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Cryptocurrency and Financial Stability

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Abstract: This paper introduces cryptocurrency into a two-country open-economy model. Based on the theoretical model, we employ the TVP-VAR model to study the dynamic interdependence among interest rate spread (a proxy in the monetary market), exchange rate (a proxy in the forex market), and Bitcoin transactions (a proxy in the cryptocurrency market). The key finding is that Bitcoin has an effect of de-fiatization in the global financial market. When there is a higher divergence in monetary policy between the US and China, Bitcoin attracts greater attention with a higher price, posing a competing force against USD. When there are greater fluctuations in the exchange rate of USD/CNY, Bitcoin diverts investors from CNY. The fiat currencies of the two largest economies are both losers while Bitcoin gains. Therefore, cryptocurrency not only decentralizes the role of commercial banks as a medium of payment, but also decentralizes the role of central banks as a monetary policymaker. In face of this challenge, it is suggested that central banks should embrace blockchain technology and develop their own digital currency to restore the trust lost in the global financial crisis. International collaborations in terms of regulation are necessary given its borderless and authority-less feature.

Keywords: cryptocurrency; financial stability; de-dollarization

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1. Introduction

The white paper released by Facebook about its plan to launch a new cryptocurrency Libra in 2019 triggered instant responses from countries and institutions, including the US which had an obscure attitude towards cryptocurrency innovations. Hours later, Democratic representative Maxine Waters requested Facebook to stop developing its cryptocurrency Libra. On the same day, the G7 stated that it would establish a high-level forum to examine the risks such currencies pose to the financial system. The development of Bitcoin since 2009 was featured with periodically skyrocketing or plummeting prices; cryptocurrency trading platforms (decentralized exchanges or

DEXs) have become a "casino" for risk-seeking speculators. Facebook is now the world's largest supranational business ecosystem benefiting from its huge user group. Its integration with cryptocurrency may signify the birth of the only super digital currency that can shake the position of the world currency (USD) at present. The potential risk caused by the fluctuation of currency values therefore is unmeasurable.

What are the determinants of cryptocurrency price fluctuations? And will the future development of cryptocurrency embrace the characteristics of fiat currencies such as the USD? And most importantly, as the two largest economies in the world, will China and US's monetary policies have spillover effects on cryptocurrency? To answer these research questions, we start with a literature review on the academic literature of policy transmission mechanisms. A two-country open-economy model of cryptocurrency is then presented. Following the theoretical model, we report the empirical results of a time-varying analysis and breakpoint regressions. Next, by trend analysis, the Granger causality test, and breakpoint regressions, we analyze the policy impacts of China and the US's monetary policies on transaction prices and volumes of cryptocurrencies. Impulse response functions of a TVP-VAR model are discussed to quantify the dynamic effects on cryptocurrency.

2. Literature Review

Cryptocurrencies are P2P (Peer-to-Peer) solutions based on cryptography, blockchain, and smart contract technologies, primarily issued and circulated on the internet. Satoshi Nakamoto (2008) operationalized and popularized the concept of distributed ledger technology (DLT) by creating the first cryptocurrency Bitcoin. The integration of finance and computing technology provides a higher level of information symmetry, increases efficiency of transaction settlement, and reduces the cost of trust (Zhang and Zhou, 2021). Bitcoin has since become the world's most dominant cryptocurrency and served as a potential alternative to fiat currencies (e.g., USD, EUR, JPY).

The features of cryptocurrency spark numerous discussions on whether it meets the economic definition of currency (Raskin and Yermack, 2018). Bitcoin, for example, resembles mainstream currencies, such as the USD, since it was designed as a P2P medium of exchange. In contrast, Bitcoin holds its unusual position by being a "private currency" that is not backed by a sovereign state (Bjerg, 2016). The analysis of Dyhrberg (2016) puts the position of Bitcoin between USD and gold, highlighting its advantages as a medium of exchange and its disadvantages as a store of value. Furthermore, the result from the asymmetric GARCH model supports her argument that Bitcoin provides a hedging capability like gold. On the contrary, Glaser et al. (2014) conclude that Bitcoin users mainly trade with a speculative intention. By comparing the characteristics of Bitcoin, fiat currencies (USD, RMB, EUR and JPY), and their corresponding treasury bonds, Slawotsky (2020) concludes that Bitcoin-like cryptocurrencies promote "de-dollarization". In contrast, our paper also argues for a "de-fiatization" effect of cryptocurrencies via the crowding-out effect. This is partly caused by exchange rate movements and the negative pressure on government bonds due to interest rate differences.

As an intensively investigated topic, the literature on drivers of the Bitcoin price seems to have reached a more balanced consensus. That is a combination of fundamentals and speculative behaviors. Kristoufek (2015) analyses four commonly claimed influential factors of the Bitcoin price, including fundamentals, speculation, technology, and the Chinese market. The fundamental factors are found to play a role over the long term, while short-term demands driven by speculation also serve to elevate the short-term price volatility. Hence, he concludes that "*Bitcoin forms a unique asset possessing properties of both a standard financial asset and a speculative one*".

Furthermore, the media and academic attention on Bitcoin went beyond merely its speculations and implications. The technological and conceptual advantages have also sparked thoughts and excitement about its development and potential applications. In mid-2010s, China started to explore potential application of blockchain in a more traditional context—Central Bank Digital Currency (CBDC). Guo and Zhou (2023) acknowledge that the central bank's traditional currency issuance will face new challenges in the face of information technology development. And the central bank's issuance of cryptocurrency may point in the direction of future development. They explore the potential of the CBDC from conceptual, technical, and practical dimensions, and make proposals of using blockchain technology to further incorporate technological advancement. Barrdear and Kumhof (2022) analyze a DSGE model calibrated to match pre-crisis US economy and identify several macroeconomic advantages associated with the CBDC, including a sizeable gain in the steady-state GDP, the business cycle stability assisted by a second policy instrument, and the financial stability given certain policy assurance.

Cryptocurrencies are meant to be globally used because the economy is increasingly interconnected globally. At the same time, the literature on traditional monetary policy has also been devoted to explaining how and to what degree one country's monetary policy can have impacts on its global counterparts. A few channels of international monetary policy transmission mechanism are proposed and studied extensively. Rey (2016) studies open economies from the financial market friction aspect empirically and finds significant monetary policy spillover from the US to major economies that operate based on floating exchange rates with an established inflation targeting regime. Georgiadis (2015) analyses the validity of "impossible trinity" in the context of financial globalization using a GVAR (Global VAR) model. He concludes that the flexibility of exchange rate is not only still critical for monetary autonomy under free capital mobility but is also an increasingly important channel for the monetary policy transmission. However, few research attempts to bridge decentralized cryptocurrency and centralized monetary policy in one unified framework despite the substitutability between cryptocurrencies and fiat currencies. This paper aims to fill this gap.

3. Model

VAR models are extensively used in macroeconomic research. Recent extensions from the simple VAR model are mainly developed in two dimensions. First, the progress of the ever-complex economic analysis is frequently stalled by the dimensionality curse—the trade-off between economic coherence and statistical consistency. Pesaran et al. (2004) first propose a relatively practical, yet effective GVAR model that has since been adopted widely particularly in the area of policy analysis and risk evaluations. Second, the economic complications are far beyond a set of linear relationships presented by a VAR model—time series can have multiple structural breakpoints that correspond to economic and policy shifts. To capture these time-varying features, Primiceri (2005) first develops a TVP-VAR model which allows both coefficients and variance-covariance matrix to vary over time. Time-varying coefficients capture the variation in the systematic dynamics of the economy, while time-varying variance-covariance matrix capture the variation in the non-systematic shocks of the economy.

This study contributes to literature in two aspects. First, as world's two largest economies, both China and the US are considered as open economies with policy externalities in the literature. Studies of China and the US' influences on Bitcoin trading have been done in various aspects. Nevertheless, studies from the aspect of joint policy dynamics are rare. This study investigates the joint impacts of monetary policies in China and the US on the Bitcoin trading price and volume. It bridges and enriches the literature on monetary policy and cryptocurrency from an open-economy and multilateral macroeconomic perspective. Second, this study carries out various time-varying analysis to identify underlying structural changes around the steady states. A TVP-VAR model with stochastic volatility is used to explore the roles of systematic and non-systematic changes in Bitcoin trading.

What distinguishes a "two-country open-economy" model from a "small open-economy" model is the extent to which a country's economic and policies influence its counterparts. For example, the Chinese economy has gradually made the transition to a small open economy since 2001 when it joined the WTO (Wei et al., 2023). From 2010, China became the second largest economy after the US, which made the two-country open-economy model more appropriate (Zhang and Zhou, 2021). Moreover, cryptocurrency can be used globally as a substitute for fiat currency, so both China and the US are potentially relevant. In this paper, we introduce cryptocurrency into a two-country open-economy model and establish the relationship between monetary policy, inflation, exchange rates, and interest rates.

In this context, country A (US) is the leading economy which incorporates cryptocurrency into its money supply alongside its traditional fiat currency. It is assumed that the cryptocurrency is not big enough to impact the economy of country A substantially. Country B (China) represents the counterpart economy, within which the circulation of cryptocurrency is restricted, though the exchange between fiat currency and cryptocurrency is allowed. The structure of the model follows a standard RBC model augmented with money.

The economic conditions of country A (denoted by *) consist of:

Aggregate demand: $y_t^* = AD^*\left(y_{t-1}^*, i_{t-1}^*, e_t\right)$
Aggregate supply: $y_t^* = AS^*\left(y_{t-1}^*, \pi_t^* - \pi_{t-1}^*, e_t\right)$
Money supply: $m_t^* = MS^*\left(\gamma_t^*, \theta_t^*\right)$
Money demand: $m_t^* = MD^*\left(p_t^*, y_t^*, i_t^*\right)$

The economic conditions of country B consist of:

Aggregate demand: $y_t = AD\left(y_{t-1}, i_{t-1}, e_t\right)$
Aggregate supply: $y_t = AS\left(y_{t-1}, \pi_t - \pi_{t-1}, e_t\right)$
Money supply: $m_t = MS\left(\gamma_t, \theta_t\right)$
Money demand: $m_t = MD\left(p_t, y_t, i_t\right)$

The relationship between the two countries:

PPP: $p_t^* = p_t - e_t$
Uncovered IRP: $e_t = E_t\left[e_{t+1}\right] + i_{t+1}^* - i_{t+1}$
Balance of payment: $e_t = e\left(y_t, y_t^*, r_t, r_t^*, E_t\left[e_{t+1}\right]\right)$
Fisher equation: $r_t = i_t - E_t\left[\pi_{t+1}\right]$

Following conventional notations, $p_t, y_t, i_t, e_t, \pi_t, \gamma_t, \theta_t, m_t$ denote the price level, output, nominal interest rate, real interest rate, exchange rate, inflation rate, fiat currency, cryptocurrency, and total money supply in country B at time t. Variables with * indicate the counterparts in country A.

After combination and approximation, the log-linearized money demand function of country A can be rewritten as a linear function:

$$m_t^* = m^*\left(y_t^*, i_t^*, E_{t-1}\left[e_t\right], e_{t-1}, E_t\left[e_{t+1}\right], i_{t+1}^*, i_{t+1}, i_t^*, i_t\right)$$

Similarly, the amount of cryptocurrency in circulation can be expressed as:

$$\theta_t^* = \theta^*\left(y_t^*, p_t^*, m_t^*, \gamma_t^*, E_{t-1}\left[e_t\right], e_{t-1}, E_t\left[e_{t+1}\right], i_{t+1}^*, i_{t+1}, i_t^*, i_t\right)$$

The factors can be classified as fundamental factors $F_t\left(y_t^*, p_t^*, m_t^*, \gamma_t^*\right)$, exchange rate factors $X_t\left(E_{t-1}\left[e_t\right], e_{t-1}, E_t\left[e_{t+1}\right]\right)$, interest rate factors $R_t\left(i_{t+1}^*, i_{t+1}, i_t^*, i_t\right)$, and shock factors (ϵ_t). The θ_t^* equation suggests that the monetary policies of two economies play a role in determining the volume of cryptocurrency. It also suggests that the cryptocurrency in circulation can be affected by the past and expected exchange rates and interest rates.

In this study, cryptocurrency is denominated in currency A, the total volume of cryptocurrency can be defined simply as: $\theta_t^* = P_t^* Q_t^*$, where P_t^* denotes the price of cryptocurrency denominated in currency A, and Q_t^* denotes the quantity of cryptocurrency in circulation. An empirical model of Q_t^* can be specified with transaction-driven factors, technology-driven factors, security-driven factors, speculation-driven factors, and China-related factors. Note that, cryptocurrency shows a substitution effect on fiat currencies implied from the structural equations above, i.e., $corr(\theta_t^*, \gamma_t^*) < 0$. This is what is termed as "de-dollarization" effect of cryptocurrency in the literature. But this is not the only effect. Given that CNY also has a "de-dollarization" effect on USD in regional trade (Guo and Zhou, 2021), there is a competition between cryptocurrency and CNY as well. It is arguable that cryptocurrency not only promote de-dollarization, but also induce de-fiatization in general. It decentralizes the entire monetary economic system.

4. Data

In line with the discussion in the previous session, the empirical model in this section operationalizes the theoretical model to estimate the impact of policy differences on cryptocurrency. Building on that, policy implications are evaluated to mitigate financial risks and strengthen financial stability.

Bitcoin trading price (BTC/USD) and volume are two main indicators for the performance of cryptocurrency. In terms of policy differences, the US-China interest rate (10-year government bonds) spread is used. The exchange rate is defined as the amount of CNY for one unit of USD (USD/CNY). The daily sample is obtained from the Wind Database, ranging from 2013M1 to 2019M6. To match the frequency of other macroeconomic variables, daily data are transformed to monthly data by mean.

The TVP-VAR model with stochastic volatility is a vector autoregressive model with time-varying parameters. It has been widely used in the literature on financial markets to capture continuous evolution of underlying market structures. This is especially evident in the turbulent international financial and money markets of modern times, such as forex and cryptocurrency markets. Hence, the TVP-VAR model is well suited to the purpose of this study as the time-varying factor enables an in-depth analysis of such structural changes.

Figure 1 compares Bitcoin price P_t^* and US-China interest spread s_t. After 2017M1, the trend of Bitcoin price and the US-China interest rate spread seem to co-move with each other. The interest rate spread shows neither leading nor lagging position until 2019M1 when the interest rate spread starts to show a leading position against the Bitcoin price. In comparison, the trade volume shows a two-month lag against the interest rate spread, particularly after 2017M11. Similarly, the exchange rate also shows certain synchronicity with Bitcoin after 2016, but it exhibits more time-variations and an alternating parallel-deviating-parallel pattern. For example, the two variables ran in parallel in 2016 and 2018M1–2018M5, while diverging in 2017 and 2018M5–2018M11.

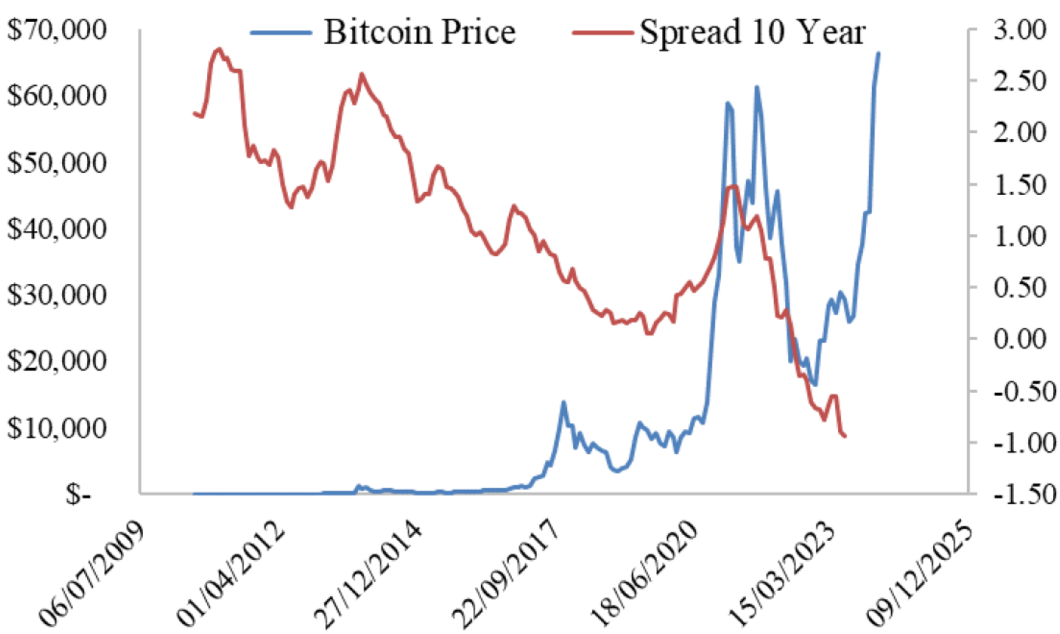

Figure 1: Time plots of key variables used in the empirical model.

Given the complicated lead-lag co-movements, we apply Granger Causality test in Table 1 to all four series. The lag order is set to 2. First, there are bi-directional causalities between the interest spread s_t and Bitcoin price P_t^*, while the causality from s_t to the Bitcoin trade volume Q_t is only unidirectional. Second, there are bi-directional causalities between the exchange rate e_t and Bitcoin price P_t^*, but the causality from e_t to Bitcoin trade volume Q_t^* is only unidirectional. Monetary policy differences between the Fed and the PBoC are the driving force behind fluctuations of Bitcoin trade volume. e_t and Q_t^* are not two divergent indicators; rather, e_t reflects the policy differences between the two economies and acts as a leading indicator of Q_t^*. The results of the Granger causality test are in line with the Interest Rate Parity theory of exchange rates and interest rates since there is a one-way causal relationship between the China-US interest rate difference and the exchange rate, but no reverse causal relationship.

Table 1: Granger Causality Test Results.

Null hypothesis H_0	F-Test	Pr (H_0)
s_t does not Granger-cause P_t^*	0.57597	0.5623
P_t^* does not Granger-cause s_t	1.30247	0.2722
s_t does not Granger-cause Q_t^*	8.17259	0.0003 ***
Q_t^* does not Granger-cause s_t	0.0316	0.9689
e_t does not Granger-cause P_t^*	2.20734	0.1103
P_t^* does not Granger-cause e_t	2.09013	0.124
e_t does not Granger-cause Q_t^*	7.94196	0.0004 ***
Q_t^* does not Granger-cause e_t	0.76728	0.4645

Notes: *** = significant at the 1% level.

Granger causality tests only verify the short-term relationship between variables. An insignificant result does not rule out the possibility of long-term equilibrium relationship. Johansen cointegration tests are therefore carried out to verify possible long-term causal relations. Both trace tests and maximum eigenvalue tests show the existence of two cointegration vectors. Hence, long-term causal relationships should not be neglected either.

Furthermore, standardized breakpoint tests are used to identify unknown structural breakpoints in the time series (Figure 2). The interest rate difference between the two countries is not substantial to destabilizing the bond markets and the effectiveness of monetary policy regulation. Therefore, we can use the China-US interest rate difference as reference for trend comparison, especially the jumping feature of breakpoints.

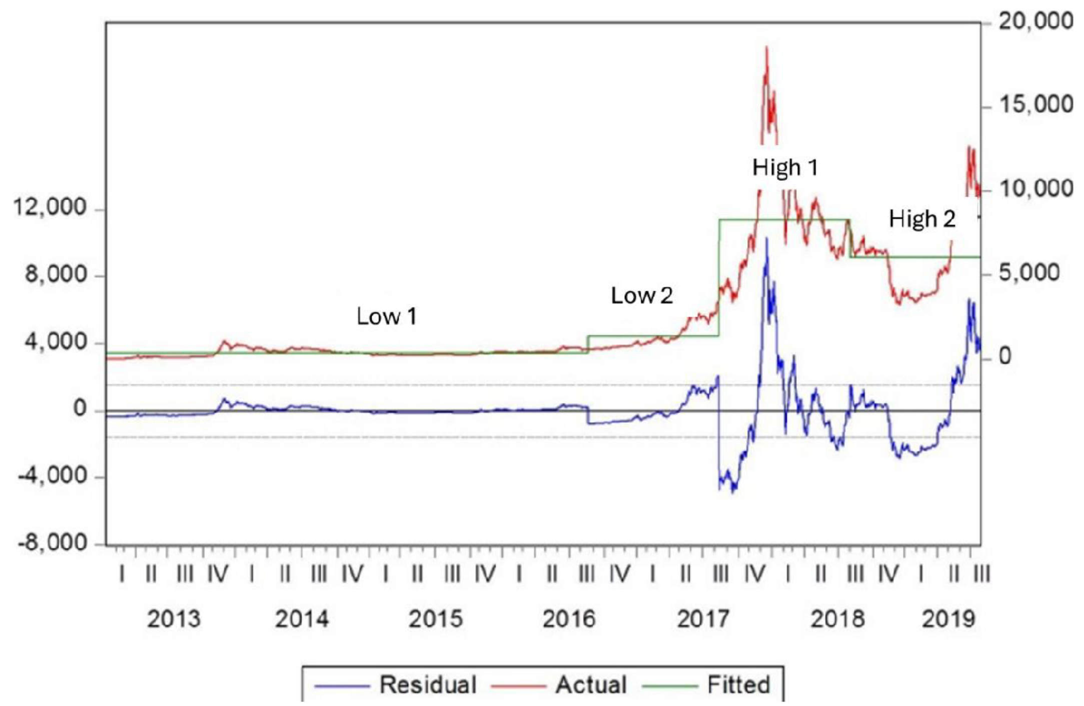

Figure 2: Breakpoints of Bitcoin price.

Four breakpoints are detected in the sample period from 2002M1 to 2019M7. They divide the sample into five phases corresponding to monetary policy differences between the US and China over the global economic cycles (Table 2).

Table 2: Monetary policy differences between the US and China.

Difference	Period	Months	Fed Policy	PBoC Policy	Events
Medium-low	2001M1–2005M2	49	Move from tightening to easing	Follow the FED	Recovery after recession
Low	2005M3–2007M9	31	Expansionary	Follow the FED	Bubbles
Medium	2007M10–2011M6	44	Counter-cyclical	Follow the FED	Global financial crisis
High	2011M7–2015M3	44	Quantitative easing	Not following	European debt crisis
Medium-high	2015M4–2019M7	47	Raising interest rate, reducing balance sheet	Independent	US: recovery; China: supply-side structural reform

Phase 1. Starting from 2001M1, the US economy recovered from the previous recession (the dot-com bubble) and China started to be integrated into the world economy via joining WTO. Both US and China's interest rates were high, and monetary policies were relatively tight to curb the new bubble. Hence, during this period, the policy differences were maintained at a medium-low level.

Phase 2. This phase witnessed a global economic boom with the ease of monetary policies. Economic bubbles started to form in this phase in the housing market. The policy differences were at a low level as monetary policies were very consistent across countries.

Phase 3. The global economy plummeted in this phase. The subprime mortgage crisis in 2007 triggered a global financial crisis in 2008. Conventional and unconventional counter-cyclical monetary policies were used all over the world, so this phase is a period of synchronization in monetary policy.

Phase 4. The policy gap between China and the US had started to widen due to different timing and magnitude of monetary policies. The double-dip European debt crisis further reinforced the policy divergence. On the one hand, the Fed and European Central Bank (ECB) adopted unconventional quantitative easing, expanding central bank balance sheet, entering an era of liquidity trap. On the other hand, China turned her attention inward and focused on domestic economic development and policy independence. Its monetary policy deviated from major economies in the world.

Phase 5. Starting from 2015M4, the phase is characterized by a medium-high level of monetary policy divergence. The Fed's policy rate follows a steep-climbing curve from 2016 as the US economy rebounded from the crisis. China's monetary policy continues to decouple from the US and focuses more on the domestic economy. The policy difference is maintained at a relatively high level.

Specifically, the medium-high level echoes the concept of "US-China interest rate spread comfort zone" proposed by the PBoC. In this zone, there is room for mild policy adjustments without substantially diverging from the US counterpart. The interest rate spread fluctuates around a relatively stable level, so one shall expect that deviations from this level are temporary due to financial market arbitrage. For example, amid the Fed's frequent interest rate hikes, prudent monetary policies were followed in China. There was a significant deviation from the "comfort zone" at the end of 2018 and in the first half of 2019. But soon the Fed decided to cut interest rates due to the pressure on the economy. As a result, the interest rate spread returned to the "comfort zone".

Table 2 also shows the four structural breaks of exchange rate during the sample period. Before 2015, the low to medium-low levels of exchange rate coincided with higher levels of interest rate spread. The trend is in line with the conventional economic theory in general. However, the structural break in 2015 occurred during China's exchange rate reform, followed by a period of erratic CNY depreciations. At the meantime, a widening interest rate spread reflects the divergence of monetary policies between the two economies. China's monetary policy remained prudent, while the US underwent several interest hikes to curb the inflation. Conventional open-economy theory can no longer explain the post-2015 exchange rate movements.

The Bitcoin price shows three structural breaks during the sample period from 2013M1. The price was kept at a stable, low level until 2017M8 when the price suddenly soared. In 2018M8, a downward trend of the Bitcoin price level coincided with the "comfort zone" of interest rate spread and the high post-reform exchange rate.

To avoid spurious regressions, all variables are tested for unit root using the ADF (augmented Dickey-Fuller) test. Results from the unit root test suggest stationarity at 1% significance level for all variables. Further tests with and without trend and intercept also confirm the above finding. Finally, to determine the optimal lag length, multiple standards (e.g., LR and AIC) suggest that the optimal lag length is 2.

5. Results

Building on the theoretical model and the data description, this section applies the TVP-VAR model to analyze the dynamics between monetary policy differences and Bitcoin price/volume.

5.1. Posterior Estimation of Parameters

This study adopts common calibrations from Nakajima (2011) who provides a comprehensive overview of TVP-VAR models with stochastic volatility. Given the previous discussion and test results of structural breaks, the time-varying coefficients are set to follow a random walk to ensure that any structural break and permanent change are properly captured. To calculate the parameter posterior distribution, the MCMC (Markov Chain Monte Carlo) method iterates 20,000 times and discards the initial 2000 samples as the burn-in period (10%).

The null hypothesis of the convergence to the posterior distribution is not rejected for any of the estimates at the 5% significance level. The MCMC iterations converge in all cases. The highest inefficiency factor is around 220, which gives at least $\frac{20000-2000}{220} \approx 82$ uncorrelated samples for the parameter. Since this study focuses more on identifying time-varying characteristics and less on the precise quantification, the number of uncorrelated samples is sufficient.

Figure 3 shows the autocorrelations (top row), sample paths (middle row), and posterior densities (bottom row) of selected parameters. The left panels are the first chain, and the right panels are the second chain. As shown by the declining trends (top), the autocorrelations of the simulations are well removed by MCMC algorithm. The sample paths (middle) converge to white noises, so the estimated parameters are independently distributed. The posteriors (bottom) show that some parameters may be bimodal, but most are normally distributed.

The simulated volatilities of interest rate spread and exchange rate exhibit an upward trend from the end of 2017 (Figure 4). On the one hand, the economic recovery in the US signaled the end of quantitative easing and a round of interest rate hikes were implemented to curb overheated investment. However, the trade war between China and the US since 2018 weakened the recovery which eventually forced the Fed to cut interest rate. On the other hand, China continued to strengthen her monetary policy independence, but also faced severe domestic and international challenges such as the shortened domestic bond market cycles, de-leveraging, and the trade war with the US. They jointly caused a significant level of high volatility in the interest rate spread. At the meantime, the volatility of the exchange rate was amplified since the exchange rate reform in China—the exchange rate was no longer a monetary policy target and was more influenced by the market force rather than central bank interventions. Coupled with external depreciation pressures, the exchange rate exhibits excessive volatility since 2018.

The volatilities of Bitcoin price and volume surged during the same period. The Bitcoin price skyrocketed first, ending the year of 2017 with a historical high price at 19891.99 USD. It was then followed by a plunge in 2018, its 10^{th} anniversary, touching a low point at just over 3000 USD before a more gradual rebound in 2019. The Bitcoin trade volume followed a similar pattern but maintained a longer period of high volatility after the peak.

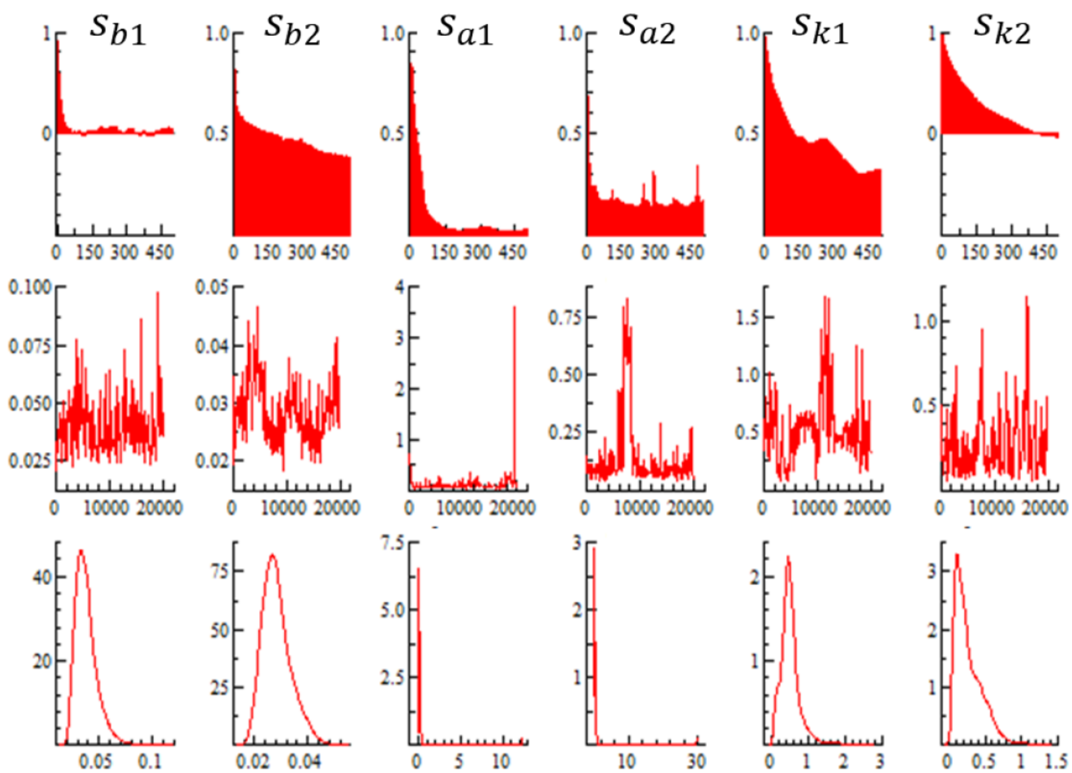

Figure 3: MCMC simulation diagnosis of selected parameters.

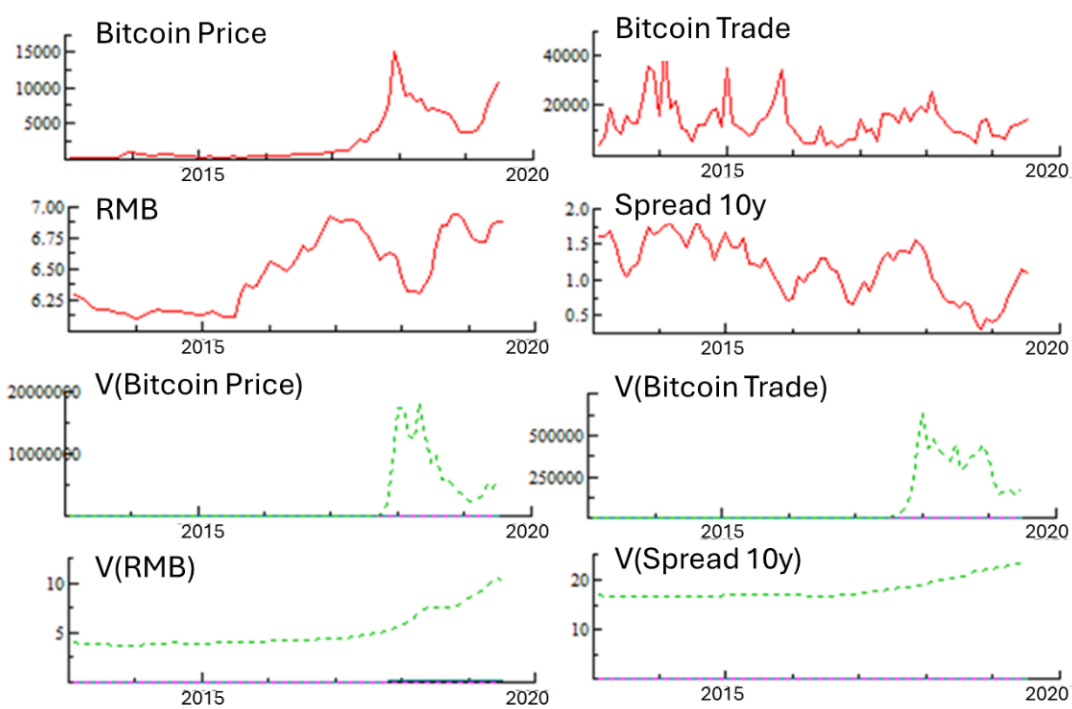

Figure 4: MCMC simulation results of selected volatilities over time.

5.2. Impulse Response Functions

Note that responses of an impulse vary over the analysis time (periods after the shock), and TVP-VAR models can generate different impulse response functions (IRFs) over historical time. This paper presents the IRFs in two ways: (i) selected IRFs at a specific analysis time over the complete historical time; and (ii) complete IRFs at specific points in historical time over the complete analysis time.

Figure 5 shows the time-varying responses of the Bitcoin price to various shocks. We select three analysis time of the IRFs (1, 3, and 5 periods after the shocks). The magnitude (absolute value) of the responses diminishes over analysis time for all three shocks. There are two clear features of the IRFs. First, interest rate spread imposes a positive effect on Bitcoin price, while exchange rate inflicts a negative effect. Second, over the sample period, the effects of interest rate spread on Bitcoin price have been weakened, especially between 2013 to 2015. This process coincided with the reform of Chinese exchange rate management. Other IRFs are maintained relatively stable.

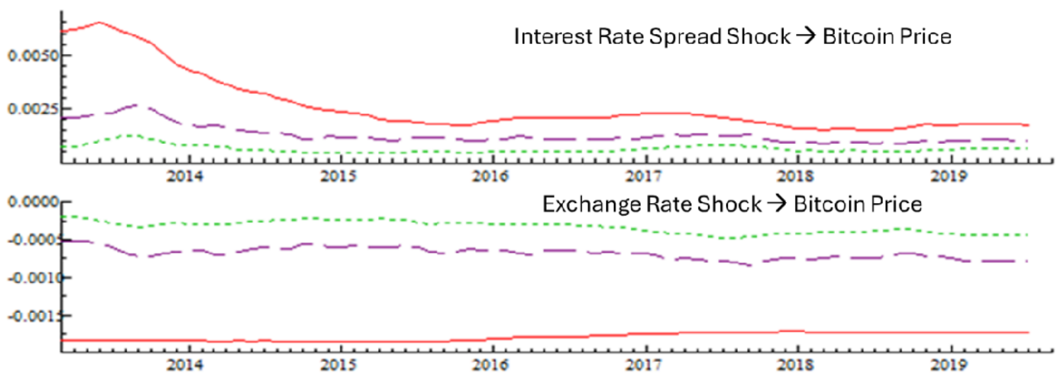

Figure 5: IRFs of Bitcoin price over the complete historical time.

The positive effect of interest rate spread on Bitcoin price suggests that Bitcoin has a feature of "de-dollarization". A higher spread (≡US interest rate minus China interest rate) leads to two effects. First, as conventional wisdom of international finance suggests, an interest rate hike by the Fed leads to appreciation of dollar-denominated assets because they become more appealing to yield-seeking investors. Second, the Bitcoin price tends to rise according to the IRF. Therefore, Bitcoin and dollar-denominated assets behave similarly (as competing investments). Similarly, the negative effect of exchange rate on Bitcoin price implies that Bitcoin has a feature of "de-renminbization" as well. A higher exchange rate (≡price of 1 USD in terms of CNY) leads to two effects. On the one hand, a higher exchange rate of USD/CNY means a depreciation of CNY or renminbi (the alternative name of CNY). On the other hand, a higher exchange rate leads to a lower Bitcoin price according to the IRF. Therefore, Bitcoin and renminbi-denominated assets behave similarly (as competing investments). Thus, Bitcoin exerts a challenge to both fiat currencies, which we refer to "de-fiatization".

Figure 6 shows the IRFs of Bitcoin trading volume. Again, the deviation from the steady state diminishes over time after the shock. There are two other features shown in the IRFs. First, both effects are positive on Bitcoin trading volume. Second, the magnitude of IRFs maintains stable over the sample period, but the interest rate spread has a greater effect than exchange rate. The effects on the Bitcoin volume reinforce the conclusion of de-fiatization feature of cryptocurrencies.

A positive effect of US-China interest rate spread on Bitcoin volume suggests that a greater divergence in monetary policy promotes trading activities in the crypto market. When monetary policies in the two largest economies run in opposite directions (e.g., the interest rate hike by the Fed), it raises the uncertainties in the financial market because it is not stable outside the "comfort zone". In this case, Bitcoin, as a decentralized currency, gains greater value, which has an effect of de-dollarization. Similarly, a positive effect of USD/CNY exchange rate on Bitcoin volume suggests that a devaluation of renminbi renders the market attention to Bitcoin too. This is an effect of de-renminbization. Therefore, both fiat currencies lost to the cryptocurrency, reinforcing the conclusion of de-fiatization.

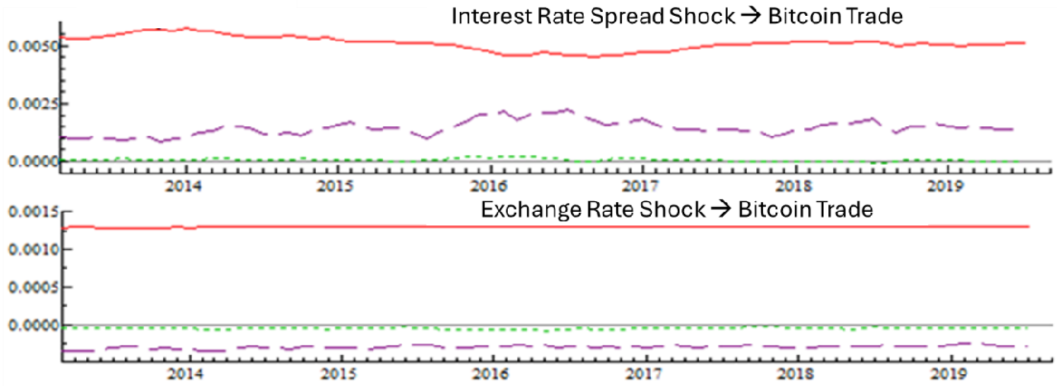

Figure 6: IRFs of Bitcoin volume over the complete historical time.

To paint a more complete dynamic path of IRFs, we select three meaningful points in historical time and show the effects over complete analysis time. The three points are:

- Time 1 (T1): 2013M12. This time point is featured by a low level of Bitcoin trading volume and a high level of interest rate spread caused by a monetary expansion in the US including quantitative easing.
- Time 2 (T2): 2018M2. This time point is featured by high volatilities of Bitcoin price and a medium level of interest rate spread caused by monetary tightening in the US and the monetary independence movement in China. This period is within the "comfort zone" and is right before the start of the US-China trade war in 2018.
- Time 3 (T3): 2019M5. This time point is featured by a surging level of Bitcoin price and a "comfort zone" level of US-China monetary policy difference. However, this is a period of recovery and convergence. Bitcoin price rebounded from a big dip and the US-China policy deviations have re-converged to the "comfort zone".

As shown in Figure 7, the positive effects of interest rate spread on Bitcoin price decrease from T1 to T2 but is not significantly different between T2 and T3. This is in line with the feature shown in the previous time-varying IRFs, which suggest a cutting point around 2016. The peak of the response is at one period after the shock and the half-life of the effect is about three periods. In contrast, the negative effects of exchange rate on Bitcoin price do not change much over the sample period, again consistent with the earlier findings. The timing of peak effect and half-life of exchange rate shocks rhymes with that of interest rate spread shocks.

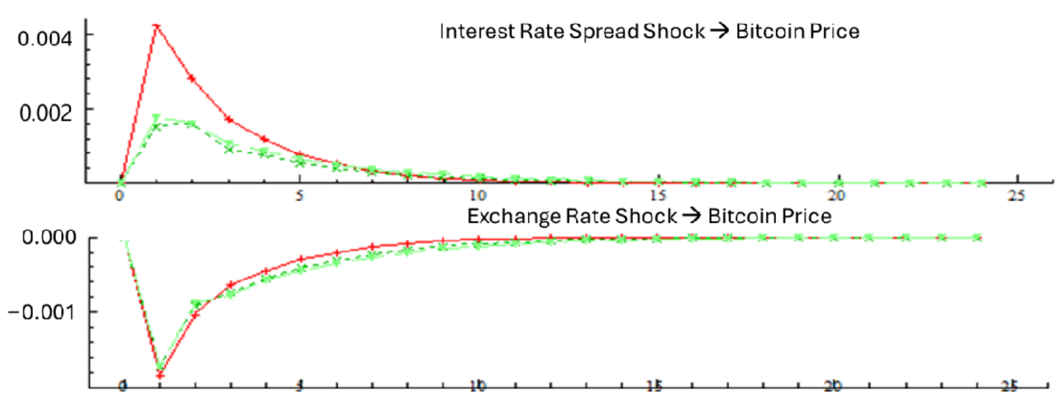

Figure 7: IRFs of Bitcoin price over the complete analysis time.

Figure 8 plots the IRFs of Bitcoin volume at the three historical points in time (T1, T2, T3). The timing of peak effects is the same for interest rate spread and exchange rate (one period after the shock). It is also shown that both effects are stable over the sample period and both IRFs are oscillatory. The oscillation occurs because Bitcoin has more speculative movements in the market, so overshooting behavior of prices and volume is a common phenomenon.

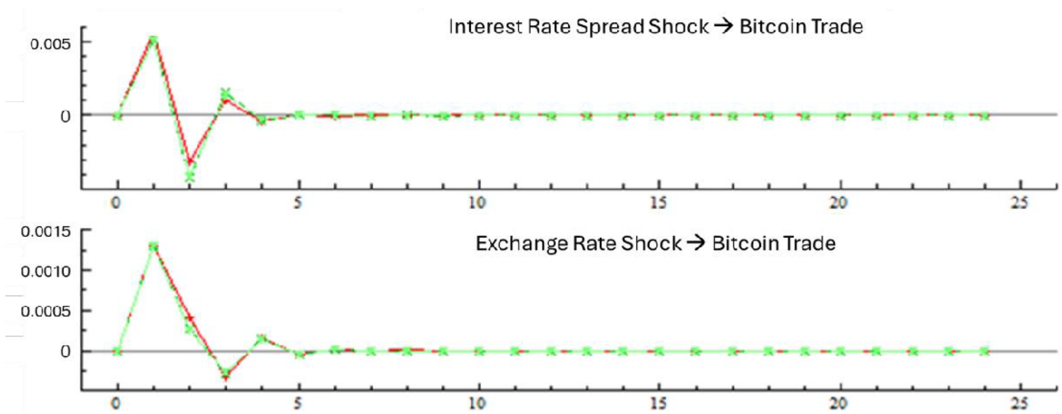

Figure 8: IRFs of Bitcoin volume over the complete analysis time.

6. Conclusions

By introducing cryptocurrency into a two-country open-economy model, this study deduces the functional relationship among interest rate spread, exchange rate, and cryptocurrency transactions. The empirical analysis employs the Bayesian TVP-VAR model to capture the time variation of coefficients and volatilities. The key finding is that Bitcoin has an effect of de-fiatization. When there is a higher divergence in monetary policy between the US and China, Bitcoin attracts greater attention with a higher price, posing a competing force against USD. When there are greater fluctuations in the exchange rate of USD/CNY, investors are diverted from CNY to Bitcoin. The fiat currencies of the two largest economies are losers while Bitcoin gains. Therefore, cryptocurrency not only decentralizes the role of commercial banks as a medium of payment, but also decentralizes the role of central banks as a monetary policymaker.

However, in the empirical analysis, we find that Bitcoin price has excessive volatility which suggests that it is prone to artificial manipulation of “whale traders”. In many cases, the trading volume actually shrinks after a surge in price, which is a common indicator of manipulation in traditional centralized trading platforms. As a result, a decentralized currency is still subject to centralized attacks which limits the potential of cryptocurrencies in the international payment system. As the crypto market plunged in 2022M5 (due to the event of Terra Luna), the market entered the “crypto winter”. There is still a long way for cryptocurrencies to play an influential role in parallel with fiat currencies. Based on the findings, we draw three policy implications.

First, blockchain technology is a promising solution to trust, which is not necessarily limited to cryptocurrency. Commercial banks and central banks can benefit from adopting blockchain to improve efficiency and trust in financial services as well. For example, Nasdaq announced that it would start issuing, cataloguing, and managing transactions of their privately issued shares through blockchain technology in 2015. The first blockchain-based digital fiat currency, Digital Yuan, was issued by China’s central bank in 2021. IBM recently developed blockchain-based solutions to transform the process of proof in traditional insurance such as healthcare, vehicle, and catastrophe. In summary, decentralized and traditional currencies and finance compete with each other, inspire each other, and co-evolve with each other.

Second, the biggest challenge to policymakers is to develop timely regulations to keep up with the development in cryptocurrency. The high volatility of cryptocurrency and its spillover effects create uncertainties to financial stability. As a multi-trillion market, it is hard to ignore cryptoassets and their effects on the financial system, the monetary system, and the economic system. Let alone the social and legal problems it may cause such as cybersecurity, privacy, and money laundering. This is not a country specific challenge though. As we have seen in the impulse responses, the USD also faces the same (maybe even bigger) challenge from cryptocurrency. Given that cryptocurrency is borderless and authority-less, it calls for international collaborations in regulatory effort.

Third, the de-fiatization effect of cryptocurrency not only decentralizes the old economic order, but also decentralizes the old political order. The international monetary system has not changed much since 1973 when the Bretton Woods System collapsed. The rise of cryptocurrency since 2008 seems to start a possibility of a revolutionary era but the full potential is yet to be revealed. After all, the traditional US-led global financial system is still the dominating institution. Regional development (e.g., EU, RCEP) has already shaken the role of USD in trade. Global ambitions such as Bitcoin and Ethereum weaken the dominance of USD in the international financial market even more. Recent geopolitical conflicts between Russia and the West also promote the role of cryptocurrencies in the international payment system to surpass financial sanctions (Zhou and Guo, 2023). Along this trend, other fiat currencies are facing greater opportunities if they can grasp the market gaps ripped open by cryptocurrencies.

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