

Global Markets Daily: The Economics of Algorithmic Stablecoins (Rosenberg/Pandl)

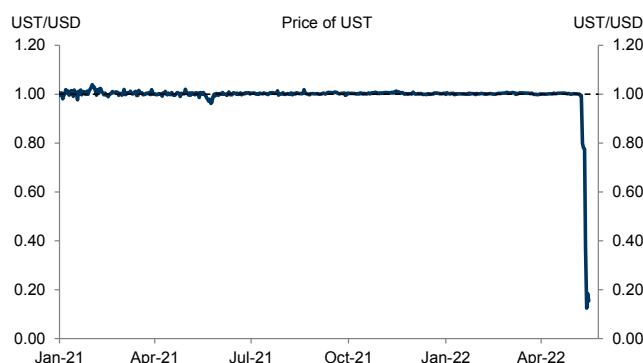
- In addition to the major drop in cryptocurrency prices, digital asset markets have recently been dominated by volatility in stablecoins—cryptocurrencies intended to be pegged 1:1 with fiat currencies, most commonly the US Dollar. Within the last few weeks, two prominent “algorithmic” stablecoins have de-pegged (“broke the buck”), Terra USD and Neutrino USD.
- Like fixed exchange rates in traditional finance, algorithmic stablecoins are vulnerable to speculative attacks. They also face competitive threats from other forms of public and private money, as did similar assets in earlier experiments with private money in US history.
- While stablecoins can provide a useful service within the digital asset ecosystem, current designs can be risky. More stability could be achieved through forms of government regulation and/or deeper network effects from greater non-speculative usage of the underlying protocols.

The Economics of Algorithmic Stablecoins

In addition to the major drop in cryptocurrency prices, digital asset markets have recently been dominated by volatility in stablecoins—cryptocurrencies intended to be pegged 1:1 with fiat currencies, most commonly the US Dollar. Within the last few weeks, two prominent “algorithmic” stablecoins have de-pegged (“broke the buck”), Terra USD and Neutrino USD ([Exhibit 1](#) & [Exhibit 2](#)). Awareness of the risks and fragilities inherent to stablecoins has grown alongside their broader usage. While these assets are fairly new (introduced in 2014), many of the economic issues affecting stablecoins will be familiar to FX market participants and other investors. For example, algorithmic stablecoins closely resemble traditional pegged exchange rates as well as earlier forms of private money. Unlike fully-collateralized stablecoins (e.g. USDC), algorithmic stablecoins hold a volatile cryptocurrency as their reserve asset—the LUNA token in the case of the UST stablecoin—and use economic incentives to maintain the fiat peg. Unsurprisingly, algorithmic stablecoins share many of the vulnerabilities of pegged exchange rates, including the risk of speculative attacks.

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Exhibit 1: Algorithmic stablecoin UST de-pegged...

Source: CoinGecko, Goldman Sachs Global Investment Research

Exhibit 2: ...along with a sharp drop in LUNA's market cap below that of UST

Source: CoinGecko, Goldman Sachs Global Investment Research

Stablecoins are digital assets that are pegged to the value of a fiat currency, such as the US Dollar.¹ In their simplest form, they are virtually identical to money market fund shares: tradable claims on low-risk and short-dated securities that are nearly equivalent to cash from an economic standpoint.² Stablecoins have become a popular way to exit positions in volatile cryptocurrencies, while remaining within the crypto ecosystem (i.e. without transferring assets back to fiat currency via the traditional banking system). Protocols that issue “algorithmic” stablecoins may also offer high yields (often through a decentralized lending protocol) to encourage investors to hold the token. In traditional finance, these structures are analogous to high yield savings accounts or high carry currencies. Stablecoins have limited use as a payments medium at this time. If that real-world use case were to grow over time, it could create a more stable demand base for these assets.

We can classify stablecoins into three broad categories: fiat-backed, crypto-backed, and algorithmic. **Fiat-backed stablecoins** are tokens that are backed by a reserve of fiat-denominated assets held “off-chain” (i.e. in traditional securities and custody arrangements); they make up the largest share of USD stablecoin market cap among the top 14 stablecoins ([Exhibit 3](#)). These assets might include US Treasury bills, for example, if the protocol is attempting to peg to USD. In order to create a new unit of a fiat-backed stablecoin, the equivalent amount of fiat collateral needs to be added to the reserve.

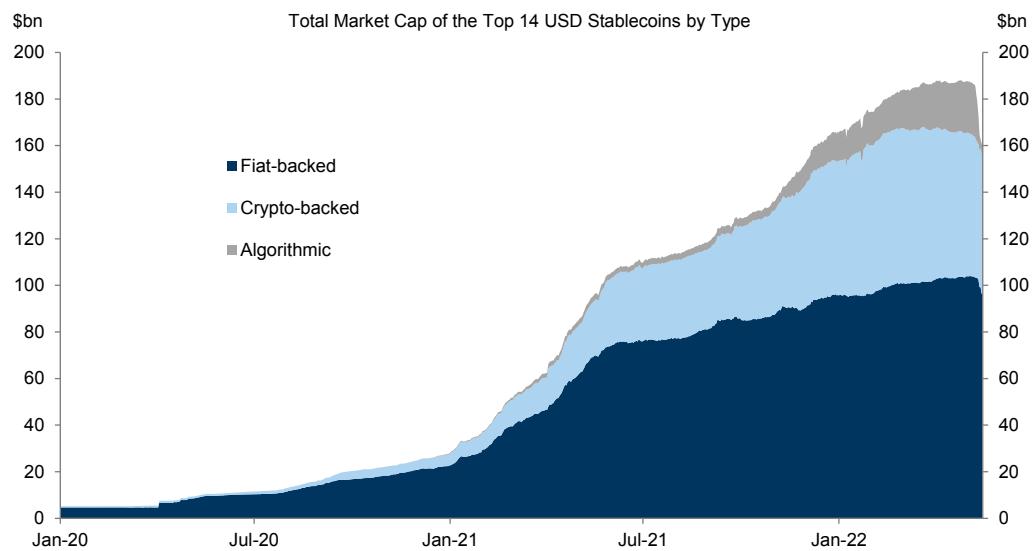
Crypto-backed stablecoins operate in a similar fashion, but rather than being fully-collateralized by a reserve of fiat-denominated assets, they are backed by an *over-collateralized* pool of cryptocurrencies. In order to create a new unit of a crypto-backed stablecoin, cryptocurrency must be added to the reserve by an amount exceeding the withdrawn stablecoin (e.g. 150%), measured at current cryptocurrency prices in US Dollar terms. For example, to generate the stablecoin DAI on the MakerDAO platform, a user must deposit 150% of the amount in Wrapped Ether at

¹ Though many are pegged to fiat currencies, such as the US Dollar or Euro, they can also be pegged to commodities such as gold; in this piece, though, we will focus on those pegged to fiat currencies.

² We will abstract from decentralization in this discussion.

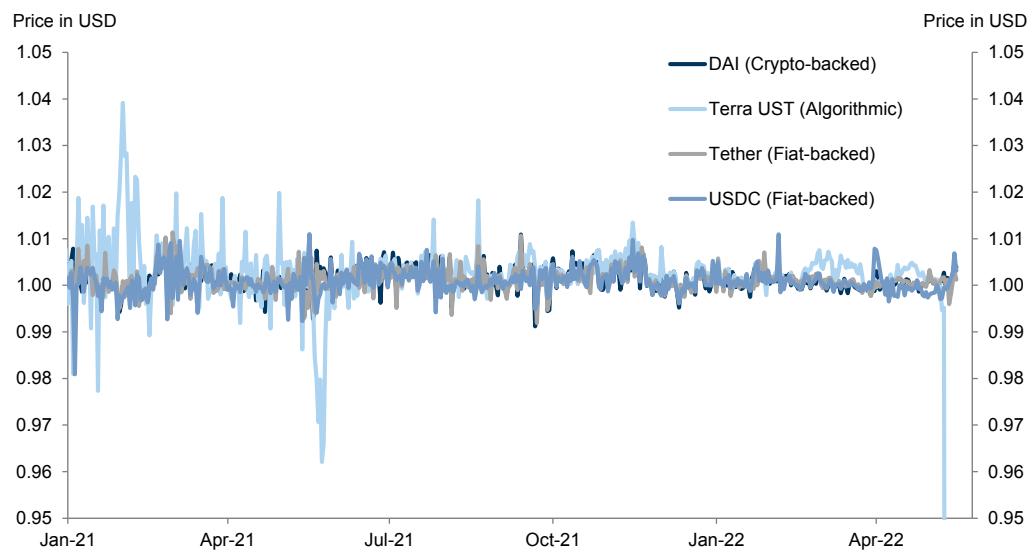
current market prices. If the market price of Ether declines, pushing the market value of assets below the minimum collateralization ratio, the smart contract will automatically sell the assets and consider the claim settled. Through this mechanism, crypto-backed stablecoins have remained generally stable, despite holding volatile cryptocurrency assets ([Exhibit 4](#)).

Exhibit 3: Fiat-backed stablecoins account for the largest share of market cap among the top 14 USD stablecoins



Source: CoinGecko, Goldman Sachs Global Investment Research

Exhibit 4: Many Types of Stablecoin Structures

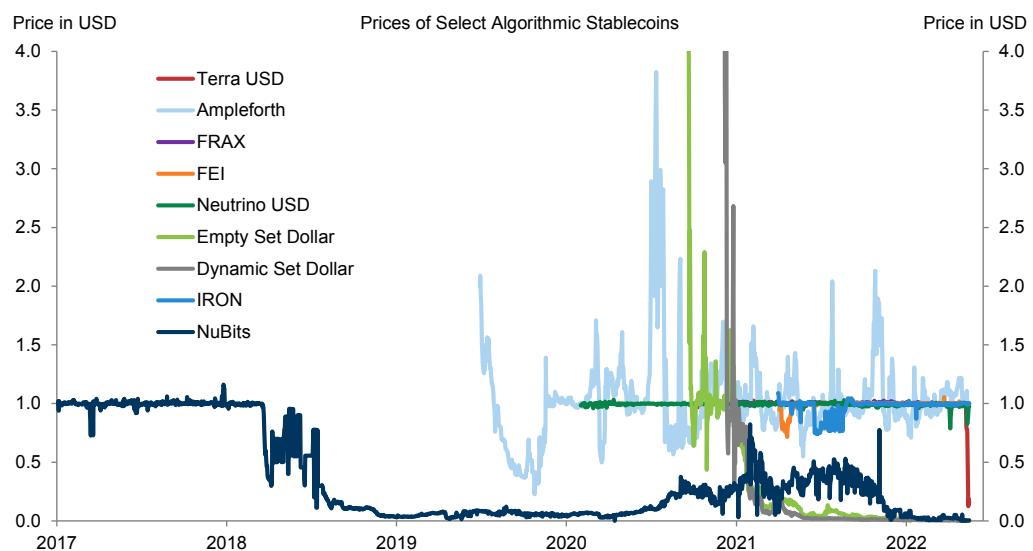


Source: CoinGecko, Goldman Sachs Global Investment Research

In contrast, **algorithmic stablecoins** are typically pegged not through the use of reserves, but through an expansion and contraction of the supply of the stablecoin (note that the terminology on these topics varies across the industry). The exact mechanism

through which algorithmic stablecoin pegs are maintained can be quite different, and multiple different models have emerged over the past few years, with most eventually de-pegging or adopting a fiat- or crypto-backed reserve model ([Exhibit 5](#)).³

Exhibit 5: A Volatile History for Algorithmic Stablecoins



Source: Coin Gecko

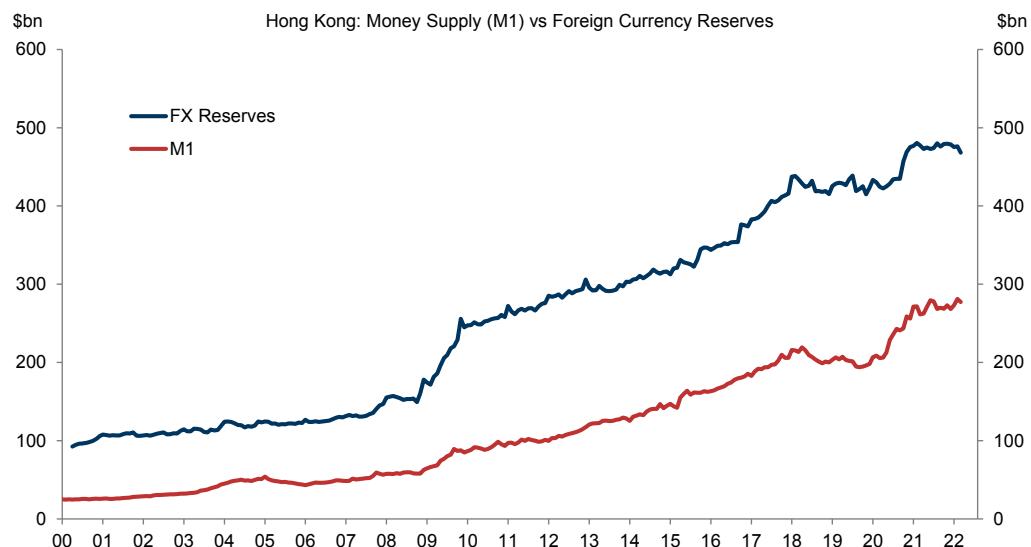
The ill-fated Terra USD (UST) had a relatively simple stability mechanism. When users create (or “withdraw,” “convert fiat into”) UST, an equivalent amount of the blockchain’s native LUNA token is “burned” (destroyed). When users redeem UST (or “pay back,” “convert back into fiat”), an equivalent amount of the LUNA token is “minted” (issued). This creates the incentive mechanism intended to maintain UST’s peg to the US Dollar. For example, if the market price of UST falls below \$1, an arbitrageur could purchase it in the open market, then redeem it through a smart contract for \$1 of LUNA. After selling LUNA in the open market, assuming the steps happen simultaneously, the trader would net the difference between the market price of UST and the \$1 gained from selling LUNA. The same arbitrage incentives are intended to keep the market price of LUNA from rising above \$1. Similar algorithmic stablecoins include USDN, IRON, and USDD. Most of these structures have no other “reserve” asset, but some, including UST and FRAX, are partly fiat-backed or crypto-backed.

Algorithmic stablecoins, like other stablecoins, resemble pegged exchange rates (for this discussion we will abstract from capital controls). In order to maintain a fixed exchange rate, a central bank must always stand ready to buy and sell the national currency at a stated price in foreign currency terms (i.e. at a stated exchange rate). Central banks support this mechanism by maintaining reserve assets denominated in the foreign currency. In a currency board, the most stable structure, these reserve

³ One of the earliest examples of an algorithmic stablecoin is NuBits, issued in 2014, which functioned through a “seigniorage-style” mechanism. This model inspired several other seigniorage-style stablecoins, such as Basis, Empty Set Dollar, and Dynamic Set Dollar, which also relied on bond- or option-like instruments to push the value of the stablecoin up if it fell below parity.

assets exceed the nation's monetary base and are invested in low-risk assets denominated in the target currency, effectively guaranteeing that the central bank cannot run out of reserves. For example, the Hong Kong Monetary Authority, which operates under a currency board regime, holds low-risk USD assets exceeding the nation's monetary base ([Exhibit 6](#)). This system resembles "fiat-backed" stablecoins in crypto markets.

Exhibit 6: Currency Boards are More Stable than Other Fixed FX Regimes



Source: Haver Analytics, Goldman Sachs Global Investment Research

In most other fixed exchange rate regimes there will be higher uncertainty about the stability of the peg: reserve assets may not cover net balance of payments outflows in all possible future scenarios. These structures are typically evaluated along a spectrum, using [indicators of reserve adequacy](#). Although fixed exchange rate regimes can be stable over long periods of time (sometimes supported by capital controls), most countries will not hold reserves sufficient to cover all possible tail-risk events, and there will always be some probability that the peg could break. As a result, these systems are vulnerable to runs, crashes, and speculative attacks. In our dataset covering 109 major currency crashes, many of which are peg breaks, nominal USD crosses depreciate by 45% in the median case over 48 months ([Exhibit 7](#)).

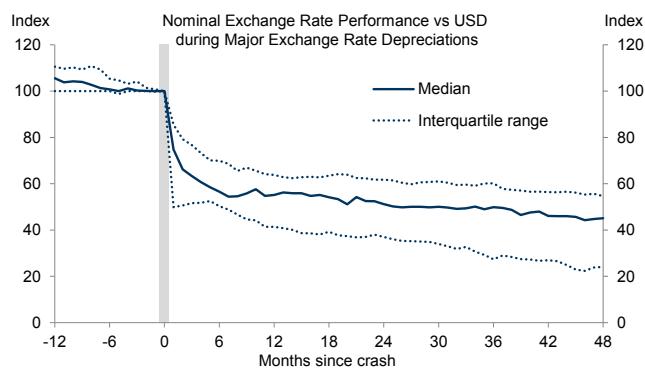
Balance of payments crises/currency crises typically occur when market participants expect that a fixed exchange rate will eventually be abandoned, leading to capital flows out of the domestic currency and a decline in foreign exchange reserves. One key element to currency crises is that they can be partly self-fulfilling.⁴ If investors begin to sell a currency because they expect it to be devalued in the future, their speculation can, in fact, be the dominant source of balance of payments pressure on the currency. Once this pressure has been applied, it can be costly for a government or organization to defend the pegged exchange rate—it can require sharply higher interest rates, a large

⁴ Krugman, Rockoff, Fischer, & McDonough, "Currency Crises," 1999.

decline in reserve assets, and/or capital controls.⁵ Therefore, a sufficiently large speculative attack can in fact trigger a peg break. As a result, pegged exchange rates are especially vulnerable if a country runs a current account deficit funded with short-term portfolio financial account liabilities—in other words, funding that can exit quickly (Exhibit 8).

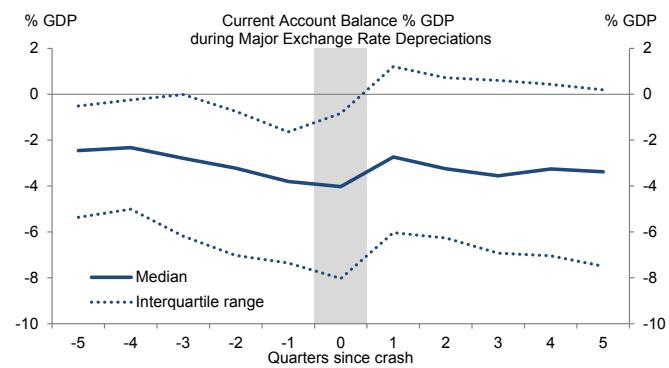
Exhibit 7: Pegged Exchange Rates Can be Subject to Large Crashes

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Source: Haver Analytics, Goldman Sachs Global Investment Research

Exhibit 8: ... Usually Resulting from Sudden Capital Flight



Source: Haver Analytics, Goldman Sachs Global Investment Research

These types of self-fulfilling crises can also occur in algorithmic stablecoins. Investor confidence in a fixed exchange rate can be rattled for a number of reasons. In the case of UST, the broader drawdown in digital assets may have raised investors' subjective probabilities of the risk that LUNA's market cap could fall below the supply of UST, such that it might be insufficient to cover all redemptions. If investors rush to sell/redeem UST, new LUNA will be minted, adding to LUNA supply and potentially weighing on its price. The peg is intended to self-stabilize by incentivizing arbitrageurs to buy UST if selling pressure pushes its price below \$1. But if the price of LUNA is crashing market participants may be unwilling to make this arbitrage, such that prices of both the stablecoin and the blockchain-native cryptocurrency can spiral downward. Raising deposit rates can help slow capital outflows—as in traditional currency markets—but these steps may be insufficient against overwhelming capital outflow pressure.

Hypothetically, an algorithmic stablecoin could survive in the long-run, if it were to have ongoing transaction-related demand (similar to a fiat currency). However, stablecoins have competitors, such that demand for any one asset may prove unstable. One of the best historical analogues for the current state of stablecoins is the circulation of private bank notes as money during the US Free Banking Era (1837-1863), as Gorton and Zhang (2021) explain. During this Era, US banks were able to issue private bank notes, which circulated as money and were payable in specie on demand at the issuing bank; however, they importantly did not trade at par away from the issuing bank, but rather at a discount, given the large number of different banks' notes in circulation (branch banking was limited during this period⁶) and the difficulty of ascertaining bank-specific risk across the entire system. Ultimately, the US took control of the money system with

⁵ Krugman & Obstfeld, *International Economics*, 7th ed., 2006.

⁶ Rockoff, "Banking and Finance, 1789-1914," *The Cambridge Economic History of the United States*, 2008.

the National Banking Act, producing national bank notes, and, much later, Federal Reserve Notes took over.

There are two main lessons that the US (and Canadian⁷) experience with private money can teach us about the future of stablecoins. First is Gorton and Zhang's claim that private money generally does a worse job of acting like money than public money. To this point, stablecoins often trade at a discount, likely related to protocol-specific risk, much like bank notes did in response to bank-specific risk. Additionally, there are a large number of alternative stablecoins that can coexist, each with its own risk profile, making them difficult to use across platforms, much like private money once was away from issuing banks. The second key lesson from this experience is that while private and public money can coexist for a time, the private money system is eventually regulated and/or later supplanted by public money.

Stablecoins provide a useful service within the digital asset ecosystem: users need a less volatile base asset in these markets—ideally without converting back to fiat currency and the traditional banking system, given the frictions and transaction costs involved—and stablecoins have filled this need. However, algorithmic stablecoins in particular are vulnerable to self-fulfilling crises, as is now obvious after the decline of UST and LUNA. Regulation seems likely, in our view, and appropriate regulation could improve stability and lower risk in the stablecoin market (or possibly displace stablecoins through an alternative government-backed medium). Within the digital asset market, positive network effects from greater non-speculative use cases for these protocols could contribute to a more stable demand base over time.

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Zach Pandl

⁷ Fung, Hendry & Weber, "Canadian Bank Notes and Dominion Notes: Lessons for Digital Currencies," 2017.

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