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Research article

Monetary attribute of stablecoins: A theoretical and empirical test

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Abstract: With the continuous expansion of their market size and scope of use, the monetary attribute of stablecoins has become a focal point. The identification of the monetary attribute of stablecoins is a prerequisite for their supervision. Based on the essence and macroeconomic effects of money, this paper analyzes the monetary attribute of stablecoins from theoretical and empirical perspectives. We find that in the traditional financial market, stablecoins are not widely accepted, and their increased supply competes with traditional financial assets. As new types of digital assets, they do not possess a monetary attribute. However, in the digital asset market, stablecoins are widely used. The increase in issuance pushes up asset prices and brings liquidity effects to the market. Therefore, stablecoins possess a monetary attribute in the digital asset market and play the role of "digital fiat currency". This private sector liquidity is not controlled by the government and tends to accumulate risk. Therefore, the government should clarify the legal attribute of stablecoins according to their monetary attribute, strengthen the supervision of stablecoin issuers and prevent the private sector from monopolizing the digital asset market transaction medium.

Keywords: stablecoin; monetary attribute; cryptocurrency; TVP-SV-VAR

JEL Classification: E42; E51; G23

1. Introduction

Cryptocurrencies are known for their high security, anonymity and fast transaction speeds, resulting in a rapid expansion of their market size in recent years. However, cryptocurrencies like Bitcoin are plagued by excessive price volatility, with prices typically fluctuating more than ten times the value of major fiat currencies. This volatility makes it challenging for cryptocurrencies to serve as

effective mediums of exchange and perform monetary functions (Yermack, 2015). To address the issue of unstable cryptocurrency values and establish stable purchasing power in the digital asset market, stablecoins were introduced. Stablecoins are crypto assets designed to maintain a stable price relative to a specific asset or pool of assets (FSB, 2019). Offering low transaction costs, stable prices and support from major trading platforms, stablecoins have rapidly gained popularity as a means of trading digital assets. Since 2019, the trading volume of bitcoins through stablecoins has exceeded direct trading in U.S. dollars, making stablecoins the dominant method of trading in the digital asset market and functioning as "digital fiat currency" (Lyons and Viswanath-Natraj, 2020; Kristoufek, 2021). However, concerns have been raised regarding the insufficient reserves backing stablecoins, which could hinder their long-term viability and prevent them from fully embodying the characteristics of a currency (Griffin and Shams, 2020).

Stablecoins can be classified into three main categories: those pegged to off-chain assets, those pegged to on-chain assets and algorithmic stablecoins. The first two types maintain stability by anchoring themselves to specific assets and ensuring convertibility, while the third type achieves stability by automatically adjusting its supply through algorithms. Currently, most stablecoins belong to the first category. In this mechanism, users deposit fiat currency into an issuer's account, and the issuer issues an equivalent amount of cryptocurrency on the public chain for users to utilize. Stablecoins can be used for trading or other financial activities, and at the end of the circulation, users can exchange them back to fiat currency with the issuer, who will subsequently destroy the stablecoins. The issuer profits by charging fees throughout this process. The credit and purchasing power of the U.S. dollar, as claimed by the issuer, serve as guarantees for the purchasing power of the stablecoin, allowing it to theoretically function as money and possess monetary properties. However, since their inception, stablecoins have experienced significant price fluctuations, leading to doubts about the adequacy of their reserves and raising concerns about their monetary properties. Moreover, existing research on the monetary attributes of stablecoins primarily focuses on legal perspectives or comparative analyses with other cryptocurrencies like Bitcoin, lacking systematic analysis and empirical testing of stablecoins' monetary attributes. Understanding the attributes of stablecoins is crucial in assessing their macroeconomic impact, formulating appropriate regulatory measures and considering central bank monetary policies. Therefore, we aim to examine the monetary attributes of stablecoins from theoretical and empirical perspectives based on the nature of money and its macroeconomic effects.

Stablecoins pegged to the U.S. dollar are the most widely utilized type of stablecoin, accounting for over 95% of the market share by the end of 2021. Consequently, this paper primarily focuses on such stablecoins, and all subsequent references to stablecoins pertain to those pegged to the U.S. dollar. The contributions of this paper lie in two main areas. Firstly, we concentrate on cryptocurrencies that are theoretically closer to traditional forms of money and provide an in-depth examination of the monetary attributes of stablecoins and their applicability. While previous research on the monetary attributes of cryptocurrencies has predominantly focused on Bitcoin, stablecoins have been neglected in these studies. Secondly, we employ a combination of theoretical analysis and empirical testing, starting from the nature of money and its potential impacts, to analyze and test the monetary properties of stablecoins based on our theoretical analysis. To ensure the reliability of our conclusions, we utilize multiple transaction data from cryptocurrencies as well as macroeconomic data. The remainder of this paper is structured as follows: Section 2 provides a summary of relevant existing literature, Section 3 presents the theoretical analysis, Section 4 entails the empirical analysis and robustness testing and finally, in Section 5, we draw conclusions and provide corresponding policy recommendations.

2. Literature review

The monetary attribute of a stablecoin refers to whether the stablecoin plays the role of money. To determine whether a commodity possesses a monetary attribute, it is essential to assess whether it fulfills the criteria for being a currency in terms of its nature and issuance mechanism. Additionally, it is crucial to investigate whether it effectively performs the functions of a currency and influences macroeconomic variables in a manner similar to other established currencies. Accordingly, the relevant literature for this paper primarily consists of studies focusing on the nature and issuance mechanism of stable money, as well as research exploring the connection between stable money and macroeconomic variables.

2.1. The connotation, issuance mechanism and potential risks of stablecoins

Stablecoins are a type of cryptocurrency designed to maintain a stable price relative to a specific asset or pool of assets (FSB, 2019). Tether was the first to propose a comprehensive and viable operational system for stablecoins in its 2014 white paper. This pioneering work in defining the concept and issuance mechanism of stablecoins laid the groundwork for the development of other types of stablecoins (Tether, 2014). Mita et al. (2019) differentiate the issuance mechanisms of various stablecoins in the market and classify them accordingly. They conclude that unsecured stablecoins with automatic algorithmic adjustment of supply and demand are the easiest to implement at the application level. Lyons and Viswanath-Natraj (2020) observe that the low transaction costs and efficiency of stablecoin trading mechanisms make them a popular trading instrument in the digital asset market. Furthermore, there are studies analyzing the legal status of stablecoins by examining their definition and mechanism from a legal perspective. Sokolov (2020) investigates whether stablecoins like Libra, USDT and DAI qualify as e-money based on the legal definition of e-money in the EU and UK regulations. By closely analyzing the relevant regulations, including the EU's Second Electronic Money Directive (EMD2) and the UK's Electronic Money Regulations (EMRs), the author concludes that, except for USDT, which closely resembles electronic money, the other stablecoins do not meet the criteria.

The examination of the nature and transaction mechanism of stablecoins is often associated with an analysis of their potential risks. For instance, in the case of privately issued stablecoins like USDT, they claim to strictly issue digital tokens in a 1:1 ratio. However, as the issuers are not directly under the jurisdiction of central banks like commercial banks, there may be concerns regarding insufficient reserves. Griffin and Shams (2020) study the relationship between stablecoins and Bitcoin and identify a potential risk of over-issuance. Stablecoin issuers could manipulate the price of digital assets and disrupt market order by utilizing opaque reserves. Stablecoins also carry risks related to illicit trading, data breaches and unlawful use, which pose challenges to the stability of the financial market (FSB, 2019). As a result, scholars suggest that the development of stablecoins should be regulated by enhancing infrastructure, establishing market access criteria and implementing effective regulatory mechanisms between the issuer system and regulatory authorities to mitigate these risks (Arner et al., 2020). However, some scholars argue that the emergence of central bank cryptocurrencies and other factors may render privately issued stablecoins unsustainable, thereby limiting their long-term negative impact on the macroeconomy (Eichengreen, 2019; Gorton et al., 2022).

2.2. The relationship between stablecoin and macroeconomic variables

The existing research on the relationship between stablecoins and other variables predominantly focuses on digital asset prices. USDT, being the earliest issued and most widely used stablecoin, has garnered significant attention from scholars. Many studies concentrate on the correlation between USDT and digital asset prices. Bianchi et al. (2020) and Mita et al. (2019) propose that stablecoins, particularly USDT, are extensively utilized as a means of payment. They employ Bayesian Vector Autoregression models to demonstrate that an increase in USDT issuance injects additional purchasing power into the market and drives up digital asset prices. Furthermore, stablecoins can potentially manipulate the prices of digital assets by controlling their issuance (Griffin and Shams, 2020). However, it has also been argued that the increase in issuance merely reflects the rising demand for digital assets in the market, rather than being a causal factor (Kristoufek, 2021).

Fewer studies have investigated the impact of stablecoins on macroeconomic variables outside the digital asset market. Bojaj et al. (2022) examines the economic impact of a 1:1 anchored euro stablecoin using macro data from Montenegro. They find that for Montenegro, a small eurozone country heavily reliant on external capital inflows, adopting a stable currency is beneficial in increasing investment levels and promoting local tourism, which subsequently boosts local GDP. Liao and Caramichael (2022) and Xu and Yang (2022) analyze the potential effects of stablecoins on the banking system. They discover that as stablecoins gain more popularity, the acceptance of stablecoins by commercial banks affects credit creation. The decreasing transaction costs and increasing transaction efficiency associated with stablecoins fuel the development of decentralized finance (DeFi) scenarios, thereby diminishing the role of traditional financial intermediaries.

Research on the relationship between Bitcoin and macroeconomic variables is relatively abundant and can provide references for this study. Scholars assess the monetary attributes of Bitcoin by examining its relationship with macroeconomic variables. For instance, studies utilizing models such as STVAR-BTGARCH-M and mixed-frequency GARCH-MIDAS reveal significant spillover effects between Bitcoin, as a new asset class, and returns and volatility of traditional assets, with asymmetry in these spillover effects. Bitcoin typically receives information spillovers (Bouri et al., 2018; Conrad et al., 2018). However, Bitcoin demonstrates relatively low correlation with other financial assets, making it beneficial for portfolio diversification (Corbet et al., 2018). These studies collectively demonstrate that Bitcoin has competitive effects with traditional financial assets and is considered a digital asset rather than a currency.

From the review of existing literature, it becomes evident that the current studies on the monetary attributes of stablecoins primarily approach the topic from a legal perspective, defining their monetary attributes by comparing them with legal provisions. However, there is a lack of economic analysis based on the nature of money and macroeconomic performance compared to research on Bitcoin. Consequently, accurately grasping the monetary attributes of stablecoins based on existing studies proves challenging. Given the increasing scale and widespread adoption of digital stablecoins in financial management, settlement and cross-border payment scenarios, understanding whether and to what extent stablecoins possess monetary attributes becomes a central focus of this paper. To address these questions and supplement existing research, this study examines the monetary attributes of stablecoins from both theoretical and empirical perspectives.

3. Theoretical analysis of the monetary attribute of stablecoins

Money is a special commodity separate from commodities in the development of trading and fixed as a general equivalent. Medium of exchange is the most basic attribute of money. Frictions such as incomplete monitoring and asymmetric information in the market reduce the efficiency of transactions. Money is an optimal mechanism for the market by serving as a proof of historical transaction information and a "general equivalent" with generally accepted purchasing power, which alleviates the friction in the market and improves the efficiency of transaction (Wallace, 2010). The purchasing power of money is based on the holder's perception that it can store value and be exchanged for agreeable goods when needed, and it is a contract between market participants, so money is credit. In the period of metallic money, the credit of money comes from the natural properties of metal; in the period of fiat money, the credit of money comes from the endorsement of the government and the compulsory binding of law. In recent years, central bank digital currencies (CBDCs), which have garnered widespread attention, are an extension of fiat currency. They are digital liabilities of the central bank and derive their credibility from the same source as traditional fiat currency.[1] As a digital product pegged to fiat currency, stablecoins' issuers promise to exchange fiat currency at a fixed ratio, which is a kind of private credit built on government credit. Under the existing monetary system, stablecoins' credit depends on the private credit of the issuing unit. The credit nature of money can be externalized to their general acceptability as the medium of exchange and stability of purchasing power in the market. Therefore, we analyze the monetary attribute of stablecoins by examining the general acceptability of stablecoins as a medium of exchange and the stability of their purchasing power.

3.1. General acceptability

In a currency-mediated transaction, from a practical point of view, the currency has no value to the holder or is worth less than the value of the original commodity. The holder is willing to hold money in anticipation that it will be accepted by other market participants in the future exchange process, i.e., it is universally acceptable. This general acceptability makes money a temporary residence of purchasing power, performing the function of store of value and converting it into a commodity again on the appropriate occasion. Both commodity money and fiat money are universally accepted for the corresponding period. In the case of commodity money, this universal acceptability derives from the natural properties of the commodity. In fiat money, this general acceptability derives from the credit of the government and is governed by law. CBDCs are designed to serve as an extension of fiat currency, sharing the same source of credibility as traditional fiat currency and only differing in form. As electronic money (e-money) becomes increasingly convenient for everyday transactions, it has paved the way for CBDCs to gain widespread acceptance (Auer & Böhme, 2020). Therefore, a commodity has a monetary attribute and can play the role of a medium of exchange only if it has universal acceptability in the market.

For stablecoins, their general acceptability comes from the credit of the issuer and the fiat currencies they are pegged to. Stablecoins' issuers typically claim that stablecoins can be converted into fiat currency at any given time at a fixed percentage, so stablecoin holders expect always be able to convert them into accepted purchasing power in real world. Therefore, for the digital market participants and who want to enter the digital asset market, stablecoins are an optimal gateway to

[1] The Federal Reserve (2022), "What is a central bank digital currency?", https://www.federalreserve.gov/faqs/what-is-a-central-bank-digital-currency.htm.

connect real purchasing power to the digital asset market, and they have been widely accepted. From a realistic point of view, the most important application scenario for stablecoins is as a means of trading digital assets and serving as a bridge between fiat currencies and the digital asset market. More and more people are participating in the digital asset market by paying USD to issue companies in exchange for stablecoins. All major digital cryptocurrency platforms around the world accept stablecoins as a means of payment for digital assets. After 2019, the number of transactions using stablecoins for Bitcoin has surpassed the number of transactions made directly in U.S. dollars. Stablecoins have become the most dominant means of purchasing Bitcoin. According to The Block, in April 2022, stablecoins were involved in around 75% of digital asset trading and were the most used means of payment in decentralized financial scenarios.[2] Stablecoins have become the "digital fiat currency" of the digital asset market (Kristoufek, 2021). In addition to the digital asset market, stablecoins are also considered as a potential way to make peer-to-peer payments and cross-border funds transfer due to their fast, convenient, 24/7 and weak regulatory features. However, it should be noted that although some enterprises or traditional financial companies have shown signs of accepting stablecoins such as USDT as a means of payment in recent years, they are currently limited to the conception and project pilot stage and have not yet been applied on a large scale. In addition, the offline use of stablecoins is strictly restricted by the laws of each country. Once a country declares stablecoins are illegal, the general acceptability of stablecoins as an offline payment means will be significantly reduced. This is also the reason why Libra's advancement has slowed down significantly after the introduction of corresponding regulatory measures for it in various countries. From the above analysis, we can see that the stablecoins represented by USDT have been widely accepted as a medium of exchange by participants in the digital asset market, while the physical asset market has not. Therefore, in terms of universal acceptance, the monetary attributes of stablecoins are currently limited to the digital asset market.

3.2. Currency stability

Stability of currency value is an inherent requirement for performing monetary functions. As a temporary place of purchasing power, the fluctuation of currency value makes it impossible to perform functions as a measure of value and a medium of exchange, which will bring disorder to the commodity market. The stable purchasing power of commodity money comes from the intrinsic value of commodities, while the stable purchasing power of fiat currency comes from the credit of government department and legal regulation. CBDC, as the electronic form of fiat currency, shares similar usage scenarios with traditional fiat currency, possessing the same stable purchasing power as traditional fiat currency. They all meet the inherent requirement of performing monetary functions in corresponding periods. Bitcoin and other cryptocurrencies are not backed by credit, and their value depends entirely on the expectations of market participants, making the value of the currency more volatile. The large fluctuations in the value of the currency provide room for arbitrage, and the arbitrage behavior of market participants further amplifies the volatility of its value, which is the reason why many scholars believe that it is difficult for Bitcoin to become a currency. Stablecoins overcome the problem of high currency value volatility by pegging to national credit. In fact, the purpose of the stablecoin is to provide the digital asset market a cryptocurrency that is stable in value, and both the USDT and USDC white papers indicate that the value of them are as stable as digital dollar.

[2] Data from "Share of Trade Volume by Pair Denomination", The Block.

Although stablecoins can achieve the goal of currency stability in terms of issuance mechanism, all major stablecoins have exhibited some degree of volatility in their values since their issuance. These fluctuations are mainly due to the redemption risk of investors and price dislocation in the secondary market. Throughout history, large fluctuations in the price of stablecoins usually occur after news about the issuer's reserve shortage. To allay market concerns, starting in March 2021, Tether's Corporate Communications Department will publish third-party audit bulletins on the company's reserve quarterly to allay market concerns about reserve shortfalls and reduce redemption risk. Like Tether, Circle's official website also regularly publishes the USDC Transparency and Trust Report and claims that it will be audited annually regarding USDC reserves and submit the audit report to the SEC as required. In addition to publishing the status of the company's reserves, over 69% of stablecoin issuers also choose to open their stablecoin issuance codes (e.g., smart contracts, etc.) for market oversight.[3] All the above measures have significantly mitigated the redemption risk of stablecoins, as shown by the data of stablecoin price fluctuations.

Another source of volatility in the value of stablecoins lies in the imbalance between supply and demand in the secondary market. For example, in March 2020, at the beginning of COVID-19, a large number of digital asset investors wanted to exchange cryptocurrency such as bitcoin for stablecoins, and the rapid increase in demand for stablecoins in the secondary market pushed up the price of stablecoins. Due to the 1:1 exchange rate claimed by the stablecoin issuer, this created room for arbitrage in the market and the supply of stablecoins rose rapidly. As the supply of stablecoins in the secondary market increases, its price returns to the official price. As long as the stablecoin issuers are able to secure sufficient reserves, fluctuations in the price of stablecoins will be offset by the spontaneous supply and demand behavior of the primary and secondary markets. Thus, the issuance mechanism of stablecoins can satisfy the requirement of value stability needed for currency as a medium of exchange.

In order to test the realistic performance of the stability of digital currency coins, we plot the price fluctuations of stablecoins against major assets and major national fiat dollars. In this paper, the fluctuations of the major digital asset Bitcoin, the major commodity currency gold and the major world currencies' (RMB, EUR, JPY and GBP). USD prices are selected for comparison with the fluctuations of the major stablecoins, USDT and USDC's USD prices. In Figure 1, the gray lines represent the fluctuations in the prices of different assets or major world currencies. The black lines represent the fluctuations in the prices of stablecoins. Observing Figure 1, we can find that Bitcoin and gold, as representatives of digital assets and traditional assets, respectively, both have significantly higher price fluctuations than stablecoins during the sample period, and stablecoins show better stability in terms of their currency values. For the dollar prices of four major world currencies—RMB, EUR, JPY and GBP—the fluctuations of stablecoin prices are significantly higher than those of each world currency at the beginning of the sample. After September 2020, the stable currency prices remain at a relatively stable level, with much less volatility than the fluctuations of the dollar prices of the world currencies. Therefore, from the perspective of currency stability, the stability of stablecoins is better than that of different types of assets and major world currencies, and they meet the requirements of performing monetary functions in terms of currency stability and have monetary attribute.

[3] Data from "The State of Stablecoin", www.blockchain.io.

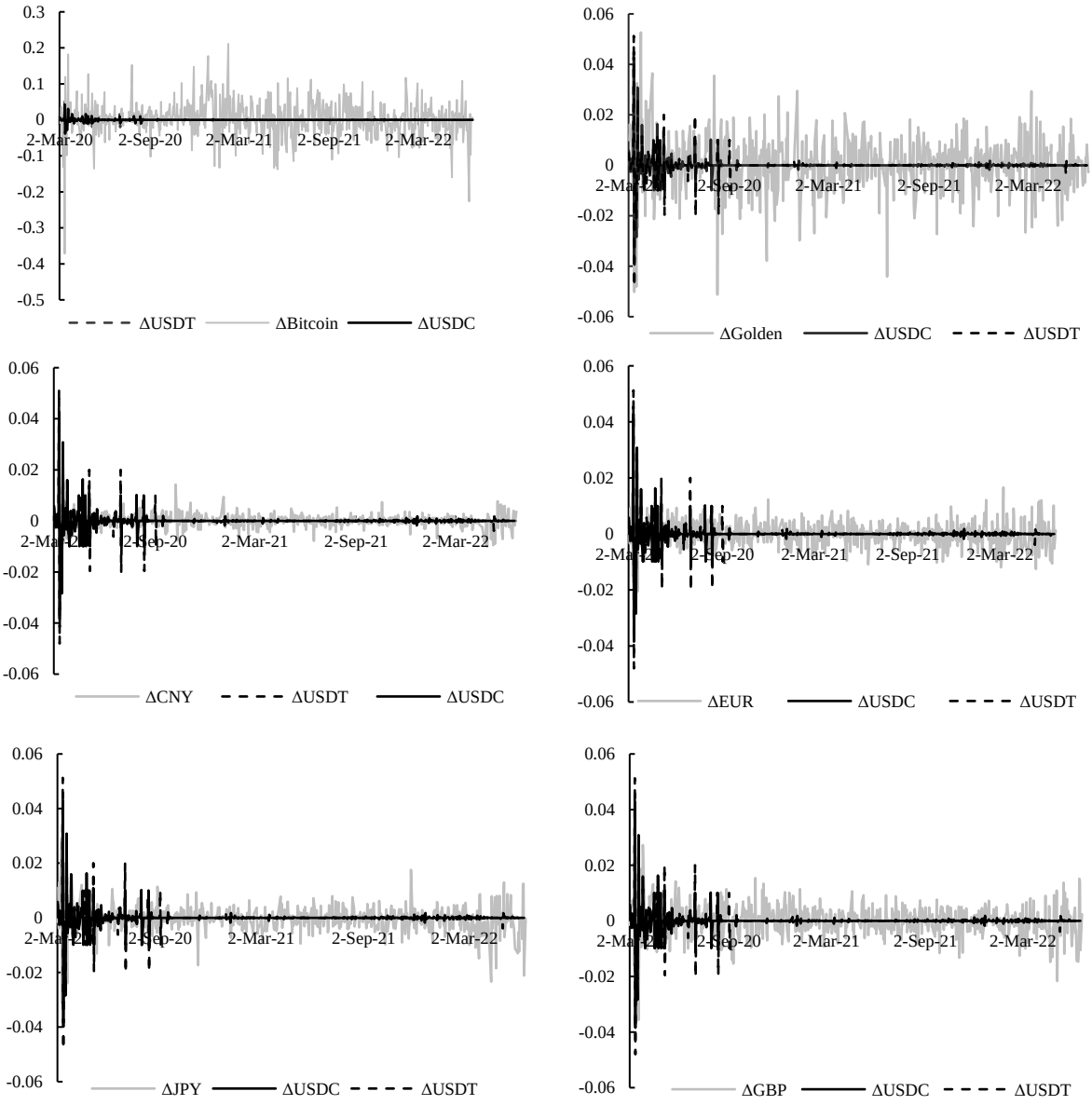

Figure 1. Comparison of price fluctuations of stable currencies with major assets and currencies USD. Data source: Wind, Coinmarketcap.

The analysis in this section based on the nature of money reveals that the essence of stablecoin is the same as money, which is a kind of credit. Of the two characteristics required to perform the function of a currency, stablecoins have universal acceptance in the digital asset market, but not outside the digital asset market, partially satisfying the first characteristic. In addition, compared to assets such as bitcoin, gold or major world currencies, stablecoin prices exhibit better currency stability, satisfying the second characteristic. The above analysis suggests that stablecoins have a monetary attribute within the digital asset market and do not have a monetary attribute outside of digital assets. To further validate the analysis in the theoretical section, the remainder of this paper will use econometric methods to test the monetary attribute of stablecoins.

4. Empirical study

In theory, if stablecoins have monetary attributes in the economy, the increase in stablecoins issuance acts as a liquidity creator outside the traditional monetary system, increasing the money supply in the economy. Stablecoins supplement the liquidity provided in the market, which in turn brings about changes in asset prices and money market prices. If the stable currency is used only as a means of investment, the increase in aggregate volume competes with other assets in the market, affecting asset prices and money demand, producing a different response than a liquidity shock. Therefore, it is possible to determine whether a stablecoin has monetary attributes by examining the response of various variables in the market to the increase in stablecoin issuance.

In the IS-LM (Investment Saving-Liquidity Preference Money supply) framework, the LM curve slopes downward in the short run and the quantity of money is negatively correlated with the interest rate. The liquidity brought to the market by an increase in the money supply increases the money supply relative to the money demand, lowering the market interest rate. The increase in the money supply also pushes up asset prices and brings inflationary effects, which will persist over time. Therefore, if the stable currency has monetary attributes in the market, the increase in the issuance of stablecoins will bring down the market interest rate and increase the asset price in the long run. If stablecoins are only a digital asset, the increase in supply will not have a liquidity effect on the market. The increase in the number of assets will have a competitive effect with other assets in the market, crowding out other asset prices. At the same time, the purchase demand for the asset will also increase the demand for currency in the market, which will raise the price of currency. Therefore, if the stablecoins play the role of digital assets in the market, the increase in the number of stablecoins will cause the price of other assets in the market to fall and the price of currency to rise, which has the opposite effect of the increase in currency issuance. In this section of the paper, the monetary attribute of stablecoins is tested by observing the relationship between stablecoin issuance and other variables in the market.

4.1. Data selection

4.1.1. Stablecoin issuance

As of early 2022, there are nearly 200 different types of stablecoins in the market, with the largest, most actively traded and most widely applicable stablecoin being the 1:1 USD-anchored Tether coin (USDT). As of April 8, 2022, USDT's market capitalization in circulation has reached $83.886 billion, second only to Bitcoin and Ethereum among cryptocurrency. Tether is currently the most valuable stablecoin, with its trading volume accounting for more than 65% of the entire stablecoin market, and its 24-hour turnover rate peaking at more than 300%. The second largest stablecoin in terms of size after USDT is the USD Coin (USDC) issued by Circle, Inc. Circle has the unique advantage of being the stablecoin issuer with the largest number of payment licenses. It has gained market popularity since its birth in September 2018 and the market size is rapidly increasing. As of April 2022, the total market capitalization of USDT and USDC accounts for about 90% of the overall stablecoin market capitalization, which is representative of the whole. Therefore, this paper uses the weekly average daily total issuance of USDT and USDC as a proxy variable for stablecoins. Since the earliest available date for USDC transaction data is October 15, 2018, the sample time range of this paper is 182 weeks of data from October 15, 2018 to April 10, 2022. The stablecoin market experienced a wave of rapid growth during the sample time of this paper, which provides a good sample for this paper to examine

the impact of stablecoin issuance on other variables and thus verify the monetary attribute of stablecoins. The data related to USDT and USDC in this paper are obtained from Coinmarketcap, a digital currency trading data collection platform.

4.1.2. Currency prices

In this paper, we use the US dollar interest rate as a proxy variable for currency price. Since the samples in this paper are all stablecoins pegged to the U.S. dollar, and the U.S. is the country with the largest number of stablecoin project teams and stablecoin legally registered projects in the world, and most transactions involving stablecoins occur in the U.S. (Hileman, 2019), the U.S. dollar interest rate is used as a proxy variable for currency prices. Specifically, with reference to existing studies, 1 month USD London InterBank Offered Rate (Libor) is chosen to represent the price of the US dollar. The data on the U.S. dollar interest rate are obtained from the Wind database. In order to further verify the results of the analysis, the US dollar price is also represented by the 3 months Treasury bill rate in the robustness test later in the paper, which is obtained from the International Monetary Fund official website.

4.1.3. Traditional asset prices

With reference to the existing studies, this paper uses the S&P 500 index to represent asset prices. The S&P 500 index covers important stocks in major U.S. exchanges, which has the characteristics of wide sampling and strong representation, and is an important indicator of asset prices. There are abundant studies proving its positive relationship with money supply (Rogalski and Vinso, 1977), which can effectively achieve the purpose of this paper to judge the monetary attribute of stable currencies through the relationship between them. In addition, in order to ensure the robustness of the empirical findings, we further use the Dow Jones Index as a proxy variable for asset prices in the robustness test section. As one of the most influential and widely used stock price indices in the world, the Dow Jones Index covers the most influential companies in the industry. These large multinational companies are not only representative of the U.S. stock asset prices, but also reflect the fluctuations of the world stock asset prices to a certain extent, and receive attention from global investors. So, it provides a useful supplement to test the relationship between stablecoins and asset prices.

4.1.4. Digital asset prices

In this paper, we use the dollar prices of Bitcoin and Ethereum as proxy variables for digital assets' price. Bitcoin, the world's first digital currency based on blockchain technology, has symbolic significance to the digital currency market and is currently the most valuable cryptocurrency. The change in its price is considered as a barometer of the digital asset market. Ethereum is the specific currency of the Ethernet network, and is the second valuable cryptocurrency. Ethereum is known as the "King of Public Chain", and almost all the new generation of digital stablecoins including USDT and USDC are issued mainly based on the Ether blockchain network. Ethereum is used to pay for Ether block rewards and miners' fees, and all Ether-based smart contracts need to pay Ethereum as fees. It is the "fuel" for using the Ethernet network, known as "Digital Oil". Therefore, the price of Ethereum can also fully reflect the development of the digital asset market. Bitcoin and Ethereum are the most dominant and actively traded digital assets in the digital crypto market (excluding stablecoin), so we use their prices to represent the prices of digital assets to test the relationship between stablecoin and digital asset prices.

4.2. Model selection

We examine the monetary attribute of cryptocurrency based on the responses of relevant variables to the supply of stablecoins. If the stablecoins have monetary attribute, they will lower interest rates and push up asset prices in the market. If they have no monetary attribute, they will compete with existing assets and have the opposite effect. Considering the rapid expansion of stablecoins' volume and the wider use of stablecoin as a medium of exchange in our sample, the monetary attribute of digital stablecoin may exhibit time-varying characteristics and the relationship between the variables may be somewhat complex. In order to better distinguish the possible time-varying characteristics of the monetary attributes of digital stablecoins, we use the TVP-SV-VAR model to test them. In addition to reflecting the time-varying effects of stablecoin, this nonlinear model helps to solve the heteroskedasticity problem caused by time-varying volatility, improving the accuracy of model estimation. So, the estimation results outperform other fixed-parameter VAR models (Nakajima, 2011).

TVP-SV-VAR incorporates the time factor into the SVAR model, a vector autoregressive model with time-varying parameters by setting the intercept terms, coefficients and variances of the underlying VAR model as time-varying parameters (Primiceri, 2005). The simplified SVAR model can be expressed as follows:

$$y_t = A^{-1}F_1 y_{t-1} + \cdots + A^{-1}F_s y_{t-s} + A^{-1}\sum \varepsilon_t \tag{1}$$

where A is the coefficient of the interaction between contemporaneous variables, and the lower triangular matrix of A is $\begin{bmatrix} 1 & 0 & \cdots & 0 \\ a_{2,1} & \ddots & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ a_{k,1} & \cdots & a_{k,k-1} & 1 \end{bmatrix}$ when the time factor is not included. The vector of element stacking in A_t is $a_t, a_t = (a_{2,1}, \cdots, a_{k,k-1})'$ when time factor is included. F_1, ..., F_S are the coefficients of the interactions between variables and lagged variables in a k × k dimensional matrix. $\sum {}_t \varepsilon_t$ is the structural shock, $\sum {}_t = \begin{bmatrix} \sigma_{1t} & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & \sigma_{kt} \end{bmatrix}$. Further stack $A_t^{-1}F_i$ by rows can obtain the new matrix β_t, where β_t is the $k^2 s \times 1$ dimensional vector. Define the matrix $X_t = I_k \otimes (y_{t-1}, \cdots, y_{t-s})$ to represent the lag variables, where $\otimes$ represents the Kronecker product operation. According to the above setup, the simplified form of the TVP-SV-VAR equation can be expressed as

$$y_t = \beta_t X_t + A_t^{-1}\sum_t \varepsilon_t \tag{2}$$

Let $h_t = [h_{1t}, \cdots, h_{kt}]'$ be the logarithmic stochastic volatility vector, where $h_{j,t} = \log \sigma_{j,t}^2$, $j = 1, 2, \cdots, k$. In order to effectively capture the variation of structural parameters and improve the estimation efficiency, this paper assumes that the coefficients in the TVP-SV-VAR model obey the random wandering process, i.e., $\beta_{t+1} = \beta_t + v_{\beta t}$, $a_{t+1} = a_t + \epsilon_{at}$, $h_{t+1} = h_t + \xi_{ht}$. And there are,

$$\begin{bmatrix} \varepsilon_t \\ v_{\beta t} \\ \epsilon_{at} \\ \xi_{ht} \end{bmatrix} \sim N\left(0, \begin{bmatrix} I & 0 & 0 & 0 \\ 0 & \sum_{\beta t} & 0 & 0 \\ 0 & 0 & \sum_{at} & 0 \\ 0 & 0 & 0 & \sum_{ht} \end{bmatrix}\right) \tag{3}$$

where $v_{\beta t}$, ϵ_{at}, ξ_{ht} is the shock to β_t, a_t and h_t, respectively. The three are independent of each other. The TVP-SV-VAR model is estimated mainly in a Bayesian framework using a Markov Chain Monte Carlo (MCMC) approach. In this paper, y_t is a three-dimensional observable vector of the S&P 500 index (S&P500), 1 month USD Libor and issuance volume of Stablecoin (USDT plus USDC), i.e., $y_t = (S\&P500_t, Libor_t, Stablecoin_t)'$. The empirical model of this paper can be expressed as,

$$\begin{aligned} (S\&P500_t, Libor_t, Stablecoin_t)' = I_3 \otimes \beta_t [(S\&P500_{t-1}, Libor_{t-1}, Stablecoin_{t-1})', \\ \ldots, (S\&P500_{t-s}, Libor_{t-s}, Stablecoin_{t-s})'] + A_t^{-1} \sum_t \varepsilon_t \end{aligned} \tag{4}$$

Referring to the usual practice, in the empirical process, we first use the MCMC method to find the posterior distribution of the parameters, and then analyzes the shocks of stable currency volume on nominal interest rates and asset prices by plotting impulse response plots.

4.3. Empirical analysis

4.3.1. Test of the relationship between stablecoins and traditional financial markets

Given the large number of estimated coefficients required for the TVP-SV-VAR model, in order to avoid spurious regressions due to non-stationary time series, previous studies usually use the VAR model to select the smoothness and lagged terms of the data. We conduct the ADF test to test the smoothness of the time series variables first. The test results show that there is a significant time trend for all three time series variables in this paper, so the first-order difference is taken for the time series variables, and the variables pass the smoothness test. After the unit root test, the lags are selected according to the setting of the VAR model. Considering the results of LR, FPE, AIC and SIC tests and the characteristics of the TVP-SV-VAR model, the lag order is chosen to be 2. The model is simulated and solved using MATLAB software, and the settings of the relevant parameters and the MATLAB code used in our analysis are mainly referred to Nakajima (2011) and Amar (2019). We first perform 10,000 simulated samples using the MCMC method, and the final estimation results are shown in Table 1. Observing Table 1, it can be found that the Geweke test values of all parameters are less than the critical value of 1.96, so the original hypothesis cannot be rejected, and the model parameters converge to a posteriori distribution. The maximum invalid impact factor is 42.84, indicating that at least 233 ($\frac{10000}{42.84}$) uncorrelated samples can be obtained in the 10,000 simulated samples, which can meet the estimation requirements. Based on the above model estimation results, and combined with the MCMC simulation parameters distribution graph and other comprehensive judgment, the simulation of the model using MCMC method in this paper is effective.[4]

[4] Due to the limitation of space, the detailed parameter distribution chart is not provided in this paper, which is kept for reference.

Table 1. Estimation results of TVP-SV-VAR model.

Parameters	Average value	Standard deviation	95% confidence interval	Geweke convergence judgment value	Invalid impact factor
$\left(\sum_{\beta}\right)_1$	0.0023	0.0003	[0.0018, 0.0029]	0.389	8.34
$\left(\sum_{\beta}\right)_2$	0.0023	0.0003	[0.0018, 0.0028]	0.210	9.96
$\left(\sum_{\alpha}\right)_1$	0.0057	0.0017	[0.0035, 0.0099]	0.010	42.17
$\left(\sum_{\alpha}\right)_2$	0.0053	0.0015	[0.0033, 0.0090]	0.105	37.14
$\left(\sum_{h}\right)_1$	0.2943	0.0615	[0.1859, 0.4310].	0.114	42.84
$\left(\sum_{h}\right)_2$	0.4985	0.0806	[0.3621, 0.6752].	0.591	14.94

The key to the analysis process of the TVP-SV-VAR model is the impulse response diagram. Impulse response plots can visually observe the mutual shocks among the variables and their time-varying characteristics, and examine the impact of the increase in stablecoins' volume on other variables. According to the characteristics of the sample, three time points with consistent time intervals are selected to test the impulse responses of each variable. The three time points correspond to the 45th period (August 19, 2019 to August 25, 2019), the 90th period (June 29, 2020 to July 5, 2020) and the 135th period (May 10, 2021 to May 16, 2021) of the sample, respectively. Figure 2 shows the results of shocks between the variables over different periods. This paper focuses on the supply of stablecoins on interest rate and asset price shocks. As can be seen in Figure 2, an increase in the supply of stablecoin has a significant negative shock on asset prices, and this negative shock converges in three to four periods. It means that the shock to asset prices from the supply of stablecoins disappears in about a month. The negative shock does not exhibit significant heterogeneity across periods. The shock of stablecoin has a positive impact on interest rates, and the increase in stablecoin volume boosts money market demand and raises the price of money. This positive shock to stablecoin has significant temporal heterogeneity. The boost in stablecoin issuance had a relatively small impact on interest rates during the relatively small stablecoin size period in 2019. By mid-2020, the market size of stablecoins grows rapidly, and the impact of stablecoin issuance on market funding prices is relatively large during that period. The trading volume of stablecoins reached a peak before the third point in time, and in May, due to the successive introduction of regulatory measures in various countries, the trading volume of stablecoins declined significantly, and the impact on market interest rates also weakened. Comparing the two, we can see that the impact of stablecoins on market interest rates lasts much longer than asset prices, which may be caused by the time lag of monetary policy. All the above results suggest that for traditional financial markets, stablecoins do not exhibit a liquidity effect. They are digital assets rather than currency. The supply of stablecoins has a competitive effect with traditional assets, crowding out traditional asset prices. The elevated demand for stablecoins drives the demand for money, bringing about an increase in market interest rates.

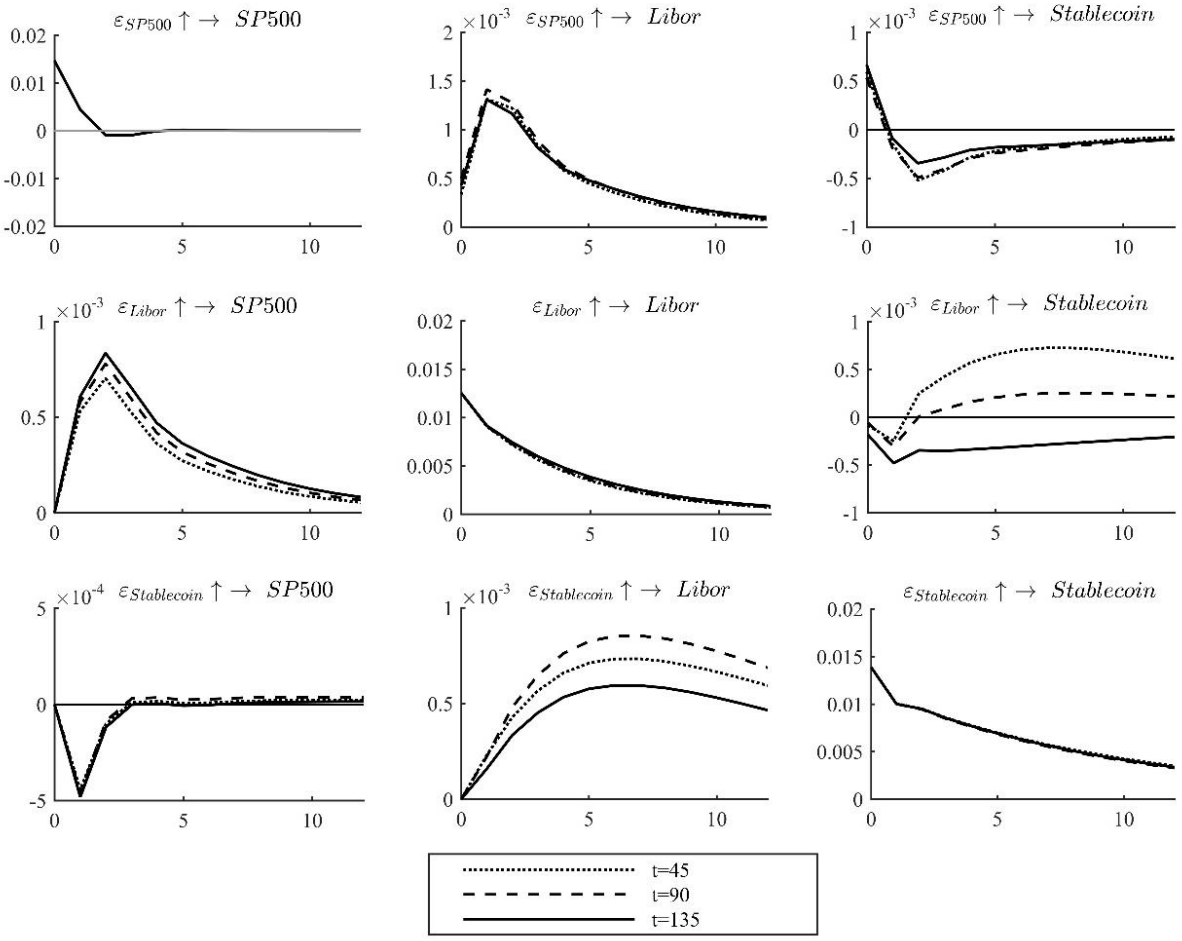

Figure 2. Impulse response analysis of digital stable coin shock.

Observing the impact of asset prices on stablecoin issuance reveals that, except for a positive impact on stablecoin issuance at the beginning of the shock that quickly diminishes, the overall increase in asset prices reduces the supply of stablecoins, which exhibit a competitive effect between assets rather than a boost in currency issuance brought about by an increase in demand for currency when asset prices are high. In the early period of our sample, the increase in money market prices causes stablecoin to experience some increase after a brief decline. However, as the size of the stablecoin market continues to expand, the driving effect of the increase in money market prices on stablecoin volume gradually diminishes. By the third time point of this paper, the impact of the increase in money market price on stablecoin issuance is completely negative. The increase in money prices raises the cost of holding stablecoin assets, causing stablecoin's volume to decline.

In order to further analyze the time-varying characteristics of stable currency shocks to asset prices and market interest rates, referring to Nakajima's (2011) setting, we examine the results of cumulative shocks with lags of 2, 4 and 6 periods, respectively. Figure 3 presents the cumulative impulse response plots with lags of 2, 4 and 6 weeks. From Figure 3(a), stablecoins generate negative shocks to asset prices during the sample period. Although there are some fluctuations in the negative shocks during the sample period, the direction of it remains unchanged. This suggests that stablecoins mainly act as a competition for traditional assets rather than a medium of exchange. Moreover, this negative shock mainly concentrates within 2 weeks and disappears after 4 weeks. According to

economic theory, in the long run, an increase in the money supply translates into an increase in the price level. If stablecoins enter the traditional financial market as a currency, the impact of the increase in their supply on the price level will not disappear in the short run. All the above indicates that stablecoins do not enter the financial market as a currency and have no monetary attribute. The same is true for the impact of stablecoins on market interest rates in Figure 3(b). Positive shocks to stablecoins always have a positive impact on currency prices, indicating that stablecoins stimulate the market demand for liquidity as an asset, rather than providing liquidity to the market as a substitute for existing currencies. The results of the cumulative impulse responses demonstrate that stablecoins do not have monetary attribute in traditional financial markets and are only a digital asset.

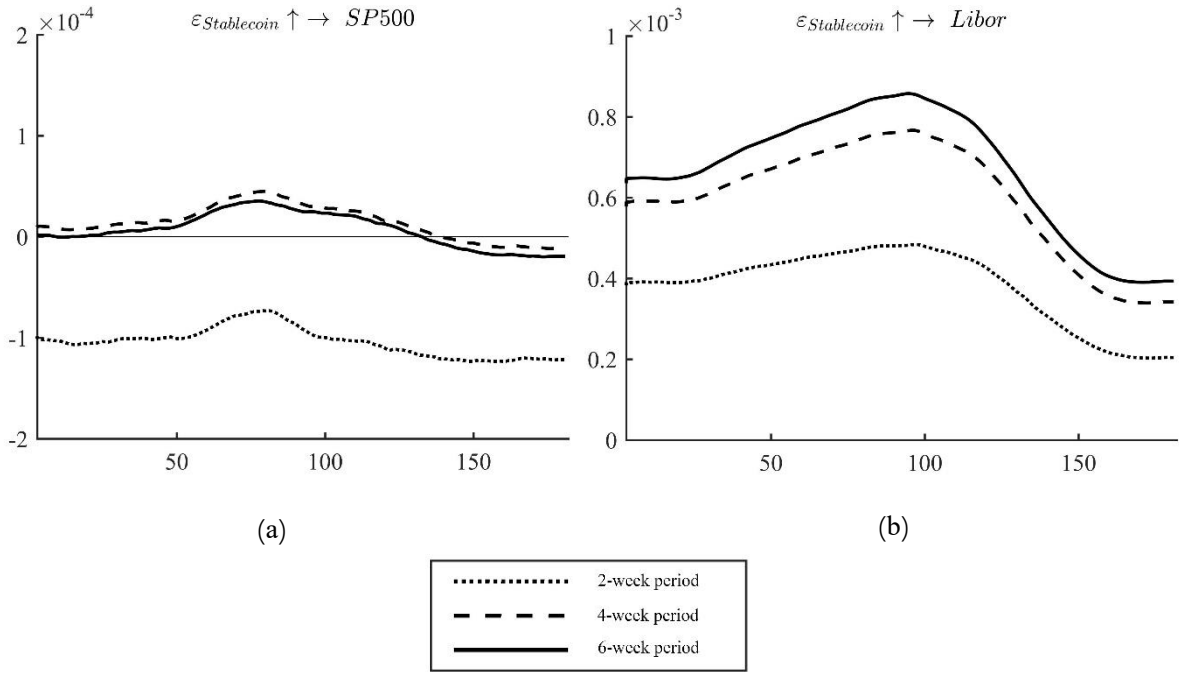

Figure 3. Cumulative impulse response of digital stable coin shocks.

4.3.2. Test of the relationship between stablecoins and digital asset market

This section adopts the same approach as the above section and uses the TVP-SV-VAR model to test the impact of the elevated stablecoin issuance on the price of digital assets, and then determine whether stablecoins have monetary attributes in the digital asset market. According to the theoretical analysis in the previous section, if the stablecoin has monetary attributes within the digital asset market, the increase in its volume will bring liquidity to the digital asset market and raise the price of the remaining assets; if the stablecoin does not have monetary attributes and is only a new type of digital asset, the increase in issuance volume of the stablecoin will form a competitive effect with other digital assets and squeeze out the price of other assets.

We perform the unit root test and select the lag term as the above section. The model was estimated by MCMC simulation and the validity of the estimation was judged based on the relevant graphs. After proving the validity of the model, the impulse response plots of each variable were drawn, and the results are shown in Figure 4.

In Figure 4 we mainly focus on the impact of stablecoin on the price of Bitcoin and Ethereum. The impulse response results show that the increase in the supply of stablecoins significantly raises the prices of Bitcoin and Ethereum. The impact of stablecoin on digital asset prices reaches a maximum within two weeks and then slowly diminishes. This result suggests that stablecoins enter the digital asset market as a purchasing power rather than an asset, bringing a liquidity effect to the market rather than competing. Bitcoin and Ethereum, two cryptocurrencies that are widely considered as assets in the literature, have prices that compete with each other, in contrast to stablecoins. Looking at Figure 4, it can be observed that as two major digital assets, a positive shock to the price of Ethereum has caused a significant decline in the price of Bitcoin. The rise in Bitcoin price, in turn, drives up the price of Ethereum, mainly because most of the current market transactions regarding Bitcoin use stablecoins based on the Ethereum network, and the increase in trading volume brought about by the rise in Bitcoin price leads to an increase in demand for stablecoins. As mentioned in the indicator selection section of this paper, Ethereum is a special currency of the Ethereum network, and the increase of stablecoins will naturally increase the price of Ethereum. In summary, the mutual influence between the two assets and the influence of stablecoin on them are different, which proves the monetary attribute of stablecoin in the digital asset market.

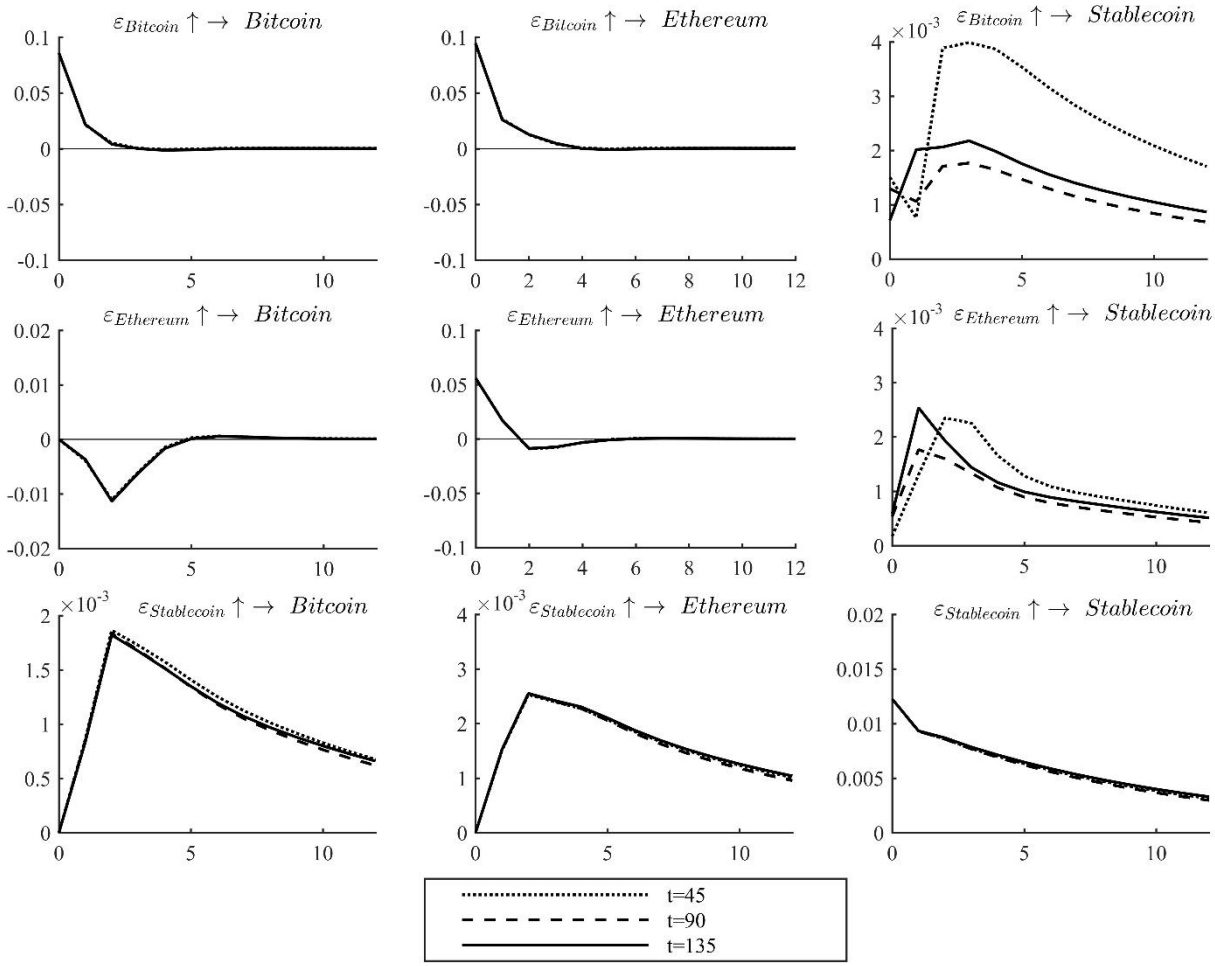

Figure 4. Stable Coin Impulse Response Plot.

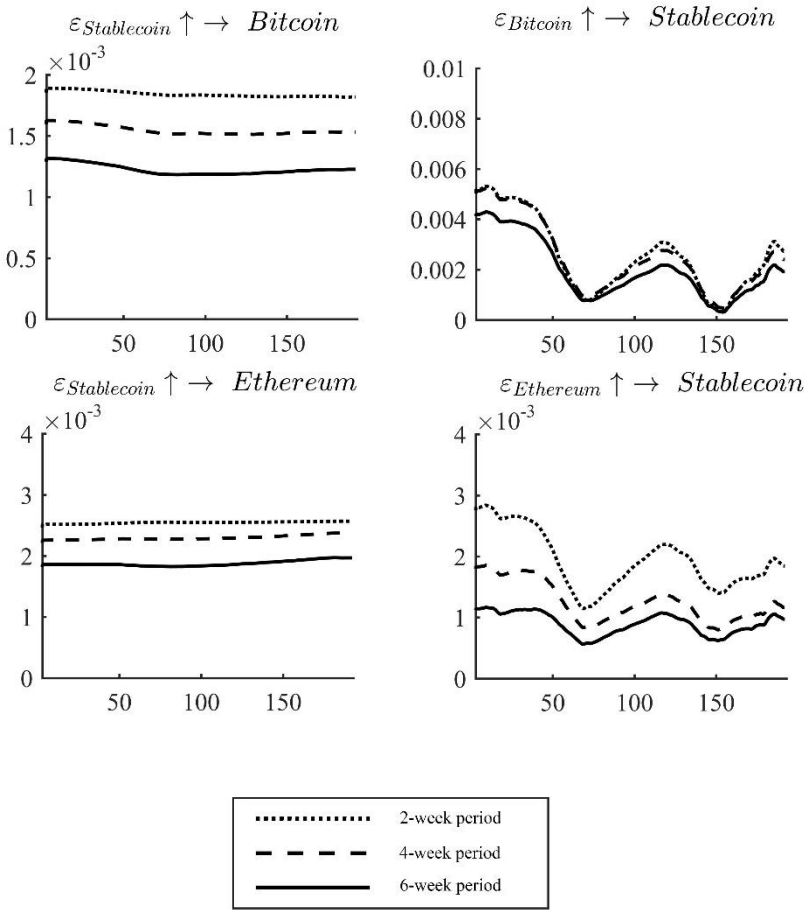

Figure 5. Cumulative impulse response graphs.

In order to examine the time-varying characteristics of stablecoin on the price shocks of major assets in the digital asset market and verify the monetary attribute of stablecoin, we further plot the cumulative impulse responses of stablecoin and digital asset market prices. In order to be consistent with the previous paper, impulse response plots with a lag of 2 weeks, 4 weeks and 6 weeks are chosen. The results are shown in Figure 5. From the impact of stablecoins on the prices of major monetary assets, we can find that the increase in stablecoin's volume has a continuous and stable positive impact on the prices of Bitcoin and Ethereum, which decays slowly over time and still has a significant positive impact after 6 periods. Currency issuance has a long-term horizontal effect on market prices, and increase in currency issuance brings inflation to the market, resulting in asset prices remaining at high levels. The above analysis shows that stablecoin as a liquidity brings inflation to the digital asset market, so they have monetary attributes. In terms of the cumulative impact of digital asset prices on stablecoin, although it shows some volatility during the sample period, the increase in digital asset prices still significantly boosts the issuance of stablecoin. The elevated demand for transactions brought about by the increase in digital asset prices increases the demand for stablecoins, rather than generating a competitive effect with it and reducing the issuance of stablecoin. The above analysis based on cumulative impulse response plots suggests again that stablecoins have monetary attributes in the digital asset market and play the role of a medium of exchange.

4.4. Robustness test

In this paper, we test the robustness of the empirical results by replacing the econometric model and replacing the proxy variables. Under the original model and analytical framework, we first conduct robustness check by replacing proxy variables. In the analysis of stablecoin and macroeconomic variables, the Dow Jones index is used as a proxy variable for asset prices, and the U.S. March Treasury rate is used as a proxy variable for the price of U.S. dollar. In the test of stablecoin on digital asset prices, the respective supply of USDT or USDC alone and the trading volume (in USD) of USDT and USDC are used as proxy variables of stablecoin to verify the impact of stablecoin on macroeconomic variables and the digital asset market. In addition, we also construct a basic VAR model to test the relationship between stablecoin issuance and macroeconomic variables as well as digital asset prices using each of the proxy variables covered in the previous paper. The results show that the results obtained in the above section are reliable.[5]

5. Conclusions and recommendations

This paper first analyzes the monetary attribute of stablecoins from the perspective of acceptance and currency stability from the nature of money. Based on the TVP-SV-VAR model, the monetary attributes of stablecoins are examined from the perspective of macroeconomic interrelationships. We find that: stablecoins have stable price, but do not have universal acceptability in the traditional financial market, so they have no monetary attributes; in the digital asset market, stablecoins are widely accepted, play the role of a medium of exchange and have monetary attributes. The empirical results based on historical data of stablecoins show that stablecoins compete with traditional financial assets, and the increase of their volume lowers the price of other assets. In addition, the increase of stablecoin issuance stimulates the demand for money and raises the price of the money market. Therefore, stablecoins are assets in the traditional financial market and have no monetary attributes. In the digital asset market, the increase in the issuance of stablecoins pushes up the price of digital assets, brings liquidity to the market, and allows them to plays the role of a "digital fiat currency", which has monetary attributes.

It's important to note that the analysis in this article is limited to the two main types of stablecoins that are pegged to the U.S. dollar, namely USDT and USDC. Although these two stablecoins make up around 90% of the total stablecoin market capitalization, there are still other stablecoins pegged to the U.S. dollar, such as BinanceUSD (BUSD) and TrueUSD (TUSD), among others. These stablecoins mostly perform similarly to the two stablecoins analyzed in this paper in terms of value stability, but they have more limited usage and are primarily seen as supplements to USDT and USDC. Therefore, they only play the role of money within a limited scope. Furthermore, apart from U.S. dollar-pegged stablecoins, there are also stablecoins that are pegged to other digital assets or algorithmic stablecoins. These stablecoins can have greater fluctuations in their value relative to the U.S. dollar, and their use cases are narrower compared to U.S. dollar-pegged stablecoins. The conclusions drawn in this article may not directly apply to these stablecoins. The monetary characteristics of these stablecoins require further research and discussion in the future.

Stablecoins have not been widely used in real-life scenarios and their monetary attributes are limited to the digital asset market. However, as the concepts of decentralized finance (DeFi) and Metaverse continue to be promoted, more and more individuals are participating in the digital asset

[5] For space reasons, the results of this part of the test are not reported in this paper.

market, and the systemic importance of the digital asset market continues to grow. These "digital fiat currencies", which are outside of state regulation and controlled by the private sector, are playing an increasingly important role in the financial system. The goals of the private sector may sometimes diverge from the society, and the lag in relevant regulatory measures may cause the liquidity of the digital asset market to escape from government control, posing financial risks and impacting the financial security of the country. According to the conclusions of this paper, the following policy recommendations are proposed: (1) Clarify the legal status of stablecoins according to their monetary attributes and guide the relevant agencies for their regulation. The legal recognition of this digital product, which is mainly pegged to US dollars and has certain monetary functions, is a prerequisite for a country to clarify its regulatory body and regulatory approach, which is of great significance to the construction of a regulatory system in the era of digital economy. According to the research of this paper, stablecoin is a new type of asset in the traditional financial market, while it has monetary attributes and is a currency in the digital asset market. Therefore, the government should distinguish the market position of stablecoins and cryptocurrency such as Bitcoin, clarify the regulatory unit for stablecoins based on an accurate understanding of the nature of stablecoins and strengthen the regulation of them. Prevent privately controlled stablecoins from bringing systemic risk to the digital asset market, disrupting the market order and thus having an impact on the entire financial system. Second, for the monetary policy departments, they should pay attention to the digital asset market in formulating monetary policy, including the possible impact of stablecoins on the effect of monetary policy in the scope of investigation, and monitor the possible impact of digital stablecoins on the currency market to ensure that inflation and other relevant macro variables can still be accurately controlled. (2) Draw on the operation mechanism of stablecoins to help expand the use of national currencies and make up for the shortcomings of the existing international monetary system. As a means of payment, stablecoin has become a medium of exchange in the digital asset market by enhancing the speed and simplifying the procedures of cross-border payment with the help of blockchain technology. Such features as anonymity and convenience of stablecoin overcome the complex process of existing international payment, making cross-border transactions of digital assets much more efficient. This provides a useful reference for the cross-border use of fiat currencies. On the other hand, the private credit in stablecoins makes them risky to be redeemed, and cryptocurrency based on national credit can overcome the private credit risk and are a better choice than stablecoins. Governments can reasonably use the design idea and technology of combining stablecoin and the Ethereum network to overcome the problems of cumbersome payment links in the existing international monetary system, promote the use of national currency in the digital asset market, and take the digital asset market as an opportunity to promote the expansion of the use of fiat currency.

Use of AI tools declaration

The authors declare they have not used Artificial Intelligence (AI) tools in the creation of this article.

Conflict of interest

All authors declare no conflicts of interest in this paper.

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