THE FUTURE OF BANKING WITH BITCOIN

New Opportunities for Institutional Adoption in 2025 & Beyond

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EXECUTIVE SUMMARY

We've reached an inflection point in bank adoption of digital signature-based assets. Today, the focus is on stablecoins (covered in this report), but the role of Bitcoin in this adoption is misunderstood, and we anticipate the focus will change materially.

Epoch is a venture capital firm investing in Bitcoin adoption. We wrote this with the former CTO of Silvergate Bank, Chris Lane, and the Global Innovation Director — T&E at Bank Julius Baer, Sagun Garg. Our goal for this report is to express how closely tied Bitcoin adoption will be towards stablecoin adoption and the like as Bitcoin consumes the market for reserves.

You need to understand Bitcoin well to truly grasp its value. The 7th Property is a good place to start. For the intermediate reader, we suggest starting at the beginning of this report, and the advanced industry practitioners can focus their attention on the final section.

The report is organized into five sections:

1. **deCentral Banking**: an independent essay describing the multi-tiered banking system and Bitcoin as a new, completely neutral, central bank that will naturally be integrated into it.
2. **Bitcoin Banking at the Margin** - This section highlights how banks and start-ups can overcome constraints to adopt timely Bitcoin services through strategic plays in custody, lending, payments, and correspondent banking.
3. **Market Overview**: covers each of the primary functions of banking, how Bitcoin will be used within each, a comparison to non-bank providers, and estimated market sizes for each function. Stablecoins, CBDCs, and Tokenized Deposits are covered in this section as well.
4. **Market Predictions**: proposes five key trends that we expect to emerge from bank adoption across varying timelines.
5. **Bitcoin Bank Integration Applied**: the final section is a technical deep dive for bank executives and founders interested in building digital asset technologies to integrate with banks today.

If you want to understand where Bitcoin adoption is heading and precisely how it is going to get there, this report is for you.

Enjoy,

Eric Yakes and Chris Lane

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DECENTRAL BANKING

deCentral Banking

I. Bitcoin's Challenge to Central Banking

Understanding the modern banking system is key to understanding the near-term adoption path for Bitcoin. To frame this perspective, recall the words inscribed by the Bitcoin founder, Satoshi Nakamoto, at the creation of the Bitcoin blockchain. Contained within the very first block, which Satoshi referred to as Bitcoin's "genesis block," is this simple phrase, quoting the Times of London article from January 3rd, 2009.


THE TIMES

Saturday January 3 2009 timesonline.co.uk No 69523 £1.50

Chancellor on brink of second bailout for banks

Billions may be needed as lending squeeze tightens

Bitcoin has one genesis block, one opportunity to inscribe a message upon which every subsequent block would be built. With limited "blockspace" for that inscription, Satoshi chose to juxtapose Bitcoin with modern central banking. Leaving long arguments for Bitcoin as a form of peer-to-peer electronic cash in the Bitcoin Whitepaper aside, Satoshi used the genesis block to put the Bank of England directly in Bitcoin's crosshairs.

We believe that a major historical barrier to Bitcoin's integration into the traditional financial system has been a widespread misunderstanding of the modern banking system itself. Too often, Bitcoin is treated as something entirely "other," conflated with "crypto," or dismissed as little more than a speculative form of "magic internet money." [1]

Recently however, things have changed as bitcoin is now being adopted by the largest financial institutions and governments in the world.[2] Today, there are approximately 180 central bank-issued currencies worldwide.[3] By nominal value, Bitcoin already ranks among the top five[4]. And while critics often cite Bitcoin's limited on-chain transaction capacity, the Bitcoin base layer processes roughly the same number of transactions per year as Fedwire (~200 million)[5], the real-

[1] **FreeMoney**, "Re: Famous Bitcoin Quotes," *BitcoinTalk*, July 24, 2012. Available at: https://bitcointalk.org/index.php?topic=94883.msg1049911#msg1049911

[2] Source: https://bitbo.io/treasuries/

[3] **International Monetary Fund**, *"The Glaciers of Global Finance: Central Banks,"* IMF Blog, December 16, 2020. Available at: https://www.imf.org/en/Blogs/Articles/2020/12/16/blog120620-glaciers-of-global-finance

[4] For comparisons between Bitcoin and other monetary assets, see Matthew Mezinskis, Top Money: A Running Dashboard of Global Monetary Aggregates, Porkopolis Economics, https://www.porkopolis.io/topmoney/. See also: @1basemoney on X (formerly Twitter).

[5] Fedwire annual statistics: https://www.frbservices.org/resources/financial-services/wires/volume-value-stats/annual-stats.html

time gross settlement system provided by the U.S. Federal Reserve and used for USD interbank transfers.

People fail to understand Bitcoin as money, because they do not truly understand fiat money. The first section of this writing seeks to remedy this problem through a stepwise exploration of the two-tier banking system as shown below, taking care to show how Bitcoin fits into this system as an alternative form of central bank money:

II. — Introduction to Two-Tier Banking
III. — Not All Banks Are Created Equal (Division of Banking Functions)
IV. — Accounting View of Two-Tier Banking
V. — Commercial Banking System View of Two-Tier Banking
VI. — Bitcoin as a Central Bank

While Bitcoin may ultimately eliminate the complexities of the existing two-tier banking model, we believe that in the near term, companies building tools to help commercial banks interact with Bitcoin, much like they access other central bank services, will achieve product-market fit.

In short, we believe Bitcoin is a new, fairer form of central banking for a multi-polar world.[6] The commercial banks that are first to connect to it, and the companies which help them scale its functionality, will enjoy a significant first-mover advantage and accrue substantial value in the coming decade.

II. Introduction to Two-Tier Banking

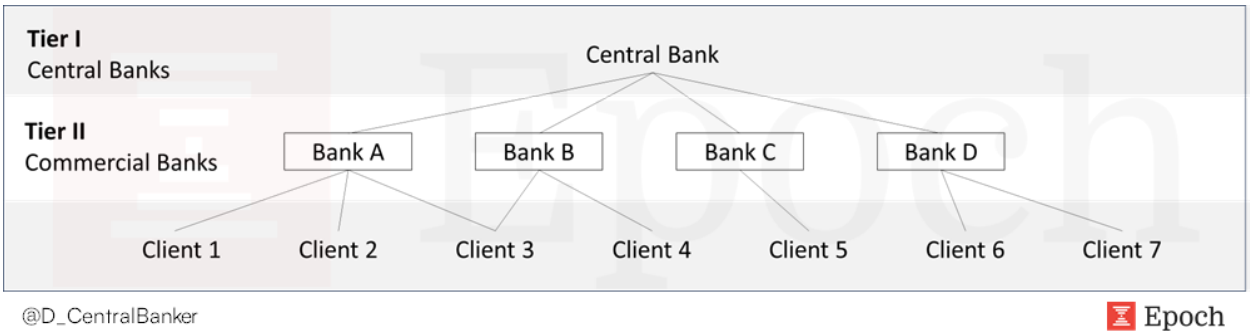
The modern fiat monetary system is structured around a two-tier hierarchy (figure 1 below).

At the top of the hierarchy (Tier I) sits the central bank responsible for both setting monetary policy and providing a stable foundation upon which all banks can both lend and settle transactions amongst themselves. Tier II consists of chartered commercial banks and investment banks which are built upon the foundation established by the central bank in order to provide banking services for end users (i.e., retail and institutional customers).

Note: an important design feature of this two-tier banking system is that the central bank does not typically provide banking services to the end-user. Instead, the central bank relies on commercial banks to distribute banking services, as shown in figure 1.

[6] *"'A natural desire to diversify': Janet Yellen says Americans should anticipate a decline in the USD as the world's reserve currency," Yahoo! Finance*, September 24, 2023. Available at: https://finance.yahoo.com/news/natural-way-diversify-janet-yellen-125500087.html

Figure 1: Two-Tier Banking System[7]



The tiered structure, shown in the diagram above, positions the institutions in the commercial banking layer (Tier II) to serve as central bank hyper-scalers. Thus, through the chartering and supervision process, commercial banks are essentially deputized to distribute banking services from the central bank to the end-user.[8] While this model assists in scaling central bank services, it's important to note that the commercial banking layer is not merely distributing central bank services; the commercial banking layer scales the creation of money itself.[9] We'll explore this topic in greater detail shortly, but first, it's important to gain a deeper understanding of the specific roles played by institutions at each of the two tiers described above.

III. Not All Banks Are Created Equal (Division of Banking Functions)

The modern financial system is made up of multiple types of banks, each with distinct roles, responsibilities, and regulatory frameworks. Yet we often use the word "bank," and the title "banker," to describe them all. This linguistic shortcut hides the complexity of a tiered and specialized system, making it difficult for even financially literate individuals to fully grasp how money moves, where risk resides, and how the system fits together. See figure 2 below for a short list of bank functions by type.

Central Banker (Tier I)

Walking the streets of Jackson Hole, Wyoming each summer[10], one will find representatives of *central banks* from around the world. While it would of course be correct to refer to these individuals as "bankers," and they are in fact some of the world's most influential bankers, their minds are likely occupied with yield curves, inflation targets,

[7] Rochon, L.-P., & Rossi, S. (2007). The two-tier domestic banking system and the related markets [Figure]. In *Central Banking and Post-Keynesian Economics* (adapted from an unspecified original source). Retrieved from https://www.researchgate.net/figure/The-two-tier-domestic-banking-system-and-the-related-markets_fig1_24088451

[8] **Bank for International Settlements**, *Annual Economic Report 2020*, Chapter III: "Central banks and payments in the digital era," June 2020. Available at: https://www.bis.org/publ/arpdf/ar2020e3.htm

[9] **Bank for International Settlements**, *Annual Economic Report 2025*, Chapter III: "The next-generation monetary and financial system," June 2025. Available at: https://www.bis.org/publ/arpdf/ar2025e3.htm

[10] Top central bankers meet annually in **Jackson Hole, Wyoming**, for a symposium hosted by the **Kansas City Fed** since **1982.**

and systemic risk. Not deal flow, IPO valuations, or client acquisition. Their work shapes the monetary environment in which all other bankers operate, making them architects of the financial system rather than participants in its daily hustle.

Commercial Banker (Tier II)

When the typical *main-street* individual hears the word "bank," they will likely think of a bank offering *commercial banking* services. A commercial bank accepts deposits for three primary purposes: to securely store money, to extend credit to businesses and individuals, and to facilitate financial transactions. Note that 'commercial' in this context refers to the bank's for-profit structure, not a focus on business versus retail customers. Banks which specialize in providing retail banking services (i.e., deposit accounts and loans for consumers) are in fact still chartered as commercial banks. The U.S. presently has approximately 4,000 commercial banks[11] providing traditional deposit and loan accounts to both businesses and consumers.

Investment Banker (Tier II)

When the typical *Wall Street* professional hears the word "bank," they will likely envision an *investment bank*. While this individual will understand well the familiar services a commercial bank provides to meet their own banking needs, there's a decent chance this individual will not appreciate the fact that the majority of U.S. banks bear little resemblance to the "buy side" or "sell side" institutions they are imagining in that moment. Investment banks primarily assist institutions with raising capital, performing mergers and acquisitions, accessing financial markets (e.g. foreign exchange), and providing market analysis. From a regulatory perspective, Tier II investment banking functions are often considered "non-bank financial services" and do not require a bank charter to perform. In practice, these services are generally provided by non-bank subsidiaries of large bank holding companies, or by specialized intermediaries operating as broker-dealers or investment banks regulated as non-bank financial institutions (NBFIs).[12] Nonetheless, these functions are an important aspect of what is generally considered to be banking/ financial services.

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[11] Federal Deposit Insurance Corporation, Statistics at a Glance — Historical Trends, First Quarter 2025, table "Commercial Banks," showing 3,917 FDIC-insured commercial banks as of March 31 2025. Available at: https://www.fdic.gov/quarterly-banking-profile/statistics-glance-historical-trends-first-quarter-2025-pdf.pdf

[12] **Board of Governors of the Federal Reserve System**, *12 CFR § 225.28(b)(7) & (8)*, Regulation Y, List of permissible nonbanking activities, permitting (b)(7) agency transactional services (e.g. forward contracts) and (b)(8) investment transactions as principal. See also accompanying rulemaking discussion in Federal Register (71 FR 67867, Nov. 2006)

Figure 2: Banking Functions by Bank Type

Tier I Functions	Central Banks	
	• Accept Deposits (from Banks) • Lend (to Banks) • Facilitate Interbank Settlement • Supervise Banks • Set Monetary Policy	
Tier II Functions	Commercial Banks	Investment Banks
	• Accept Deposits (from consumers & businesses) • Lend (to consumers & business) • Facilitate Payments • Take Custody of Assets	• Underwrite Transactions • Provide Brokerage Services • Provide Liquidity via Market-Making Services • Provide Merger & Acquisition Support

As shown in the consolidated function view above, despite sharing the same title of "banker," professionals across these institutions serve very distinct functions. Most have deep expertise within their own role and institution type[13], but a limited understanding of how the broader financial system operates - few fully grasp how its tiers interact to create, transmit, and manage money or how risk is distributed across them.[14] In this way, the word "bank" does more than simplify; it obscures the complexity of a layered and interdependent system, contributing to a widespread misunderstanding of how modern money actually works.

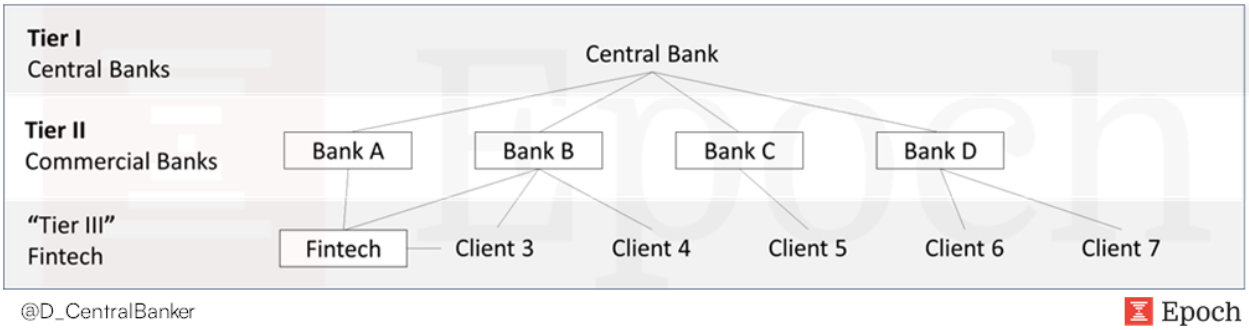
A Note on Fintechs

In the two-tier banking system, many consumer-facing financial technology companies, aka "fintechs", operate at the level of end-users just below Tier II banks, which is sometimes referred to informally as "Tier III". Thus figure 1 could be updated as follows (figure 3 below):

[13] Investopedia. "Investment Banking vs. Commercial Banking." Updated September 16, 2015. https://www.investopedia.com/articles/professionals/091615/career-advice-investment-banking-vscommercial-banking.asp

[14] UK Parliament, Hansard, "Money Creation and Society," debate held in Westminster Hall, November 20, 2014, Column 588. Available at: https://hansard.parliament.uk/commons/2014-11-20/debates/14112048000001/MoneyCreationAndSociety

Figure 3: Two-Tier Banking System w/ Fintech



While they are generally not chartered or licensed as banks, fintechs offer services like payments, stored value accounts, lending, and investment access. Many of these services are provided by partnering with Tier II commercial banks.[15] Examples of payment companies which operate at this tier are PayPal and Cash App.

IV. Accounting View of Two-Tier Banking

Having now introduced the concept of the two-tier banking system, we will begin to explore how institutions at each level participate in the creation of fiat money through a simplified accounting view. More specifically, we will focus on the balance sheets of the financial institutions in each tier. Special focus on the liability side of the balance sheet will be given to the specific liabilities which typically function as "money."

Therefore, the balance sheet model we will build upon will look like this.

Balance Sheet		
Bank Type	Assets (Backing Money Issued)	Liabilities (Serving as Money)

Building upon this view of a single bank's balance sheet shown above, a typical balance sheet for financial institutions within each of the three tiers of the modern financial system would therefore look like figure 5 below. Again, this is not an exhaustive list of assets and liabilities, but rather a select list chosen to highlight the specific liabilities which serve the function of end-user "fiat" money, along with the most pertinent assets backing the money from each tier of the banking system. [16]

[15] Consider that both Varo and SoFi hold US bank charters: https://thefinancialbrand.com/news/fintech-banking/fintech-big-tech-baas-charter-csbs-industrial-bank-loan-company-rent-111990

[16] Federal Reserve Bank of St. Louis, *"Teaching the Linkage Between Banks and the Fed: R.I.P. Money Multiplier,"* Page One Economics, Sept. 17 2021 (simplified bank balance sheet); https://www.stlouisfed.org/publications/page-one-economics/2021/09/17/teaching-the-linkage-between-banks-and-the-fed-r-i-p-money-multiplier

Note the green text below is used to highlight the specific liabilities typically viewed as money by the end-users of fiat money.

Figure 4: Tracing Fiat Money to Its Source at Each Tier of Banking Hierarchy[17]

	Assets backing "money" issued in this tier	Liabilities serving as "money" from this tier
Tier I Central Banks	• US Treasuries • Mortgage-Backed Securities • Loans to Banks	• Bank Reserves • Paper Currency or "notes"
Tier II Commercial Banks	• Reserve Acct Deposits • Loans to Customers • Investment Securities *FDIC Insurance	• Customer Deposits*
"Tier III" Fintech	• Commercial Bank Deposits • T-Bills	• "Stored Value" or Customer Funds

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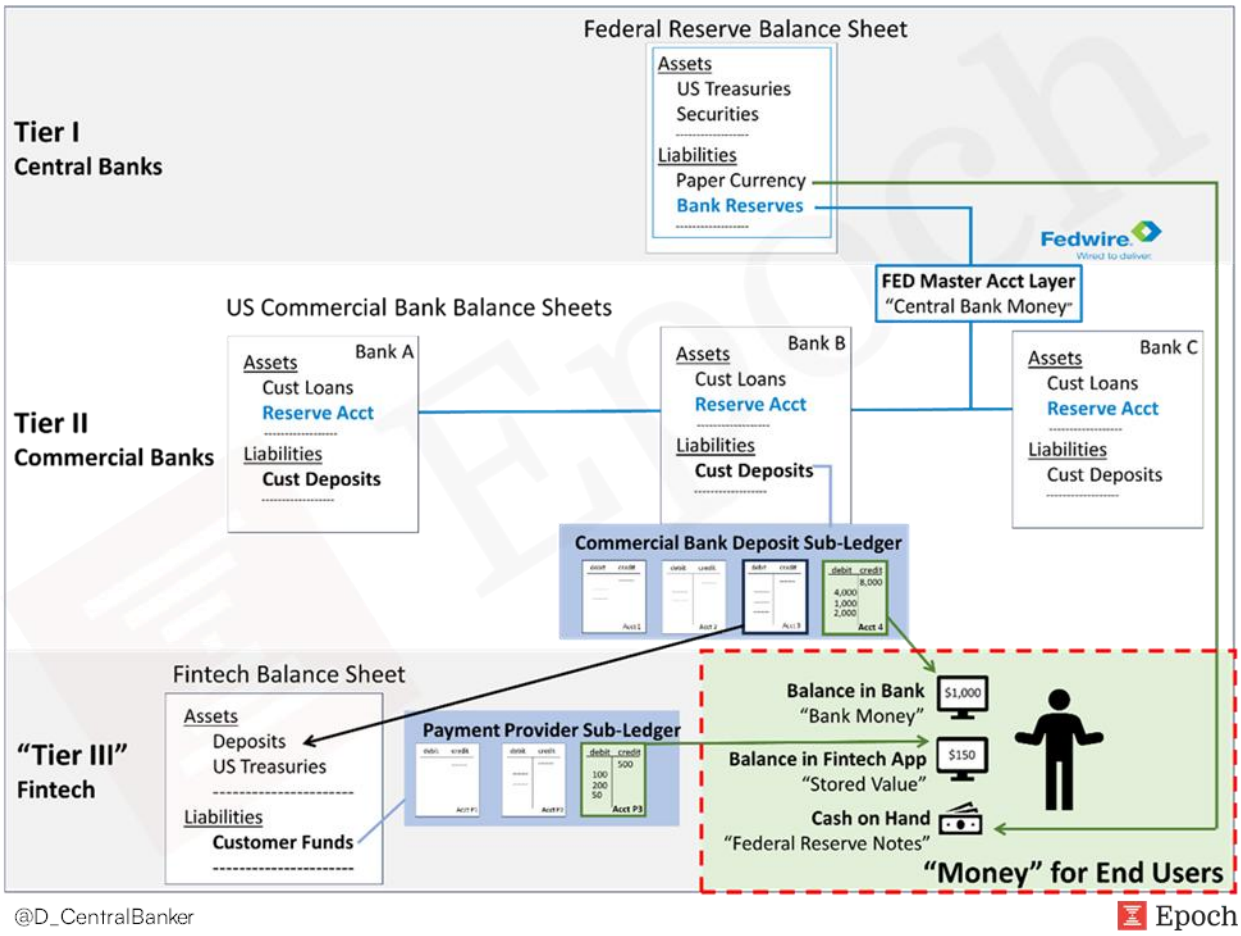
[17] **Ibid.** See simplified bank balance sheet.

Aggregate Level View

And finally, having laid the foundational understanding for a typical financial institution balance sheet at each tier of the modern banking system (above), we will shift our focus to the aggregate level accounting view of the modern fiat system, with the end goal of understanding how to trace various types of money back to their respective sources in the fiat system. The section below provides a detailed explanation of figure 5. End user fiat money is shown in lower right of the diagram (within the red box).

Figure 5: Aggregate Level - Accounting View



Central Bank (Tier I)

As noted in the introduction, the Federal Reserve balance sheet (top tier) is the foundation or "base layer" for the U.S. financial system.

The blue line, which flows from the bank reserves (Tier I) down to the "reserve accounts" held by commercial banks (in Tier II), show the deposit accounts administered by the Federal Reserve for

commercial banks. At this time, these reserve accounts[18] are the highest-quality settlement asset in the financial system[19] and are often referred to as "central bank money".[20] Final interbank settlement occurs through adjustments to these reserve accounts.

The integrity of the global financial system hinges on the central bank's ability to safely administer these liability accounts through provision of irrevocable settlement. One way this is accomplished is via Real Time Gross Settlement (RTGS) mechanisms like Fedwire[21], which we'll see in more detail in the *Bitcoin Bank Integration* section at the end of this report. It's important to note that the reserve accounts (blue line) are only available to Tier II Commercial Banks.[22]

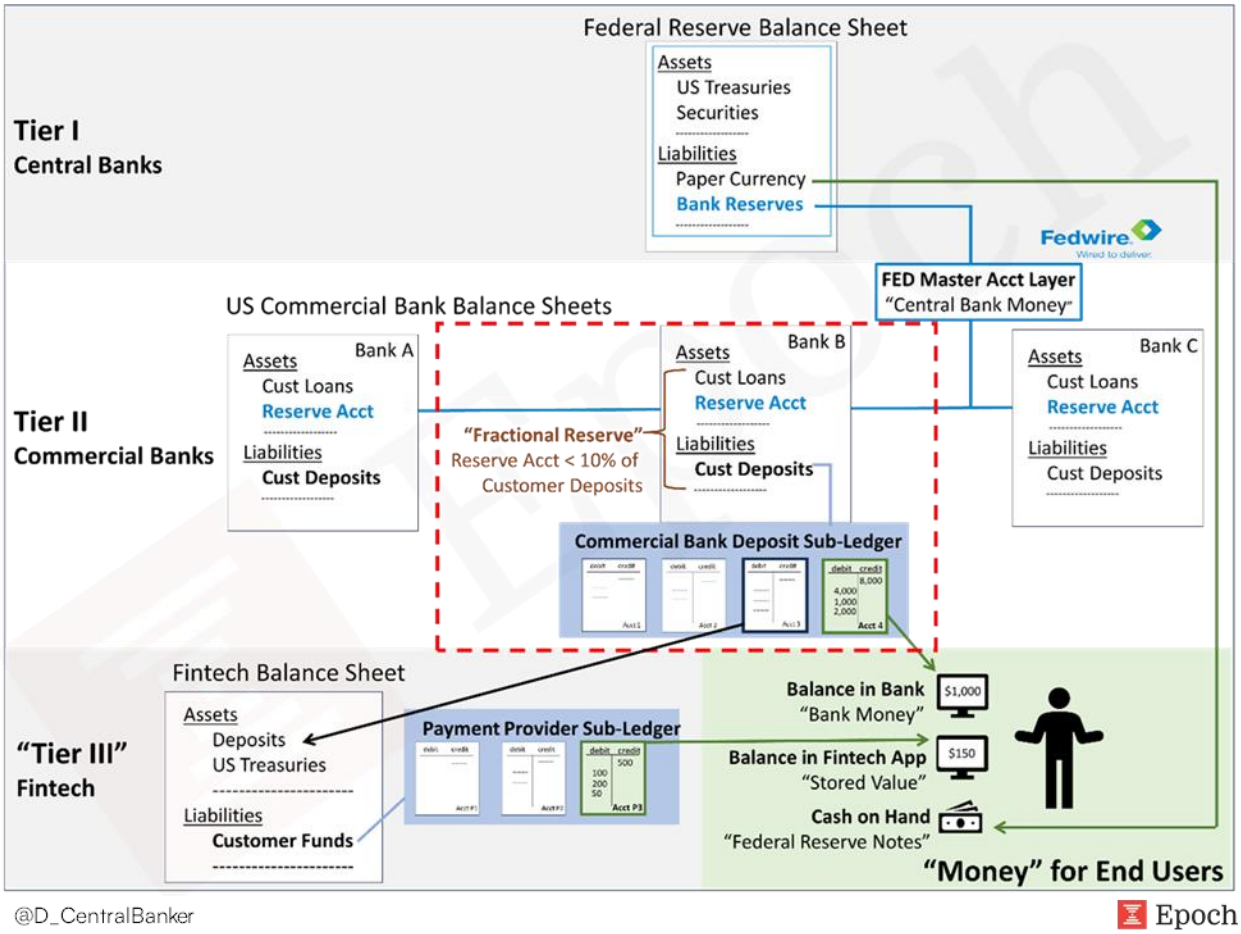
Shifting to the asset make-up of the Fed's balance sheet (i.e., what the Fed owns), again you see this consists primarily of U.S. Treasuries and other government-backed securities.[23] We'll revisit this when we talk about stablecoins and tokenized reserve deposits in the *Market Overview* section of the report.

Central Bank Reserves in Summary
The reserves held at the central bank are used exclusively for interbank transactions and are not available to the public. These reserves serve as the base layer of liquid collateral which underpins all customer deposits in the banking system, though only a small fraction of customer deposits are actually backed by these reserves.

[18] **CPMI-IOSCO**, *Principles for Financial Market Infrastructures*, April 2012, Section 3.9.3 ("Central bank money"). Available at: https://www.bis.org/cpmi/publ/d101a.pdf
[19] **European Central Bank (ECB).** "Central bank money settlement of wholesale transactions in the face of technological innovation." *ECB Economic Bulletin*, Issue 8/2023.
"The Eurosystem facilitates the settlement of wholesale financial transactions in central bank money, the safest and most liquid settlement asset." https://www.ecb.europa.eu/press/economic-bulletin/articles/2024/html/ecb.ebart202308_01~d9a13e1609.en.html
[20] Central bank money is a core component of base money. Base money consists of two elements: reserves held by commercial banks at the central bank, referred to as central bank money, and physical currency issued by the central bank. Primarily used for inter-bank settlement, central bank money forms the foundation of the fiat monetary system. **Matthew Mezinskis**, *"Top Money: Understanding the Layers of Global Money,"* Porkopolis Economics. Available at: https://www.porkopolis.io/topmoney/
[21] **Board of Governors of the Federal Reserve System**, *Fedwire Funds Service*. Available at: https://www.federalreserve.gov/paymentsystems/fedfunds_about.htm
[22] Board of Governors of the Federal Reserve System. "Can individuals, businesses, or government agencies open accounts at the Federal Reserve?" FederalReserve.gov, Accessed August 2025. https://www.federalreserve.gov/faqs/about_12799.htm
[23] **Board of Governors of the Federal Reserve System.** *Factors Affecting Reserve Balances — H.4.1 Statistical Release*, July 31, 2025. https://www.federalreserve.gov/releases/h41/20250731/h41.pdf

Commercial Bank (Tier II)

Moving down to Tier II (i.e., commercial bank) balance sheets, we will focus on Bank B (middle of the second row).



Note that for Bank B, we can see a sub-ledger of the customer deposits liability. The sub-ledger is a special system which keeps track of specific deposit accounts, transactions, etc., for each of the bank's customers. The aggregated total of the deposit sub-ledger at any point in time will equal the amount shown on the customer deposits liability line of the bank's balance sheet. This is a simple mathematical function and is not subject to asset valuations.

Having established that the aggregate sum of the deposit sub-ledger for any commercial bank will be equal to the amount of customer deposits, let us shift our focus to the asset side of the bank's balance sheet, which serves as the "backing" for the customer deposit liability.

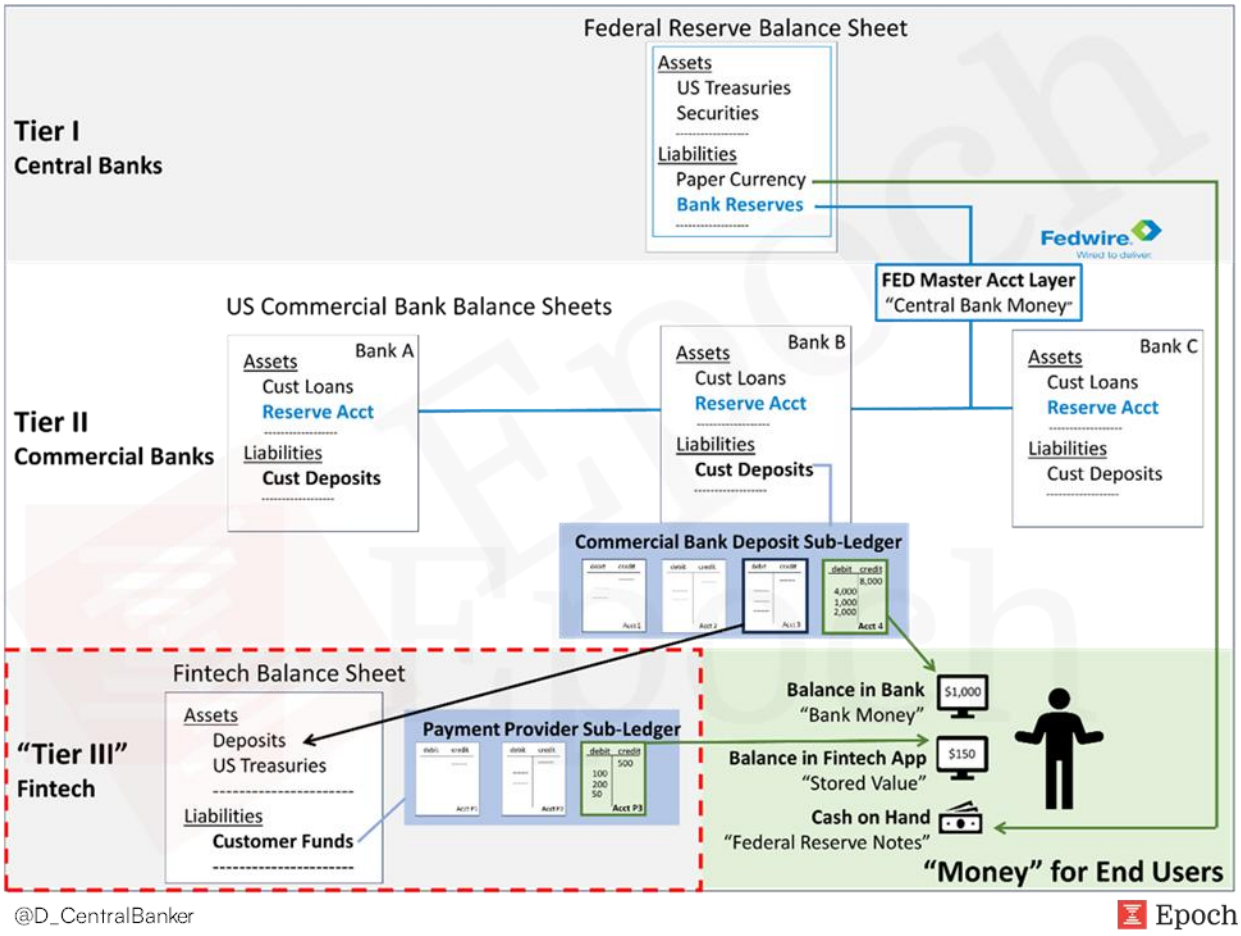
For Bank B we can see the customer deposit liability is backed by both a reserve account, which rolls up to the central bank, and customer loan assets, which represent loans the bank has made to its customers. The note in brown (middle of the diagram above) highlights the money creation process of fractional reserve banking, namely that the customer deposits are not backed 1:1 with the reserve account. In fact, a bank will typically hold less than 10% of its customer deposit

liability in its reserve account with the central bank[24]. The remainder of that deposit liability, which the bank's customers consider money in the bank, is backed by loans (or other investments the bank has made). In short, when a bank issues a loan, it doesn't transfer existing central bank money to the borrower, it typically increases the borrower's deposit balance and records an offsetting loan asset on its own books. In doing so, the bank creates new money by expanding its own balance sheet.[25]

> **Loans as Deposit Backing**
> While depositors see U.S. dollars in their accounts, those deposits are primarily backed by loans the bank has issued and carries as assets on its balance sheet.

Fintech (Tier III)

Positioned below the commercial banking tier in the lower left of the diagram, the fintech tier is shown.



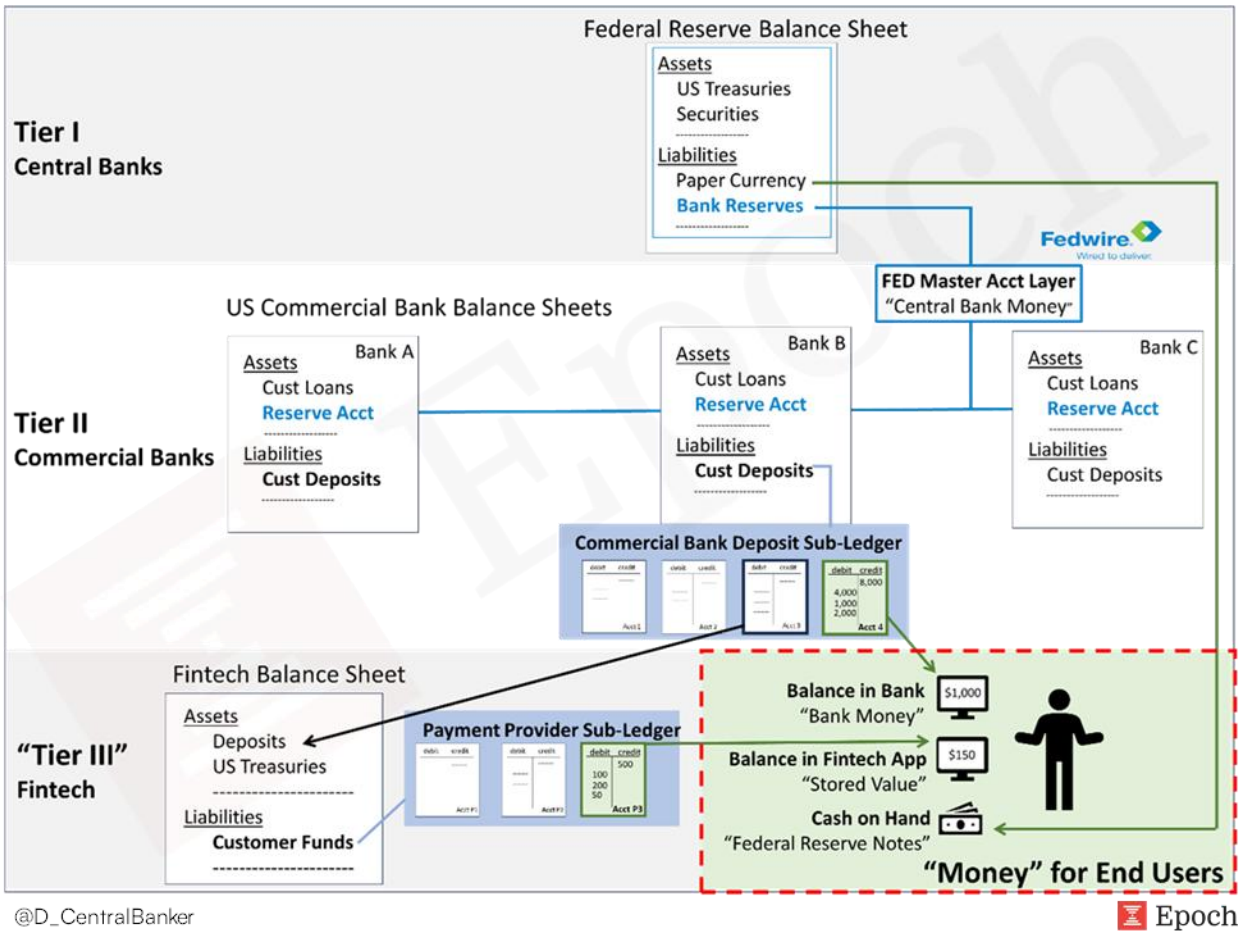
[24] **Federal Reserve Board.** "The reserve requirement ratio is currently 0%." *Reserve Requirements*, updated March 2020. https://www.federalreserve.gov/monetarypolicy/reservereq.htm

[25] **McLeay, Michael, Radia, Amar, and Thomas, Ryland.** "Money creation in reality." In *Money in the Modern Economy*, *Bank of England Quarterly Bulletin*, Q1 2014, pp. 17–24. https://www.bankofengland.co.uk/-/media/boe/files/quarterly-bulletin/2014/quarterly-bulletin-2014-q1.pdf

While payment-focused fintechs operate systems similar to commercial banks (e.g., deposit sub-ledgers) and are subject to various registration and licensing regimes to govern their activities, these entities lack the authority to perform fractional reserve banking.[26] Fintechs instead hold customer funds on deposit at commercial banks and/or make conservative investments (e.g., U.S. T-Bills), in accordance with state licensing requirements, to back 100% of the customer funds on their balance sheet.[27]

Money's End Users (Tier III)

Now we return our focus to the lower right-hand portion of this diagram, which shows how to map end-user money back to its source in the two-tier banking system.



[26] CSBS. *Reengineering Nonbank Supervision*, Aug 2019, Ch. 2, p. 5 — "Instead of a fractional reserve, there is a 100% reserve requirement https://www.csbs.org/node/196861

[27] CSBS. *The Reality of Money Transmission*, Nov 12, 2024 — *Myth 3: Variations in state laws allow money transmitters to make risky financial investments that put consumers at risk.* https://www.csbs.org/reality-money-transmission-secure-convenient-and-trusted-under-state-supervision

Each form of money can be traced to a complex stack of ledgers and legacy technology solutions. For example:

- A fintech user sees a stored value account balance, which is actually a liability tracked on the fintech's sub-ledger, backed by commercial bank deposits (and possibly highly liquid securities).
- The commercial bank, in turn, holds a fraction of the user's account value in its reserve account at the Federal Reserve to back the deposit claim. The rest of that claim is backed by loans and potentially other assets of the bank.

The IOU Stack of Fiat

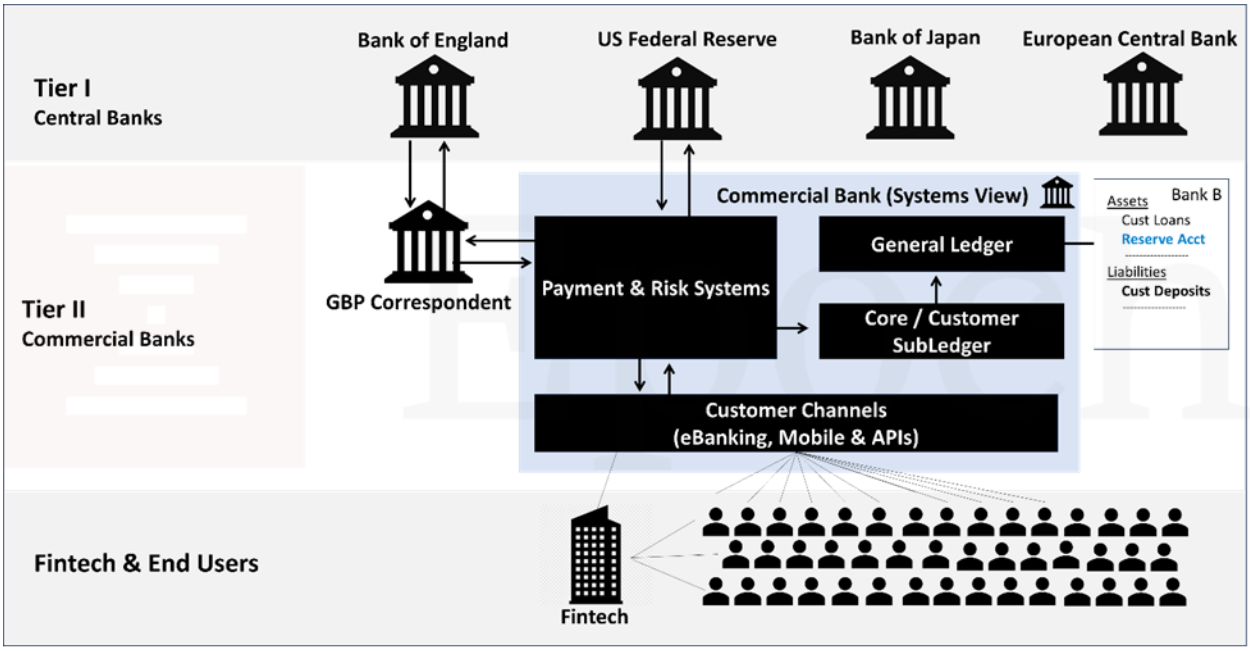
This multi-layered system reveals fiat money as a complex structure of IOUs.[28] Each tier of this stack introduces additional operational friction and counterparty risk, creating a complex web of activity, distorting the concept of money with the systems and ledgers which move it.

[28] **McLeay, Michael, Radia, Amar, and Thomas, Ryland.** "Money is an IOU" Money *in the Modern Economy*, *Bank of England Quarterly Bulletin*, Q1 2014, pp. 17—24. https://www.bankofengland.co.uk/-/media/boe/files/quarterly-bulletin/2014/quarterly-bulletin-2014-q1.pdf

V. Commercial Banking System View of Two-Tier Banking

Having examined how fiat money is both created and accounted for in the modern banking system, we now turn our focus to how those balance sheets are managed in practice, namely through technology systems.

Figure 6: Commercial Bank — Systems View



While most institutions in figure 6 are represented as a single building icon, one U.S. commercial bank (blue box) is exploded to reveal the key components of its internal architecture (i.e., a high-level "systems view").

The arrows in this diagram show a basic flow of data through the bank's systems, which work together to manage state change of the bank's balance sheet (carried forward from figure 5). A primary function of the commercial bank, which is shown here, is the connection of end users and fintechs (Tier III) with the central bank (Tier I). It's worth pausing for a moment to note that this is no small feat. The technology and operational processes which must function daily within each bank in order to maintain accurate records, and ultimately trust in the existing system, is nothing short of remarkable, particularly when considering the tenure of many of the systems operated by these same banks. [29]

To the left of the commercial bank "systems view", we see how the institution has structured its operations to access British Pound Sterling (GBP) and, ultimately, the Bank of England's ledger.

[29] **Federal Reserve Bank of Kansas City.** *Core Banking Systems and Options for Modernization*, Payments System Research Briefing, May 2023. https://www.kansascityfed.org/research/payments-system-research-briefings/core-banking-systems-and-options-for-modernization/

In short, GBP access is achieved through a fellow Tier II commercial bank which has direct access to the Bank of England, providing Bank B with correspondent banking services.[30]

VI. Bitcoin as a Central Bank

Ask most bankers today how Bitcoin fits into the financial system, and you'll likely get a diagram that looks something like figure 7 (below), with Bitcoin off to the side as a curiosity or threat, bypassing the traditional flow of currency from central banks, through commercial banks, and instead sitting down somewhere in the fintech world (i.e., Tier III).

Figure 7: Perception of Bitcoin as an "alternative" Type of Monetary Asset

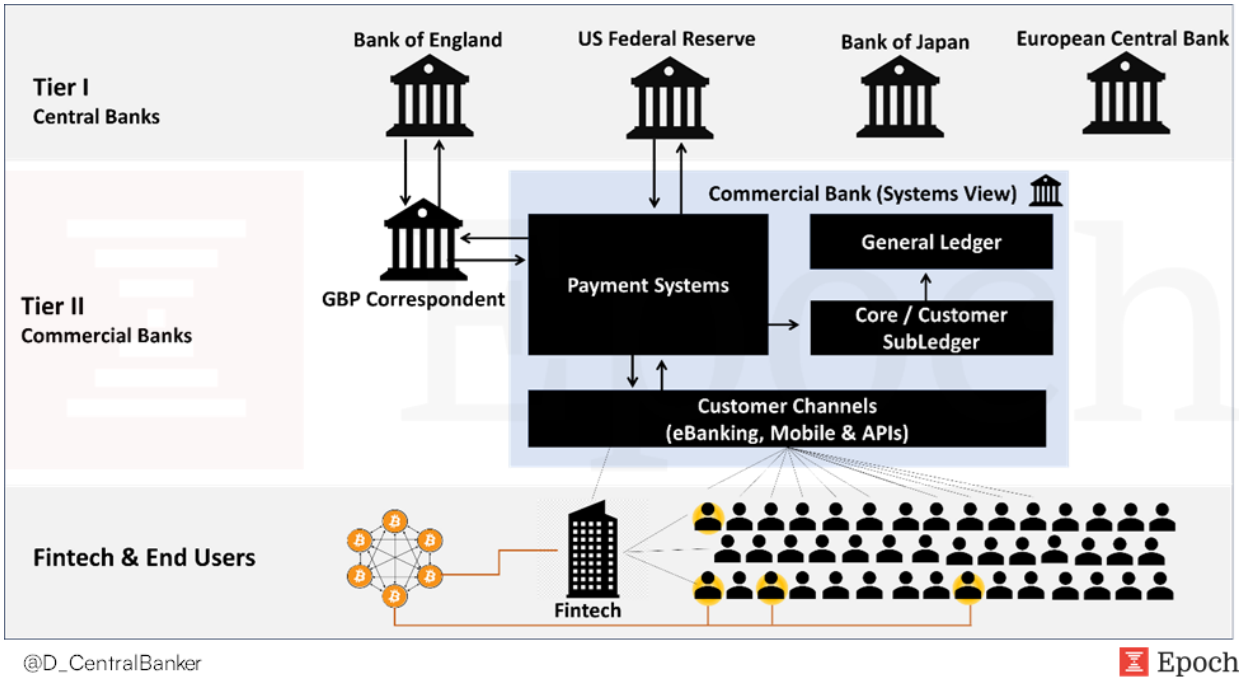
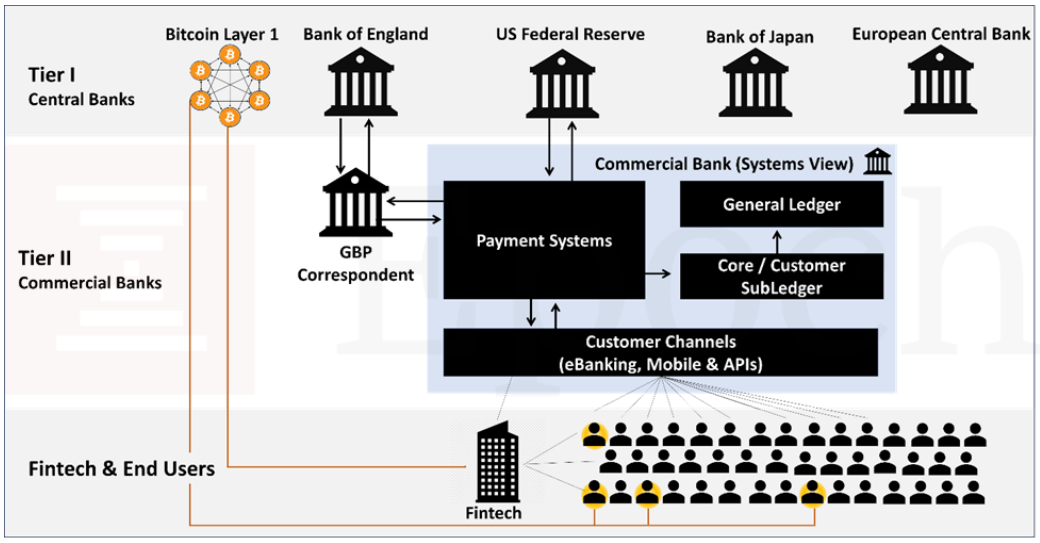


Figure 7 is the current perception of Bitcoin, and it's deeply flawed. In the revised diagram below (figure 8), we see Bitcoin not as a side network, but as a monetary system with a base asset similar to central bank reserves: final settlement and limited counterparty risk.[31] Bitcoin operates on a global ledger that any person or institution can access. From a systems perspective, it functions today as a decentralized central bank, open to all.

[30] **Investopedia.** "Correspondent Bank: Definition and How It Works." Updated July 29, 2025. https://www.investopedia.com/terms/c/correspondent-bank.asp

[31] **Office of the Comptroller of the Currency**, *Counterparty Risk.* Available at: https://www.occ.treas.gov/topics/supervision-and-examination/capital-markets/financial-markets/counterparty-risk/index-counterparty-risk.html comptrollerofthecurrency.gov+15occ.treas.gov+15reddit.com+15

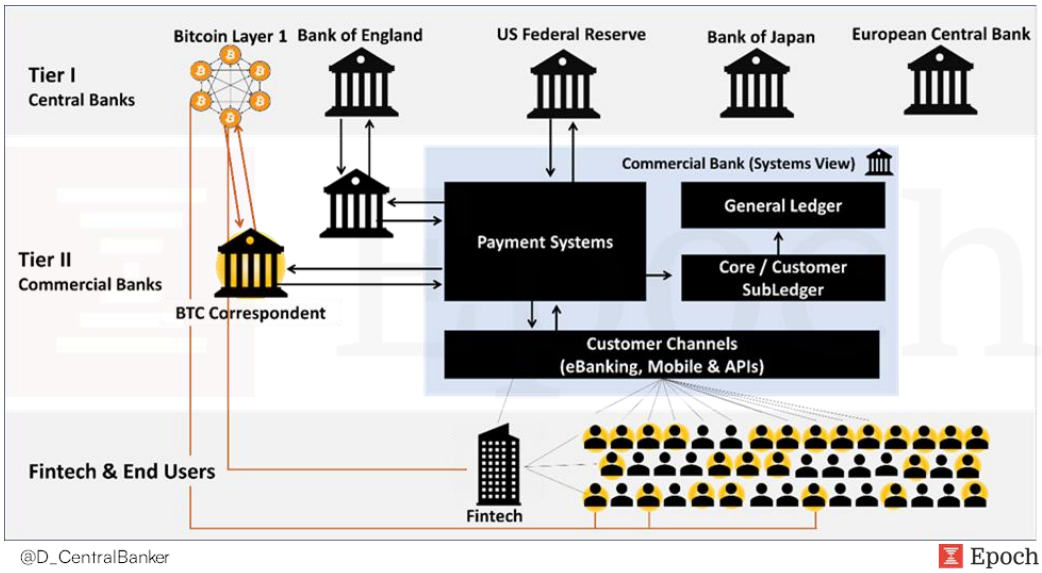
Figure 8: Reality of Bitcoin as a Central Bank (Current State)



This perspective shift is crucial. Because when you see Bitcoin not as an alternative or replacement for the global banking system, but as a participant within it, the path forward becomes obvious.

The future state doesn't look revolutionary; it looks familiar. Banks already use correspondent institutions to access foreign central bank ledgers. Adding a Bitcoin correspondent bank as shown in figure 9 below, fits neatly within that model. No reinvention of the banking stack is needed. The commercial bank plumbing remains largely intact.

Figure 9: Near-Term Future State — the Bitcoin Correspondent



What's different in this near-term state is the nature and role of the reserve asset. Bitcoin offers the same settlement finality as Fedwire, with transaction throughput that mirrors it. Unlike

traditional central bank reserves, Bitcoin operates on a globally accessible, politically neutral network, and the bitcoin asset itself is programmatically finite.[32] This combination positions it as the future of base money.[33]

Just as commercial banks today hold reserves at the Fed, Bank of Japan, or European Central Bank (ECB), they will, at some point, hold reserves on the Bitcoin ledger. The entry point is likely not radically different than connecting to a foreign central bank today; it's simply leveraging a designated correspondent. From there, Bitcoin can be integrated into treasury operations, custody infrastructure, and payment rails. And while some individuals and businesses will continue to connect directly to Bitcoin, many will access it through their commercial bank (Tier II), just as they do today for fiat money.

Conclusion

Bitcoin is being built independently of the current system, with its own native architecture, rules, and global settlement network. At the same time, it is increasingly being integrated into the existing financial infrastructure as collateral, as a settlement rail, and as a reserve asset.[34] In fact, Bitcoin's ability to operate both outside the existing financial system and within it makes it uniquely positioned. **Bitcoin is the only asset that can function as a sovereign, censorship-resistant base layer, while also plugging into the legacy stack as a form of Tier I base money.** This dual capability, both standalone and interoperable, is what makes bitcoin the apex predator of reserve assets. No other form of money has these properties.

Roughly 180 central banks issue base money today. Bitcoin already ranks among the **top five** by market value, and it combines absolute sovereignty with seamless bank integration. Commercial banks are starting to connect to the Bitcoin network as they do other central banks... we call this emerging trend deCentral Banking.

[32] River Financial. "Can Bitcoin's Hard Cap of 21 Million Be Changed?" River Learn, 2025. https://river.com/learn/can-bitcoins-hard-cap-of-21-million-be-changed/
[33] Mezinskis. (2025). Top monetary assets worldwide [Web page]. Porkopolis Economics. "The future is already here, it's just not very evenly distributed" - William Gibson. Retrieved from https://www.porkopolis.io/topmoney/
[34] "Czech central bank governor to present plan to hold reserves in bitcoin — FT reports," *Reuters*, January 29, 2025, https://www.reuters.com/technology/czech-central-bank-governor-present-plan-hold-reserves-bitcoin-ft-reports-2025-01-29/.

BITCOIN BANKING AT THE MARGIN

Bitcoin Banking at the Margin

In Bitcoin Marginalism,[35] we argued that progress comes from engaging "at the margin", the point where market realities are tested, value is created, and adoption accelerates. In banking, this is when a Bitcoin-related product has moved beyond early experimentation to become technically mature, operationally tested, and commercially viable.

As discussed in the previous section, the lines between traditional banking and Bitcoin are being blurred. Commercial banks are already beginning to experiment with direct integration into the Bitcoin network, and the question is shifting from *if* to *when* these services will be launched at scale. This is not about speculative technologies or distant possibilities. These are products that have already been piloted, tested in live environments, or quietly deployed in limited contexts. For years they sat on the edge of broader rollout, awaiting only the right regulatory climate to move into the mainstream. We believe that time has come.

Five Bitcoin Banking Services

The following Bitcoin-related services are technically viable, strategically compelling, and ready to move from early pilots to scaled, revenue-generating bank products.

(1) Bitcoin Custody

Banks are positioning to safeguard Bitcoin with the same trust, scale, and regulatory oversight they bring to gold and other high-value assets. Custody technology has matured to deliver bank-grade security, compliance, and operational integration. As the foundational layer, custody enables other high-value services, including brokerage, lending, and settlement.

(2) Brokerage Services

The ability for bank clients to buy, sell, and hold Bitcoin directly through their existing banking relationships is increasingly expected. ETF approval has further legitimized the asset class, prompting more banks to explore direct integration into their wealth and retail platforms. This service often builds on an existing custody capability, allowing banks to execute and settle client trades securely within their own infrastructure.

(3) Bitcoin-Backed Lending

What will likely evolve to be viewed among the most attractive forms of secured lending a commercial bank can offer, Bitcoin-backed loans use a highly liquid, 24/7-settled asset as collateral. Structurally similar to securities-based lending, these loans unlock liquidity for holders

[35] For a detailed discussion of this concept, see *Bitcoin Marginalism* (Epoch Management, 2024), available at: https://epochvc.io/pdf/Bitcoin-Marginalism-Epoch-Management-2024.pdf.

without requiring asset sales. The path forward depends on robust custody frameworks and avoiding the risks of collateral rehypothecation.

(4) Cross-Border Settlement

Bitcoin offers permissionless final settlement that bypasses the delays, costs, and intermediaries of traditional correspondent banking chains. While stablecoins will dominate certain corridors, Bitcoin is uniquely positioned for markets where finality, neutrality, or independence from capital controls is paramount. In some use cases, it will complement stablecoins; in others, it may outperform them entirely.

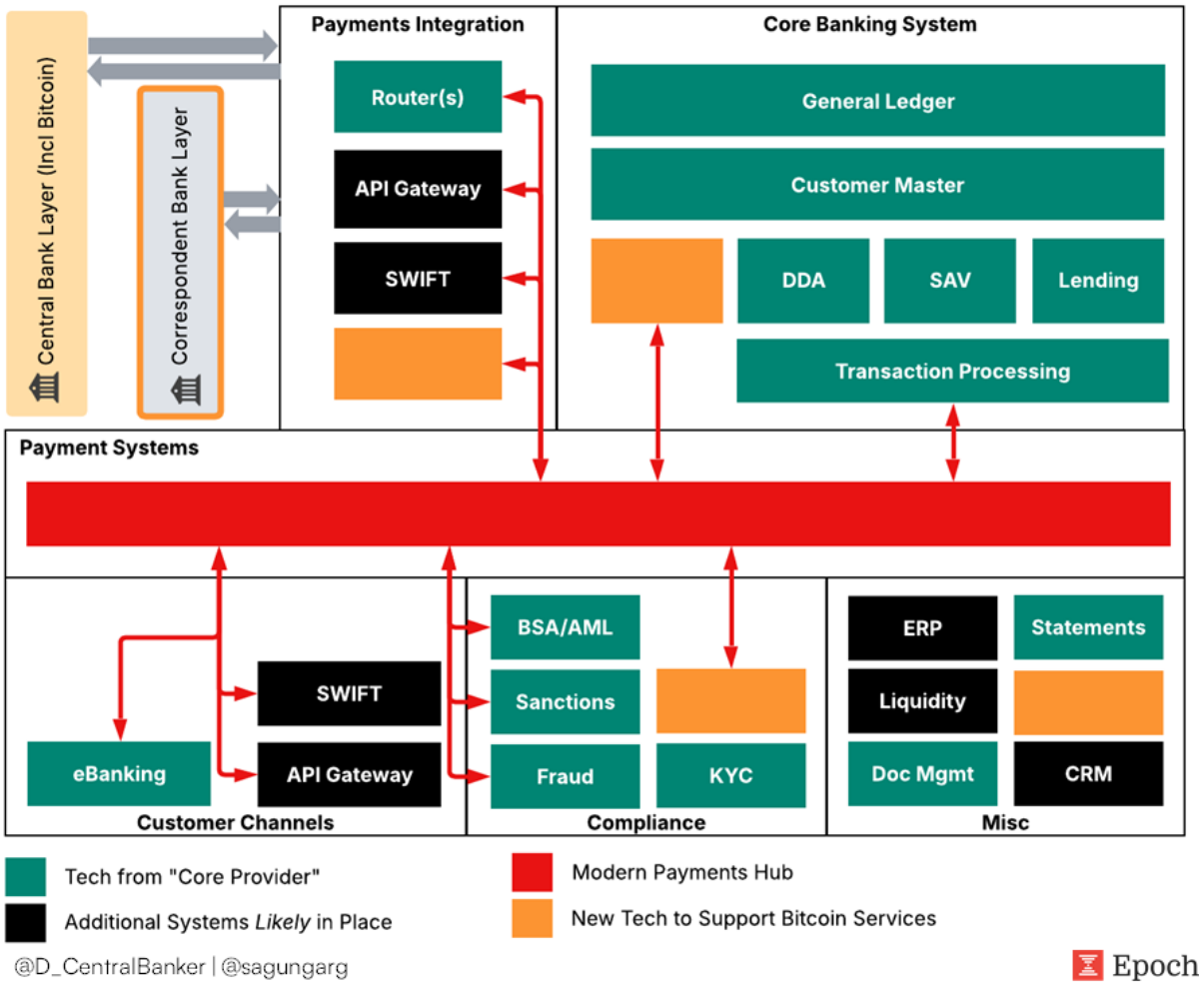
(5) CBDCs & Tokenized Bank Money

Banks are piloting tokenized deposits, reserves, and treasuries, often via stablecoins. While not directly tied to Bitcoin today, this infrastructure will form the plumbing for future Bitcoin integration, with Bitcoin's role as a reserve layer potentially becoming a key differentiator. As tokenized money markets mature, competition will increasingly center on transparency, settlement assurance, and reserve composition.

A Call to Action: Pain points and Strategy

This specific section is written for industry practitioners. As an investor or more general reader you can advance to market overview section.

For innovators and builders exploring Bitcoin-integrated banking, we encourage you to review the *Bitcoin Bank Integration* section at the end of this report, which includes a more detailed reference architecture and exploration of the Commercial Bank System View (shown below).



Our goal with this paper is to help banks see the benefits of adopting Bitcoin, anticipate the pain points, and understand how founders can address them through targeted products and services. In the following section, we outline a few challenges and potential mitigation strategies.

Traditional Banks

Primary Problems

Commercial banks will seek to begin offering Bitcoin services (and other digital signature-based assets) through correspondent banks, but U.S. Banks in particular often lack sophistication in managing correspondent relationships at scale. Compounding this, their legacy core banking systems they run are not fit for purpose to support digital signature-based assets. Over time, this will constrain the bank's strategic flexibility and competitiveness. Consider the following primary issues:

1) Replacing the core is time consuming and doesn't materially improve things: all legacy cores with broad support of fiat products, are about the same (old tech, vendor lock-in, etc).

2) Standing up a side-car core system, and/or additional supporting systems to meet existing control objectives for digital signature-based assets is complicated by core bank service providers' unwillingness or inability to integrate new systems.
3) Most banks, at least in the US, do not have a modern payments hub which would allow them to effectively operate multiple cores and integrate new fit for purpose systems to support digital signature-based assets.

Potential Strategies for Traditional Banks

Approach	Tips	Challenges
"Me Too": Wait until existing core banking service provider partners with digital asset providers and offer services that become possible.	• Evaluate parallel ledger architectures and payments hub vendors to reduce strategic risk.	• Banks that wait for their existing core banking providers to enable digital asset services risk delayed market entry, limited product scope.
Tactical Partnerships: Partner with a digitally native institution (e.g., PNC's recent partnership with Coinbase), capable of providing digital asset correspondent banking services and build appropriate point-to-point integrations with this provider.	• Select partners with a proven track record in regulated environments and a clear roadmap that aligns with your bank's strategic goals. • Prioritize those who can grow with you into new markets and services, reducing the risk of outgrowing the relationship.	• Partnerships with digitally native institutions can accelerate market entry, but point-to-point integrations often create long-term technical debt, operational dependencies, and limited flexibility to switch providers. • Custodial partners may not provide bitcoin specific protocol stack services (Multi-Sig, Miniscript, etc).
Strategic Architecture: Implement a modern Payments Hub to reduce vendor lock-in and take control of payment orchestration enabling multi-correspondent offerings.	• Start with phased deployment, targeting high-impact payment flows first (e.g., cross-border or digital asset settlement), then expand to other payment types.	• Implementing a modern payments hub requires significant upfront investment, cross-department coordination, and changes to entrenched operational processes.

Start-Up Financial Institutions

Start-ups have an opportunity to outperform incumbent banks on digital services, or even provide correspondent services to existing banks, but they must navigate infrastructure,

compliance, and customer-trust challenges when offering Bitcoin (and other digital signature-based asset) services. Without a clear architectural strategy, and a commitment to compliance, they risk building fragmented systems that are expensive to scale and difficult to differentiate in a competitive market.

Advantages

1) Without decades of technical debt, start-ups can integrate Bitcoin-native correspondent networks early, gaining settlement flexibility, liquidity access, and global reach faster than traditional banks.
2) Start-ups can design custody models for differentiation from the outset. MPC offers cross-chain compatibility, while collaborative custody (e.g., 2-of-3 key structures with shared custody model) provides a trust advantage, accepting manageable UX tradeoffs for stronger client control and security.
3) Bitcoin-backed lending can be built around a specialized collateral management platform purpose-built for protocol-aware monitoring, real-time LTV tracking, automated margin calls, and compliant liquidation, features that incumbents struggle to retrofit into their systems.
4) Bitcoin-focused RIAs can structure their operations, client service, and compliance frameworks to meet private banking standards from day one, making them prime acquisition targets as private banks expand digital asset capabilities.

Potential Strategies for Start-Up Financial Institutions

Approach	Tip	Challenges
Bitcoin-Native Correspondent Banking: Become the Bitcoin-native correspondent to help banks deliver faster settlement, lower costs, and broader reach, without having to wait for their legacy provider to adapt.	• Implement collaborative custody to differentiate and strengthen client trust, or • Leverage MPC for cross-chain asset support and operational flexibility.	• Banks will apply rigorous third-party risk management (TPRM). • If you are in the flow of funds, expect licensing requirements in applicable jurisdictions.
Specialized Bitcoin Lending Platform: Deploy a niche-specific collateral management system that handles the full Bitcoin lending lifecycle natively, from monitoring to liquidation, with minimal operational friction.	• Integrate directly with custody platforms to streamline operational processes, from collateral verification to release. • Build automated LTV monitoring and margin-call triggers tied to live market data feeds. • Support multiple custody models (including collaborative custody) to appeal to both banks and high-net-worth clients.	• Banks will apply rigorous third-party risk management (TPRM). • Custody integrations can be complex, particularly when supporting multi-custodian arrangements. • Consumer lending activities may trigger state-by-state licensing requirements and must adhere to a patchwork of lending, disclosure, and usury regulations.
RIA-to-Private Bank Positioning: Design the business as if a private bank will acquire it tomorrow, offering white-glove service, robust compliance, and smooth integration potential.	• Build client service processes to private banking standards, including personalized relationship management and high-touch communication. • Implement compliance and reporting frameworks that meet or exceed bank regulatory expectations.	• Committing to bank-grade processes can slow product iterations. • Differentiating enough to thrive independently while still aligning with private banking norms.

Conclusion

Custody, brokerage, Bitcoin-backed lending, cross-border settlement, and tokenized bank money now sit at the forefront of Bitcoin's integration into banking. These are not speculative ideas, they are the product of years of technical refinement, regulatory adaptation, and

competitive testing by both banks and fintechs. With historic barriers such as SAB 121's accounting constraints and the chilling effects of Operation Chokepoint 2.0[36] beginning to recede, new incentives are emerging: competitive pressure from digital-first challengers, opportunities created by the GENIUS Act,[37] and Bitcoin's appeal as a politically neutral, credibly scarce reserve asset.

The sections ahead move from strategy to execution. The *Market Overview* quantifies the opportunity for each service, while the *Bitcoin Bank Integration* section offers a practical roadmap for building them, detailing the architectures, integrations, and operational models that can bring these offerings from "at the margin" to mainstream adoption.

[36] For background on Operation Chokepoint 2.0, see the *Market Overview* section's regulatory environment note, and refer to the *OCP 2.0 Appendix* for a detailed chronology.
[37] *Guiding and Establishing National Innovation for U.S. Stablecoins Act* (GENIUS Act), Pub. L. 119-27, July 18, 2025; https://www.congress.gov/119/plaws/publ27/PLAW-119publ27.pdf

MARKET OVERVIEW

Introduction

As discussed above, Bitcoin can be understood as a new type of central bank, operating within the existing two-tier banking framework. Unlike the others, it is the only central bank that is apolitical and provably neutral. Its novelty comes from two distinct aspects:

- The Bitcoin network (uppercase B) provides settlement finality and can interact with new systems that the traditional system cannot (at least directly)
- The bitcoin asset (lowercase b) is deterministically issued and possesses unique properties that the other central banks cannot replicate themselves (at least directly)

The unique capabilities of the Bitcoin network, combined with the distinct properties of the bitcoin asset, create the foundation for a new class of banking services. In the sections that follow, we examine the five "at the margin" offerings most likely to shape early bank integration.

I. Bitcoin Custody
II. Brokerage Services
III. Bitcoin-Backed Lending (Asset-Based Lending)
IV. Cross Border Settlement
V. Central Bank Digital Currencies (and Tokenized Bank Money)

A Note on Historical Regulatory Challenges

As with all new technologies threatening an entrenched incumbent, Bitcoin has, over the past 16 years, seen varying degrees of regulatory acceptance and challenges. The most notable regulatory challenge in the U.S. occurred during the Biden administration in the period from 2022 to 2024, which has been chronicled in multiple detailed blog posts by Nic Carter (Pirate Wires) and referred to by the industry using the name first suggested by Nic, "Operation Choke Point 2.0." Throughout this paper you will see the tag [OCP 2.0] used to indicate where additional context related to specific adverse regulatory events may be useful. While the reader who is uninterested in past regulatory issues may safely skip over these references, an appendix providing a summary of these events, along with some additional contextual references, has been included at the end of this paper.

I. Bitcoin Custody

Banks began announcing the intent to offer bitcoin custody services in 2021, driven in large part by regulatory clarity from the Office of the Comptroller of the Currency (OCC) in November of that year.[38] This opened the door for banks to support digital assets, but the door did not remain open for long. By March 2022, the U.S. Securities and Exchange Commission (SEC) under Gary Gensler had issued Special Accounting Bulletin 121 ("SAB 121"), requiring banks to record custodied crypto assets as liabilities on their balance sheet [OCP 2.0]. This unique treatment for

[38] Interpretive letter #1170 available at this link: https://www.occ.gov/news-issuances/news-releases/2021/nr-occ-2021-121.html

crypto asset custody, as compared to other custody services, made provision of crypto custody services challenging for banks from a capital perspective.

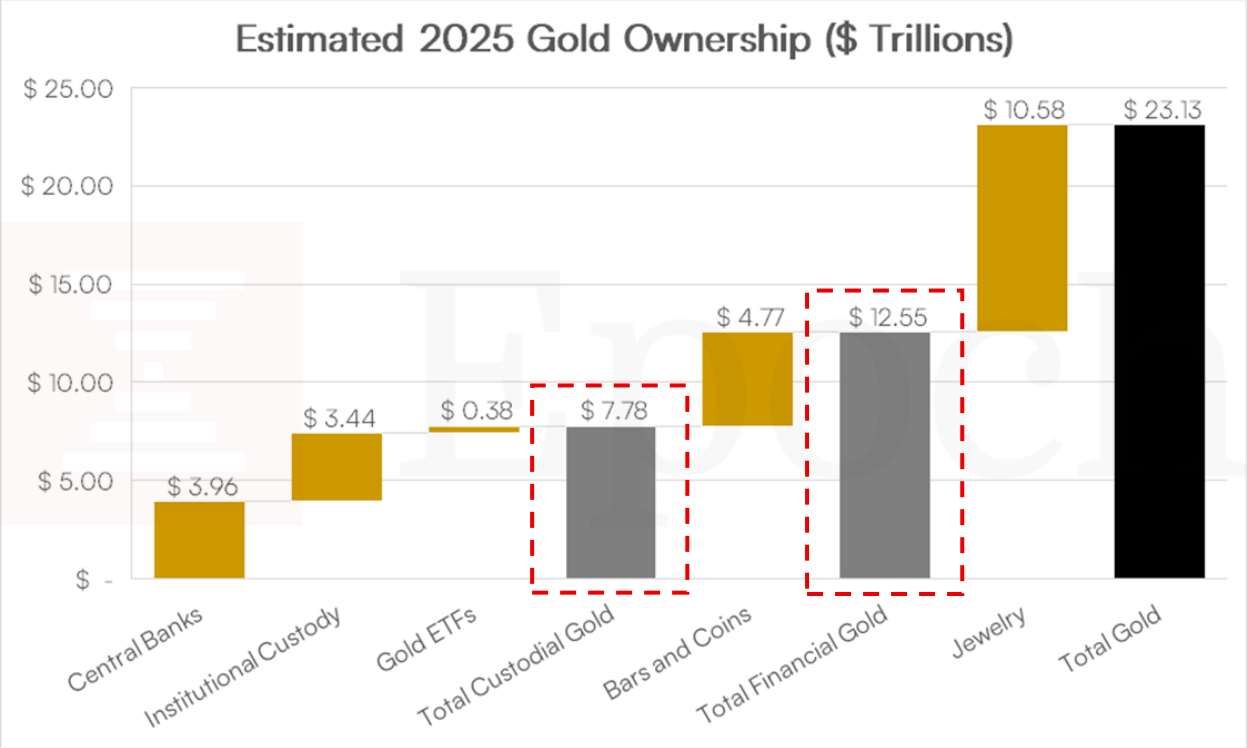
Below is a short list of custody related announcements made over the past 5 years:

Bank	Year	Implementation	Description
U.S. Bank	2021	Outsourced	Partnered with NYDIG as its qualified sub-custodian leveraging its expertise in regulatory compliance.
State Street	2021	Outsourced	Collaborated with Lukka for data services and Gemini for custody and New York for regulatory compliance.
Anchorage Digital	2021	In-House	Received an OCC trust charter making Anchorage Digital the first federally regulated digital asset bank. Provides Bitcoin custody infrastructure that can be leveraged by other banks.
BNY Mellon	2022	Outsourced	Collaborated with Fireblocks and Chainalysis to develop a custodial platform for Bitcoin and Ether.
Standard Chartered	2023 & 2025	Joint Venture	Partnered with Northern Trust to launch Zodia Custody allowing Standard Charter to offer custody without direct balance sheet exposure in Europe. In 2025 services were expanded into the U.S.
Deutsche Bank	2025	Joint Venture	Plans to launch institutional-grade Bitcoin and crypto custody services in 2026, developed in partnership with Bitpanda's technology unit and Swiss custodian Taurus SA.
SoFi	2025	TBD	Announced plans to reenter crypto with custody and staking services slated to launch in late 2025.

Market Size

SAB 121 greatly hindered growth of crypto custody service and likely contributed directly to the centralization of Bitcoin ETF custody with Coinbase, a non-bank financial institution or "fintech" company serving the Bitcoin space since 2012. SAB 121 was rescinded in early 2025[39], and banks are once again signaling intent to enter the bitcoin and crypto custody space. We anticipate that the addressable market size for custodial bitcoin services to approach the market size of gold custodial services.[40]

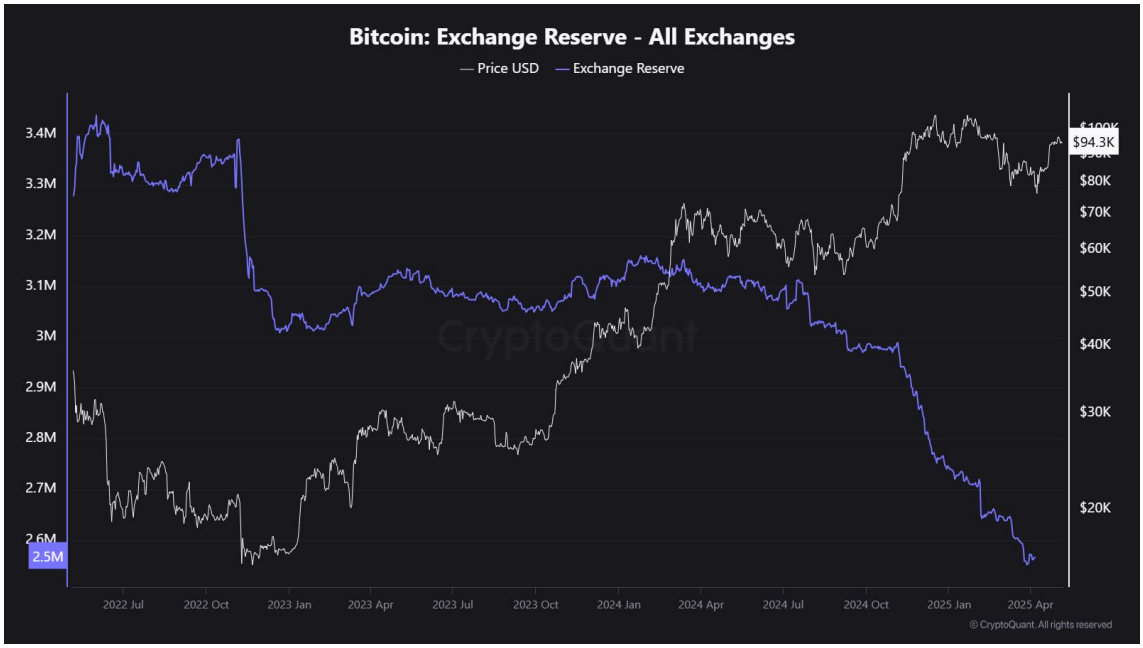
[39] In May 2024, a Bill with significant bi-partisan support passed in both the House and Senate to repeal SAB 121. This Bill was ultimately vetoed by President Biden. SAB 121 was later rescinded by the SEC in early 2025.
[40] We of course understand this to be much larger but presume this to be current perception of the banking industry at large.



The value of gold held in custody is ~$8 trillion (~33% of all gold), primarily consisting of central bank holdings, institutions, and ETF products. The remaining 66% of the market is held by the individual or in a quasi-form of custody (e.g., safety deposit). We expect Bitcoin to consume the market for financial gold (i.e., non-jewelry gold) of $12.55 trillion, with 62% currently in custody.

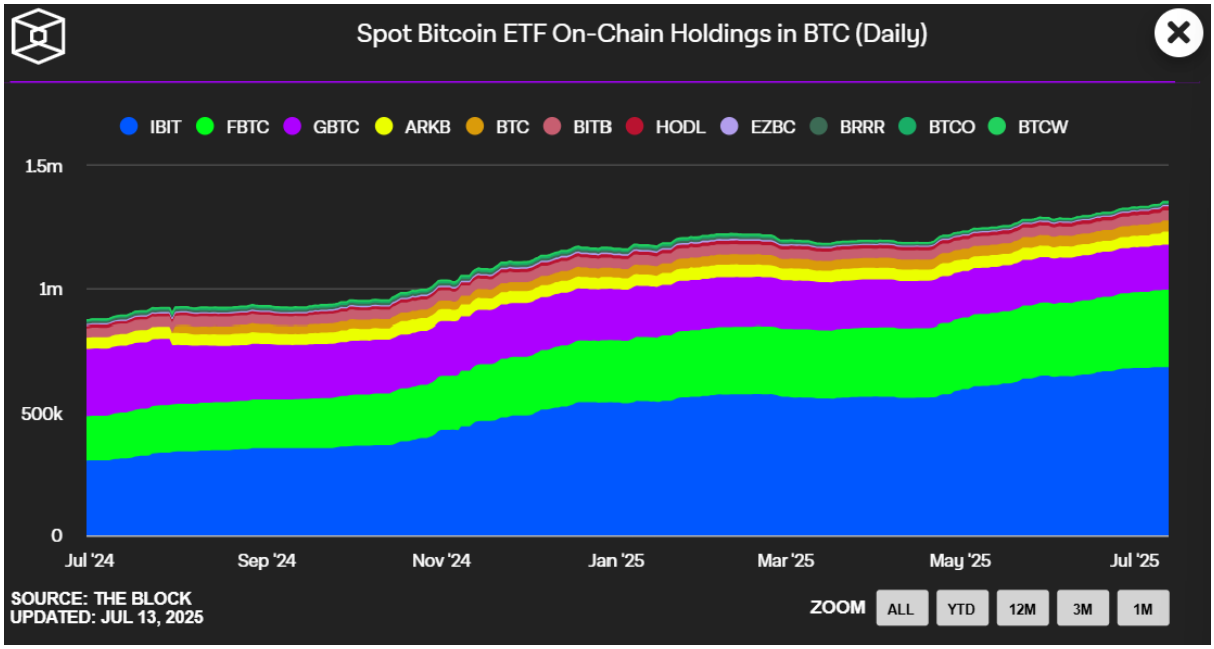
Thus, because bitcoin cannot be used as jewelry, we expect banks to view over half of the Bitcoin market capitalization as addressable for services. However, the fundamental properties of bitcoin enable self-custodial ownership that is drastically simpler, cheaper, and far more useful (e.g., permissionless cross-border payments) than holding physical gold. As such, the gold market is not a direct comparison but a proxy, and adjustments to the custodial market proportions should certainly be made downward.

For example, the estimated amount of bitcoin held on exchanges today is persistently falling since early 2024 and currently represents only ~13% of the outstanding supply at 2.4 million coins.



Source: Cryptoquant.com[41]

The ETFs hold an additional 1.4 million coins bringing the total custodial supply from both exchange reserves and ETF products to about ~19% of the total supply.



Source: The Block[42]

Banks may perceive the custodial market size to become gold-like in which case they expect somewhere between 30-60% of the total bitcoin market capitalization to be held at banks in the

[41] Available at: https://cryptoquant.com/asset/btc/chart/exchange-flows/exchange-reserve?exchange=all_exchange&window=DAY&sma=0&ema=0&priceScale=log&metricScale=linear&chartStyle=line
[42] Available here: https://www.theblock.co/data/crypto-markets/bitcoin-etf/spot-bitcoin-etf-onchain-holdings

medium term (~$0.6-1.2 trillion). This value will depend significantly on how central banks and government entities choose to hold bitcoin. Today, much of the custodial bitcoin is held via institutions, specifically the ETF products. As governments continue to adopt bitcoin as a strategic asset, a self-custodial approach may prove more rational to them and change custodial market proportions drastically.

Banks vs. Non-Banks

Custodial banks will likely be chosen for trust and scale, while non-banks (e.g., exchange custody) will be preferred for flexibility and cost. Banks and other SEC or Commodity Futures Trading Commission (CFTC) registered entities are eligible for the increased compliance levels of a qualified custodian.

Asset segregation and bankruptcy remoteness of custodial assets will protect clients in the event of insolvency. Further, integration with traditional infrastructure and existing client relationships will reduce the friction of participation. All that said, much of the technology and services we expect to be outsourced to crypto-native custodial providers with a minority of banks building solutions in-house.

Aspect	Qualified Custodian	Non-Qualified
Regulation	OCC, SEC, FDIC, FINRA, or state banking oversight	Variable prudential oversight (e.g., state licenses only)
Eligible Entities	Banks, trust companies, broker-dealers, FCMs, select foreign entities	Crypto exchanges, wallet providers, unregulated firms
Asset Protection	Segregated accounts, bankruptcy remoteness	No bankruptcy segregation requirements, higher insolvency risk
Compliance	Standardized audits, capital requirements, KYC/AML	Variable audits, minimal capital requirements
Client Trust	High (fiduciary obligations, required for institutions)	Lower (non-fiduciaries, act as intermediaries)
Costs	Higher fees due to compliance costs	Lower fees, cost-competitive
Innovation	Slower due to regulatory constraints	Faster, supports broader crypto services

Novel Applications

Collaborative Custody Bitcoin Accounts: A custodial service where Bitcoin is held in a 2-of-3 multisig wallet, with keys distributed among the customer, bank, and third-party provider. Customers can initiate transactions but require bank co-signing for compliance or security checks. This combines customer autonomy with banks' regulatory oversight, addressing concerns about single points of failure. This is applicable to customers like institutional investors

(e.g., hedge funds) or high-net-worth (HNW) individuals seeking secure storage with partial control.

Escrow arrangements: An escrow service using multisig wallets for transactions like real estate or M&A, where the buyer, seller, and bank each hold a key. Smart contracts automate condition verification (e.g., title transfer), releasing funds when two keys sign. This functionality reduces manual processes, enhances transparency, and leverages Bitcoin's ledger for immutable records. This can be applied to real estate purchases, cross-border trade, or online high-value transactions.

II. Brokerage Services

Similar to custodial services, brokerage services, enabling clients to buy, sell and hold bitcoin through their platform, began in 2021, following regulatory guidance from the OCC the year prior.

The SEC's approval of spot Bitcoin ETFs in January 2024 further legitimized bitcoin as an asset class, encouraging banks to integrate brokerage services. Thus far the primary brokerage services provided by banks in the U.S. include:

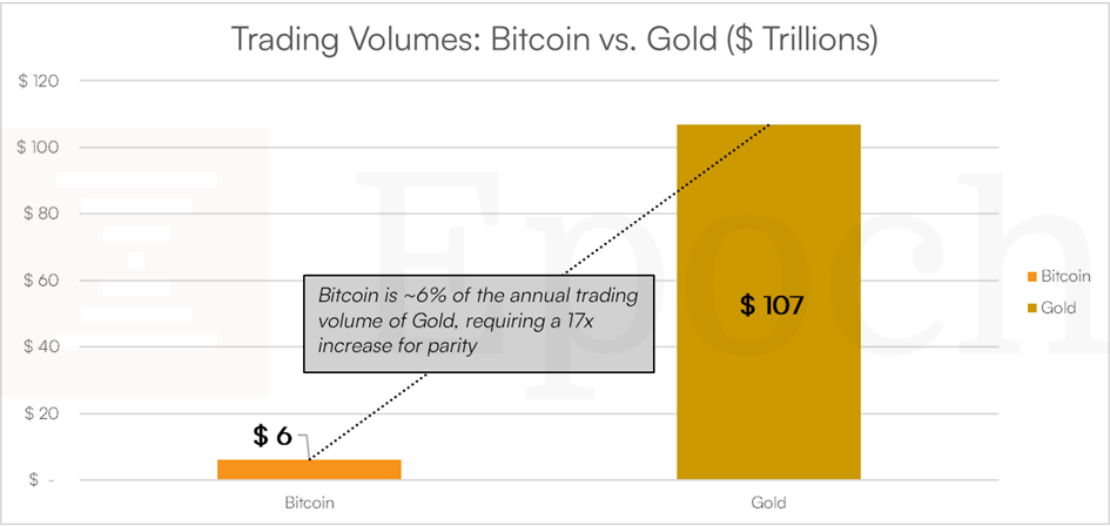
Bank	Year	Implementation	Description
VAST Bank	2021	Outsourced	Vast Bank was the first nationally chartered U.S. bank to enable direct bitcoin trading from a checking account, launching in 2021. Partnered with Coinbase for trade execution and custody, it offered retail customers the ability to buy, sell, and hold bitcoin through its mobile app, blending traditional banking with regulated crypto access (discontinued in 2024).
Morgan Stanley	2021	Outsourced	Morgan Stanley was an early mover among major U.S. banks, announcing in March 2021 that its wealth management clients could access bitcoin funds. By 2023, it expanded to offer direct bitcoin trading for HNW individuals with at least $2 million in assets. Partnered with Galaxy Digital, NYDIG, and Fidelity Digital Assets to provide fund exposure, trading, and execution.
Goldman Sachs	2021	Outsourced	In 2021, offering bitcoin non-deliverable forwards (NDFs) and CME bitcoin futures for institutional clients. In 2022, it became the first major U.S. bank to launch over-the-counter (OTC) bitcoin trading. By 2024, it extended direct bitcoin trading to private wealth clients. Goldman partnered with Galaxy Digital as its liquidity provider for OTC trading and uses Coinbase Prime for market access and execution.
JPMorgan Chase	2021	Proprietary & Outsourced	Despite CEO Jamie Dimon's 2017 dismissal of Bitcoin as a "fraud," JPMorgan began offering bitcoin funds to wealth management clients in 2021. By 2023, it expanded to direct bitcoin trading for select clients via its brokerage platform. The bank uses its proprietary blockchain platform. Kinexys (formerly Onyx), for trading and settlement, partnering with NYDIG for fund management and Chainalysis for compliance.
Citibank	2021	Outsourced	Citibank started offering bitcoin trading to institutional clients in 2021 through its wealth management division. By 2024, it expanded to select private banking clients, including Ethereum alongside Bitcoin. Citibank collaborates with Fidelity Digital Assets for trading execution and market data, and Chainalysis for compliance.
Standard Chartered	2023	Joint Venture	Standard Chartered launched bitcoin trading in 2023 through its Singapore and Dubai branches for institutional clients. By May 2025, it extended services to U.S. clients, offering brokerage alongside custody via its Zodia Custody venture. The bank partnered with FalconX, a digital asset prime broker, for liquidity and execution, while Zodia Custody handles secure storage.
SoFi	2025	TBD	SoFi announced in June 2025 that it would reintroduce bitcoin trading through its app later this year. Targeted at retail users, the service will allow buying, selling, and holding of bitcoin and other cryptocurrencies. Reentering the space after a 2023 pause, SoFi aims to offer crypto access alongside its broader banking and investing platform.

As with custody services, the lack of progress between 2023 and 2025 likely resulted from U.S. regulatory pressure. In 2022, within a few weeks of the SEC issuing SAB 121, it is widely believed the Federal Deposit Insurance Corporation (FDIC) initiated an informal directive, resulting in what is referred to as a series "FDIC pause letters" being issued, requesting banks under their supervision to halt or delay the development of cryptocurrency-related activities, including Bitcoin brokerage services [OCP 2.0].

The challenge with these pause letters was that, despite the apparent legal permissibility of these services under existing banking laws, approval for these services never materialized. By May 2025, this was essentially a moot point, as every major U.S. financial regulator had updated both formal and informal guidance clarifying that banks may proceed with crypto-related activity deemed permissible with the always present proviso that the bank must operate the services in a "safe and sound manner." In short, banks were, once again, enabled to proceed with notification rather than approval from the FDIC for crypto-related activities.

Market Size

The gold market is the most immediately addressable market for bitcoin brokerage services in the near term. The gold brokerage market size is estimated based on the total annual trading volume of gold, which reflects the value of gold bought and sold annually, a key metric for banks facilitating these transactions. Similar to bitcoin, gold can be traded frequently in various global markets across spot, OTC, and derivatives markets.



The opportunity of Bitcoin in the near term is significant. Annual bitcoin trading volumes are ~6% of gold's requiring a 17x increase to reach gold parity. However, we anticipate that these volumes will significantly increase in absolute terms over the coming decade as scarce assets receive increasingly greater allocations in response to unsustainable fiscal and monetary policy. Thus, the potential for both Bitcoin to consume the market of gold as well as a rising tide for store of value assets could drive a materially greater increase in bitcoin annual trading volumes.

Bank vs. Non-Bank

As Bitcoin adoption grows, both bank entities (e.g., JPMorgan Chase, Goldman Sachs, SoFi) and non-bank entities (e.g., Coinbase, Kraken) will compete and partner to provide brokerage services. Below are the competitive distinctions to consider:

Brokerage Characteristic	Bank	Non-bank
Regulatory Compliance & Trust	**Advantage**: Operate under oversight from OCC, SEC, and FINRA, and, depending on charter, the Federal Reserve and FDIC, fostering trust among institutional clients. OCC guidance (e.g., Interpretive Letter #1170, 2020) ensures legal clarity. Example: JPMorgan Chase's compliance systems reduce legal risks, appealing to risk-averse clients.	**Disadvantage**: Face heavier regulatory scrutiny and perceived risk due to lighter oversight. Past failures (e.g., FTX collapse, 2022) erode trust. Example: Coinbase lacks the institutional trust of banks like Goldman Sachs.
Existing Infrastructure & Integration	**Advantage**: Integrate Bitcoin brokerage with existing payment, settlement, and custody platforms, offering a more seamless experience. Example: Goldman Sachs provides Bitcoin trading alongside stocks within its wealth management platform.	**Disadvantage**: Operate standalone platforms without the integrated financial ecosystems of banks, limiting service breadth. Example: Kraken's trading platform is crypto-focused, lacking traditional banking integration.
Large Customer Base & Relationships	**Advantage**: Leverage extensive client bases (e.g., corporations, HNW individuals) for quick adoption. Example: Morgan Stanley offers bitcoin trading to its $4 trillion wealth management clientele.	**Disadvantage**: Lack the established client networks of banks, requiring higher customer acquisition efforts. Example: Binance targets new users, competing with banks' built-in markets.
Access to Institutional Capital	**Advantage**: Excel at serving institutional clients with high liquidity and tailored OTC trading desks. Example: Citibank partners with Fidelity Digital Assets for deep liquidity in bitcoin trading.	**Disadvantage**: Limited scale and liquidity compared to banks, hindering large trade capabilities. Example: Coinbase struggles to match banks' institutional-grade liquidity pools.
Operational Costs & Fees	**Disadvantage**: Higher costs from regulatory burdens and legacy systems lead to elevated fees. Example: JPMorgan's trading fees may exceed Coinbase's due to compliance overhead.	**Advantage**: Leaner models enable lower fees, appealing to cost-conscious clients. Example: Kraken offers competitive pricing for retail bitcoin trading.
Innovation & Agility	**Disadvantage**: Regulatory constraints and bureaucracy slow innovation. Example: Goldman Sachs took years to launch bitcoin trading, lagging behind non-banks.	**Advantage**: Crypto-native expertise allows rapid adoption of advanced features. Example: Coinbase offers trading tools and staking, outpacing banks' slower rollouts.
Onboarding & Accessibility	**Disadvantage**: Complex application process and onerous KYC/AML checks drive high minimums (e.g., $2 million at Morgan Stanley) deter retail clients. Example: Banks' stringent requirements limit casual trader access.	**Advantage**: Simple sign-up and low entry barriers (e.g., Binance's $10 minimum) attract retail investors. Example: Kraken's easy onboarding draws smaller traders.

III. Bitcoin-Backed Lending (Asset-Based Lending)

Bitcoin-backed lending is one of the most attractive forms of lending a commercial bank can offer. Unlike traditional credit products that rely on a borrower's income or business cash flow, these loans are secured by a highly liquid, transparent, 24/7-settled collateral asset, bitcoin. The collateral can be verified and marked to market in real time, reducing credit risk and improving underwriting precision.

- For the bank, this means lower capital charges, faster execution, and programmable collateral management.
- For the borrower, it unlocks liquidity without needing to sell a long-term asset.

Structurally, it's cleaner, more efficient, and aligns with the kinds of balance sheet leverage banks are built to offer.

No traditional banks are documented as actively providing direct bitcoin lending services as of the time of this writing. The history of banks indirectly participating in bitcoin lending is sparse, primarily due to regulatory hurdles and the dominance of crypto-native platforms like BlockFi, Celsius, and Ledn. Key milestones include:

- **Pre-2020**: Bitcoin lending was almost exclusively handled by crypto platforms. Traditional banks avoided direct involvement due to regulatory uncertainty, Bitcoin's association with illicit activities (e.g., Silk Road seizures in 2013), and lack of infrastructure.
- **2020—2021**: The OCC's Interpretive Letter #1170 (July 2020)[43] allowed federally chartered banks to provide cryptocurrency custody, enabling banks to hold bitcoin collateral, a prerequisite for lending. This spurred interest from banks, though direct lending remained rare. Instead, banks like U.S. Bank began offering custody services, indirectly supporting lending through partnerships.
- **2021-2022:** Silvergate was the only U.S. bank to actively offer bitcoin-collateralized lending to institutional clients. Silvergate's SEN Leverage program allowed customers to borrow USD against bitcoin held with approved custodians, while Signature Bank announced an intent to offer similar services through Signet-integrated partners. Silvergate's Bitcoin backed loan book grew to $1.5 billion at its peak, and they experienced zero credit losses from this product[44].
- **2022—2023 (FDIC Pause)**: The FDIC issued at least 25 letters to banks under its jurisdiction, requesting a pause on proposed plans for crypto-related activities, including bitcoin-backed loans, due to concerns about consumer protection, financial stability, and AML risks. This halted smaller banks' plans to enter the lending space, as noted in Coinbase's 2024 court findings [OCP 2.0].

[43] https://www.occ.gov/topics/charters-and-licensing/interpretations-and-actions/2020/int1170.pdf
[44] https://podcasts.apple.com/us/podcast/bitcoin-is-pristine-collateral-with-jon-melton/id1709751656?i=1000714550933

- **2024—2025**: The SEC's approval of spot Bitcoin ETFs in January 2024 and the FDIC's March 2025 clarification, allowing banks to engage in crypto activities with notification, renewed interest. However, traditional banks have not yet launched direct bitcoin lending services, focusing instead on custody or brokerage.

Primary examples of banks facilitating lending indirectly through partnerships or custody include:

Institution	Role in Bitcoin Lending	Service Provider	Details
Fidelity Digital Assets	Facilitated bitcoin collateral loans	BlockFi	In 2020, Fidelity partnered with BlockFi to offer cash loans against bitcoin collateral, with Fidelity providing custody. Clients could borrow up to 60% of their bitcoin's value.
U.S. Bank	Custody supporting potential lending	NYDIG	Offers Bitcoin custody since 2021, which could enable lending, but no direct lending services confirmed.
BNY Mellon	Custody supporting potential lending	Fireblocks, Chainalysis	Launched digital asset custody in 2022, potentially supporting bitcoin collateral for loans, but no direct lending.
Silvergate	Facilitated Bitcoin collateral loans	Bitstamp, Fidelity	Launched SEN leverage program in January 2020 which allowed customers to borrow USD against bitcoin held with approved custodians. Silvergate's bitcoin backed loan book grew to $1.5 billion at its peak, and they experienced zero credit losses from this product.
SoFi	Facilitated bitcoin collateral loans	TBD	In June 2025, SoFi announced plans for bitcoin-backed lending, allowing members to borrow against their bitcoin holdings, with services to launch within 6 to 24 months, supported by their national banking charter and potential partnership with NYDIG.

While Cantor Fitzgerald is not a bank accepting deposits, it is a major financial services firm which began making institutional grade loans in 2025, using bitcoin as collateral, in partnership with Anchorage Digital, Copper.co, and Tether. Further, JP Morgan has recently announced it is

accepting the Bitcoin ETF as collateral.[45] And even further, the Fannie Mae and Freddie Mac were issued an order by the Federal Housing Finance Agency (FHFA) to consider cryptocurrency as an asset for reserves in a single-family mortgage loan risk assessment.[46]

Market Size

From a bank's perspective, asset-based lending encompasses various types, including accounts receivable financing, inventory financing, equipment financing, real estate financing, and securities-based lending. For bitcoin, which is a digital asset with market value and typically held as an investment, the most directly comparable form of lending from banks is securities-based lending.[47] This type of loan is secured by marketable securities, such as stocks, bonds, and mutual funds, offered primarily to HNW individuals and institutional investors through private banking and wealth management services.

Bitcoin has many traits in common with financial assets. Both are traded on markets, have liquid valuations, and are used as collateral for loans without disrupting the borrower's investment strategy. In contrast, other forms like inventory or equipment financing are more relevant for business operations and less aligned with bitcoin's current nature as a store of value or investment asset.

Considering this, we've broken down the current market sizes for the securities, gold, crypto, and bitcoin lending markets:

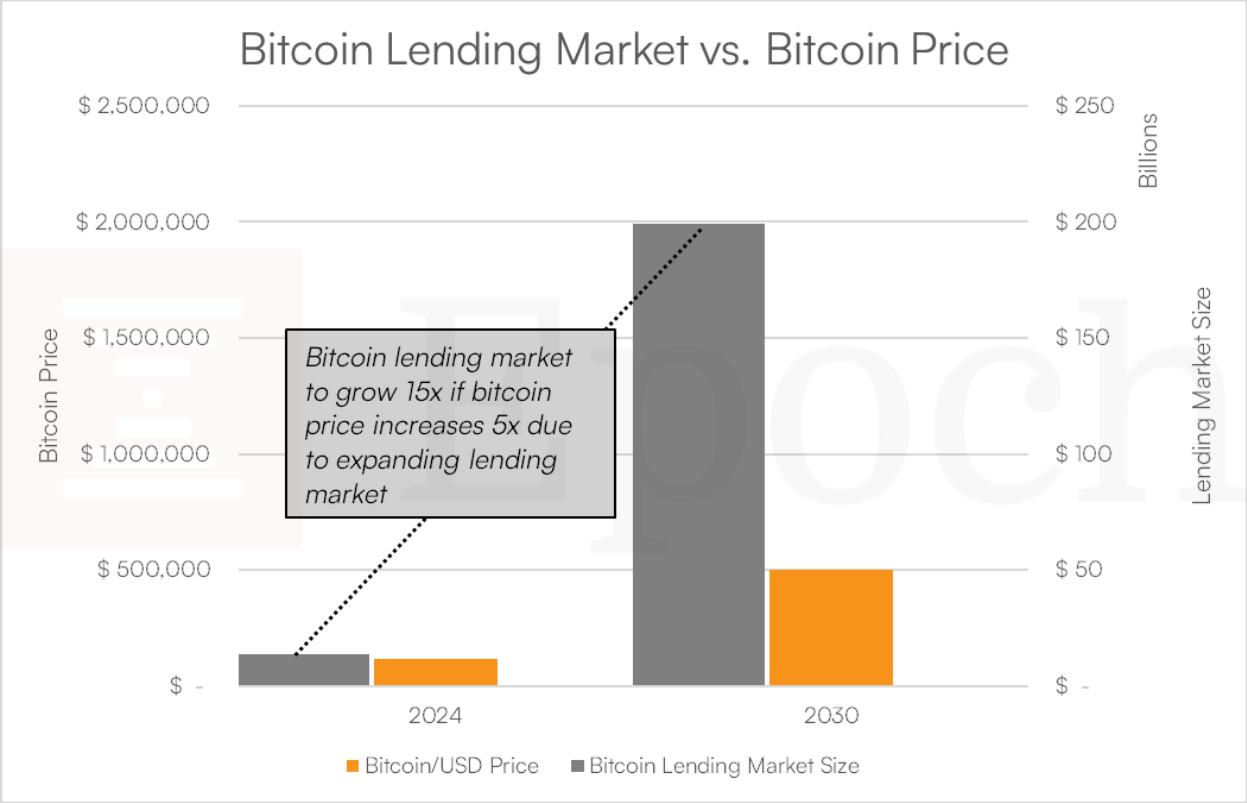
Lending Market Type	2024 Estimates	Market Cap of the Asset	% of Market Cap
US Securities	$ 1,300 bn	*$ 100,000 bn*	*1.3%*
Gold Securities*	$ 6 bn	*$ 374 bn*	*1.6%*
Gold	$ 115 bn	*$ 23,133 bn*	*0.5%*
Crypto Lending	$ 30 bn	*$ 3,500 bn*	*0.9%*
Crypto lending 2022 YE	$ 35 bn	*$ 2,000 bn*	*1.8%*
Bitcoin Lending*	$ 14 bn	*$ 2,348 bn*	*0.6%*
**Epoch estimate*			
Sources: Federal Reserve, Galaxy Digital Research, Market Research Future			

Considering how large we believe bitcoin *will* grow, our goal is to surmise the extent to which leverage exists as a percentage of its total market capitalization. Broader securities lending by banks is about 1.3% and gold specific securities are 1.6%.[48] Further, while the crypto lending market is estimated at 0.9%, at peak during the prior cycle it was much closer to the gold

[45] JP Morgan accepting the bitcoin ETF as collateral founder at this link: https://www.bloomberg.com/news/articles/2025-06-04/jpmorgan-plans-to-offer-clients-financing-against-crypto-etfs
[46] FHFA Order news article: https://cointelegraph.com/news/fannie-mae-freddie-mac-recognize-crypto-assets-mortgage-risk-assessments
[47] For bitcoin securities this logic only applies more so
[48] Epoch estimate derived from gold securities short interest.

securities market at 1.8%. Gold's securities' outsized use as collateral aligns with the idea that there is proportionally greater demand for securities lending against store of value assets.

Further, given the superior collateral characteristics, we anticipate bitcoin securities and bitcoin collateralized lending to exceed that of the gold securities proportions and broader crypto during the prior cycle peak. The chart below assumes the outstanding bitcoin specific loan balance *achieves 2% of its total market capitalization* by 2030. If bitcoin goes to $500,000 per coin, the lending market would be $200 billion:



We anticipate bitcoin lending to expand more rapidly than the market capitalization in the medium term for the following reasons:

- Bitcoin's unique value permissionless 24/7/365 liquid collateral
- A return of broader crypto lending to prior cycle highs in proportion to market capitalization
- An expansion of bitcoin as collateral for lending within the crypto lending market

Bank vs. Non-Bank

The primary advantage of banks over non-bank providers such as Ledn, Nexo, or Unchained Capital is that large pools of capital will work with banks. Banks operating within established regulation use qualified custodians and have the ability to take deposits and lend against them on

a fractional reserve basis. Non-banks have to source their liquidity from elsewhere. Both institutions will have the ability to rehypothecate collateral, but banks will be far more trusted for the execution of rehypothecation. The below table outlines some of the primary differences between the two types of institutions:

Characteristic	Bank	Non-Bank
Regulatory Compliance & Trust	**Advantage**: Operate under strict OCC, SEC, FDIC, and FINRA oversight, fostering trust among institutional clients. OCC's Interpretive Letter #1170 (2020) and FDIC's March 2025 clarification ensure legal clarity. Example: JPMorgan's acceptance of Bitcoin ETFs as collateral leverages regulatory standing, appealing to risk-averse clients.	**Disadvantage**: Face lighter oversight, leading to trust issues after failures like 3AC and Celsius (2022). Example: Ledn, despite regulation, lacks banks' institutional trust.
Infrastructure & Integration	**Advantage**: Integrate bitcoin lending with existing loan, custody, and wealth management systems. Example: BNY Mellon's custody platform, using Fireblocks, supports seamless collateral management for lending.	**Disadvantage**: Operate standalone platforms, limiting integration with traditional finance. Example: Nexo's lending is crypto-focused, lacking banks' broader financial ecosystem.
Access to Capital & Liquidity	**Advantage**: A large deposit base enables large-scale lending. Example: Citibank's $17.923 trillion in deposits (Feb 2025) supports high-value bitcoin-backed loans.	**Disadvantage**: Rely on client funds or external capital, restricting loan size. Example: Aave's lending pool is smaller than banks' deposit base.
Fractional Reserve Lending	**Advantage**: Can lend customer deposits (e.g., 90% with 10% reserve requirement), lowering funding costs. Example: U.S. Bank could use $559 billion in deposits to fund loans at 5—8% APR, competitive with traditional rates.	**Disadvantage**: Cannot lend deposits, relying on client crypto or borrowed funds. Example: Ledn funds loans via client bitcoin, increasing costs and rates (10—15% APR).
Security & Risk Management	**Advantage**: Robust cybersecurity, segregated accounts, and FDIC insurance (up to $250,000 for fiat) mitigate risks. Example: JPMorgan's infrastructure secures Bitcoin ETF collateral.	**Disadvantage**: Higher vulnerability to hacks (e.g., Bitfinex, 2016). Example: Non-banks like BlockFi faced breaches, eroding client confidence.
Innovation & Agility	**Disadvantage**: Regulatory constraints and bureaucracy slow innovation. Example: FDIC's 2022—2023 pause delayed banks' entry, unlike non-banks' rapid product launches.	**Advantage**: Crypto-native expertise enables fast innovation. Example: Aave offers flexible LTV ratios and DeFi integrations, appealing to retail clients.
Costs & Fees	**Disadvantage**: Higher compliance and operational costs lead to elevated fees or rates. Example: Banks may charge higher than Ledn's competitive rates ($1.16 billion loans, 2024).	**Advantage**: Leaner models offer lower fees and rates (e.g., 3—10% APR on Aave). Example: Nexo attracts cost-sensitive borrowers with affordable terms.
Global Reach & Accessibility	**Disadvantage**: Regional regulatory hurdles limit global operations. Example: U.S. banks face stricter rules than international non-banks.	**Advantage**: Global operations serve diverse clients. Example: Bitcoin Suisse offers bitcoin loans in USD, EUR, and CHF worldwide.
Rehypothecation Capability	**Advantage**: Can rehypothecate bitcoin collateral, especially ETFs, generating income to lower rates. Example: JPMorgan's 2025 ETF collateral strategy.	**Disadvantage**: Rehypothecation common but riskier due to less oversight. Example: Unchained avoids it for security, potentially raising rates (14%+ APR).

Unlike non-bank lenders, banks have a structural funding advantage: they can use customer deposits, low-cost and stable liabilities, to fund lending activities. This gives them access to a large pool of money without needing to raise expensive equity or wholesale debt. Non-bank lenders, by contrast, must fund loans directly from investor capital or lines of credit, making their models more constrained and cost intensive.

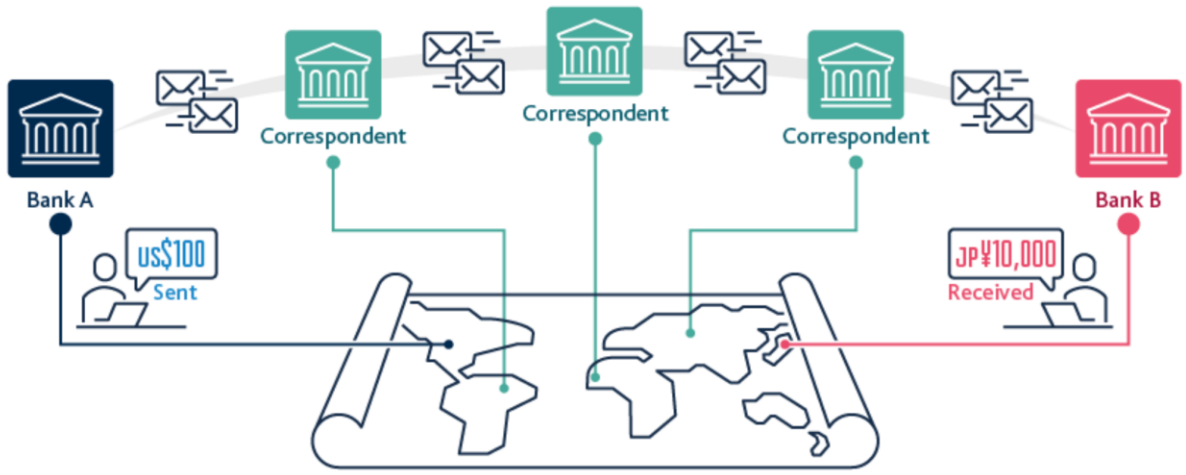
This difference is fundamental. Banks can extract a form of seigniorage from deposits, operate on a fractional reserve basis, and assume more risk while offering lower interest rates. And in a liquidity crunch, they have access to the Federal Reserve's discount window, an institutional backstop non-banks do not enjoy.

IV. Cross Border Settlement

Many cross-border payments today use antiquated banking infrastructure. Banks that do not have accounts with one another must use a correspondent bank where both hold accounts. The less common the currency pair, the more correspondent banks are required as intermediaries.

Figure 3: Cross-border payment using the correspondent-banking network

The less common the currency pair, the more correspondent banks will be required to make the payment, incurring costs and delays at each stage.



Source: Bank of England

This system fundamentally lowers the quality of service and increases costs, via fees and delays. Higher volume currency pairs benefit from less intermediation, while lower volume currency pairs suffer from more, as they must pass through a long chain of correspondent banks, each taking a fee.[49]

[49] Financial Stability Board, *Targets for Addressing the Four Challenges of Cross-Border Payments: Consultative Document*, 31 May 2021, pp. 1-2 (outlining the G20 roadmap's emphasis on enhancing the speed, cost, transparency, and accessibility of cross-border payments, including the role of systems such as correspondent banking).

The set of payment flows through correspondent banks between two countries is called the country or payment corridor. Payments that must pass through multiple corridors become increasingly costly. When compared to domestic payments, cross-border payments are more expensive, slower, less accessible, and less transparent.

Not only is the process of intermediation a material economic friction, but the intermediaries themselves are antiquated. The globally integrated banking system, while intended to become a mosaic, is a patchwork with several notable deficiencies:

Notable Deficiencies of Bank Cross-Border Payment Network Infrastructure[50]	
Deficiency	Description
Incompatible Data Formats	Standards vary by jurisdiction, reducing automation, which causes increased technology and staffing costs.
Redundancy of Compliance Checks	Various regulatory regimes create redundancy in compliance checks with complexity, delays, and costs increasing by the number of intermediaries in the chain.
Limited Operating Hours	Settlement can only occur when systems are available, and this complexity increases across corridors with time zone differences. Not only does this cause delays, but it increases capital costs. Known as trapped liquidity, cash must be held to cover unknown FX rate changes across downtime hours.
Physical Dependencies	A significant proportion of systems rely on paper-based processes, which create delays and trapped liquidity.
High Funding Costs	Uncertainty of incoming funds requires overfunding, leading to capital inefficiencies.
Long Transaction Chains	Correspondent banking chains increase costs, delays, funding needs, redundancy of validation checks, and the probability of error.
High Barriers to Entry	Incumbent infrastructure materially increases the costs for new entrants to enter the system.

The use of Bitcoin and stablecoins for cross-border payments by banks has evolved over the past decade, driven by the need to address inefficiencies in the traditional system. Bitcoin initially offered a decentralized alternative but was limited by volatility and regulatory concerns. Stablecoins, pegged to fiat currencies (e.g., USDT, USDC), emerged around 2014 with early examples like Tether. They offered a more practical solution by collapsing the chain of intermediaries into a token representing the most dominant medium of exchange in the world.

Banks began experimenting with these technologies around 2015. Below is a detailed list of historical stablecoin adoption by banks (don't worry; we'll get to Bitcoin):

[50] A detailed discussion of these problems can be found here: https://www.bankofengland.co.uk/payment-and-settlement/cross-border-payments

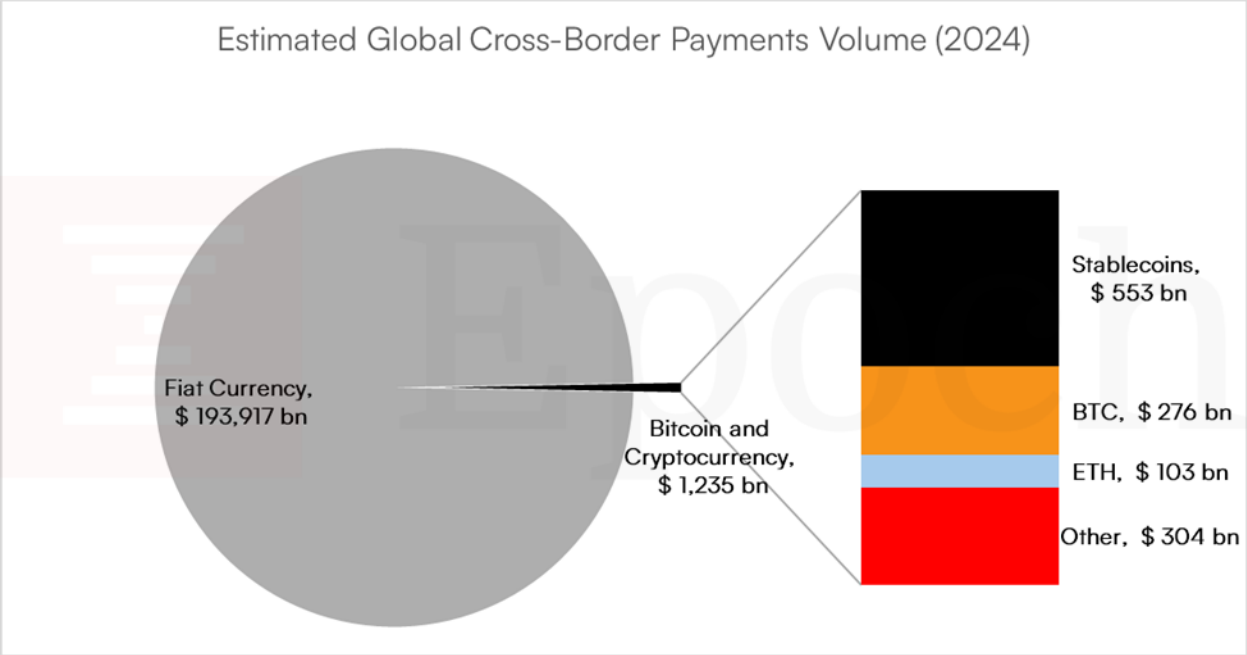
Bank	History & Role	Service Provider
JPMorgan Chase	Launched Kinexys (2019) for 24/7 institutional cross-border payments. Piloted JPMD stablecoin on Base blockchain in June 2025.	Kinexys (in-house), Base (Coinbase)
Standard Chartered	Part of Partior since 2021. Launched stablecoin payments in 2023 via Zodia Markets.	Partior, Zodia Markets
MUFG (Japan)	Joined Project Pax (2024) for stablecoin-based payments; tested JPY/USD stablecoins with DRW Cumberland.	Progmat, Datachain, Ginco
SMBC (Japan)	Part of Project Pax (2024) with MUFG and Mizuho; collaborated with Partior for DLT payments.	Progmat, Datachain, Partior
Mizuho (Japan)	Joined Project Pax (2024) for stablecoin cross-border payments; worked with Partior.	Progmat, Datachain, Partior
Wells Fargo	Piloted proprietary digital cash system (2024) for internal cross-border transfers, faster than SWIFT.	In-house blockchain
ANZ Bank (Australia)	Launched A$DC stablecoin (2022); executed public blockchain transaction (2023) for pension payments.	n/a
FV Bank (U.S.)	Supports direct USDT deposits (December 2024) for cross-border payments, reducing wire transfer reliance.	Circle (USDC), Tether (USDT)

Bitcoin vs. Stablecoins

The advantage of stablecoins over cross-border banking settlement is well researched as it solves most technical deficiencies of the banking payment system. However, the advantage of Bitcoin over stablecoins is not well researched. What is evident is that people choose stablecoins over Bitcoin because bitcoin has significant price volatility. Indeed, the benefits of Bitcoin over stablecoins are misunderstood.

It is not yet obvious that stablecoins will remain completely dominant for cross-border settlement. Currently both exist as an immaterial percentage of the market for cross-border settlement. SoFi recently announced they're using bitcoin for cross-border settlement which is a significant validation for the Bitcoin use case.[51]

[51] Sofi announcement on CNBC: https://x.com/BitcoinNewsCom/status/1939987595020140708



Sources: BVNK, FXCIntel, Chainalysis, McKinsey, Epoch Estimates[52]

For reasons to be stated, we anticipate Bitcoin to hold a material percentage of this market as stablecoins continue to consume share. We've identified three primary advantages of bitcoin as a means of cross-border settlement over stablecoins: settlement finality, economic, and regulatory.

(1) Settlement Finality:

Stablecoins do not provide finality of settlement,[53] rather they are a claim upon assets held by a bank or non-bank financial institution. Bitcoin provides settlement finality, and thus, a comparison to stablecoins is flawed to some degree. Bitcoin is purely native and purely digital allowing it to be permissionless.

The permissionless nature of the Bitcoin network holds obvious advantages: no counterparty risk and permissionless payments. You can send bitcoin to anyone, in any amount, whenever you want, and without trusting anyone.[54] As the world evolves, we anticipate this benefit to remain a primary defense against human rights abuse which history has shown is desperately needed.[55] For these reasons alone, the volatility of bitcoin is often well worth its final settlement assurances.

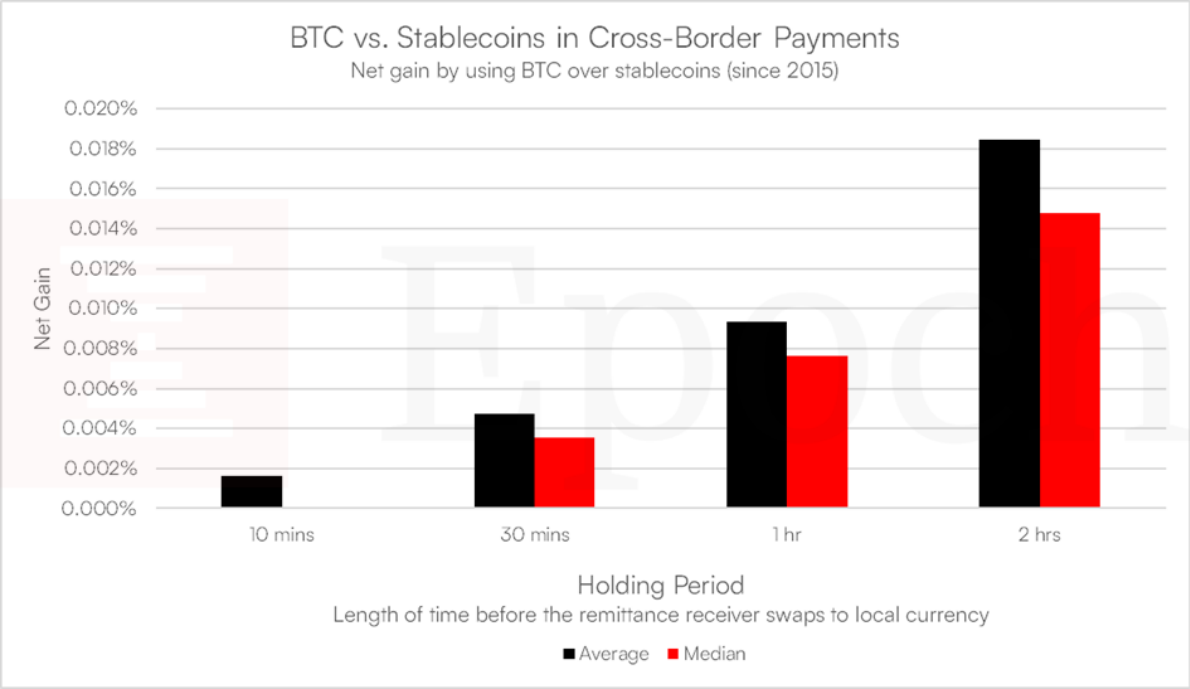
[52] Epoch estimate assumes that cross border payment volume for stablecoins is proportionally equivalent to cross border payment volumes as a percentage of global payments. We compiled multiple sources of data and perceive these estimates to be within reason but not gospel.
[53] Bank for International Settlements, *Principles for Financial Market Infrastructures*, April 2012 (Principle 8: Settlement finality, p. 64); https://www.bis.org/cpmi/publ/d101a.pdf
[54] VanEck confirms China and Russia are settling energy trades in Bitcoin: https://finance.yahoo.com/news/vaneck-confirms-china-russia-settling-164524926.html
[55] Read Alex Gladstein's book *Hidden Repression*: https://www.amazon.com/Hidden-Repression-Exploitation-Development-Gladstein/dp/B0C1JK6MG7

As recent as 2023, the USD stablecoin Circle lost its dollar peg, falling below 87 cents, due to 8% of it's reserves being held at collapsing Silicon Valley Bank.[56] The markets perception of reserve liquidity is paramount towards maintaining a fiat currency peg. As stablecoins expand globally their lack of settlement finality will pose a material risk to reserve liquidity.[57] Offshore stablecoins will ultimately require dollar liquidity to maintain their dollar peg. If redemptions cannot be met with dollar liquidity via liquidating treasuries (often illiquid off-the-run) or providing cash, central bank reserves, or clearing system access, then maintaining a peg will become challenging. Over time, this will impact the general fungibility of stablecoins.

Bitcoin will not have this problem because achieving final settlement is based on an open protocol. Bitcoin is the most fungible global financial asset, and this advantage will continue to become apparent as stablecoins proliferate.

(2) Economic:

The economic advantage may surprise readers. The stability sought from stablecoins for cross-border transfers has resulted in a loss for the service providers historically, relative to Bitcoin. Had Bitcoin been used instead of a fiat currency for cross-border settlement, it would have resulted in an economic benefit. The scale of which is dependent upon the holding time of the receiver of payment:[58]

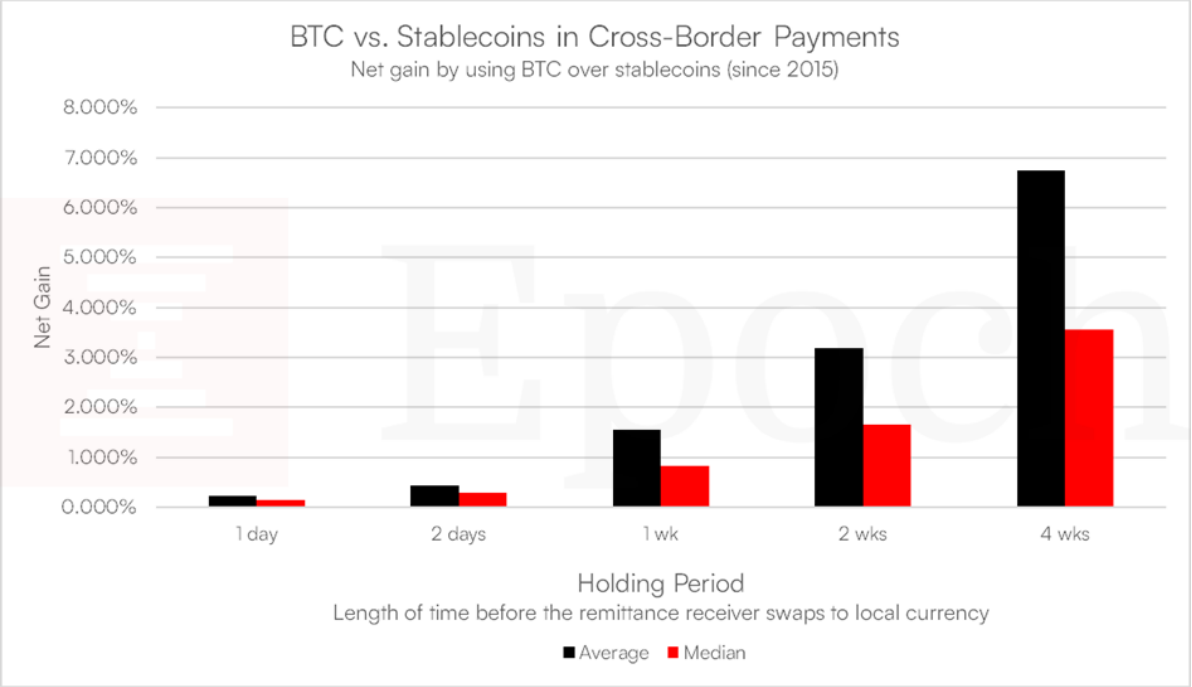


[56] Available at: https://www.cnbc.com/2023/03/11/stablecoin-usdc-breaks-dollar-peg-after-firm-reveals-it-has-3point3-billion-in-svb-exposure.html

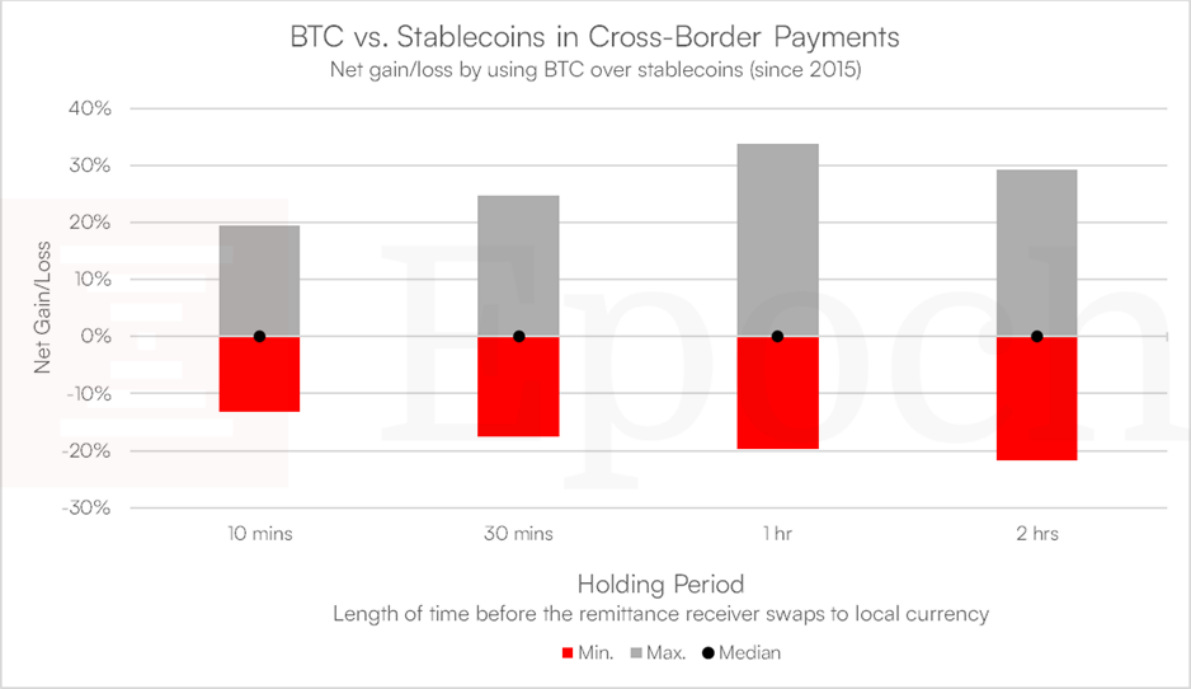
[57] CPMI-IOSCO, *Principles for Financial Market Infrastructures*, Bank for International Settlements, April 2012, https://www.bis.org/cpmi/publ/d101a.pdf, Principles 8—9.

[58] The following four charts comparing btc assumes low cost settlement and does not compare varying fee costs for stablecoins. It is simply showing that the volatility of bitcoin makes you money on average when compared to stablecoins.

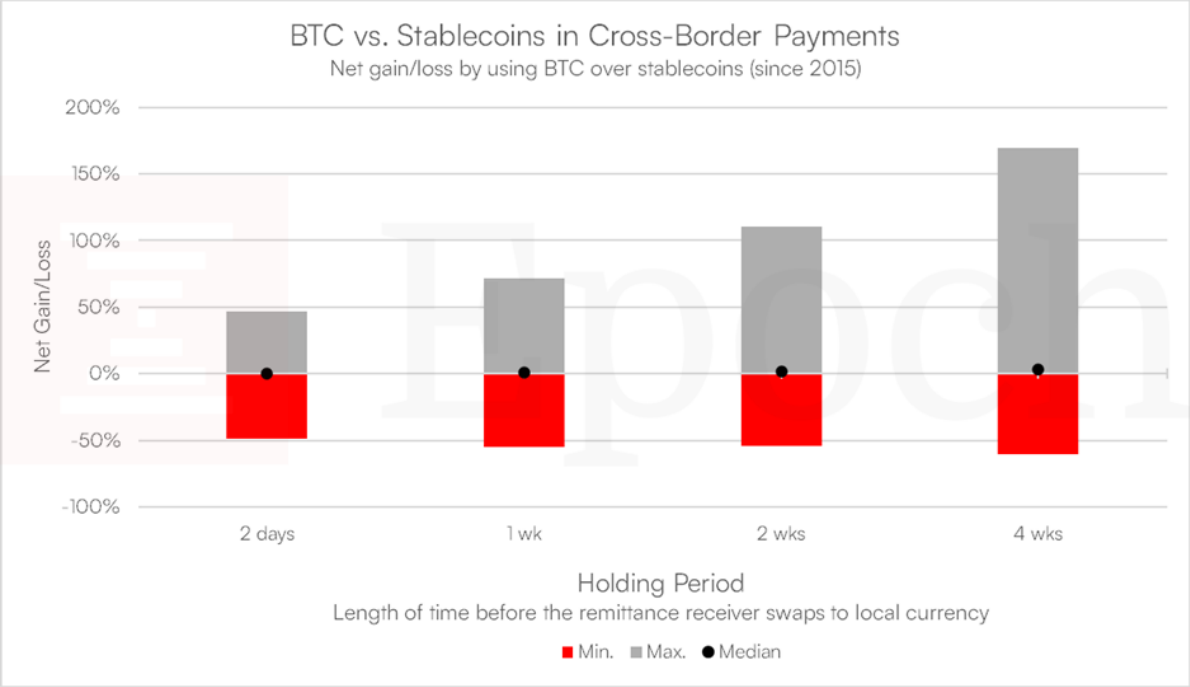
For longer periods, typically for those wishing to hold bitcoin as a working capital source the benefit is more obvious:



However, the range is wide for the potential gain and loss which is the primary reason stablecoins are preferable:



And the longer you wait, the more asymmetric the benefits of holding bitcoin become:



The primary takeaway is that businesses should expect to benefit from holding working capital in bitcoin for payment settlement over the long term. As long as a business holds sufficient capital to weather drawdowns, it will directly benefit your margins by using bitcoin instead of stablecoins as a payment provider.

That being said, as the market for payments transitions to the digital economy, stablecoins will continue to hold significant dominance. Currently, cross-border adoption leverages stablecoins to disintermediate the correspondent banks between the onramp and offramp bank accounts. Meaning, as long as people still use banks or fintechs still use banks, the advantages of bitcoin or stablecoins are hindered. But as more merchants accept stablecoins this will change. People will not need an off-ramp anymore, further collapsing the intermediation of the banking system by removing it altogether from cross-border payments (or at least, changing its nature to that of a stablecoin institution). Technological leapfrogging within developing economies will ensue, and end users will save in dollars or some alternative (...bitcoin?). The economic benefits of holding bitcoin over the US dollar are very real and as individuals accrue the necessary wealth to think long term about their savings, the share of bitcoin accepted directly for payments will persist and grow. This will result in individuals choosing to accept some percentage of payments in bitcoin (i.e., the amount of their wealth they plan to put away for savings).[59]

[59] See Epoch portfolio company Castle providing a platform SaaS service for this: https://savewithcastle.com/

(3) Regulatory:

Another downstream source of demand for direct bitcoin settlement will be various forms of capital controls. As stablecoins continue to dollarize the world, they will become an increasingly visible target for foreign regulators, particularly in markets where the U.S. dollar is seen as a threat to monetary sovereignty. In such a world, dollar stablecoins may operate in a "grey market" while bitcoin, often classified as a commodity, could exist in a "white market" and thus be a more acceptable medium for cross-border FX settlement.

This dynamic is unfolding against the backdrop of an emerging "fiat currency war," where foreign central banks are accelerating retail CBDC projects to compete with dollar stablecoins,[60] particularly in the wake of the GENIUS Act. In effect, foreign Tier I institutions (i.e., central banks) are entering direct competition with U.S. Tier II and Tier III money issuers (i.e., commercial banks and fintechs) for global currency influence. Over time, some central banks may recognize that integrating with the Bitcoin network provides a strong counterbalance to the U.S. T-bill reserves backing dollar stablecoins, and that holding Bitcoin as a reserve asset could become a strategic defense of their sovereign currency.

As an investment firm focused on bitcoin adoption, we've invested in multiple companies providing infrastructure for bitcoin and stablecoin infrastructure for cross-border settlement. We've identified that it could be advantageous to use bitcoin instead of stablecoins in markets where regulators view bitcoin as a commodity and outside of foreign exchange capital control regulations.

In summary:

- Settlement finality is a material advantage of Bitcoin over stablecoins that will become more apparent as the world evolves.
- Bitcoin increases in value over time, which would have benefited businesses providing bitcoin settlement historically. This relationship will continue while bitcoin's price volatility decreases.
- Bitcoin may fall outside capital controls regulations that attempt to either block or hinder dollar FX conversions as stablecoins proliferate dollar dominance.

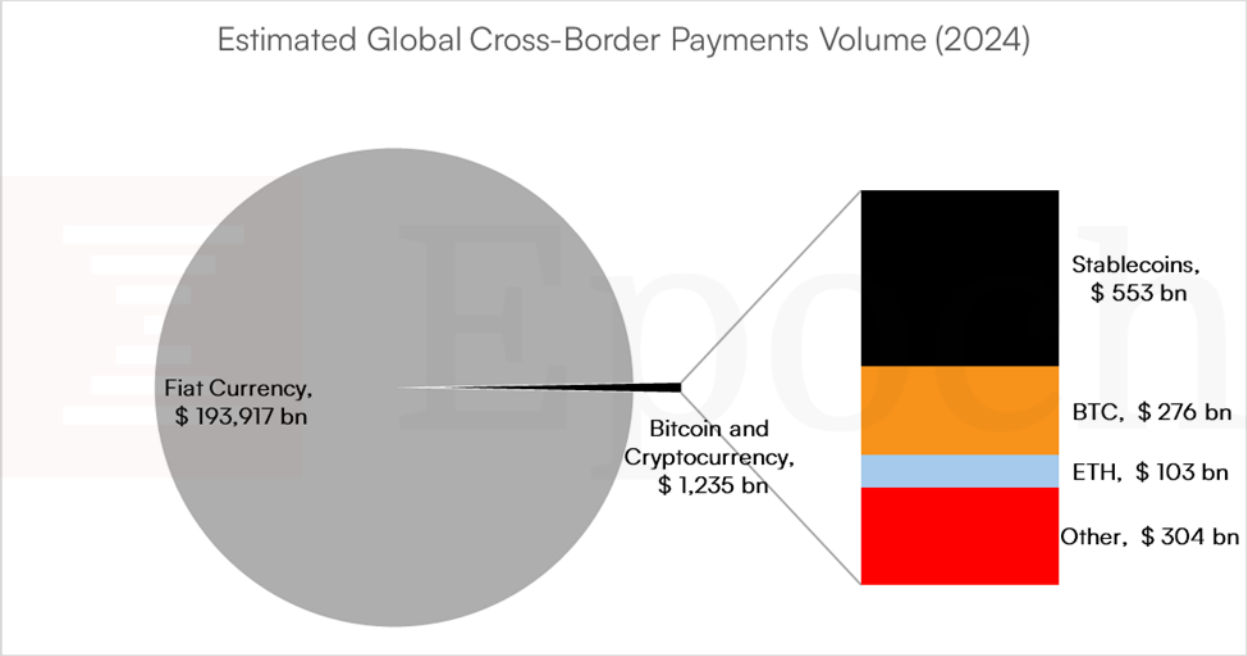
Market Size

Stablecoins will see significant near-term demand, and banks will partner with industry stablecoin providers to execute this settlement and integrate auditability and compliance into the core ledger systems. This may in effect hinder the user experience and functionality of stablecoins.

However, the downstream demand for Bitcoin that exists will persist and perhaps grow in the medium term. When sizing this potential opportunity for banks the question becomes: what is the

[60] European Central Bank. (2025, July 24). Christine Lagarde: "Doing everything that we can to be on time and prepared to make this digital form of sovereign money available in the shortest possible time" [Press conference statement]. Retrieved from https://x.com/TFTC21/status/1949884942554738763

percentage of the market that could be attributed to the regulatory (capital controls), economic, and permissionless advantage of Bitcoin for settlement over stablecoins? Bitcoin is 22% (~$276 billion) of the value received globally today amongst digital assets. As the digital economy grows and as bitcoin's volatility declines, we expect global share to expand. Initially, it will consume the non-stablecoin market and subsequently become increasingly more competitive against stablecoins for the reasons stated.



As a final point, we expect that as the digital economy expands, the need for an independent reference unit will grow. Today, this is the International Monetary Fund (IMF) Special Drawing Rights (SDR), which is a self-referential basket of currencies effectively. Bitcoin is the internet-native reference unit that is completely independent of fiat currency. So, Bitcoin is likely to be used as a reference rate simply because it is a single source of truth.

Time will tell. In the meantime, we expect banks are beginning to issue their own form of cryptographic signature-based asset, which will be discussed next.

V. Central Bank Digital Currencies (and Tokenized Bank Money)

We're going to talk about Bitcoin, but first some background. Many of the issues of our patchwork banking system have drawn attention towards Central Bank Digital Currencies (CBDCs). Banks have been involved in CBDC research since the 1990s, with significant advancements post-2014. Wholesale CBDCs, used exclusively for interbank settlements, have seen banks like JPMorgan participate in projects like Project Agorá, testing blockchain-based

settlements. Retail CBDCs, aimed at public use, are less advanced in the U.S., with banks supporting pilots like China's Digital Yuan.

The most recent framework for CBDCs included two different types:

- **Wholesale CBDCs**: Designed for interbank settlements, wholesale CBDCs have been tested with projects like the Bank for International Settlements' (BIS) Project Agorá (2024), involving seven central banks and 43 private institutions. The ECB has explored wholesale CBDCs to modernize settlement systems, with six banks participating in ECB blockchain tests in 2024.
- **Retail CBDCs**: Aimed at public use, retail CBDCs are less advanced in the U.S., where the Federal Reserve has not launched a retail CBDC, partly due to a 2021 House bill prohibiting direct issuance[61]. China's Digital Yuan has over 120 million users, with commercial banks like the Industrial and Commercial Bank of China (ICBC) distributing it.

CBDCs are issued by central banks, serving as direct liabilities, and can be used for wholesale or retail purposes, potentially bypassing commercial banks. A retail CBDC in the U.S. would effectively create the most centrally influenced ledger the world has seen. This ledger being controlled by a *de facto* government agency led to the public backlash against it as such a tool is a prerequisite for an Orwellian state. Public backlash against CBDCs ultimately led to Trump's executive order prohibiting government agencies from issuing CBDCs[62]:

> *"Sec. 5. Prohibition of Central Bank Digital Currencies.*
>
> *(a) Except to the extent required by law, agencies are hereby prohibited from undertaking any action to establish, issue, or promote CBDCs within the jurisdiction of the United States or abroad.*
>
> *(b) Except to the extent required by law, any ongoing plans or initiatives at any agency related to the creation of a CBDC within the jurisdiction of the United States shall be immediately terminated, and no further actions may be taken to develop or implement such plans or initiatives."* [63]

[61] The 2021 house bill prohibiting the direct issuance of a retail Central Bank Digital Currency (CBDC) in the United States was H.R. 2211, known as the Central Bank Digital Currency Study Act of 2021. Introduced on March 26, 2021, by Representative Jake Auchincloss (D-MA), this bill did not explicitly ban retail CBDC issuance but required the Board of Governors of the Federal Reserve System to conduct a comprehensive study on the impacts of introducing a CBDC on consumers, businesses, monetary policy, and the U.S. financial system.

[62] Recently Tom Emmer's Anti-CBDC Act passed the House: https://emmer.house.gov/media-center/press-releases/majority-whip-tom-emmer-s-flagship-legislation-the-anti-cbdc-surveillance-state-act-passes-house-of-representatives

[63] Link: https://www.whitehouse.gov/presidential-actions/2025/01/strengthening-american-leadership-in-digital-financial-technology/

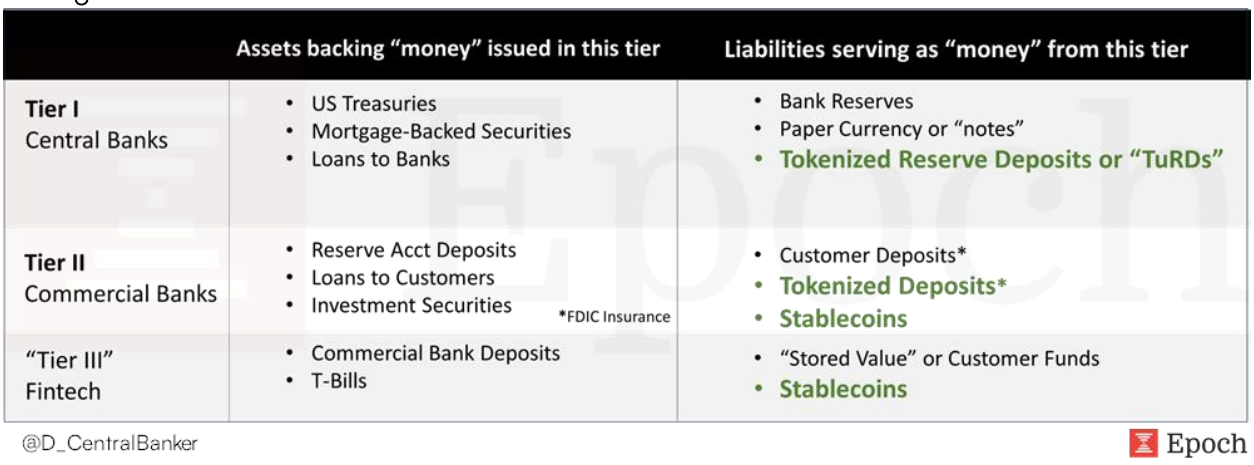
Tokenized Deposits (and Central Bank issued TuRDS)

Despite this executive order, CBDCs aren't going away but rather taking a new form: Tokenized Reserve Deposits (TuRDs).[64] TuRDs are digital tokens issued by central banks, a tokenized version of central bank reserves, which can be leveraged by commercial banks as a replacement for FedWire. These are effectively a new name for a wholesale CBDC.[65]

Characteristic	Tokenized Reserve Deposits (TuRDs)	Wholesale CBDCs
Issuer	Central banks	Central banks
Backing	Direct liability of the central bank, akin to digital cash or "bank reserves"	Direct liability of the central bank, akin to digital cash or "bank reserves"
Purpose	Interbank settlement	Interbank settlement
Regulatory Status	Governed by central bank policies, with broader implications for monetary policy	Governed by central bank policies, with broader implications for monetary policy

The idea of a retail CBDC emerging in the U.S. is expected to remain dormant through 2028 given Trump's executive order and pending legislation. However, commercial banks themselves are issuing Tokenized Deposits (TDs), as seen with JPMorgan's JPMD issued on Base this year[66], which are tokenized deposit accounts and have key distinctions from stablecoins directly. Common to all these technologies is the use of cryptographic signatures to represent value and the efficiencies gained from doing so.

Here is how this all applies to the three-tiered monetary framework from the beginning of this writing:



[64] The "u" stands for either useful or useless — well let you decide
[65] Fed Governor Christpher Waller on not using the word "Wholesale CBDC": https://x.com/AtlanticCouncil/status/1887599175032054045
[66] JP Morgan released a tokenized reserve deposit on the Coinbase Base blockchain: https://www.bloomberg.com/news/articles/2025-06-17/jpmorgan-to-pilot-deposit-token-jpmd-on-coinbase-linked-public-blockchain

Note that while we've created a new type of liability viewed as "money" in each of the respective banking tiers, we do not expect material deviations from the corresponding asset makeup within these tiers.

And here is the detailed comparison of all these categories:

COMPARISON OF CRYPTO-DOLLAR TYPES			
Characteristic	Tokenized Reserve Deposits (Central Banks)	Tokenized Deposits (Banks)	Stablecoins (Non-Banks)
Issuer	Central banks (e.g., Federal Reserve)	Commercial banks (e.g., USDF Consortium).	Non-bank entities (e.g., Tether, Circle, Paxos).
Backing	Direct liability of the central bank (i.e., fiat money backed by treasuries, mortgage-backed securities, loans to banks, etc)	Loans to customers, investments, cash reserves, and capital	1:1 backed by liquid assets (e.g., USD, Treasuries), per GENIUS Act (2025)
Purpose	Interbank settlements, clearing, enhancing wholesale payment systems	Broader applications: retail payments, corporate transactions, lending	Cross-border payments, trading, DeFi lending, remittances
Regulatory Status	Governed by central bank policies, with broader monetary policy implications	Treated as bank deposits, subject to OCC and FDIC	Regulated as payment stablecoins under GENIUS Act, with AML/KYC and 1:1 reserve rules
Yield-Bearing Capability	Expected to be "non-yield-bearing" (i.e., earn overnight fed funds rate) but who knows	Can offer interest as tokenized deposits, subject to fractional reserve banking	Prohibited from offering yield under GENIUS Act (2025) to reduce risk.
Reserve Transparency	n/a	Monthly disclosures and audits, but equivalent to other types of customer deposits	GENIUS Act requires monthly disclosures and annual audits, increasing costs
Fractional Reserve Banking	No fractional reserve, as a direct central bank liability	Fractionally reserved, customer deposits are lent	GENIUS Act mandates 1:1 backing, prohibiting lending
Customer Relationships	Limited to financial institutions, not retail clients	Leverages existing banking clients for broad adoption	Must build new relationships
Innovation and Agility	Central bank bureaucracy slows innovation, focused on pilots	Similar regulatory constraints limit agility	Rapid development and deployment across a variety of infrastructure
Operational Costs	Minimal operational costs but central banks have too many employees	Higher costs from banking regulations, infrastructure, and scale	Leaner models offer lower fees (e.g., Tether's operating margins).
Global Reach	Limited to where central banks are	Bank infrastructure/regional constraints	Anywhere the internet is

Tokenized Deposits vs. Stablecoins

The terms stablecoins and tokenized deposits will likely be used interchangeably, but they have key distinctions. Primarily, banks have access to a Fed account, can fractionally reserve customer deposits, and can pay interest on them. Stablecoins from non-banks will not be able to do this, as they exist today. In effect, TDs will be the fractionally reserved, interest bearing, and FDIC ensured version of existing stablecoins, trading at par with the U.S. Dollar, as long as faith in the commercial bank issuing the TD remains intact.

The GENIUS Act specifically prevents non-banks stablecoin issuers from paying interest via stablecoins which conveniently carves out a major competitive advantage for banks: the ability to take their fractionally reserved deposits and issue a token representing them. Consumers will be drawn to TDs for yield-bearing characteristics. They will also be drawn to originate bank loans backed by bitcoin collateral from the "low interest rates" offered via fractionally reserving customer deposits. It will be challenging for stablecoins and lenders in general, to compete against this advantageous regulatory carve out for banks because seigniorage is the cheapest cost of capital in the world. If stablecoins were allowed to pass along the interest from the treasuries they hold to back the coin, this would materially undermine any competitive advantage of banks.

Stablecoins vs. The Banking System

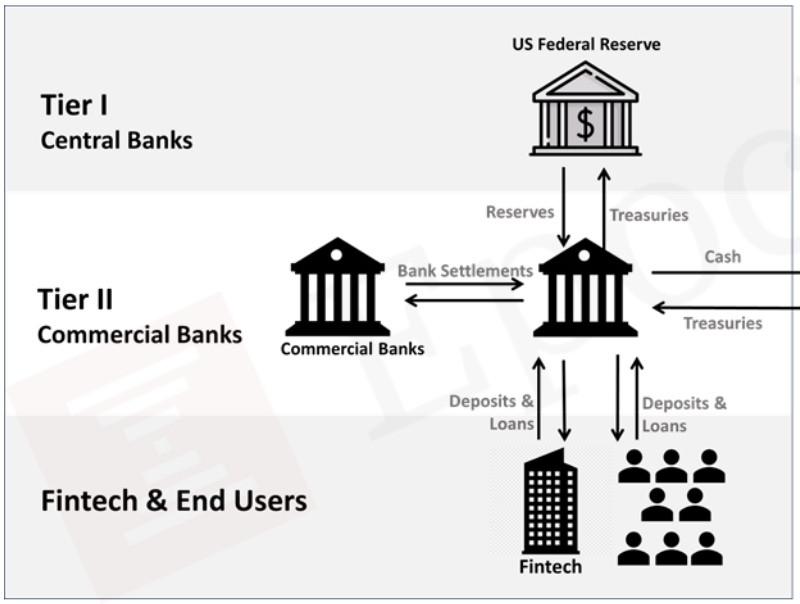
Over time, stablecoins may effectively collapse the chain of intermediation that we call the banking system. If non-bank stablecoin providers were allowed to pay interest, market incentives would likely lead to a world where consumers would effectively be using a cryptographic signature to pay for things with U.S. treasuries directly.[67]

The diagram below illustrates how U.S. Treasuries move through the banking system and are transformed into reserves. The U.S. Treasury issues treasuries, which are purchased by select commercial banks (primary dealers). These banks can then sell the treasuries to the Federal Reserve in exchange for central bank reserves, which are held in the bank's respective Fed master accounts.

With these reserves, commercial banks provide loans and create deposits for businesses and consumers. Payments between customers are settled through the banking system, while commercial banks leverage reserves to expand credit. This process underpins both money creation and payment settlement across the financial system.

[67] While the GENIUS Act has passed and stablecoin providers are not allowed to pay interest in the US, these practices will exist in other jurisdictions

Current State — How U.S. Treasuries Back the Fiat Banking System

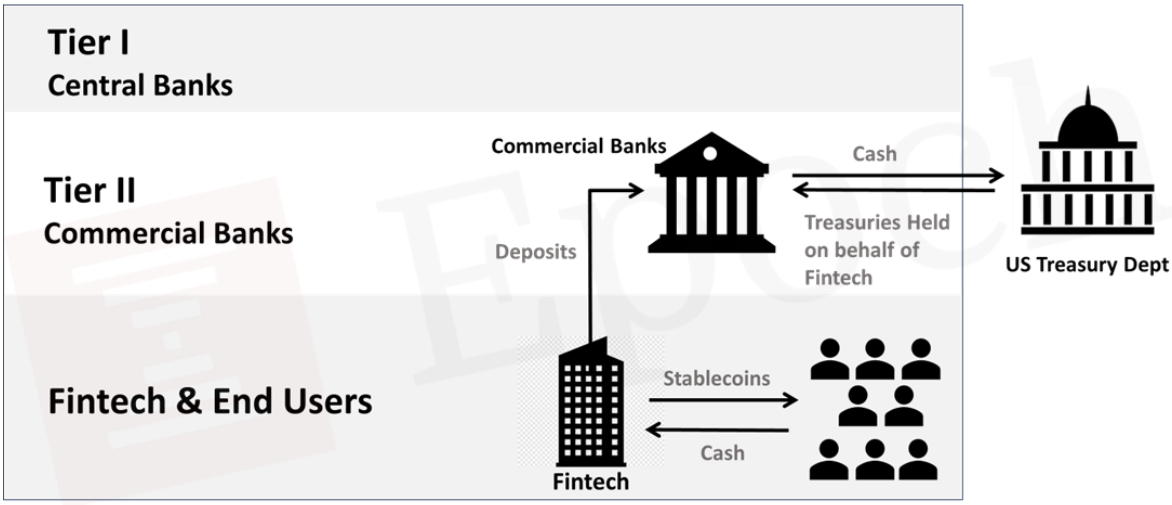


The second diagram (below) illustrates how this structure would change if stablecoin providers were able to source U.S. treasuries directly from the Treasury Department,[68] using cash to acquire government securities as backing. The stablecoins they issue are then distributed to end users, who use them to make payments, bypassing the traditional two-tier banking structure.

Unlike bank deposits, which rely on the assets of the commercial bank (e.g., reserve deposits, loans, and investments), stablecoins issued in this manner would optimize the asset side by holding treasuries directly. And, if structured to pay interest[69], such instruments could represent the most efficient and homogeneous form of the U.S. dollar, backed by a carefully curated blend of short-term government liabilities, and usable for instant digital settlement.[70]

[68] While the issuer will primarily back the stablecoin with US Treasuries, commercial banks are currently still required to purchase and sell securities, and to facilitate the issuance and redemption of stablecoins through standard banking rails.
[69] The GENIUS Act, which became law on July 18th, prohibits stablecoin issuers from paying interest to holders, codifying a clear separation between payment stablecoins and interest-bearing instruments.
[70] While significant policy attention has focused on prohibiting the Federal Reserve from issuing a retail central bank digital currency (CBDC), comparatively little discussion has addressed the potential implications of the U.S. Treasury issuing tokenized Treasury securities directly to consumers.

Interim State — Stablecoins Built on Tiered Banking Model



The value being added by a stablecoin provider here is two-fold:

(1) Providing the cryptographic rails to send the token on
(2) Managing the reserves to blend non-fungible treasuries into a fungible medium of exchange

The regulatory barriers set up by the GENIUS act are critical to stalling this evolution and maintaining the economic rents banks derive from seigniorage. Notably, the Independent Community Bankers Association (ICBA) revealed how large of a threat stablecoins are in a letter to the Chairman of the House Financial Services Committee effectively asking them to regulate stablecoins so that they can't compete with banks.

"*Nonbank issuers must be clearly prohibited from having access to Federal Reserve Master Accounts, which would create direct access for high-risk institutions to payment systems of the Federal Reserve to settle transactions in central bank money. Granting Federal Reserve Master Account access to nonbank stablecoin issuers would essentially create a pass-through central bank digital currency that would undermine payment system resilience and drastically increase deposit drain from community banks.*" [71]

This system only continues to exist from regulatory capture and path dependencies, which will not last forever in the U.S. and certainly won't remain globally.

Bitcoin vs. Fiat

This is all deeply relevant to Bitcoin adoption. Two primary trends will enable Bitcoin to infiltrate the banking system via stablecoins:

[71] The letter can be found here: https://www.icba.org/advocacy/letter-details/letter-to-house-on-stablecoin-legislation

1) Stablecoins will move both institutions and individuals onto the same rails as Bitcoin: whether it is stablecoins that are bitcoin collateralized, on Bitcoin layer 2s, or even alternative blockchains, people will be paying for things and settling value using cryptographic signatures. This will build infrastructure and draw adoption towards infrastructure that allows people to flip a switch into Bitcoin (we'll cover more on this in the next section).
2) Stablecoins will give people a better understanding of money: as people learn what can be done by having far more control over their money than a deposit account at a bank, this will spark further curiosity that unlocks an understanding of what makes Bitcoin valuable.

Many Bitcoin advocates tout that stablecoins will proliferate dollar hegemony in the digital world and will hinder Bitcoin adoption. This argument can basically be reduced to the idea that if people in the digital world use dollars they won't want to use Bitcoin, which is just an argument that dollars are preferable to bitcoin.

We disagree. If you understand that as people learn about the benefits of Bitcoin they will choose it, then having them use stablecoins is a vastly preferable scenario to the captured banking system they all use today. Banks are controlled and monitored with significant friction upon exiting them while stablecoins are a step away from Bitcoin adoption.

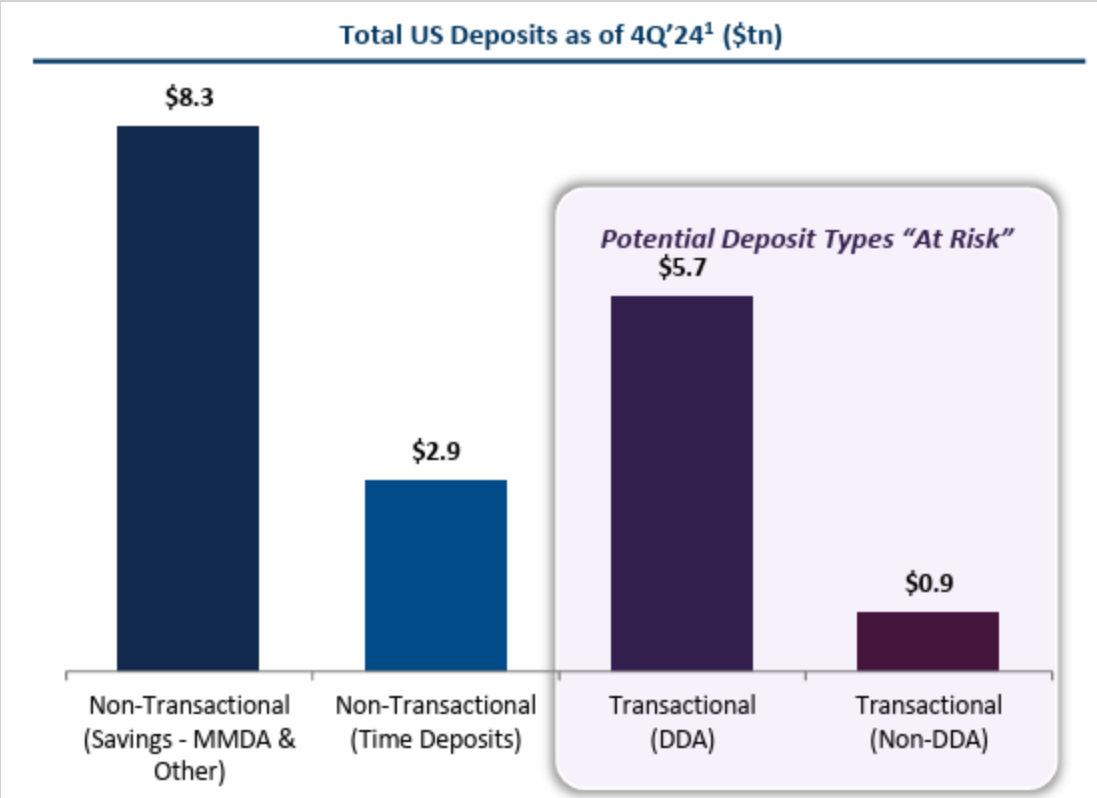
For now, the dollar will maintain dominance from its depth of liquidity, deep unit of account entrenchment, and geopolitical advantages. As Bitcoin grows in all three of these dimensions, things will change. Until then, people will use Bitcoin and as others adopt stablecoins they will be positioned to understand and adopt Bitcoin far better than existing within traditional banking rails.

Gradually more value for savings will be moved from either stablecoins or tokenized deposits to Bitcoin. Institutions will be aware of this and attempt to combat it by adding bitcoin to reserves (the same incentive that launched Bitcoin ETFs and Bitcoin treasury stocks will apply to banks as well!). Adding bitcoin as a reserve will be a differentiator for banks tokenizing their products. Bitcoin will slowly creep into reserves until it finds a dominant position.[72]

Market Size

U.S. bank deposits are ~$18 trillion and reserves are ~$3 trillion (~17%). The U.S. Treasury has estimated $6.6 trillion of these to be demand deposits and thus at risk of stablecoin disruption.

[72] The GENIUS Act in the US does not allow bitcoin as a reserve for stablecoins. Further, US banks are prohibited from holding bitcoin on their balance sheet (even though they can now provide Bitcoin custody, an off-balance sheet product). Bitcoin is very clearly an impermissible investment or reserve for US banks and stablecoins today. This point is in reference to global expectations over the long term.

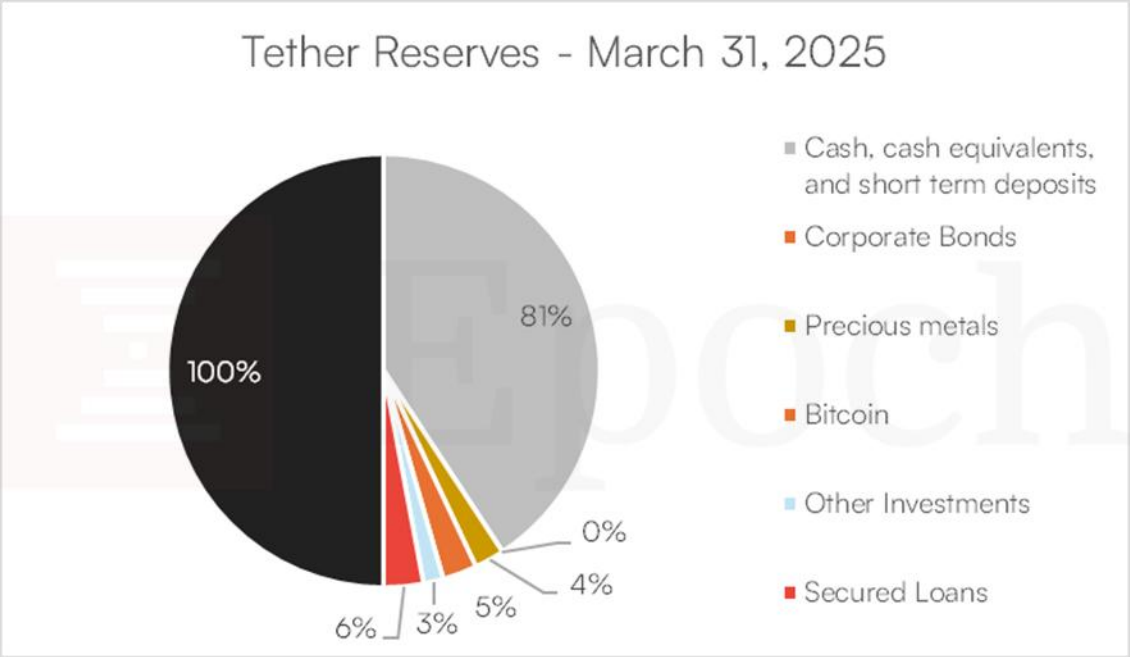


Characterizing "At-Risk" Deposit Types

- Current transactional deposit types are already non-interest bearing
- Unlike savings or time deposits, transactional deposits are primarily utilized for daily activities and can be easily transferred to other accounts
- More broadly uninsured deposits can leave holders to rationalize where to park deposits opportunistically or during periods of uncertainty (as evidenced in past migrations to MMFs during periods of stress)[2]

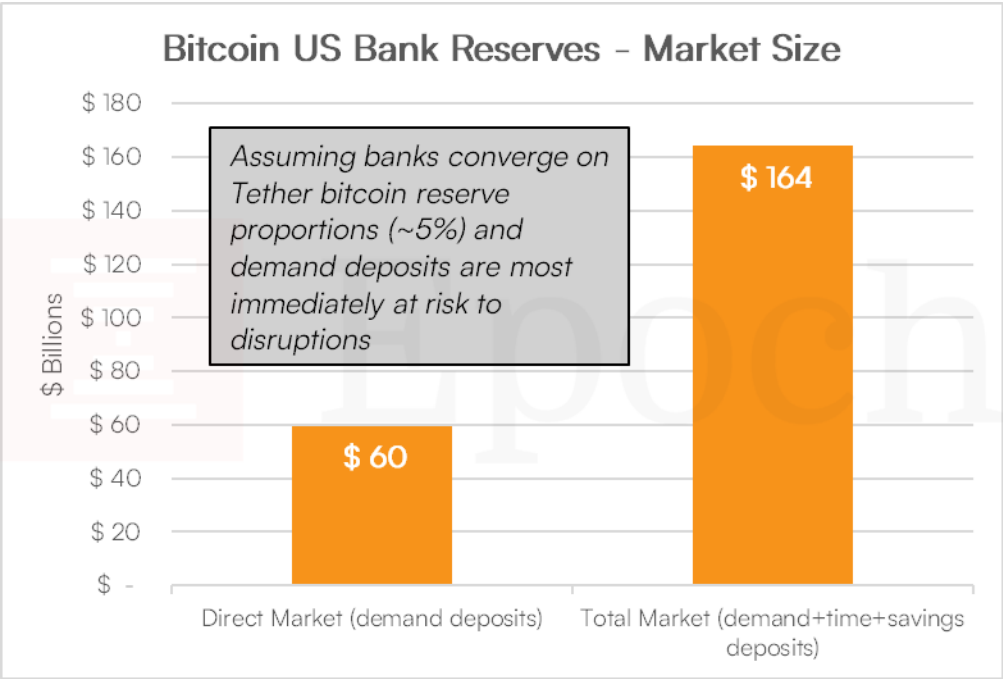
Source: TBAC

Now consider that the most dominant stablecoin, Tether, currently reports 5% of its reserves are held in bitcoin.



Source: Tether

When the bitcoin reserve proportion of Tether is applied to the U.S. banking system, it implies that there is a $60 billion market for demand deposit accounts and a $164 billion market for all deposit accounts in the U.S. By the time the regulatory environment allows for it, this market for U.S. bank reserves will likely be much larger:



Conclusion

The potential market size of Bitcoin adoption by U.S. banks is significant and impending. The history of adoption thus far has adjusted the industry for adoption barring regulatory clarity. The rescinding of SAB 121 was a major step in that direction, with more to come as banks realize that this technology is changing money and fundamentally changing their function within the financial system. Key takeaways include:

1. **Bitcoin's Novel Functionality**: Bitcoin's network enables interactions with systems inaccessible to traditional banking, while its deterministically issued asset offers properties that other central banks cannot replicate. These characteristics provide banks with new opportunities in custody, brokerage, lending, and cross-border settlement services.
2. **Custody Market Potential**: Bitcoin custody services, enabled by regulatory clarity in 2021, face challenges due to SEC's SAB 121, which treats crypto assets as balance sheet liabilities. With gold as a comparison, bitcoin is should be less than the gold market's custodial ownership at 33% and banks are poised to capture a significant share. Though self-custody and collaborative custody are superior alternatives that will take time to proliferate.
3. **Brokerage and Lending Opportunities**: The approval of spot Bitcoin ETFs in 2024 has legitimized Bitcoin as an asset class in the minds of wall street, encouraging banks to offer brokerage services. While direct Bitcoin lending by traditional banks is limited due to regulatory hurdles, Bitcoin's properties as liquid, permissionless collateral position it for growth in securities-based lending, particularly as regulatory frameworks evolve.
4. **Cross-Border Settlement Advantages**: Bitcoin's permissionless nature and settlement finality offer significant advantages over stablecoins and traditional banking systems for cross-border payments. As stablecoin adoption grows, it will familiarize users with cryptographic payment rails, paving the way for increased Bitcoin adoption, particularly in markets with capital controls.
5. **Stablecoins, Tokenized Deposits, and CBDCs**: Stablecoins challenge traditional banking by bypassing intermediaries, but regulations like the GENIUS Act protect banks' advantages through seigniorage and fractional reserve banking. Meanwhile, tokenized reserve deposits (TuRDs), a rebranded form of wholesale CBDCs, offer banks modernized settlement mechanisms. Stablecoins' integration with Bitcoin infrastructure and bitcoin's growing presence in reserves (e.g., Tether's 5% bitcoin reserve) will drive broader understanding and adoption of bitcoin as a store of value, positioning it as a reserve asset for banks' tokenized products.

Bitcoin is the new central bank that is credibly neutral and predictable. Institutions anticipating this change will build financial infrastructure for the next generation while those assuming the alternative will be left behind in a world they no longer recognize.

The following section will cover our predictions for how this system will evolve in the medium to long term.

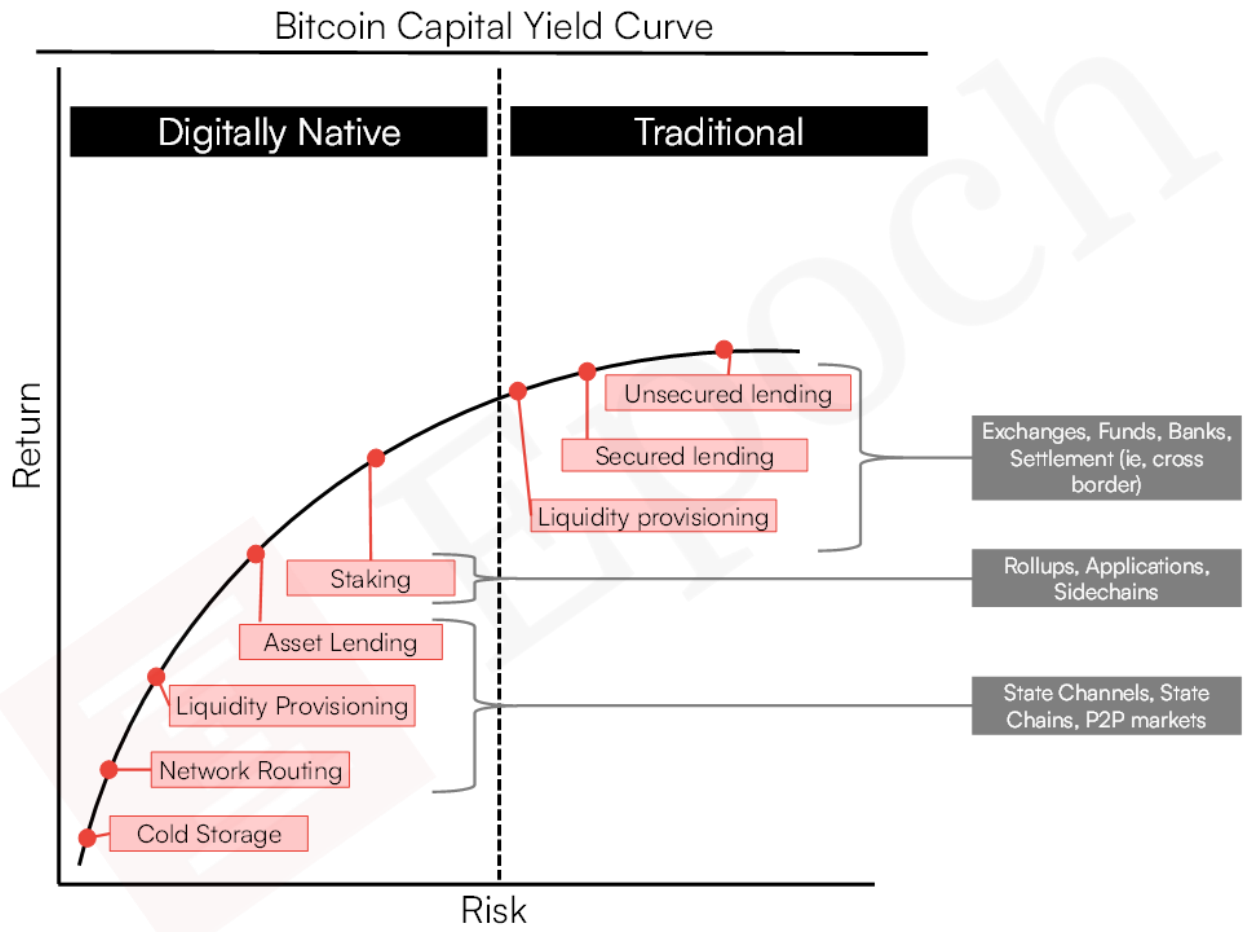
MARKET PREDICTIONS

Here, we will describe the long-term view for the industry across several themes we are predicting. Our goal is to describe the fundamental future vision of Bitcoin banking and how the ecosystem today will evolve towards this. We advance through our predictions starting with the more immediate and ending with the longest term.

Our predictions are posed with declarative writing, but of course, they remain predictions, and we are fallible.

I. Bitcoin Treasury Companies Become or Use Asset Managers

The recent explosion of Bitcoin treasury companies has many speculating on their long-term value proposition. Aside from capturing inefficiencies in capital raising to acquire bitcoin, they must remain as productive as possible in deploying this bitcoin to produce an economic yield from the asset base to remain competitive overtime. There is a novel yield curve emerging for bitcoin capital providers leveraging digitally native capital provisioning as well as traditional forms.



As Bitcoin treasury companies expand from exploiting inefficiencies in capital markets, they will eventually need to differentiate primarily through either capital provisioning or operating models. Put simply, they need to leverage bitcoin to earn a return or buy a business that needs their bitcoin as liquidity.

If there are Bitcoin treasuries, then there must be Bitcoin treasury (asset) managers. The above yield curve expresses the native opportunities for earning a yield on bitcoin capital, but this also demands technical wherewithal possessed by few today. Specialization is a necessity for optimal treasury management.

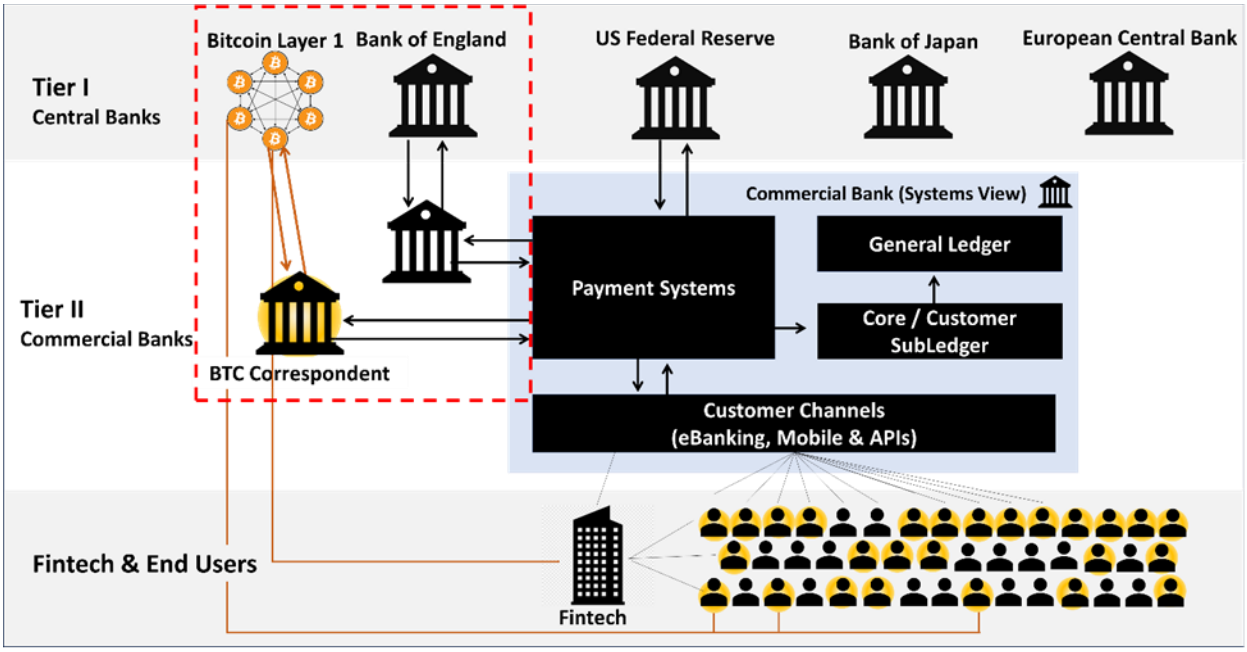
Many Bitcoin treasury companies will need to outsource their treasury management to more specialized providers. Bitcoin Treasury management businesses will likely leverage proprietary bitcoin capital and source capital from other treasuries seeking yield to scale their asset management practices.

We expect the pooling of Bitcoin treasuries is more likely to create systemic risk than any other source and will take some time to develop. By pooling capital to generate yield, Bitcoin treasury management businesses will be akin to the non-bank lenders we have witnessed historically (e.g., Ledn, BlockFi, Celsius, Genesis, Galaxy, etc.) but focused on bitcoin this time around because the market is getting wiser. With the same incentive to maximize yield to Bitcoin treasuries, if there is a systemic crash in the Bitcoin treasury company market, this will likely be the cause as Bitcoin treasury companies pool capital in various treasury managers implementing rehypothecation and poor risk management.

All of that said, we anticipate treasury management companies to assume the role of financial service companies and over a long enough time horizon, they could eventually acquire bank charters. In the near term, they'll likely become bitcoin liquidity providers for bank operations (e.g., ETF in-kind redemptions). The process begins with a management business pooling treasury capital that is likely to acquire Bitcoin companies (i.e., bring their liquidity provisioning in house) via custodians, exchanges, cross-border payment providers, or any business model that requires bitcoin.

II. The Bitcoin Correspondent Bank

Consider the model of the correspondent bank expressed in the first section of this writing through which commercial banks interact with central banks from foreign jurisdictions:



Correspondent banks are often those granted master account access to a central bank issuing a currency desired by a given respondent bank. The Bitcoin network acting as the only neutral central bank will itself have correspondent banks for different reasons. The Bitcoin network is completely open, and anyone can have an account with it by downloading Bitcoin software (e.g., run a node). However, for technical reasons, interacting with an intermediary that streamlines interaction with the Bitcoin network, and its related layered protocols, has been and will continue to be demanded by the market.

We view two primary avenues from which correspondent banks will emerge:

- Bitcoin native infrastructure providers
- Bitcoin financial service providers
- Large correspondent banks that will improve service quality by integrating with Bitcoin

While we anticipate that Bitcoin technology companies will interact with commercial banks and financial institutions, it's likely that regulated entities (e.g.,Coinbase, Anchorage, Fidelity Digital Assets) will find product-market fit by providing comprehensive correspondent services for all crypto use cases.

Banks that specialize in correspondent banking are well-positioned to lead as Bitcoin correspondents. Their expertise in multi-currency settlement, liquidity provisioning, and cross-border risk management maps naturally to the demands of Bitcoin correspondent banking. By leveraging existing banking relationships with both non-local central banks and commercial

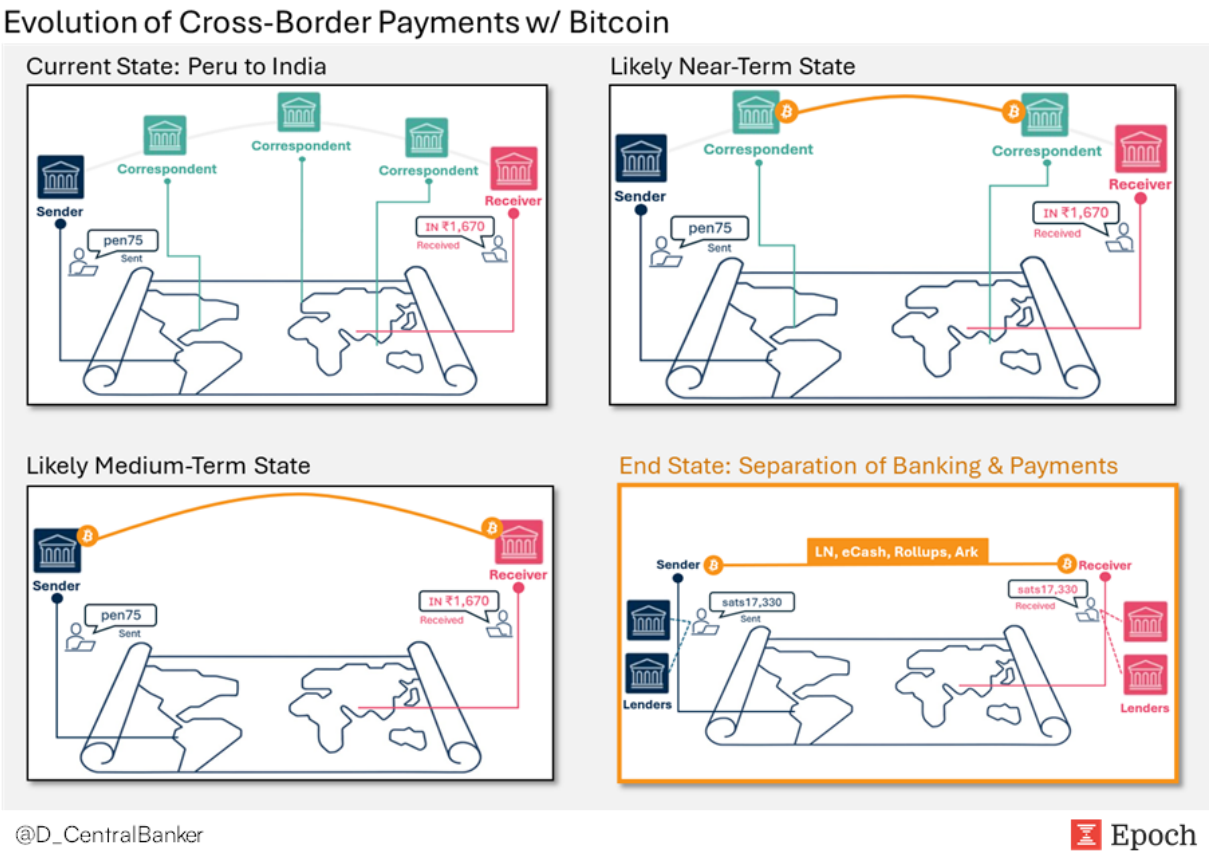
banks, they can facilitate real-time settlement between bitcoin and multiple fiat currencies. These institutions are uniquely equipped to offer conversion, custody, and settlement services while meeting global regulatory and compliance standards.

A Note on Counterparty Risk

As Bitcoin correspondent banking grows and daily settlement volumes through intermediaries increase, the counterparty risk associated with delayed or failed settlement will become increasingly untenable for regulated institutions. To mitigate this risk at scale, payment-versus-payment (PvP) mechanisms will need to be considered. Given its global liquidity, 24/7 settlement capability, and increasing use in institutional financial services, Bitcoin may emerge as a viable candidate for inclusion in PvP networks such as Continuous Linked Settlement (CLS), potentially becoming the first non-sovereign currency added to its settlement infrastructure.

Correspondent banking will be the next step for Bitcoin adoption by banks and through this it will spread throughout the system as banks leverage it as an asset and connect to it as a network. Eventually so many correspondent banks will have connected to it that it will disintermediate the multi-hop cross-border system everyone is forced to use today. As this network effect of banks connecting to Bitcoin grows, new banks entering the market will ask themselves if it makes sense to connect to a correspondent, or just to Bitcoin directly. The larger the network effect Bitcoin direct connections to banks, the greater the incentive becomes for every bank to connect to it.

To illustrate how this transition could unfold in practice, we adapt the Bank of England's cross-border payment framework from the section above to a less common currency pair, Peruvian sol to Indian rupee. The graphic below depicts a progression from the current state (top left) to Bitcoin enabled correspondent banks (top right), and finally to the point where most banks have integrated Bitcoin (bottom left).



In short, we expect Bitcoin integration will streamline cross-border settlement and reduce reliance on traditional correspondent chains over time.

III. Bitcoin Becomes the FX Unit of Account

Through correspondent banking practices, we see the first usage of bitcoin as an FX unit of account emerging. This will be driven by two primary trends:

(1) Neutral Denomination

As the only neutral money, there will be a natural convergence upon denomination of fiat currencies in it. Today, fluctuations in fiat currencies can only be denominated in indices which are composites of other fiat currencies. The dollar index or IMF's SDRs are examples of this. Over time, an established, neutral settlement commodity money like bitcoin will be the FX medium with fiat neutrality. As Bitcoin adoption grows, this quality will become increasingly apparent.

(2) Stablecoin Adoption

The astute reader is now asking: "why hasn't gold been used as an FX unit of account?". It has historically but this question is relevant in the context of the modern economy. Gold is scarce and neutral, but it cannot be used for final, borderless, and apolitical settlement which has naturally hindered any use in FX denomination. Final settlement is very important, and Bitcoin stands alone in this category (i.e., stablecoins are not final settlement), because it will enable fungibility over the long term.

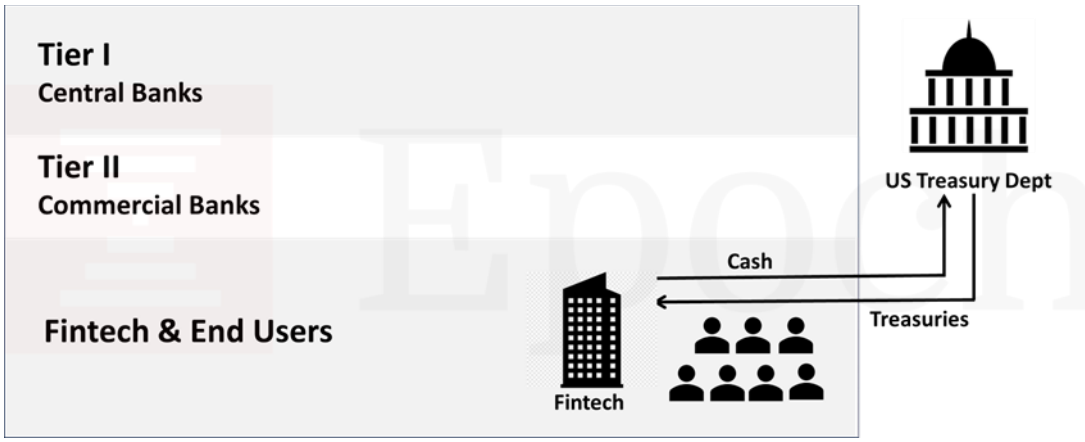
Stablecoins need reserves to maintain their peg and the only reserve asset that doesn't require government permission to access or liquidate is bitcoin. This point, made earlier, is paramount for global adoption. Stablecoin technology will exist globally but regulatory barriers will create material distinctions in collateral and introduce variance in fungibility. While stablecoins become regulated into a variety of colors and flavors, bitcoin will remain the only true measure amongst them. Baskets, indices, and the like will eventually be formed and ultimately measured against bitcoin.

A second order effect of stablecoin adoption will be the exacerbation of dollar dominance. When the adoption becomes increasingly threatening, stablecoins will become a systemic risk to other governments. The only digital money without fiat risk will be Bitcoin, and they will naturally default to it against riskier alternatives. Putting the systemic risk aside, there will be political reasons to avoid using competing fiat currencies as well.

IV. Bitcoin Becomes the Stablecoin Reserve Asset

First, two things will happen:

(1) TuRDs: tokenized reserve deposits (i.e., a wholesale CBDC) will be deployed and used for interbank settlement amongst commercial banks. This will increase the risk that they evolve towards a retail CBDC as sophisticated individuals/businesses will likely continue to prefer "central bank money" to commercial bank tokenized deposits and/or stablecoins.
(2) Stablecoins will become tokenized treasuries, circumventing not only commercial banks but also central banks. Anyone can buy U.S. Treasuries today on a smaller scale but bank access (primary dealers) is required to acquire treasury securities at scale. The regulatory environment will also need to allow non-banks to pass along the interest earned from treasury securities.

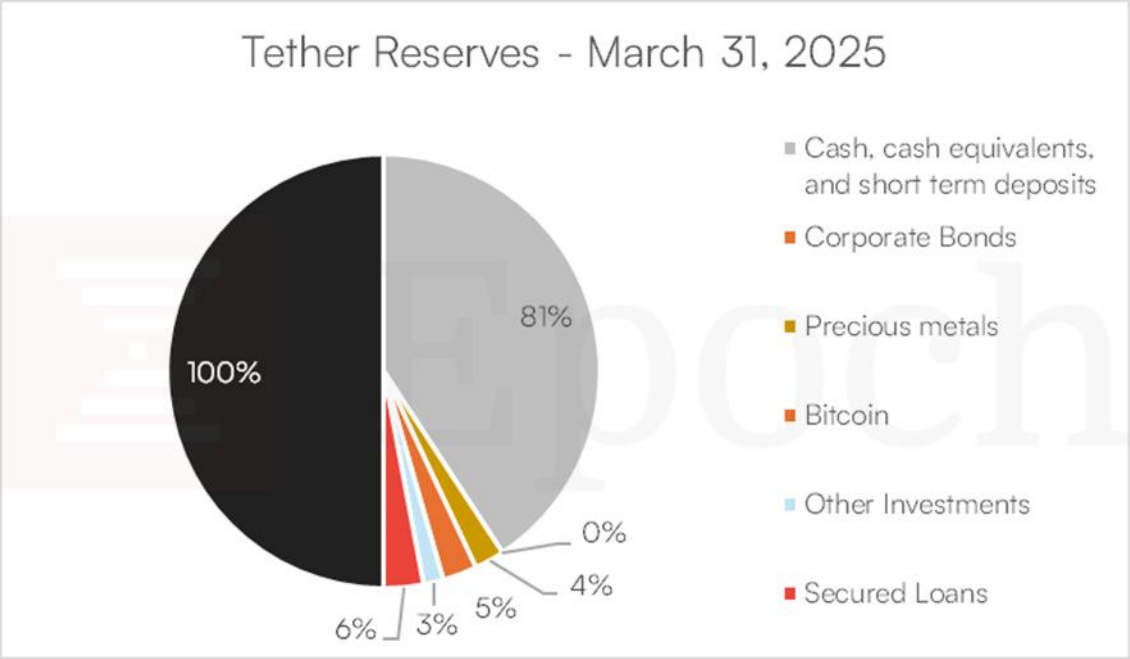


The primary consideration here is that both commercial banks and central banks are at risk of disintermediation on a longer horizon. If non-bank or bank-chartered stablecoin providers are permitted to acquire treasury securities at scale and pay interest directly, this would effectively bypass the banking system, enabling individuals to trade government debt directly using cryptographic signatures.

A problem with trading government debt directly is that not all debts are the same, so the direct trade of singular debts will lack fungibility and serve as a poor form of money. However, aggregating many different treasuries of varying vintages and maturities as reserves effectively blends the debts of the government to a more fungible state. Thus, the primary role of stablecoins will be to increase the fungibility of U.S. debt by blending it together for direct trade.

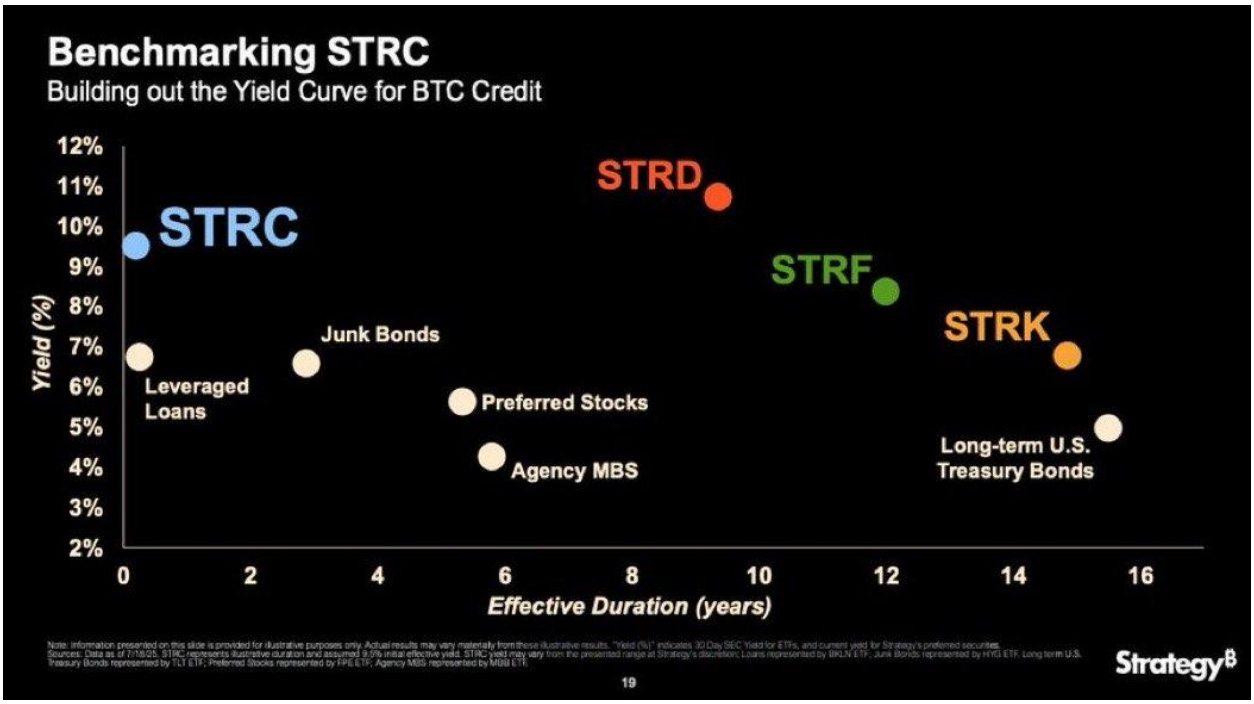
The marginal source of demand for interest-paying stablecoins will come from the amount of interest they ultimately pay (assuming all else equal), and at this point, the primary motivation for a stablecoin operator will be to maximize the risk-adjusted returns for their stablecoin (as people are trading credit funds effectively).[73] Bitcoin is the scarcest asset with 24/7 liquidity, immaterial storage costs, and market depth that will gradually consume reserve balance sheets during this process. It is already doing so today:

[73] So it goes in fiat world



Source: Tether

Tether is using bitcoin as a reserve today, but it's not passing along the benefits as interest. The Strategy preferred equity issuance (STRC) is the most economically similar example of this concept today:



The STRC product is aligning duration to be similar to short-duration cash equivalents but paying vastly higher interest by using bitcoin. For reasons known to all, this of course can backfire from

the asset's volatility; however, this problem decreases with time and adoption. All institutions will wonder why they aren't using bitcoin as a reserve asset as this phenomenon persists.

Of course, the GENIUS Act restricts collateral for stablecoins to effectively short-term government securities and bank deposits, and companies like Tether will either need to change their reserves or bifurcate their U.S. operations with global operations. However, global competitive pressures will likely expand the bitcoin reserve interest paying stablecoin model (even domestic securities pressure against STRC and the like).

V. Bitcoin Is Owned Directly, Circumventing Stablecoins (AKA - Money)

As the world adopts stablecoins, the infrastructure required to accept transactions via digital signature will become ubiquitous, placing the ability to accept bitcoin a flip of a switch away. Further, stablecoins will always and everywhere be subject to maturity and asset mismatching. Runs will occur, and stablecoins will fail.[74] Meanwhile, Bitcoin will become increasingly more liquid and less volatile. As individuals realize the compelling rates of return provided by stablecoins stem predominantly from bitcoin reserves, they will directly adopt bitcoin themselves.

As Bitcoin matures to becoming the commodity with the deepest market liquidity in the world, individuals and institutions will find little risk in holding it directly and government debt as collateral will gradually become a thing of the past. Bitcoin will spread like a virus throughout the banking system. The primary mechanism for its spread will be incentives. As long as bitcoin makes people wealthier, this will not stop. Any argument that stablecoins will take market share from Bitcoin is an argument that government debt is superior money to bitcoin. It is not. As the friction from path dependency on the legacy financial system erodes, Bitcoin will consume the market of money.

For the same reason that stablecoins will cause people to directly trade US debt, people will begin directly trading bitcoin. It all begins with disintermediating the commercial banking system and ends with everyone asking: "If the yield I earn on my stablecoin comes from the bitcoin in reserves and not the US debt, why am I not just trading bitcoin directly?"

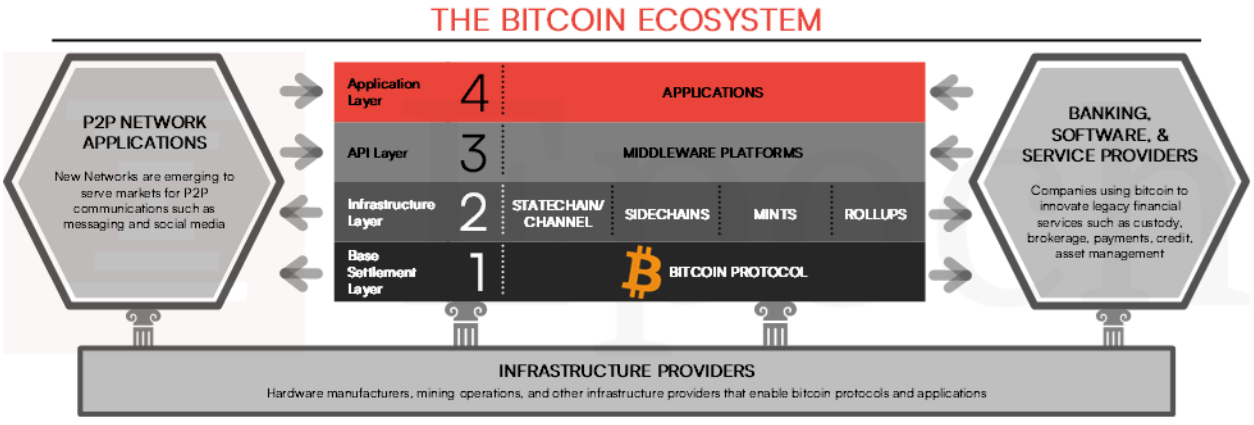
[74] However, the GENIUS act relegating stablecoins to that of a narrow bank arguably makes them safer today in the US than banks themselves.

For this reason, when people ask what our opinion of stablecoins is, we say:

VI. Banks without Bankers

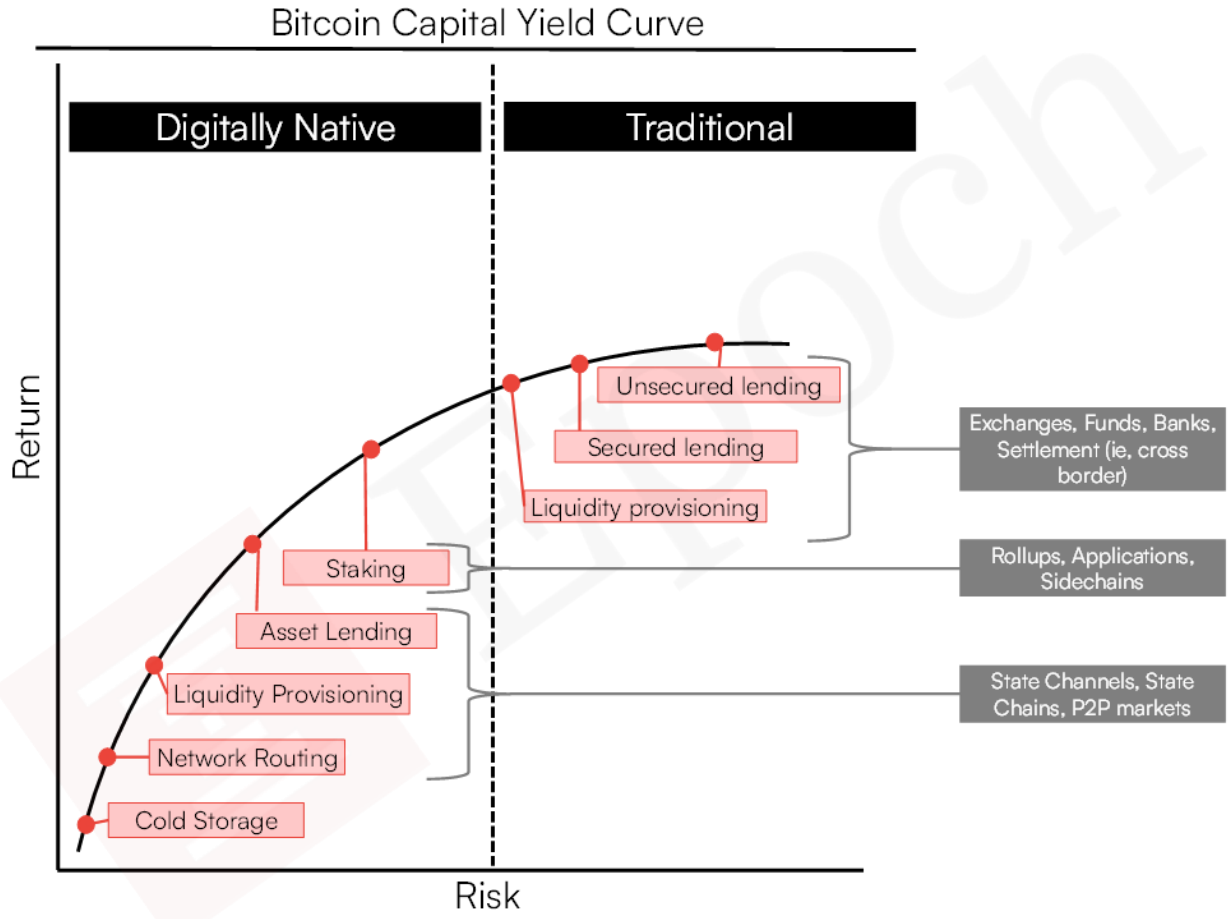
As bitcoin is traded directly, the banking system will turn towards capital provisioning of bitcoin directly. Eric Yakes' *Banks without Bankers* paper discusses the technical systems emerging for this Bitcoin native banking system and how it will be akin to free banking but automated significantly by technology.[75]

Protocols integrated with Bitcoin allow users to do more things with bitcoin at faster speeds, all with vary degrees of tradeoffs. This is the infrastructure layer in the below graphic:



[75] Banks without Bankers paper found here: https://epochvc.io/pdf/Banks-without-Bankers-Eric-Yakes-2023.pdf

Capital markets for bitcoin will emerge from how Bitcoin interacts with the protocol infrastructure layer, P2P network applications, and centralized service providers which is this chart from earlier:



We already have Bitcoin-native capital markets emerging. Bitcoin is a medium of exchange which has various means of payment that exist today (e.g., Lightning Network, eCash, VTXOs, etc). As more digitally native use cases expand, the downstream demand for capital provisioning towards these use cases will become increasingly attractive. The inflection point occurs when bitcoin shifts from being a reserve of various systems to the asset being traded itself. At that point is when large scale capital growth will catalyze itself towards maturity.

Digitally native systems will be peer-to-peer as well as intermediated. Most of the functionality of the intermediated systems will be automated when compared to modern banking. Imagine a system where users dollar-cost-average into Bitcoin via Ark, utilize federated technology for custody, use eCash as a private cash balance for everyday transactions, and, on the backend, all service providers are clearing balances between one another via the Lightning Network. Mints and ASPs could act as banking infrastructure, and the Lightning Network could support various clearing houses amongst them as a hub-and-spoke model.

Such a system is irreducibly complex; it will require bridging and scaffolding along the way. The natural progression of bitcoin as collateral, to a reserve asset, to direct money will facilitate this

scaffolding process along the way. The final goal here is to eliminate the agency problem inherent in central banking, and this will take decades to unfold. The devil is in details, and the final section of this report is designed to lay out the technical foundation for the start of this process.

Conclusion

Bitcoin's integration into the financial system will progress from a reserve asset to a directly traded medium of exchange, driven by its unique properties and the growth of digital infrastructure. While regulatory and systemic challenges persist, Bitcoin's adoption is expected to accelerate, reshaping banking into a more decentralized, automated, and efficient system over decades. Our key predictions include:

1. **Bitcoin Treasury Companies Evolve:** Large Bitcoin treasury companies will transition from capital-raising entities to treasury management firms, leveraging bitcoin to generate economic yield. These firms will either specialize in capital provisioning or acquire Bitcoin-centric businesses, potentially pooling capital and introducing systemic risks through rehypothecation, similar to historical non-bank industry providers.
2. **Emergence of Bitcoin Correspondent Banking:** The Bitcoin network, as a neutral central bank, will foster correspondent banking models through native infrastructure and financial service providers. Regulated entities and banks with expertise in multi-currency settlement are well-positioned to streamline Bitcoin interactions, managing custody, conversion, and settlement while addressing counterparty risks from increasing transaction volumes.
3. **Bitcoin as a Stablecoin Reserve Asset:** Stablecoins, particularly those backed by bitcoin, will drive adoption by familiarizing users with cryptographic rails. Bitcoin's advantages will eventually drive users to bypass stablecoins and hold bitcoin directly.
4. **Disintermediation & Direct Bitcoin Trading:** As stablecoin infrastructure proliferates, it will reduce reliance on traditional banking systems, enabling direct trading of bitcoin. This shift will be driven by Bitcoin's superior monetary properties, diminishing the appeal of government debt-backed stablecoins. Over time, individuals and institutions will prefer Bitcoin for its permissionless, liquid nature, eroding fiat dominance.
5. **Banks Without Bankers:** The future of Bitcoin banking envisions a "banks without bankers" model, where automated, Bitcoin-native protocols (e.g., Lightning, eCash, VTXOs) enable peer-to-peer and intermediated capital systems, minimizing agency problems and fostering decentralized capital markets.

Commercial banks existed before central banks, and they will exist after. The final section of the report explains how these commercial banks will begin to hitch their tattered and worn wagons to this new system. Banks never really get to shut off, they are always having to overhaul their engines in flight, the transition to Bitcoin banking will be no different...

Epoch

BITCOIN BANK INTEGRATION:

APPLIED TECHNICAL OVERVIEW

Bitcoin Bank Integration: Applied Technical Overview

I. Overview

Having established that Bitcoin, and other digital signature-based assets, are unlikely to replace the financial system outright in the near term, we now turn to a more technical exploration of how integration is poised to occur. This section outlines how bank technology executives should prepare for this future, and highlights areas where non-bank technologists can build the services banks will require.

As detailed in the *deCentral Banking* section of this report, the strategic path for integrating Bitcoin should mirror how most banks access foreign payment systems today: through correspondent banking. In the pages that follow, we'll break down the commercial bank technology stack and identify key integration points for cryptographic assets, with a specific focus on how banks can support the Bitcoin services discussed in the Market Overview section of this report.

This section focuses on the technical enablers of Bitcoin services, but it's worth noting that a bank's competitive advantage in this domain may not lie in its technology stack. In fact, there are credible paths for banks to enter the Bitcoin space, meeting all control objectives, with minimal technical investment. This is particularly true for bitcoin-backed lending but may be true for other services as the industry matures.

Note on Stablecoins & Other Types of Digital Assets
While this paper focuses primarily on Bitcoin, many of the integration strategies described herein apply equally to other digital asset types, including stablecoins and tokenized deposits. While in practice, many banks may begin by building systems to support tokenized fiat instruments (including stablecoins), we believe these systems will ultimately be used to support Bitcoin banking services.[76]

II. Exploring the Legacy Bank Technology Stack

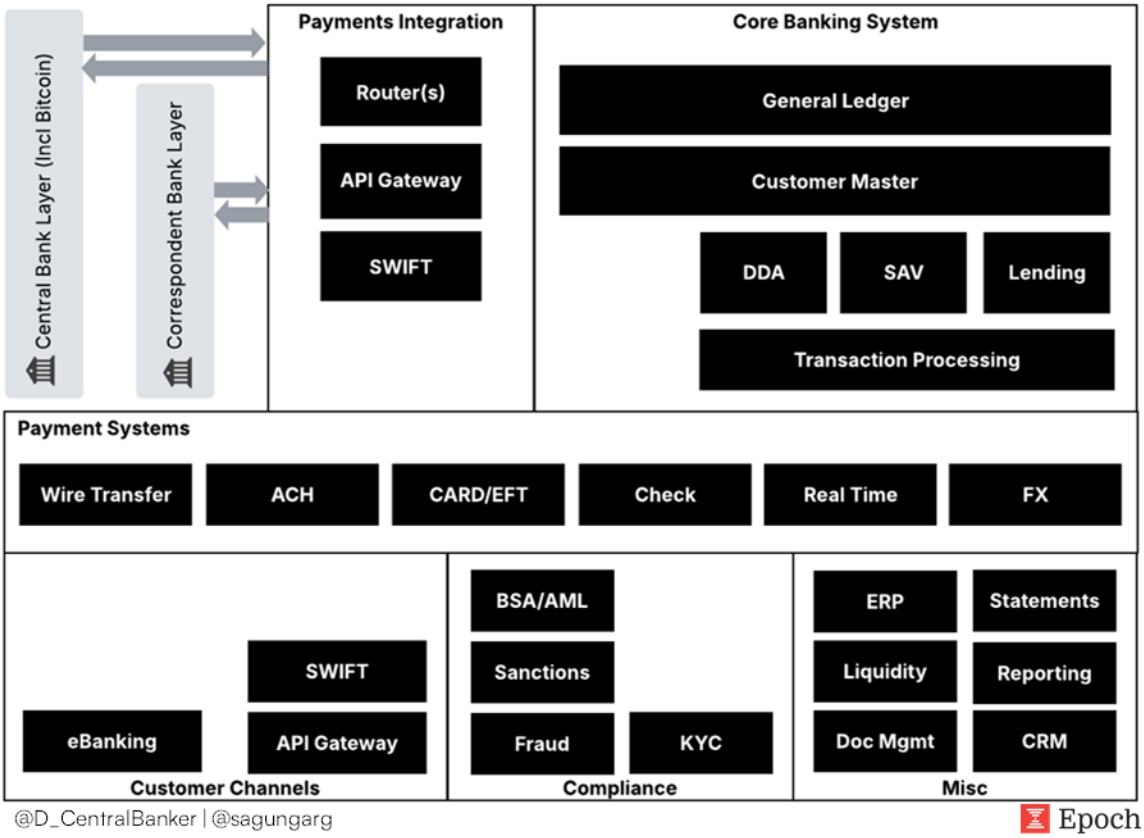
Reference Architecture

Below is a reference technical architecture for a typical U.S. regional or community bank.

We will explore specific systems within this architecture later; for now, focus your attention on the broader system categories: Payments Integration, Core Banking System, Payment Systems, Customer Channels, and Compliance.

[76] If you don't have confidence in this, consider learning more about the history of money

Figure 1: Typical Bank Reference Architecture



This architecture diagram is not an exhaustive list of systems but rather logical groups of the primary systems that make up a typical U.S. regional or community bank. Each category represents a distinct set of systems that work together to support deposit-taking, lending, payment processing, and external connectivity.

With this reference architecture in mind, we'll proceed.

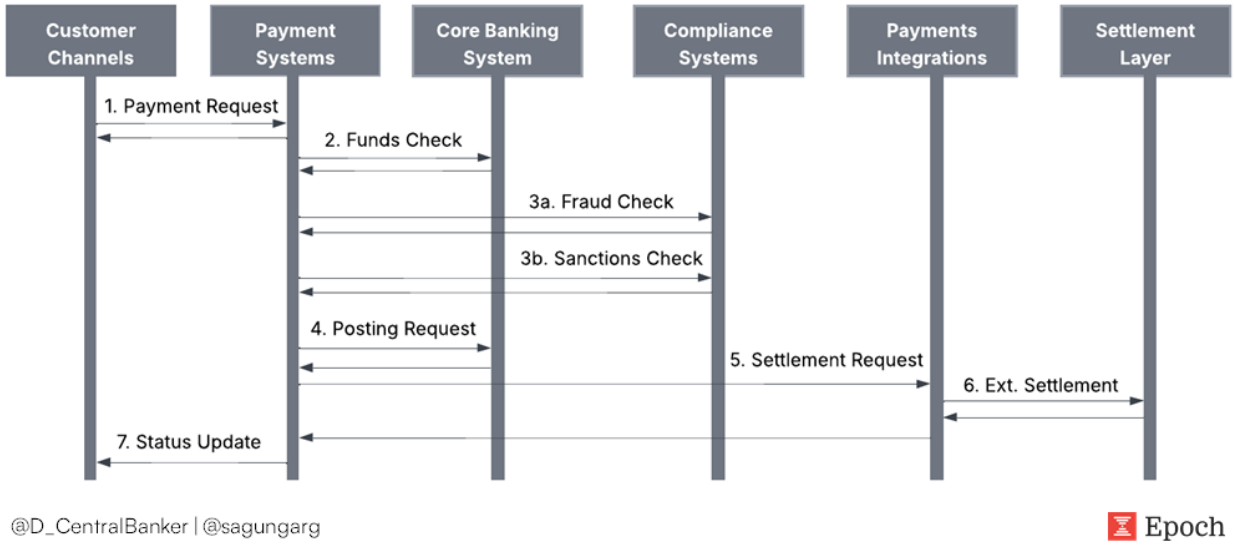
Sample High-Value Payment Flow

Focusing on the system categories in the reference architecture, we can trace a typical outgoing high-value payment, such as a Fedwire (Real Time Gross Settlement or "RTGS") transaction, using a simple sequence diagram for clarity (figure 2 below).

Payment Processing Steps:

Step 1) Customer Channel sends payment request to Payment System
Step 2) Payment System requests account balance (possibly places a hold)
Step 3) Payments System requests compliance checks (fraud, sanctions, etc)
Step 4) Payment System requests transaction posting
Step 5) Payment System sends payment message internally for settlement
Step 6) Integration Layer transforms and/or sends payment message externally
Step 7) Payment System updates payment status in Customer Channel

Figure 2: Outgoing High Value Payment Sequence Diagram



While the above process may appear complex, a modern payments hub executes these steps in seconds, runs many payments in parallel, and achieves full straight-through processing when no exceptions occur. When exceptions do arise (e.g., a sanctions match), the payments are automatically routed for review.

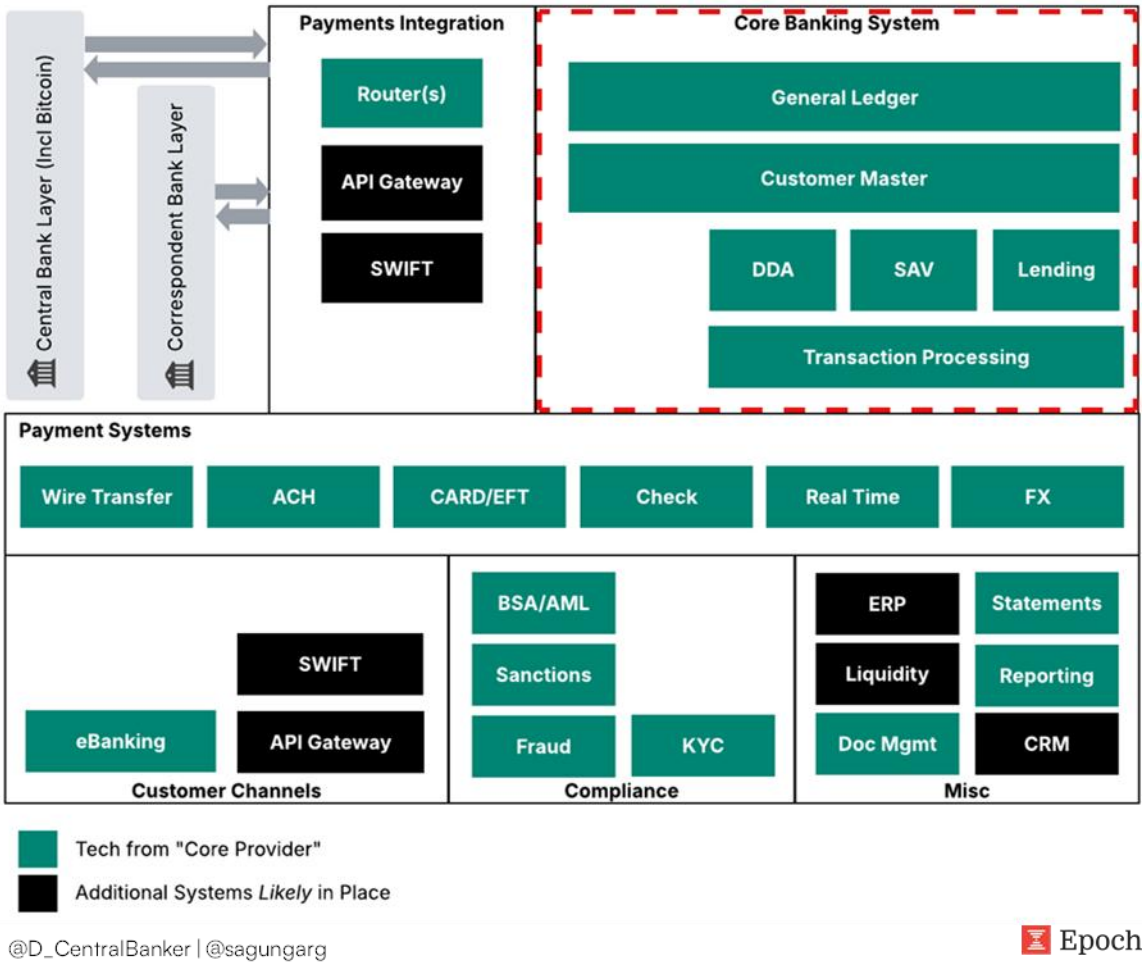
Keep in mind, the sequence diagram above shows only a “happy path” outgoing Fedwire transaction, and each box in the diagram represents a category of systems, not specific system types. A well-architected payments hub can support many different channels, core systems, compliance systems, and even settlement rails, dynamically routing based on payment direction, asset type, and timing.

So what’s the problem? On paper, this architecture appears robust and efficient, but real-world constraints tell a different story.

The "Core Problem" with Existing Bank Architecture

Returning now to the reference architecture, please focus your attention on the Core Banking System (upper right-hand corner of the graphic below). While the Core Banking System is just one section of the architecture, and involved only briefly in the sequence diagram, the reality is far more complicated. For most banks, the Core Service Provider is indistinguishable from the Core Banking System. The Core Service Provider typically delivers a tightly integrated suite of tools: the updated architecture below includes color coding to indicate the systems which are typically provided by the Core Service Provider. Again, please keep in mind this is not an exhaustive list of banking systems.

Figure 3: Reference Architecture with Core Service Provider Color Coding



This bundling of systems offers simplicity and scale, particularly for Core Service Providers that resell this technology stack to hundreds of banks, but it comes at a cost: innovation is limited to what the core provider is willing to support. Banks are often unable to independently integrate new systems, including those required for Bitcoin, without explicit vendor cooperation.

Competing as a Third-Party Service Provider

Vendor consolidation makes it difficult for banks to adopt solutions from digitally native providers, as selection processes often favor incumbent providers with scale and existing relationships. Those positioned as full-service providers, not just tech platforms, are best equipped to earn bank trust and drive adoption.

To compete, service providers must offer more than technical innovation. They need System and Organization Controls 2 (SOC 2) or International Organization for Standardization (ISO) certifications, strong Service Level Agreements (SLAs), and ideally off-the-shelf integrations with legacy systems.

Many core providers are building API-enabled service layers to address third-party integration challenges and make it easier for their banks to integrate with external systems, but few have succeeded in enabling true bank-led innovation. In short, these API service buses are not a silver bullet for banks who want to innovate.

So what is?

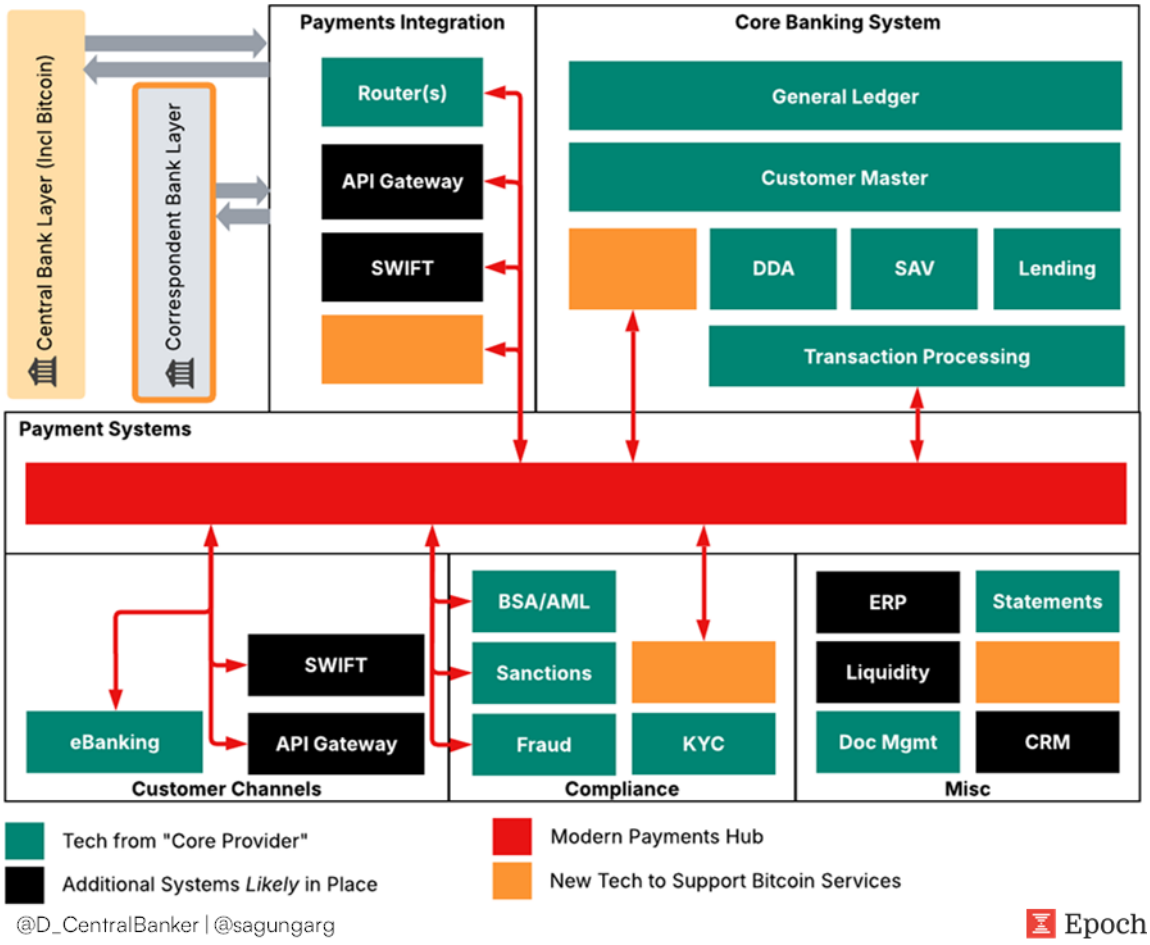
Payment Hub: A "No Regrets Move" for Innovation & Bitcoin Integration

The most powerful and flexible entry point for enabling bank innovation, including Bitcoin and other assets transferred via digital signatures, is a modern payments hub.

As shown in the diagram below, these hubs are designed to support:

- **Multiple cores**, including "sidecar" sub-ledgers for new asset types
- **Multiple channels**, such as online banking, APIs, and SWIFT
- **Multiple settlement rails**, including Fedwire, ACH, RTP... and now Bitcoin

Figure 4: Modern Payment Hub Flexibility

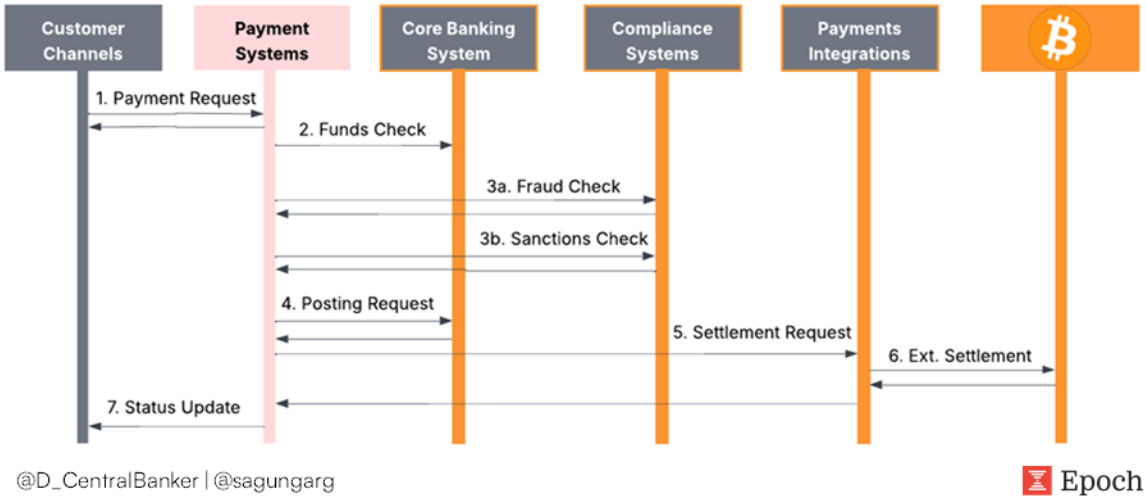


A payments hub serves as an abstraction layer that routes payment messages between internal systems and external ledgers, and as we discussed at length in the *Banking System Primer* at the beginning of this report, Bitcoin is a new Tier I settlement rail that we expect will continue gaining adoption among commercial banks in the coming years.

Once a bank has control over its payments orchestration, it can begin to integrate fit-for-purpose systems for settling bitcoin, whether directly with the Bitcoin network, or through a correspondent partner.

Finally, the updated sequence diagram below illustrates how a payments hub enables Bitcoin settlement, not by drastically altering existing payment flows, but effectively routing payment requests to new Bitcoin-enabled internal systems which are fit-for-purpose to meet existing control objectives, before ultimately settling on the Bitcoin network.

Figure 5: Outgoing High Value Payment Sequence Diagram w/ Bitcoin



Bitcoin Bank Integration Summary

In summary, the most impactful step a bank can take to prepare for Bitcoin integration is not replacing the core, it's retooling the payments stack.

This provides immediate flexibility, future-proofs the architecture, and breaks the innovation dependency on the Core Service Provider by decoupling payment functionality from the core. With a modern payments hub, banks gain the ability to introduce new asset types(e.g., bitcoin and other digital signature-based assets) without waiting for core vendors to support them.

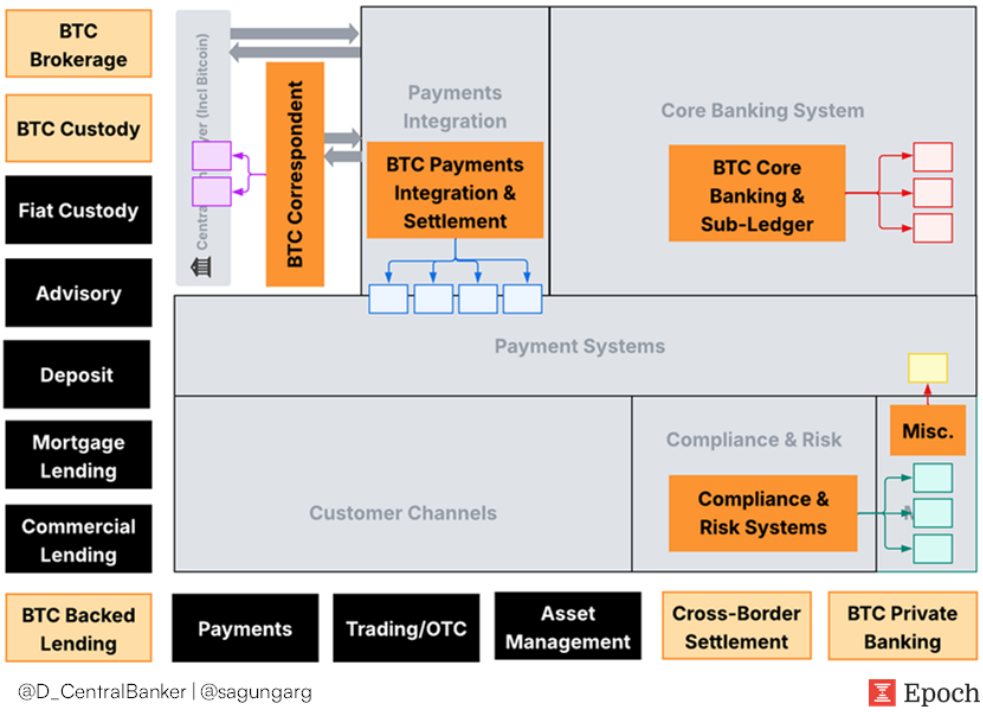
In the next section, we'll examine the Bitcoin-specific components (i.e., the "orange boxes" in the diagrams above) to see how they come together to deliver the Bitcoin banking services discussed in the *Market Overview* (e.g., Custody, Brokerage, bitcoin-Backed Lending, etc).

III. The Bitcoin Stack & Banking Integration

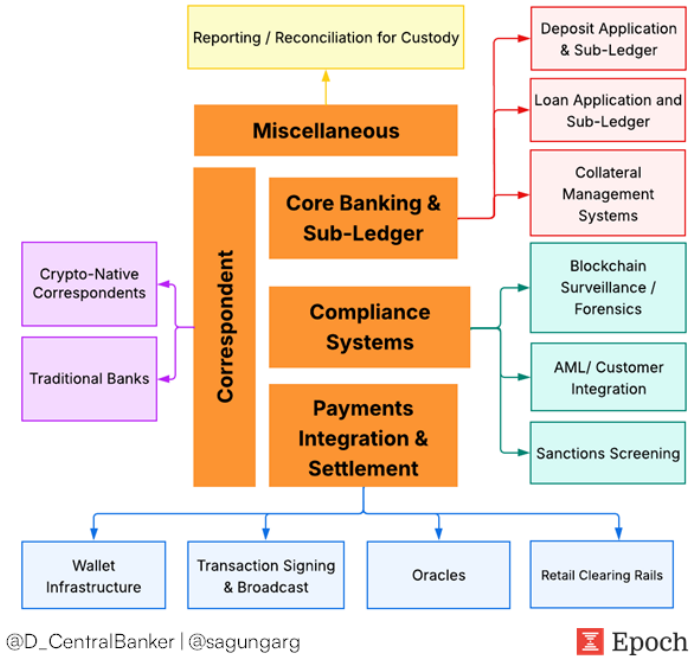
Before we can embark on a technical exploration of the specific Bitcoin services banks may offer (section IV below), we need to understand the systems that make those services possible. This section introduces the key technical components that underpin Bitcoin banking and explains how they fit into the broader banking technology environment.

To guide this exploration, we've updated the reference architecture to map the functional sub-systems required to support Bitcoin services within the traditional banking environment. In particular, we'll focus on the orange boxes from the prior diagrams, representing the digital asset-specific modules that sit alongside a bank's existing infrastructure.

Figure 6: Typical Bank Reference Architecture with Bitcoin Sub-Systems

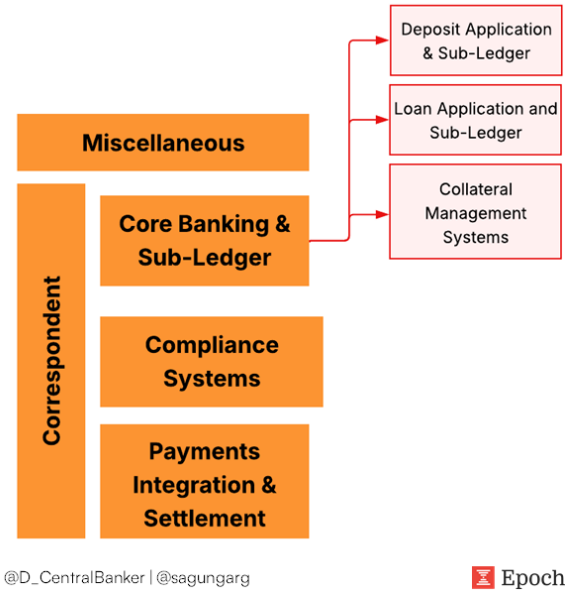


A consolidated view of the digital asset-specific modules is shown below and will serve as our guide through each of the sub-systems in the Bitcoin technology stack. These components represent the areas where new capabilities must be integrated alongside existing banking infrastructure. In a few instances, we'll also highlight current market suppliers to illustrate how banks are approaching these integrations in practice.



New Core Banking Systems (Digital Assets)

Core banking systems are the operational backbone of deposit and lending functions. These sub-ledgers are typically integrated tightly with the customer record and general ledger, providing a unified view of customer accounts across deposit, loan, and custody services. To support bitcoin and other cryptographic signature-based assets, banks don't need to replace their core systems immediately. Instead, they can deploy strategic, fit-for-purpose core components to support digital assets alongside existing infrastructure.



Deposit Application & Sub-Ledgers

Traditional deposit sub-ledgers must be adapted to recognize bitcoin-denominated balances, even if held off balance sheet. Some banks may opt for shadow ledgers or memo posts linked to segregated wallets or custodians. Integration should support real-time updates, interest calculation (if applicable), and visibility across channels.

Loan Application & Sub-Ledgers

Fiat loans collateralized by bitcoin require specialized collateral management and monitoring tools, ideally integrated with real-time price oracles and automated liquidation systems. Sub-ledgers should be able to classify bitcoin exposure as secured or pledged, depending on the model.

Collateral Management Systems

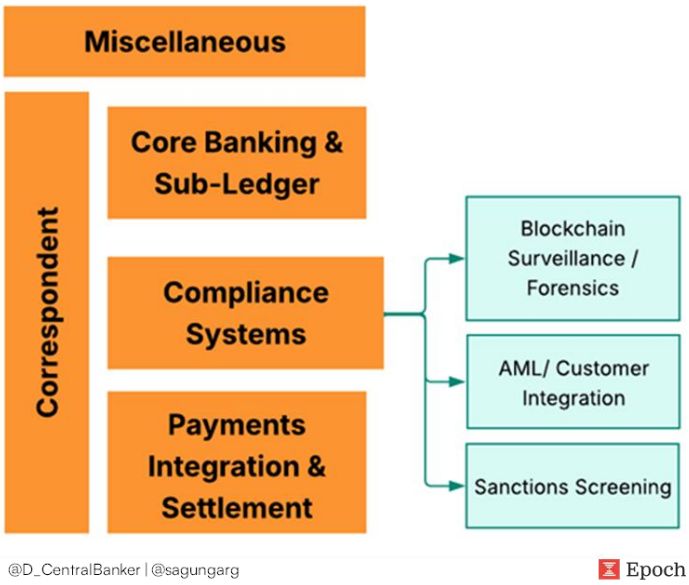
Effective integration with custodians and real-time pricing engines is critical for managing bitcoin collateral. Systems should support configurable Loan-to-Value (LTV) ratios, automated margin calls, and multi-asset eligibility tracking. Bitcoin's volatility means risk parameters need to be tunable and auditable.

Company Showcase

Galoy Galoy Inc. Founded: 2019 **Website:** galoy.io	Galoy provides core banking and payments infrastructure purpose-built for bitcoin applications. The Galoy stack enables financial institutions to offer modern services such as bitcoin-backed lending, digital asset deposit accounts and real-time payments over the Lightning Network. Galoy's core banking system features a double-entry BTC and fiat ledger as well as modules for account management, approval workflows, and interest & collateral management. GraphQL APIs enable integration with other components in a bank's technology stack. The platform may be operated as the primary core for startup financial institutions, whereas traditional banks seeking to plug into bitcoin may operate it in a "sidecar" core model.

New Compliance Systems for Digital Assets

Compliance systems ensure that Bitcoin and other digital asset services operate within regulatory expectations, both domestically and internationally. As banks integrate digital signature-based assets, these systems must expand to include wallet-level monitoring, blockchain analysis, and sanctions screening. The compliance stack likely includes a combination of third-party analytics, internal case management, and transaction monitoring tools. The components outlined below represent essential building blocks for maintaining AML, KYC, and sanctions compliance in a digital asset environment.



Blockchain Surveillance/ Forensics

Banks must integrate chain analytics tools to monitor transaction provenance, flag high-risk addresses, and comply with "Travel" rule requirements. Systems should allow for real-time alerts, retrospective audits, and should be integrated into AML case management systems.

AML/ Customer Integration

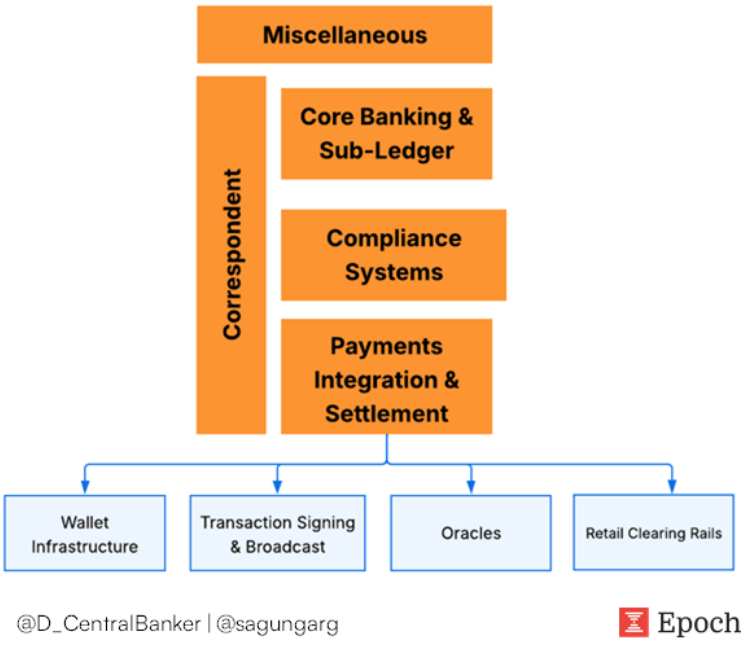
Similar to fiat transactions, customer identity data should be tightly coupled with wallet addresses and transaction history. Banks may embed crypto-specific risk scoring and implement enhanced due diligence based on asset flows or jurisdictional risk.

Sanctions Screening

Wallet screening must include OFAC and global sanctions list checks, with support for updating lists dynamically and flagging direct or indirect exposure to sanctioned addresses. Sanctions screening tools should include sanctioned blockchain addresses and should be integrated with the payment systems for real-time interdiction.

Payments Integration & Settlement Layer

As shown in the reference architecture, the Payments Integration Layer is not the Payment System itself. Rather, it connects the internal Payment System to external payment and settlement networks. The specific systems within this layer can vary widely based on the bank's overall architecture and digital asset strategy. As banks begin to support Bitcoin services, this layer becomes the critical interface for wallet infrastructure, transaction routing, signing workflows, and integration with both Bitcoin's Layer 1 and Layer 2 networks. The components outlined below represent foundational building blocks for enabling secure and scalable Bitcoin payments within the bank's existing payments stack.



Wallet Infrastructure

Banks offering direct Bitcoin services must integrate hot, warm, and cold wallet infrastructure, either through custodians or in-house solutions. Wallet management systems should support hierarchical deterministic (HD) wallet structures, user authentication, withdrawal limits, and address whitelisting. The wallet service is distinct from "Transaction Signing and Broadcast" as wallets are typically just private key management, the transaction construction can be a combination of risk threshold, quorum formulation (multiparty orchestration) and policy engine adherence.

Transaction Signing & Broadcast

Secure multisig signing workflows and broadcast mechanisms must be established. This includes hardware security module (HSM) integrations, threshold signing, and risk-based approval logic for outbound transactions.

Oracles

Secure and auditable price feeds are critical for both consumer transparency and system integrity. Oracles must be resistant to manipulation and integrated directly into collateral monitoring and/or risk management systems, especially for loans and auto-conversion features.

Retail Clearing Rails

Integration with Bitcoin's Layer 1 and Layer 2 networks allows real-time settlement without intermediaries. For retail, Lightning Network is essential for instant, low-fee transactions. Banks may choose to run their own Lightning node or integrate via a Lightning Service Provider (LSP).

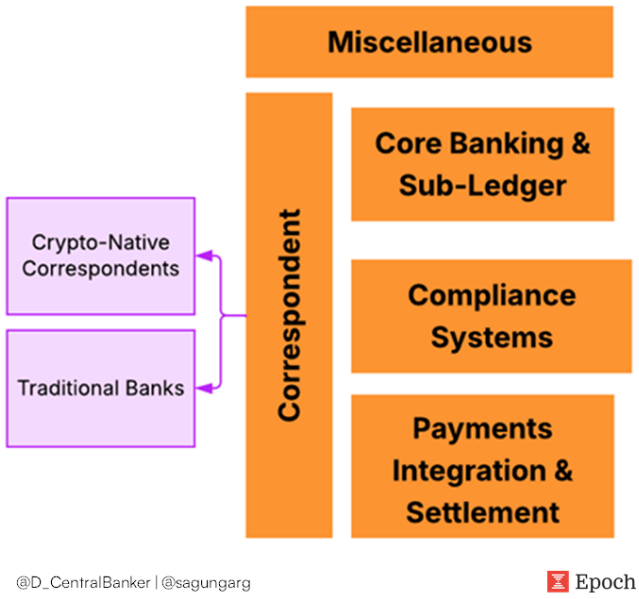
 Lightspark Group, Inc. Founded: 2021 **Website:** lightspark.com	Lightspark offers banks and fintechs a solution for cross-border and remittance payments with minimal operational overhead, and without requiring direct Bitcoin exposure. For institutions seeking to operate their own infrastructure, Lightspark provides a full technology stack that manages channel operations, liquidity provisioning, and intelligent routing. This enables seamless integration of Lightning-based settlement into mobile apps, online banking, or payment platforms. For institutions that prefer a lighter approach, Lightspark can serve as a correspondent or payment service provider, delivering Lightning settlement capabilities with minimal changes to existing systems.
 BitGo, Inc Founded: 2013 **Website:** bitgo.com	BitGo provides institutional-grade custody and wallet infrastructure for Bitcoin and other digital signature-based assets. Its platform features multisig wallets, policy-controlled workflows, and HSM integrations giving banks secure, compliant control over digital asset transactions. Through its Policy Engine, BitGo enables whitelisting, approval chains, and spending limits, all accessible via API. As a regulated trust company, BitGo allows banks to custody assets off balance sheet or integrate directly with internal systems, reducing the need to build these capabilities in-house.

Correspondent Partner Banks

While the correspondent banking model allows institutions to offer Bitcoin services without directly managing digital asset infrastructure, it's important to note that this does not require banks or their customers to be fully exposed to the counterparty risk of the correspondent.

Bitcoin's native features (e.g., multisig wallets, and emerging scripting tools like Miniscript), enable shared control over assets, even when those assets are held by a third-party provider. These tools allow banks to structure correspondent relationships that eliminate single points of failure and preserve enforceable access to customer funds.

As custody models continue to evolve, this hybrid approach offers a compelling balance of security, operational control, and regulatory alignment. It may also allow crypto-native correspondents willing to leverage these tools to distinguish themselves from larger, more traditional institutions typically viewed as safer, but often less flexible.



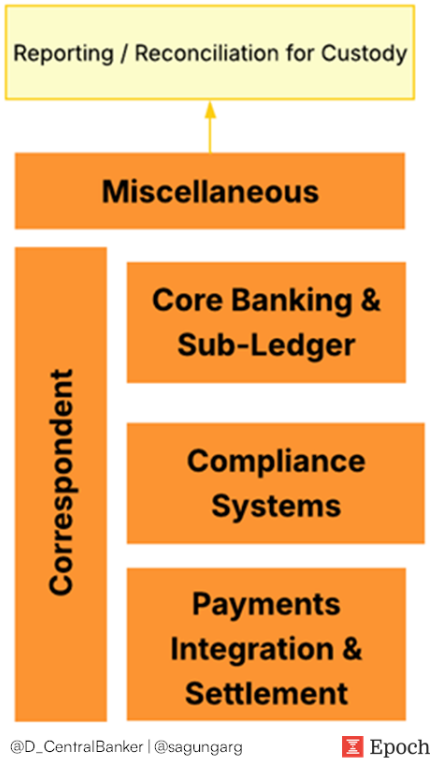
Crypto-Native Correspondents

These providers offer custody, settlement, FX conversion, and often brokerage, allowing banks to offer bitcoin without holding it on balance sheet. Some also support lending functions such as loan origination, servicing, collateral monitoring, and automated liquidation, enabling banks to offer bitcoin-backed loans with minimal operational overhead. When paired with shared custody tools like multisig, these correspondents can offer strong risk controls that rival or exceed those of more traditional institutions.

Traditional Banks

Banks specializing in regulated custody, settlement, and trading services are beginning to enter the Bitcoin space, often by extending their existing infrastructure to support digital assets. This creates a familiar and trusted path for smaller institutions that prefer to work with household-name providers rather than newer or lesser-known firms. By leveraging these established providers, respondent banks can offer Bitcoin access while relying on proven compliance frameworks and existing banking relationships.

 Unchained Capital, Inc. Founded: 2016 **Website:** unchained.com	Unchained provides Bitcoin-native financial services with a core focus on secure custody and collateralized lending. Through their multi-institution multisig custody model ("Collaborative Custody"), Unchained offers banks and financial institutions a solution to deliver bitcoin-backed loans without building or operating technical infrastructure themselves. This Collaborative Custody approach significantly reduces counterparty risk by ensuring no single entity (including Unchained) can move funds unilaterally. Their platform manages private key infrastructure, loan origination, collateral monitoring, and liquidation logic, enabling banks to extend credit with minimal operational or technical overhead. By delivering an end-to-end lending service with reduced custodial risk, Unchained simplifies the process for banks to participate in bitcoin-secured credit markets.
 **NYDIG** New York Digital Investment Group LLC Founded: 2017 **Website:** nydig.com	NYDIG is a regulated, institutional-grade infrastructure provider focused exclusively on Bitcoin, making it a trusted correspondent partner for banks seeking to integrate Bitcoin services within a compliant, secure framework. As a Bitcoin-only firm, NYDIG offers custody, trade execution, and treasury solutions purpose-built for financial institutions. Their platform enables banks to offer Bitcoin buy/sell functionality, savings plans, and corporate treasury services without having to interface directly with crypto exchanges or manage digital asset custody in-house. In 2021, NYDIG announced a high-profile partnership with FIS, aiming to bring Bitcoin trading and custody to hundreds of U.S. banks through core and digital banking integrations. While momentum around the rollout appears to have paused [OCP 2.0], the initiative demonstrated NYDIG's strategic intent to embed Bitcoin access directly into mainstream banking infrastructure at scale.
 Galaxy Digital Inc Founded: 2018 **Website:** galaxy.com	Galaxy Digital provides institutional-grade digital asset infrastructure and capital markets services, making it a strong correspondent partner for banks entering the Bitcoin space. Galaxy offers trade execution, liquidity provisioning, and Bitcoin custody through its regulated entities, allowing banks to offer seamless buy/sell services without directly interfacing with crypto exchanges or custodians. Their platform supports API-based execution, post-trade settlement, and integration with compliance frameworks. By acting as a correspondent, Galaxy allows banks to extend digital asset access to their customers while leveraging Galaxy's operational scale, regulatory footprint, and deep market expertise.



Miscellaneous Systems

While core banking, payments integration, and compliance infrastructure form the foundation of digital asset operations, other supporting systems can be critical to delivering these services at scale. Even a single ancillary component, such as reporting and reconciliation for outsourced custody, can play a vital role in establishing the necessary control environment to ensure transparency, auditability, and operational integrity.

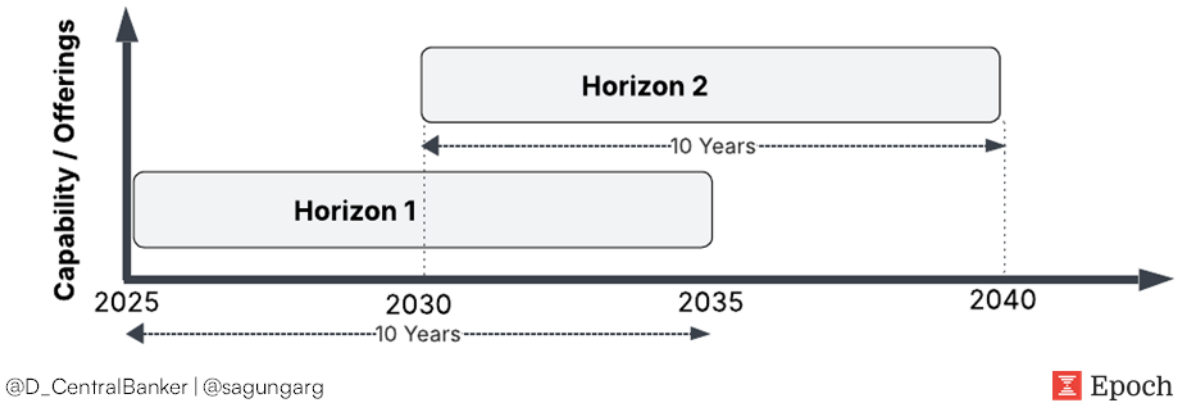
Reporting / Reconciliation for Custody

To support outsourced custody, banks require robust reporting and reconciliation tools that integrate with existing core, ledger, and compliance systems. These tools enable daily position tracking, transaction reconciliation, cost basis, tax reporting, and automated integration into general ledgers and portfolio management systems. Leading custody partners offer APIs and data exports that support real-time audit trails, facilitating operational oversight, regulatory compliance, and internal controls.

IV. Bitcoin Capability Horizon: Enabling Bitcoin Banking Services

Bitcoin services can be integrated into a given bank gradually. To help institutions plan this journey, we introduce the **Bitcoin Capability Horizon** framework, a structured view of how Bitcoin-related capabilities are likely to evolve over time. This is not a fixed timeline, but a logical build sequence that reflects increasing technological maturity, regulatory clarity, and customer demand. As shown in the image below, we expect these phases (or "Horizons") to run in parallel.

Figure 7: Bitcoin Capability Horizon Timeline



The table below provides an overview of the two distinct horizons of capability development we expect banks to follow. While the associated years represent when we anticipate these services will reach maturity and broader public availability, they are not intended to imply that banks or service providers will wait until, for example, 2030 to engage with Lightning infrastructure. Rather, this framework helps banks and technology leaders identify which services to prioritize today, which to begin preparing for, and how to align internal systems and partnerships with Bitcoin's evolving adoption curve.

Note: Vendor names referenced in this section are illustrative rather than exhaustive. The market landscape for Bitcoin-related service providers is expected to evolve rapidly in the coming years, and banks should monitor developments closely as they plan their capabilities and partnerships.

Figure 8: Bitcoin Capability Horizon Framework Table

Horizon	Era	Key Developments	Banking Impact	Challenges
Horizon 1 (2025—2035)	Hybrid TradFi Integration Era	Mature custody infrastructure, bitcoin-backed lending, BTC/fiat-linked settlement	Balance sheet exposure, new system integrations	Regulatory hurdles, integration costs
Horizon 2 (2030—2040)	Native Bitcoin Capitalization Era	Mature Lightning infrastructure, stablecoin consolidation, Spark/Ark adoption	Real-time settlements, DeFi integration, partial SWIFT replacement	Cybersecurity, regulatory evolution

Horizon 1 Evolution (2025-2035)

Horizon 1 reflects the initial wave of Bitcoin-related services that banks are already beginning to offer, including custody, brokerage, and bitcoin-backed lending. These capabilities build on one another, allowing institutions to start with low-risk, modular offerings, often delivered through trusted third-party providers. The focus during this phase is on regulatory alignment, technical integration, and safe operationalization of Bitcoin within traditional banking frameworks. With most of the enabling technologies already maturing, Horizon 1 presents a practical and near-term path for banks to enter the digital asset space.

Custody: The Technical Foundation

Purpose:
Securely hold bitcoin and other cryptographic signature-based assets on behalf of customers, either directly or through a regulated third-party custodian.

Key System Components:

- Wallet Infrastructure (Hot/Warm/Cold) & Custody Design (Air gapped or not)
- Key Programmability & Management Systems(Multisig, Miniscript, HSMs, MPC)
- Transaction Signing and Broadcast (Quorum Orchestration, Policy Engines Adherence and Privacy based Communication Channels)
- Sub-ledger Integration & Regulatory Multi-jurisdiction Digital Asset treatment
- Compliance Systems (AML, Sanctions Screening, Bitcoin Blockchain Forensics)
- Customer Reporting and Reconciliation Tools

Integration Model:
Banks may integrate directly with crypto-native custodians (e.g., Coinbase, Unchained, Anchorage, Galaxy Digital) or leverage traditional banking correspondents offering custody (e.g., Fidelity Digital Assets, BNY Mellon). Custody is non-negotiable; it is the base layer for all further Bitcoin Banking services.

Key management decisions will vary by architecture: multisig wallets and miniscript, native to Bitcoin, allow distributed key control and eliminate single points of failure, while multi-party computation (MPC) is preferred for less intensive engineering and cross-chain compatibility, including stablecoins as one simple hybrid chain solution. Though still widely used, hardware security modules (HSMs) are less suited for decentralized or remote-first environments. Some banks may also explore secure enclave technologies like Intel SGX and integrate custom policy engines to define internal governance, access control, and compliance rules tailored to digital asset operations.

Key Considerations:

- Cryptographic Security Model:
    - **Multisig vs. MPC Trade-offs:** Multisig wallets using Bitcoin's native P2SH or P2WSH scripts (e.g., 2-of-3 or 3-of-5) provide robust, Bitcoin-specific security but require careful keyholder coordination. Multi-party computation (MPC) offers flexibility for cross-chain assets (e.g., Bitcoin and Ethereum-based stablecoins) by enabling threshold signatures without on-chain key exposure. However, MPC introduces computational overhead and requires secure off-chain communication channels (e.g., Shamir's Secret Sharing over encrypted channels). Plus, the risk of using MPC is to forgo core native Multisig & Miniscript native on-chain capabilities specific to Bitcoin.
    - **HSM Limitations:** Hardware Security Modules (HSMs) with FIPS 140-2 Level 3 compliance are suitable for centralized key storage but lack flexibility for distributed or remote-first custody. Secure enclaves (e.g., Intel SGX, AWS Nitro) offer isolated execution environments but require careful integration to prevent side-channel attacks like Spectre(A class of security vulnerabilities that exploit speculative execution in modern processors. Spectre attacks trick CPUs into speculatively executing instructions that leak sensitive data (e.g., cryptographic keys) through side channels, such as cache timing).
    - **Miniscript Adoption:** Bitcoin's Miniscript enables complex, programmable signing policies (e.g., time-locked releases, quorum thresholds and custom programmability) while maintaining auditability. Evaluate Miniscript for advanced custody workflows but note its dependency on compatible wallet software as it evolves into an industry standard across all wallet providers.
- Network & Privacy Risks:
    - **Transaction Metadata Leakage:** Broadcasting transactions or coordinating multisig signatures over internet exposes metadata (e.g., IP addresses, transaction patterns). Use privacy-preserving protocols like Tor or Dandelion++ to anonymize communication between keyholders and nodes. Even Signal protocol (uses

techniques like the Double Ratchet Algorithm, Curve25519, and AES-256 to ensure secure, forward-secret communication) could be considered.
    - **Chain Analysis Vulnerabilities**: Privacy techniques like CoinJoin or Taproot's Schnorr signatures can obscure transaction flows but may trigger compliance flags. Ensure blockchain forensics tools can differentiate legitimate privacy measures from illicit activity. ZKPs(Zero-Knowledge Proofs are cryptographic techniques that allow one party (the prover) to prove to another (the verifier) that a statement is true without revealing any additional information beyond the fact that the statement is true), such as those used in protocols like Zcash (with zk-SNARKs), allow users to prove the validity of a transaction (e.g., sufficient funds, compliance with protocol rules) without revealing sensitive details like sender/receiver addresses, transaction amounts, or patterns
- Regulatory & Compliance Integration:
    - **AML/CFT Requirements**: Custody systems must integrate with real-time AML/KYC and sanctions screening APIs (e.g., TRM Labs, CipherTrace) to monitor Bitcoin addresses and transaction histories against watchlists. Implement UTXO-level tracking to comply with FATF's "Travel" rule for virtual asset service providers (VASPs).
    - **Proof of Reserves**: Use cryptographic commitments (e.g., Merkle tree-based attestations) to prove Bitcoin holdings without exposing private keys. Consider protocols like OpenTimestamps for immutable audit trails.
    - **Regulatory Variation**: Account for jurisdictional differences (e.g., U.S. FinCEN/OCC/SEC vs. EU MiCA frameworks) when configuring compliance rules, particularly for cross-border custody and reporting.
- System Scalability & Resilience:
    - **Transaction Throughput**: Hot wallets must handle high-frequency, low-value transactions (e.g., customer withdrawals) while maintaining low latency. Optimize transaction batching using various native Bitcoin blockchain techniques to reduce fees and improve scalability.
    - **Fault Tolerance**: Design custody systems (e.g. multi-jurisdiction key distribution) with no single point of failure. Multisig, Miniscript and MPC help distribute risk but require robust key backup and recovery mechanisms (e.g., Shamir's Secret Sharing with geographically dispersed shards).
    - **Sub-ledger Synchronization**: Ensure sub-ledger integration supports high-throughput updates (e.g., via Apache Kafka or RabbitMQ) to reflect on-chain balances in near real-time, minimizing reconciliation errors.
- Interoperability & Future-Proofing:
    - **Bitcoin-Specific Features**: Support dynamic RBFs(Replace-by-Fee is a Bitcoin feature defined in BIP-125 that allows users to replace an unconfirmed transaction with a new one that pays a higher fee) for reduced transaction fees and Taproot for enhanced privacy and smart contract capabilities (e.g., Schnorr-based multisig). Ensure wallet infrastructure can upgrade to future Bitcoin Improvement Proposals (BIPs).

    - **Cross-Chain Compatibility**: MPC-based custody enables interoperability with Ethereum or stablecoin networks, but requires additional cryptographic libraries (e.g., TSS-Lib for ECDSA/EdDSA). Plan for modular architectures to accommodate emerging digital assets.
    - **API Standardization**: Use RESTful APIs with JSON or gRPC for integration with core banking systems, ensuring compatibility with ISO 20022 for financial messaging.
- Operational & Cost Constraints:
    - **Key Management Overhead**: Multisig, Miniscript and MPC require secure key rotation and periodic re-signing health checks to mitigate long-term risks. HSMs reduce operational complexity but incur high upfront costs (e.g., Thales, YubiHSM).
    - **Third-Party Custodian Risks**: External custodians (e.g., Anchorage, Fireblocks) offload infrastructure management but introduce counterparty risks. Evaluate their SLAs, SOC 2 Type II compliance, and insurance coverage for hacks or insolvency.

Implementation Notes:

- Wallet Infrastructure Deployment:
    - **Hot Wallets**: Deploy hot wallets on air-gapped servers with automated signing via policy engines (e.g., Bitcoin Core with custom scripts). Use optimized transaction fees methods like dynamic RBF and enable Lightning Network compatibility for microtransactions.
    - **Warm Wallets**: Configure warm wallets with 2-of-3 multisig requiring manual approval from designated keyholders. Store keys in geographically dispersed HSMs or secure enclaves, with signing orchestrated via encrypted APIs (e.g., AWS KMS, Azure Key Vault).
    - **Cold Wallets**: Implement 3-of-5 multisig cold storage using offline hardware wallets (e.g., HSMs & Institutional grade equivalent offerings of Trezor, Cold Card & Ledger) stored in physically secure vaults. Use Miniscript to define on chain complex policies, such as time-locked fund releases or quorum changes. Use policy engines to help offline complex policies within the institution firewall.
- Key Management System:
    - **Multisig Setup**: Implement Bitcoin-native multisig, with keys distributed across independent systems or keyholders. Use BIP-32 HD wallets for key derivation and BIP-39 mnemonics for backup, stored in tamper-evident hardware.
    - **MPC Implementation**: For cross-chain compatibility, deploy threshold signature schemes (e.g., GG18/GG20 for ECDSA) using libraries like ZenGo's TSS-Lib. Ensure key shards are encrypted and distributed across cloud providers or on-premises servers with HSM-backed storage.
    - **Recovery Mechanisms**: Use Shamir's Secret Sharing for key backup, splitting secrets into *n* shares with a *k* threshold (e.g., 3-of-5). Store shares in physically secure locations (e.g., bank vaults, escrow services). Test recovery workflows quarterly to ensure operational continuity.

- Transaction Signing & Broadcast:
  - **Quorum Orchestration:** Build a signing workflow using a policy engine (e.g., HashiCorp Vault, custom Rust-based engine) to enforce quorum rules, transaction limits, and compliance checks. Implement role-based access control (RBAC) for keyholder authentication via OAuth2 or SAML.
  - **Privacy Channels:** Route signing requests and transaction broadcasts through Tor or VPNs to minimize metadata leakage.
  - **Monitoring and Alerts:** Deploy monitoring tools (e.g., Prometheus, Grafana) to track signing latency, failed attempts, and policy violations. Configure alerts for suspicious activity, such as repeated failed signatures or abnormal transaction volumes.
- Sub-ledger Integration:
  - **Real-Time Sync:** Use message queues (e.g., Kafka, RabbitMQ) to stream on-chain transaction data to the sub-ledger. Implement event-driven updates with retry mechanisms to handle network failures.
  - **Reconciliation:** Develop automated reconciliation scripts (e.g., in Python or Go) to compare on-chain UTXOs with sub-ledger balances every 10 minutes (one Bitcoin block). Flag discrepancies for manual review and integrate with reporting tools for audit trails. Idempotency of records is the key here.
  - **Data Format:** Use JSON, AVRO or Protobuf for API payloads, ensuring compatibility with core banking systems. Map Bitcoin transaction fields (e.g., txid, vout) to ISO 20022 standards for financial reporting.
- Compliance Systems:
  - **AML/Sanctions Screening:** To the extent required by law, perform real-time address screening and transaction monitoring. Configure rules to flag high-risk transactions (e.g., mixing service interactions, dark pool activity) and generate Suspicious Activity Reports (SARs) as needed.
  - **Blockchain Forensics:** Deploy tools to analyze Bitcoin's UTXO set and trace fund flows using clustering heuristics. Support Taproot and Lightning Network analysis to address emerging privacy features with Zero Knowledge Proof systems (ZKP).
  - **Regulatory Reporting:** Automate generation of FATF-compliant reports, including originator and beneficiary data for cross-border transfers. Use OpenTimestamps to notarize compliance logs on Bitcoin's blockchain for immutability.
- Third-Party Custodian Integration:
  - **API Onboarding:** Use REST or gRPC APIs to integrate with custodians like Fireblocks or Anchorage. Validate API security with mutual TLS and OAuth2 token-based authentication.
  - **SLA Enforcement:** Define SLAs for transaction processing (e.g., <5s for hot wallet withdrawals) and uptime (>99.95%). Monitor custodian performance via automated health checks and failover to backup providers if thresholds are breached.

    - **Fallback Plans**: Maintain an in-house multisig wallet as a contingency for custodian outages. Pre-configure keyholder workflows to transition funds within 24 hours.
- Testing & Auditing:
    - **Security Testing**: Conduct red-team exercises targeting wallet infrastructure, key management, and signing workflows. Simulate attacks like key theft, side-channel exploits, or DDoS on API endpoints.
    - **Proof of Reserves**: Implement a Merkle tree-based attestation system (e.g., inspired by Kraken's audit model) to cryptographically verify holdings. Publish attestations quarterly via a public API or blockchain commitment.
    - **Audit Schedule**: Engage third-party auditors (e.g., PwC, Deloitte) for SOC 2 Type II and ISAE 3402 audits annually. Perform internal audits monthly to validate key rotation and compliance adherence.
- Operational Governance:
    - **Keyholder Training**: Train staff on BIP-32/BIP-39 key management, multisig & miniscript workflows, and MPC protocols using sandboxed environments. Simulate key loss and recovery scenarios to ensure preparedness.
    - **Policy Engine**: Deploy a custom policy engine (e.g., written in Rust or Go) to enforce governance rules, such as transaction approval thresholds, geographic restrictions, or time-based access controls.
    - **Incident Response**: Establish a 24/7 incident response team with predefined playbooks for key compromise, network breaches, or custodian failures. Integrate with SIEM tools (e.g., Splunk, ELK) for real-time threat detection.

Brokerage: Layering in Trading Access

Purpose:
Allow customers to buy and sell bitcoin via the bank's interface, either self-directed or advisory-based.

Built-on Custody:
Brokerage cannot operate without secure custody. Every buy/sell trade must settle into (or out of) a wallet under bank or custodian control. Here the demand may be for a lot of fiat & digital assets to be traded and settled into Bitcoin.

Key System Components

- FX/ Conversion Engines:
    - Coinbase Institutional: Provides fiat-to-crypto conversion with competitive rates
    - Amina Bank: Supports multi-currency conversions for seamless funding
    - Sygnum: Offers FX services tailored for digital assets
- Trading Interfaces or APIs:
    - Coinbase Institutional: Robust APIs for trade execution and portfolio management
    - Anchorage: Secure trading APIs with institutional-grade reliability
    - Kraken: APIs for high-speed trade execution and market data

    - Sygnum, Amina and Nexo in Europe: Secure trading APIs with institutional-grade reliability for high-speed trades
- Oracles (for Pricing & Risk):
    - Chainlink: Decentralized oracle network for real-time, tamper-proof pricing
    - Band Protocol: A decentralized, cross-chain data oracle platform designed to aggregate and deliver real-world data to smart contracts on various blockchains
    - CoinGecko: Aggregated pricing data for transparent market insights
    - Kaiko: High-quality market data for risk assessment and pricing
- Retail Clearing Rails (Layer 1 & Layer 2 Integration):
    - Bitcoin Layer 1: Direct on-chain settlement via providers like Coinbase and Anchorage with market making capabilities of institutional scale & slippage
    - Lightning Network: Layer 2 integration via Lightspark for fast, low-cost transactions
    - Coinbase and Kraken Institutional: Supports hybrid Layer 1 and Layer 2 clearing for retail clients

Integration Model (Sub-Custody Model):
Brokerage can be offered via correspondent partnerships (e.g., Coinbase Institutional, Anchorage, Sygnum, Amina, ZeroHash, Bakkt, etc) or directly via API integrations with exchanges. The goal is fast execution, transparent pricing, and seamless funding via bank accounts. Some examples of this model are as follows: PNC Bank (in the U.S.) and Bank Julius Baer (in Europe) have adopted this model with strategic partnership integrations for sub-custody. PNC has partnered with Coinbase Institutional for digital asset brokerage services[77], while Bank Julius Baer has integrated with Amina Bank in Switzerland.

Key Considerations:

- Regulatory Compliance:
    - Ensure adherence to local and international regulations, including KYC/AML requirements, securities laws, and crypto-specific regulations (e.g., FinCEN in the U.S., FINMA in Switzerland, or MiCA in the EU).
    - Obtain necessary licenses for brokerage and custody services, and verify compliance of third-party partners (e.g., Coinbase, Amina).
- Security & Custody:
    - Robust custody infrastructure is critical, as all trades settle into or out of controlled wallets.
    - Implement multisig wallets, cold storage, and regular security audits to mitigate risks of hacks or unauthorized access. Ensure sub-custody partners meet high security standards.
- Pricing Transparency & Fairness:
    - Oracles must provide real-time, reliable pricing data from multiple sources to avoid manipulation and ensure competitive spreads.

[77] https://www.prnewswire.com/news-releases/pnc-bank-coinbase-announce-strategic-partnership-to-advance-digital-asset-solutions-and-expand-banking-services-302510790.html

    - Disclose all fees (e.g., trading, conversion, and network fees) clearly to customers.
- Liquidity & Execution Speed:
    - Partner with exchanges or liquidity providers offering deep order books to ensure fast trade execution with minimal slippage.
    - Evaluate the trade-off between in-house execution versus reliance on correspondent partners.
- User Experience:
    - Design intuitive trading interfaces for both self-directed and advisory-based customers.
    - Ensure seamless integration with bank accounts for funding and withdrawals, minimizing friction in the user journey.
- Risk Management:
    - Implement robust risk controls, including position limits, margin requirements (if applicable), and real-time monitoring of market volatility.
    - Use oracles to assess and mitigate counterparty and market risks.
- Scalability & Reliability:
    - Systems must handle high transaction volumes, especially during volatile market conditions.
    - Ensure APIs and clearing rails (Layer 1 and Layer 2) are scalable and resilient to network congestion.
- Partnership Due Diligence:
    - Evaluate correspondent partners (e.g., Coinbase, Anchorage) for financial stability, regulatory compliance, and operational reliability.
    - Define clear SLAs for uptime, execution speed, and dispute resolution.
- Customer Education & Support:
    - Offer resources to educate customers on Bitcoin trading risks and processes, particularly for advisory-based clients.
    - Provide 24/7 support to handle trade disputes, custody issues, or technical queries.
- Tax & Reporting: Ensure systems capture transaction data for tax reporting purposes (e.g., cost basis, capital gains). Integrate with tools or services to provide customers with tax-compliant reports, especially in jurisdictions with strict crypto tax laws.

Implementation Notes:

- Custody Integration: Select a custody provider (e.g., Coinbase Institutional, Anchorage, or Amina) with a proven track record. Implement APIs to ensure real-time settlement of trades into secure wallets. Test failover mechanisms to handle custody provider downtime.
- API & Trading Interface Development: Build or integrate trading APIs with exchanges for order placement and execution. For self-directed clients, develop a user-friendly interface with features like limit/market orders and portfolio tracking. For advisory-based clients, create tools for advisors to manage trades and monitor client portfolios.

- **Oracle Integration**: Source pricing data from multiple trusted oracles (e.g., Chainlink, CoinGecko, or exchange APIs) to ensure redundancy and accuracy. Implement failover logic to switch between oracles if one fails or provides inconsistent data.
- **Clearing Rails Setup**: Integrate with Bitcoin Layer 1 for on-chain settlements and Layer 2 solutions (e.g., Lightning Network) for faster, lower-cost transactions. Test transaction throughput under high-load scenarios to ensure reliability.
- **Funding & Withdrawal Flows**: Enable seamless fiat-to-bitcoin and bitcoin-to-fiat conversions via bank accounts. Use FX/ conversion engines to handle currency conversions efficiently, ensuring competitive exchange rates. Test integration with existing banking systems for ACH, SEPA, or SWIFT transfers.
- **Partnership Agreements**: Draft contracts with sub-custody and exchange partners, specifying responsibilities, revenue-sharing models, and liability for losses. Include clauses for regular audits and performance reviews.
- **Compliance Framework & Periodic Audits**: Deploy KYC/AML tools to verify customer identities and monitor transactions for suspicious activity. Automate regulatory reporting to comply with local laws. Work with legal teams to ensure compliance with evolving crypto regulations.
- **Testing & Rollout**: Conduct end-to-end testing of the brokerage system, including custody, trading, pricing, and settlement workflows. Start with a pilot program for a limited user group to identify and resolve issues before a full-scale launch.
- **Customer Onboarding**: Develop onboarding flows that guide users through account setup, KYC verification, and wallet creation. For advisory-based clients, assign dedicated advisors and provide tools for portfolio recommendations.
-

Bitcoin-Backed Lending: Capital Efficiency through Collateralization

Purpose:
Enable customers to borrow fiat (or stablecoins) using bitcoin as collateral.

Built-on Custody & Brokerage:
Lending requires real-time pricing, liquidation logic/ margin call hooks, and the ability to sell BTC in real-time, making both custody and brokerage critical dependencies.

Bitcoin-backed lending has two primary custody models to choose from: custodial and non-custodial, each with distinct operational and technical considerations. Here's a concise breakdown:

Custodial Model:

- **Overview**: Banks or lending platforms hold the bitcoin collateral in their custody, managing the assets directly. This model leverages existing banking infrastructure but requires trust in the custodian.
- **Integration**: Banks can partner with firms like Unchained or Fidelity Digital Assets for custody and brokerage services or build in-house systems. Bitcoin is treated as eligible

collateral within risk and underwriting frameworks.

- Key System Components:
  - **Collateral Management Systems:** Track and value bitcoin collateral in real-time, ensuring accurate LTV ratios.
  - **Loan Sub-ledgers:** Record loan details, including principal, interest, and repayment schedules.
  - **Oracles:** Provide real-time Bitcoin pricing for LTV calculations and margin call triggers.
  - **Compliance Monitoring:** Verify source of funds and assess borrower creditworthiness to meet regulatory requirements.
  - **Custody Platform Integration:** Enables pledging of Bitcoin, liquidation during margin calls, and seamless asset transfer. Requires robust APIs for real-time pricing and sell orders.
- **Dependencies:** Real-time pricing, liquidation logic, and brokerage capabilities to sell bitcoin instantly during market volatility or loan defaults.

Noncustodial Model:

- **Overview:** Borrowers retain control of their bitcoin via smart contracts, reducing reliance on intermediaries. This model uses Bitcoin-native technologies for trust-minimized lending.
- **Integration:** Leverages Miniscript or Discreet Log Contracts (DLCs) on the Bitcoin blockchain to enforce loan terms, collateral pledging, and automated liquidations. Banks can partner with Firefish, Debifi, Lava, Ledn, Lendasats etc. for this kind of non-custodial lending.
- Key System Components:
  - **Miniscript/DLC Smart Contracts:** Programmable Bitcoin scripts that lock collateral and execute loan conditions (e.g., LTV thresholds, repayments, or liquidations) without a custodian
  - **Collateral Management:** Handled on-chain, with oracles feeding price data to smart contracts for active and dynamic LTV monitoring based on price action.
  - **Loan Sub-ledgers:** Can be maintained off-chain by lenders or decentralized protocols, synced with blockchain events
  - **Oracles:** Critical for providing trusted price feeds for margin calculations and automated liquidations
  - **Compliance Monitoring:** Challenging in noncustodial setups; may require off-chain KYC/AML checks or integration with compliance-focused protocols
- **Dependencies:** Robust oracles, Bitcoin Layer 2 solutions (e.g., Lightning for faster transactions), and secure smart contract frameworks.

Key Considerations:

- Custodial:
  - Offers tighter integration with traditional banking systems, easier compliance, and scalability but introduces counterparty risk.
  - Liquidation is centralized, relying on the custodian's infrastructure.
- Noncustodial:
  - Enhances user sovereignty and aligns with Bitcoin's ethos but faces challenges in compliance, oracle reliability, and transaction speed.
  - MiniScript/DLCs are still evolving, limiting mainstream adoption, and & wallet support.
- Risk Management:
  - Both models require sophisticated LTV monitoring and liquidation triggers due to Bitcoin's volatility.
  - Overcollateralization is common to mitigate risks.
- Brokerage Dependency:
  - Both rely on real-time pricing and sell capabilities, making brokerage integration (or decentralized exchange connectivity for noncustodial) essential.

Implementation Notes:

- Lending Model Selection: Choose custodial, noncustodial, or hybrid based on customer profile (traditional vs. crypto-native), regulatory constraints, and technical readiness. Custodial aligns with banking infrastructure; noncustodial targets decentralized finance (DeFi) users.
- Partner Selection:
  - Custodial: Partner with Bitcoin-native custody providers (e.g., Unchained, Fidelity Digital Assets, BitGo) offering shared custody models (e.g., multi-signature wallets) and integrated brokerage APIs for real-time pricing and liquidation.
  - Noncustodial: Collaborate with platforms like Firefish, Debifi, Lava, Ledn, or Lendasats supporting Miniscript or Discreet Log Contracts (DLCs). Evaluate smart contract security and wallet compatibility (e.g., Sparrow, BlueWallet, Electrum).
- Regulatory Compliance:
  - Implement KYC/AML using banking systems (custodial) or off-chain tools like Chainalysis or Elliptic (noncustodial).
  - Align with crypto lending regulations (e.g., SEC's Reg D for securities, FinCEN's MSB rules, or FCA's cryptoasset guidelines).
- Risk Framework:
  - Set overcollateralization ratios (150-200% LTV) to buffer Bitcoin's volatility (e.g., 30% price drops in 24 hours, based on historical data).
  - Define LTV thresholds (e.g., margin call at 70%, liquidation at 80%) with automated triggers for real-time risk management.
- Infrastructure Setup:
  - Deploy oracles (e.g., Chainlink CCIP, Band Protocol) for BTC/USD price feeds, ensuring <1-minute latency.

    - Integrate brokerage APIs (custodial) or DEX protocols (noncustodial, e.g., Uniswap v3 via DLCs) for liquidation execution.
- Collateral Management System:
    - **Custodial:** Build or license a system to track Bitcoin collateral via custody provider APIs, ensuring real-time balance and valuation updates.
    - **Noncustodial:** Use on-chain mechanisms (Miniscript/DLC smart contracts) to lock and monitor collateral, with oracles feeding price data for dynamic LTV tracking.
    - Ensure compatibility with user interfaces (banking portals for custodial, Bitcoin wallets like Sparrow or BlueWallet for noncustodial).
- Loan Sub-ledger:
    - **Custodial:** Extend banking ledger systems to record loan details (principal, interest, repayment schedules), integrated with custody platforms for asset pledging/release.
    - **Noncustodial:** Maintain off-chain ledgers synced with blockchain events or leverage decentralized protocols for transparent loan tracking.
- Smart Contract Setup and Liquidation Logic:
    - **Custodial:** Develop automated margin call and liquidation workflows triggered by oracle price feeds, with brokerage APIs executing sell orders (<5-minute execution target).
    - **Noncustodial:** Deploy audited Miniscript/DLC smart contracts to enforce loan terms, LTV thresholds, and automated liquidations via DEX connectivity.
    - Test liquidation speed and reliability under volatile conditions (e.g., 50% BTC price drop in 24 hours).

Horizon 2 Evolution (2030-2040)

Horizon 2 marks a deeper integration of Bitcoin into existing banking functions, including treasury, private banking, and scalable off-chain payment infrastructure. Services introduced in Horizon 1 serve as foundational building blocks, enabling banks to extend Bitcoin support to HNW clients, corporate treasury functions, and real-time payments via the Lightning Network. This phase emphasizes operational sophistication and embedded digital asset capabilities, with banks increasingly managing Bitcoin in parallel to fiat systems. While some institutions may begin exploring Horizon 2 earlier, broad adoption is expected to follow maturing infrastructure and institutional demand.

Off Chain Settlements/ Lightning Payments & Remittance Transfers

Purpose:
Enable real-time payments using Bitcoin via scalable, off-chain settlement layers such as the Lightning Network. Primary use cases include instant domestic transfers, low-cost cross-border remittances, micropayments, real-time merchant settlements and settlement of natively-issued digital assets e.g. stablecoins on lightning network. These are scenarios where the Lightning Network's speed and cost-efficiency offer clear advantages over legacy rails.

Built-on Custody & Brokerage:
Secure wallet infrastructure in L2 Lightning Network context and transaction controls must be in place for high velocity and volume transfers. Liquidity and rebalancing become critical.

Key System Components:

- Lightweight Lightning Node Infrastructure (Breez, Blockstream)
- Industrial Weight Lightning Node Infrastructure (Lightning Labs, Mion)
- Channel Management Platforms (Breez, Blockstream, Mion)
- Liquidity Providers (Breez LSP, Blockstream, LQWD)
- Rebalancing Algorithms and Fee Management Systems (Lightspark)
- Secure LN Wallet Infrastructure (Lightspark, River, Breez)
- LN Corporate Invoicing Systems with BTC Support (Breez SDK)
- API and Core Banking Integration Layers (Blockstream, Breez SDK)
- Compliance and Monitoring Tools (Custom Built)

Integration Model:
Banks can offer Lightning Network payment services either by operating their own Lightning nodes or by partnering with LSPs and channel liquidity partners. These integrations enable instant, low-cost bitcoin payments and are particularly relevant for inter-financial institution settlements, merchant settlements, remittances and real-time treasury operations.

- Direct Offering as Native Self Hosted Capability: Banks can operate their own Lightning nodes and manage liquidity directly, allowing for full control over routing, fee structures, and channel operations. This model supports integration into existing payment systems and customer channels (e.g., mobile apps, APIs, merchant platforms) but requires investment in infrastructure, node security, and 24/7 operations. High-volume use cases, such as enterprise remittances or retail clearing, especially privacy seeking ones may demand industrial-grade infrastructure and dedicated liquidity management on a self-hosted basis.
- Lightning-as-a-Service Providers: Banks may partner with enterprise-grade LSPs (e.g., Lightspark, River, Breez, Blockstream Greenlight or Mion) to abstract away node operations, channel management, and liquidity provisioning. These providers offer API-driven integration, automated channel rebalancing, and scalable backend infrastructure, enabling banks to embed Lightning functionality into digital channels with minimal operational overhead. This approach accelerates time-to-market and reduces technical risk, especially for smaller institutions or pilot programs.
- Channel & Liquidity Partnerships: Correspondent banks can play here a big bridge role for the incumbent bank to upgrade faster. For banks operating nodes directly, third-party liquidity providers or federated channel partners can help ensure sufficient inbound/outbound capacity across major Lightning corridors. Institutions may establish dedicated liquidity pools, use liquidity automation tools, or contract with specialized Lightning market makers to support stable routing and minimize failed payments.
- Verticalized Backward Integration by ERP & Payment Platform Integration: For treasury and B2B use cases, banks can integrate Lightning payment flows into ERP

systems (e.g., SAP, Oracle) and corporate cash management tools. Existing solutions already plugged into big enterprises can start supporting these capabilities as additional new modules for real-time settlement data, payment reconciliation, and Bitcoin-denominated invoicing. In merchant or remittance contexts, integration with POS systems, wallets, and fiat off-ramps may also be required.

Key Considerations:

- Node Type Selection (Lightweight vs. Industrial Weight):
  - Lightweight nodes, like those supported by Breez's self-hosted solutions or Blockstream's Greenlight, prioritize ease of use and minimal resource requirements, ideal for mobile apps or small-scale merchants. Industrial weight nodes, such as Mion's high-performance infrastructure, are suited for high-volume, enterprise-grade applications like large-scale remittances or merchant settlements, requiring robust hardware and constant uptime. Banks must choose based on transaction volume and operational needs.
- Scalability & Network Reliability:
  - Lightweight nodes (e.g., Breez SDK, Blockstream Greenlight) offer scalability for low-to-medium transaction volumes but may face channel capacity constraints.
  - Industrial weight nodes (e.g., Mion's high-performance setups) ensure reliability for high-throughput scenarios but demand significant infrastructure investment. Both must maintain node uptime to prevent transaction failures.
- Liquidity Management:
  - Effective liquidity is critical for both node types. Lightweight nodes rely on automated liquidity from providers like Breez's LSP, suitable for micropayments. Industrial weight nodes, like Mion's, require dedicated liquidity pools and advanced rebalancing to handle large-scale remittances or merchant settlements, ensuring seamless inbound/ outbound routing.
- Regulatory Compliance:
  - Both node types must adhere to AML/KYC regulations, especially for cross-border remittances.
  - Lightweight nodes, often non-custodial (e.g., Breez, Greenlight), simplify compliance for users holding keys, while industrial weight nodes (e.g., Mion) require robust monitoring systems due to higher transaction volumes.
- Cost Efficiency vs. Fee Structures:
  - Lightweight nodes benefit from low setup costs (e.g., Blockstream's Greenlight LaaS) but may incur routing fees.
  - Industrial weight nodes, like Mion's, involve higher upfront costs but optimize long-term fee efficiency for high-volume use cases through custom fee management.
- Interoperability with Legacy Systems:
  - Both node types need API integration with banking systems (e.g., SWIFT, ACH). Lightweight nodes, such as Breez's SDK, simplify integration for smaller

institutions, while industrial weight nodes, like Mion's, support complex enterprise workflows for real-time BTC invoicing alongside fiat rails.

- Security & Risk Management:
  - Lightweight nodes (e.g., Breez, Blockstream Greenlight) use non-custodial designs to secure user funds, with keys stored on user devices.
  - Industrial weight nodes (e.g., Mion) require advanced security measures, like multisig wallets and hardware redundancy, to protect high-value transactions.
- User Experience:
  - Lightweight nodes abstract complexity for end-users (e.g., Breez's mobile wallet), ideal for consumer-facing micropayments.
  - Industrial weight nodes prioritize backend efficiency for enterprise clients, requiring banks to develop user-friendly frontends to drive adoption.

Implementation Notes:

- Lightweight Node Deployment (Breez, Blockstream, & LightSpark): Banks can leverage Breez's independent, self-hosted nodes or Blockstream's Greenlight cloud-based nodes for lightweight setups. Breez's SDK, powered by Greenlight, enables non-custodial mobile wallets with automated channel management, ideal for micropayments or small merchants. Greenlight's cloud infrastructure, running on Core Lightning, offers a low-resource footprint and API-driven integration, allowing banks to deploy nodes without deep Lightning expertise. For example, Greenlight's non-custodial model ensures user keys remain on devices, with Blockstream managing node operations.
- Industrial Weight Node Deployment (Mion & LightSpark): For high-volume use cases, banks can adopt Mion's industrial weight nodes, designed for high-performance environments (e.g., m.2 drive, i9, 32GB RAM, Tor-only setups). These nodes support enterprise-grade remittances and merchant settlements, offering robust connectivity and capacity for thousands of channels. Banks must invest in dedicated hardware or partner with Mion for managed infrastructure to ensure 24/7 uptime.
- Channel Management Automation: Lightweight nodes benefit from Breez's SDK or Greenlight's built-in tools for automated channel opening and closing. Industrial weight nodes require advanced platforms like LND or custom solutions to optimize high-capacity channels, ensuring efficient routing for large transactions.
- Liquidity Partnerships (Lightspark, Blockstream, & Breez): For lightweight nodes, partner with Breez's LSP or Blockstream's liquidity services to provide instant inbound liquidity, as Breez gradually increases capacity based on usage. Industrial weight nodes, like Mion's, should establish dedicated liquidity pools with providers like LN Big to support high-value remittances.
- Rebalancing Strategies: Lightweight nodes use Breez's automated rebalancing or Greenlight's algorithms to maintain liquidity. Industrial weight nodes require custom rebalancing algorithms, leveraging machine learning to predict demand and optimize fees for high-frequency transactions. Lightspark's intelligent AI based routing offering is particularly of great interest for multi-jurisdiction based large scale deployments for leveraging routing to save fees at industrial scale.

- **API Integration:** Lightweight nodes integrate via Breez SDK or Blockstream's Greenlight's simple APIs for real-time BTC invoicing within banking systems. Industrial weight nodes need enterprise-grade APIs to connect with FI invoicing platforms, supporting hybrid BTC/fiat workflows for merchants and cross-border transfers. Lightspark also is a great option from a developer first standpoint and offers simple integrations
- **Compliance Integration:** Both node types must embed AML/KYC checks. Lightweight nodes benefit from Breez's non-custodial design, reducing compliance overhead. Industrial weight nodes require RegTech solutions to monitor high-volume transactions, ensuring regulatory adherence without sacrificing speed.
- **Testing & Phased Rollout:** Start with lightweight nodes for pilot programs targeting micropayments (e.g., Breez for digital services). Scale to industrial weight nodes for enterprise use cases like remittances, testing Mion's infrastructure for performance under high loads. Refine based on real-world data.
- **User Onboarding & Support:** For lightweight nodes, provide plugins (e.g., Breez SDK for BTCPay Server) to simplify merchant adoption. For industrial weight nodes, offer enterprise-grade support and SDKs for large-scale invoicing systems, ensuring seamless BTC integration.

Private Banking & Treasury Services

Purpose:
Enable private banks to enhance their private banking and corporate treasury services by integrating advanced Bitcoin infrastructure and technology, building on the foundational custody and brokerage capabilities established in Horizon 1. This empowers HNW clients and corporate treasuries to directly access and manage Bitcoin, offering full control, superior cost efficiency, and minimized counterparty risk. By providing sophisticated, direct Bitcoin exposure, banks can disintermediate traditional Wall Street-style products like ETFs, delivering tailored, secure, and scalable solutions that leverage Bitcoin's decentralized infrastructure for wealth management and treasury operations.

Built-on Custody & Brokerage:
These services depend on robust custody and trade execution rails already in place from Horizon 1.

Key System Components:

- **Institutional-Grade Bitcoin Custody:** Secure, scalable custody platforms compliant with SOC 2/ISO 27001 standards, enabling real-time transaction processing and integration with private banking and treasury systems for seamless asset management.
- **Air-Gapped Cold Storage:** Offline hardware security modules (HSMs) or dedicated devices for private key storage, geographically distributed across secure locations, with biometric and time-locked authentication to minimize cyber risks. Multi jurisdiction spread-out of private keys is considered state of the art setup from a sovereignty standpoint and is valued by private clients especially from unstable political jurisdictions

- **Hot Wallet Liquidity Management**: Minimal Bitcoin holdings in hot wallets for trading or rebalancing, secured with multi-factor authentication, real-time monitoring, and insurance to mitigate hacking or loss risks.
- **Advanced Portfolio Analytics and Reporting**: Real-time dashboards with Bitcoin price feeds (via oracles like Chainlink), performance metrics, tax reporting (e.g., IRS Form 8949), and cross-asset integration for holistic portfolio insights.
- **Tiered Custody for Multi-Entity/Region Support**: Flexible custody workflows for family offices, trusts, or corporate subsidiaries, with jurisdiction-specific compliance (e.g., EU MiCA, U.S. SEC) and multi-currency reporting. Workflows vary from operational flexibility vs risks standpoint, and this becomes a critical ask to work on an expanded base of clients' personas for a bank to be truly a leader in the space.
- **Multisig Wallet, DLCs or Miniscript Configurations**: Customizable 2-of-3 or 3-of-5 multisig setups for secure transaction approvals, with keys stored in air-gapped systems to reduce single points of failure for HNW clients and treasuries.
- **Inheritance and Continuity Planning**: Trustless on-chain inheritance mechanisms using time-locked transactions with miniscript or Discreet Log Contracts (DLCs) for HNW estate planning, and key rotation protocols for corporate continuity during employee turnover.
- **Programmatic Rebalancing Tools**: Automated, rule-based rebalancing for Bitcoin and stablecoin allocations, with DeFi integration for hedging and low-slippage conversions to manage volatility.
- **Concierge-Level UX for HNW Clients**: Customizable, white-glove interfaces with 24/7 support, tailored portfolio visualizations, and guided multisig/inheritance setup to meet HNW expectations for premium service.
- **Treasury Policy Enforcement**: Configurable rulesets for corporate treasuries, enforcing allocation limits, transaction approvals, and risk thresholds, integrated with ERP systems (e.g., SAP, Oracle) for cash flow management.
- **Compliance Automation and Audit Trails**: Embedded KYC/AML monitoring, sanctions screening (e.g., via Chainalysis), and immutable audit logs to comply with FATF, MiCA, and other regulations, with real-time reporting for regulators.
- **Cross-Asset Risk Management**: Advanced risk modeling tools to assess Bitcoin's volatility within diversified portfolios, including stress testing and scenario analysis for HNW clients and treasuries to mitigate market downturns.
- **Stablecoin Liquidity Pools**: Integration with stablecoin liquidity pools (e.g., USDC, USDT) for efficient cash management, enabling treasuries to park funds in low-volatility assets and HNW clients to diversify exposure.
- **Decentralized Finance (DeFi) Integration (Optional)**: Support for DeFi protocols (e.g., lending, yield farming) to enhance Bitcoin's utility for HNW clients seeking yield and treasuries optimizing idle assets, with secure oracles for pricing.
- **Real-Time Oracle Integration**: Robust oracles (e.g., Chainlink, Band Protocol) for accurate, real-time Bitcoin and stablecoin pricing, ensuring reliable valuations for portfolio analytics, rebalancing, and compliance reporting.

Integration Model:
Private banks can offer these services directly or partner with white-labeled private banking providers. Treasury integration with corporate ERPs and cash management platforms will become increasingly important.

- Direct Offering: Banks can develop in-house platforms, integrating custody, brokerage, and portfolio tools into their wealth management or treasury services. This requires significant investment in systems and compliance infrastructure.
- White-Labeled Custody Providers: Partner with firms (e.g., Unchained, BitGo, or Blockstream) to offer branded bitcoin custody and management services. These partners provide pre-built custody and reporting tools, reducing time-to-market.
- Corporate ERP Integration: For treasuries, integrate Bitcoin management with ERP systems (e.g., SAP, Oracle) and cash management platforms. APIs must support real-time data feeds for bitcoin holdings, transactions, and valuations.

Key Considerations:

- Scalability
  Systems must support high-net-worth (HNW) clients and corporate treasuries managing substantial Bitcoin holdings across multiple entities, jurisdictions, and asset classes. Infrastructure should ensure:
  - Low-latency operations: Real-time transaction processing, portfolio valuation, and rebalancing to handle volatile Bitcoin markets.
  - Multi-entity support: Seamless management of Bitcoin across subsidiaries, trusts, or family offices, with tiered access controls for different stakeholders (e.g., advisors, beneficiaries, or treasury managers).
  - Global scalability: Cross-border compatibility to accommodate clients in multiple regions, accounting for varying time zones, currency conversions, and regulatory frameworks.
  - Capacity planning: Infrastructure must scale to handle increased transaction volumes as Bitcoin adoption grows, with robust APIs to integrate with existing banking systems.
- Security, Cold Storage Custody & Air gapped Architecture
  Bitcoin's decentralized nature demands best-in-class security to mitigate risks while ensuring user trust. Key considerations include:
  - Multi-signature (multisig) wallets: Implement multisig setups (e.g., 2-of-3 or 3-of-5 keys) to distribute control and reduce single points of failure. Keys should be stored across geographically dispersed, secure locations (e.g., hardware security modules or air-gapped devices).
  - Inheritance and business continuity: Develop user-friendly interfaces for multisig delegation and inheritance planning to ensure seamless asset transfer in estate planning or employee offboarding scenarios. For example, automated workflows for key reassignment in case of death or corporate restructuring.

  - **Auditability**: Provide tamper-proof audit trails for all transactions and key management activities to ensure compliance and transparency for HNW clients and corporate treasuries.
  - **Cybersecurity resilience**: Protect against phishing, social engineering, and hacking attempts through mandatory two-factor authentication (2FA), biometric verification, and regular security audits.
  - Defense Against Emerging Threats especially the modern sophisticated ones like (1) AI-Driven Attacks: Protects against AI-based hacking attempts (2) Quantum Attacks: Safeguards against potential future quantum computing threats that could compromise traditional encryption and (3) Man-in-the-Middle Attacks: Ensures secure communication and key retrieval processes
  - **Structured Recovery Framework**: Provide a predefined, audited process for rapid asset retrieval, ensuring minimal disruption during disasters. This helps ensure there is mitigation of key man risk & no third-party reliance
  - **Geographic Redundancy**: Assets are stored in geographically distributed locations to protect against localized risks such as floods, fires, or power outages
  - **Zero-Trust Security**: Only authorized personnel can access assets, with strict authentication controls to prevent unauthorized access
- Regulation and Compliance
  Bitcoin and stablecoin regulations are evolving rapidly, requiring adaptive compliance frameworks:
  - **Regulatory alignment**: Systems must comply with jurisdiction-specific rules, such as the U.S. SEC's custody rules, EU's MiCA framework, and FATF's travel rule for virtual assets. Compliance rulesets should be programmable to adapt to regulatory changes without requiring full system overhauls.
  - **Cross-border challenges**: For global HNW clients and multinational corporates, systems must support multi-domicile compliance, including KYC/AML checks, tax reporting (e.g., IRS Form 8949 for crypto transactions), and sanctions screening across jurisdictions.
  - **Stablecoin integration**: As treasuries may use stablecoins for liquidity management, ensure compliance with stablecoin-specific regulations (e.g., reserve audits under MiCA or NYDFS).
  - **Proactive monitoring**: Implement real-time transaction monitoring and reporting tools to flag suspicious activities and meet regulatory reporting deadlines (e.g., FinCEN's Suspicious Activity Reports).
- Market Volatility and Risk Management (Programmatic vs Concierge)
  Private banking HNIs & Corporate treasuries' first goal is wealth protection and preservation hence this is often a default background passive portfolio watching service that many clients value especially in a volatile asset class like Bitcoin. Subscribing to such a service is optional and based on suitability risk persona. These capabilities help a client when markets are in their extreme avatar

    - **Volatility mitigation:** Offer programmatic rebalancing tools to automatically adjust Bitcoin and stablecoin allocations based on predefined risk tolerances or market conditions.
    - **Hedging capabilities:** Integrate with decentralized finance (DeFi) protocols or traditional derivatives markets to provide hedging options for Bitcoin exposure.
    - **Stress testing:** Systems should support scenario analysis and stress testing to evaluate portfolio performance under extreme market conditions (e.g., Bitcoin price drops of 30% or more).
- Cost Efficiency & Complexity
  This must be highlighted explicitly, implementing a fully offline, zero-trust architecture with geographically distributed storage may involve significant setup and maintenance costs, which organizations should evaluate.
    - **Minimized counterparty risk:** By leveraging Bitcoin's decentralized infrastructure, banks can reduce reliance on third-party intermediaries (e.g., ETF custodians), lowering fees and counterparty risks.
    - **Fee transparency:** Provide clear cost structures for custody, transaction processing, and rebalancing to build trust with HNW clients and treasuries.
    - **Economies of scale:** White-labeled solutions or modular APIs can reduce development and maintenance costs, enabling banks to offer competitive pricing.
- User Experience
  HNW clients and corporate treasuries demand intuitive, high-touch interfaces tailored to their needs:
    - **HNW client expectations:** Deliver concierge-level UX with customizable dashboards, real-time portfolio analytics, and white-glove support (e.g., dedicated account managers or 24/7 chat support). Interfaces should simplify complex operations like multisig setup or inheritance planning.
    - **Treasury integration:** Ensure seamless integration with corporate ERP systems (e.g., SAP, Oracle NetSuite) and cash management platforms for real-time visibility into Bitcoin holdings, cash flows, and hedging strategies.
    - **Automation and alerts:** Provide automated alerts for price movements, policy violations (e.g., exceeding risk thresholds), or compliance triggers to enhance decision-making.
    - **Accessibility:** Support multi-platform access (web, mobile, desktop) with consistent UX across devices, ensuring HNW clients and treasury teams can manage assets on the go.

Implementation Notes:

- Leveraging Bitcoin-Native Infrastructure
    - **Partnerships with custody providers:** Collaborate with established Bitcoin custody providers like Unchained, BitGo, Blockstream or Anchorage Digital to leverage pre-built, battle-tested custody and reporting tools. These partners offer SOC 2-compliant infrastructure, multisig support, and regulatory frameworks, reducing time-to-market and development costs.

    - White-labeled solutions: Use white-labeled platforms to brand custody and portfolio management tools under the bank's name. For example, integrate BitGo's multisig wallet APIs or Unchained's collaborative custody model to offer secure, client-facing solutions.
    - Open-source protocols: Explore Bitcoin-native protocols like the Lightning Network for low-cost, high-speed transactions or Miniscript & Discreet Log Contracts (DLCs) for trustless financial agreements (e.g., inheritance or treasury delegation). These can enhance scalability and reduce reliance on centralized systems.
- Regulatory and Compliance Integration
    - Dynamic rulesets: Build compliance modules that can be updated via API to reflect new regulations (e.g., MiCA's stablecoin reserve requirements or SEC's custody rules). Use modular architecture to avoid system-wide updates for minor regulatory changes.
    - Cross-border compliance: Implement jurisdiction-specific KYC/AML templates and integrate with global sanctions databases (e.g., OFAC, EU sanctions lists). Support multi-currency reporting for clients with assets in multiple domiciles.
    - Audit and reporting tools: Develop dashboards for real-time compliance monitoring, with exportable reports for regulators and internal audits. Ensure compatibility with standards like ISO 27001 and SOC 2 for institutional credibility.
- In-House Platform Development
    - Core Banking Systems Integration: Seamlessly integrate Bitcoin management tools with core banking systems to ensure operational coherence and enhanced client experiences for private banking and treasury services. Interoperability with legacy systems i.e. develop APIs to connect Bitcoin custody, trading, and reporting tools with core banking platforms (e.g., Temenos, Avaloq, Finacle) for unified client account management. Transaction reconciliation i.e. integrates Bitcoin transactions with core banking ledgers to streamline accounting, auditing, and reconciliation processes, ensuring consistency across fiat and crypto operations.
    - Custody integration: Build on Horizon 1's custody and brokerage rails by integrating with secure custody solutions (e.g., cold storage, multisig wallets) and trade execution APIs. Use hardware security modules (HSMs) for key management to meet institutional-grade security standards.
    - Portfolio management systems: Develop or license advanced portfolio tools with real-time analytics, risk modeling, and tax reporting capabilities. These should integrate with oracles (e.g., Chainlink, Band Protocol) for accurate, real-time Bitcoin and stablecoin pricing.
    - ERP integration: For corporate treasuries, build APIs to connect Bitcoin management tools with ERP systems like SAP, Oracle, or NetSuite. Ensure support for real-time data feeds (e.g., holdings, transactions, valuations) and batch processing for treasury workflows.

    - **Compliance automation**: Embed programmable compliance rulesets into the platform, leveraging tools like Chainalysis or Elliptic for KYC/AML monitoring and transaction tracing. Automate tax reporting and regulatory filings to reduce manual overhead.
- APIs for Client Side: ERP Integration for Treasuries
  Build robust APIs to connect Bitcoin management tools with enterprise resource planning (ERP) systems like SAP, Oracle, or NetSuite, tailored for corporate treasury workflows. Key features include:
    - **Real-time data feeds**: Support live updates for Bitcoin holdings, transactions, and valuations to enable accurate cash flow forecasting and liquidity management.
    - **Batch processing**: Facilitate bulk transaction processing for treasury operations, such as payroll or supplier payments, with automated reconciliation to ERP financial modules.
    - **Policy enforcement**: Integrate treasury policy controls (e.g., allocation limits, approval workflows) into ERP systems to ensure compliance with internal governance and risk frameworks.
    - **Multi-currency support**: Enable seamless tracking of Bitcoin alongside fiat and stablecoin holdings within ERP systems for global treasury operations.
- Compliance Automation
  Embed programmable compliance rulesets into the platform to meet evolving regulatory requirements for Bitcoin and stablecoin management. Key components include:
    - **KYC/AML monitoring**: Leverage tools like Chainalysis, Elliptic, or CipherTrace for real-time transaction tracing and sanctions screening, ensuring compliance with FATF's travel rule and regional regulations (e.g., EU MiCA, U.S. SEC).
    - **Automated regulatory filings**: Streamline reporting for tax authorities (e.g., IRS, HMRC) and financial regulators with pre-built templates and exportable audit trails.
    - **Dynamic rulesets**: Design modular compliance frameworks that can be updated via API to adapt to new regulations without requiring system-wide overhauls.
    - **Cross-border compliance**: Support multi-jurisdictional KYC/AML requirements and data sovereignty laws (e.g., GDPR) for global HNW clients and multinational treasuries.

Conclusion

The integration of Bitcoin into the commercial, private and retail banking system is not a distant, theoretical exercise; it is a practical, modular, and increasingly necessary evolution of financial infrastructure. As this report has demonstrated, banks do not need to overhaul their core systems to begin offering Bitcoin-related services. Instead, by strategically upgrading specific components of their architecture, particularly payments orchestration, custody integration, compliance systems, and correspondent partnerships, banks can begin delivering real value today while positioning themselves for broader participation in the digital asset economy.

At the heart of this transformation is the **modern payments hub**, a foundational abstraction layer that enables dynamic routing of transactions across traditional and emerging settlement networks, including Bitcoin. This flexibility decouples innovation from the constraints of legacy core systems and creates a pathway for phased adoption, from simple brokerage integrations to full-scale Bitcoin-backed lending, Lightning payments, and private treasury services. Banks that implement this architecture gain a future-proofed environment, capable of supporting not only Bitcoin but any cryptographic signature-based asset that achieves market or regulatory legitimacy.

Importantly, the maturity of the tools and providers available today (i.e., wallet infrastructure, collateral management systems, Lightning-as-a-Service platforms, and multi-party custody) means that banks do not have to go it alone. The correspondent banking model, a proven structure in global payments, is being repurposed for Bitcoin, offering smaller banks a clear on-ramp through partnerships with regulated infrastructure providers. These correspondents handle custody, execution, and liquidity while enabling banks to retain control over the customer relationship, compliance, and balance sheet exposure.

As digital asset adoption grows, institutions that delay integration risk falling behind, not only in offering competitive products, but also in maintaining operational relevance. Bitcoin's settlement finality, 24/7 availability, and programmable control features offer advantages that fiat rails cannot replicate. Banks that move first will gain an edge in building new revenue lines, attracting clients, and shaping the standards for regulated Bitcoin finance.

Ultimately, Bitcoin integration is not a bet on price, it is a strategic commitment to infrastructure optionality, risk management, and innovation. The roadmap (key systems, key considerations, implementation notes) laid out in the above section outlines how banks can begin that journey today.

Appendix: Operation Choke Point 2.0

Appendix A: Operation Choke Point 2.0 (Summary of reporting by Nic Carter)

Operation Choke Point 2.0 refers to a coordinated campaign by U.S. federal agencies from 2022 to 2024 that aimed to restrict crypto industry access to the traditional banking system. Though never officially acknowledged as a formal program, it was widely recognized by market participants and policy commentators as a deliberate effort to isolate digital asset firms from the financial system using regulatory pressure on the banking system rather than legislative action.

The campaign draws its name from *Operation Choke Point*, an Obama-era initiative that began in 2013. That earlier effort sought to marginalize politically disfavored but legal industries, such as firearms dealers and payday lenders, by pressuring banks to sever ties with them. Though Operation Choke Point was officially shut down under the Trump administration in 2017, the underlying strategy of using bank access as leverage appears to have persisted. Choke Point 2.0 seemingly applies the same strategy to the digital asset sector.

Rather than issuing new laws or explicit bans, regulators in the Biden administration framed their actions around "reputation" risks. This allowed them to discourage crypto engagement while avoiding a formal rulemaking process. Importantly, many observers incorrectly assumed that these regulatory efforts were a reaction to the collapses of major crypto firms like Three Arrows Capital (3AC), Celsius, and FTX. In fact, based on new information coming to light, the crackdown appears to have kicked off a few months prior.

Current Understanding of the Choke Point 2.0 Timeline

March 2022

On March 9, 2022, the Biden administration issued an Executive Order titled Ensuring Responsible Development of Digital Assets.[78] While the order was presented as a coordinated strategy to support innovation, it appears to have kicked off a secret turning point in federal posture toward the crypto industry.

Two days later on March 11 2022, the FDIC sent what would become known as the first in a series of confidential "pause letters" to a U.S. bank that had disclosed plans to offer Bitcoin brokerage services.

- In these letters, which were not publicly known until disclosed as part of Coinbase's lawsuit against the federal government in late 2024, the FDIC instructed banks it regulated to pause or delay development of digital asset activities.
- The informal directive specifically targeted services such as Bitcoin and Ethereum buy/sell products for clients, bitcoin-backed lending, and participation in private or public blockchain settlement networks.

[78] https://bidenwhitehouse.archives.gov/briefing-room/presidential-actions/2022/03/09/executive-order-on-ensuring-responsible-development-of-digital-assets/

- By the end of June 2022, six such letters had been sent, signaling a coordinated but opaque shift in regulatory posture that effectively discouraged banks from engaging with the crypto sector.
- Dozens more letters were sent by the FDIC privately to banks throughout 2023.
- On March 31, the SEC released SAB 121, requiring banks that custody digital assets to treat them as liabilities on their balance sheets.[79]
    - This treatment diverges from traditional custody accounting and makes digital asset custody prohibitively capital-intensive for regulated banks.

June to November 2022

Importantly, the actions above, which appear to demonstrate cross-agency coordination targeting the US digital asset industry *pre-dated* the crypto market's high-profile failures of 2022.

- The collapse of 3AC and Celsius began in June 2022, and FTX fell five months later in November 2022.
- While these adverse events intensified scrutiny, the federal apparatus targeting the banking-crypto nexus appears to have been set in motion months prior, even if perhaps undetected by many industry participants at that time.

December 2022

In December 2022, following the demise of FTX, the pressure escalated.

- On December 6, U.S. Senators led by Elizabeth Warren publicly rebuked Silvergate Bank for its association with FTX.
- On this same day, Signature Bank announced it would significantly reduce its exposure to the crypto industry.
- On December 7th, Elizabeth Warren penned a letter to the Federal Reserve, FDIC, and OCC expressing concerns about crypto firms "ties to the banking system."[80]

January 2023

In January 2023, three major events occurred in rapid succession.

- On January 3, the Federal Reserve, FDIC, and OCC issued a joint statement warning banks about crypto-related risks.[81]
    - This guidance was formally rescinded by the respective regulatory agencies on April 24, 2025.
- On January 9, Metropolitan Commercial Bank announced its plans to exit the space entirely. [82]

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[79] https://www.sec.gov/rules-regulations/staff-guidance/staff-accounting-bulletins/staff-accounting-bulletin-121
[80] https://www.warren.senate.gov/imo/media/doc/Letter%20to%20Regulators%20re%20Banking%20System%20Exposure%20to%20Crypto.pdf
[81] https://www.federalreserve.gov/newsevents/pressreleases/bcreg20230103a.htm
[82] https://www.businesswire.com/news/home/20230109005186/en/Metropolitan-Bank-Holding-Corp.-to-Exit-Crypto-Asset-Related-Vertical

- And on January 27, the Fed denied Custodia Bank's long-pending applications for a master account and Fed membership.[83]
    - That same day, the White House's National Economic Council released a statement reinforcing these themes, making clear that direct engagement with public blockchains was now viewed as a serious risk.

February 2023

In what was likely a direct response to Senator Elizabeth Warren's December 7, 2022 letter criticizing crypto-bank relationships, the Federal Reserve, FDIC, and OCC issued a joint letter in February 2023 outlining supervisory expectations for banks engaging with digital asset firms.[84]

- The agencies warned that crypto-related activities pose significant safety and soundness risks and strongly discouraged banks from offering services involving digital assets or stablecoins.
    - This guidance was formally rescinded by the respective regulatory agencies on April 24, 2025.

March 2023

In March 2023, the impact of this regulatory posture became more visible.

- On March 8, Silvergate Bank announced a voluntary liquidation.[85]
    - According to its chairman Mike Lempres, the bank had been operating its digital asset banking model with transparency and regulator engagement for ~10 years, only to be undermined by shifting policies and newly applied restrictions.
    - According to John Maxfield (@MaxfieldOnBanks), Silvergate survived an unprecedented 70% deposit run before being shot in the back by its regulators. Maxfield notes that a typical bank could not survive a 10-20% run.[86]
- Two days later on March 10, Silicon Valley Bank (SVB) experienced a catastrophic deposit run and entered FDIC receivership.
    - While the SVB collapse was unrelated to crypto, the timing highlighted broader fragility in U.S. banking.
- Then, on Sunday, March 12, Signature Bank was abruptly seized by regulators, despite former U.S. Congressman and board member Barney Frank stating the bank was solvent and being targeted specifically due to its crypto involvement.[87]
    - The sudden takeover of Signature, just days after Silvergate's liquidation announcement and SVB's failure, fueled speculation that regulators used the broader banking panic as cover to eliminate the last major crypto-friendly bank.

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[83] https://www.federalreserve.gov/newsevents/pressreleases/orders20230127a.htm
[84] https://www.federalreserve.gov/newsevents/pressreleases/bcreg20230223a.htm
[85] https://www.cnbc.com/2023/03/08/silvergate-shutting-down-operations-and-liquidating-bank.html
[86] John Maxfield (@MaxfieldOnBanks) tells the story of Silvergate Bank on @7investing podcast with Simon Erickson and Caitlin Long https://x.com/7Innovator/status/1864686170703003706/video/1
[87] https://www.reuters.com/business/finance/new-york-state-regulators-close-signature-bank-2023-03-12/

- Nic Carter's article "*Did the Government Start a Global Financial Crisis in an Attempt to Destroy Crypto?*" explores this sequence in detail and presents evidence supporting the view that Signature's failure was politically motivated rather than market-driven.[88]

- While not widely reported and/or perceived by the general public, 22 banks in total, most with no notable crypto-asset exposure, experienced significant deposit runs between March 9th and March 14th.[89]

Crypto Industry Impact

By design, the operation achieved what would have been politically untenable through legislation: it curtailed crypto activity by isolating firms from banking rails. While no laws were passed banning digital assets, banks were made to understand that engaging with the sector would subject them to heightened scrutiny, reduced supervisory ratings, capital limitations, and reputational risk. In effect, regulators forced crypto back into a financial grey zone.

Critics argue that this approach not only damaged domestic innovation, but it also pushed activity offshore into less regulated jurisdictions. Paradoxically, the effort to reduce systemic risk may have increased it by severing oversight from U.S.

Lessons & Outlook

What makes Operation Choke Point 2.0 especially troubling is the manner in which it was executed: through confidential communications, informal threats, and tone-setting rather than transparent rulemaking. It revealed how easily access to financial services can be weaponized when regulators operate without formal accountability.

As of this writing, congressional investigations are underway. The long-term legacy of Choke Point 2.0 remains uncertain, but it may be remembered as a cautionary tale in the political use of banking infrastructure, and a case study in the fragility of financial neutrality in the United States.

[88] https://www.piratewires.com/p/2023-banking-crisis
[89] Cipriani, M., Eisenbach, T. M., & Kovner, A. (2024). *Tracing Bank Runs in Real Time* (Federal Reserve Bank of New York Staff Report No. 1104, revised December 2024). Retrieved from https://www.newyorkfed.org/medialibrary/media/research/staff_reports/sr1104.pdf?sc_lang=en

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Chris Lane led the technical section and is the primary mind behind the “deCentral Bank” idea. He now advises banks on technology and operations strategy, and you can reach him at: https://x.com/D_CentralBanker or https://www.linkedin.com/in/chrislane3/

Sagun Garg focused on the banking upgrades system architecture via the lens of 2 horizons of native Bitcoin technology upgrades in banking institutions through implementation notes for digitally native integrations and can be contacted at: https://x.com/sagungarg

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