Analysis on Off-chain Collateralised Stablecoin Demand and Volatility

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July 14, 2022

Abstract

Stablecoins are a bridge between fiat currencies and cryptocurrencies. As they are on-chain (on the blockchain) assets that are reliably pegged to the value of off-chain fiat currencies, users gain relatively low-risk access to store or trade fiat and cryptocurrencies. The two most important stablecoin concepts are demand (quantity) and volatility (quality). This article firstly provides an empirical analysis of off-chain collateralised stablecoin demand with respect to the transparency of the collateral details and regulatory status; and secondly, to bring to light on how transactions between entities of the protocol relates to volatility of the protocol's stablecoin. Evidence shows that collateral transparency does not have any impact on demand. However, transaction flow types between entities in a protocol are seen to correlate with stablecoin volatility.

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1 Introduction

Stablecoins are arguably one of the most important mechanisms in the cryptocurrency world. They provide users with a way to hold assets whose values are pegged to their native currencies that they are familiar with. This in turn boosts adoption, as users have another avenue to control the risk of their cryptocurrency portfolio. From this simple introduction, we can quickly identify the most important features of a stablecoin: demand and volatility.

Demand allows new stablecoins to be minted and subsequently improves the efficiency of value transfer within the protocol. As demand grows, Metcalfe's law suggests that the value of the network grows quadratically. And as we see in the case of US Dollar as the fiat currency with the highest demand, it becomes the standard of pricing for most financial assets. Stablecoin protocols are in the race for a bigger slice of the pie as evidence in the centralised finance market hints on a 'winner takes all' scenario.

Volatility might be the most important mechanism of a stablecoin, as to reduce volatility with respect to the currency it is pegged to is the goal of the design. As the stablecoin is priced by the market, it also signifies the trust the market has on the longevity and the reliability of the protocol.

2 Scope

This analysis focuses solely on stablecoins that are allegedly 100% collateral backed. In theory, this means that there should always be enough assets to match every token in distribution, regardless of the condition of the markets. However, some stablecoins are less transparent and less reliable than others, as discussed in section 3. Other categories of stablecoin, not included in this analysis, are algorithmic stablecoins and hybrids.

The 7 stablecoins analyzed here are:

1. BUSD
2. GUSD
3. HUSD
4. TUSD
5. USDC
6. USDP
7. USDT

All the coins analyzed are centrally controlled, meaning that they can be easily regulated and some of them such as Tether even have the power to blacklist addresses or seize funds onchain at will.

3 Empirical Analysis

This section attempts to determine whether a relationship exists between the demand for a specific token and the public sentiment surrounding its collateral backing. We use a simple empirical analysis comparing the reliability and transparency of its collateral backing to its market cap.

Even though each token is 100% collateral backed, they will each have their own unique breakdown of assets being used as collateral. Ideally, a protocol's collateral will be fully backed by cash and cash equivalents. According to an article on the Paxos website [3], cash equivalents refer to short-term, highly liquid investments that are both readily convertible to known amounts of cash, and so near their maturity (3 months or less) that they present insignificant risk of changes in value due to changes in interest rates. Some protocols appear to be 100% backed by cash and cash equivalents, however we did not find any protocols that are 100% backed by actual cash, which would be least risky for investors. Additionally, many protocols include other investments as collateral that are less liquid and may be more risky for its end users than cash and cash equivalents. Stablecoin protocols have a financial incentive to minimize their actual cash backing, since cash earns no interest. Cash equivalents and other financial instruments are another way these stablecoin companies can turn a profit in addition to issuance and redemption fees.

Table 1 below shows the market cap and 24h trading volume for each token. For further empirical analysis, the market caps and trading volume are used as an indication of demand for the token. The market cap rankings are largely consistent with the trading volumes, except for BUSD which has almost the same trading volume than USDC although its market cap is significantly lower.

Protocol	busd	gusd	husd	tusd	usdc	usdp	usdt
Market cap	18b	277m	277m	1.2b	54b	924m	72b
24h Volume	7.3b	4.4m	20m	155m	8b	25m	59b

Table 1: Market cap and 24h trading volume as at Jun 13 2022 07:20 GMT

3.1 Regulation

Stablecoins appear to be one segment of the crypto industry where regulation is welcomed by end users, who need some form of protection in such a volatile and unregulated industry. In addition to regulations placed on the stablecoin issuers themselves to ensure consumer safety, there will also be regulations placed on the end-users which could include KYC (know your client) and AML (anti-money laundering) procedures for those who want to be directly issued with or redeem stablecoins. So, if a stablecoin issuer is following high degrees of compliance under some governmental or other well established financial institution, this may be seen as an indicator of trustworthiness and is likely to be positively correlated with demand.

Also, all of these stablecoin protocols produce some sort of evidence of collateral backing in order to satisfy cautious investors, who want to have some way to verify that every onchain dollar issued is fully backed by asset collateral. Most protocols have regular attestations performed, but not all of them have had audits. Audits are supposed to provide a thorough analysis of a company's financials over a period of time whereas attestations are snapshots of a company's balance sheet on a specific date.

Gemini dollar (GUSD) and Paxos, which includes USDP and BUSD, appear to be adhering to a high standard of compliance set by the New York State Department of Financial Service (NYDFS). To qualify, they are obligated to meet the same standards a bank would. This means that their reserves are supposed to be 'fully segregated from corporate assets and are held bankruptcy-remote according to the New York Banking Law', according to Cointelegraph [4]. Gemini has claimed that GUSD is the first regulated stablecoin, though Paxos also launched a NYDFS regulated stablecoin the same day [6].

USDC is not regulated by the NYSDFS but is regulated and licensed by multiple state financial services departments in the US and complies with a similar high standard to Gemini

and Paxos. An article by Dante Disparte states, "Circle and dollar digital currencies like USDC, are regulated across the U.S. on a comparable footing to major payments companies and innovations such as PayPal, Venmo, Apple Pay, among other globally trusted firms" [2].

Tether, by contrast, is not regulated by the NYDFS, nor is it regulated by any other U.S. state financial services department. When questioned on regulation, Paolo Ardoino, Tether's chief technology officer, responded that they are registered with (Financial Crimes Enforcement Network) FinCEN, however, registration with FinCEN should not be regarded as an indication of regulation [5].

True USD's website states, "We partner with unaffiliated third-party trust companies in the state of Nevada to hold the escrowed funds. The Nevada Department of Business & Industry, Financial Institutions Division regulates Nevada State Trust Companies. Therefore, TrueUSD is regulated by a state financial institutions regulator, similar to a few of our competitors. We are also registered as a federal Money Service Business with the Financial Crimes Enforcement Network ("FinCEN")." A more in-depth blog article on their website, which compares the regulatory standard of various stablecoins, states, "TrueCoin, LLC currently collaborates with independent third-party trust companies in the state of Nevada (currently Prime Trust and Alliance Trust) to hold escrowed funds. The DBI regulates Nevada-charted trust companies. Therefore, given that TrueUSD operates through Prime Trust and Alliance Trust, which are regulated by the DBI, TrueUSD is subject to regulatory scrutiny by the state trust regulator in Nevada in addition to FinCEN. Unlike the NYDFS, other state financial regulators like the DBI in Nevada have not made public statements about their regulation of trust companies and associated stablecoins" [7]. Their insinuation of being regulated seems to be tenuous, since the DBI has yet to release any public statements about regulation of stablecoins, and again, registration with FinCEN does not imply regulation.

On HUSD's website, it states that "HUSD token is backed by U.S. dollars in a 1:1 ratio, and the funds are held by a regulated trust company. All deposits and withdrawals will be handled by the trust company, Stable Universal and Stcoins do not directly handle any customer assets." The 29 October 2021 Attestation Report identifies the Trust Company that holds the dollars as the Huobi Trust Company. According to Huobi Trust's website, Huobi is licensed under The Hong Kong Trust Company and The Hong Kong Trust or Company Service Provider (TCSP) license, which means that they have to comply with the relevant regulations and Comply with the industry AML and CTF ordinances.

3.2 USDT (Tether)

Tether is perhaps the most contentious stablecoin out of these being analyzed. It was founded in July 2014, and was originally called "Realcoin". Through our research, it appears that Tether may be reluctant to be completely transparent and has so far hasn't completed its promise of releasing an official audit report, although it produces regular attestations.

Although collaterally backed by off-chain assets, USDT is not totally cash backed. It is backed by a sum of commercial paper, fiduciary deposits, cash, reserve repo notes, and treasury bills that are supposed to be equal to the number of USDT in circulation. In April 2019, tether's own lawyer admitted that USDT is only 74% cash backed [1]. Since then, they seem to have improved on this as it is now allegedly backed by 85% cash and cash equivalents, as shown in Figure 1, which can be found at `https://tether.to/en/transparency/#reports`.

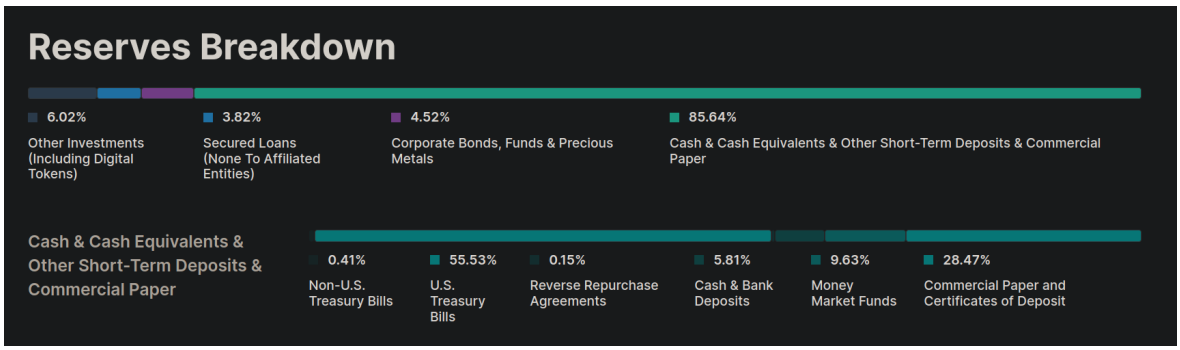

Figure 1: Tether collateral backing summary as at June 13th 2022

USDT also has a somewhat controversial past. From Wikipedia: "Tether Limited and the Tether cryptocurrency are controversial because of the company's alleged role in manipulating the price of Bitcoin, an unclear relationship with the Bitfinex exchange, and the company's failure to provide a promised audit showing adequate reserves backing the Tether token."

However, despite all this, USDT is still strongly in the lead as the most popular stable coin in terms of demand, likely due to the fact that it has already developed such a large amount of liquidity and is available on almost all exchanges. Tether was also able to handle redemptions totalling over 10 billion dollars, approximately 10% of their total assets, in just a few days during the Terra-Luna fiasco [8].

3.3 USDC

USDC was launched in 2018 by the Center Consortium, which is a partnership between Coinbase and Circle, very established institutions in the crypto industry. Most cryptocurrency users should be familiar with the Centralized exchange Coinbase, and Circle is a blockchain based institution that is backed by Goldman Sachs.

According to its regular attestations, USDC is completely backed by cash and short-dated U.S. government obligations. Figure 2 below shows the reserve breakdown for USDC. We can see that actually only 23.46% of circulating USDC is backed by actual cash, the rest is backed by short-term US treasuries. Current breakdowns for USDC reserves can be found at `https://www.circle.com/en/usdc`.

Weekly USDC reserves breakdown[1]

Balances

	JUNE 3RD,2022	JUNE 10TH, 2022
USDC in circulation	**$54.0B**	**$53.7B**
USDC reserves [2]	**$54.1B**	**$53.8B**
Cash	$12.9B	$12.6B
Short-duration U.S. Treasuries	$41.2B	$41.2B

USDC issuance and redemption, June 3rd – June 10th 2022[1]

USDC issued	$2.6B
USDC redeemed	$2.9B
Weekly change in circulation	**-$0.3B**

Figure 2: USDC reserves summary as at June 13th 2022

USDC can be traded between fiat currency at any time with a Circle Account. However, only businesses can create such an account whereby they have to follow the relevant regulatory processes. It appears that individuals cannot be issued or redeem USDC directly.

3.4 BUSD (Binance)

BUSD is closely related to USDP since the Paxos organization is the official issuer of the BUSD stablecoin and holds its reserves. BUSD was created through a partnership between Binance and Paxos in September 2019.

According to their monthly attestations, BUSD is backed by "(i) fiat cash in dedicated omnibus accounts at insured U.S. banks and/or (ii) U.S. Treasury bills (including through repurchase agreements and/or money-market funds invested in U.S. Treasury bills)".

It is currently the 3rd largest stablecoin by marketcap. The increasing popularity of BUSD may be due to the fact that it includes some perks when used on the Binance exchange such as fee reduction for trading and borrowing and lending and zero fees for issuance and redemption. This could be why its trading volume is so high compared to its marketcap. It can also be issued or redeemed instantly after creating a Binance account.
According to the Paxos website, the reserves for Paxos stablecoins, which includes BUSD and USDP, are made up of 96% cash and cash equivalents, and 4% US treasury bills as shown in Figure 3 below. This claim was made in June 2021 and we weren't able to find any more recent breakdowns of its collateral in its attestations.

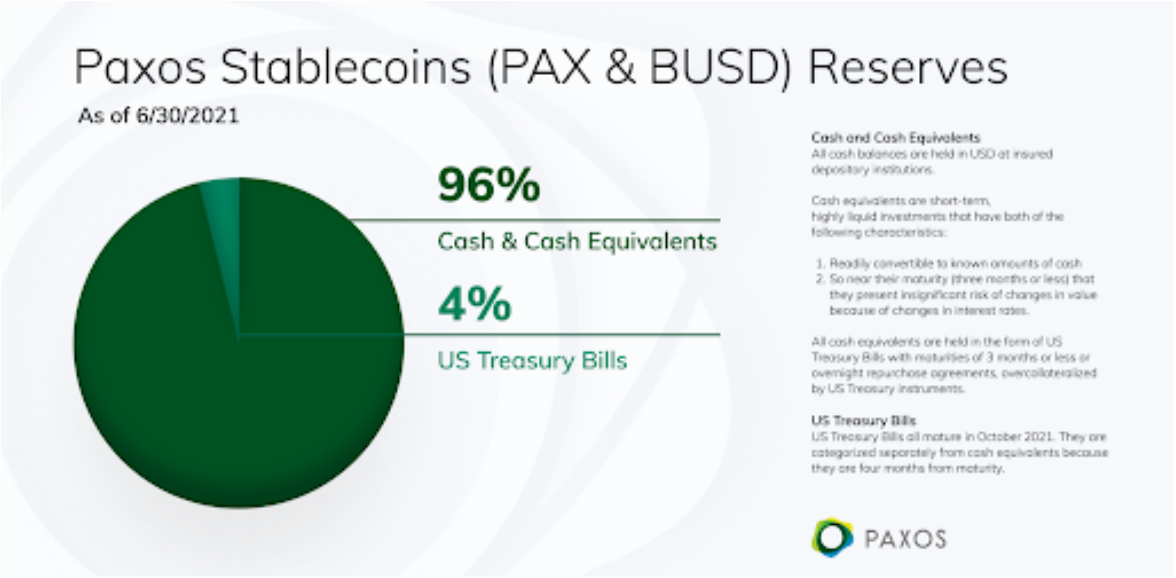

Figure 3: Paxos tokens' (USDP and BUSD) collateral backing

3.5 USDP (Paxos)

Paxos token is named after its founding company, which started out as a centralized exchange in 2012 and later starting to offer other crypto services. The Pax token ended up launching in September 2018.

Paxos has attestations performed on a regular basis that state "its supply matches the reserve account comprised of US Dollars and debt instruments that are expressly guaranteed by the full faith and credit of the United States Government, including through repurchase agreements and/or money-market funds composed of such debt instruments". It website also states that all reserves are held in cash and cash equivalents.

See Figure 3 above and related comments for a breakdown of USDP's reserves.

3.6 TUSD (True)

TUSD was originally launched on the Tron network in January 2018 by its parent company TrustToken, but it has since expanded to other blockchains. TrustToken has partnered with many institutional firms such as banks and accounting companies. This may be seen as a strong indicator of transparency since these institutions will likely require reliable 3rd party audits to confirm balances.

TrustToken doesn't only support US dollars, it also offers onchain stablecoins for alternate fiat currencies such as TGBP, TAUD, TCAD, and THKD.

TUSD appears to be transparent with real-time attestations on its website that provide constant assurity of its reserves, which can be found at `https://real-time-attest.trustexplorer.io/truecurrencies`.

3.7 HUSD (Huobi)

HUSD was created Huobi Trust Company in October 2018, which is a regulated US based company based in Nevada. Their are attestation reports that HUSD is backed by dollars. One attestation report on the 29th October 2021 stated that HUSD was overcollateralized with a backing of $492 million with only $406 million stablecoin tokens in existence.

It may be worthwhile to note that the Huobi Trust Company is owned by Huobi Global, which is a cryptocurrency exchange that originated in China and their website states that it cannot provide services to US based residents, yet their subsidiary, Huobi Trust, is US based.

3.8 GUSD (Gemini)

GUSD was created by crypto exchange Gemini in September 2018. Its website states "Each GUSD corresponds to a U.S. dollar held by Gemini in accounts at U.S. FDIC-insured bank accounts and money market funds holding short-term U.S. treasury bonds and maintained at a custodian."

Also, GUSD appears to be have attestations performed on a monthly basis.

3.9 Interpretation

From our analysis above, it seems that the type of collateral backing does not have much effect on the demand of the coin. It seems that USDT has a hold on the stablecoin market and will continue to do so for the foreseeable future, even though the protocol has lacked transparency in the past and is not as cashed backed as other stablecoins.

It also appears that no stablecoin is truly 100% backed in actual cash. We were unable to find detailed breakdowns of the collateral backing for every coin, but for the ones we did find we discovered that they all appear to have some component of short or long term debt assets as well, which can help them earn additional revenue. The percentage of cash-backing varies from token to token, with BUSD being allegedly backed by 96% cash and cash equivalents, while that same figure for USDT is around 85%.

We can also infer that collateral backing, at least for now, has little impact on the demand of a stablecoin, as our research shows that Tether is the least trustworthy and transparent out of all 7 collateral backed stablecoins analyzed, while still being the most popular stablecoin by far in terms of marketcap and trading volume. As aforementioned, this is likely due to its widespread availability and deep liquidity compared to other stablecoins.

After the high profile collapse of the algo stablecoin UST and its corresponding onchain collateral, LUNA, many stablecoins experienced deviations from their peg of $1, including USDT, which experienced 10 billion dollars of redemptions in just a few days during this period. If this wasn't just a temporary scare, perhaps public may slowly transfer funds away from Tether to safer and more transparent stablecoins. The public may be becoming more cautious of the fact that USDT is less cash backed and possibly less transparent than some other stablecoins, and that its collateral backing could theoretically fail to hold up under very extreme conditions.

Interestingly, instead of a observing a distinct relationship between the demand and collateral backing, we can see a relationship in certain tokens between the volatility and collateral backing, with Tether having the highest volatility and the least transparent collateral backing.

Beyond the scope of this research, a few algorithmic stable coins have completely lost their peg after the LUNA-UST fiasco, due to a lack of trust in their collateral backing e.g. DEI and USDN, which presents a direct relationship between demand and collateral backing, though so far the relationship is only evident for algorithmic stablecoins.

4 Volatility and Transactions Analysis

This part of the analysis aims to measure, for stablecoins allegedly backed with 100% collateral, what is the relationship between the types of transactions (CEX, P2P, DEX) within a

protocol and the price volatility of their underlying stablecoin. We have identified the entities of concern and the required dataset, which will be detailed in the two subsections below.

4.1 Transaction Data

4.1.1 Entities

All addresses are to be classified into 4 main categories, namely:

1. Centralised Exchanges (CEX)
   Wallets owned by centralised exchanges. These addresses are the gateway of transaction between exchanges and their users. As of now, the list is manually maintained, with the list sourced from Etherscan. They are addresses with tag: Exchange.

2. Decentralised Exchanges (DEX)
   Addresses where decentralised exchanges host their contracts, with the list again sourced from Etherscan. They are addresses with tag: DEX.

3. Contracts
   Contracts are automated scripts that live and run on the blockchain. To identify contracts, we check if for a given address there is any code published to the blockchain. As an example, for EVM compatible chains, calling 'getCode' through the JSON-RPC Etherscan API will identify smart contracts.

4. Normal Addresses
   All EOAs (externally owned accounts i.e non-contracts) that aren't classified as exchanges are normal addresses.

For the purpose of this analysis, we will exclude transactions between users and non-exchange owned contracts. The result of classifying the entities is shown in the table below.

Protocol	busd	gusd	husd	tusd	usdc	usdp	usdt
DEX	0.119	0.313	0.514	0.098	0.051	0.204	0.016
CEX	0.381	1.282	1.199	0.403	0.243	1.125	0.114
Users	99.500	98.405	98.288	99.499	99.706	98.671	99.871

Table 2: Proportion of each entities excluding contracts by protocol, in percentages

4.1.2 Transaction dataset

Python is chosen as the programming language of choice to run the analysis. For each stablecoin protocol, the data required contains information such as the transaction hash, sending address, receiving address, block, and transacted amount.

We collect roughly one month worth of USDT and USDC transactions, one year worth of USDP transactions, and 1.5 year worth of BUSD, GUSD, HUSD, and TUSD transactions. The choice of time periods was motivated purely by technical feasibility, as an analysis of the entire history of high velocity coins such as USDT and USDC would be too much for traditional retail computers.

4.1.3 Trimming

Table 3 below indicates the total number of wallets and transactions for each protocol in the data.

Protocol	busd	gusd	husd	tusd	usdc	usdp	usdt
Num wallets	203,933	63,165	19,674	223,632	604,990	124,962	1,492,848
Num txns	736,779	369,411	198,633	1,155,345	1,673,004	306,089	4,232,357

Table 3: Total number of wallets and transactions

Some protocols have around about 3 transactions per wallet, on average. Wallets with very low total transaction counts are considered out of scope in this analysis - we assume these wallets will have little to no impact on the volatility of the asset. We set minimum total transaction count as 6 for a wallet to be considered in our analysis.

After trimming by way of transaction count, we the total number of addresses to analyze by protocol provided in Table 4 below.

Protocol	busd	gusd	husd	tusd	usdc	usdp	usdt
Number wallets	8788	6410	1240	22207	21715	4207	66718

Table 4: Number of addresses analyzed

4.1.4 Transaction classification

Transactions were classed into 5 separate categories:

1. P2P - Person to person
2. P2C - Person to centralized exchange (CEX)
3. C2P - CEX to person
4. P2D - Person to Decentralized exchange (DEX)
   From-stablecoin swaps, providing liquidity
5. D2P - DEX to person
   To-stablecoin swaps, removing liquidity

Table 5 below shows the percentages of transaction types of each category for each protocol.

Protocol	busd	gusd	husd	tusd	usdc	usdp	usdt
P2P	48.62	56.32	41.02	57.12	76.51	64.83	58.50
P2C	21.03	22.39	26.06	15.50	6.53	14.71	12.11
C2P	29.91	19.26	32.65	24.90	13.53	19.11	26.08
P2D	0.44	0.97	0.10	2.00	3.34	1.35	1.67
D2P	0.00	1.06	0.17	0.48	0.09	0.00	1.64
No. Transactions	351,990	196,082	161,855	656,765	510,511	99,812	1,300,027

Table 5: Percentages of each transaction class

One immediately striking result is how much of USDC's transactions are classified as P2P. It also has a very high proportion of P2D transactions and a much lower proportion of interactions with CEXes, both to and from, than other protocols.

Tether has the highest proportion of D2P interactions.

4.2 Price Data

To calculate volatility of the stablecoins, first we collect hourly price data. The collection process is detailed in Appendix A. From this price data, we can then easily deduce the returns of the asset by time.

Volatility There are various ways to quantify volatility of an asset, with the most popular one being the standard deviation, often calculated on a rolling basis. In the relatively unstable world of cryptocurrencies, calculations using a quadratically-growing metric such as the standard deviation might overestimate perceived risk. In this analysis, we use mean absolute deviation (MAD) as a volatility measure as it grows linearly and therefore reduces the presence of extreme tail values of our dependent variable in regression.

We must choose the width of the window that will be used to calculate the rolling values of the metric. From a micro perspective, large price movements in cryptocurrencies typically start and end in time periods that span a few hours to a few days. Sacrificing a little sensitivity of our volatility measure, a larger window of 72 hours is chosen to improve the 'signal-to-noise ratio'. Hence, the volatility is measured as the MAD of the asset returns over rolling windows of 72 hours.

4.3 Methodology

4.3.1 Panel data regression

Panel data regression methods allow us to control for dependencies of variables not included in the model. There may be differences between the various groups in the data, in our case the different protocols, that are associated with the observed variables of interest; known as unobserved heterogeneity. Using a traditional linear regression on the pooled panel data can lead to biased and inconsistent estimators since it will lead to the group-specific characteristics being subsumed in the error term, which causes endogeneity since the error term is correlated with one or more independent variables. Luckily, there are specific panel data regression techniques that acknowledge heterogeneity and treat it as fixed or random.

Panel data regression is specified by the following formula:

$$y_{it} = X_{it}\beta + \alpha_i + \mu_{it} \quad \text{for t = 1,...,T and i = 1,...,N}$$

Where:
y = dependent variable
X = independent variable(s)
β = coefficients
α = unobserved group specific error term (heterogeneity effect)
μ = Idiosyncratic error term
t = time period
i = group (or protocol in this case)

The three candidate models, which utilize variations of this formula, are pooled OLS, fixed effects model, and random effects model.

4.3.2 Multicollinearity

As the proportion of the transactions sum to a constant which is 1, uncentered regression will introduce multicollinearity, which will adversely affect the interpretation of our results. Therefore, we take out the variable **P2P transaction proportion** from the regression due to its relatively high variance, therefore effectively reducing the chance of multicollinearity happening.

4.4 Model Selection

The pooled OLS is not appropriate for our analysis. Empirically, we say this since we previously saw in Table 5 that the protocols have different distributions of the independent variable. To statistically validate it, we can check whether our data satisfies the assumptions of linear regression. The first assumption to check is homoskedasticity i.e. constant variance of the residuals. The plot for predicted values against the residuals is shown in Figure 4 below:

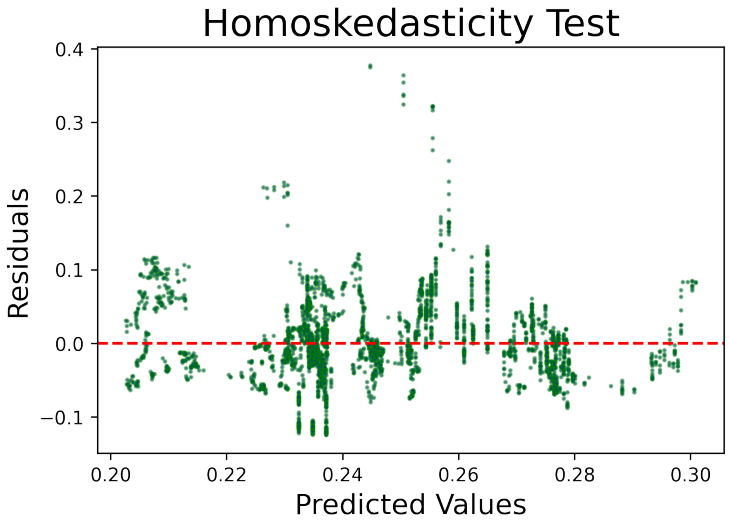

Figure 4: Predicted values against residuals for linear regression

The variance doesn't appear to be constant, but we can test this more formally with the Breusch-Pagan test, where the null hypothesis is that homoskedasticity is present. The statistic of the test is 7530.37, which under $F(4, 67195)$ distribution gives a p-value of practically zero. Thus we can reject the null hypothesis that the residuals display constant variance and now have the first violation of the linear regression assumptions.

We can also test the assumption of no autocorrelation using Durbin-Watson test. This test returns a number between $0 - 4$. Values closer to zero indicate strong positive autocorrelation, and values closer to 4 indicate strong negative autocorrelation, with values close to 2 indicating little autocorrelation. For our data, the result is 0.0020, which clearly indicates strong positive autocorrelation since it is close to zero.

Thus, we have 2 assumptions of linear regression being violated, so we can assume that an FE/RE model will be more appropriate, and will proceed with those. We use the Hausman specification test to formally decide which model is most appropriate between the fixed effects and random effects. The vale of the test-statistic is 0.0886, which gives us a p-value of 0.9990. Therefore, random effects model is preferred.

4.5 Results

The results of the random effects model are tabulated below:

	Parameter	S.E.	T-stat	p-val	Lower CI	Upper CI
C2P	-0.0030	0.0041	-0.7324	0.4639	-0.0109	0.0050
P2C	0.0049	0.0024	2.0765	0.0378	0.0003	0.0096
D2P	0.0322	0.0161	2.0036	0.0451	0.0007	0.0638
P2D	-0.0072	0.0030	-2.4033	0.0163	-0.0132	-0.0013

Table 6: Random effects model results

We see that the p-values for the P2C, D2P, and P2D coefficients are below 0.05, suggesting a significant effect on stablecoin volatility.

We can further deduce that an increase in transaction proportion going from users into CEXs (P2C) signals an increase in volatility. This may suggest that during periods of high volatility and therefore high trading activity, traders prefer to exchange their stablecoins through CEXs for cost efficiency and to avoid price impact and high transaction fees. This points to the yet restrictive gas fees of the Ethereum network. The long-awaited Ethereum upgrade, which involves merging with Beacon chain, should largely mitigate this issue and possibly reduce overall activity within CEXs. Another possible reason for transfer to CEX is conversion from token to fiat, as some exchanges support this activity.

Decentralized exchanges are interesting because an increase in the proportion of transactions of both P2D and D2P signals an increase in volatility. This makes intuitive sense because in periods of high volatility, stablecoins make their way out of the DEX contracts/pools through swaps where volatile assets enter DEX pools or where liquidity providers withdraw their liquidity to avoid incurring impermanent loss.

Since volatility is measured bidirectionally, the negative correlation between volatility and the amount of stablecoins in DEX pools imply that volatile periods more often relate to depreciation of volatile assets.

The lower p-value for P2D transactions which signals decreasing volatility, compared to the higher p-value for D2P transactions which signals increasing volatility, implies a possibility of different correlation strength between stablecoins entering contracts and decreased volatility in comparison to the other direction. This alludes to asymmetric sensitivity to volatility present in stablecoin flow to and from DEX contracts.

4.6 Conclusion

While transactions out of a centralised exchange into user wallets does not imply growing/tapering volatility in the market - perhaps due to the ease and lower cost of transactions that CEXs bring relative to DEXs, we see evidence of strong correlation between into-CEX, into-DEX, out-of-DEX transactions and volatility. The direction of effects in transactions in and out of DEXs allude to the conventional wisdom that value being locked in contracts is a determinant of trust, which in turn allows the market to price the stablecoin at its fair and intended value - pegged to the underlying fiat.

4.7 Future Research

As mentioned in 4.5, there is evidence of "asymmetric sensitivity to volatility present in stablecoin flow to and from DEX contracts". Validity of this statement may be explored in future research as it is beyond the scope of this article. Time-series analysis and identification of a suitable sensitivity metric could be sufficient in quantifying this effect.
Also, more complex methods may be used to determine the volatility at a point in time e.g. time series ARCH or GARCH models, instead of rolling standard deviation.

Appendices

A Token price history data

The API query to get the price data for each token is reproducible, i.e. should give same results every time, and is as follows:
https://api.coingecko.com/api/v3/coins/{token_id}/market_chart/range?
vs_currency=usd&from={startUnix}&to={endUnix}

Where:
token_id = Unique id of the token, can be found in Coingecko
startUnix = UNIX start time of the query filter
endUnix = UNIX end time of the query filter

For each of the stablecoins, the transactions are extracted from blocks:

- USDT and USDC: 13450000 (Oct-19-2021 07:13:17 PM +UTC) to 13650000 (Nov-20-2021 05:18:41 AM +UTC)
- USDP: 1129000 (Nov-19-2020 06:04:59 PM +UTC) to 13650000 (Nov-20-2021 05:18:41 AM +UTC)
- BUSD, GUSD, HUSD, and TUSD: 12150245 (Apr-1-2020 00:00:05 AM +UTC) to 13650000 (Nov-20-2021 05:18:41 AM +UTC)

References

[1] Nikhilesh De. *Tether lawyer admits Stablecoin now 74% backed by cash and equivalents.* 2019. URL: https://www.coindesk.com/markets/2019/04/30/tether-lawyer-admits-stablecoin-now-74-backed-by-cash-and-equivalents/.

[2] Dante Disparte. *10 stablecoin myths busted.* URL: https://www.circle.com/en/10-stablecoin-myths-busted.

[3] Walter Hessert. *The digital dollar that always equals a dollar - paxos standard (PAX) is now pax dollar (USDP).* 2021. URL: https://paxos.com/2021/08/24/the-digital-dollar-that-always-equals-a-dollar-paxos-standard-pax-is-now-pax-dollar-usdp/.

[4] Sarah Jansen. *BUSD: A case study for stablecoin compliance and security.* 2021. URL: https://cointelegraph.com/news/busd-a-case-study-for-stablecoin-compliance-and-security.

[5] JP Koning. *What tether means when it says it's 'regulated'.* 2021. URL: https://www.coindesk.com/policy/2021/01/26/what-tether-means-when-it-says-its-regulated/.

[6] Paxos. *Paxos ® Launches new stablecoin, Paxos Standard™.* 2018. URL: https://www.prnewswire.com/news-releases/paxos--launches-new-stablecoin-paxos-standard-300709434.html.

[7] TrustToken. *On the regulation of Stablecoin Trust Companies.* 2018. URL: https://blog.trusttoken.com/stablecoinregulation-4d8bcd829206.

[8] *Understand Tether's Peg And Reserves.* URL: https://tether.to/en/understanding-tethers-peg-and-reserves/.