How the fiat-backed stablecoins are manipulating US money supply

Nizam, Ahmed Mehedi

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Ahmed Mehedi Nizam[1*],

1 The Central Bank of Bangladesh, Motijheel, Dhaka, Bangladesh

* ahmed.mehedi.nizam@gmail.com

Abstract

Fiat-backed stablecoins have been around for quite some time and yet not much have been said about its impact on US money supply. Although a few studies have qualitatively discussed that the issuance of fiat-backed dollar-pegged stablecoins might have an impact on US money supply, they are unable to quantify it. Here we have developed a detailed framework to quantify the impact of the issuance of fiat-backed US dollar-pegged stablecoins on US money supply. According to the proposed framework, the issuance of US dollar denominated stablecoins is supposed to have a contractionary effect on US money supply. The said contraction stems from the fact that the issuers of stablecoins tend to invest heavily in US treasury bills and bonds, which takes funds out of the process of fractional reserve banking and thereby stops the money multiplication process. Fitting empirical data into our proposed framework, we have shown that the top 3 issuers of stablecoins together have brought about a monetary contraction in US in the range of 1.1-1.2% of total US money supply during different months of 2022.

JEL Codes

E51, E52, E44

Keywords

Cryptocurrencies, stablecoins, money supply

1 Introduction

Cryptocurrencies are types of digital assets that are designed to work as a medium of exchange without the need of a central authority to issue, govern and maintain their circulation. They are often considered as one of the most significant developments of the last decade in monetary and financial sector [1] delivering a wide array of advantages, which includes but not limited to access to custodial services for funds at lower cost, cheaper and faster transactions and reduced financial frauds [2], [4], [3]. Despite what their names suggest, cryptocurrencies often fall short of what a true currency is in most of the jurisdictions around the globe except for El Salvador and Central African Republic [5] and are often treated as commodities, securities etc [6], [7], [8]. To be qualified as a true currency, cryptocurrencies are supposed to deliver at least three core functionalities of money, namely, medium of exchange, store of value and unit of account [2]. However,

due to their highly volatile nature, cryptocurrencies often directly fail to act as a suitable store of value and unit of account [9], [10]. To discharge the other important function of money, namely, the medium of exchange, the cryptocurrencies need to be widely accepted for payment in business enterprises around the globe and a substantial volume of transactions should be settled through the crypto payment system [2]. In this regard, a 2020 survey reveals that at least one third of US small and medium sized businesses accept cryptocurrencies as an applicable medium of exchange [11]. The list includes Wikipedia, Microsoft, AT&T, Burger King, KFC, Subway, Pizza Hut, Dallas Maverick, Virgin Galactic, Norwegian Air among others and it continues to grow over time [12]. However, the number and volume of transactions using cryptocurrencies remain substantially low as compared to conventional payment system providers like Visa and PayPal [13]. So, although a growing number of business enterprises are accepting crypto as a means of payment, it is less frequently used than its conventional peers, which surely downplays its role as an effective medium of exchange. To understand the reason why the cryptocurrencies are trailing behind the conventional payment mechanism as a valid payment source, one must understand different functionalities of money and how they interact with each other over the course of time. It has been argued that the three core functionalities of money, i.e., medium of exchange, store of value and unit of account are interdependent and interact heavily with each other [14], [15]. As the roles of cryptocurrencies as a store of value and unit of account have been greatly compromised due their volatile nature, these two functionalities (of a true currency) interact and interfere with the third important functionality of money, namely, medium of exchange, which eventually adds greatly to the slower adoption of crypto platforms as a suitable payment mechanism [2].

To circumvent the volatility inherent to the crypto ecosystem, stablecoins have been designed [16], which have the potential to discharge all the three core functionalities of conventional money in a more reasonable way than all other altcoins. Stablecoins are kinds of crypto assets the values of which are often pegged to a hard currency like US dollar. The dollar peg is usually maintained by the issuers of the coins by maintaining a dollar denominated reserve assets, the value of which at any instance of time must be greater than or equal to the total amount of stablecoins in circulation. It has been shown that the stablecoins have turned out to be safe heaven investments during the periods of extreme crypto market crisis of 2020 and 2021, when all the un-backed altcoins literally experienced near freefalls in their prices [17]. Moreover, with the advent of decentralized finance colloquially known as DeFi, stablecoins have found new use cases and are now frequently staked in various decentralized platforms adding to the liquidity pool and gaining interest for its owners in return [18]. In short, stablecoins have all the benefits of conventional un-backed crypto assets with the added advantages of price stability and decentralized finance (DeFi). Although stablecoins are still in their nascent states, it has been argued that they have the potential to substantially influence the traditional banking and credit creation process [17]. However, to date, there is no such study that quantitatively analyzes the role of the stablecoins in the money creation process, although a few studies have addressed the issue from a rather qualitative point of view [see for example, Liao and Caramichael (2022)]. Here, we address the issue from a more quantitative perspective and derive specific formulation that attempts to explain the impact of the issuance of stablecoins on US money creation process. From the presented formulation, we can anticipate that the US dollar denominated stablecoins are supposed to have a contractionary effect on US money supply. The reasoning behind the observation is that unlike banks and financial institutions, the stablecoins' issuers tend to invest a significant portion of their total funds in US treasury bills/bonds. Investment in US treasury securities happens to have an impact on US money supply as it immediately takes funds out of the fractional reserve banking process. If the funds were kept in banks

and financial institutions instead, then a comparatively lower portion of it would get invested into US treasury securities. Apart from keeping funds as deposits in banks and financial institutions, the funds could have been invested directly in treasury securities, stocks, corporate bonds, real estate etcetera and each of these alternates to stablecoins could have effected US money supply differently. Here, we weight the impact of each of these alternative investment opportunities on US money supply according to the asset holding patterns of the US households to calculate the consolidated net effect on US money supply brought about by the investments in various fiat-backed stablecoins available in the market. We have found that together the top 3 fiat-backed stablecoins have contributed to around 1.1-1.2% contractionary changes in US money supply during different months of 2022.

The rest of the paper is organized as follows. Section: 2 presents some preliminary definitions that will be helpful to go through the article from scratch. Section: 3 describes the asset compositions of the reserves maintained by the top 3 fiat-backed stablecoins' issuers. Section: 4 dissects the asset holdings of top 3 US banks and compares it to that of the reserves of the stablecoins' issuers. Section: 5 attempts to investigate the impact of fiat-backed stablecoins on US money supply from a theoretical point of view. Section: 6 uses the methodology presented in section: 5 to generate results. Section: 7 discusses the possible policy implication of the current study and finally section: 8 concludes the article.

2   Some preliminary definition

- **Reserve-backed stablecoins:** Reserve-backed stablecoins are types of cryptocurrencies the values of which are pegged to some reference assets like a fiat currency, exchange traded commodities or other cryptocurrencies. Depending upon the nature of the reference assets, the reserve-backed stablecoins are further classified into fiat-backed stablecoins, commodity backed stablecoins and cryptocurrency backed stablecoins. Issuers of the every type of stablecoins must need to maintain reserve in their designated reference assets. For example, an issuer that issues USD denominated stablecoins must need to maintain a reserve denominated in USD, the value of which at any instance of time must not be less than the value of the said stablecoins currently in circulation. The issuer must maintain 1:1 peg for their stablecoins with USD. If anyone wants to purchase USD denominated stablecoins, then he/she must deposit the equivalent amount of USD to the issuer's account. Issuer then transfers the fund to its reserve assets and issues an equivalent amount of stablecoins in favor of the purchaser. If any previous purchaser wishes to redeem his/her coins, then the issuer can easily accommodate for this through the reserve assets it maintains. 1:1 peg with the USD is maintained through the arbitrage mechanism prevailing in the financial market. If the value of the stablecoins falls below its 1 USD peg, then the holders of the coin may redeem their coin with its issuer getting 1 USD in return. As the price of the coin is below its 1 USD peg, then investors rush to the market to buy it for less than 1 USD and redeem it for 1 USD through its issuer gaining a solid margin from such arbitrages. As buyers rush to purchase the coin from the market, it drives the price up to its 1 USD peg. If the price of it exceeds its 1 USD peg, then the investors request the issuer of the coin to issue more coins for 1 USD per coin on their behalf. As the issuer is committed to issue coin for 1 USD, the investors get new coins from the issuer at 1 USD and sell it in the market rate of greater than 1 USD netting a gain in the process. As the selling pressure and also the supply of the coin rise, the price of it falls back to its original peg of 1 USD again.

- **Money supply:** There are different measures of money supply, e.g., M1, M2, M3 etc. Here, we adopt M2 as our measure of money supply. M2 comprises the physical currencies that are in the people's wallets plus the total demand and time deposits maintained by the public with banks and financial institutions. More formally M2 is defined as the sum of currency outside banks, demand deposits other than those of the central government, and the time, savings, and foreign currency deposits of resident sectors other than the central government [19].

- **Monetary base:** Monetary base is the amount of money created by the central bank. It includes the physical currency in circulation, notes and coins in banks' vaults and the commercial banks' deposits maintained with the central bank to comply for the regulatory requirements. Monetary base is also known as base money, money base, high-powered money, reserve money, outside money, central bank money as this is the money that gives rise to other measures of money like M1, M2, M3 through the fractional reserve banking process.

- **Money multiplier:** As we have discussed earlier that monetary base is the amount of money that has been generated by the central bank in the first place. When this base money enters into the commercial bank as deposit, then the bank will keep a portion of it as regulatory requirements and lend the remaining portion. The entity receiving loan does not usually invest/spend it instantaneously. Rather, it initially keeps it as deposits in its bank account and thus new deposit is created. Again, the bank keeps a portion of it with the central bank to fulfill regulatory requirements and lends the remaining portion and the process continues. This process of creating more money through successive lending is known as the fractional reserve banking and this is reason why there are more money in an economy than that has been created by the central bank in the first place. Money multiplier captures the extent to which the base money has been multiplied inside an economy through the fractional reserve banking process and in our present context, it is formally defined as follows:

$$MB = \frac{M2}{MB}$$

- **US treasury securities and federal open market operations:** US treasury securities are bills and bonds of different maturities issued by the US government to meet up its budget deficits. However, these treasury securities are often used by Federal Reserve as a primary tool to implement the monetary policy. When the Fed wants to pursue a contractionary monetary policy, then it sells treasury bills and bonds to the commercial banks. Banks purchasing the bills/bonds will lose their liquidity and find it difficult to lend more money in the credit market. As the credit operation comes to a stall due to shortage of fund, the process of fractional reserve banking also stops. As the money creation stops, money supply does not increase as an immediate aftermath. On the other hand, when the Fed wants to pursue an expansionary monetary policy, then it buys back treasury bills/bonds from the banks and through this, it injects extra liquidity into the market. Banks now find it easier to extend more credit as there are idle funds in their accounts. So, credit operation begins and money supply boosts up as an eventual consequence. So, unlike all other investments, investments in treasury bills/bonds are specifically significant as it is directly linked to the total supply of money in an economy.

- **Fed fund:** Banks in the United States are supposed to keep a certain portion of their total demand and time liabilities with the Federal Reserve as a regulatory

requirement. These are kept with individual bank's account with the Federal Reserve. Funds in those accounts are generally known as fed funds. Banks usually borrow and lend fed funds within themselves to meet up regulatory requirements and lending bank makes profit in the process. Investing in fed funds is equivalent to the purchase of treasury bills and bonds in a sense that fed funds are maintained with the Federal Reserve and they cannot multiply through the fractional reserve banking process. So, when the banks have too much funds stuck up with the Fed, they cannot lend. As the lending process stops, so does the money creation process, which eventually results into a monetary contraction. So, unlike any other investments, banks' investments in fed funds have a special significance in terms of overall supply of money in the economy.

- **Repurchase agreement (repo) and reverse repurchase agreement (reverse repo):** Repurchase agreement (repo) is a type of transaction, where one party agrees to sell securities to another party at a specified price with the agreement to buy it back at a later date at a higher price. For the party initially selling its securities, the transaction is known as repurchase agreement (repo), while for the other party, the transaction is known as reverse repurchase agreement (reverse repo). Through repo, banks and financial institutions usually meet up their emergency liquidity needs from the market. On the other hand, through reverse repo, banks and financial institutions park their extra liquidity in a safe way. Generally repos maturing overnight are known as overnight repos, while repos with a maturity greater than one day, are known as term repos. Apart from overnight and term repos, there are repos with no specified maturity, which are known as open repos and can be cancelled by either party at any time. So, whenever one economic entity provides funds to other through reverse repo, the lending entity is indirectly financing the (previous) purchase of securities of the borrowing entities and in a practical sense, the securities underlying a repo transaction are not actually sold and bought back, rather they simply serve as collaterals of a secured financing operation between the two parties involved. It is customary for US banks to use their unemcumbered Held For Trading (HFT) treasury securities as an underlying asset in repo transactions.

3 Asset composition of the reserve maintained by the stablecoin issuer

According to CoinMarketCap data as on July 2023, there are some 146 stablecoins currently in the market with a consolidated market capitalization of USD 127.48 billion [20]. Amongst these large number of stablecoins in the market, top 3 fiat-backed stablecoins, namely, Tether (USDT) [21], USD Coin (USDC) [22] and Binance USD (BUSD) [23] jointly account for nearly 90% of total stablecoin market capitalization as on July 2023 [20]. USDT, USDC and BUSD are issued by Tether Foundation, Circle and Binance respectively and together they are the major players in global stablecoin market with a combined stablecoin market capitalization of USD 114.86 billion as on July 2023 [20]. To be more precise, USDT is by far the first in row with a market capitalization of USD 83.34 billion, followed by USDC with a market capitalization of USD 27.39 billion and BUSD with a market capitalization of 4.13 billion. USDT, USDC and BUSD are all fiat-backed stablecoins, which means each of them is supposed to maintain a reserve in US dollar, the value of which at any instance of time must not be less than the total amount of stablecoins issued by it at that time. Stablecoins minted by each of them comprise a liability for the issuer and each of the coins is said to be redeemable at any instance at par value of 1 US dollar. Each of the claims of redemption

is entertained through liquid reserves maintained by its issuer. Once a coin is redeemed, the issuer can lower its reserve balance accordingly. So, to maintain its dollar peg, the issuer must ensure that they have sufficient amount of liquid US dollar at hand to handle such redemption request. Although USDT, USDC and BUSD are said to be fiat-backed, this does not necessarily mean that they have to keep their entire reserves in fully liquid bank accounts denominated in USD. Rather, the companies tend to keep a portion of their reserve in cash form with some banks, while a substantial portion of it gets invested in US treasury bills and bonds of different maturities, corporate bonds and even in various other crypto currencies. Let us now dissect the reserve balances maintained by USDT, USDC and BUSD one by one and see their asset compositions.

- **Reserve breakup of USDT stablecoin:** From the independent auditor's report on the consolidated reserves maintained by the Tether Holdings Limited (which is the mother organization of USDT stablecoin) as on 31/3/2023, it has been observed that the total reserve stands at USD 81.83 billion, which consists of US treasury bills, overnight reverse repurchase agreement, term reverse repurchase agreement, money market funds, cash and bank deposits, non-US treasury bills, corporate bonds, precious metals, bitcoin, secured loans and other investments [24]. Detailed breakup of reserve maintained by Tether Holdings is given in Fig: 1.
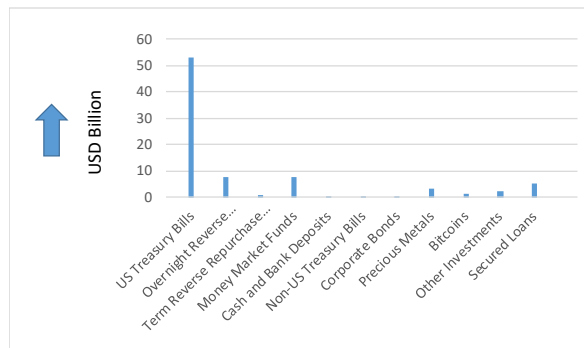

Fig 1. USDT reserve assets as on 31/3/2023

From Fig: 1, we can see that out of USD 81.83 billion total reserve, USD 53.04 billion or 64.82% is invested in US treasury bills. It is to be noted in this regard that reverse repurchase agreements of various maturities are indeed secured loans extended by the Tether Holdings to other entities by taking collateralized US treasury bills/bonds as securities. On the specific maturity of a reverse repurchase agreement, the borrowing entity will pay off the Tether Holdings and collateral will be released. So, these are the secured loans extended by the Tether Holdings to other entities which, in other words, are indirectly used by the borrowing entities to finance their previous purchase of US treasury bills and bonds. So, if we sum up the investment in reverse repurchase agreement which is indirect investment in US treasuries with the direct investment in US treasuries, we will get USD 61.33 billion in total, which is 74.95% of total reserve.

- **Reserve breakup of USDC stablecoin:** According to the independent accountant's report on the USDC reserve assets as on 31/3/2023, it has been observed that the total USDC coin in circulation stands at USD 32.52 billion, while the fair value of the assets held in USDC reserve is found to be USD 32.57 billion [25]. Unlike the diversified reserve portfolio maintained by the Tether Holdings Limited, the backing reserve for USDC coins in circulation only contains US treasury bills of different maturities and cash holdings at different US banks. The detailed breakup of the reserve asset maintained by Circle Internet Financial LLC to backup USDC

coins in circulation is portrayed in Fig: 2. From Fig: 2, it is evident that out of USD 32.58 billion reserve asset, USD 28.89 billion or 88.67% of the total reserve is maintained in US treasury securities.
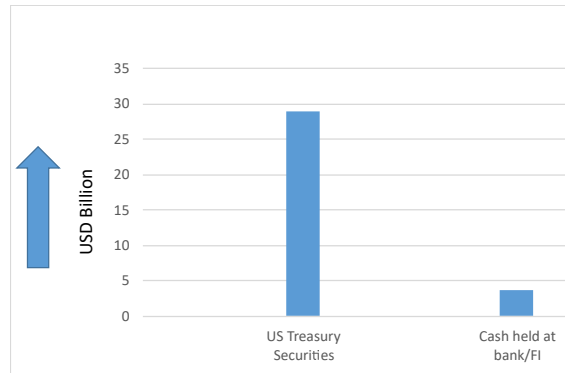

Fig 2. USDC reserve assets as on 31/3/2023

- **Reserve breakup of BUSD stablecoin:** According to the independent accountant's report on the BUSD reserve assets as on 31/3/2023, it has been observed that the total volume of BUSD coin in circulation stands at USD 7.56 billion, which is backed by USD 7.68 billion of reserve assets [26]. Reserve assets are maintained under three categories namely, US treasury securities, reverse repurchase agreement of US treasury securities and USD holdings. The detailed breakup of BUSD reserve assets are presented in Fig: 3.
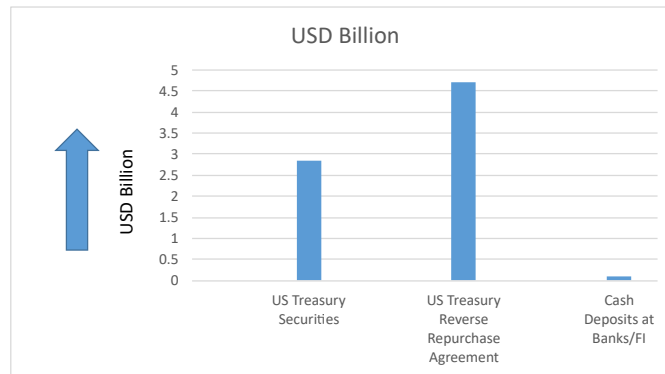

Fig 3. BUSD reserve assets as on 31/3/2023

From Fig: 3, we can see that out of USD 7.68 billion reserve asset, USD 2.85 billion is directly invested into US treasury securities. Another USD 4.72 billion of reserve asset is maintained in reverse repurchase agreement, which are loans given to different regulated banks and financial institutions as overnight loans by taking US treasury securities as collateral. So, the entire amount of reserve asset in the form of reverse repurchase agreement (reverse repo) is indeed indirect investment in US treasury securities. So, if we sum up the direct investment in US treasury securities and investment in reverse repo together, then we will be able to get a complete picture of total effective investments in US treasury securities. The said sum is found to be USD 7.57 billion, which is approximately 98.57% of total reserve asset maintained against total BUSD in circulation as on 31/03/2023.

The above analysis of the reserve assets maintained by the top 3 fiat-backed stablecoin issuers reveals that the majority of the reserve assets backing the stablecoins are

maintained in US treasury securities of different maturities and its equivalents. This is to be noted in this regard that investments in US treasury securities have a direct consequence on US money supply. This is because when an entity purchases US treasury securities, then money enters from the commercial banks to Federal Reserve and this money is effectively taken out of the process of fractional reserve banking and thus it loses its power to multiply. Eventually a monetary contraction will follow and in the following chapters, we will develop a detailed methodology to quantify the magnitude of such monetary contraction.

4   Asset composition of top US banks

In the previous chapter, we have discussed how the reserve assets of top 3 fiat-backed stablecoin issuers have been distributed over different investment modes. In this chapter, we will discuss how the top 3 US banks have allocated their resources in different investment buckets. This comparative analysis is contextual in the current study as it is the banks where the investors in stablecoin would otherwise keep their funds into if there was no stablecoin in the market. Even if the investors in stablecoins might not keep their funds directly with the banks, their deposits would eventually come into banking system. For example, the investors might have invested into real estate, if there was no such thing as stablecoins in the market. In this case, their funds would simply transfer from their bank account to the property seller's bank account leaving the total bank deposits unaltered. We will discuss more about the alternate investment opportunities in the disposal of the investors and their potential impacts on bank deposits and money supply in the chapters to come. For now, we will keep our focus on asset compositions maintained by the top US banks.

According to Federal Reserve Statistical Release [27], top 3 US banks according to consolidated assets are JP Morgan Chase, Bank of America and Citibank NA. We will now take a deeper look into the asset composition of these banks. We collect asset composition data of the said banks from World Street Journal, which are publicly available through [28], [29], [30].
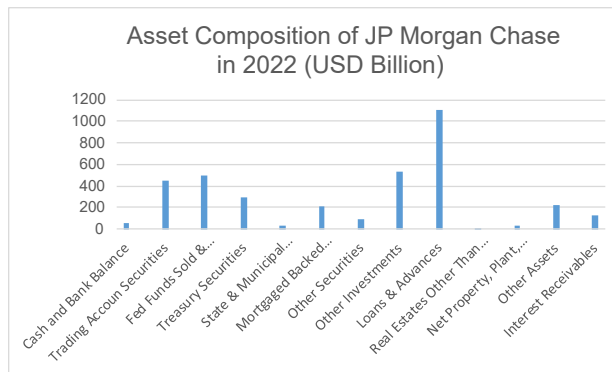

Fig 4. Asset composition of JP Morgan Chase as on December 2022

- **Asset composition of JP Morgan Chase:** According to the data reported by World Street Journal [28], consolidated asset of JP Morgan Chase Bank as on December 2022 stands at USD 3.67 trillion. Out of these USD 3.67 trillion of total assets, USD 453.8 billion, USD 500.96 billion and USD 299.52 billion are invested in trading account securities, fed funds and treasury securities respectively. Trading account securities are mostly Held For Trading (HFT) US treasury securities that are bought and sold over a short span of time usually within a year and are reported

in the fair value in the bank's balance sheet. On the other hand, fed funds are the balance that the commercial banks keep with their accounts with the Federal Reserve in order to meet up the regulatory requirements. So, investment in US treasury securities and investment in fed fund are similar in the way that in both cases the fund is kept with the Federal Reserve and is inevitably kept out of the process of fractional reserve banking. So, the money invested in US treasuries and fed funds does not multiply, what it would certainly do if it was kept outside of the Federal Reserve. So, if we sum up the trading account securities, fed funds and US treasury securities for JP Morgan Chase as on December 2022, we get a figure of USD 1.25 trillion, which is 34.06% of its total asset on the reference date. The total asset composition of JP Morgan Chase as on December 2022 is presented graphically in Fig: 4.
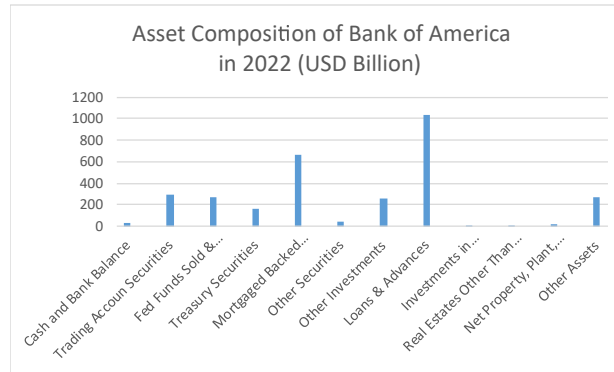

Fig 5. Asset composition of Bank of America as on December 2022

- **Asset composition of Bank of America:** Fig: 5 presents the asset composition of Bank of America as on December 2022. From the figure, it can be seen that out of USD 3.05 trillion total assets, USD 296.11 billion is invested in trading account securities, while USD 267.57 billion and USD 159.02 billion respectively are invested in fed funds and US treasury securities. So, the total effective investments in US treasury securities including the trading account securities and fed fund come out to be USD 722.70 billion, which is 23.68% of the bank's total asset as on December 2022.
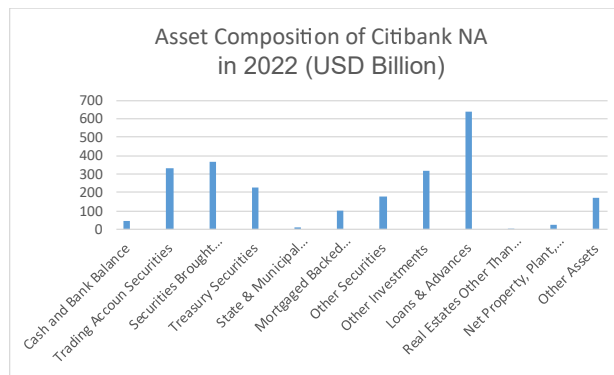

Fig 6. Asset composition of Citibank NA as on December 2022

- **Asset composition of Citibank NA:** Fig: 6 depicts the asset composition of Citibank NA, the third largest commercial bank in US in terms of size of assets. From Fig: 6, we can see that the total asset of Citibank NA as on December 2022

is USD 2.42 trillion. Out of this USD 2.42 trillion asset, USD 334.11 billion, USD 365.40 billion and USD 227.25 billion are invested in trading account securities, reverse repurchase agreement and US treasury securities respectively. Reverse repurchase agreement as we have discussed earlier is a kind of lending to other entities by keeping US treasury bills and bonds as securities. On maturity of the reverse repurchase agreement, the fund is paid back and the securities are released in favor of its original owner. So, through reverse repurchase agreement, Citibank NA has effectively extended loans to some entities that have invested in US treasury securities. Evidently through reverse repurchase agreement, Citibank NA is actually financing the previous purchase of US treasury securities by other entities. So, if we sum up trading account securities, reverse repurchase agreement and investments in US treasury securities, then we will be able to get its consolidated direct and indirect exposure to US treasury securities and this figure comes out as USD 926.76 billion, which is 38.26% of the bank's total asset.

The above analysis suggests that the top 3 US banks tend to invest relatively lower proportion of their total asset in US treasuries and fed funds as compared to the top 3 issuers of fiat-backed stablecoins.

5 Impact of fiat-backed stablecoins on US money supply

Before delving into further detail, let us analyze how inward and outward remittances may effect US money supply. These analyses are relevant in the present context as the issuers of the stablecoins might have received a portion of their funds from aborad to issue stablecoin. It is also likely for them to remit a portion of their received funds to the rest of the world for investment purposes.

Proposition 1: Remitting US dollar from abroad to US does not change US money supply

Explanation: Let us assume person P_1 in country C_1 is remitting fund to person P_2 in US through his (person P_1's) account with bank B_1 in country C_1. Let us also assume person P_2 has an account with bank B_2 in US. So, person P_1's account with bank B_1 is debited and person P_2's account with bank B_2 is credited in the process. The settlement takes place through another bank B_3 in US with which both bank B_1 and B_2 have their accounts. In the first phase, bank B_1 debits person P_1's account by the remitted amount and credits the same to its own general account. Then bank B_1 asks bank B_3 to debit B_1's account with B_3 by the remitted amount and credit the same to B_2's account with B_3. Now, as bank B_2 has received the fund in its account, it then debits its own account and credits it to person P_2's account. In the above process, no new deposit is created. Rather, deposit is transferred from one account to another leaving the total demand and time deposits (money supply) unaltered.

Proposition 2: Sending US dollar from US to the rest of the world does not change US money supply

Explanation: Let us assume person P_1 is sending some US dollars from its account with bank B_1 in US to person P_2's account in bank B_2 in country C_2. After receiving the remitting request from person P_1, bank B_1 will debit person P_1's account by the requested amount and credit the same to its general account. Then again the settlement takes place through a third bank B_3 with which both bank B_1 and B_2 have their accounts.

Now, the bank B_1 will ask bank B_3 to debit its account (B_1's account with B_3) and credit B_2's account by the initially remitted amount as requested by person P_1. After bank B_2's account is credited, it (bank B_2) then debits its own general account and credits the same to person P_2's account with it. In the whole process, no new deposit is created leaving to total US money supply unchanged.

The issuer of the stablecoin may receive US dollar to issue stablecoin from both home and abroad. If it receives fund from inside US, then obviously no new deposit is created as the deposit is simply transferred from purchaser's account to the issuer's account. If the deposit is received from outside of US, then invoking proposition: 1, we can say that still no new deposit is created. So in either way, there is no change in US money supply till now. After receiving the fund, the issuer of the stablecoin may choose to remit it outside of US. If it chooses to do so, then invoking proposition: 2, we can say that there is no change in US money supply yet. The change in US money supply is brought about only when the issuer of stablecoin chooses to invest its funds in US treasury bills and bonds. We have discussed earlier that the issuers of the stablecoins tend to invest heavily in treasury bills and bonds. In the process of investing heavily in US treasury securities, they (issuers of the stablecoins) are indeed siphoning out a huge portion of liquidity from US banking system, while depositing the same to Federal reserve. As the money enters into Fed, it has now been isolated from the process of fractional reserve banking and consequently it loses its power to multiply. As money multiplication process is stopped, it is supposed to have a contractionary/negative effect on total US money supply, i.e., money supply will be lower as compared to what it would have been in the absence of any such stablecoins. Now, let us analyze the possible investment opportunities that would have been otherwise utilized by the purchasers of the stablecoin in the absence of any such coin.

A. Banks and financial institutions: If there is no stablecoin in the market, then the entities now purchasing it may wish to keep their funds in their bank accounts. We have discussed earlier that banks in the United States usually invest a lower percentage of their total deposits in US treasury bills and bonds as compared to the issuers of the stablecoins. However, banks need to keep a certain portion of their total deposit (total demand and time liability) with the Federal Reserve as a regulatory requirement. Funds kept with the Federal Reserve is known as fed funds and money kept as fed funds is comparable to money invested into US treasury securities in a sense that both the funds are siphoned out of the fractional reserve banking process and thus do not multiply. Now let us assume that the US banks and the issuers of the stablecoins invest $TB_B\%$ and $TB_{SC}\%$ of their total deposits in US treasuries and fed funds respectively, where $0 \leq TB_B, TB_{SC} \leq 1$. We will show later that empirically $TB_B < TB_{SC}$. Let us also assume that the total volume of issued stablecoins be X. Now, in the absence of any such stablecoin in the market and in the circumstances considered under the present subhead, the X amount would be kept with the banks and financial institutions as deposits and would multiply according to the process of fractional reserve banking. Let us assume that the money multiplier be given by MM. So, the total amount of money created in the process after investing $TB_B\%$ of total deposits in US treasury bills, bonds and fed funds would be given by the following construct:

$$(1 - TB_B) \times MM \times X$$

However, in the presence of stablecoins in the market, the said X amount of deposit will create the following amount of money in reality:

$$(1 - TB_{SC}) \times MM \times X$$

As we have discussed earlier that $TB_B < TB_{SC}$, the presence of stablecoins in the

market is supposed to have a contractionary effect on US money supply, i.e., there is lower amount of money in the market as compared to what it would have been in the absence of stablecoins and this contractionary effect is captured by the following construct:

$$\Delta MS_1 = (1 - TB_B) \times MM \times X - (1 - TB_{SC}) \times MM \times X = (TB_{SC} - TB_B) \times MM \times X$$

$$\Delta MS_1 = (TB_{SC} - TB_B) \times MM \times X \tag{1}$$

B. Treasury bills and bonds: Under this subhead, we are going to discuss what would happen if there was no stablecoin in the market and the investors in stablecoin choose to invest directly into US treasury bills and bonds. Let us now assume that the total volume of issued stablecoin be X. Under this subhead, the entire X amount would be invested in US treasury bills and bonds. Then the whole amount would be taken out of the process of fractional reserve banking bringing about a total monetary contraction. If the money multiplier is given by MM, then the extent of plausible monetary contraction would be given by the following construct:

$$MM \times X$$

However, there are stablecoins in the market and as we have discussed previously that the issuers of the stablecoins do not tend to invest their entire reserves in US treasury bills, bonds and fed funds. If the issuers of the stablecoins combinedly invest $TB_{SC}\%$ of their total reserve in US treasury bills, bonds and fed funds, then the actual contractionary effect will be given by the following construct:

$$MM \times (1 - TB_{SC}) \times X$$

So, under the present scenario (in which the investors instead of investing into stablecoin choose to invest directly into US treasuries), the issuance of stablecoin is supposed to have an expansionary effect on US money supply, i.e., money supply would be higher than what it currently is and this expansionary effect would be given by the following quantity:

$$\Delta MS_2 = MM \times X - MM \times (1 - TB_{SC}) \times X = MM \times TB_{SC} \times X$$

$$\Delta MS_2 = MM \times TB_{SC} \times X \tag{2}$$

C. Any other investments: Apart from the above two scenarios, the investors may also choose to invest in a number of other investment opportunities which include but not limited to real estate, stocks, corporate bills and bonds, rental properties etc. However, any such investment decision would have left the total US monetary supply unchanged. This is because if the investor chooses to purchase a house, then deposit will simply be transferred from purchaser's account to the seller's account leaving the total deposits unaltered. The same is true if the investor chooses to invest in any of the corporate bonds out there, where money is simply transferred from the investor's account to the issuer's account and no new deposit is created in the process leaving the total supply of money untouched. Thus investments considered under the current subhead are equivalent to keeping deposits with the banks from a monetary perspective.

Now, we are in the position to combine the scenarios presented under the above three subheads, which will allow us to derive a quantitative statement that captures

the consolidated effect of the issuance of stablecoin on US money supply. The quantity presented in equation: 1, i.e., MS_1 represents a contractionary effect on money supply, while the construct presented in equation: 2 embodies an expansionary effect on money supply. So, the total effect of the issuance of stablecoins on US money supply will be a signed weighted sum of MS_1 and MS_2 and is given by the following construct:

$$\Delta MS = -W_1 \times MS_1 + W_2 \times MS_2 \tag{3}$$

where $0 \leq W_1, W_2 \leq 1, W_1 + W_2 = 1$ are two weighting factors. W_2 represents the probability of investment in US treasuries (in the absence of stablecoins) and W_1 represents the probability of investment in anything other than US treasuries (in the absence of stablecoins). Here, a negative sign is placed before $W_1 \times MS_1$ as it denotes monetary contraction and a positive sign is placed before $W_2 \times MS_2$ as it indicates monetary expansion.

Through out the above analysis, whenever we mention total deposits, we mean total amount of funding available at hand, which includes both the deposits and capital as sources of funding. So, by the term total deposits, we mean total external and internal liabilities of an entity, which is evidently equal to the total assets of it according to the principle of basic accounting equation.

6   Data and Results

We collect monthly data of US money supply (M2) and US monetary base from January 2022 to December 2022 from Federal Reserve Economic Data [31], [32]. We then divide money stock (M2) by the monetary base (MB), which gives us the value of money multiplier during the span of one year. The money multiplier values thus calculated is shown in Fig: 7.
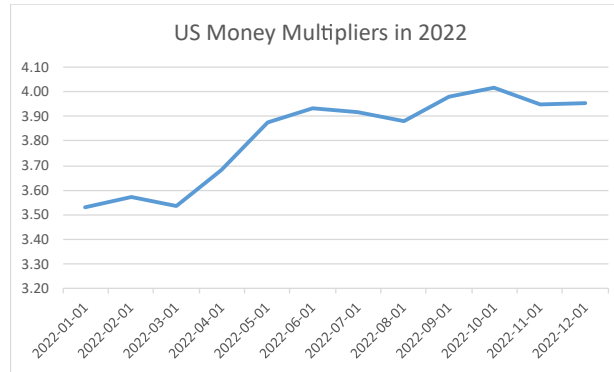

Fig 7. US M2 money multiplier during 2022

From Fig: 7, it is evident that the US M2 money multiplier swings between 3.53 to 4.01 in 2022.

Next, we collect asset composition data of top 3 fiat-backed stablecoins in the market namely, USDT, USDC and BUSD and calculate a weighted average percentage of their total asset that has been invested into US treasury bills, bonds, repurchase agreements against US treasury securities and alike. Weightage given to each of the stablecoins represents its share in the consolidated stablecoin market. Data are collected from transparency reports published in each of the stablecoin issuers website, which are accessible through [24], [25] and [26]. Then we collect data regarding asset compositions of top 10 us banks from World Street Journal website and the respective bank's annual report of 2022. The top 10 bank list according to consolidated total assets has been

collected from the latest Federal Reserve Statistical Release [27]. The top 10 US banks according to consolidated total assets during 2022 are JP Morgan Chase, Bank of America, Citibank NA, Wells Fargo, US Bankcorp, Truist Financial Corporation, PNC Financial Services, Capital One, TD Bank and BNY Mellon.

To collect data regarding US household investment pattern, we consult wealth of household report 2020 prepared and published by the US census bureau through its 2021 Survey of Income and Program Participation (SIPP) public-use data, which is the latest report of its kind [33]. The report reveals that the median value of US household's wealth is USD 140,800, while the share of different kinds of bonds including treasury securities in household's total wealth is only USD 2,600. So, out of USD 140,800 total assets, only USD 2,600 is invested in bonds of different natures, which comprises 1.85% of total assets. Hence, according to the aforesaid report, the values of W_1 and W_2 as defined in equation: 3 are 98.15% and 1.85% respectively.

After all the data have been collected and compiled, we are now in the position to measure the changes in money supply that have been brought about by the introduction of stablecoins in the market. Here we would like to measure the aforesaid changes during different months of 2022. First, we use equation: 1 to calculate ΔMS_1. In this regard, we may recall that ΔMS_1 is the probable changes in money supply that would have occurred if all the fiat money used to purchase stablecoins would have been invested in different US banks or invested into any other forms except for purchasing US treasury securities instead. The monetary change that occurs in aftermath is negative and is graphically presented in Fig: 8.
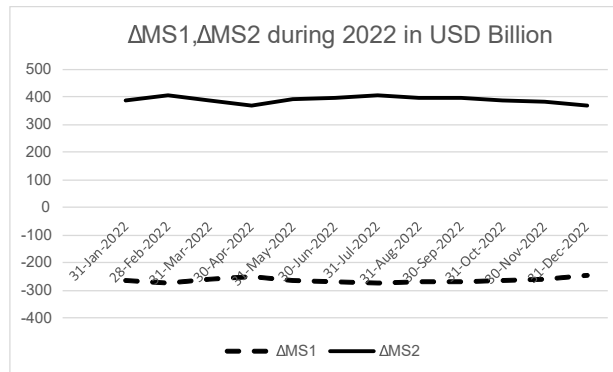

Fig 8. ΔMS_1 and ΔMS_2 during different months of 2022

Next, we use equation: 3 to calculate ΔMS_2, which captures the probable changes in US money supply that would have occurred otherwise if all the funds used to purchase stablecoins would have been solely invested into US treasury bills and bonds of different maturities. As we have discussed earlier, ΔMS_2 is positive, i.e., it represents a plausible monetary expansion. The results are presented graphically in Fig: 8.

We are now in the position to measure the overall changes in money supply as given by equation: 3. To do this, we use previously calculated values of ΔMS_1 and ΔMS_2 and arrange them in accordance with equation: 3 using appropriate weighting factors W_1 and W_2. The results are presented in Fig: 9.

As we have anticipated earlier, the changes in money supply are overly negative, i.e., the issuance of stablecoin has had a contractionary effect on US money supply. The extent of this monetary contraction during different months of 2022 ranges between USD (-) 261.25 billion in February 2022 to USD (-) 235.56 billion in December 2022. In percentage terms, the monetary contraction brought about by the issuance of stablecoins varies between (-) 1.20% in February 2022 to (-) 1.11% in December 2022 of total money supply in the respective period.
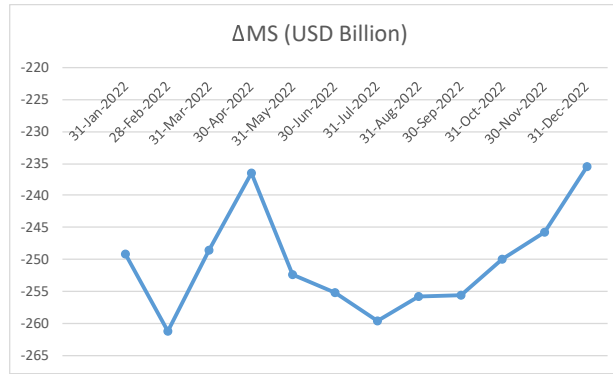
Fig 9. Consolidated changes in money supply ΔMS due to issuance of stablecoins

7 Policy implication

Stablecoins have entered the altcoin market in 2014 and since then its share in the crypto market has been growing exponentially with time. Today stablecoin market capitalization stands at nearly USD 127.48 billion [20]. There are multiple benefits for the users to quickly adapt to this nascent payment ecosystem. Firstly, the market capitalization of the stablecoins indicates that they are now widely accepted as a suitable medium of exchange like the legal tenders of any sovereign country, although they are not so. Moreover, stablecoins now appear as a counterpart in most of the traded crypto pairs in all the major crypto exchanges, which further indicates its acceptability as a medium of exchange [35]. Next, stablecoins offer a suitable mechanism for investors to park their deposits, when the crypto market is volatile. Thus it serves as a store of value in an otherwise volatile environment. Apart from serving as a safe store of value, it provides a rather seamless platform for the parties spreading across the globe to settle cross border financial transactions instantaneously at costs often lower than that of conventional payment mechanisms [34]. Moreover, from opening an account to initiating such cross border payments, everything can be done in a mobile screen through apps. Last but not the least, privacies of the parties involved in any such transactions are preserved and such transactions are not under the strict regulatory surveillance as it is the case for transactions through banking channels. Due to these multifarious benefits at the user end, i.e., a store of value, medium of exchange, instantaneous cross border financial transactions with lower cost and less surveillance lure investors around the globe to go for USD denominated stablecoins. Although, there are other stablecoins denominated in euro, Japanese yen, Chinese yuan or even in Mexican peso, USD denominated stablecoins have got global attention as revealed from the volume of all such pegged stablecoins currently in circulation.

If the USD denominated stablecoins succeed in paving their way to mass adaptation in a global scale, it is supposed to exert a significant contractionary pressure on US money supply. We have discussed in this article that USD denominated stablecoins are bringing about monetary contractions in the Untied States in the scale of 1.11% to 1.2% of total money supply. If the market continues to grow with the current pace, it is likely to exert more contractionary pressure on US money supply. Thus, the role of stablecoins to manipulate US money supply should be more meticulously monitored during the formulation of monetary policy in United States.

8   Conclusion

In this study, we have shown how the issuance of stablecoins denominated in USD may have a contractionary impact on US money supply. We also measure the aforesaid contractionary effect, which turns out to be in the range of 1.11-1.2% of total total money supply at the time of analysis. The analysis presented here suggests that the major issuers of the stablecoins tend to invest extensively in US treasuries and allied products. Investment in US treasury ssecurities takes money away from the fractional reserve banking process and this money enters into the Federal Reserve and thereby loses its power to multiply. In the absence of any such stablecoins in the market, the funds that are now invested in stablecoins would have been invested into various US banks as deposits and the alike and we have empirically shown here that US banks happen to invest lesser amount of their funds in US treasury securities as compared to the issuers of the stablecoins. Thus, in that alternative scenario, less money would enter into the Federal Reserve and the most of it would multiply according to the process of fractional reserve banking. So, money supply would have been greater than what it is now in the presence of stablecoins. Reasoning through this line, here we argue that USD denominated stablecoins are bringing about a monetary contraction in US economy and which, according to our analysis, comes up to be 1.1-1.2% of total supply of money as on 2022.

9   Acknowledgement

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