the statistic above 5%. The causality is tested with bi-directionality, in order to explain the behavior of investors towards both cryptocurrencies and fiat currency given the chance to invest in each option using US dollar as vehicle currency.

In this paper, the Chi-Square version of the test is adopted, in that it offers more robust results of the  $F$ -test when it comes to a large set of data. The Chi-Square test is based on the relevant distribution and must be interpreted by comparing the test coefficients with the degrees of freedom of the distribution, which in this case are given by the number of lags used in the test.

In case of non-stationary time series, the Granger causality test is not applicable anymore, and a Vector Error Correction Model (VECM) is needed to approach the problem (Zapata et al. 2014).

The error correction is specified as:

$$\Delta \mathbf{x}_t = \Sigma \mathbf{x}_{t-1} + \sum_{i=1}^{p-1} \mathbf{K}_j \mathbf{x}_{t-i} + \varepsilon_t$$

in which the vector of variables follows a Vector Auto Regression (VAR) process of order  $p$  of variables integrated of order 1, in the form:

$$\mathbf{x}_t = \Phi_1 \mathbf{x}_{t-1} + \Phi_2 \mathbf{x}_{t-2} + \dots + \Phi_p \mathbf{x}_{t-p} + \varepsilon_t$$

and the model matrices take the form:

$$\mathbf{K}_j = - \sum_{i=j+1}^p \Phi_i$$

and

$$\Sigma = -(\mathbf{I} - \Phi_1 - \Phi_2 - \dots - \Phi_p) = \mathbf{A}\mathbf{B}'$$

in which

$\mathbf{A}$  is the matrix of adjustment vectors

$\mathbf{B}$  is the matrix of cointegrating vectors

In case the VECM approach returns coefficients that are significant, the null hypothesis of no causality is rejected, and it is possible to assume some causality relationship between the variables.

### 3. Data and Preliminary Results

The dataset for the variables listed in section one come with same daily frequency but different number of ticks, which varies from one currency to another, given that the six cryptocurrencies analyzed in the paper came into existence at different points in time.

Therefore, the datasets cover different time spans, as summarized in Table 2 below:

**Table 2.** Length of the Datasets.

Cryptocurrency	Time Span	Ticks
Bitcoin	From 28 April 2013 to 7 March 2018	1775
Ethereum	From 7 August 2015 to 7 March 2018	944
Ripple	From 4 August 2013 to 7 March 2018	1677
Litecoin	From 28 April 2013 to 7 March 2018	1775
Monero	From 21 May 2014 to 7 March 2018	1386
Dash	From 14 February 2014 to 7 March 2018	1483

With thousand or more ticks for all the observed variables, the analysis relies on the fact that all the tests and statistics applied to data can benefit from consistency and accuracy.

However, in order to homogenize all results without loss of consistency, all datasets are homogenized to the length of the Dash series, i.e., from 14 February 2014 to 7 March 2018. Moreover, after taking out the weekends in order to also synchronize the data to the fiat currency series, the analysis is based on 1059 ticks for all cryptocurrencies except Ethereum, which is fixed at 944 ticks.

With all data synchronized, the analysis is believed to yield more significant and easily interpretable results, especially for what relates to the understanding of the reasons behind potential correlations and causalities.

The initial multivariate regressions are summarized in Tables 3–8 below, with specific emphasis on the significant coefficients.

**Table 3.** Results of the multivariate regression of each cryptocurrency against the fiat currencies (significant coefficients are in bold, with significance in parentheses).

	Bitcoin	Ethereum	Ripple	Litecoin	Monero	Dash
EUR/US	0.3461 (0.3567)	<b>1.3385</b> <b>(1.4180)</b>	0.4102 (0.6258)	0.3666 (0.5640)	− <b>1.6900</b> <b>(2.4400)</b>	− <b>1.3241</b> <b>(0.7252)</b>
AUD/US	0.1822 (0.3662)	−0.2688 (1.0646)	−0.4294 (0.6425)	0.1699 (0.5791)	−0.6438 (1.9702)	−0.3408 (0.7446)
IND/US	−0.5561 (0.5190)	<b>1.2805</b> <b>(1.6716)</b>	−0.3767 (0.9106)	−0.4178 (0.8208)	− <b>1.3540</b> <b>(2.8493)</b>	−0.5150 (1.0553)
CH/US	−0.4227 (0.2567)	− <b>1.5503</b> <b>(1.5132)</b>	−0.5687 (0.4505)	−0.1127 (0.4060)	0.5657 (2.6724)	<b>0.7882</b> <b>(0.5220)</b>
MLY/US	0.2190 (0.3403)	0.6425 (0.9379)	−0.3475 (0.5971)	−0.2920 (0.5382)	− <b>9.4660</b> <b>(3.1103)</b>	0.3202 (0.6920)
THA/US	<b>0.8283</b> <b>(0.7211)</b>	− <b>1.7866</b> <b>(2.1074)</b>	− <b>0.8506</b> <b>(1.2651)</b>	<b>2.0140</b> <b>(1.1403)</b>	<b>2.9866</b> <b>(3.8114)</b>	<b>0.7951</b> <b>(1.4661)</b>
TAW/US	− <b>0.8480</b> <b>(0.6076)</b>	− <b>1.0941</b> <b>(1.6383)</b>	<b>0.5918</b> <b>(1.0661)</b>	− <b>0.6017</b> <b>(0.9609)</b>	<b>3.1248</b> <b>(2.9475)</b>	− <b>1.5051</b> <b>(1.2355)</b>
SAF/US	0.1333 (0.1860)	−0.3451 (0.4563)	0.4034 (0.3263)	0.0852 (0.2941)	−0.1229 (0.7540)	−0.1178 (0.3782)
VEN/US	−0.0383 (0.0075)	−0.0428 (0.0167)	−0.0413 (0.0131)	−0.0102 (0.0118)	−0.0334 (0.0194)	−0.0415 (0.0152)
NZL/US	−0.0168 (0.3171)	0.5705 (0.8864)	0.4151 (0.5563)	−0.3431 (0.5015)	−0.2852 (1.6491)	−0.0749 (0.6448)
CHI/US	−0.0427 (0.8539)	<b>5.2811</b> <b>(2.1763)</b>	− <b>1.4971</b> <b>(1.4981)</b>	<b>0.5357</b> <b>(1.3503)</b>	<b>2.6319</b> <b>(3.6151)</b>	<b>1.0009</b> <b>(1.7361)</b>
JAP/US	−0.0698 (0.2879)	−0.7137 (0.7761)	−0.2386 (0.5051)	−0.4034 (0.4553)	− <b>2.0529</b> <b>(1.6109)</b>	0.6953 (0.5854)

The multivariate regression clearly shows well-defined correlative relationships between each cryptocurrency and some of the fiat currencies involved in the analysis.

These relationships determine the subsequent step of the analysis in which the Granger causality measure is taken for each cryptocurrency vs. the fiat currencies that are relevant to them due to the regression results.

The summary of the relevant relationship is given in Table 4 below:

**Table 4.** Positive (+) and negative (−) relationships resulting from the coefficients of the multivariate regression of each cryptocurrency vs. the fiat currencies.

Cryptocurrency	Related Fiat Currency
Bitcoin	Thai Baht (+) Taiwan Dollar (−)
Ethereum	Euro (+) Indian Rupee (+) Swiss Franc (−) Thai Baht (−) Taiwan Dollar (−) Chinese Yuan (+)
Ripple	Thai Baht (−) Taiwan Dollar (+) Chinese Yuan (−)
Litecoin	Thai Baht (+) Taiwan Dollar (−) Chinese Yuan (+)
Monero	Euro (−) Indian Rupee (−) Malaysian Ringgit (−) Thai Baht (+) Taiwan Dollar (+) Chinese Yuan (+) Japanese Yen (−)
Dash	Euro (−) Swiss Franc (+) Thai Baht (+) Taiwan Dollar (−) Chinese Yuan (+)
None of the Cryptocurrencies	Australian Dollar South African Rand New Zealand Dollar

The first result that stands out is that all the cryptocurrencies are somehow related to one or more of the fiat currencies. There is a clear predominance of Asian currencies when it comes to getting significant regression coefficients, underlying the existence of correlation of some kind.

Surprisingly, two currencies that are not normally considered of primary importance, like the Thai Baht and the Taiwan Dollar, seem to be correlated to all the cryptocurrencies analyzed, a phenomenon that is worth investigating further in the second part of the analysis.

Only three of the involved fiat currencies, namely, Australian Dollar, South African Rand, and New Zealand Dollar, seem to have no relationship with any of the major cryptocurrencies, as per the analysis.

Is there a Commonwealth effect on the analyzed relationships? It is interesting to see how three of the major Commonwealth countries end up being the ones with no relationship whatsoever with any of the most popular and liquid cryptocurrencies currently available to investors.

As for the second stage of the analysis, before studying the causality of any time series, it is opportune to check the stationarity of them. In particular, the focus is on the unit roots of the time series of cryptocurrencies.

An Augmented Dickey Fuller is run, in order to assess whether the time series of each cryptocurrency is stationary or not. The results of the test are summarized in Table 5 below:

**Table 5.** Augmented Dickey-Fuller unit root test for the cryptocurrencies.

	Obs.	MacKinnon	Test Statistics	1% Critical Value	5% Critical Value	10% Critical Value
Bitcoin	846	0.4640	−1.637	−3.43	−2.86	−2.57
Ethereum	846	0.0718	−2.713	−3.43	−2.86	−2.57
Ripple	846	0.9981	1.690	−3.43	−2.86	−2.57
Litecoin	846	0.0001	−4.619	−3.43	−2.86	−2.57
Monero	846	0.0000	−12.899	−3.43	−2.86	−2.57
Dash	846	0.0956	−2.587	−3.43	−2.86	−2.57

The test shows that we cannot reject the null hypothesis of presence of unit root for Bitcoin and Ripple, at all levels of significance. For Ethereum, the hypothesis is not rejected at 1% and 5% critical value but is rejected at the 10% critical value.

The hypothesis of presence of unit root for Litecoin, Monero, and Dash can be rejected, and this is true for all critical values. One may conclude that time series of cryptocurrencies somehow shows a general lack of stationarity, except in a few cases.

**Table 6.** Granger causality test for Bitcoin vs. relevant fiat currencies.

Equation	Excluded	chi2	df	Prob
bitcoin	Thaus (Thai Baht/USD)	4.491	4	0.344
bitcoin	Tawus (Taiwan D/USD)	4.836	4	0.305
bitcoin	ALL	7.517	8	0.482
thaus	bitcoin	1.537	4	0.820
tawus	bitcoin	2.292	4	0.682

**Table 7.** Granger causality test for Ethereum vs. relevant fiat currencies.

Equation	Excluded	chi2	df	Prob
ethereum	eurus	3.177	4	0.529
ethereum	indus	4.095	4	0.393
ethereum	chus	1.356	4	0.852
ethereum	thaus	8.287	4	0.082
ethereum	tawus	6.730	4	0.151
ethereum	chius	10.157	4	0.038
ethereum	ALL	25.961	24	0.355
eurus	ethereum	6.784	4	0.148
indus	ethereum	1.571	4	0.814
chus	ethereum	1.066	4	0.900
thaus	ethereum	4.464	4	0.347
tawus	ethereum	3.4268	4	0.489
chius	ethereum	27.316	4	0

**Table 8.** Granger causality test for Ripple vs. relevant fiat currencies.

Equation	Excluded	chi2	df	Prob
ripple	thaus	5.473	4	0.242
ripple	tawus	2.717	4	0.606
ripple	chius	6.913	4	0.141
ripple	ALL	20.993	12	0.050
thaus	ripple	0.970	4	0.914
tawus	ripple	3.661	4	0.454
chius	ripple	35.107	4	0.000



The Granger causality test to follow works well with stationary series but causes serious issues when the time series under analysis is nonstationary. [Zapata et al. \(2014\)](#) elaborate on the identification of causality relationship for nonstationary series.

#### 4. The Hunt for Causality

Causality in nonstationary time series is normally analyzed with Vector Error Correction Models (VECM), which allow one to divide the causality into short-term vs. long-term.

When analyzing the causality between two or multiple variables, the stationarity of those variables is very important (see above) and determines the reliability of the Granger test.

It is opportune for the second part of the analysis to run Granger causality for Bitcoin, Ethereum, and Ripple, while dropping Litecoin, Monero, and Dash, given that they do not exhibit unit roots.

The latter three cryptocurrencies will be then analyzed using a VECM approach and the results interpreted in order to determine whether there is some consistency in the relationship with fiat currencies.

Since the three biggest cryptocurrencies present stationary time series, we limit the analysis to these. In the following section, the papers then analyze the Granger causality for each of the three cryptocurrencies vs. fiat currencies.

Apparently Bitcoin is caused by both the Thai Baht and the Taiwan Dollar, but not any of them when considered singularly. The lack of causality seems to be confirmed by the opposite relationship with both cryptos not affecting any of the two fiat currencies.

The result reinforces the ones from the multivariate regression, and clearly identifies a causal relationship sustained by correlation between Bitcoin and the Asian currencies, which is labeled as the Asian Effect in the following paragraphs.

The analysis of causality relationships for Ethereum shows again that the causality effect is concentrated on the Asian fiat currencies, thus again confirming the robustness of the relationship revealed by the multivariate regression.

It is interesting to note how the remaining fiat currencies have no causality relationship with Ethereum, while there is a strong bi-directional causality effect when it comes to the aggregate of all currencies.

The opposite relationship is again observable, and it seems like Ethereum is Granger-causing only the Chinese Yuan while not being connected to any of the other fiat currencies related to it.

Ripple shows a very strong causality relationship with the Chinese Yuan, while the result cannot be considered as strong when it comes to the causality with the Thai Baht, in both directions.

In this case, the Taiwan dollar shows no causality at all in any direction with Ripple, and the correlation suspected from the multivariate regression is not confirmed in terms of causality.

Again, when it comes to the opposite relationship, it is possible to observe how Ripple only affects the Chinese Yuan, while not affecting any of the other fiat currencies in the bunch.

The approach to the VECM analysis is chosen to be quite conservative, so the choice is to input to the model only one cointegration vector. This is also due to the fact that we choose not to run a cointegration test before the analysis, in order to simplify the work.

Table 9 shows the results of the VECM analysis of the three cryptocurrencies not analyzed in the Granger causality test. For Litecoin, Monero, and Dash, the VECM approach allows one to determine whether the null hypothesis of absence of causality is rejected, for significant coefficients.

The results clearly show how the coefficients for Litecoin are partly insignificant (Thai Baht and Taiwan Dollar) and partly significant (Chinese Yuan), making it hard to draw a conclusion about the existence of an Asian Effect, as we concluded for the currencies analyzed previously.

Further to this, it is then interesting to note how the coefficients for Monero and Dash are not significant when it comes to the Euro area and Switzerland, while becoming very significant for the Asian currencies, including again the Thai Baht and the Taiwan Dollar, therefore confirming the Asian Effect, in some sense.

It is also interesting to see how the whole of the Asian fiat currencies play a role in the determination of all the three cryptocurrencies, with very significant coefficients.

There is a strong effect of the Chinese Yuan on all the cryptocurrencies analyzed, if we consider that only for Bitcoin the Chinese Yuan did not pass the significance stage of the multivariate regression.

**Table 9.** VECM analysis on Litecoin, Monero, and Dash, against their respective driving fiat currencies.

	Litecoin	Monero	Dash
EUR/US	-	−0.0460 (1.5653)	0.0412 (0.0425)
IND/US	-	−0.2761 (2.3584)	-
CH/US	-	-	−0.0045 (0.0336)
MLY/US	-	3.4687 (2.9533)	-
THA/US	−0.0237 (0.9533)	−9.4578 (3.3310)	−0.0338 (0.0850)
TAW/US	−0.1555 (0.9602)	−2.0483 (2.3470)	0.0229 (0.0872)
CHI/US	1.2820 (1.2235)	5.0093 (3.1342)	−0.0359 (0.1054)
JAP/US	-	2.9921 (1.4341)	-

## 5. Conclusions

Is Asia driving the major cryptocurrencies in the world? According to the analysis in this paper, it seems so. There is definitely a correlation and causality effect that deserves further analysis.

More research on this topic should be developed in order to uncover the reasons behind such a dependence, and how these features can be used for financial purposes, including but not limited to monetary policy, regulation, and diversification of international portfolios.

There is no doubt that three fiat currencies (Thai Baht, Taiwan Dollar, and Chinese Yuan) are strongly connected to the six major cryptocurrencies currently available to investors in the world.

Is the effect limited to the dataset analyzed? Or is it something that could be observed over several time windows? The purpose of this paper is also to instill curiosity and ambition into researchers to look further into the matter.

A summary of the results shows how all the analyzed cryptocurrencies have some dependence of selected major fiat currencies. Results from a multivariate regression show how all but three countries show some significant relation with some of the cryptocurrencies under analysis.

The three countries that show no significant coefficients are among the major Commonwealth countries in the world. Further research may analyze data of other important Commonwealth countries and see if there is a red line connecting the dots, and try to offer an interpretation to that.

Further to the multivariate regression, a Granger causality test on the cryptocurrencies that exhibit unit roots shows how there is a persistent causality effect of Asian fiat currencies on three cryptocurrencies.

Moreover, the trend is confirmed by the VECM analysis of the remaining three cryptocurrencies that do not exhibit unit roots, giving a confirmation that the Asian fiat currencies show significant coefficients.

The Asian effect on cryptocurrencies is certainly an interesting subject to be analyzed more in depth. Current results suggest that by addressing the topic further with a new dataset and a wider selection of countries, the results could be confirmed.

The results of the paper also show that the effect is bidirectional in most cases, with Bitcoin and Ethereum in particular causing the main relevant currencies (Thai Baht, Taiwan Dollar, and Chinese Yuan).

Further analysis could be done on the generalized reverse effect, addressing the issue of how cryptocurrencies affect emerging markets economies, thus inverting the relationships investigated in this paper.

**Funding:** This research received no external funding.

**Conflicts of Interest:** The author declares no conflicts of interest.

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