A New Money Landscape

Elliot Paschal

September 2024

Abstract

Stablecoins and other privately issued currencies are gaining prominence throughout economies due to their ability to operate across borders, especially in regions where traditional currencies falter. This study explores the issuance of stablecoins by private agents in relation to other fiat currencies, all aiming to be money that is universally accepted with no questions asked (NQA). When these currencies are normalized with the United States dollar (USD), they show that fiat currencies with high levels of volatility often have larger distances to NQA than some stablecoins, suggesting that these currencies may not be as reliable in inflation-prone economies.

1 Introduction

Monies issued by private agents have become integrated into economies, particularly in emerging markets. These private monies impact welfare, monetary policy, and global financial cycles (Murakami and Viswanath-Natraj 2023). Both stablecoins and cryptocurrencies have been positioned to influence emerging market economies, though they present unique and sometimes heightened risks. The resurgence of private money, last seen during the Free Banking Era, is largely driven by advancements in digital technology (Yahya and Fong 2022). As private money becomes more sound and trustworthy, it is essential to examine its relationship with fiat currencies. This study uses new models to determine whether private money can circulate at par with No Questions Asked (NQA) (Gorton, C. P. Ross, and S. Ross 2023).

This study contributes to understanding monetary pluralism within global financial systems. It addresses a gap in the existing literature by providing a theoretical foundation for examining the relationship between private money and fiat currency. Initially, this research is a replication of Making Money by Gordon et al. but applies the model across different currency types. Adjusting the model in this way lends new insights into how these currencies interact with each other.

2 Literature

Holmström (2015) introduces the concept of no questions asked (NQA) money, emphasizing the role of debt instruments in financial markets. He explains that debt achieves liquidity by minimizing the need for price discovery, allowing it to function as NQA money. Debt can circulate in markets without requiring detailed investigation or information acquisition, which prevents adverse selection. Holmström highlights that opacity is a key characteristic of debt markets because it avoids costly due diligence, enabling these instruments to trade without buyers needing to assess their quality. As a result, debt instruments, particularly in money markets, maintain liquidity even during financial stress. Holmström demonstrates that debt as NQA money plays a critical role in ensuring market stability during downturns (Holmstrom 2015).

Gorton et al. (2023) extend this NQA framework to examine privately-issued stablecoins, a digital form of money within the decentralized finance (DeFi) system. They suggest that stablecoins function similarly to non-interest-bearing perpetual debt, with the added feature of being pegged to fiat currencies like the USD. Gorton et al. develop a model to calculate distance to NQA for stablecoins, defined as the difference between the stablecoin's market price and its redemption value at par. This distance represents market trust in the stablecoin's ability to maintain its peg. As this distance grows, the stablecoin moves further from NQA status. The framework provides insight into how liquidity risks and market confidence affect stablecoins' effectiveness as NQA money, especially in volatile environments (Gorton, C. P. Ross, and S. Ross 2023).

3 Theoretical Framework

The distance from no questions asked (NQA) can be interpreted as the relative difference between the price of a stablecoin on an exchange and its price set by the issuer. To calculate the distance of stablecoins to NQA status, denoted as $\hat{d}$, I follow the method outlined by Gorton et al. by comparing price discrepancies between two locations: the exchange and the issuer. Consider the scenario where a stablecoin trades on an exchange at price $P_{Ex}(d, \sigma)$, while it can be bought or redeemed directly from the issuer at a fixed price $P_I(d, \sigma) = 1$. If $P_{Ex}(d, \sigma) \neq 1$, arbitrage opportunities arise. Specifically, if $P_{Ex}(d, \sigma) > 1$, arbitrageurs can buy the stablecoin from the issuer for \$1 and sell it on the exchange for a profit. Conversely, if $P_{Ex}(d, \sigma) < 1$, they can buy the stablecoin at a discount on the exchange and redeem it for \$1 from the issuer.

To formalize the arbitrage payoff, let $\hat{P}(d, \sigma)$ represent the price required to secure a \$1 payoff:

$$\hat{P}(d, \sigma) = \begin{cases} \frac{1}{P_{Ex}(d,\sigma)} & \text{if } P_{Ex}(d, \sigma) > 1 \\ P_{Ex}(d, \sigma) & \text{if } P_{Ex}(d, \sigma) < 1 \end{cases} \tag{1}$$

The distance, $\hat{d}$, is then calculated using a modified Black-Scholes model (Black and Scholes 1973), where the stablecoin is treated as non-interest-bearing perpetual debt with an embedded put option allowing redemption at par from the issuer. We derive $\hat{d}$ using the following equation, as adapted from Gorton et al. (Gorton, C. P. Ross, and S. Ross 2023):

$$P_t(d) = \frac{V_t(d)\left[1 - N(h_D + \sigma)\right] + (1 + r_f)^{-1} D_t^R(d) N(h_D)}{D_t^R(d)} \tag{2}$$

where

$$h_D = \frac{\ln\left(\frac{V_t(d)}{D_t(d)}\right) + \ln(1 + r_f)}{\sigma} - \frac{\sigma}{2} \tag{3}$$

For this model, I set $V_t(d) = 100$, representing the uncertainty regarding the issuer's collateral. Additionally, I assume $D_t(d) = 1$, meaning that the stablecoin can be redeemed at \$1. To standardize with the USD, the risk-free rate r_f is represented by the 3-month U.S. Treasury Bill rate during the same period. The Treasury Bill rate serves as a benchmark for risk-free returns in financial markets, representing the opportunity cost of holding stablecoins or fiat currencies versus holding USD. By incorporating r_f into the modified Black-Scholes equation, we provide a clearer framework for evaluating the financial efficiency of holding stablecoins or fiat currencies, particularly in environments characterized by elevated risk and instability. The price, $P_t(d)$, for each currency is normalized to USD, denoting the value relative to \$1. Volatility, σ, represents the standard deviation of the return on the issuer's value and is calculated using a 30-day rolling period.

3.1 Proposition 1

Following the model from Gorton et al. If $DR(d)V'(d) - DR'(d)V(d) < 0$, then the convenience yield is decreasing with respect to $\hat{d}$, i.e., $\frac{\partial CY}{\partial d} < 0$. The proof is provided in Appendix A.1.

3.2 Analysis

While Gorton et al. focus on the theoretical modeling of stablecoin risk, this study expands on their framework by incorporating real-world market data from multiple stablecoins and fiat currencies. We use the modified Black-Scholes model to standardize currencies to the USD and analyze the convenience yield of these assets, taking into account their deviation from NQA status. The novelty of our approach lies in applying these insights to both stablecoins and fiat currencies, allowing for a comparative analysis of their performance in high-risk environments.

This model includes several assumptions that are important for this specific analysis. For instance, the model assumes that stablecoins are redeemable at par by the issuer, which is often not the case in practice. When redemption is permitted, it typically involves transaction costs and may be subject to additional conditions. These factors create friction, which the distance to NQA metric is intended to measure. Additionally, the model applies to fiat currencies in a similar way, despite the fact that real-world scenarios (e.g., redeeming the Naira for USD at the Central Bank of Nigeria) may differ significantly. However, retaining the ability to redeem within the model allows us to examine the hypothetical trade-offs between fiat currencies and stablecoins in a standardized way, as measured against the USD.

Table 1: Summary statistics for currencies distance from NQA

	Coin	**Mean**	**Median**	**SD**
(1)	USDT	2.39	2.39	0.00
(2)	USDP	2.39	2.39	0.00
(3)	USDC	2.39	2.39	0.00
(4)	TUSD	2.39	2.39	0.00
(5)	GUSD	2.39	2.39	0.00
(6)	FRAX	2.39	2.39	0.00
(7)	DAI	2.39	2.39	0.00
(8)	BUSD	2.38	2.39	0.00
(9)	XRP	2.62	2.62	0.05
(10)	NGN (Naira)	8.37	8.33	0.17
(11)	TRY (Lira)	8.35	8.35	0.13

Table 1 presents the summary statistics for the distance to NQA across various stablecoins and fiat currencies. For the stablecoins (USDT, USDP, USDC, TUSD, GUSD, FRAX, DAI, and BUSD), the mean and median distances from NQA are consistently low, all clustering around 2.39, with virtually no variation. This indicates that stablecoins maintain a relatively stable relationship with NQA, reflecting their ability to hold their peg to the USD consistently across the market. However, XRP, which is another form of cryptocurrency rather than a stablecoin, shows a slightly higher distance from NQA at 2.62, with a small standard deviation, indicating a minor deviation in trust relative to stablecoins.

In contrast, the fiat currencies—Naira (NGN) and Lira (TRY)—show significantly larger distances from NQA, with mean values of 8.37 and 8.35, respectively. These distances suggest that fiat currencies, particularly those from inflation-prone economies like Nigeria and Turkey, exhibit much greater volatility and risk in maintaining their perceived value. The larger standard deviations for these currencies indicate that the trust in their value fluctuates more compared to stablecoins, making them more susceptible to shifts in market confidence. These results highlight the relative stability of stablecoins in maintaining

NQA status compared to fiat currencies in more volatile economies.

4 Convenience Yield

In this study, we focus on the convenience yield as a measure of the premium or discount associated with holding a currency, whether a stablecoin or a fiat currency, instead of investing in a risk-free asset like the U.S. Treasury bond. Unlike previous studies, such as Gorton, C. P. Ross, and S. Ross 2023, which use Bitcoin lending rates as a risk-free benchmark, we normalize currencies to the USD and calculate the convenience yield using the 10-year Treasury Bill rate. This approach captures the long-term financial stability of the assets in question.

In general, the convenience yield refers to the nonpecuniary benefit derived from holding an asset. For currencies, the convenience yield reflects the liquidity, transactional ease, and stability of a currency compared to holding a risk-free asset. In the context of stablecoins and fiat currencies, the convenience yield highlights the relative convenience of holding these assets compared to the USD, particularly in volatile and inflation-prone economies.

For fiat currencies like the Naira (NGN) and Lira (TRY), which do not directly offer a yield, we use their respective 10-year government bonds as proxies for the currency yield. This is because these bonds represent the best available risk-adjusted return within their economies, given the absence of direct yield-bearing alternatives. However, it is important to note that the actual convenience yield of holding the currencies themselves may be even lower, as the risks associated with currency depreciation, liquidity issues, and inflation are likely greater than those captured by bond yields. This may lead to a downward bias in the convenience yield calculation.

Likewise, some stablecoins, though not all, offer a yield to holders. Instead of sorting stablecoins based on whether they directly offer a yield, we use the yield from staking stablecoins in lending pools on a decentralized exchange. Staking involves depositing the stablecoin into a lending pool, where it can be lent out to others, generating a return for the holder. We use **Exchange X** to calculate this yield for USDT, USDC, DAI, and FRAX.

Although this method may result in higher yield volatility, as decentralized exchanges can experience significant fluctuations in lending rates, it provides a consistent baseline for comparison across stablecoins. It's worth noting that the data quality may not be optimal due to the wide spread of yields across pools, but it is the best data available given the constraints of this research. With better data sources or more stable lending environments, it's likely that the results could be further refined, yielding more accurate comparisons between stablecoins and fiat currencies.

The convenience yield is calculated as the difference between the yield on the risk-free asset and the yield on the currency:

$$\text{Convenience Yield}_{it} = \text{Benchmark Yield}_t - \text{Currency Yield}_{it} \tag{4}$$

Where:

- Benchmark Yield_t is the yield on the 10-year U.S. Treasury Bill, reflecting long-term market expectations for stable, low-risk assets.

- Currency Yield_{it} is the yield on the stablecoin or fiat currency, where for fiat currencies like NGN and TRY, the 10-year government bond yield serves as a proxy.

A positive convenience yield implies that holding the asset is more attractive than holding the risk-free benchmark, indicating a premium for liquidity or stability. Conversely, a negative convenience yield reflects higher risks or inefficiencies associated with the asset, particularly when inflation or volatility makes holding the currency less desirable than a risk-free asset.

Table 2 presents summary statistics for the convenience yields of both stablecoins and fiat currencies. The convenience yields for fiat currencies such as the Naira and Lira are significantly negative, indicating that these currencies offer much lower risk-adjusted returns compared to U.S. Treasuries. The use of their respective government bonds as proxies for currency yield likely results in a conservative estimate of their convenience yield, as the true risks of holding these currencies, particularly in volatile markets, are even greater. This suggests that the actual convenience yield could be even more negative than the figures reported here. In contrast, stablecoins such as USDT, USDC, and DAI exhibit less negative convenience yields. While still negative, these yields suggest that stablecoins provide relatively more stability and liquidity compared to volatile fiat currencies, though they do not match the safety and stability of U.S. Treasuries.

Table 2: Summary statistics for convenience yield

	Coin	**Mean**	**Median**	**SD**
(1)	USDT	-2.02	-1.29	2.76
(2)	USDC	-2.41	-2.28	2.44
(3)	DAI	-2.22	-1.51	2.83
(4)	FRAX	-3.05	-1.78	5.03
(5)	NGN	-12.96	-13.38	2.39
(6)	LIRA	-21.22	-21.24	1.01

The results indicate that while stablecoins still exhibit negative convenience yields, they are not as inconvenient compared to volatile fiat currencies like the Naira and Lira. This suggests that stablecoins offer relatively greater stability, making them more efficient as mediums of exchange in high-risk environments, despite market volatility and fluctuations in decentralized exchange lending rates. In contrast, the larger negative convenience yields for the Naira and Lira reflect the significant risks and inefficiencies associated with holding these currencies, such as inflation, currency depreciation, and liquidity concerns. These findings highlight the relative attractiveness of stablecoins in comparison to volatile fiat currencies, though neither matches the safety and stability of U.S. Treasuries.

5 NQA and Convenience Yield

In this section, we examine the relationship between distance to No Questions Asked (NQA) and the convenience yield for both stablecoins and fiat currencies. We estimate this relationship by regressing the convenience yield of each currency on its distance to NQA. The results from this regression are presented in Table 3.

Table 3 shows that the coefficients for stabelcoins are positive, meaning that as the distance to NQA increases, the convenience yield becomes less negative (or improves).

Table 3: Distance to NQA and Convenience Yield

	Coin	**Distance**	$\mathbf{R^2}$	**N**
(1)	USDT	971.39*	0.03	277
(2)	USDC	1033***	0.07	277
(3)	DAI	959.94**	0.05	277
(4)	FRAX	34.07	0.00	277
(5)	NGN (Naira)	3.29***	0.06	277
(6)	TRY (Lira)	-0.98*	0.01	277

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

The relatively large coefficients for stalecoins may also be partially attributed to the small sample size and limited deviation from the peg during the sample period. Stablecoins can maintain a strong peg to their underlying assets, and deviations from this peg are often small and infrequent. This limited variability may have inflated the coefficients, making the relationship between distance to NQA and convenience yield appear more pronounced than it might be with a larger and more diverse dataset. Essentially, since the deviations were minor, the impact of small changes in distance to NQA resulted in large changes in convenience yield in the regression model which is, in fact, opposite of what we would expect.

For fiat currencies such as the Naira (NGN) and Lira (TRY), the results show divergent relationships between distance to NQA and convenience yield. The Naira (NGN) exhibits a positive coefficient, suggesting that as the distance to NQA increases, the convenience yield improves. This outcome is somewhat unexpected and may be influenced by data quality issues or random fluctuations in the dataset. Given the small sample size, it is possible that the yield on the U.S. T-Bill coincidentally increased alongside the Naira's distance from NQA, leading to this relationship. With a more robust dataset, we would expect a clearer and more consistent relationship.

In contrast, the Lira (TRY) displays a negative coefficient, indicating that as distance to NQA increases, the convenience yield becomes more negative. This suggests that the yield on Turkish government bonds rises as the currency moves further from NQA, likely reflecting the market's response to Turkey's macroeconomic instability. Concerns about currency depreciation and high inflation likely drive up yields, which in turn makes the convenience yield more negative. This result aligns more closely with expectations, as the increasing distance from NQA would typically be associated with higher perceived risks and, consequently, higher yields to compensate for those risks.

6 Data

The price data on stablecoins was collected from August 8, 2023, to September 8, 2024, using CoinGecko, a widely recognized cryptocurrency data provider. Although the data was assumed to be averaged across exchanges, this was not explicitly provided by the source. Volatility was calculated using a 30-day rolling window, which limited our ability to calculate distance from NQA for the entire year. Consequently, the distance from NQA was calculated for the period from November 11, 2023, to August 7, 2024. Only the top stablecoins were selected for analysis, with those having lower market caps (calculated as total supply multiplied by the current trading price) excluded. A small number of days for certain stablecoins lacked complete data, and to ensure consistency, linear interpolation was applied in these instances, as the price deviations were not significant.

Data on stablecoin yields was obtained for the same period from DefiLlama, a well-known decentralized finance data hub. Unfortunately, due to constraints, this exchange only provided yield data for a subset of the selected stablecoins. The exchange was smaller, and free alternatives were not available at the time of collection. This led to greater variation in yields, likely caused by liquidity issues within the lending pools. To mitigate extreme fluctuations, data points that deviated by more than three standard deviations from the mean were removed, after which linear interpolation was again applied to smooth the data. This allowed us to preserve the integrity of the overall yield trend while filtering out anomalous signals.

For fiat currencies, such as the Naira and Lira, bond yields were sourced from Trading Economics, a global economic data provider. Missing data was handled through linear interpolation to ensure continuity, and all conversions to USD were carried out using World Bank LCU (Local Currency Unit) data.

6.1 Data Limitations

While every effort was made to ensure the robustness of the dataset, there are a few limitations that should be noted. The use of linear interpolation to fill missing data points and the removal of extreme yield fluctuations may have introduced some smoothing into the dataset that could affect the precision of the results. Additionally, the small sample size of stablecoin yield data, due to the limited availability of free yield sources, may have caused liquidity-induced shocks to influence the results disproportionately. These practices are acknowledged as less ideal for research; however, given the constraints of this study and the exploratory nature of the analysis, they were necessary to maintain the continuity and usability of the data.

7 Conclusion

This study demonstrates that many stablecoins maintain smaller distances to No Questions Asked (NQA) status and exhibit less negative convenience yields compared to volatile fiat currencies like the Naira (NGN) and Lira (TRY). Stablecoins, such as USDT and USDC, generally offer greater stability, maintaining their peg to the USD with minimal deviations. In contrast, fiat currencies from inflation-prone economies experience larger fluctuations in both NQA distance and convenience yield, indicating higher risks, such as currency depreciation and inflation.

The analysis shows that while stablecoins provide more reliable stores of value in high-risk environments, they still carry negative convenience yields, reflecting their inherent risks when compared to U.S. Treasuries. Nonetheless, stablecoins are emerging as important alternatives to fiat currencies, particularly in emerging markets where economic volatility is prevalent. The ability of stablecoins to mitigate some risks in these regions suggests their growing relevance in modern monetary systems.

These findings have implications for economic policy, particularly in countries facing currency instability. Stablecoins could offer a viable solution to issues of liquidity and inflation, potentially playing a larger role in monetary policy frameworks. Policymakers must carefully consider the regulatory environment surrounding private digital currencies to balance the benefits of increased liquidity and financial inclusion with the need to mitigate risks, such as volatility and market confidence.

References

Black, Fischer and Myron Scholes (1973). "The Pricing of Options and Corporate Liabilities". In: *The Journal of Political Economy*. URL: https://www.cs.princeton.edu/courses/archive/fall09/cos323/papers/black_scholes73.pdf.

Gorton, Gary B., Chase P. Ross, and Sharon Ross (2023). "Making Money". In: *NBER*. Available at SSRN: https://ssrn.com/abstract=4021072 or http://dx.doi.org/10.2139/ssrn.4021072.

Holmstrom, Bengt (2015). "Understanding the Role of Debt in the Financial System". In: *Bank for International Settlements* 479. PDF full text available at: https://www.bis.org/publ/work479.htm. URL: https://www.bis.org/publ/work479.htm.

Murakami, David and Ganesh Viswanath-Natraj (2023). "Cryptocurrencies in Emerging Markets: A Stablecoin Solution?" In: *SSRN*. First version: October 24, 2021 (posted SSRN). This version: March 21, 2023 (posted SSRN). URL: https://ssrn.com/abstract=3949012.

OpenAI (2024). *ChatGPT: Language Model for Paper Editing Assistance*. Accessed via OpenAI's ChatGPT platform. Assisted in editing and refining the content of the paper. URL: https://openai.com/chatgpt.

Yahya, Moin A. and Ian Fong (2022). "In Defense of the Free-Banking Stablecoins". In: *Journal of Technology Law & Policy* 26. Available at SSRN: https://ssrn.com/abstract=4056359. URL: https://ssrn.com/abstract=4056359.

I acknowledge the use of OpenAI's ChatGPT for assistance in editing and refining this paper (OpenAI 2024).

A Proof of Proposition 1

Proposition 1. From Gorton et al. 2023. $\frac{\partial(\text{CY})}{\partial d} < 0$

First, expand the convenience yield equation:

$$\text{Convenience Yield}_t = R_t^f - R_t^d = R_t^f - \frac{1}{P_t(d)}$$

$$= R_t^f - \frac{D_t^R(d)}{V_t(d)\left[1 - N(h_D + \sigma)\right] + (1 + r_f)^{-1} D_t^R(d) N(h_D)}$$

We want to show that:

$$\frac{\partial(\text{CY})}{\partial d} = \frac{\partial}{\partial d}\left(\frac{-D_t^R(d)}{V_t(d)[1 - N(h_D + \sigma)] + (1 + r_f)^{-1} D_r^R(d) N(h_D)}\right) < 0$$

For simplicity, let $D_t^R(d) = D(d)$ and $V_t(d) = V(d)$. Using the quotient rule:

$$\frac{\partial(\text{CY})}{\partial d} = \frac{\left(\frac{D'(d)N(h_D)}{1+r_f} + \frac{D(d)h_D' N'(h_D)}{1+r_f} - V(d)h_D' N'(h_D + \sigma) + V'(d)[1 - N(h_D + \sigma)]\right)}{\left(\frac{D(d)N(h_D)}{1+r_f} + V(d)[1 - N(h_D + \sigma)]\right)^2}$$
$$- \frac{D'(d)}{\left(\frac{D(d)N(h_D)}{1+r_f} + V(d)[1 - N(h_D + \sigma)]\right)^2}$$

Simplifying further:

$$= D'(d)\left(\frac{D'(d)N(h_D)}{1+r_f} + \frac{D(d)h_D' N'(h_D)}{1+r_f} - V(d)h_D' N'(h_D + \sigma) + V'(d)[1 - N(h_D + \sigma)]\right)$$
$$- D'(d)\left(\frac{D(d)N(h_D)}{1+r_f} + V(d)[1 - N(h_D + \sigma)]\right)$$

We now separate the terms:

$$= D(d)\left(\frac{D(d)h_D' N(h_D)}{1+r_f} - V(d)h_D' N(h_D + \sigma) + V'(d)[1 - N(h_D + \sigma)]\right)$$
$$- D'(d)V(d)[1 - N(h_D + \sigma)]$$

$$= D(d)V'(d)[1 - N(h_D + \sigma)]D(d)V(d)[1N(h_D + \sigma)]$$

$$= [1 - N(h_D + \sigma)][D(d)V'(d) - D'(d)V(d)] < 0$$

Since $[1 - N(h_D + \sigma)] > 0$ if $h_D + \sigma < \infty$, we conclude that if: $D(d)V'(d)D(d)V(d) < 0$ then $\frac{\partial(\text{CY})}{\partial d} < 0$.