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Global Taxonomy of Stablecoins

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Abstract. As stablecoins address the challenges of price stability in the cryptocurrency market, this paper provides a comprehensive taxonomy of stablecoins, categorizing them based on governance, value, and design dimensions. Our study aims to enrich the ongoing discourse in digital currency and provide insights into the future trajectory of stablecoins in decentralized finance.

Keywords: Stablecoins · Taxonomy · Cryptocurrencies · Blockchain · Decentralized Finance (DeFi)

1 Introduction

In the rapidly evolving landscape of digital currencies, stablecoins have emerged as a pivotal innovation. Pegged to assets like fiat currencies or commodities (e.g., USD or gold), they address the challenges of price stability in the cryptocurrency market [1,2]. They serve various functions, ranging from facilitating smoother trading to providing a safe haven for investors during turbulent times.

Decentralized stablecoins offer the promise of greater transparency, reduced counterparty risk, and enhanced accessibility without the notorious volatility that plagues assets like Bitcoin and Ethereum. Bridging the traditional and decentralized financial systems, they have garnered significant attention from investors, regulators, and innovators alike. But despite their benefits, decentralized

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stablecoins face multifaceted challenges, including regulatory scrutiny [3,4], scalability issues [5], and concerns over their underlying mechanisms for maintaining stability [6,7].

This paper aims to clarify the diverse models of stablecoins through a comprehensive taxonomy. We explore their mechanisms, provide implementation examples, and discuss the potential risks and potential benefits associated with these systems. By doing so, we aim to provide valuable insights into their role and future trajectory.

2 Related Work

Previous studies have extensively analyzed various aspects of stablecoins. [1,2] focused on the economic implications of stablecoins, while [8] provided a classification framework for stablecoin designs. However, there remains a need for a more detailed taxonomy that includes recent notable developments, such as the emergence of CBDCs, which represent state-backed digital assets. Additionally, commodity-backed stablecoins are growing, offering stability tied to physical assets like gold or oil.

Our taxonomy extends beyond the traditional classification of stablecoins [9,10,11], which typically differentiates between fiat-backed, crypto-backed, and algorithmic stablecoins. It acknowledges the growth of this field in design and usage. The taxonomy also highlights an innovative crypto-backed design that diverges from the standard Collateralized Debt Position (CDP) model, termed here as the “reserve-backed” model. Furthermore, it distinguishes between the varieties of algorithmic stablecoins. Our work offers a more nuanced classification and addresses the current gaps in understanding the diverse stablecoin ecosystem.

3 General Presentation of Stablecoins

Stablecoins, a specialized subset of cryptocurrencies, are engineered to provide price stability [1,2]. Typically, it is achieved by being pegged to a reference asset such as a fiat currency, commodity, or a diversified basket of assets. It represents a strategic response to the significant volatility commonly associated with traditional cryptocurrencies like Bitcoin [12]. Their inherent stability makes stablecoins more conducive for everyday transactions, positioning them as a reliable store of value and a consistent unit of account. Key to their interest is their capacity to combine the operational efficiency and robust security features of blockchain technology with the relative stability of conventional financial assets.

Stablecoins are thus uniquely positioned to unlock novel opportunities, not just limited to financial markets but into broader socioeconomic realms. For instance, they offer a path towards financial inclusion for the unbanked or underbanked [13]. Moreover, stablecoins hold the potential to revolutionize cross-border transactions and remittances by significantly reducing costs and transaction times [14]. Their integration into traditional financial systems could signal a

new era of more efficient, transparent, and inclusive financial systems on a global scale [15,8]. This evolution reflects a growing recognition of their potential and has led to diverse developments in the stablecoin sector.

3.1 Evolution of the Stablecoin Sector

The stablecoin landscape began to take shape in 2014 with the introduction of several pioneering projects [16]. USDT (Tether) was one of the first stablecoins, launched on the Bitcoin blockchain using the Omni Layer protocol, aiming to maintain a 1:1 peg with the US dollar. Alongside Tether, BitUSD on the BitShares blockchain and NuBits were also launched in 2014, each offering unique mechanisms to achieve price stability. In 2017, the stablecoin ecosystem expanded with the introduction of DAI by MakerDAO on the Ethereum blockchain. Unlike its predecessors, DAI operates as a decentralized stablecoin, maintaining its peg to the US dollar through over-collateralization with various cryptocurrencies [17]. This innovation marked a significant advancement in stablecoin design, setting the stage for further developments in the sector.

The stablecoin sector has since experienced notable growth, driven largely by the increasing interest in decentralized finance (DeFi) and the continuous evolution of blockchain technologies [18]. Initially, stablecoin development predominantly focused on centralized models issued by private entities, such as USDT (Tether) and USDC (USD Coin), pegged to the US dollar and backed by fiat-reserve assets owned by these companies [18]. Currently, the landscape spans a broad spectrum, from centralized models and state-issued Central Bank Digital Currencies (CBDCs, as, e.g., [19]) to decentralized algorithmic stablecoins that maintain stability through complex mechanisms. While the sector's growth has since stabilized after the significant boom of the "DeFi summer" in 2020, it remains a major segment of the cryptocurrency market, with several stablecoins ranking in the top-10 by market capitalization.

3.2 Stablecoin Trilemma and Current Challenges

While addressing some longstanding shortcomings of the global financial system, stablecoins also face critical challenges, tempering their widespread adoption and effectiveness. The trade-off between three core attributes is prominently illustrated by the "Stablecoin Trilemma" [20] (see Figure 1):

- **Price Stability** is a fundamental and critical challenge for all stablecoin categories, with decentralized stablecoins facing particular difficulty in maintaining stable value relative to the reference asset. For stablecoins backed by Real World Assets (RWAs), there is a direct convertibility mechanism with their real-world equivalents, typically through over-the-counter operations, which aids in maintaining stability. In contrast, decentralized stablecoins lack direct convertibility and do not have reserves consisting of the reference asset, thereby facing additional challenges such as market volatility.

- **Decentralization** emphasizes the elimination of central control and the promotion of a distributed governance structure. The challenge lies in maintaining a stablecoin’s functionality and value without relying on a central authority to manage the peg to the reference asset consistently.
- **Capital Efficiency** encompasses the effective utilization of capital for a stablecoin’s operations, which is crucial to its economic sustainability. It is achieved by maximizing the quantity of stablecoins that can be issued per unit of a reserve asset. It also involves strategically investing the reserve assets for yield generation, ensuring that the capital is not under-utilized.

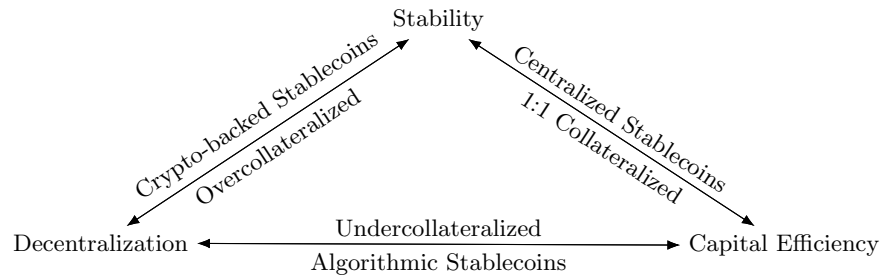


Fig. 1. The Stablecoin Trilemma

In some conceptualizations of the trilemma, scalability, which refers to the system’s ability to issue stablecoins in alignment with market demand, may supplant capital efficiency [21]. Scalability proves especially challenging for Collateralized Debt Position (CDP) models, where stablecoin supply is not directly driven by the demand for the stablecoins themselves but by the demand for collateralized loans. In such models, balancing the issuance of stablecoins with fluctuating loan demand presents a unique challenge in achieving scalable growth.

Navigating the stablecoin trilemma entails balancing decentralization, value stability, and capital efficiency. Each stablecoin model adopts unique strategies to address these aspects, which is essential for understanding its role in the digital economy.

4 Global Taxonomy of Stablecoins

We introduce a more comprehensive taxonomy of stablecoins. Beyond the technology and functionality, the taxonomy reflects each model’s governance structures, the intrinsic value from which the stablecoin’s value is derived, and its underlying design mechanism.

Methodology To construct a taxonomy of stablecoins, we followed a systematic approach involving several key steps. First, we conducted an extensive literature

review, examining academic papers and industry reports to gather diverse perspectives on stablecoin classification and characteristics.

Next, we collected data on various stablecoin projects from multiple sources, including whitepapers and on-chain data, to gain insights into governance structures, collateral types, stability mechanisms, and market performance.

Based on the insights obtained from the literature review and data collection, we developed a set of criteria to categorize stablecoins, capturing the key dimensions of their design. Using these criteria, we constructed a hierarchical classification framework, as presented in Figure 2.

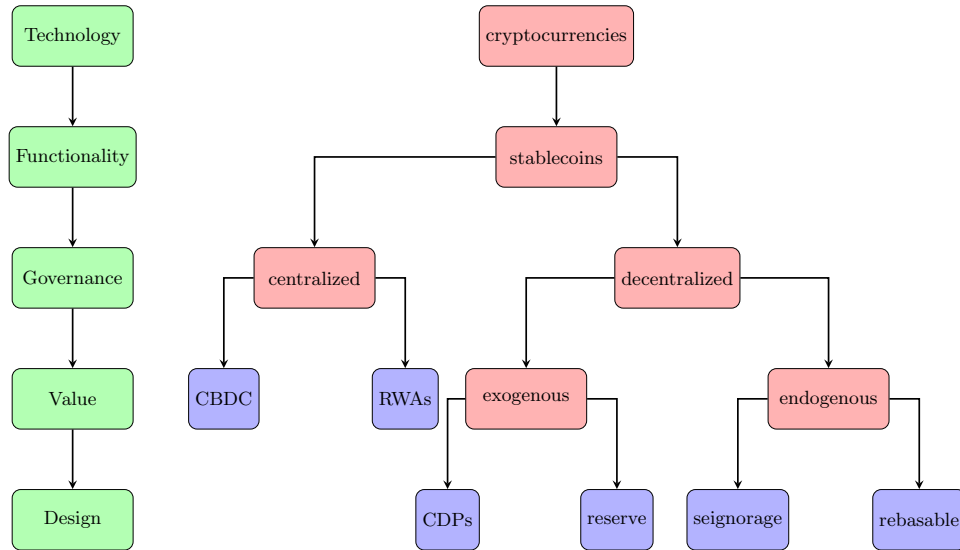


Fig. 2. Hierarchical Taxonomy of Stablecoins

4.1 Technology and Functionality Dimensions

At the highest level, stablecoins, as a subset of cryptocurrencies, embody the technological advancements of blockchain and distributed ledger technology. They inherit the attributes of security, transparency, and decentralization that are hallmarks of blockchain-based assets. The next level then focuses on the primary function of stablecoins. They provide a stable value relative to a reference asset, which enhances their utility as a medium of exchange, a unit of account, and a store of value within the digital economy.

4.2 Governance Dimension

Two types of governance structures for stablecoins exist: centralized and decentralized. Centralized stablecoins are usually under the control and oversight of

a single entity, for instance, a private company or a sovereign state’s central bank. These entities bear the responsibility for managing the stablecoin and ensuring its regulatory compliance, stability, and reliability. As such, centralized stablecoins are subject to the risks associated with centralized control, including censorship, insolvency, and regulatory intervention.

By contrast, decentralized stablecoins adopt a distributed governance model, enhancing the system’s transparency and resistance to centralized control. This provides benefits like permissionless access and censorship resistance, fostering systems less vulnerable to centralized manipulation. This decentralized approach can manifest in two primary forms: through a Decentralized Autonomous Organization (DAO), where decision-making is democratized and collective within the community, or via programmatic rules hard-coded into the smart contract. The latter, often referred to as a “governance-less” approach, removes reliance on human intervention by automating key operational decisions.

4.3 Value Dimension

This level focuses on the origin and nature of the stablecoin’s intrinsic value. Within this category, CBDCs stand out among centralized stablecoins. CBDCs are not just pegged to a nation’s currency; they actually are a digital version of the sovereign currency issued and regulated by the country’s central bank (see, e.g., [19]). It is important to notice that most CBDC projects are still in development and have not yet been integrated into the broader DeFi ecosystem. In contrast, the most prevalent form of centralized stablecoins is those backed by RWAs, predominantly fiat currencies like the USD [18]. These reserves, managed by the private entity issuing the stablecoin, are typically homogeneous with the reference asset. For instance, a stablecoin pegged to the USD would have reserves composed of USD, ensuring a direct correlation in value.

In decentralized stablecoins, the categorization bifurcates into exogenous and endogenous types. Exogenous stablecoins, often called “crypto-collateralized stablecoins”, are backed by external crypto-assets. Commonly, this external asset is the native currency of the blockchain hosting the protocol (e.g., ETH for Ethereum-hosted protocols). The external backing provides a tangible asset base, albeit in the form of cryptocurrency. Conversely, endogenous stablecoins, or “algorithmic stablecoins”, derive their value internally from within the ecosystem.

4.4 Design Dimension

The final layer of our taxonomy delves into the unique design mechanisms underpinning stablecoins. In the domain of exogenous decentralized stablecoins, two primary approaches are prevalent: those based on Collateralized Debt Positions (CDPs) and those employing hedging strategies for the backing asset through a surplus reserve [22]. CDPs-based stablecoins attain stability through over-collateralization, wherein users lock in assets of greater value than the stablecoins being issued. In contrast, reserve-based models utilize risk mitigation strategies involving a secondary role of actors known as hedgers. These hedgers endorse

the volatility risk of the reserve asset through leveraged positions, thereby contributing to the overall stability of the stablecoin.

Within endogenous decentralized stablecoins, there are two distinct models: seignorage-based and rebasable stablecoins [23,11]. Seignorage-based stablecoins maintain stability using a secondary “seignorage token”, which adjusts the circulating supply of the stablecoin in response to price fluctuations, similar to a central bank’s monetary policy. As for rebasable stablecoins, they directly adjust the token balances in holders’ wallets. This dynamic alteration across all wallets allows them to maintain a stable value relative to the reference asset by responding to changes in supply and demand.

5 Designs and Mechanisms of Stablecoins

This section examines the designs and mechanisms of stablecoins and their approaches to addressing the challenges outlined in Section 3. Table 1 compares the features and mechanisms across various types of stablecoins.

Table 1. Comparative Table of Stablecoin Features

Feature	RWAs-backed	CDP Based	Reserve Based	Seignorage Based	Rebasable
Examples	USDT, USDC	MakerDAO’s DAI, Liquity (LUSD)	Djed, Gold, Angle Pro-ocol (AgEUR)	Cyber- Terra (LUNA), Basis Cash	Ampleforth (AMPL), Yam Finance
Collateral Type	RWA (fiat, commodities)	Crypto assets	Crypto assets	None required	None required
Stability	High	Medium	High	Medium	Medium
Capital Efficiency	Medium	Low	Medium	High	High
Resilience	Medium	High	Medium	Low	Medium
Scalability	High	Low	Medium	High	High
Stability Mechanism	Convertibility through OTC operations	Liquidation, PSM, fees, interest rates	Full convertibility, arbitrage interest	Supply adjust-ment	Elastic supply, account rebasement
Solvency Mechanism	1:1 backing of the reference set	Over-collateralization, liquidation	Reserve pool, hedging	Bond issuance	None required
Specific Risks	Regulatory risk, Counterparty risk, Management risk	Liquidation risk, market volatility	Hedger’s market volatility	risk, Confidence demand fluctua-tion	risk, Confidence supply & demand elasticity
Business Model	Yield of backing assets	Liquidation fees, lending interest, reserves yield	Issuances, serves transactions fees	re- Seignorage yield, transaction fees	Reflection fees, transaction fees

5.1 RWAs-backed Stablecoins

RWAs-backed Stablecoins are typically backed by real-world assets such as fiat currencies (e.g., USD) and commodities (e.g., gold). These stablecoins derive

their value from the underlying assets held in reserve, and their economic model depends on the profitability of the capital placed as collateral. The stability of RWAs-backed stablecoins is maintained through arbitrage opportunities, made possible by the convertibility of the stablecoin against the underlying asset in Over-the-Counter (OTC) operations, which are typically only available during office hours. For instance, if the stablecoin’s price deviates downward from its peg, arbitrageurs can buy the stablecoin and redeem the underlying asset, thereby restoring the stablecoin’s price to its intended level. This convertibility ensures that the stablecoin’s value remains closely tied to the value of the reserved assets.

Despite their stability advantages, RWAs-backed stablecoins are exposed to several risks. Regulatory risk is a significant concern, as changes in regulatory frameworks can impact the issuance and management of these stablecoins. Counter-party risk is another critical factor, exemplified by the 2023 USDC depeg incident, where the insolvency of a bank holding the reserve funds led to a temporary loss of peg stability [24]. These risks highlight the vulnerabilities associated with the centralized nature of RWAs-backed stablecoins.

5.2 CDPs-based Stablecoins

CDPs-based Stablecoins, such as MakerDAO’s DAI [25] and Liquity’s LUSD [26], use over-collateralized loan positions known as CDPs. In these systems, users deposit collateral, usually in the form of cryptocurrencies like Ethereum, and receive stablecoins in return. Its value is typically higher (often around 150%) than that of the stablecoins borrowed, a buffer to ensure system stability. CDPs-based stablecoins also employ a liquidation process, activated when the value of the collateral falls below a specified threshold. This process involves the automatic sale of the collateral to stabilize the system.

Price stability is primarily managed through the adjustment of interest rates on loans and stablecoin staking, leading to a soft peg to the reference asset. Some platforms further implement a Price Stability Module (PSM), which directly swaps their stablecoin with other stablecoins to enhance peg integrity. This increased stability comes with the trade-off of exposure to the risks associated with other stablecoins. A notable example was the depegging of DAI in March 2023 [22]: it occurred as a direct consequence of the USDC depeg event [27], highlighting the potential vulnerabilities of this approach.

Despite its resilience during market volatility, the CDPs-based model faces challenges in scalability. First, the supply of stablecoins is constrained by the demand for collateralized loans rather than the direct demand for the stablecoins. Furthermore, the model exhibits relatively low capital efficiency due to the need for over-collateralization to ensure solvency.

5.3 Reserve-backed Stablecoins

Reserve-backed Stablecoins are also known as delta-neutral stablecoins. They employ a hedging-based design where roles are distinctly divided between sta-

blecoin users and protocol hedgers. In this model, direct issuance (minting) or redemption (burning) of stablecoins at par value with the reserve asset is enabled at the smart contract level, a feature known as full convertibility. Hedgers play a crucial role by contributing additional reserve assets to mitigate potential devaluations, thus maintaining a leveraged position that helps balance the system. Examples of this design include Dollar on Chain (DoC) [28], Djed [29], Angle Protocol [30], and CyberGold [31].

Due to its full convertibility feature, this model offers strong peg integrity. By automatically adjusting the supply of the stablecoin in response to market demands, it also boasts excellent scalability and good capital efficiency. Nonetheless, maintaining adequate hedging levels can be challenging due to investor risk aversion, particularly in bear markets.

5.4 Seignorage-based Stablecoins

Seignorage-based Stablecoins draw inspiration from the traditional concept of seignorage, which historically denotes the profit a government earns by issuing currency, primarily the difference between the face value of coins and their production costs. This approach to stablecoin design is based on this principle as detailed in [32]. In this model, the value of a stablecoin is linked not only to an underlying asset, but also to its function as money, including its acceptance as a means of payment.

These protocols introduce a secondary token, known as seignorage shares, intended to capture the value created by the stablecoin’s acceptance and use as a medium of exchange. When the stablecoin’s price exceeds its peg, the protocol issues and sells new stablecoin tokens in exchange for seignorage shares. Conversely, when the price falls below the peg, the protocol issues new seignorage shares, selling them in exchange for circulating stablecoins. This design aims to regulate the stablecoin’s supply to maintain price stability.

Nonetheless, such systems have experienced significant challenges, including deflationary spirals [33], as seen with the collapse of Terra’s UST [34]. These spirals occur when a falling stablecoin price triggers a chain reaction. If the price drops below the peg, the protocol issues more seignorage shares to buy back and reduce the stablecoin supply, aiming to restore value. However, diminishing confidence or unfavorable market conditions can intensify the selling pressure. In turn, this leads to a dilution of the value of seignorage shares, eroding trust in both the shares and the stablecoin. Consequently, this declining price and trust cycle can quickly spiral and cause the collapse of the stablecoin. This risk’s mere existence has led to considerable skepticism regarding the model’s viability [35].

5.5 Rebasable Stablecoins

Rebasable Stablecoins, such as Ampleforth [36], take inspiration from [37]. These stablecoins maintain price stability by dynamically modulating the circulating tokens, specifically by adjusting the number of tokens in each holder’s wallet. As noted in [38], the consequence is twofold. On the one hand, it renders rebasable

stablecoins efficient as units of account and mediums of exchange. On the other hand, it is fundamentally unsuitable for long-term value preservation, as the purchasing power of holders is subject to high levels of volatility, akin to other cryptocurrencies. While stabilizing the coin’s value, this model merely shifts the volatility risk to the coin’s holders.

6 Conclusion

This paper presents a comprehensive taxonomy of stablecoins, highlighting the diverse mechanisms and designs used to achieve price stability. By analyzing different models, we provide insights into their potential and challenges in the digital currency landscape and their impact on decentralized finance.

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