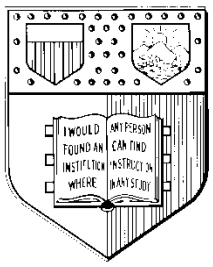

Payment Network Governance

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The authors thank conference participants at the 2022 ALEA Annual Meeting (hosted by Columbia Law School), Money as a Democratic Medium 2.0 Conference (hosted by Harvard Law School), the 6th Annual Law & Macroeconomics Conference (hosted by Tulane Law School), and the 2024 Winter Deals Conference (hosted by BYU Law School) for their helpful comments and suggestions.

Abstract

New technology is rapidly changing how we make payments. In order to successfully harness this new technology, the architects of our payment systems-like all network utilities-must grapple with a series of thorny decisions about network stability, access, and investment. This Article demonstrates that these decisions present important and often intractable tradeoffs: with these architects generally only able to control at most two of these three critical network features. Using examples from the domestic U.S. payment system, the global correspondent banking system, and the emerging crypto ecosystem, this Article argues that these tradeoffs have wide-ranging policy implications for financial stability, for payment system competition and innovation, and for financial inclusion. These tradeoffs highlight the important role of network governance in promoting a level playing field, coordinating the development and adoption of new payment technology, and ensuring that the resulting network infrastructure serves to advance the public good.

Keywords: Payment systems, financial networks, network governance, innovation, financial stability, network regulation, banking, correspondent banking, cryptocurrency, digital assets

JEL Classifications: K2, L1, L5, O1

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INTRODUCTION

They say money makes the world go around. But what makes money go around? In a world where the use of paper bills, coins, and checks is in inexorable decline, the answer is increasingly a vast, sprawling, and largely invisible patchwork of electronic payment networks.[1] These payment networks are the technological hubs and spokes that connect banks and other financial institutions, enabling them to send and receive money on behalf of households, businesses, and governments across the country and around the globe. Accordingly, while we seldom stop to think about these networks, how they work, or who controls them, there is no question that they represent critical—and yet in many ways critically understudied—financial market infrastructure. Without them, the global financial system and world economy would very quickly grind to a halt.

The failure of these payment networks can also have devastating consequences far closer to home. Significant disruptions to network service can prevent people from paying rent, buying groceries, or meeting their ongoing financial obligations.[2] Even where these networks are fully operational, chronically slow service can force people living paycheck to paycheck to rely on expensive and risky consumer credit products.[3] The financial, technological, and other costs of using these networks can also erect significant barriers to access: hurting small businesses, impeding the delivery of public benefits, and contributing to financial exclusion.[4] Last but not least, closed networks can undercut competition and

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[1] *See* Fed. Res. Bank of Atl., *Global Data Tracks Decade-Long Decline in Check Payments* (Aug. 14, 2023), https://www.atlantafed.org/blogs/take-on-payments/2023/08/14/global-data-tacks-decade-long-decline-in-check-payments (reporting a decline in check usage of 6.7 percent per year between 2012 and 2021); Fed. Res. Bank of Atl., 2022 Survey and Diary of Consumer Payment Choice (Jun. 2023), https://www.atlantafed.org/banking-and-payments/consumer-payments/survey-and-diary-of-consumer-payment-choice (reporting a year-over-year decrease in cash usage).

[2] *See e.g.* Chris Giles, *House Purchases Delayed by BoE IT Payment System Crash*, THE FINANCIAL TIMES (Aug. 14, 2023); Matt Egan, *The Federal Reserve Suffers Widespread Disruption to Payment Services*, CNN (Feb. 25, 2021), https://www.cnn.com/2021/02/24/business/federal-reserve-outage-fedwire/index.html; BBC News, *RBS Computer Problems Kept Man in Prison* (Jun. 25, 2012) (reporting that for several days, RBS customers were left unable to access their account information, withdraw cash, pay bills, or use their credit and debit cards). For a description of the causes and consequences of major payment network disruptions, see Tanai Khiaonarong, Harry Leinonen & Ryan Rizaldy, *Operational Resilience in Digital Payments: Experiences and Issues*, International Monetary Fund Working Paper WP/21/288 (Dec. 2021). For scholarly work on the impact of these disruptions, see e.g. Morten Bech & Rodnet Garratt, *Illiquidity in the Interbank Payment System Following Widespread Disruptions*, 44 J. OF MONEY, CREDIT AND BANKING 903 (2012).

[3] *See e.g.* Nakita Cuttino, *The Rise of 'Fringetech': Regulatory Risks in Earned Wage Access*, 115 NORTHWESTERN UNIV. L. REV. 1505 (2021); Aaron Klein, *The Fastest Way to Address Income Inequality? Implement a Real Time Payment System*, THE BROOKINGS INSTITUTION (Jan. 2, 2019); Aaron Klein, *How the Fed Can Help Families Living Paycheck to Paycheck*, THE BROOKINGS INSTITUTION (Nov. 22, 2017).

[4] *See* Michael Barr, Adrienne Harris, Lev Menand & Wenqi Xu, *Building the Payment System of the Future: How Central Banks Can Improve Payments to Enhance Financial Inclusion*, University of Michigan Law & Economics Research Paper No. 20-038 (Jul. 31, 2020); Raphael Bostic, Shari Bower, Oz Shy, Larry Wall, & Jessica Washington, *Shifting Focus: Digital Payments and the Path to Financial Inclusion*, Federal Reserve Bank of Atlanta Policy Report No. 20-1 (Dec. 2020).

innovation that might otherwise lower costs, improve the quality of payment services, or expand access for consumers.[5] Just like power outages, road closures, and internet service disruptions, the failure of these networks can thus have an enormous impact on our daily lives.

Despite their importance, debates about the design, regulation, and governance of payment networks have historically remained under the purview of a small number of central bankers, bureaucrats, and academics.[6] The technocratic nature of these debates reflected in part the relatively slow pace of technological innovation in payments over the course of most of the twentieth century. It also reflected the fact that powerful incumbents—namely banks—were firmly entrenched as the owners, gatekeepers, and custodians of these networks.[7] Yet recent decades have witnessed a flurry of transformative technological advances: everything from the internet and web-based application programming interfaces (APIs), to smartphones, contactless payments, and real-time settlement.[8] These technological advances are rapidly changing the way that we send and receive money. Many of these advances have also taken place in the shadow of the global financial crisis, driving home the potential costs of entrenching banks at the apex of our financial system. For the first time, these forces of technological and financial disruption have thrust the design, regulation, and governance of payment networks and other financial market infrastructure into the spotlight.

This increased interest in payments systems is likely due, at least in part, to the rapid rise of crypto assets and the broader crypto ecosystem.[9] While at present crypto assets like Bitcoin (BTC), Ether (ETH), and Tether (USDT) are not widely used to make payments, the decade following the creation of BTC witnessed a flood of new investment into technology firms seeking to build the first generation of crypto payment networks.[10] On the back of this investment, industry leaders like Coinbase have spent millions on high profile advertising campaigns touting crypto as the future of money and payments.[11] Whether these lofty

[5] *SEE* DAN AWREY, *BEYOND BANKS: TECHNOLOGY, REGULATION AND THE FUTURE OF MONEY* (2024); Dan Awrey, *Unbundling Banking, Money, and Payments*, 110 GEORGETOWN L. J. 715 (2022).

[6] For a flavor of these debates, see e.g. DOMINIQUE RABURE & ALEC NACUMULI (EDS.), *PAYMENT SYSTEMS: FROM THE SALT MINES TO THE BOARDROOM* (2008); ANDREW HALDANE, STEPHEN MILLARD & VICTORIA SAPORTA (EDS.), *THE FUTURE OF PAYMENTS* (2007).

[7] Awrey, *Unbundling , supra* note __.

[8] For a narrative description of the development of these and other technologies, along with their impact on the development of modern payment networks, see GOTTFRIED LEIBBRANDT & NATASHA DE TERAN, *THE PAY OFF: HOW CHANGING THE WAY WE PAY CHANGES EVERYTHING* (2021).

[9] *See* Part II.B for a more detailed description of cryptocurrencies and the evolving crypto ecosystem.

[10] *See* Part II.B for empirical data measuring the flow of new investment into crypto payment firms and how it has changed over time.

[11] *See e.g.* Coinbase, *The Future of Money is Here—And It's Crypto*, *COINBASE BLOG* (Dec. 19, 2023), https://www.coinbase.com/de/blog/the-future-of-money-is-here-and-its-crypto; Coinbase, "Future of Money" TV Advertisement, https://www.youtube.com/watch?v=BHP_S2qi1eo.

predictions prove accurate remains to be seen.[12] Nevertheless, the emergence, growth, and sometimes spectacular failures experienced within the crypto ecosystem highlight the chronic problems encountered by many far more well-established payment networks. Importantly, it also highlights how ineffective payment network governance can contribute to these problems, and how better governance can yield potential solutions.[13]

This Article explores key policy challenges in the design, regulation, and governance of modern payment networks. We begin by developing a framework for understanding what it takes to build a successful payment network. Broadly speaking, successful networks combine three key features. The first is financial and technological *stability*: the ability of a network to perform without interruption, without successful cyber-attacks or data breaches, and without exposing its users to financial loss. The second is network *access*: the ability of financial intermediaries and their customers to send and receive money within the widest possible network of households, businesses, and governments. The third is network *investment*. The development of modern, technology-driven payment networks demands enormous initial investments of financial, human, and other capital. As technology advances, these networks must also make significant ongoing investments in technological maintenance and upgrades. Over the long term, whether the architects of a payment network are in a position to make these investments—and crucially whether they are incentivized to make them—will be important determinants of their success.

The challenge is that simultaneously pursuing all three of network stability, access, and investment requires policymakers to navigate a series of important and potentially intractable tradeoffs. Promoting network stability typically demands the imposition of costly regulation, erecting barriers to access and potentially leading to underinvestment by powerful and entrenched incumbents. Promoting open access can help spur investment, but it can also lead to deadweight losses and potential instability as rival payment networks compete for the

[12] For more scholarly perspective predicting that crypto assets represent the future of money and payments, see ESWAR PRASAD, *THE FUTURE OF MONEY: HOW THE DIGITAL REVOLUTION IS TRANSFORMING CURRENCIES AND FINANCE* (2021).

[13] This period of rapid technological and financial disruption has coincided with a broader revival of interest on the part of scholars, policymakers, and even the general public in network utility regulation. This interest has recently led several prominent scholars to publish a new cross-sectoral textbook exploring issues in network, platform, and utility regulation; see MORGAN RICKS, GANESH SITARAMAN, SHELLEY WELTON & LEV MENAND, *NETWORKS, PLATFORMS, AND UTILITIES: LAW AND POLICY* (2022); *see also* Aneil Kovvali & Joshua C. Macey, *The Corporate Governance of Public Utilities*, 40 YALE J. ON REG. 570 (2023); Lina Khan, *Amazon's Antitrust Paradox*, 126 YALE L. J. 710 (2017); TIM WU, *THE CURSE OF BIGNESS: ANTITRUST IN THE NEW GILDED AGE* (2018); Erik Hovenkamp, *The Antitrust Duty to Deal in the Age of Big Tech*, 131 YALE L. J. 1385 (2022). There has also been renewed interest in physical network infrastructure and its regulation; see e.g. GANESH SITARAMAN, *WHY FLYING IS MISERABLE AND HOW TO FIX IT* (2023). Yet despite the obvious parallels, this more general interest in network utility regulation has not yet translated into a wave of new research or thinking about the infrastructural role of modern payment networks, how these networks respond to rapid technological change, and how policymakers can harness this technology in pursuit of the public good. Although by no means a wave, there has been a ripple of excellent papers exploring the governance of modern payment systems; see e.g. Peter Conti-Brown & David Wishnick, *Private Markets, Public Options, and the Payment System*, 37 YALE J. ON REG. 380 (2020).

market. And promoting initial and ongoing investment forces policymakers to make a difficult choice between promoting private sector investment—typically by placing restrictions on network access—or making direct public investments in order to guarantee open access and advance other important policy objectives.

Together, these tradeoffs can place significant constraints on the ability of policymakers to ensure network stability, access, and investment. Further compounding matters, these are not the only objectives that policymakers might want to prioritize in connection with the design, regulation, and governance of modern payment networks. Perhaps most importantly, policymakers may wish to control the cost of payment services for lower income households or small businesses, leverage payment networks to deliver public benefits, or ensure that the least fortunate have access to a safe, reliable, and easy to use means of making electronic payments.[14]

Navigating the tradeoffs between network stability, access, and investment while simultaneously advancing these and other important policy objectives illuminates a simple and inescapable fact. The biggest challenge associated with building modern payment networks is not financial or technological—it's *governance*. It's a problem with who makes the decisions about payment network design. It's a problem with their expertise, their incentives, and their time horizons. It's a problem of balancing competition with coordination and collective action. It's a problem of how to extract the benefits of new technology, enormous economies of scale, and network effects while ensuring that these benefits are shared widely across society. And far too often, it's a problem of who doesn't get a seat at the table. Better, stronger, and more dynamic network governance can help solve all these problems and, in the process, advance these important policy objectives.

The most constructive role for network governance—and therefore the tools that policymakers should use—will inevitably depend on the specific circumstances in which they find themselves. Where payment networks are controlled by a small number of powerful and entrenched incumbents, network governance can help level the playing field by promoting open access and interoperability. Where unbridled competition threatens to produce overinvestment and potential instability, network governance can be used to develop common technical standards, coordinate private investment, and ensure effective regulation. And where market forces fail to produce payment networks that advance broader public policy objectives, network governance can provide the foundation for direct public sector investment, oversight, and accountability.

The role of network governance becomes even more critical during periods of rapid technological change. New technology holds out the tantalizing promise of faster, cheaper, safer, more convenient, and more accessible payments. Yet fulfilling this promise will almost inevitably require sustained coordination and investment, the development of new technical

[14] *See e.g.* Michael Barr, Federal Reserve Board, Vice Chair for Supervision, Opening Remarks at the Economics of Payments XII Conference (Oct. 27, 2023) ("[I[nnovation must proceed in a way that respects fundamental principles for serving the public good. Payments innovation should support and promote broad access and financial inclusion… too often the cost of a payment service is prohibitive and represents a barrier that limits access for low- and moderate-income households and small businesses").

standards and, ultimately, some hard choices. For the public sector, new technology will often demand new thinking, forcing policymakers to combine creative problem-solving with a healthy dose of caution. For the private sector, the race to develop and monetize new technology will often and understandably be accompanied by strategies designed to protect the economic value of their investments. These strategies will often involve restricting network access, erecting artificial barriers to entry or interoperability, and other potentially anticompetitive conduct. Accordingly, we should not be overly sanguine about the potential for either government intervention or the uncoordinated forces of technological disruption to yield socially desirable network infrastructure. Nevertheless, the hallmark of good network governance is that it is responsive to these challenges and that it ensures that new technology is harnessed for the public good.

The United States has at best a mixed record when it comes to payment network governance. While the reasons for this are complex and contested, two in particular stand out. First, the U.S. is home to more than 9,000 banks and other insured depository institutions.[15] These institutions come in all shapes and sizes: from global behemoths like JPMorgan, Bank of America, and Citigroup to the smallest community banks. Reflecting this diversity, the U.S. is also home to a growing number of payment networks that cater to different types of financial institutions and transactions.[16] This uniquely large, fragmented, and diverse financial system generates acute conflicts of interest that sometimes stand in the way of effective coordination and investment in the development of new payment networks and the adoption of new technology. Second, the U.S. has made a series of increasingly anachronistic policy choices around the role of the Federal Reserve System as both payment network operator and regulator,[17] the imposition of restrictions on network access for financial institutions other than banks,[18] the introduction of a real-time payments,[19] and other key technological and operational network features.

While some of these policy decisions have arguably bolstered the stability of the U.S. financial system, they have also come with significant and growing costs. Perhaps most importantly, despite its reputation as a world leader in both finance and technology, the U.S.

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[15] *See* Federal Deposit Insurance Corporation (FDIC), Annual Historical Banking Data (2024), https://banks.data.fdic.gov (reporting 4,036 commercial banks and 563 savings institutions operating in the U.S. as of 2023); National Credit Union Administration, Quarterly Credit Union Data Summary Q1 2024, https://ncua.gov/analysis/credit-union-corporate-call-report-data/quarterly-data-summary-reports (reporting 4,572 credit unions operating in the U.S. as of the first quarter of 2024).

[16] *See* Part II.A for a more detailed description of the major U.S. payment networks.

[17] *See* Aaron Klein, *Structural Conflicts in Central Banking: Regulator or Operator of a Payment System?*, BROOKINGS INSTITUTION RESEARCH PAPER (Nov. 9, 2023), https://www.brookings.edu/articles/structural-conflicts-in-central-banking-regulator-or-operator-of-a-payment-system/.

[18] *See* Julie Hill, *Opening a Federal Reserve Master Account*, 40 YALE J. ON REG. 453 (2023); *see also* Compliant, *Custodia Bank, Inc.* v. *Federal Reserve Board of Governors and the Federal Reserve Bank of Kansas City*, Case 1:22-cv-00125-SWS (filed June 7, 2022).

[19] *See* John Heltman, *Is FedNow a Mistake?*, *AMERICAN BANKER* (Aug. 30, 2022). (describing some of the problems with the Federal Reserve's recently launched real-time payment network). *See* Part III.C more a more detailed description of FedNow and the problems with its design.

is now widely viewed as a global laggard in the adoption of new payment technology.[20] The U.S. also has a relatively large unbanked and underbanked population—especially in comparison with other highly developed countries.[21] And as painfully exposed by the Covid pandemic, U.S. payment networks are still a long way from becoming an effective vehicle for the delivery of public benefits.[22] As we shall see, payment network governance is both an important part of the problem and critical to building safer, faster, more convenient, and more accessible payment networks.

This Article proceeds in three parts. Part I describes the importance of stability, access, and investment in the development of modern payment networks, along with the complex tradeoffs between these critical network features. Part II explores these tradeoffs in greater detail through the lens of three case studies: the domestic U.S. payment system, the global correspondent banking system, and the emerging crypto ecosystem. Part III examines the critical role of network governance in navigating these tradeoffs and describes the set of tools that policymakers need to promote a level playing field, coordinate the development and adoption of new payment technology, and ensure that the resulting network infrastructure serves to advance the public good.

I. PAYMENT NETWORK STABILITY, ACCESS, AND INVESTMENT

Payment systems are vital financial market infrastructure: sprawling electronic networks that connect hundreds of millions of households, businesses, and governments across the country and around the world.[23] Like roads, bridges, electric power grids, and the internet, the structure and economic function of these systems mean that they bear all the

[20] Compare for example FDIC, How America Banks: Household Use of Banking and Financial Services (2019), https://www.fdic.gov/analysis/household-survey/2019report.pdf (reporting that 34 percent of survey respondents in the U.S. used mobile banking), with Statista, Online Banking Penetration in Great Britain from 2007 to 2020 (Aug. 2020), https://www.statista.com/statistics/286273/internet-banking-penetration-in-great-britain/ (reporting that 73 percent of households in the United Kingdom used mobile banking as of 2019). *See also* Kathleen Elkins, *Why It Took the US So Long to Adopt the Credit Card Technology Europe Has Used for Years*, BUSINESS INSIDER (Sept. 27, 2015), https://www.businessinsider.com/why-it-took-the-us-so-long-to-adopt-emv-2015-9; Susan Pandy, "Developments in Open Banking and APIs: Where Does the U.S. Stand?," Federal Reserve Bank of Boston Brief (Mar. 17, 2020) (describing the status of open banking initiatives in the U.S. relative to Singapore, Hong Kong, China, Japan, Australia, and New Zealand); Katie Robertson, *Why Can't Americans Ditch Checks?*, *BLOOMBERG BUSINESS* (Jul. 26, 2017), https://www.bloomberg.com/news/articles/2017-07-26/why-can-t-americans-give-up-paper-checks.

[21] Although more recently the U.S. has also made some significant strides in reducing the number of unbanked households; see FDIC, How America Banks: Household Use of Banking and Financial Services (2021), https://www.fdic.gov/analysis/household-survey/index.html.

[22] *See* Government Accountability Office, Unemployment Insurance: Transformation Needed to Address Program Design, Infrastructure, and Integrity Risks, GAO-22-105162 (Jun. 7, 2022), https://www.gao.gov/products/gao-22-105162 (reporting an increase in payment delays, payment errors, and fraud in the delivery of employment benefits during the Covid pandemic).

[23] For a detailed treatment of payment systems as network utilities, see RICKS, SITARAMAN, WELTON & MENAND, *supra* note __, chapter 17.

fundamental hallmarks of a network utility. Policymakers pursue three important objectives in the context of network utility regulation.[24] The first is network *stability*. Reflecting their dual status as both technological and financial networks, the stability of a payment system can be understood in two distinct, yet overlapping, ways. From a technological standpoint, the stability of a payment network is a function of whether it provides a safe, secure, and reliable means of transferring money or other financial assets.[25] It is also a function of whether a network is vulnerable to exploitation as a conduit for money laundering, terrorist financing, or other illicit activities. From a financial standpoint, meanwhile, stability is a function of whether a payment network is resilient in the face of both idiosyncratic and systemic threats to its liquidity and solvency.

The second policy objective revolves around network *access*.[26] Like stability, access in this context can be understood in two distinct ways. First, in the context of the centralized "hub-and-spoke" networks that characterize most modern payment networks (*see* Figure 1), network access is a function of the prevailing legal, technological, and other barriers to entry imposed on the *financial intermediaries* through which households and businesses make payments. Viewed from this first perspective, network access is an important determinant of the prevailing level of industry competition. Second, in the context of decentralized "web-based" networks, access is a function of the ease with which *end users*—i.e. households and businesses themselves—can directly connect to and use these networks. Viewed from this second perspective, network access is an important determinant of financial inclusion. Whereas low barriers to entry for financial intermediaries, households, and businesses are synonymous with "open" access, high barriers to entry are synonymous with "closed" access.

[24] *Id.*, at 21-28 (identifying "robust and resilient systems" (*stability*), "curbing monopoly abuses" and "promoting access," (*access*) and preventing "subpar service quality" (*underinvestment*) and "destructive competition" (*overinvestment*) as important policy objectives in the context of network utility regulation).

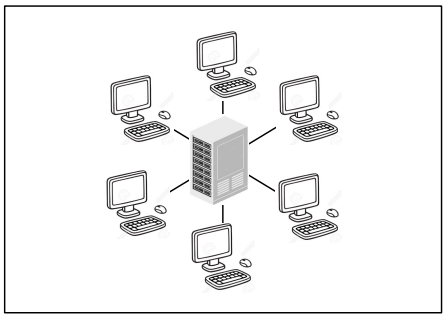
[25] For recent statements from senior policymakers on the importance of stability in payment networks, see Lael Brainard, The Digitalization of Payments and Currency: Some Issues for Consideration, Speech at the Symposium on the Future of Payments, Stanford, California (Feb. 5, 2020) (highlighting the need for investment in national payments infrastructure that was "safe as well as efficient and fast."); Kristalina Georgieva, Four Cornerstones of Payments in the Digital Age, Speech at the (Virtual) Singapore FinTech Festival 2020 (Dec. 11, 2020) (stating that payment networks must remain safe and resilient).

[26] *See e.g.* White House, Executive Order on Ensuring Responsible Development of Digital Assets, E.O. 14067 (Mar. 9, 2022); Georgieva, *supra* note __ (identifying as a key policy goal "provid[ing] access to financial services for 1.7 billion adults who are still unbanked. And help many more vulnerable people who are currently paying high fees.")

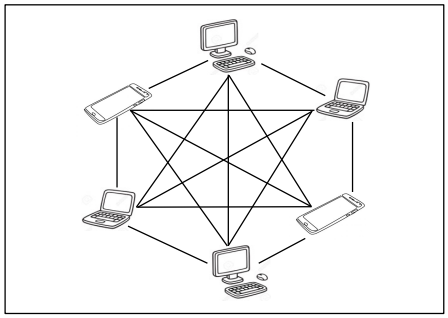
Figure 1

Basic Network Models

A "Hub-and-Spoke" Network



A "Web-based" Network



The third objective is *investment*. Designing, building, and maintaining secure, reliable, resilient, and widely accessible payment networks and other financial market infrastructure demands enormous initial and ongoing investments of financial, human, and other capital.[27] Over the longer term, it also demands investments in the development and adoption of new technologies designed to improve the quality of the products and services these networks provide. In theory, these investments can be made by the private sector, the public sector, or some combination of the two. What is important is that these investment are actually made, that they target the right network infrastructure projects, and that projects ultimately advance socially desirable policy objectives.

Together, stability, access, and investment are key to building a successful payment network. The challenge for policymakers is that simultaneously promoting all three of these critical network features requires them to navigate a series of important, complex, and often unavoidable tradeoffs. Let's start with the tradeoff between stability and investment. In order to promote the stability of conventional hub-and-spoke payment networks, policymakers must ensure that the financial intermediaries that own, control, or connect to these networks are adequately protected against risks to their microprudential safety and soundness. This typically involves establishing a legally defined perimeter around the types of intermediaries to which access will be granted, and then subjecting them to burdensome prudential regulation and supervision.[28] To further promote their safety and soundness, these financial intermediaries

[27] *See e.g.* White House, Executive Order on Digital Assets, *supra* note __ ("The United States has a strong interest in promoting responsible innovation that expands equitable access to financial services, particularly for those Americans underserved by the traditional banking system, including by making investments and domestic and cross-border funds transfers and payments cheaper, faster, and safer, and by promoting greater and more cost-efficient access to financial products and services."); Georgieva, *supra* note __ (highlighting the need for public and private investment in payment networks).

[28] *See* JOHN ARMOUR, DAN AWREY, PAUL DAVIES, LUCA ENRIQUES, JEFFREY N. GORDON, COLIN MAYER & JENNIFER PAYNE, *PRINCIPLES OF FINANCIAL REGULATION* (2016), chapters 13-17; MICHAEL BARR, HOWELL JACKSON & MARGARET TAHYAR, *FINANCIAL REGULATION: LAW AND POLICY* (2021), chapters 2.1-2.7.

are also typically provided with access to central bank emergency lending facilities and other forms of state support designed to ensure that short-term liquidity problems do not prevent them from meeting their obligations to other network participants.[29]

The tradeoff in this context arises from the fact that the combination of closed access, burdensome regulation, and state support necessary to promote financial stability also creates high and potentially insurmountable barriers to new market entry.[30] Where these barriers insulate incumbent financial intermediaries from competition, the effect will be to weaken their incentives to make the technological and other investments necessary to build, maintain, and upgrade the payments infrastructure to which they enjoy privileged access. These incentives problems are often compounded by the strong economies of scale and network effects associated with modern payment networks. Economies of scale exist when the average unit cost of producing a product or service decreases as production increases.[31] Thus for example, once a new payment network has been built, the marginal cost of processing each additional payment is typically relatively small, with the result that the average cost of each payment decreases as more payments are cleared and settled through the network. These economies of scale are often accompanied by large network effects: with each new network user increasing the value of the network for existing users.[32] These network effects are reflected in the fact that, all other things being equal, households and businesses would prefer to use the payment networks that enable them to transact with the largest population of other households and businesses.

Together with the high barriers to entry erected by prudential regulation, these economies of scale and network effects understandably weaken the incentives of aspiring new entrants to invest in the development of faster, safer, cheaper, or more efficient payment technologies and networks. Put bluntly: if there is ultimately little hope of winning—even by providing technologically superior products and services—many of these potential new entrants may rationally decide not to play the game. And in absence of a credible threat of new entry, incumbents financial intermediaries and network operators will often have little reason to make significant new investments in network infrastructure. We will return to this tradeoff in Parts II.A and II.C when we explore the drivers of chronic underinvestment in the technological infrastructure supporting both the domestic U.S. payment system and global correspondent banking system.

The second tradeoff is between network access and stability. In the absence of a well-defined regulatory perimeter and strong prudential regulation, new entrants will face relatively

[29] *Id.*

[30] *See* George Stigler, *The Theory of Economic Regulation*, 2:1 BELL J. OF ECON. AND MGMT. SCIENCE 3, 13-14 (1971) (describing how the creation of a regulatory perimeter and the imposition of burdensome regulation can erect high barriers to entry).

[31] *See* ROBERT FRANK, BEN BERNANKE, KATE ANTONOVICS & ORI HEFFETZ, *PRINCIPLES OF ECONOMICS* 32-33 (2019).

[32] *See* Paul Klemperer, *Network Goods (Theory)*, in STEVEN DURLAUF & LAWRENCE BLUME (EDS.), *THE NEW PALGRAVE DICTIONARY OF ECONOMICS* 915 (2d. ed., 2018).

few barriers to entry. In the short term, this is likely to spur investment in new payment technologies and networks. In fact, given the winner-take-all dynamics in industries characterized by pronounced economies of scale and network effects, it is likely spur *over*investment as rival firms compete not only *in* but ultimately *for* the market.[33] Yet over the longer term, these same economies of scale and network effects, along with the resulting tendency toward natural monopoly, are likely to result in a new equilibrium in which the market is dominated by a small number of large networks.[34] As we move toward this equilibrium, we would also expect to observe many smaller networks struggle to achieve sufficient adoption and, ultimately, fail. In the absence of strong prudential regulation, these correlated network failures can pose a threat to the stability of the wider financial system. We will return to this tradeoff in Part II.B when we explore how it has played out in the context of the emerging crypto payment system.

The third and final tradeoff is between network access and investment. In the presence of a well-defined regulatory perimeter and strong prudential regulation, it becomes possible for policymakers to subsidize investment in network infrastructure. However, successful subsidization requires policymakers to make a choice about the type of access and investment they want to encourage. If policymakers want to encourage *private* investment, they will likely have to limit network access and then impose an affirmative obligation—a *public mandate*—on the financial intermediaries to which access is granted that requires these intermediaries to make ongoing investments in network development, maintenance, and upgrades. In theory, this mandate could also expressly require these intermediaries to advance other policy objectives like financial inclusion. In effect, closed access serves as both a valuable carrot—with insulation from competition representing a subsidy for incumbent network participants—and the stick by which policymakers effectively target and enforce the obligation to make ongoing investments in network infrastructure.

Conversely, if policymakers want to promote open access, this will often require direct *public investment* in new payment networks and infrastructure. Reflecting the low barriers to entry and potential flood of new entrants associated with open access, these investments are likely to include significant public sector involvement in technical standard setting and the coordination of private investment in order to ensure sufficient interoperability, capture economies of scale and network effects, and, thereby, prevent a destructive winner-takes-all race to build new and potentially duplicative network infrastructure. Where open access leads to market fragmentation and potential underinvestment in common network infrastructure, policymakers may also be forced to make more significant, longer term, and direct investments in actually building, maintaining, operating, and upgrading payment networks.

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[33] *See* Michael Kades & Fiona Scott Morton, *Interoperability as a Competition Remedy for Digital Networks,* Wash. Ctr. For Equitable Growth 1 (Sept. 2020), https://equitablegrowth.org/working-papers/interoperability-as-a-competition-remedy-for-digital-networks ("[T]he competition that matters most is often for the market not within the market. Anticompetitive conduct is more likely to succeed. And the harm to consumers is greater because the market tends to be winner-take-all, or most…").

[34] *See* Josh Macey & Dan Awrey, *Open Access, Interoperability, and the DTCC's Unexpected Path to Monopoly*, 132 YALE L. J. 1 (2022) (describing the role of economies of scale and network effects in determining the industry structure of securities clearinghouses, depositories, and other financial market infrastructure).

These tradeoffs between network stability, access, and investment are not a complete representation of the choices that policymakers face. Regulatory objectives vary from jurisdiction to jurisdiction and can be pursued in different ways. The advancement of these objectives should also be measured on a spectrum, opening the door to incremental tradeoffs that are not fully captured by this tripartite framework. Nevertheless, this framework can help us understand the tradeoffs that policymakers confront when tackling the increasingly complex challenges associated with the design, regulation, and governance of modern payment networks.

In advancing this framework, we also do not seek to place network stability, access, and investment at the top of the list of objectives that policymakers can or should pursue. Nor are we arguing that greater competition and technological innovation will inevitably yield significant benefits for consumers, for network participants, or for the stability of the wider financial system. Ultimately, competition and innovation are only ever means to other, more important, ends. Nevertheless, policy choices around network access, stability, and investment are necessary if not sufficient conditions—critical determinants of the emergence, development, and evolution of successful payment networks. What matters is that policymakers understand these tradeoffs, along with their implications for financial stability, consumer welfare, financial inclusion, and other policy objectives. As we explore in Part III, this highlights the critical role of payment network governance in both navigating these tradeoffs and harnessing new technology in pursuit of the public good.

II. THE TRADEOFFS IN ACTION

This part explores three case studies that illuminate the nature and importance of the tradeoffs between network stability, access, and investment. The first examines the domestic U.S. payment system, where tightly controlled network access and strict prudential regulation have contributed to private underinvestment in new payments technology. The second examines the still emergent but rapidly evolving crypto ecosystem, where largely unfettered access has both contributed to an influx of new investment and planted the seeds of future instability. The last case study examines the global correspondent banking system, where the fragmentation of control over network stability, access, and investment poses unique challenges for the development of financial market infrastructure. In many ways, these case studies are very different. What they all share in common is the absence of effective governance mechanisms that would have helped network architects, financial intermediaries, and policymakers better navigate these complex and thorny tradeoffs.

A. The Domestic U.S. Payment System

It is almost impossible to overstate how important banks are within the current U.S. payment system. As a starting point, banks are far and away the largest source of money: with demand, savings, time, and other bank deposits currently representing over 90 percent of the

total money supply—or roughly $17.2 trillion.[35] Banks are also the primary owners, gatekeepers, and custodians of a vast electronic payments infrastructure that moves this money across the economy. To process these payments, banks have created, own, and control a patchwork of clearinghouses and other financial market utilities or FMUs (*see* Figure 2).[36] Every day, these bank-owned FMUs process trillions of dollars in payments to households, businesses, and governments.[37] Yet while this system may seem perfectly natural—indeed, no American alive today has ever known anything else—it is actually the product of deeply entrenched and self-reinforcing legal, institutional, and technological path dependencies. It is also a policy choice— one that comes with enormous and often poorly understood costs.

In order to promote the stability of this intertwined system of banking, money, and payments, Congress has created a unique financial safety net that enables banks to perform their critically important functions during periods of severe institutional and systemic stress. This safety net includes the Federal Deposit Insurance Corporation (FDIC) deposit insurance scheme, a special resolution regime for failing banks, and a growing collection of emergency lending or "lender of last resort" facilities.[38] To combat the resulting moral hazard problems, banks are then subject to a complex and costly regulatory framework that includes mandatory chartering, capital and liquidity requirements, portfolio and activity restrictions, and intensive prudential supervision.[39] Banks are also required to design and implement systems, processes, and controls that prevent them from becoming unwitting accomplices to money laundering and terrorist financing.[40] Compliance with this far-reaching and constantly expanding regulatory framework can be very costly. While reliable data is scarce, it has been estimated that the largest U.S. banks can each spend over $1 billion per year on regulatory compliance.[41]

[35] *See* Federal Reserve Bank of St. Louis, Money Stock Measures – H.6 (March 2024), reporting bank M2 (deposits minus currency in circulation) of $18.642 trillion, total reserve balances of $3.543 trillion, and currency in circulation of $2.340 trillion).

[36] The major private clearing networks in the U.S. are the Clearinghouse Interbank Payments System (CHIPS), Automated Clearing House (ACH) Network, Electronic Payments Network (EPN), and Real-Time Processing (RTP). *See* Figure 2 for additional information about these clearing networks.

[37] CHIPS alone clears and settles on average $1.8 trillion of domestic and international payments per day; *see* The Clearing House, *About CHIPS*, https://www.theclearinghouse.org/payment-systems/chips.

[38] For a more detailed description of this safety net, *see* ARMOUR, ET. AL., *PRINCIPLES*, *supra* note __; BARR, JACKSON & TAHYAR, LAW AND POLICY, *supra* note __, chapters 2.4 and 9.1-9.3.

[39] *Id.*

[40] *See* Federal Financial Institutions Examination Council, Bank Secrecy Act/Anti-Money Laundering Compliance Manual (2023), https://bookstore.gpo.gov/products/bank-secrecy-actanti-money-laundering-examination-manual.

[41] *See* Peter Farley, *Spotlight on Compliance Costs as Banks Get Down to Business with AI*, *INT'L BANKER* (Jul. 4, 2017).

And at the other end of the spectrum, compliance costs are also a significant component of the operating budgets for many smaller community banks.[42]

Figure 2

Major U.S. Payment Networks

Name	Est.	Ownership	Membership	Other Key Features
Fedwire	1918	Public	Approximately 5,500 deposit-taking institutions	• Large-value interbank clearing and settlement system • Real-time gross settlement via member accounts at the Federal Reserve • Operates 21.5 hours/day, business days only
CHIPS	1970	Private	48 member banks	• Large-value interbank clearing and settlement system • Deferred net settlement funded via transfers from Fedwire
FedACH	1981	Public	Approximately 5,500 deposit-taking institutions	• Small-value interbank clearing system • Deferred net settlement via member accounts at the Federal Reserve
EPN	1981	Private	Approximately 450 deposit-taking institutions	• Small-value interbank clearing system • Deferred net settlement via member accounts at the Federal Reserve
RTP	2017	Private	Approximately 350 member banks	• Small-value interbank clearing and settlement system • Real-time gross settlement via a joint account held by members at the Federal Reserve • Operates 24 hours/day, seven days a week
FedNow	2023	Public	Approximately 500 banks	• Small-value interbank clearing system • Real-time gross settlement via member accounts at the Federal Reserve

Source: Federal Reserve System and The Clearing House

Importantly, compliance with this complex and costly regulatory framework comes with an important and exclusive advantage: *access*. Pursuant to Section 13(1) of the Federal Reserve Act, this access takes the form of eligibility to open what is known as a "master account" with one of the Federal Reserve System's twelve regional reserve banks.[43] These master accounts enable banks to discharge their payment obligations toward one another using the Federal Reserve's own deposit liabilities—known as "reserve balances"—as the ultimate

[42] For example, a 2016 survey conducted by the Federal Reserve Bank of St. Louis found that, on average, 8.7 percent of the non-interest expenses of banks with under $100 million in assets go toward regulatory compliance; *see* Drew Dahl, Andrew Meyer & Michelle Clark Neeley, "Scale Matters: Community Banks and Compliance Costs," Federal Reserve Bank of St. Louis (Jul. 14, 2016).

[43] *See* 12 U.S. Code §§ 342, 461, 1813. A limited number of public institutions, including the U.S. Treasury Department, are also expressly permitted to open master accounts; see Federal Reserve Board, Federal Reserve Banks Operating Circular 1: Account Relationships (2013), https://www.frbservices.org/assets/resources/rules-regulations/020113-operating-circular-1. pdf; Federal Reserve Board, Guidelines for Evaluating Account and Service Requests (Aug. 15, 2022), https://www.federalreserve.gov/newsevents/pressreleases/files/other20220815a1.pdf.

risk-free settlement asset. Compounding this advantage, these master accounts are also a legal and operational pre-condition for full membership in each of the major clearinghouses and other FMUs.[44] Accordingly, whereas banks are permitted to settle their payments directly on the balance sheet of the Federal Reserve, the rest of us are forced to transact through banks as the gatekeepers of the conventional payment system.

Predictably, the combination of rigorous chartering requirements, high regulatory compliance costs, and legal restrictions on access to network infrastructure erect significant barriers to new market entry. These barriers are exacerbated by the pronounced economies of scale and network effects that have long characterized the markets for both money and payments.[45] In the case of payments, these scale and network effects reflect, among other things, the high *initial* costs of designing and building the necessary technological and operational infrastructure, along with the relatively low *marginal* costs of adding new network participants and processing each additional payment once this infrastructure has been built. Together, these scale and network effects help explain the highly concentrated structure of the conventional U.S. payment system. In fact, despite being home to over 9,000 banks and other insured depository institutions, over 75 percent of total of payments by dollar value currently flow through just 15 systemically important banks.[46] These same banks are also responsible for well over half of the total deposits currently held within the entire U.S. banking system.[47]

This concentration of deposits and payment flows presents these large banks with a wealth of profit-making opportunities. One of the oldest and at times most lucrative opportunities involves investing the funds that banks receive in connection with inbound payments—commonly known as the "float"—in the period before these funds are credited to their customers' accounts.[48] Thus for example, subject to applicable law, if a bank receives a

[44] *See* Awrey, *Unbundling*, *supra* note __, 744-748.

[45] In effect, these economies of scale and network effects enable banks to amortize their initial fixed costs of building payment infrastructure across a larger number of users and payments. For research examining economies of scale in payment systems, *see* Christine Beijnen & Wilco Bolt, *Size Matters: Economies of Scale in European Payments Processing*, 33 J. OF BANKING AND FIN. 203 (2009); Wilco Bolt & David Humphrey, *Payment Network Scale Economies, SEPA, and Cash Replacement*, 6 REV. OF NETWORK ECON. 453 (2007); Robert Adams, Paul Bauer & Robin Sickles, *Scope and Scale Economies in Federal Reserve Payment Processing*, Federal Reserve Bank of Cleveland Working Paper 02-13 (November 2002). For research examining network effects in payment systems, see Sujit Chakravorti & Roberto Roson, *Platform Competition in Two-Sided Markets: The Case of Payment Networks*, 5:1 REV. OF NETWORK ECON. 118 (2006); Alistair Milne, *What Is In It For Us? Network Effects and Bank Payment Innovation*, 30:6 Journal of Banking and Finance 1613 (2006); James McAndrews, *Network Issues and Payment Systems*, Federal Reserve Bank of Philadelphia Business Review 15 (November/December 1997).

[46] *See* Gara Afonso, Darrell Duffie, Lorenzo Rigon & Hyun Song Shin, *How Abundant Are Reserves? Evidence From the Wholesale Payment System*, Federal Reserve Bank of New York Staff Report No. 1040, 7-8 (November 2022).

[47] *See* FDIC Banking Data, http://www.banks.data.fdic/gov (reporting the total deposits for every U.S. bank as of March 31, 2023).

[48] Even where banks provisionally credited customer accounts, they would still typically put a "hold" on the funds until the conclusion of the check clearing process. The practical effect was the same either way: customers could not access the relevant funds.

check payable to one of its customers on Monday, it can theoretically invest the funds in interest bearing assets like U.S. Treasury securities or other money market instruments before eventually clearing the check on Friday, at which point the funds will be made available to the intended recipient. By waiting until Friday to clear the check, the bank can thus capture any interest payable on these assets over the course of the business week. As this example makes clear, the ability of the bank to capitalize on this float opportunity is a joint function of the *volume* of inbound payments, the length of *time* between when the bank receives payments and when it credits the funds to customer accounts, and the prevailing *interest rates* within short-term money markets.

Not surprisingly, the issue of when and how profitably banks invest the float first entered the public spotlight during the extremely high interest rate environment of the early 1980s.[49] As short-term interest rates soared well into the double digits, a study conducted by the Federal Reserve reported that banks were taking an average of between 7-9 days to clear checks written by the customers of other banks located within the same state, and between 10-12 days for banks located in other states.[50] *The Washington Post* reported that some customers were even being told by their banks that they would be required to wait up to 20 business days before they could access their money.[51] Adding insult to injury, the average length of these processing delays had increased in parallel with the rise in prevailing interest rates.[52]

These lengthy check processing delays eventually caught the attention of Senators John Chaffee and Chris Dodd, who convened a series of hearings before the Senate Banking, Housing, and Urban Affairs Committee to explore the issue.[53] At the hearings, Senator Dodd speculated that these delays enabled banks to generate as much as $1 billion a day by investing the float.[54] The banks pushed back that these delays were necessary to limit potential losses from fraud and bounced checks.[55] For its part, a witness for the Federal Reserve Board testified that the central bank did "not consider the problems sufficiently widespread at this time to require federal legislation or regulation."[56] Undeterred, a succession of bills were subsequently

[49] The issue was covered widely in the national press. *See e.g. Nancy Ross, Check Float: Do Not Pass Go, Do Not Collect…*, *THE WASHINGTON POST* (Oct. 19, 1980); Editorial, *Why Hold Checks Hostage?*, *THE NEW YORK TIMES* (Oct. 4, 1982); Peter Kerr, *Clearing Checks: Waiting Time Varies*, *THE NEW YORK TIMES* (Apr. 2, 1983). For contemporaneous scholarly work on the issue, see e.g. Emma Coleman Jordan, *Ending the Float Check Game: The Policy Arguments for Delayed Availability Reform*, 36 HASTINGS L. REV. 515 (1985); Michael Delohery, *Bank Check-Hold Policies: A Proposal to Protect Consumers*, 14 NOTRE DAME J. OF LEG. 53 (1987).

[50] *See* Ross, *Do Not Pass Go*, *supra* note __.

[51] *Id.*

[52] *Id.*

[53] *See* Delayed Funds Availability: Hearing Before the Subcomm. on Consumer Affairs of the Senate Comm. on Banking, Housing, and Urban Affairs, 97th Cong., 2d Sess. (1982).

[54] *See* Jay Rosenstein, *Two Senators Say Banks Hold Check Funds Too Long; Charge Float Abuse is Costly to Consumers*, *AMERICAN BANKER* (Mar. 11, 1982).

[55] *Id.*

[56] *Id.*

introduced in Congress, eventually leading to the enactment of the Expedited Funds Availability Act of 1987 (EFAA).[57]

The key provisions of the EFAA required banks to disclose their funds availability policy to customers, and then to pay interest to customers starting on the same business day that their bank received the relevant funds. Crucially, the EFAA also established a complex schedule of maximum timeframes within which banks were required to make funds available to their customers. These timeframes depended on whether a payment was made using a "local check," a "nonlocal check," or if the check could be considered "low risk." For these purposes, a low risk check included one that (i) was issued by either the U.S. Treasury, or a state or local government in the same state as the intended recipient or (ii) took the form of a wire transfer, cashier's check, certified check, in-bank payment, or other instrument that effectively posed no risk of fraud or non-payment to the receiving bank. Whereas the statutory schedule required low risk payments to be made available to customers the next business day, local checks were to be made available in two business days, and nonlocal checks five business days after they were deposited.[58]

The EFAA was a step in the right direction. Yet by no means did it completely eliminate the powerful incentives that banks possessed to generate revenue from the float. Nor did it eliminate the incentives of their customers to find novel ways of ensuring that the checks they received were deposited and credited to their accounts as quickly as possible and, conversely, that the checks they wrote took the longest possible route on their journey to the recipient's bank account.[59] The resulting "float game" was reinforced by the fact that the EFAA funds availability clock only started ticking once a bank *physically* received a check. Customers would thus draw checks on banks headquartered in remote locations in order to buy themselves a few extra days before they were cashed. Large corporations receiving these checks would then spend small fortunes chartering fleets of private jets to deliver bundles of them—often weighing thousands of pounds and collectively worth billions of dollars—directly to banks across the country.[60] One New York bank, eager to capture the float revenue over the Memorial Day long weekend, even sent an employee on a last-minute commercial flight to Chicago to hand deliver $100 million worth of checks.[61] As an executive for the bank explained: "A day's worth of interest on $100 million was $23,000. The plane ticket, hotel room, and meals were about $500."[62]

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[57] Pub. L. No. 100-86, 101 Stat. 552, § 601 (1987).

[58] For a more detailed description and critical evaluation of the EFAA, see Robert Cooter & Edward Rubin, *Orders and Incentives as Regulatory Methods: The Expedited Funds Availability Act of 1987*, 35 UCLA L. REV. 1115 (1987).

[59] *See generally*, Hal Scott, "Float" [working paper on file with authors].

[60] *See* Fred Bleakley, *Electronic Payments Now Supplant Checks At More Large Firms*, *WALL STREET JOURNAL* (Apr. 13, 1994).

[61] *See* Nicholas Kristof, *Squeezing Profits From Float*, *THE NEW YORK TIMES* (May 27, 1985).

[62] *Id.*

This float game was costly, inefficient and, as a practical matter, could only be played by big banks and their large corporate customers. It also became increasingly less profitable for banks as interest rates declined during the late 1980s and early 1990s.[63] Over the next two decades, the development of remote deposit capture technology also made it possible for customers to take an electronic image of any checks they received, and to then send these images directly to their bank via the internet for clearing and settlement. In order to capitalize on the potential efficiency benefits of this new technology, Congress passed the Check Clearing for the 21st Century Act[64] in 2003, permitting banks to accept these images in lieu of paper checks. The practical effect of the Act was to make all checks deposited using remote deposit capture technology "local" checks for the purposes of the EFAA, thereby requiring banks to credit the customer's account within two business days.[65] While industry data should be taken with a grain of salt, a survey of over 1,000 U.S. consumers conducted in July 2022 suggests that over one third of Americans deposited one or more checks using this technology over the course of the preceding year.[66]

The policy response to the global financial crisis provided big banks with a new source of potential float revenue. In the wake of the crisis, the Federal Reserve shifted from a *scarce-reserves* regime—in which aggregative reserve balances were relatively low and actively traded between banks in what is known as the "fed funds" market—to an *ample-reserves* regime in which the Fed uses its monetary policy and other tools to encourage banks to hold reserve balances significantly exceeding their short-term liquidity needs. These tools include paying interest on excess reserves (IOER) held by banks in their master accounts.[67] This shift was a consequence of the large-scale asset purchases conducted by the Federal Reserve in order to reduce interest rates and stimulate the economy in the aftermath of the crisis.[68] Whereas total reserves under the scarce-reserves regime typically measured in the tens of billions, total reserves under the ample-reserves regime stood at almost $3.4 *trillion* as of May 2024.[69] And perhaps not surprisingly, the same 15 banks that are responsible for roughly three quarters of

[63] Although even then banks increasingly turned to technological and operational solutions designed to maximize float revenue; see Karen Gullo, *Float Management Yields Big Returns Despite Low Rates*, *AMERICAN BANKER* (Apr. 17, 1991).

[64] Pub. L. No. 108-100, 117 Stat. § 1177 et seq. (October 28, 2003) (the "Check21 Act").

[65] *See* Federal Reserve Board, Regulation CC, Availability of Funds and Collection of Checks, https://www.federalreserve.gov/paymentsystems/regcc-about.htm.

[66] *See* Cornerstone Advisors & Mitek Systems, Mobile Deposit Benchmark Report (2022), https://www.miteksystems.com/blog/2022-mobile-deposit-benchmark-report (finding that 53 percent of the 88 percent of Americans that use smartphones or tablets also used remote deposit capture technology).

[67] *See* Federal Reserve Regulation D, Reserve Requirements of Depository Institutions, 12 C.F.R. Part 204. The Federal Reserve was given the power to pay interest on reserve balances pursuant to the Financial Services Regulatory Relief Act of 2006, Pub. L. No. 109-351, 120 Stat. 1966 (Oct. 13, 2006).

[68] *See* Joseph Gagnon, Matthew Raskin, Julie Remache & Brian Sack, *Large-Scale Asset Purchases by the Federal Reserve: Did They Work?*, 17 Federal Reserve Bank of New York Economic Policy Review 41 (May 2011).

[69] *See* Federal Reserve Bank of St. Louis, FRED Data, Monetary Base; Reserve Balances (BOGMBBM) (May 2024), https://fred.stlouisfed.org/series/BOGMBBM.

all payments also hold approximately 40 percent of the total outstanding reserve balances within the U.S. banking system.[70]

Under the Fed's old scarce-reserves regime, banks relied heavily on inbound payments to supply the reserve balances necessary to fund outbound payments to other banks. Where banks anticipated a shortfall, they would then borrow reserve balances from other banks in the fed funds market. However, given the high costs of borrowing in this market, and conversely the potential revenue from lending out excess reserves, banks had powerful incentives to conserve scarce liquidity: creating strong dependence between inbound and outbound payments. This dependence can be measured using what is known as a "payment reaction function" that estimates the extent to which a marginal increase in the volume of inbound payments over a given timeframe translates into a corresponding increase in the volume of outbound payments. Predictably, this payment reaction function was relatively high under the scarce-reserves regime, reflecting the critical importance of inbound payments as a means of replenishing a bank's reserve balances, thereby enabling it to honor its financial commitments to other banks.[71]

In theory, this payment reaction function should look different under the new ample-reserves regime. Specifically, we should expect to observe a relatively low payment reaction function, reflecting the fact that banks holding large reserve balances no longer need to rely on inbound payments as a source of short-term liquidity. However, this theoretical expectation has been confounded by recent empirical work conducted by researchers at the Federal Reserve Bank of New York. This research has found that—even in the new era of ample reserves—there remains a stubbornly high degree of dependence between inbound and outbound payments.[72] Equally important, the findings suggest that the payment reaction function is still far from one-to-one for banks holding large reserve balances: consistent with the existence of an ongoing temporal lag between inbound and outbound payments.[73] Put simply, these banks are receiving payments faster than they are making them. All of which begs a trillion dollar question: what exactly are banks doing with these supposedly "ample" reserves?

While there is no single answer to this question, it appears that at least some of these reserve balances—including the reserves that only exist by virtue of the temporal lag between inbound and outbound payments—are being redirected by banks into profitable investments. These investment opportunities stem from two principal sources. First, beginning in mid-2018, overnight interest rates in the short-term U.S. dollar repurchase agreement—or

[70] Duffie et al., *supra* note __, at 7.

[71] *See* Gara Afonso & Hyun Song Shin, *Precautionary Demand and Liquidity in Payment Systems*, 43:2 J. OF MONEY, CREDIT AND BANKING 589 (2011*);* James McAndrews & Simon Potter, *Liquidity Effects of the Events of September 11, 2001*, 8:2 Economic Policy Review 59 (2002); James Hamilton, *Measuring the Liquidity Effect*, 87 AM. ECON. REV. 80 (1997).

[72] Duffie et al., *supra* note __.

[73] For example, the authors find that a 1 percent increase in inbound payments over the prior 15 minutes translates into a 0.4 percent increase in outbound payments over the next minute; *id.*, 13 and 21.

"repo"—market increased above the interest that the Federal Reserve paid banks on their excess reserve balances.[74] Whereas U.S. banks had previously been net *borrowers* within the repo market, the emergence of this arbitrage opportunity was followed by a pronounced shift: with these banks quickly becoming important net *lenders* within this market.[75] This shift was led by the big four banks which, by mid-2019, had collectively amassed a net lending position of over $300 billion.[76] Second, for large bank holding companies (BHCs) like JPMorgan and Goldman Sachs, banks are increasingly using their excess reserves to lend money to their affiliated broker-dealers.[77] These broker-dealers then deploy the funds within the foreign exchange (F/X) swap market, Treasury repo markets, and other short-term money markets. Together, these "reserve draining"[78] strategies have become an important new revenue source—especially for the largest BHCs.

The key takeaway here is that banks have long been able to use their privileged position at the heart of the U.S. payment system to generate revenue—whether by investing the float, receiving interest on their reserve balances, or using these balances as the basis for making profitable investments. Importantly, all of these revenue generating opportunities are at least in part a function of the speed of payments: with faster inbound payments and slower outbound payments both theoretically increasing a bank's potential revenue. Depending on the volume of payments and prevailing interest rates, these opportunities can weaken the incentives of banks to invest in new payment technology or other network infrastructure that would increase the speed or transparency of payment clearing and settlement. It can also weaken their incentives to give their customers more control over when and how they make payments. These incentives help explain the reticence of banks to shift to electronic payments in the early 1980s.[79] They also help explain the anxiety that banks felt following the shift to real-time gross settlement, the invention of remote deposit capture technology, and the

[74] *See* Fernando Avalos, Torsten Ehlers & Egemen Eren, *September Stress in Dollar Repo Markets: Passing or Structural?*, *BIS QUARTERLY REVIEW* (Dec. 2019). In a nutshell, the repo market is a segment of the institutional money market in which banks and other financial institutions sell high quality liquid assets like U.S. treasury securities in exchange for cash on the promise that they will repurchase—hence the name—equivalent securities at a predetermined time. The duration of repo contracts can range from overnight to several years, with the majority of contracts contemplating repurchase within 3 months or less.

[75] *See* Gara Afonso, Marco Cipriani, Adam Copeland, Anna Kovner, Gabriele La Spada & Antoine Martin, *The Market Events of Mid-September 2019*, 27:2 Federal Reserve Bank of New York Economic Policy Review 1 (Aug. 2021); Avalos et al., *supra* note __.

[76] Avalos et al., *supra* note __, 12.

[77] *See* Ricardo Correa, Wenxin Du & Gorgon Liao, *U.S. Banks and Global Liquidity*, National Bureau of Economic Research Working Paper 27491 (Jul. 2020); Afonso et al., *supra* note __.

[78] Correa, Du & Liao, *supra* note __.

[79] *See* Robert Trigaux, *Electronic Cash Management Systems Still Lack Wide Corporate Acceptance*, *AMERICAN BANKER* (Sept. 10, 1982) ("[I]t is the age old corporate game of float—investing funds backing paper check payments until funds are cleared—that remains the major obstacle to substantial increases in electronic payments.").

adoption of the Check21 Act.[80] Put simply: banks have always understood that faster payments will often translate into lower profits.

These incentives are consistent with what we observe in the real world. The U.S. banking industry has long been relatively slow to roll out a variety of new payment technologies, including the development and use of web-based APIs,[81] mobile banking,[82] EMV security chips,[83] contactless payments,[84] and real-time settlement.[85] Although their use has declined significantly in recent years, the U.S. is also the only developed country in the world that still relies heavily on costly, inconvenient, unsecure, and environmentally harmful paper checks.[86] Viewed from this perspective, the problem is not that new and better payment technologies do not presently exist—they most certainly do. Indeed, in many cases, U.S. financial institutions and technology firms have played an important role in their development.[87] Rather, the problem is that U.S. banks have been relatively slow to invest in the adoption of these new technologies. Accordingly, while the U.S. is often held up as a global leader in both finance and technology, the benefits of this leadership have not always been immediately or fully shared with the customers of U.S. banks.

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[80] *See* Jennifer Kingson, *Debating The Future of ACH: How Fast Should It Be?*, *AMERICAN BANKER* (Mar. 25, 2004) ("Perhaps the top vote-getter was a faster payment cycle, whether real-time or not. This is a controversial area, in part because banks are fearful they would lose a good deal of float revenue if the now-common batch payments, which settle in a few days, were to one day become instantaneous.").

[81] "*See* Susan Pandy, *Developments in Open Banking*, *supra* note __ (comparing open banking initiatives in the U.S. to Singapore, Hong Kong, China, Japan, Australia, and New Zealand).

[82] *Compare* FDIC, HOW AMERICA BANKS: HOUSEHOLD USE OF BANKING AND FINANCIAL SERVICES 4 (2019), https://www.fdic.gov/analysis/household-survey/ (reporting that 34 percent of survey respondents in the United States used mobile banking), with *Online Banking Penetration in Great Britain from 2007 to 2020*, *STATISTA* (Aug. 2020), https://www.statista.com/statistics/286273/internet-banking-penetration-in-great-britain/ (reporting that 73 percent of households in the United Kingdom used mobile banking as of 2019).

[83] *See* Elkins, *Why It Took the US So Long*, *supra* note __.

[84] *See Is the US on the Verge of a Contactless Surge?*, *PYMNTS.COM* (Jun. 6, 2019), https://www.pymnts.com/news/retail/2019/contactless-payments-tap-and-pay-mpos/ (noting that the United States has lagged behind other developed countries in the adoption of contactless payments).

[85] *See* U.S. DEP'T OF TREAS., A FINANCIAL SYSTEM THAT CREATES ECONOMIC OPPORTUNITIES: NONBANK FINANCIALS, FINTECH, AND INNOVATION 156 (2018), https://home.treasury.gov/sites/default/files/2018-08/A-Financial-System-that-Creates-Economic-Opportunities---Nonbank-Financials-Fintech-and-Innovation.pdf ("Many jurisdictions around the world have embarked on initiatives to increase the speed of payments. In many cases, the progress towards faster payments abroad has outpaced progress in the United States."); Morten Bech, Yuuki Shimizu & Paul Wong, *The Quest for Speed in Payments*, *BIS QUARTERLY REVIEW* 57, 59–60 (2017), https://www.bis.org/publ/qtrpdf/r_qt1703.pdf (describing country-level developments in real-time payment systems and notably excluding any mention of the United States).

[86] *See* Robertson, *Why Can't Americans Ditch Checks?*, *supra* note __.

[87] EMV security chips, for example, were first developed by U.S.-based Visa and Mastercard, together with the European company Europay. *See* Robin Saks Frankel, *When Were Credit Cards Invented: The History of Credit Cards*, *FORBES* (Jul. 27, 2021), https://www.forbes.com/advisor/credit-cards/history-of-credit-cards/.

This lack of private investment helps frame a fundamental tradeoff. In order to promote stability, U.S. policymakers have erected a financial safety net for banks and subjected them to a sophisticated framework of prudential regulation and supervision. They have also given banks exclusive access to the central bank reserve accounts, FMUs, and other infrastructure through which the vast majority of payments currently flow. And while other countries have increasingly explored new ways of integrating non-bank financial institutions into conventional payment networks, the U.S. has been steadfast in the approach that has entrenched banks as the apex of this system.[88] The practical effect has been to undercut competition and innovation from outside of the conventional banking system that might have otherwise spurred more and faster private investment in this critical, and yet increasingly neglected, network infrastructure.

B. The Emerging Crypto Ecosystem

Even when new payment networks are able to attract private investment, there is no guarantee that this will yield socially desirable competition, genuine innovation, or reliable and resilient network infrastructure. The emerging digital asset—or "crypto"—ecosystem offers an illustrative example. Digital assets like BTC, ETH, and USDT are based on pairs of cryptographic keys: a "public" key that can be seen by anyone, and a "private" key known only to the owner of the digital asset.[89] Together, these public and private keys enable the users of a given payment network to authenticate the ownership of digital assets, and to transfer them to other network users. The networks themselves are built on a type of decentralized database known as a distributed ledger or "blockchain."[90] While the features of these blockchains vary from network to network, most envision some type of direct participation by their users in network development, governance, and transaction processing. They also typically record final settlement using a unique cryptographic signature, creating a publicly-verifiable record of all transactions.

The crypto ecosystem emerged from the rubble of the global financial crisis. For many, the crisis triggered a profound loss of confidence and trust in banks and other conventional

[88] *SEE* AWREY, *BEYOND BANKS*, *supra* note __, chapter 6 for a description of some of these experiments. For example, the Bank of England recently published a report recommending that regulated stablecoin issuers be granted access to the Bank's reserve accounts; see Bank of England, Regulatory Regime for Systemic Payment Systems Using Stablecoins and Related Service Providers (Nov. 6, 2023), https://bankofengland.co.uk/paper/2023/dp.

[89] *See generally* Igor Makarov & Antoinette Schoar, *Cryptocurrencies and Decentralized Finance*, National Bureau of Economic Research Working Paper No. 30006 (2022) (providing an extensive treatment of cryptocurrencies); Council of Economic Advisers, Economic Report of the President 237-272 (March 2023), https://whitehouse.gov/wp-content/uploads/2023/03/erp-2023.pdf. *See also* Hilary Allen, *$=€=Bitcoin?*, 76 MARYLAND L. REV. 877, 886-87 (2017) (describing Bitcoin basics); Giordano De Marzo, Francesco Pandolfelli & Vito D. P. Servedio, *Modeling Innovation in the Cryptocurrency Ecosystem*, 12 SCI. RPTS. 12942 (2022) (defining blockchain).

[90] For a useful description of blockchain technology and its potential applications in money and payments, see PRASAD, *supra* note __.

financial institutions.[91] This quickly morphed into the fervent desire to build a more open, transparent, and decentralized financial system—one without a single point of access, control, or failure.[92] This desire is reflected in the 2009 whitepaper published Satoshi Nakamoto, the anonymous creator of BTC. As explained by Nakamoto: "I've developed a new open source P2P e-cash system called Bitcoin. It's completely decentralized, with no central server or trusted parties, because everything is based on crypto proof instead of trust."[93]

As described by Nakamoto, BTC was originally designed as "a purely peer-to-peer version of electronic cash [that] would allow online payments to be sent directly from one party to another without going through a financial institution."[94] In this brave new world, Bob, who lives in North America, would no longer need a bank account to send money to Alice, who lives in Sub-Saharan Africa. All they would both need is a smartphone, a SIM card, and mobile network access. And if Alice possessed some modest computer programming skills and the burning desire to create her own digital asset, the open source software upon which this new network infrastructure was built would mean that she was completely free to do so.[95] At least in theory then, the openness, programmability, and decentralization associated with the crypto ecosystem represents a radical tool for promoting universal access to financial products and services—including money and payments.[96] It also represents a radical departure from the highly centralized banks, clearinghouses, and other FMUs at the heart of conventional payment networks.

There are two basic species of digital assets within the emerging crypto ecosystem. The oldest and most popular are those—like BTC and ETH—that are completely untethered from any other real or digital assets. As of July 2024, there were over 10,000 different digital assets of this type listed and trading on various blockchain networks.[97] The market value of these untethered digital assets fluctuates, often wildly, in response to changes in market supply and

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[91] Alan Feuer, *The Bitcoin Ideology*, *THE NEW YORK TIMES* (Dec. 14, 2013), https://www.nytimes.com/2013/12/15/sunday-review/the-bitcoin-ideology.html. *See also* Raphael Auer, Bernhard Haslhofer, Stafan Kitzler, Pietro Saggese & Friedhelm Victor, *The Technology of Decentralized Finance (DeFi)*, Bank for International Settlements Working Paper No. 1066 (January 2023) (defining crypto as "a competitive, contestable, composable and non-custodial financial ecosystem built on technology that does not require a central organization to operate and that has no safety net.").

[92] Feuer, *supra* note __.

[93] Satoshi Nakamoto, *Bitcoin Open Source Implementation of P2P Currency*, *BITCOIN.COM* (Feb. 11, 2009), https://www.bitcoin.com/satoshi-archive/forum/p2p-foundation/1/.

[94] *Id.*

[95] *See* Werner Vermaak, *How to Create Your Own Cryptocurrency*, *COINMARKETCAP* (Apr. 2023) (providing a step-by-step guide to creating a cryptocurrency, including checking whether it is legal to do so in a given country).

[96] Although in reality, this ecosystem has often more closely resembled the concentrated access and control associated with more conventional forms of financial intermediation. *See e.g.* Sirio Aramonte, Wenqian Huang & Andreas Schrimpf, *DeFi Risks and the Decentralization Illusion*, *BIS QUARTERLY REVIEW* (Dec. 2021).

[97] *See* CoinMarketCap, *All Cryptocurrencies* (accessed Jul. 4, 2024), https://coinmarketcap.com/all/views/all/ (listing 10,013 digital assets, including 109 stablecoins).

demand. Between January 2017 and November 2021, for example, the price of BTC increased from roughly $1,000 to over $64,000, only to plummet to under $17,000 over the next 12 months.[98] A little over two years later, BTC would reach its all-time high of over $70,000.[99] This volatility makes BTC and other similar digital assets an extremely unstable foundation upon which to build a new system of money and payments.

In sharp contrast, the second species of digital assets—known as stablecoins—are designed to maintain a stable nominal value in relation to an underlying reference asset like the U.S. dollar, pound sterling, or euro.[100] In order maintain this value, stablecoins are typically collateralized by other assets, or use algorithms that automatically change their outstanding supply in real time in response to changes in demand.[101] Ultimately, while Nakamoto and other early proponents envisioned BTC as a new and novel means of payment, it has been these stablecoins that have emerged as potential competitors to banks, FMUs, and other conventional payment networks.

Stablecoins were originally created to address a very specific technical challenge. This challenge stemmed from the fact that most blockchains were and remain technologically incompatible with both each other and conventional payment networks. As a consequence, it could often take several days to transfer money from the buyer's bank account to a digital wallet in order to purchase BTC or other digital assets. And even where the buyer was purchasing BTC using another digital asset like ETH, clearing and settling the transaction across incompatible blockchain networks could still take several days or even weeks—thus exposing both the buyer and seller to any volatility in the price of these assets over the intervening period. What these early crypto traders needed was a digital asset that was compatible both with and across blockchain payment networks and designed to maintain a fixed nominal value.

The first stablecoins were launched in 2014 to little fanfare and enjoyed only modest levels of adoption. This relatively low public profile changed dramatically in June 2019, when Facebook announced the creation of the Libra Association and its intention to launch a global stablecoin to be known as Libra.[102] The original objective of the Libra Association was to

[98] *Id.*

[99] *Id.*

[100] For a more detailed description of stablecoins and their mechanics, see Dan Awrey, *Bad Money*, 106 CORNELL L. REV. 1 (2020); Gary B. Gorton & Jeffery Y. Zhang, *Taming Wildcat Stablecoins*, 90 U. CHI. L. REV. 909 (2023). *See also* Garth Baughman, Francesca Carapella, Jacob Gerszten & David Mills, *The Stable in Stablecoins*, FEDS NOTES (Dec. 16, 2022) (explaining the mechanics of stablecoins).

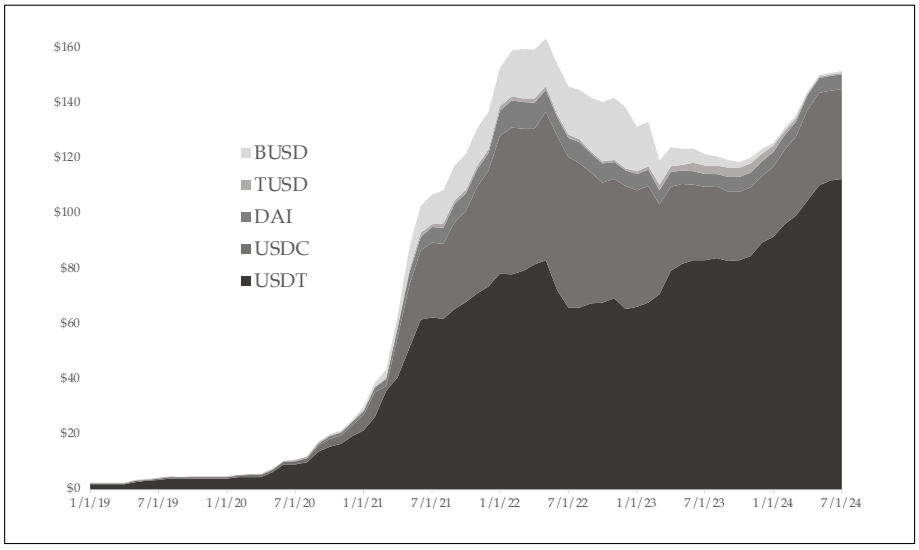
[101] Although significant questions remain around how successful this collateralization and algorithmic stabilization are in ensuring that stablecoins can maintain their nominal value, especially during periods of market stress; see e.g. Anneke Kosse, Marc Glowka, Ilaria Mattei & Tara Rice, *Will the Real Stablecoin Please Stand Up?*, Bank for International Settlements Paper No. 141 (Nov. 2023) (classifying stablecoins and evaluating the ability of each class to maintain its nominal peg).

[102] *See* Libra Association, *Introducing Libra* (Jun. 18, 2019), https://www.diem.com/en-us/updates/introducing-libra/; Mike Isaac & Nathaniel Popper, *Facebook Plans Global Financial System Based on*

create a "global currency and financial infrastructure" designed to overcome the speed, cost, and interoperability problems that had long plagued international payment and remittance systems.[103] As originally designed, the Libra stablecoin was to be backed by a basket of fiat currencies and sovereign debt, accessed through a network of authorized trading platforms, and held in digital wallets developed by Facebook's subsidiary, Calibra. Once up and running, the vision was that units of Libra could be transferred instantaneously between user wallets via the Libra blockchain.

Figure 3

Market Capitalization of Top Five Stablecoins (USD billions)



Source: CoinMarketCap.com (own calculations)

The Libra project died an ignominious death in January 2022.[104] Yet rather than signaling the demise of the nascent stablecoin market, Libra's exit coincided with a period of dramatic market growth. Between January 2021 and September 2022, the market capitalization of what were then the three largest stablecoins—USDT, Circle's USDC, and Binance's BUSD—grew by almost 600 percent to over $110 billion (*see* Figure 3). And by the autumn of

Cryptocurrency, THE NEW YORK TIMES (Jun. 18, 2019), https://www.nytimes.com/2019/06/18/technology/facebook-cryptocurrency-libra.html.

[103] *See* Libra Association White Paper v1.0, 3 (Jun. 18, 2019), https://www.diem.com/en-us/updates/introducing-libra/.

[104] After receiving significant pushback from regulators in several key jurisdictions, the Libra Association announced in April 2020 that it intended to pursue a more modest version of its proposal based on a series of single-currency stablecoins pegged to the U.S. dollar, British pound, Euro, and other major global currencies. Shortly thereafter, Facebook rebranded the project from Libra to Diem.; Libra Association, White Paper v2.0 (Apr. 2020), https://wp.diem.com/en-US/wp-content/uploads/sites/23/2020/04/Libra_WhitePaperV2_April2020.pdf.

2022, more than three quarters of all transactions on digital asset trading platforms involved at least one stablecoin.[105] Today, the five largest stablecoins have a combined market capitalization of over $150 billion.

At present, the use of stablecoins is still almost exclusively limited to transactions within the emerging crypto ecosystem. Yet looking farther ahead, many see stablecoins as the technological backbone of a new and better global payment network. According to Libra veterans Christian Catalini and Jai Massari, now both senior executives at the crypto payments start-up Lightspark:

> "[T]he benefits of stablecoins include lower-cost, safe, real-time, and more competitive payments compared to what consumers and businesses experience today. They could rapidly make it cheaper for businesses to accept payments and easier for governments to run conditional cash transfer programs (including sending stimulus money). They could connect unbanked or underbanked segments of the population to the financial system."[106]

Between 2009 and 2020, the growing optimism surrounding the potential role of stablecoins and blockchain technology in building the payment networks of the future can be seen in the number of start-ups entering this burgeoning new industry. Using data from PitchBook, Figure 4 charts the sharp growth in the number of start-ups involved in the development of blockchain-based payment networks that were founded between the 2009 publication of Satoshi Nakamoto's BTC whitepaper and November 2023.[107] These start-ups included a wide range of firms: from now well-established payment industry players like Stripe and Ant Group, to digital asset trading platforms like Kraken, and stablecoin issuers like Circle. They also included hundreds of smaller technology firms targeting specific layers of the blockchain tech stack—e.g. cybersecurity, network interoperability, and the development of decentralized applications or "dapps"—or looking to address payments problems in specific industries like online retail, real estate, energy, and healthcare.

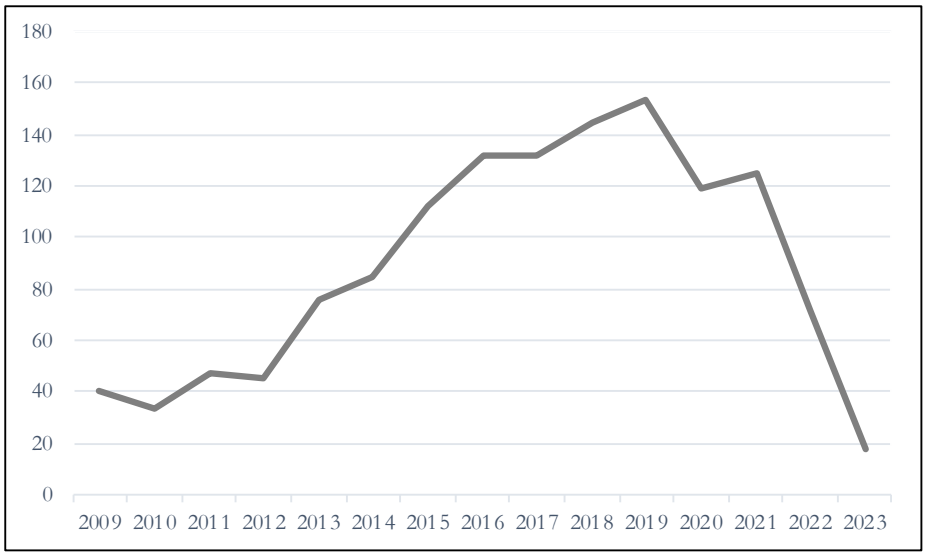
[105] The Block, *Share of Trade Volume by Pair Denomination* (Sept. 2022), https://www.theblock.co/data/crypto-markets/spot/share-of-trade-volume-by-pair-denomination.

[106] *See* Christian Catalini & Jai Massari, *Stablecoins and The Future of Money*, HARV. BUS. REV. (Aug. 10, 2021).

[107] One of the limits of the PitchBook dataset is that it does not enable us to distinguish between firms that are *solely* or *principally* involved in the development of blockchain-based payment networks from those that only do so *incidentally* to their core businesses.

Figure 4

Blockchain Payment Firms – Firms Founded (2009-2023)



Source: PitchBook

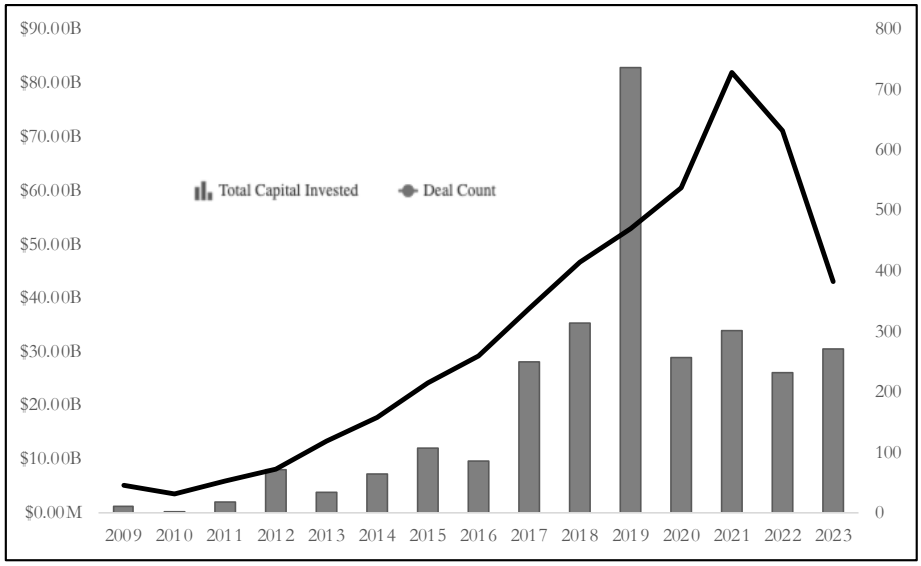
This growing optimism can also been observed in the sharp rise in both the number and size of new venture capital and private equity investments, mergers and acquisitions, and other transactions over this same period. Figure 5 reports the total deal count and capital invested in firms involved in the development of blockchain-based payment networks between 2009 and 2023.[108] In 2009, these firms were involved in a total of 45 transactions, worth approximately $1.25 billion, and averaging about $27.8 million per transaction. By the end of 2020, these figures had jumped significantly: with a total of 459 transactions, collectively worth $82.75 billion, and averaging over $180 million. These figures also exclude transactions involving some of the largest players in blockchain-based payments, including Block (which raised $2.95 billion in equity and debt during this period), Coinbase ($2.92 billion), and Ripple ($325 million).[109]

[108] One of the limits of the PitchBook dataset is that it does not enable us to determine, at the firm level, whether a given investment is directed specifically toward the development of blockchain-based payment networks. For alternative data, *see* THE BLOCK RESEARCH, DIGITAL ASSET OUTLOOK (2023), https://www.tbstat.com/wp/uploads/2022/12/Digital-Asset-2023-Outlook.pdf (reporting that venture capital firms completed 6,658 deals in the digital asset space through the end of 2022, for a cumulative total of $75.92 billion in investments since the beginning of 2017) and Alex Thorn & Gabe Parker, *Crypto & Blockchain Venture Capital, Q3 2023* (Oct. 13, 2023), https://www.galaxy.com/insights/research/crypto-and-blockchain-venture-capital-q3-2023/ (estimating that roughly $8 billion worth of venture capital deals were completed in the space over the first three quarters of 2023).

[109] PitchBook data [on file with authors].

Figure 5

Blockchain Payment Firms – Deal Count and Total Investment (2009-2023)



Source: PitchBook

Venture capital and technology firms are not the only players channeling investment into blockchain-based payment networks. Increasingly, conventional banks, peer-to-peer (P2P) payment platforms, credit card companies, and FMUs are also entering this market. One of the first financial institutions to do so was JPMorgan, which announced its intention to build a wholesale blockchain-based payment network known as JPMCoin in June 2019.[110] Since then, dozens of other banks—including a number of smaller, tech-driven neobanks—have raced to launch their own blockchain payment projects.[111] Banks have also become important investors in blockchain payment firms, with at least one industry study reporting that 55 of the largest 100 U.S. banks invested directly in crypto and blockchain-related ventures as of 2021.[112] Not to be outdone, PayPal announced in October 2020 that it would enable its

[110] *See* Helen Partz, *JPMorgan Will Pilot 'JPM Coin' Stablecoin by End of 2019: Report*, *COINTELEGRAPH* (Jun. 25, 2019), https://cointelegraph.com/news/jpmorgan-will-pilot-jpm-coin-stablecoin-by-end-of-2019-report.

[111] *See e.g.* Western Alliance Bank, *Industry Expertise: Blockchain & Digital Assets Industry*, https://www.westernalliancebancorporation.com/industry-expertise/blockchain-and-digital-assets (last visited Nov. 15, 2023); Yizhu Wang, *Banks Execute Transfer On Blockchain-enabled Network*, S&P Global Market Intelligence (Oct. 3, 2022), https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/banks-execute-transfer-on-blockchain-enabled-network-72332712; Press Release, *Signature Bank Launches Its Digital Payments Platform, Signet™, on the Fireblocks Network*, *BLOOMBERG* (Jun. 23, 2020), https://www.bloomberg.com/press-releases/2020-06-23/signature-bank-launches-its-digital-payments-platform-signet-on-the-fireblocks-network.

[112] *See* Sam Wouters, *Top Banks Investing in Crypto and Blockchain Companies*, *BLOCKDATA* (May 9, 2022), https://www.blockdata.tech/blog/general/banks-investing-blockchain-companies.

customers to hold BTC, ETH, USDC, and other digital assets, before eventually launching its own stablecoin in August 2023.[113] Visa, meanwhile, unveiled a pilot project in March 2021 that would enable customers to use the Ethereum blockchain to pay their credit card balances in USDC.[114] And in November 2022, a consortium of large banks including Citigroup, HSBC, and Wells Fargo announced the creation of the Regulated Liabilities Network: a permissioned blockchain designed to deliver 24/7, programmable, real-time payments between participating financial institutions.[115]

Outside the conventional banking system, one of the key factors driving investment in stablecoins and blockchain-based payment networks has been the relatively low regulatory barriers to market entry. The world's largest U.S. dollar-denominated stablecoin, USDT, has successfully structured its business and operations to almost entirely avoid the reach of U.S. regulation.[116] While in theory this means that U.S. customers should not be able to purchase USDT or use to make payments, the reality is that they can still do so through intermediaries like Coinbase and PayPal.[117] Meanwhile, the issuer of the world's second largest stablecoin, Circle's USDC, is regulated under New York's groundbreaking but still relatively opaque and untested "Bitlicense" framework, along with a patchwork of antiquated and inadequate state money transmitter laws.[118] These frameworks come nowhere close to the level of prudential regulation and supervision imposed on conventional deposit-taking banks. Nor do they provide stablecoin issuers with access to deposit insurance, special resolution frameworks, or other elements of the financial safety net.

Predictably, these low regulatory barriers to entry—combined with the torrent of new investment—created the conditions for potential instability. The first signs of trouble appeared in May 2022, when an algorithmic stablecoin known as TerraUSD lost its peg, wiping

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[113] *See* Press Release, *PayPal Launches New Service Enabling Users to Buy, Hold and Sell Cryptocurrency*, PayPal Inc. (Oct. 21, 2020), https://newsroom.paypal-corp.com/2020-10-21-PayPal-Launches-New-Service-Enabling-Users-to-Buy-Hold-and-Sell-Cryptocurrency; Anna Irrera, *PayPal Launches a Stablecoin in Latest Crypto Payments Push*, *BLOOMBERG* (Aug. 7, 2023), https://www.bloomberg.com/news/articles/2023-08-07/paypal-launches-us-dollar-stablecoin-pyusd-for-payments-transfers#xj4y7vzkg.

[114] *See* Press Release, *Visa Becomes First Major Payments Network to Settle Transactions in USD Coin*, Visa Inc. (Mar. 29, 2021), https://usa.visa.com/about-visa/newsroom/press-releases.releaseId.17821.html.

[115] *See* The Regulated Liability Network, *The Regulated Liability Network: Digital Sovereign Currency*, White Paper (Nov. 15, 2022), https://regulatedliabilitynetwork.org/wp-content/uploads/2022/11/The-Regulated-Liability-Network-Whitepaper.pdf.

[116] *See* JP Koning, *What Tether Means When It Says It's 'Regulated'*, *COINDESK* (Sept. 14, 2021), https://www.coindesk.com/policy/2021/01/26/what-tether-means-when-it-says-its-regulated/

[117] *See e.g.* Coinbase, *How To Buy Tether Using PayPal*, https://www.coinbase.com/how-to-buy/tether (last accessed November 16, 2023) (explaining how Coinbase's U.S. customers can purchase USDT via PayPal).

[118] For a more detailed description of these state-level regulatory frameworks and their shortcomings, see Awrey, *Bad Money*, *supra* note __. In January 2024, the New York State Comptroller released an audit report highlighting significant failures by the New York Department of Financial Services in its oversight of the Bitlicense framework; see Office of the New York State Comptroller, Audit of the Department of Financial Services: Virtual Currency Licensing, Report 2022-S-18 (Jan. 2024), https://www.osc.ny.gov/files/state-agencies/audits/pdf/sga-2024-22s18.pdf.

out over $18 billion in market capitalization in a matter of days.[119] This was immediately followed by the collapse of TerraUSD's sister coin, Luna, wiping out another $11 billion.[120] These widely unexpected and high profile failures destabilized the wider digital asset market, with the price of BTC falling from almost $40,000 to less than $20,000 in a little over a month.[121] This steep fall in prices had a predictable impact on leveraged crypto investors like Three Arrows Capital, which defaulted on a $660 million loan to crypto lending platform Voyager Digital before being unable to meet a margin call from another crypto lender, BlockFi.[122] This growing instability put the balance sheets of these crypto lenders under severe strain. In July, Voyager filed for bankruptcy protection.[123] A week later, another major crypto lender, Celsius Network, would follow suit.[124]

This "crypto winter" continued to gather momentum into the Fall and Winter of 2022 and early 2023. In November, the world's third largest cryptocurrency exchange, FTX, which had agreed to buy Voyager's assets out of bankruptcy, announced that it was itself filing for bankruptcy protection amidst widespread allegations of fraud and mismanagement.[125] The fallout quickly engulfed BlockFi, which had lent over $1 billion to FTX,[126] and Genesis Global, a major crypto brokerage firm.[127] The fallout also engulfed many of the banks that had most heavily invested in the development of blockchain-based payment networks. Following the collapse of FTX, the price of shares in Silvergate Bank, which had created its own blockchain payment network and counted Circle, Coinbase, and USDT amongst its stable of crypto

[119] *See generally* Gary B. Gorton & Jeffery Y. Zhang, *Bank Runs During Crypto Winter*, SSRN Working Paper (May 2023) (providing a detailed timeline of the relevant events). *See also* Krisztian Sandor & Ekin Genç, *The Fall of Terra: A Timeline of the Meteoric Rise and Crash of UST and LUNA*, *COINDESK* (Dec. 22, 2022), https://www.coindesk.com/learn/the-fall-of-terra-a-timeline-of-the-meteoric-rise-and-crash-of-ust-and-luna/.

[120] *Id.*

[121] *See* Coinmarketcap.com, BTC price history, https://coinmarketcap.com/currencies/bitcoin/ (reporting a BTC price of $39,695 on May 5, 2022 and $19,010 on June 18, 2022).

[122] *See* Kadhim Shubber & Joshua Oliver, *Crypto Hedge Fund Three Arrows Fails to Meet Lender Margin Calls*, THE FINANCIAL TIMES (June 16, 2022), https://www.ft.com/content/126d8b02-f06a-4fd9-a57b-9f4ceab3de71.

[123] *See* Brian Newar, *Voyager Digital Files for Chapter 11 Bankruptcy, Proposes Recovery Plan*, *COINTELEGRAPH* (Jul. 6, 2022), https://cointelegraph.com/news/voyager-digital-files-for-chapter-11-bankruptcy-proposes-recovery-plan.

[124] *See* Olga Kharif & Joanna Ossinger, *Crypto Lender Celsius Files for Bankruptcy After Cash Crunch*, *BLOOMBERG* (Jul. 13, 2022), https://www.bloomberg.com/news/articles/2022-07-14/crypto-lender-celsius-files-for-bankruptcy-in-cash-crunch?leadSource=uverify%20wall.

[125] *In re: FTX Trading Ltd.*; David Yaffe-Bellany, *FTX Assets Still Missing as Firm Begins Bankruptcy Process*, *THE NEW YORK TIMES* (Nov. 22, 2022), https://www.nytimes.com/2022/11/22/business/ftx-bankruptcy-sam-bankman-fried.html.

[126] *See* Lauren Hirsch, David Yaffe-Bellany & Ephrat Livni, *BlockFi Files for Bankruptcy as FTX Fallout Spreads*, *THE NEW YORK TIMES* (Nov. 28, 2022), https://www.nytimes.com/2022/11/28/business/blockfi-bankruptcy-cryptocurrency-ftx.html.

[127] *See* Stephen Alpher & Danny Nelson, *Genesis' Crypto Lending Businesses File for Bankruptcy Protection*, *COINDESK* (Jan. 20, 2023), https://www.coindesk.com/business/2023/01/20/genesis-global-files-for-bankruptcy-protection/.

clients, plunged almost fifty percent.[128] The bank would subsequently report net withdrawals of over $8 billion over the fourth quarter, forcing it to prematurely sell many of its assets[129] and eventually file for voluntary liquidation in March 2023.[130] That same month, large withdrawals at Signature Bank, which had also developed a popular blockchain-based payment network, prompted state and federal bank regulators to place it into receivership.[131]

The vectors of instability did not just see risk flowing from digital asset markets into the conventional banking system. March 2023 also saw the failure of San Francisco-based Silicon Valley Bank (SVB).[132] At the time, Circle held approximately $3.3 billion in uninsured deposits with SVB: representing over seven percent of the total reserves backing its USDC stablecoin. As the bank collapsed, news of USDC's large and uninsured exposure to SVB triggered a run, with the stablecoin's price quickly becoming untethered from its peg and eventually falling to roughly eighty-seven cents on the dollar.[133] In the event, the price of USDC only recovered after the Treasury Department, FDIC, and Federal Reserve announced that they were guaranteeing all of SVB's uninsured depositors—including Circle.[134] Having failed to effectively regulate USDC and other stablecoins *ex ante*, the federal government was forced into the uncomfortable but all too familiar position of having to provide an *ex post* bailout.

The decade between 2009 and 2019 thus witnessed a flood of new start-ups and investment targeting stablecoins and other blockchain-based payment networks. For a time, this influx of capital, expertise, and other resources was a catalyst for technological innovation and competition as new entrants raced to build network infrastructure, achieve widespread

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[128] *See* Joshua Oliver, *US Bank Silvergate Defends ties to Sam Bankman-Fried's Crypto Groups*, THE FINANCIAL TIMES (Dec. 6, 2023), https://www.ft.com/content/38ac9101-4642-4acf-92ba-3f7580987deb.

[129] *See* Manya Saini, Niket Nishant & Hannah Lang, *Silvergate Capital Shares Sink as Crypto-related Deposits Plunge by $8 Billion*, REUTERS (Jan. 5, 2023), https://www.reuters.com/technology/silvergate-capitals-crypto-related-deposits-plunge-fourth-quarter-2023-01-05/.

[130] *See* Press Release, *Silvergate Capital Corporation Announces Intent to Wind Down Operations and Voluntarily Liquidate Silvergate Bank*, Silvergate Bank (Mar. 8, 2023), https://ir.silvergate.com/news/news-details/2023/Silvergate-Capital-Corporation-Announces-Intent-to-Wind-Down-Operations-and-Voluntarily-Liquidate-Silvergate-Bank/default.aspx.

[131] *See* FDIC Press Release, *FDIC Establishes Signature Bridge Bank, N.A., as Successor to Signature Bank, New York, NY* (Mar. 12, 2023), https://www.fdic.gov/news/press-releases/2023/pr23018.html. *See also* David Benoit, Rachel Louise Ensign & Caitlin Ostroff, *Signature Bank Is Shut by Regulators After SVB Collapse*, THE WALL STREET JOURNAL (Mar. 12, 2023).

[132] *See* FDIC, Press Release, *FDIC Creates Deposit Insurance National Bank of Santa Clara to Protect Insured Depositors of Silicon Valley Bank* (Mar. 10, 2023), https://www.fdic.gov/news/press-releases/2023/pr23016.html.

[133] *See* Vicky Ge Huang, Hannah Miao & Caitlin Ostroff, *Circle's USDC Stablecoin Breaks Peg With $3.3 Billion Stuck at Silicon Valley Bank*, THE WALL STREET JOURNAL (Mar. 11, 2023).

[134] The USDC peg recovered on March 13, 2023. *See* CoinMarketCap, https://coinmarketcap.com/currencies/usd-coin/. The previous day, the Treasury, FDIC, and Federal Reserve took unprecedented measures to secure the health of the banking system, including the uninsured depositors at Silicon Valley Bank. *See* Joint Statement by the Department of the Treasury, Federal Reserve, and FDIC (Mar. 12, 2023), https://home.treasury.gov/news/press-releases/jy1337.

network adoption, and capitalize on strong economies of scale and network effects. Yet over the longer term, these same economies of scale and network effects also meant that very few of these new entrants were likely to survive long enough to reap the benefits of their investments. Of the five largest stablecoins as of 2019, effectively only two—USDT and USDC—remain standing only five years later. Further reinforcing this tendency toward industry concentration was the fact that most of these new payment networks were not technologically compatible with those of their competitors. As a consequence, new entrants were not just competing *in the market*, but also *for the market*.[135] Indeed, for every USDT or USDC, there are dozens of other stablecoins and blockchain-based payment networks that have already faded into oblivion.

In addition to what its proponents view as the potentially transformative benefits of this new technology, there is little doubt that entrepreneurs and investors were also attracted by the relatively low regulatory barriers to new market entry. In many cases, lax regulatory frameworks like state money transmitter laws may have enabled new entrants to cut corners in order to lower compliance costs, attract customers, and expand market share.[136] As the number of new entrants, investment, and competition grew, these frameworks also helped plant the seeds of future instability—seeds that ultimately bore poisonous fruit during both the crypto winter and the banking crisis of early 2023. At least for the time being, what started as a frenetic and uncoordinated race to build new and better payment networks has thus ended in the failure of several high profile firms, a collapse in new start-ups and investment, and a motley collection of largely non-interoperable networks that for the most part have yet to deliver any tangible or enduring benefits.

C. The Global Correspondent Banking System

As highlighted by Facebook's now-abandoned Libra project, one of the most frequently cited use cases for stablecoins and blockchain-based payment networks has been their potential to deliver faster, cheaper, more transparent, and more accessible cross-border payments.[137] At present, sending money from one country to another can be expensive and slow. This is especially true for smaller retail payments, and for international remittances that enable migrant workers to send money to their families overseas. As of June 2023, the World Bank estimates that the average cost for these international remittances was more than six percent of the total value of each payment.[138] More generally, the Financial Stability Board (FSB) estimates that the average cost for retail cross-border payments—defined as

[135] *See* Kades & Scott Morton, *supra* note __, at 1 ("[T]he competition that matters most is often for the market not within the market.").

[136] For further details, see AWREY, *BEYOND BANKS*, *supra* note __, chs. 5, 7.

[137] *See e.g.* U.S. Treasury Department, Remarks by Under Secretary for International Affairs Jay Shambaugh on New Technologies and Cross-border Payments (Oct. 17, 2023); Morten Bech, Umar Faruqui & Takeshi Shirakami, *Payments Without Borders*, *BIS QUARTERLY REVIEW* 53 (Mar. 2020).

[138] *See* World Bank, Remittance Prices Worldwide Quarterly 3 (Jun. 2023), https://remittanceprices.worldbank.org/sites/default/files/rpw_main_report_and_annex_q223.pdf

transactions under $100,000—is around 1.5 percent for business-to-business (B2B) transactions and 2.5 percent for P2P transactions.[139] Despite advances in information technology, cross-border payments are also notoriously slow. Almost a quarter of all payments take more than one business day,[140] and a small but not insignificant fraction take far longer.[141] And predictably, cross-border payments tend to be both more expensive and slower in developing countries, where low payment volumes and a lack of network infrastructure generate a self-reinforcing feedback loop, impeding economic development and entrenching financial exclusion.[142]

The high cost, long delays, financial exclusion, and other inefficiencies associated with the current system of cross-border payments is a function of its peculiar structure and, ultimately, governance. At the heart of this system are two distinct yet complementary and deeply intertwined types of network infrastructure. The first is a single, modern, purpose-built *telecommunications* network that enables banks and other financial institutions to send and receive electronic payment instructions. These payment instructions typically include the bank and account details of the party receiving the payment, the amount, currency, and date of the payment, and other basic information.

The second is a decidedly more fragmented and antiquated *settlement* network that enables banks to carry out these payment instructions. This "correspondent" banking system is structured around a network of bilateral counterparty relationships between individual banks. Accordingly, a bank in Country A would historically open an account with a bank in Country B for the purpose of sending and receiving payments on behalf of its customers to and from households, businesses, and governments located in Country B.[143] Where the bank in Country B is a member of domestic FMUs, this correspondent relationship would then indirectly give the bank in Country A the ability to send and receive payments to and from all the other banks in Country B.[144] Figure 6 illustrates the chain of bank account relationships and flow of funds within this simplified correspondent banking system.

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[139] Financial Stability Board (FSB), *Annual Progress Report on Meeting the Targets for Cross-border Payments: 2023 Report on Key Performance Indicators* 2 (Oct. 9, 2023), https://www.fsb.org/wp-content/uploads/P091023-1.pdf.

[140] *Id.*, at 22 (reporting that 23.7 percent of retail cross-border payments take more than one business day).

[141] For example, major cross-border payment and remittance platforms like Western Union and MoneyGram warn customers that it may take up to a week for the recipient to receive a given payment.

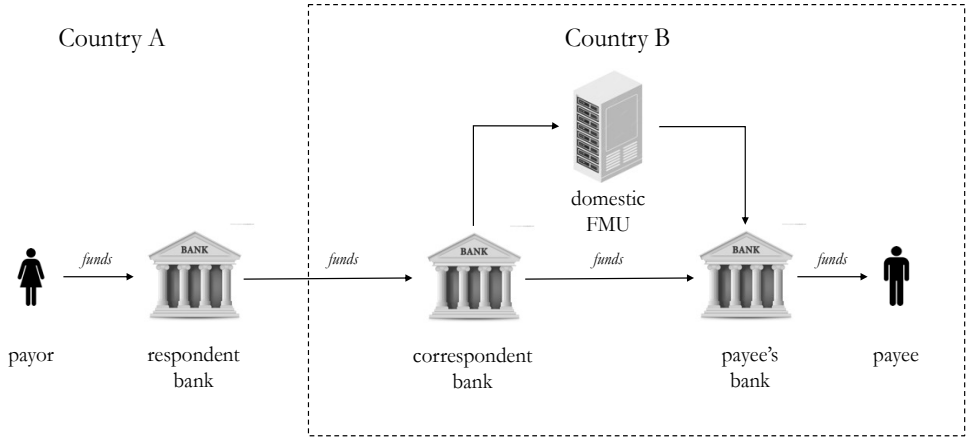
[142] *See* World Bank, *supra* note __; FSB, *supra* note __.

[143] As defined by the Bank for International Settlements, correspondent banking involves "an arrangement under which one bank (correspondent) holds deposits owned by other banks (respondents) and provides payment and other services to those respondent banks"; see Committee on Payment and Market Infrastructures (CPMI), "Correspondent Banking" 9 (Jul. 2016), https://www.fsb.org/wp-content/uploads/P091023-1.pdf.

[144] Even where this bank is not a member of domestic FMUs, the bank in Country A will still be able to transact with other banks in Country B so long as these other banks also maintain a correspondent account with the same bank.

Figure 6

A Simplified Correspondent Banking System



Despite their critical interdependences, these telecommunications and settlement networks ultimately pose very different opportunities and risks. From the perspective of participating banks, coordinating their investments in the development, maintenance, and upgrades to a shared telecommunications network holds out a number of potentially significant benefits.[145] First, banks can pool their financial, human, and other resources to share the initial fixed costs of building the network and establishing connectivity.[146] Second, having successfully built the network, coordinated adoption can help quickly unlock economies of scale and network effects, thus driving down ongoing marginal costs.[147] Third, by standardizing network operating procedures, messaging protocols, and security features, routing payment instructions through a single telecommunications network can dramatically reduce the costs of automation. In turn, greater automation can help reduce the risks of fraud and human error, improve auditability, and thereby further drive down costs. And last but not least, greater automation can increase the speed of payments.

The prospect of capitalizing on these opportunities is what led a consortium of large banks to establish the Society for Worldwide Interbank Financial Telecommunication, more commonly known as SWIFT. The origins of SWIFT can be traced back to the rising international trade volumes, corresponding growth in cross-border banking, and important

[145] Samantha Cook & Kimmo Soramäki, *The Global Network of Payment Flows*, Swift Institute, Working Paper No. 2012-006, The Swift Institute. https://www.swiftinstitute.org/wp-content/uploads/2014/09/SWIFT-Institute-Working-Paper-No.-2012-006-Network-Analysis-of-Global-Payment-Flows_v5-FINAL.pdf (2014).

[146] *Id.*

[147] *Id.*

advances in telecommunications during the late 1960s and early 1970s.[148] At the time, most cross-border payments required the use of a text-based messaging service known as a telex machine. To authenticate payment instructions using these telex machines, the sending and receiving banks would first need to agree on a codebook containing a series of predetermined keys.[149] Every time a bank wanted to send a payment instruction, a human operator would then need to manually enter the value, currency, and other payment details using this codebook to generate a telex test key.[150] The operator receiving the instruction would then need to use the codebook to decrypt the test key and verify the authenticity of the instruction.[151] The risk of human error associated with this highly manual process was compounded by the fact that the format and content of these instructions often varied between banks and operators, forcing receiving banks to interpret and reformat them for internal use before forwarding them on for clearing and settlement.[152] These instructions were also transmitted using public telephone, telegraph, and other telecommunications infrastructure, offering banks and their customers little security beyond the telex machine's rudimentary cryptography, and introducing the risk that this infrastructure would be unable to keep pace with the growing volume of cross-border payments.[153]

Beginning in the late 1960s, several industry-led initiatives were launched, each with the objective of standardizing and automating the cumbersome processes for sending and receiving cross-border payment instructions. Not surprisingly, these initiatives were spearheaded by what were then the largest and most internationally active banks, including First National City Bank, Bank of America, and Chase Manhattan in the United States, and Barclays, Lloyds, and Midland Bank in Europe.[154] SWIFT was established in May 1973 and quickly emerged as the most promising of these initiatives: with over 270 banks, operating in 15 countries, adopting SWIFT's dedicated telecommunications infrastructure and messaging standards by the end of 1975.[155] Today, SWIFT has more than 11,000 member banks and

[148] For a more detailed description of the development of SWIFT, see SUSAN SCOTT & MARKOS ZACHARIADIS, *THE SOCIETY FOR WORLDWIDE INTERBANK FINANCIAL TELECOMMUNICATION (SWIFT): COOPERATIVE GOVERNANCE FOR NETWORK INNOVATION, STANDARDS, AND COMMUNITY* (2014).

[149] *Id.* at 12-13.

[150] *Id.*

[151] *Id.*

[152] *Id.*

[153] *Id.*

[154] These initiatives included the Banks' International Message Switching Project (MSP) and Machine Readable Telegraphic Input (MARTI) project.

[155] Scott & Zachariadis, *supra* note __, at 18. This rapid adoption was in part propelled by the fact that First National City Bank, which lead the group developing MARTI, announced that it was forcing the banks with which it did business to use MARTI. First National's ultimatum triggered a mass defection of banks to SWIFT; *id.*

other financial institutions, operating in more than 200 countries, and collectively sending an average of 50 million cross-border payment instructions each and every business day.[156]

SWIFT's success in building network infrastructure and promoting widespread industry adoption can be attributed to several factors. As we have already seen, the first is simple economics: with economies of scale, network effects, and other cost efficiencies driving banks to coordinate their investments in new network infrastructure. At the same time, this coordination did little to prevent these same banks from vigorously competing with each other for deposits, lending, trade finance, and other core banking services.[157] Nor as we shall see did it prevent them from capitalizing on their central role within the global correspondent banking system to generate enormous revenue from cross-border payments. Together with SWIFT's legal organization as a member-owned cooperative, with each member's ownership and control rights proportional to its use of SWIFT messaging services, the result has been a fairly high level of incentive compatibility among its principal stakeholders and architects.[158] This incentive compatibility has in turn made SWIFT the institutional fulcrum for multiple rounds of payment innovation: beginning with SWIFT's eponymous messaging standards and culminating most recently in ISO 20022, an open platform of interoperable standards governing domestic and cross-border payments, foreign exchange transactions, securities trading and settlement, and other financial services.[159] Together, these factors have combined to entrench SWIFT, its network infrastructure, and technical standards at the heart of the global payment system.

The deep and sustained coordination that has been integral to the success of SWIFT has been largely absent from the other network at the heart of the global payment system: the correspondent banking system. To understand why, we first need to understand the basic institutional mechanics of this system, along with its principal risks. Unlike most domestic payment networks, where FMUs provide a single and highly centralized mechanism for clearing and settlement, the flow of funds across the correspondent banking system creates a chain of decentralized bilateral counterparty obligations.[160] Thus, for example, if a respondent bank in Country A—say Canada—needs to make a payment to a payee in Country B—say Brazil—it will at some point be obligated to deposit sufficient funds in its account with its correspondent bank. The correspondent bank will in turn owe a second and entirely separate

[156] *See* SWIFT, *SWIFT Traffic Highlights 2022*, https://www.swift.com/about-us/swift-traffic-highlights (reporting an average of 6 million InterAct messages and 44 million FIN messages per day).

[157] As Scott & Zachariadis point out, SWIFT is thus an example of what economists Barry Nalebuff and Adam Brandenburger describe as "co-opetition", the simultaneous coordination and competition between multiple firms in the same industry; see BARRY NALEBUFF AND ADAM BRANDENBURGER, *CO-OPETITION* (1996).

[158] For more detailed information about the ownership and governance of SWIFT, see SWIFT, "Organization and Governance," https://www.swift.com/about-us/organisation-governance/swift-governance.

[159] For further details regarding ISO 20022, see https://www.iso20022.org/.

[160] Although as we shall see, one or more legs of a cross-border payment will also typically clear though a domestic FMU.

obligation to transfer funds as instructed, via the domestic FMU in Brazil, to the payee's bank and, ultimately, the intended recipient.

These bilateral counterparty exposures introduce the risk—known as *settlement risk*—that one or more of the banks in this chain may unexpectedly fail to perform its obligations.[161] In theory, correspondent banks can address this risk in one of three ways. The first involves requiring respondent banks to prefund their accounts, thereby ensuring there are always sufficient funds before the correspondent bank processes any onward payments. The second involves sequencing the payments in the chain to ensure that the correspondent bank does not process any onward payments until the respondent bank has deposited funds sufficient to cover them. However, while both of these options effectively eliminate settlement risk from the perspective of the correspondent bank, they do so by effectively shifting this risk to the bank's counterparties. Specifically, whereas the first option imposes potentially significant opportunity costs on respondent banks—which might have otherwise profitably invested the prefunded deposits—the second imposes the costs of potential delays and inconvenience on payee banks and their customers as they wait for respondent banks to deposit funds in their correspondent accounts.

The third option involves the correspondent bank taking settlement risk onto its own balance sheet. This means using its own financial resources to satisfy the onward payment obligations incurred on behalf of its respondent banks: thus bridging any temporal lags in the payment chain. Yet this introduces a second risk—known as *liquidity risk*—stemming from the prospect that, due to a lack of predictability and synchronization around the timing of inbound and outbound payments, that the correspondent bank may not have sufficient funds to meet its outstanding obligations over a given time horizon.[162] To address this risk, the correspondent bank can of course set aside a pool of funds or other highly liquid reserves that it estimates will be sufficient to meet these obligations. However, this type of self-insurance against liquidity risk imposes clear opportunity costs where it necessitates that banks forego less liquid but more profitable investments. It also demands that correspondent banks implement systems, processes, and controls designed to proactively monitor, model, and manage this liquidity risk.

Managing liquidity risk becomes even more challenging where cross-border payments contemplate conversion from one currency into another. For example, imagine that the customer of our respondent bank in Canada is a manufacturing firm that has produced a piece of specialized drilling equipment for a mining firm in Brazil. While the mining firm generates most of its revenue in Brazilian reals, the manufacturing firm only accepts payment in

[161] As defined by the CPMI, settlement risk is "the general term used to designate the risk that settlement in a funds or securities transfer system will not take place as expected. This risk may comprise both credit and liquidity risk." BIS, *Glossary* (Oct. 17, 2016), https://www.bis.org/cpmi/publ/d00b.htm?selection=42.

[162] *See* Bengt Holmstrom & Jean Tirole, *Private and Public Supply of Liquidity*, 106 Journal of Financial Economics 1 (1998). As defined by the CPMI, liquidity risk is the risk "that a counterparty, whether a participant or other entity, will have insufficient funds to meet its financial obligations as and when expected, although it may be able to do so in the future." BIS, *Glossary* (Oct. 17, 2016), https://www.bis.org/cpmi/publ/d00b.htm?selection=42.

Canadian dollars. To facilitate this payment, the correspondent bank in Brazil has two basic options. First, it can accept reals from the mining firm's Brazilian bank, acquire Canadian dollars from a foreign exchange dealer on the open market, and then use these dollars to pay the manufacturing firm's respondent bank. Yet this forces the correspondent bank to pay a commission, typically embedded in the spread between the dealer's quoted bid and asking prices, to purchase Canadian dollars. It also exposes the bank to what is known as *foreign exchange or FX settlement risk*: the risk that having delivered the purchase price in reals, the counterparty will fail to deliver the required dollars.[163]

The second option is for the correspondent bank to itself become a foreign exchange dealer: holding an inventory of foreign currencies, including both Canadian dollars and Brazilian reals, which it can then use in precisely these type of circumstances. The principal benefit of this option is that it eliminates the correspondent bank's reliance on foreign exchange dealers, while simultaneously transforming what would otherwise be a potentially significant cost—FX commissions—into a new and potentially lucrative source of revenue. By the same token, holding an inventory of currencies for the purpose of dealing in foreign exchange and facilitating cross-border payments forces the bank to actively monitor and manage the liquidity risk associated with each currency pair. It also exposes the bank to the risk—known as *FX risk*—of losses stemming from any volatility in the exchange rate between each currency pair over time.

Lastly, correspondent banks also incur significant costs to mitigate the risk that cross-border payments are being used to launder money or finance terrorism. To address these risks, banks are typically required to conduct due diligence when opening new customer accounts, including accounts opened by foreign respondent banks.[164] Both respondent and correspondent banks must also comply with the so-called "travel rule," which requires them to pass on the name, address, and account details of the payor, the identity and contact details of the intended recipient, and other prescribed information to each bank in the payment chain.[165] When a bank in the chain identifies a suspicious payment, it is then typically required to report it to the relevant regulatory agencies and law enforcement officials for further investigation.[166]

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[163] As defined by the Basel Committee on Banking Supervision, FX settlement risk "is the risk of loss when a bank in a foreign exchange transaction pays the currency it sold but does not receive the currency it bought." Basel Committee on *Banking Supervision, Supervisory Guidance for Managing Settlement Risk in Foreign Exchange Transactions* (Feb. 2013), https://www.bis.org/publ/bcbs241.pdf. FX settlement risk is sometimes referred to as *Herstatt risk*, named after a German bank that failed in June 1974 while owing several U.S. banks millions of U.S. dollars pursuant to the second leg of foreign exchange transactions. The failure of Herstatt Bank would eventually led to one of the few meaningful upgrades to the global settlement system over the past several decades, the Continuously-Linked Settlement (CLS) system; *see* ARMOUR ET AL., *supra* note __, at 398-400.

[164] In the U.S., see 31 U.S.C. § 5311 *et seq*.

[165] In the U.S., the travel rule went into effect for cross-border payments in May 1996; *see* Financial Crimes Enforcement Network, *Funds 'Travel' Regulations: Questions and Answers*, FinCEN Advisory, Issue 7 (Jan. 1997).

[166] For U.S. bank suspicious activity reporting requirements, see e.g. 12 C.F.R. 21.11, 21.21, & 163.180.

Understandably, establishing the internal systems, processes, and controls necessary to ensure compliance with these anti-money laundering and counter-terrorist financing (AML-CTF) requirements can be extremely costly—especially for correspondent banks, which must comply with the relevant requirements in each country in which they carry on business. A 2020 study conducted by LexisNexis put these global AML-CTF compliance costs at $213.9 billion, with banks in North America and Europe paying the vast majority of them.[167] In many cases, the regulatory fines and other penalties levied in connection with AML-CTF violations have ranged well into the billions of dollars.[168]

Successfully managing these settlement, liquidity, and FX risks can make correspondent banking extremely costly. Yet critically, these costs are not the same for all banks. Specifically, internationally active banks with large, diversified balance sheets and customer bases tend to enjoy greater long-term stability in terms of the aggregate demand for their deposits.[169] The more depositors a bank has, the more deposits these depositors hold, and the more diverse the needs of these depositors are in terms of the size, timing, and currency of cross-border payments, the less costly it will be for that bank to manage the resulting settlement, liquidity, and FX risks. Amplifying these economies of scale, large banks will typically be able to spread the largely fixed costs of establishing and maintaining the internal systems, processes, and controls necessary to manage these risks—along with AML-CTF compliance—over a larger volume of cross-border payments. They may also be in a better position to offer their customers sophisticated products and services like trade financing or derivatives that complement their demand for cross-border payments. Put simply: when it comes to correspondent banking, size really does matter.

Not surprisingly, the global correspondent banking system is today dominated by an increasingly small group of large dealer banks—most of them household names in the world of international banking and finance.[170] These global correspondent banks have historically enjoyed an extremely profitable franchise: generating revenue not only from transaction fees

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[167] *See* LexisNexis Risk Solutions, "True Cost of Financial Crime Compliance Study: Global Report" (June 2021) [on file with authors].

[168] *See e.g. U.S. Judge Accepts Danske Bank Guilt Plea in $2 Bln Pact to End Estonia Probe*, *REUTERS* (Jan. 5, 2023) (reporting that the bank was forced to pay $2.06 billion in fines in connection with AML-CTF violations); Kalyeena Makortoff, "Standard Chartered fined $1.1bn for Money-Laundering and Sanctions Breaches," *THE GUARDIAN* (Apr. 9, 2019) (reporting fines totaling $1.049 billion); Danielle Douglas, *Government Extracts $2 billion in Fines from JPMorgan in Madoff Case*, *THE WASHINGTON POST* (Jan. 7, 2014) (reporting $1.7 billion in fines for AML-CTF violations); Carrick Mollenkamp, *HSBC Became Bank to Drug Cartels, Pays Big For Lapses*, *REUTERS* (Dec. 11, 2012) (reporting $1.92 billion in fines for AML-CTF violations).

[169] *See* Alton Gilbert, *Economies of Scale in Correspondent Banking: Note*, 15 J. OF MONEY, CREDIT AND BANKING 483 (1983).

[170] For a detailed qualitative and quantitative description of the increasingly high concentration in the market for correspondent banking services and its drivers, see CPMI, *Quantitative Review of Correspondent Banking Data* (ending in 2022), https://www.bis.org/cpmi/paysysinfo/corr_bank_data.htm; CPMI, "Correspondent Banking" (Jul. 2016), https://www.bis.org/cpmi/publ/d147.pdf; BIS, *New Correspondent Banking Data—The Decline Continues* (2018), https://www.bis.org/cpmi/paysysinfo/corr_bank_data/corr_bank_data_commentary_1905.htm.

in connection with cross-border payments, but also more conventional float management, FX commissions, and other sources. While complete and accurate data is scarce, it has been estimated that, despite representing only around twenty percent of global payment *flows*, cross-border payments represent around fifty percent of global payment *revenue*.[171] As recently as 2016, McKinsey & Company could thus confidently observe that "revenue margins in cross-border payments have remained healthy over time."[172]

Importantly, these persistent and healthy margins drive a wedge between these global correspondent banks and the thousands of respondent banks that rely on them to send and receive cross-border payments. Most importantly, while respondent banks and their customers would obviously benefit from cheaper and faster cross-border payments, their correspondent banks have little incentive to cut prices or upgrade the antiquated network infrastructure that is the source of these fees.[173]

The fact that a handful of large banks both control the entire infrastructure for settling cross-border payments and profit from settlement delays has unfortunate, yet predictable, consequences. First, as the competitive gap between large and small banks has widened, many smaller banks have understandably started to retreat from their correspondent relationships. Between 2012 and 2018, the number of active corresponding relationships declined by twenty percent globally.[174] According to a study by the International Monetary Fund, this decline was driven by increased regulatory costs, including the "more rigorous prudential requirements" needed to reduce systemic risk and comply with ongoing AML-CTF obligations.[175]

Second, remaining correspondent banks have increasingly narrowed the range of payment corridors and currency pairs for which they are willing to provide correspondent banking services. A payment corridor represents the bilateral flow of payments between two countries. With 195 countries, that theoretically means that there are almost 19,000 individual payment corridors. Yet data collected by SWIFT and reported by the Bank for International Settlements (BIS) suggests that correspondent banks only processed cross-border payments in approximately 9,000 of these corridors in 2022, down more than twenty percent since

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[171] *See* McKinsey & Company, *Rethinking Correspondent Banking*, 9:23 *MCKINSEY ON PAYMENTS* (Jun. 2016).

[172] McKinsey & Company, *supra* note __, at 3.

[173] As again observed by McKinsey & Company: "As margins for domestic payments were squeezed by regulation and competition in recent decades, banks were forced to pare back costs and improve the efficiency of their systems and products. But cross-border payments have not yet experienced such pressures, so banks have had little incentive to work on their back-end systems and processes or to develop innovative customer offerings." *Id.*, at 3. *See also* Harry Newman, *SWIFT's Head of Banking, Linking Interbank Payment Systems Across Borders and Currencies: How Easy Is It?*, SWIFT Market Infrastructure Forum (Sept. 2016) (acknowledging that dealer banks have little incentive to coordinate in the development of multilateral global payment infrastructure).

[174] BIS, *The Decline Continues*, *supra* note __.

[175] *See* Michaela Erbenová, Yan Liu, Nadim Kyriakos-Saad, Alejandro López-Mejía, Giancarlo Gasha, Emmanuel Mathias, Mohamed Norat, Francisca Fernando & Yasmin Almeida, IMF Staff Discussion Note, *The Withdrawal of Correspondent Banking Relationships: A Case for Policy Action* 5 (Jun. 2016), https://www.imf.org/external/pubs/ft/sdn/2016/sdn1606.pdf.

2011.[176] Payments settled through these corridors are also increasingly concentrated in a small number of currencies, with at least one of the U.S. dollar, Euro, and British pound involved in over eighty percent of cross-border payments.[177] This data is consistent with the expectation that correspondent banks will inevitably follow the money and provide cross-border payments services in only the most profitable corridors and currencies. As a consequence, it is considerably easier and cheaper to send U.S. dollars from Canada to the United Kingdom than it is to send Indian rupees from Croatia to New Zealand. This advantage can be understood as a regressive global payment tax on less wealthy countries and regions.

Lastly, over time, correspondent banks have reduced the number and type of respondent banks they are willing to serve.[178] This retrenchment has targeted respondent banks that generate lower cross-border payment volumes, are located in jurisdictions that are perceived to be too risky, or that serve customers that are deemed to pose a higher risk from the perspective of AML-CTF compliance.[179] In particular, banks have frequently identified the higher operating costs associated with the expansion of AMF-CTF requirements as one of the principal drivers of their decision to withdraw correspondent banking services.[180] Whatever the underlying drivers, this ongoing process of "derisking" has contributed to a significant reduction in both the scale and footprint of the global settlement network for cross-border payments. Much like the increasing focus of correspondent banks on a small number of profitable corridors and currencies, this shrinking network footprint almost inevitably has an impact on access to cross-border payments.[181]

The withdrawal and increasing concentration of correspondent banking services has become a source of anxiety for global policymakers. The G20 has made enhancing cross-border payments a priority: with the FSB unveiling an aspirational "roadmap" in October 2020 and subsequently releasing periodic progress reports on key performance indicators.[182] International organizations and financial standard setters have also spearheaded several projects exploring the possibility of upgrading or altogether replacing the correspondent banking system. For example, the BIS has built a working prototype of a multilateral

[176] *See* CPMI *Quantitative Review*, *supra* note __, Chart Pack, at 2.

[177] *Id.*, at 15.

[178] *See generally*, Tara Rice, Goetz von Peter & Coducta Boar, *On the Global Retreat of Correspondent Banks*, *BIS QUARTERLY REVIEW* (Mar. 2020).

[179] *See* CPMI, *Correspondent Banking*, *supra* note __, at 11-13.

[180] *Id.*

[181] For a more detailed discussion of the relationship between derisking and financial exclusion, see U.S. Treasury Department, *The Department of Treasury's Derisking Strategy*, 37 (Apr. 2023), https://home.treasury.gov/system/files/136/Treasury_AMLA_23_508.pdf; U.S. Government Accountability Office, *Bank Secrecy Act: Views on Proposals to Improve Banking Access for Entities Transferring Funds to High-Risk Countries*, GAO-22-104792 (Dec. 16, 2021), https://www.gao.gov/products/gao-22-104792; Tracey Durner & Liat Shetrey, *Bank De-Risking and Its Effects on Financial Inclusion: An Exploratory Study*, Global Center of Co-operative Security Research Report (Nov. 2015).

[182] *See* FSB, *Enhancing Cross-Border Payments: Stage 3 Roadmap* (Oct. 13, 2020), https://www.fsb.org/2020/10/enhancing-cross-border-payments-stage-3-roadmap/.

settlement system—christened Project Nexus—designed to directly connect domestic FMUs to improve the speed, cost, and transparency of cross-border payments.[183] It has also launched Project mBridge, a blockchain-based payment network designed to facilitate cross-border payments using so-called central bank digital currencies (CBDCs).[184] Yet these initiatives have thus far yielded few tangible benefits, and policymakers have made little progress toward securing the type of domestic political commitments and investment necessary to ensure widespread network adoption.

There are several reasons for this lack of progress. First, in the absence of a global central bank, there is neither a single point around which to coordinate the necessary infrastructure development, nor a single sovereign balance sheet on which to settle cross-border payments. The absence of a global central bank also means there is no single authority responsible for ensuring consistency in the law and regulation governing network access, the prudential regulation and supervision of network participants, emergency lending facilities, AML-CTF compliance, and other requirements.[185] Compounding these coordination problems is the reality that different jurisdictions often possess different incentives depending on whether or not they view themselves as net beneficiaries under the current system. While some jurisdictions—including the U.S. and other large financial centers—reap enormous benefits from their position at the heart of the global correspondent banking system, others—including many developing countries—have long borne the costs of living on the financial periphery. Similarly, while the dominant role of the U.S. dollar in international trade, finance, and cross-border payment flows inevitably gives the U.S. government an influential seat at the table, the prospect of replacing the correspondent banking system with a multilateral settlement system designed by and for U.S. interests is difficult for domestic policymakers to sell in many parts of the world. These challenges make coordinating investment in the development of cheaper, faster, and more accessible payment networks extremely difficult at the global level.

Notably, channeling cross-border payments through the balance sheets of an increasingly small number of large banks has delivered one important benefit: *stability*. In effect, the stability of the global payment system is a byproduct of the domestic prudential regulatory and supervisory frameworks in each of the jurisdictions in which these banks carry on business.[186] This includes domestic discount window and lender of last resort facilities that

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[183] *See* BIS, *Enabling Instant Cross-Border Payments: Conclusions from a Technical Proof of Concept between the Eurosystem, Malaysia, and Singapore* (Mar. 2023), https://www.bis.org/publ/othp62.pdf; BIS, *Project Nexus: Enabling Instant Cross-Border Payments* (Jul. 2024), https://www.bis.org/publ/othp86.htm.

[184] *See* BIS, *Project mBridge: Experimenting with a Multi-CBDC Platform for Cross Border Payments* (Oct. 31, 2023), https://www.bis.org/about/bisih/topics/cbdc/mcbdc_bridge.htm,

[185] For a more detailed description of the nature and impact of coordination problems in the realm of international financial law, see Chris Brummer, *How International Financial Law Works (And How It Doesn't)*, 99 Georgetown Law Journal 257 (2011); WALTER MATTLI & NGAIRE WOODS, *THE POLITICS OF GLOBAL REGULATION* (2009).

[186] With a few notable exceptions, responsibility for the regulation and supervision of cross-border banks is typically divided up between "home" and "host" countries. Whereas the home country will have primary

enable these banks to borrow high quality liquid assets from central banks, denominated in their local currency, to meet their short-term liquidity needs. In theory, the only real gap in this patchwork framework stems from the prospect that these banks might need liquidity in a foreign currency. Yet here too the Federal Reserve has typically intervened in times of crisis: lending U.S. dollars to foreign central banks and thus serving as a *de facto* global lender of last resort.[187] Yet insofar as these regulatory frameworks and interventions erect barriers to entry and exacerbate the too-big-to-fail problem described in Part II.A, even this solitary benefit comes at a potentially significant cost.

The current global payment system is thus a tale of two networks. Reflecting the strong incentive compatibility forged by an industry-wide desire to cut costs, the first tale—SWIFT—is one of deep and sustained coordination, long-term investment and innovation, and the development of a world class financial telecommunications network. While the second tale—the correspondent banking system—involves many of the same protagonists, the narrative arc could hardly be more different. Reflecting structural incentive incompatibility at both the industry and political level, the story of the global correspondent banking system is ultimately one of multi-dimensional coordination failure, chronic underinvestment, rent extraction, and the entrenchment of antiquated and inadequate network infrastructure. For the people and businesses that rely on this infrastructure, the result has been slow, expensive and, for many, increasingly inaccessible cross-border payments.

III. THE CRITICAL ROLE OF NETWORK GOVERNANCE

These three case studies span almost the entire universe of electronic payment networks: from domestic to international, from highly concentrated to highly fragmented, and from antiquated to embryonic.[188] Yet each in their own way, these case studies illuminate both the incredible importance and difficulty of striking the right balance between network stability, access, and investment. In the United States, regulatory barriers to entry combine with economies of scale and network effects to enable the largest banks to generate enormous profits from their outdated payment infrastructure: undermining their incentives to innovate and contributing to chronic underinvestment. These same incentive problems can also be observed at the global level, where they are compounded by acute conflicts of interest and coordination problems at both the industry and political level. And in cryptoland, low

responsibility for consolidated regulation and supervision of the parent and any foreign branches, the host country will take on responsibility for the regulation and supervision of domestic subsidiaries, along with some limited responsibility for foreign branches; see ARMOUR ET AL., *supra* note __, at 627-628.

[187] *SEE* DANIEL MCDOWELL, *BROTHER CAN YOU SPARE A BILLION? THE UNITED STATES, THE IMF, AND THE INTERNATIONAL LENDER OF LAST RESORT* (2016); Dan Awrey, *Brother, Can You Spare A Dollar? Designing An Effective Framework for Foreign Currency Liquidity Assistance*, 3 COLUM. BUS. L. REV. 934 (2017).

[188] The most notable exception exclusion being networks—like Kenya's M-PESA—built on *telecommunications* instead of *financial* infrastructure. For a description of M-PESA and other so-called "mobile money" networks, see William Jack & Tavneet Suri, *Risk Sharing and Transaction Costs: Evidence from Kenya's Mobile Money Revolution*, 104(1) AM. ECON. REV. 183 (2014); Ignacio Mas & Dan Radcliffe, *Mobile Payments Go Viral: M-PESA in Kenya*, 32 CAPCO INST. J. OF FIN. TRANSFORMATION 169 (Aug. 2011).

regulatory barriers to entry have contributed to overinvestment and increased the risk of network instability. In each case, the failure to strike the right balance between stability, access, and investment has cut against important policy objectives: whether it be building faster, safer, and more convenient payment networks, expanding their reach, or making them more affordable for the households and businesses that rely on them.

These problems are all ultimately problems of network governance. The question thus becomes: what tools do policymakers need in order to successfully address them? There is no single answer to this question. The right combination of tools will inevitably depend on the context. Accordingly, rather than focusing on specific policy prescriptions, it makes more sense to identify the *range of governance tools* that policymakers should have in their arsenal and *when they should seek to use them*. In this final Part, we describe and evaluate three distinct sets of policy tools: open access and interoperability requirements, industry coordination and technical standard setting, and direct public involvement in the ownership, operation, and governance of payment networks. To be perfectly clear, none of these tools can completely solve the problems with payments: the tradeoffs between stability, access, and investment will almost certainly persist. What they can do is help the architects of modern payment networks better navigate these tradeoffs and ensure that their decisions about how to design, maintain, and upgrade these networks are made in the public interest.

Importantly, these policy tools are ordered on the basis of the level of government intervention they envision. Open access and interoperability requirements are designed simply to level the competitive playing field: with government intervention only required for the purpose of enforcing the rules of the game. Where the resulting competition fails to produce stable, accessible, and technologically integrated network infrastructure, policymakers can then intervene to coordinate private investment, encourage the development and adoption of industry technical standards, and thus provide the players with more support and a greater sense of direction. And as a last resort, where these players still prove incapable of building payment networks that advance the public good, policymakers can take the field themselves and—at least with the right expertise and incentives—show them how it's done.

A. Leveling the Playing Field

As we have already seen, one of the biggest problems with payments is that the combination of high regulatory barriers to entry, economies of scale, and network effects can give incumbent payment networks enormous market power. This market power can then undercut their incentives to invest in ongoing network improvements. Importantly, this power can also be wielded to erect artificial barriers to entry: whether by simply excluding new entrants from joining a network or by incorporating network features specifically designed to limit their compatibility with rival networks.[189] Critically, while antitrust law typically seeks to

[189] *See* Fiona M. Scott Morton, *Reforming U.S. Antitrust Enforcement and Competition Policy*, Washington Center for Economic Growth (Feb. 18, 2020), https://equitablegrowth.org/reforming-u-s-antitrust-enforcement-and-competition-policy ("firms have a financial incentive to restrain competition in order to obtain

restrain these abuses of market power, conventional antitrust remedies like monetary penalties, price controls, and enforced break-ups are not well-suited to these network industries, nor to combatting these particular types of anticompetitive behavior.[190] Monetary penalties will be inappropriate and ineffective where a payment network's dominant position stems from strong economies of scale and network effects rather than any anticompetitive conduct—or where incumbents can simply pass the costs onto their customers.[191] The imposition of price controls can dilute the incentives of both incumbent payment networks and aspiring new entrants to make investments in network development, maintenance, and upgrades. Similarly, unless policymakers can ensure a high level of interoperability, the network fragmentation associated with enforced break-ups can reduce economies of scale and network effects: thereby increasing marginal costs for network operators and making these networks more expensive and less convenient for their end users.

Two distinct yet complementary policy tools for addressing these problems are open access and interoperability rules. Open access rules are designed to ensure that new entrants enjoy nondiscriminatory access to existing network infrastructure. Examples of open access rules from outside the world of finance include the "common carrier" rules imposed on railroad operators by the Interstate Commerce Commission,[192] and the now-repealed "net neutrality" rules imposed on internet service providers by the Federal Communications Commission.[193] Interoperability rules, meanwhile, require competing firms to coordinate with each other to ensure a threshold level of technological compatibility or substitutability between their products and services. This includes "interconnection" rules that require firms to build, maintain, and connect to common network infrastructure through which these products and services are provided. One example of these type of interconnection rules is the requirement

monopoly profits. There are three main harmful methods of limiting competition: colluding with rivals in a market, merging with rivals or potential rivals, and using anticompetitive techniques to exclude existing or potential entrants."). For examples of cases where firms have used technical design features to erect artificial barriers to compatibility with rival networks, see e.g., Phillip Thibault Schrepel, *Predatory Innovation: The Definite Need for Legal Recognition*, 21 SMU SCI. & TECH. L. REV. 19 (2017); John Newman, *Anticompetitive Product Design in the New Economy*, 39 FL. ST. L. REV. 681 (2012). A frequently cited example from outside the world of payment networks is Tesla, which designed its charging stations so as to prevent the owners of other vehicle brands from using them; see Shannon Osaka, *Elon Musk Agrees to Open Parts of Tesla's Charging Network to Everyone*, *THE WASHINGTON POST* (Feb. 15, 2023), https://www.washingtonpost.com/climate-environment/2023/02/15/tesla-supercharger-network-locked/.

[190] For example, the Sherman Act theoretically prohibits this type of conduct; see 15 U.S.C. § 2 (2018) (criminalizing the monopolization of "any part of the trade or commerce among the several States, or with foreign nations").

[191] *See* Joshua C. Macey, *Zombie Energy Laws*, 73 VAND. L. REV. 1077, 1107-11 (2020) (explaining how the uneconomical dispatch of coal-fired generators by electrical power plants increases consumer costs).

[192] *See* Interstate Commerce Act, ch. 104, §§ 2-22, 24 Stat. 379, 379-387 (Feb. 4, 1887).

[193] *See* Protecting and Promoting the Open Internet, 30 FCC Rcd. 5601, 5603, ¶ 4 (2015) (adopting "carefully-tailored rules that would prevent specific practices we know are harmful to Internet openness—blocking, throttling, and paid prioritization—as well as a strong standard of conduct designed to prevent the deployment of new practices that would harm Internet openness"). The Federal Communications Commission repealed the net-neutrality rules in 2017. *See* Restoring Internet Freedom, 33 FCC Rcd. 311, 312-13 (2017).

under the Interstate Commerce Act for railroad operators to "construct, maintain, and operate" switches connecting their tracks to those of other railroads.[194] Another example is the rules under the Securities Exchange Act of 1934 that require securities clearinghouses and depositories to establish and maintain electronic interfaces with their competitors.[195]

Together, open access and interoperability rules are designed to provide an effective market-driven counterweight to problems of market power. Open access rules can ensure that powerful and entrenched incumbents do not use network access as a weapon against aspiring new entrants. Interoperability rules can similarly ensure that network industries—like payments—are able to capture the benefits of economies of scale and network effects without unnecessarily concentrating the delivery of network goods in the hands of a small group of large incumbents. By forcing these incumbents to bear at least some of the costs of any technological upgrades necessary to ensure ongoing connectivity, interoperability rules can also reduce barriers to new market entry. Viewed from this perspective, the principal benefit of these rules is that they promote *contestability*: the credible threat that new competitors, perhaps looking to take advantage of new technology, could one day enter the market and attract significant market share.[196] At least in theory, this threat can then provide incumbents with powerful incentives to make ongoing investments in network improvements designed to keep any potential competitors at bay.

Scholars and policymakers have advocated for the adoption of open access and interoperability rules across a wide range of network industries.[197] In the case of modern payment networks, the introduction of these rules would require policymakers to coordinate three separate but interwoven elements. The first element would be the creation of a prudential regulatory framework for financial institutions other than banks that enabled them to directly connect to clearinghouses and other FMUs without posing new risks to network stability.[198] Having complied with this new framework, these institutions would then be eligible to open central bank reserve accounts, thereby eliminating an important barrier to new market entry and ensuring universal settlement interoperability. The second element would be the adoption

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[194] *See* Hepburn Act, ch. 3591, § 1, 34 Stat. 584, 585 (Jun. 29, 1906) (amending the Interstate Commerce Act).

[195] *See* Securities Acts Amendments of 1975, sec. 15, § 17A(a)(2), 89 Stat. 97, 141 (codified at 15 U.S.C. § 78q-1(a)(2)(A)(i)-(ii). For a more detailed description of the interconnection requirements under the Securities Exchange Act, see Awrey & Macey, *The DTCC's Path to Monopoly*, *supra* note __.

[196] *See* Giulio Federico, Fiona Scott Morton & Carl Shapiro, *Antitrust and Innovation: Welcoming and Protecting Disruption*, 20:1 INNOVATION AND THE ECONOMY 1 (2020) ("[I]nnovation is best promoted when market leaders are allowed to exploit their comparative advantages while also facing pressure to perform coming from both conventional rivals and disruptive new entrants.").

[197] Including technology, finance, and energy; see LAWRENCE LESSIG, *THE FUTURE OF IDEAS* 34-38, 147-175 (2002); Lina Khan & David Pozen, *A Skeptical View of Information Fiduciaries*, 133 HARV. L. REV. 497, 539 (2019); Morgan Ricks, *Money as Infrastructure*, COLUM. BUS. L. REV. 757, 768-769 (2018); Randal Picker, *Pursuing a Remedy in Microsoft: The Declining Need for Centralized Coordination in a Networked World*, 158 J. OF INST. & THEOR. ECON. 113, 114-15 (2002).

[198] For one possible model of what this prudential regulatory framework might look like, see AWREY, *BEYOND BANKS*, *supra* note __, chapter 7.

of an open access rule designed to ensure that these institutions enjoyed nondiscriminatory access to FMUs. This rule would be particularly important in jurisdictions like the United States, where incumbent banks own and operate many of the major payment networks. The final element would be an interoperability rule requiring incumbents and new entrants to jointly develop and adopt technologically compatible systems for communicating, verifying, and reconciling electronic payment instructions. This rule would force competitors to coordinate across a wide range of technical issues: from relatively mundane decisions about the formatting of payment messages, to more fundamental decisions about the desirability of centralized hub-and-spoke versus decentralized web-based network architectures and how to connect them.[199]

Experience suggests that combining this type of vigorous competition, long-term investment, and joint decision-making would not be easy: especially where the costs of interoperability were not allocated efficiently between incumbent operators and aspiring new entrants.[200] Nevertheless, well-designed open access and interoperability rules could go along want toward leveling what has long been a decidedly uneven playing field.

B. Coordinating Private Standard Setting

Open access and interoperability rules can promote greater *competition*. But building, maintaining, and upgrading network infrastructure frequently requires that this competition be combined with effective industry *coordination*. As we saw in the case of SWIFT, the desire to drive down operating costs will sometimes be sufficient to compel competitors to work together to harness new technology or solve common technical challenges.[201] Yet in many other cases, these cost efficiencies will simply be too small, or the coordination costs too high, to sustain this type of longer term collaboration. In the case of the global correspondent banking system, this lack of coordination has contributed to chronic underinvestment that, especially in recent years, has translated into growing barriers to access. In the case of the crypto ecosystem, it has resulted in a frenzy of new investment—with hundreds of firms raising and spending tens of billions of dollars—followed by a sudden collapse and, at least as of writing, only modest success in building stable, accessible, and scalable network infrastructure.

The fact that industry coordination is both necessary and yet far from guaranteed points to a potentially constructive role for central banks and other policymakers in helping

[199] For a real-world illustration of the type of technical challenges that payment networks must address in order to ensure this type of clearing interoperability, see ISO 20022, Universal Financial Industry Message Scheme, https://www.iso20022.org/about-iso-20022.

[200] *See* Awrey & Macey, *The DTCC's Path to Monopoly*, *supra* note __ (describing how the interoperability rules imposed under the Securities Exchange Act placed a disproportionate burden on smaller clearinghouses and depositories, ultimately contributing to—rather than preventing—industry consolidation).

[201] Beyond payments, prominent examples of this type of private sector coordination in finance include CLS Bank, securities and derivatives clearinghouses, and the International Swaps and Derivatives Association master agreements and supporting documentation for derivatives.

to support the development and adoption of private network infrastructure. This role would demand that policymakers take a more proactive approach toward acquiring the technical expertise needed to understand the challenges and opportunities presented by new technology, establishing lines of communication with a wide range of industry stakeholders, and using their convening power to bring these stakeholders together to solve their common challenges. This role would be particularly valuable in the context of legal, operational, and technological standard setting: where the race for the market may otherwise lead to duplicative and non-interoperable network infrastructure. Not only would a greater role for policymakers help reduce overinvestment during periods of rapid technological disruption, common technical standards would promote scalability for those networks that eventually won the race. Playing a more proactive role would also mean that policymakers were in an advantageous position to ensure that network stability, access, and other policy objectives were sufficiently foregrounded as part of the standard-setting process.

Looking ahead, sustained industry coordination will likely be required across several critical dimensions. In the United States, policymakers still need to find a way to fully integrate P2P payment platforms like PayPal, Venmo, and Cash App into conventional payment networks. At the global level, policymakers need to decide whether they want to replace the rapidly aging correspondent banking system: and, if so, work with banks and other key stakeholders to design and build a new global payment network. And then there is crypto. Should policymakers wish to explore this path, it would require comprehensive technical standard setting to bridge what is currently a highly fragmented and largely non-interoperable patchwork of rival networks. Today, the largest stablecoin—Tether—is currently held on sixty-six different and often incompatible blockchain networks.[202] The second largest—USDC—is held on sixty-five networks.[203] As a practical matter, this fragmentation can make it difficult and expensive to make payments using these stablecoins. More fundamentally, there is the complex and thorny question of how to safely connect the stablecoin ecosystem with conventional bank-based payment networks. Inevitably, the opportunities and risks associated with these developments will be viewed differently from the perspective of entrenched incumbents than aspiring new entrants. And even where incumbents and new entrants successfully coordinate in the development of new infrastructure, there is no guarantee that it will strike the right balance between network stability and access, or help advance other policy objectives. This frames the important role that policymakers can play in bending the arc of network development toward the public good.

Like open access and interoperability rules, playing a more proactive role in technical standard setting and coordinating network development will not be easy. Beyond acquiring the expertise necessary to play this more substantive role, policymakers would need to decide on the appropriate forum through which to promote greater coordination. They would also need to decide which stakeholders to invite to the table. An illustrative example of the

[202] *See* Defi Llama, *Tether (USDT)*, https://defillama.com/stablecoin/tether (last accessed February 2, 2024).

[203] *See* Defi Llama, *USDC Coin (USDC)*, https://defillama.com/stablecoin/usd-coin (last accessed February 2, 2024).

importance—and perils—of these decisions is the Federal Reserve's Faster Payment Task Force. Created in May 2015, the Task Force was created to "identify and evaluate alternative approaches for implementing safe, ubiquitous, faster payments."[204] The Task Force's participants were drawn from a wide range of stakeholders including the public sector, a broad cross-section of banks, non-bank payment platforms, business payment users, and consumer advocacy groups. Over the next two years, the Task Force identified the most desirable attributes of a faster payment system, solicited evidence regarding the current state of technological capabilities, and identified and evaluated the various options. The Task Force also developed a series of detailed recommendations focusing on the governance, regulation, infrastructure development, sustainability, and evolution of any new real-time payment system. They also expressed a commitment to promoting greater interoperability, improving cross-border payments, and ensuring "broader access to Federal Reserve settlement services" in order to "level the playing field and enhance competition."[205] The Task Force's final report—optimistically entitled "A Call to Action"—was published in July 2017.[206]

The fact that the Task Force involved more than 300 stakeholders with divergent positions and interests always meant that taking action on the basis of these recommendations was going to be difficult. Yet arguably the real problem was the failure of the Federal Reserve and other government stakeholders to continue to invest resources in building faster payments after the Task Force published its final report. In the event, this vacuum was filled by a consortium of the largest commercial banks, which unilaterally launched the RTP network just months after the report was issued.[207] Not surprisingly, while RTP was successful in creating the first real-time payment network in the United States, it did not follow through on the Task Force's commitment to greater interoperability, access, or competition.

Looking across the global payment industry today, one might be tempted to think that these types of coordination problems are a thing of the past. The recent completion of the ISO 20022 standards for payment messaging, which involved over 150 national standard setting bodies and includes more than 21,000 individual standards, is a case in point.[208] So too are initiatives like the Regulated Liabilities Network, Project mBridge, and Project Nexus. And even in the crypto ecosystem, there are pockets of sustained coordination amidst the vast sea of competing networks. Yet even where private standard setting and industry coordination already exist, there will still be valuable opportunities for policymakers to promote socially desirable tradeoffs between network stability, access, and investment. By carving out a

[204] *See* Faster Payments Task Force, Task Force Charter (May 2015), https://fasterpaymentstaskforce.org/meet-the-task-force/mission-and-objectives/.

[205] Faster Payments Task Force, *The U.S. Path to Faster Payments: Final Report Part 2: A Call to Action* 31 (Jul. 2017), https://fasterpaymentstaskforce.org/wp-content/uploads/faster-payments-task-force-final-report-part-two.pdf.

[206] *Id.*

[207] *See* Press Release, *First New Core Payments System in the US in More than 40 Years Initiatives First Live Payments*, The Clearing House (Nov. 14, 2017), https://www.theclearinghouse.org/payment-systems/articles/2017/11/20171114-rtp-first-new-core-payments-system.

[208] For further details regarding ISO 20022, *supra* note __.

permanent seat for themselves, policymakers can ensure that they will always be at the table when these opportunities arise.

C. Building Public Network Infrastructure

Inevitably, the combination of vigorous competition and sustained industry-wide coordination will not always be possible. In many parts of the world, neither incumbents nor potential new entrants possess the financial, human, or other resources to build, maintain, and upgrade stable, scalable, and widely accessible electronic payment networks. At the other end of the spectrum, in the midst of fierce competition for the market, rival payment networks may have relatively weak incentives to engage in meaningful coordination and collaboration. Similarly, the technological and incentive gaps between incumbents and aspiring new entrants may simply be too wide for policymakers to bridge. In these cases, direct public sector investment, design, and oversight may be the best or even only option.

Two recent examples help illustrate when this type of direct public sector intervention may be necessary. The first is Brazil. Less than a decade ago, Brazil was also home to a stubbornly large unbanked and underbanked population that was consistently around one third of the total population.[209] Despite the efforts of the Brazilian Central Bank (BCB) to encourage incumbent banks to modernize their antiquated payment infrastructure, it was also home to one of the world's slowest and most expensive electronic payment networks. To address these problems, and advance its mandate to promote "financial citizenship," the BCB introduced a new real-time payment network in November 2020. Known as Pix, this network enables retail customers to send and receive money for free using a mobile phone app, without the need to open a bank account or share sensitive personal information.

Importantly, not only did the BCB directly invest financial and human capital in the development of Pix, it also made a series of critical decisions about network design and access.[210] These decisions included the development of an open API and then requiring all incumbent banks to invest in the technological upgrades necessary to connect to the new network. They also included opening up access to the Pix network to institutions and platforms outside the conventional banking system: leveraging their superior technological expertise and cutting edge products and services to help drive network adoption and expansion. To date, the results have been extremely encouraging. Less than three years after its launch, Pix was being used by approximately eighty percent of Brazil's adult population and

[209] *See* World Bank, The Global Findex Database (2021), https://www.worldbank.org/en/publication/globalfindex/Data (reporting that only sixty-eight percent of Brazilians over the age of 15 had a bank account in 2014). *See also Digital Payments Have Gone Viral in Brazil*, THE ECONOMIST (May 14, 2022); Angelo Duarte, Jon Frost, Leonardo Gambacorta, Priscilla Koo Wilkens & Hyun Song Shin, *Central Banks, the Monetary System, and Public Payment Infrastructures: Lessons from Brazil's Pix*, BIS Bulletin No. 52 (Mar. 23, 2022), https://www.bis.org/publ/bisbull52.htm.

[210] *See* AWREY, *BEYOND BANKS*, *supra* note __, chapter 6.

more than 13 million businesses.[211] By October 2023, Pix was processing over 4 billion transactions per month.[212] This rapid adoption has been accompanied by a dramatic decrease in Brazil's unbanked population, down from 32 percent in 2014 to just 16 percent in 2021.[213] In fact, even incumbent banks have reportedly shared in the benefits: generating significantly higher fees from the almost fivefold increase in electronic payment volumes and the opportunity to sell other banking products to a rapidly expanding customer base.[214]

The second example is India. Much like Brazil, India has long struggled with a large unbanked population and other problems stemming from widespread financial exclusion.[215] In 2016, India's central bank, the Reserve Bank of India (RBI), announced the launch of the Unified Payment Interface (UPI). Like Pix, UPI is built on an open API that allows banks and other financial institutions to directly connect to the RBI's existing real-time settlement infrastructure.[216] Yet unlike Pix, UPI was actually a joint venture with the Indian Bankers Association and the country's incumbent banks. As a consequence, all UPI users are required to have a bank account.[217] Despite this requirement, UPI has been a tremendous success: with the number of transactions increasing from zero in April 2016 to over 10 billion per month as of October 2023 (*see* Figure 7).[218] At least as measured by this metric, this makes UPI the largest real-time payment network in the world.[219]

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[211] *See* IMF, *Pix: Brazil's Successful Instant Payment System*, IMF Western Hemisphere Department (Jul. 31, 2023), https://www.elibrary.imf.org/view/journals/002/2023/289/article-A004-en.xml.

[212] *See* Banco Central Do Brasil, *Pix Statistics*, https://www.bcb.gov.br/en/financialstability/pixstatistics.

[213] *See* World Bank, Findex Database, *supra* note __.

[214] *See* Sergey Sarkisyan, *Brazil's Pix Payment System Teach Us a Valuable Lesson*, THE BANKER (Feb. 24, 2023), https://www.thebanker.com/Brazil-s-PIX-payment-system-teaches-us-a-valuable-lesson-1677229744.

[215] *See* World Bank, Findex Database, *supra* note __ (reporting that only fifty-three percent of Indians over the age of 15 had a bank account in 2014).

[216] *See* Jeff Kearns & Ashlin Mathew, *How India's Central Bank Helped Spur a Digital Payments Boom*, IMF County Focus (Oct. 27, 2022), https://www.imf.org/en/News/Articles/2022/10/26/cf-how-indias-central-bank-helped-spur-a-digital-payments-boom.

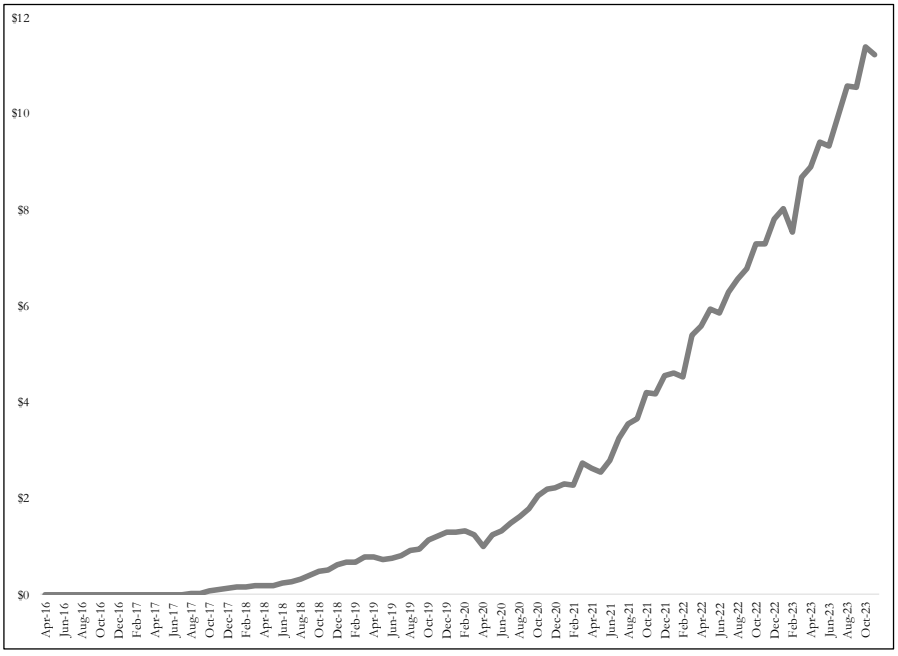
[217] *See* Reserve Bank of India, Unified Payment Interface, https://www.centralbankofindia.co.in/en/upi ("Customer needs a Bank account and a smart phone").

[218] *See* National Payments Corporation of India, *UPI Product Statistics*, https://www.npci.org.in/what-we-do/upi/product-statistics.

[219] *See* Abhinav Singh, *India Retains Top Spot in Real-time Digital Payment Transactions: Report*, THE WEEK (Mar. 31, 2021), https://www.theweek.in/news/biz-tech/2021/03/31/india-retains-top-spot-with-255-billion-real-time-payment-transactions-report.html.

Figure 7

Growth in Number of Transactions on UPI (billions)



Source: Reserve Bank of India

The introduction of UPI has supported a wave of technological innovation that today enables over 300 million customers and 50 million small businesses to send and receive payments via their mobile phones at a tiny fraction of the cost of electronic payments in many other jurisdictions.[220] It has also coincided with a dramatic fall in India's unbanked population: down from approximately 47 percent in 2017 to around 20 percent in 2021.[221] This success has prompted some observers to put forward UPI's open framework for real-time payments as a potential model for other countries—including the United States.[222]

Yet while there is no doubt that policymakers can design, build, and operate payment networks, these types of ambitious public infrastructure projects come with significant and generally well understood risks. Perhaps most importantly, these public infrastructure projects come with the risk that policymakers, having identified an apparent market failure, will themselves fail to successfully execute them. A potentially illustrative example is the Federal

[220] *See* Mujib Mashal & Hari Kumar, *Where Digital Payments, Even for a 1-Cent Chai, Are Colossal in Scale*, *THE NEW YORK TIMES* (Mar. 1, 2023).

[221] *See* World Bank, Findex Database, *supra* note __.

[222] *See* Letter from Mark Isakowitz, Vice President of Government Affairs and Public Policy, Google, to the Federal Reserve Board (Nov. 7, 2019), Docket No. OP-1670, https://www.federalreserve.gov/SECRS/2019/December/20191227/OP-1670/OP-1670_110719_136981_396266957468_1.pdf.

Reserve's recently unveiled real-time payment network, known as FedNow.[223] FedNow was launched in July 2023[224] and was almost immediately met with criticism from both the banking industry and consumer advocacy groups.[225] As a preliminary matter, FedNow was launched almost six years after a consortium of large U.S. banks introduced RTP. And while FedNow and RTP both share the same basic network structure, operating features, and fee structures, the Federal Reserve did not follow through on its original plan to make the two networks interoperable. As a consequence, not only has the Federal Reserve sunk time, money, and other public resources into a payment network that effectively duplicates an existing private sector network, it did so in a way that prevented this new network from benefiting from the economies of scale and network effects generated by its more established rival.

Further compounding matters, the Federal Reserve apparently did not view FedNow as an opportunity to address longstanding problems of payment network access or financial exclusion. Banks are under no legal obligation to connect to FedNow, nor offer their customers real-time payments. In fact, banks have the option of connecting to FedNow exclusively for the purpose of *receiving* real-time payments, but not *sending* them. Unlike UPI and Pix, there is also no FedNow app or other electronic user interface that would allow households and businesses to directly access this network to send and receive money. Where participating banks themselves do not integrate FedNow into their own customer-facing platforms, this means that businesses and households will be forced to directly contact their bank in order to request that individual payments be made using the new service—thus cutting against the greater speed and convenience generally associated with real-time payments.

Given this puzzling combination of network features, it should come as no surprise that fewer than 500 of America's 9,000 plus banks and other insured depository institutions have become FedNow participants as of January 2024.[226] And while the Federal Reserve has yet to release any data on whether customers are actually using the new network, there is little reason to think that—at least in its current form—it will ever enjoy widespread adoption. For policymakers contemplating building their own payment networks, FedNow may thus come to represent something of a cautionary tale: direct public sector involvement does not by itself translate into good payment network governance.

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[223] The Federal Reserve has a long history of undertaking payment infrastructure projects including the creation of the national check processing system magnetic ink process and the ACH system; *see* Conti-Brown & Wishnick, *supra* note ___, at 406–15.

[224] Press Release, *Federal Reserve Announces That Its New System for Instant Payments, the FedNow® Service, Is Now Live* (Jul. 20, 2023), https://www.federalreserve.gov/newsevents/pressreleases/other20230720a.htm.

[225] *See 10 Questions for the FedNow Launch*, BANK POLICY INSTITUTE (Jul. 19, 2023), https://bpi.com/ten-questions-for-the-fednow-launch/; Emma Peaslee, Morning Edition, *Banks are Taking Their Time Adopting FedNow, a Faster Way to Send Money*, National Public Radio (Oct. 6, 2023), https://www.npr.org/2023/10/06/1204098178/banks-are-taking-their-time-adopting-fednow-a-faster-way-to-send-money.

[226] *See* FRB Services, *FedNow® Service Participants and Service Providers*, https://www.frbservices.org/financial-services/fednow/organizations (count accurate as of January 7, 2023).

CONCLUSION

The failures of modern payment networks are not attributable to a single legal, technological, or other problem. Instead, they reflect a complex and interconnected constellation of problems with who makes decisions about the design of modern payment networks, their incentives, and the tradeoffs they face between network stability, access, and investment. Together, these problems frame the critical role of network governance in ensuring that these decision-makers successfully navigate these tradeoffs and advance important policy objectives like network stability, competition, and financial inclusion. They also frame the constructive role that policymakers can play in promoting a level playing field, coordinating the development and adoption of new payment technology, and ensuring that the resulting network infrastructure serves to advance the public good.

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