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Money Creation and Bank Clearing

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Like many other countries, the U.S. money supply consists primarily of deposits created by private commercial banks. How we understand bank money creation matters enormously. We are currently witnessing a debate between two competing understandings. On the one hand, a long-standing conventional view argues that bank money creation originates in individual market transactions. Based on this understanding, the conventional view narrowly limits the scope of banking regulation to market failure correction. On the other hand, authors in a new legal literature emphasize the public aspects of bank money creation, characterizing it as a "public franchise," a "public-private partnership," and part of the "social contract." This new legal literature has a broader vision of banking regulation, and has raised ambitious proposals in areas including financial stability, civil rights, climate action, and financial technology.

This Article bridges a gap in the new literature that has held it back from achieving its full potential. While the new literature recognizes bank money creation as public in important ways, it has dedicated little attention to the question of how banks are able to engage in money creation in the first place, thereby leaving key aspects of the conventional account unchallenged. The Article fills this gap by focusing on the process of clearing, through which banks pay trillions of dollars in obligations they owe each other every day. To assess the conventional account, the Article presents a case study of daily clearing practice in an environment that seems as market driven as

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possible: the New York Clearing House Association prior to the creation of the Federal Reserve system. Building on novel primary sources, the case study demonstrates that daily clearing presented NYCHA banks with serious challenges. Addressing these challenges required governance both at the level of the state, and through bank cooperation on nonmarket terms. These findings expand our understanding of how bank money creation occurs and how it should be regulated.

INTRODUCTION

Like many other countries, the U.S. money supply consists primarily of deposits created by private commercial banks. The $18 trillion in these deposits far exceed the $2 trillion in cash, currency directly issued by the government.[1] Deposits are commonly referred to as "money" because they

1. *Deposits, All Commercial Banks*, FED. RSRV. BANK ST. LOUIS (Jan. 21, 2022), https://fred.stlouisfed.org/series/DPSACBW027SBOG [https://perma.cc/G2MD-WG53] [hereinafter *Deposits*]; *Liabilities and Capital: Liabilities: Federal Reserve*

are the most common form of payment in the economy, from buying a cup of coffee, to payroll, to paying for a house or a securities transaction.[2] In jargon, one speaks of "bank money creation," to capture commercial banks' ability to issue deposits and the monetary use of these deposits. Given money's elemental role in economic activity, how we understand bank money creation matters enormously.[3]

We are currently witnessing a high-stakes debate between two competing understandings. On the one hand, a long-standing conventional view holds that bank money creation originates in individual market transactions. As that account goes, the countless individual choices of banks, depositors, and borrowers ultimately produce bank money creation as a generally efficient private arrangement.[4] Based on this understanding, the conventional view has for decades limited the scope of U.S. banking regulation to the relatively narrow task of market failure correction. Exceptions to this notion are so narrow they highlight the norm.[5]

On the other hand, since the Global Financial Crisis of 2007-2009 (the "GFC"), an emerging legal literature has recognized bank money creation as a "public franchise,"[6] a "public-private partnership,"[7] a "public utility,"[8] and part of the "social contract."[9] This approach enables scholars to identify the ways banking produces, impacts, or exacerbates some of society's most

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Notes, Net of F.R. Bank Holdings: Wednesday Level, FED. RES. BANK ST. LOUIS (Jan. 19, 2022) https://fred.stlouisfed.org/series/WLFN [https://perma.cc/3PYB-QSAY].

2. *See infra* Section I.A.

3. For money's role in shaping economic activity, see CHRISTINE DESAN, MAKING MONEY: COIN, CURRENCY, AND THE COMING OF CAPITALISM (2014); Roy Kreitner, *Legal History of Money*, 8 ANN. REV. L. & SOC. SCI. 415 (2012).

4. *See infra* Section I.B.

5. *See* discussion of bank runs, public supports, and the ensuing need to address moral hazard, *infra* Section I.B.

6. Robert C. Hockett & Saule T. Omarova, *The Finance Franchise*, 102 CORNELL L. REV. 1143, 1147 (2017).

7. *See* MORGAN RICKS, THE MONEY PROBLEM: RETHINKING FINANCIAL REGULATION 200 (2016).

8. *See* Morgan Ricks, *Money as Infrastructure*, 2018 COLUM. BUS. L. REV. 757, 763-64 (2018).

9. Mehrsa Baradaran, *Banking and the Social Contract*, 89 NOTRE DAME L. REV. 1283, 1313 (2014). Other contributions to this literature include Adam J. Levitin, *Safe Banking: Finance and Democracy*, 83 U. CHI. L. REV. 357 (2015); Nadav Orian Peer, *Negotiating the Lender of Last Resort: The 1913 Federal Reserve Act as a Debate over Credit Distribution*, 15 N.Y.U. J.L. & BUS. 367, 369 (2019); Lev Menand, *Why Supervise Banks? The Foundation of the American Monetary Settlement*, 74 VAND. L. REV. 951, 967 (2019); Dan Awrey, *Bad Money*, 106 CORNELL L. REV. 1, 3 (2020).

pressing challenges: financial instability, racial and wealth inequality, climate change, and financial technology ("fintech").[10] Scholars in the new literature have made a number of ambitious proposals in all these areas: proposals for panic proofing the financial system,[11] increasing access to credit and financial services in underserved communities,[12] funding the green economy,[13] and creating an inclusive central bank digital currency.[14] Ideas and proposals from the new literature are increasingly entering the public conversation, including in legislative and adjudicative settings.[15]

This Article bridges a gap in the new literature that, despite its many achievements, has held it back from achieving its full potential. The new literature has dedicated little attention to the question of how banks are able to engage in money creation in the first place, thereby leaving key aspects of the conventional account unchallenged. The new literature, for example, emphasizes the dramatic government interventions that stabilize bank money creation in crisis times like the GFC and the March 2020 financial market disruptions due to COVID-19.[16] This is evidence that bank money creation has a public dimension. But holders of the conventional view respond that crises are localized failures in market activity that can only justify narrowly targeted interventions, including stabilization and central bank lending-of-last-resort in times of crisis, and prudential regulation in ordinary times, e.g., capital and liquidity

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10. For proposals, see notes 11-14 *infra*.

11. For two different proposals designed to enhance stability, see Ricks, *supra* note 8; Levitin, *supra* note 9.

12. *See, e.g.*, Mehrsa Baradaran, *It's Time for Postal Banking: The USPS Should Help Extend Credit to the Unbanked Population*, 127 HARV. L. REV. F. 165, 168 (2014); John Crawford et al., *FedAccounts: Digital Dollars*, 89 GEO. WASH. L. REV. 113, 127 (2021).

13. *See, e.g.*, ROBERT. C. HOCKETT, FINANCING THE GREEN NEW DEAL: A PLAN OF ACTION AND RENEWAL (2020).

14. *See generally* Saule T. Omarova, *The People's Ledger: How to Democratize Money and Finance the Economy*, 74 VAND. L. REV. 1231 (2021).

15. *See, e.g.*, *Nomination Hearing of Dr. Saule T. Omarova to the Comptroller of the Currency, Before the S. Comm. on Banking, Hous., & Urb. Aff.*, 117th Cong. (2021); Brief of Thirty-Three Banking Law Scholars as Amici Curiae, Lacewell v. Off. of Comptroller of Currency, 999 F.3d 130 (2d Cir. 2021) (No. 50) (opposing the OCC's fintech charter); TNB U.S.A. Inc. v. Fed. Rsrv. Bank of N.Y., No. 1:18-CV-7978 (ALC), 2020 WL 1445806 (S.D.N.Y. Mar. 25, 2020) (denying The Narrow Bank's petition for relief against the New York Fed's refusal to open a master account); S. 579, Sen. No. 665, 192d Gen. Ct. (Mass. 2021) (a bill to establish a Massachusetts Public Bank).

16. *See, e.g.*, Baradaran, *supra* note 9, at 1284-85; Awrey, *supra* note 9, at 4-5.

requirements. These are far narrower measures than the new literature's reform proposals in financial stability, civil rights, climate policy, etc. As long as the methodological individualism of the conventional approach prevails, the new literature will keep running into this difficulty.[17] What is needed is direct engagement with the conventional view's premise that bank money creation arises from individual market decisions, and as such, enjoys a presumption against any but the narrowest interventions.

This Article fills this gap by focusing on bank clearing. Clearing is the crucial but little discussed process through which banks pay trillions of dollars in obligations they owe to each other every day.[18] These large obligations are a direct outcome of the monetary function deposits serve in our economy. Every time a depositor makes a payment to a recipient in another bank, that transaction must clear. How banks manage to clear these vast obligations on an extremely tight timeline, ought to be a central question for any theory of bank money creation. But despite its ubiquity in day-to-day practice, clearing is strikingly absent from the conventional view.[19] Instead, its focus is on the relationship between depositors and their banks, and the conditions under which depositors maintain sufficient trust in banks' ability to redeem their deposits. That is the trust that is undermined in crisis and can lead to bank runs and financial panics. Meanwhile, the conventional view leaves aside the ways in which banks manage to clear the trillions of obligations they owe to each other every day. This neglect of day-to-day practice is based on an impression that clearing is an easy process, one that does not raise any particular

17. Another example is the turn to endogenous money theory in some of the new literature. *See, e.g.*, Hockett & Omarova, *supra* note 6. Endogenous money theory highlights that bank deposits are created through the process of bank lending, without need for preexisting deposits of physical currency (a common assumption in textbook models; for an extensive discussion of endogenous money theory and its historical origins, see L. RANDALL WRAY, MONEY AND CREDIT IN CAPITALIST ECONOMIES: THE ENDOGENOUS MONEY APPROACH (1990)). To be sure, to many, grasping the more proactive role that banks play in money creation casts them in a more public light. At the same time, endogenous money views are today ubiquitous in policymaking circles. These views have been easily assimilated into the conventional understanding that bank money creation is private, and regulation should be limited to market failure correction.

18. *See infra* Section I.A. My interest in clearing builds takes its inspiration from the work of financial economist Perry Mehrling. *See, e.g.*, PERRY MEHRLING, THE NEW LOMBARD STREET (2010).

19. *See infra* Section I.B.

difficulties to banks, and is therefore not integral to bank money creation.[20] The new literature has not dispelled that impression.[21]

Assessing the impression that clearing is easy involves several methodological difficulties. At the most basic level, modern clearing practice is fundamentally shaped by the activities of central banks.[22] The central bank's daily involvement in clearing removes many of the challenges banks would have otherwise faced if left to their own devices. Meanwhile, the key role that central banks play in clearing remains largely invisible: we overlook the governance work that actually makes clearing possible.[23] To truly assess the conventional view's account, we must study the workings of clearing in an environment predating the modern central bank. To this extent, this Article presents a case study of the New York Clearing House Association (the "NYCHA") prior to the creation of the Federal Reserve system in 1913.[24] During that time, the NYCHA stood at the apex of the U.S. payments system, and cleared not only local New York transactions, but a large portion of the country's interregional payments. The case study builds on previously unexplored primary sources to reconstruct a highly detailed picture of daily practice at the NYCHA.[25] If NYCHA members indeed faced serious challenges in their daily clearing and those were not solved through private contracting, such findings would call into question the conventional view's account of bank money creation. That is indeed what we find.

Specifically, NYCHA banks faced large and threatening clearing "drains" in their day-to-day operations.[26] Contrary to modern assumptions, these drains were not managed through contracting between the NYCHA

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20. *See infra* Part II.

21. While the new literature includes a number of discussions of clearing, these discussions do not provide a comprehensive account of the daily challenges clearing involves, and how they are met in practice. *See, e.g.*, Hockett & Omarova, *supra* note 6, at 1162; RICKS, *supra* note 7, at 58-61; Awrey, *supra* note 9, at 20-22. *But see* discussion, *infra* note 23.

22. *See infra* Part II.

23. Hockett & Omarova take a step towards addressing that governance work when they discuss the central bank's accommodation of bank money creation as part of its role in presiding over the payments system and administration of monetary policy. Hockett & Omarova, *supra* note 6, at 1162.

24. *See infra* Part III.

25. While the NYCHA has been the studied by financial historians, those works focused on rare crisis dynamics rather than daily routines. *See infra* discussion and references in Part III; *see infra* note 118 and accompanying text.

26. *See infra* Section III.B.

banks. Instead, these banks were able to successfully clear by relying on two distinct forms of governance. The first was a very large amount of reserves of state issued money that enjoyed legal tender status under the law.[27] These reserves were not held merely to satisfy regulatory requirements or meet withdrawals from depositors, but for actively meeting clearing drains. The second form of governance was undertaken by cooperation among the NYCHA banks themselves. To keep their reserve position in-tact, the NYCHA banks did not trade reserves among themselves as predicted by economic theory. Instead, these banks created a system of "secondary reserves" by making overnight loans to stockbrokers on the New York Stock Exchange, and carefully recycling their clearinghouse balances through these brokers.[28] At a sum total, the case study demonstrates that bank money creation relied on clearing, and that clearing relied on governance, some of which was provided by the state (the issuer of reserves), and some was provided through non-market cooperation among the banks. In modern times, central banks fulfill similar daily functions and help commercial banks overcome challenges they cannot overcome through market activity.

By highlighting the role of governance in bank money creation, the article provides a stronger foundation for the new literature on the public dimensions of bank money creation.[29] This foundation responds to the conventional view that bank regulation should be narrowly limited to market failure correction. The workings of bank money creation—even in ordinary times—are far more complex than suggested by the image of simple contracting between banks, depositors, and borrowers. There is no reason to afford a presumption of market efficiency to a system that relies on considerable nonmarket components for its operation, not only rarely, in crisis, but daily, in its most quotidian operations. Recognizing the key roles of clearing, and governance in clearing, thus opens greater space for discussion of recent reform proposals raised in the new literature. One can, of course, disagree with these proposals as a matter of substance. But the notion the proposals are prima facie flawed because they "tinker" with market transactions is at odds with the history.

The remainder of the Article proceeds as follows. Part I introduces the key concepts involved in clearing and explains why clearing is essential

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27. *See infra* Section III.B.

28. *See infra* Section III.C.

29. My interest in the governance that enables money creation takes its inspiration from Christine Desan's CONSTITUTIONAL APPROACH TO MONEY. *See* DESAN, *supra* note 3, at 775.

to bank money creation. It then surveys the conventional view's account of bank money creation pointing out to its abstraction from clearing. Part II discusses three specific assumptions authors use to justify their abstraction from clearing: first, that netting of obligations is freely available to banks; second, that the probabilistic law of large numbers prevents banks from experiencing destabilizing clearing drains; and third, that interbank markets offer a solution to drains even if they do occur. This Article argues that these assumptions miss the challenges clearing raises because they take for granted the proactive role that central banks play in modern clearing. Part III provides the historical case study of daily routines of banks at the New York Clearing House Association before the creation of the Federal Reserve in 1913. The case study is organized around each of the three assumptions underlying the conventional view's abstraction from clearing. The findings call into question each of the three assumptions: netting was not free, but instead involved a considerable risk exposure between banks in the event of default; large clearing drains did in fact occur and could lead to default; and default was avoided through reserves (issued by the state) and call loans (made possible through collective action), not through trading in interbank markets. These findings can be used as ingredients for a general theory of clearing as a public function in future work.

A last note by way of introduction. Given the topic's relevance for different areas of law (civil rights, environmental law, fintech) this Article explains all key concepts with a non-technical reader in mind. Readers interested in the more technical aspects may consult the Appendix.

I. THE KEY QUESTION: HOW DO BANKS CLEAR THEIR DAILY OBLIGATIONS?

A. CLEARING IS ESSENTIAL TO BANK MONEY CREATION

Every day, the commercial banking system stands ready to clear trillions of dollars of obligations banks owe to each other. These obligations are a product of the monetary function deposits serve in our legal system, that is, the way deposits settle payments between bank customers as if they were cash. Without clearing, there can be no deposit

transfers, and no bank money creation. To develop our understanding of clearing, we must begin by understanding the legal nature of deposits.[30]

The term "deposit" is notoriously confusing.[31] It evokes the image of a bank customer providing a bank with actual cash (Federal Reserve notes) in return for a deposit. In reality, only a small fraction of deposits is created in this way. More commonly, deposits are created in the process of commercial bank lending.[32] When a bank provides a borrower with a loan, the bank credits the borrower's account with a new deposit it creates on its books. No actual cash needs to be involved in that transaction. The deposit is simply a new bank liability that the bank creates to fund the new asset it acquired, that is, the loan (the borrower's obligation for future payment). This deposit creation process is presented in **Balance Sheet 1**.[33] This deposit creation process is what leads to the typical balance sheet structure of a bank and its high degree of "maturity transformation." The assets, consisting mainly of long-term loans, are funded through liabilities consisting mainly of short-term deposits.[34]

While cash is not required for the creation of a deposit, a deposit is a legal obligation for a bank to pay and to make that payment on demand. Under the law, a bank's payment to a depositor could take place in two different ways. The simpler, but less common way, is paying cash to a depositor, e.g., when withdrawal is made at the ATM. Under U.S. Code § 5103, federal reserve notes "are legal tender for all debts."[35] A deposit is a form of debt, so by delivering the notes, the bank lawfully redeems the deposit. According to recent data, annual ATM withdrawals amount to around $0.80 trillion.[36] The far more common way to redeem a deposit

30. Discussion in the following paragraphs builds on JOHN MAYNARD KEYNES, THE COLLECTED WRITINGS OF JOHN MAYNARD KEYNES: VOLUME V: A TREATISE ON MONEY 20-29 (Austin Robinson & Donald Moggridge eds., 2d ed. 2012).

31. *See* Ricks, *supra* note 8, at 57.

32. This insight is known as "endogenous money." *See, e.g.*, Michael McLeay et al., *Money Creation in the Modern Economy*, Q. BULL. (Bank of Eng., U.K. 2014); WRAY, *supra* note 17; MARC LAVOIE, POST-KEYNESIAN ECONOMICS: NEW FOUNDATIONS 182-274 (1st ed. 2014). In legal scholarship, see discussion by Hockett & Omarova, *supra* note 17.

33. *See* Appendix, Balance Sheet 1.

34. *See* Pascal Paul, *Banks, Maturity Transformation, and Monetary Policy* (Fed. Res. Bank of S.F. Working Paper 2020-07, 2021).

35. 31 U.S.C. § 5103.

36. GEOFFREY GERDES ET AL., FED. RSRV. SYS., THE 2019 FEDERAL RESERVE PAYMENTS STUDY 11 (2019), https://www.federalreserve.gov/newsevents/pressreleases/files/2019-payments-study-20191219.pdf [https://perma.cc/V2R4-58PP]. As discussed

is through a deposit transfer.[37] Here, the depositor is not interested in holding cash, but in making a payment to some third party with a bank account. Such payments also enjoy the sanction of law. For example, under Uniform Commercial Code (U.C.C.) § 4A-406,[38] a payment by a funds transfer[39] generally discharges an obligation "to the same extent discharge would result from payment to the beneficiary [the payee] of the same amount in money . . . ."[40] Payments by transfer approximate $100 trillion a year,[41] and once financial transactions are incorporated, that figure grows to several trillions per day.[42] In other words, deposit transfers in a single day exceed (by multiples) amounts withdrawn from ATMs over an entire year. Banks' need to clear is a product of these enormous flows arising from deposit transfers to settle payments between customers.

The next step is to understand how transfers between depositors translate into clearing obligations between their banks. This process is

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below, that amount is small in comparison to the trillions of dollars per day (rather than annually) required for clearing.

37. In this Section, the term "deposit transfer" is used as an umbrella term bringing together the distinct legal frameworks that allow payment through direct use of a deposit. Those include, for example, funds transfers, checks, debit and credit cards and other forms of transfers. For a general discussion of the laws and regulations governing each of these, see COMMITTEE ON PAYMENTS AND MARKET INFRASTRUCTURES, *Payment, Clearing and Settlement Systems in the United States*, 2012 RED BOOK 471 [hereinafter BIS RED BOOK].

38. U.C.C. § 4A-406 (AM. L. INST. & UNIF. L. COMM'N 2020),

39. *See id.* at 477-78. "Funds transfers" are a legal term-of-art governed by U.C.C. § 4A-406. They are a subset of my general use of the term "deposit transfers" explained in note 37, *supra*. The examples that follow make reference to funds transfers because by their volume they are by far the most significant legal framework governing payments.

40. U.C.C. § 4A-406 (AM. L. INST. & UNIF. L. COMM'N 2020), subject to narrow exceptions in subsection (b)(i)-(iii). The notion of a discharge of the payor's obligation by means of a deposit transfer is often referred to as "payment finality." Within the broad category of deposit transfers, different legal frameworks have different requirements for payment finality. See discussion in Benjamin Geva, *Payment Finality and Discharge in Funds Transfers*, 83 CHI.-KENT L. REV. 633 (2008).

41. *See* Gerdes et al., *supra* note 36, at 13 (Table B.1) (value of core noncash payments for 2018 at $97 billion).

42. *See About Payments and Financial Market Infrastructures Statistics*, BANK FOR INTERNATIONAL SETTLEMENTS, https://www.bis.org/statistics/payment_stats.htm?m=6_36 (last visited Jan. 22, 2022) (U.S., T9: Value of transaction processed by selected payment systems). 2020 "total gross value" for Fedwire and CHIPS were $840 trillion and $382 trillion respectively. *Id.*

described in **Balance Sheet 2.**[43] Consider a Buyer of widgets (the payor) interested in paying $1 million to a Seller of widgets (the payee). The Buyer instructs its bank (the Buyer's Bank) to make a $1 million funds transfer to the Seller's account in some different bank (the Seller's Bank).[44] The Buyer's payment to the Seller would be complete when the Seller's bank account is credited with the $1 million amount.[45] From the point of view of the Buyer and Seller, the deposit transfer allows the debt to be repaid, just as if the Buyer had provided the Seller with federal reserve notes. Not so from the point of view of their banks, who now need to work out their internal financial relationship.[46]

The world would have been simple if all buyers and sellers held accounts in a single large bank. That large bank could have simply debited the Buyer's account and credited the Seller's account by the same amount (**Balance Sheet 3**).[47] In such a world, clearing would not have been necessary.[48] Our world has multiple banks, so the obligation between Buyer and Seller transforms into an obligation between their respective banks. Note that the funds transfer requires the Seller's Bank to credit the Seller's account with a new deposit, meaning that the Seller's Bank needs to increase its liabilities. The Seller's Bank cannot agree to increase its liabilities for free, or it will suffer a loss.[49] For that reason, when it credits the Seller's account by $1 million, the Seller's Bank will acquire a $1

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43. *See* Appendix, Balance Sheet 2.

44. "Funds transfer" is a technical term governed by U.C.C. § 4A (AM. L. INST. & UNIF. L. COMM'N 2020).

45. U.C.C. § 4A-406. § 4A includes detailed rules determining when a beneficiary's bank (like the Seller's Bank in the example) is considered to have accepted a payment order. These rules are beyond the scope of the current Article. *See, e.g.*, U.C.C. § 4A-209; Geva, *supra* note 40.

46. For expositional convenience, this Section presents the settlement of obligations between clients (through the crediting of the beneficiary's bank account) as preceding interbank clearing. In modern practice, with the rise of Real Time Gross Settlement and the New CHIPS (*see* discussion *infra Section II.A.*), the order is often reversed (or the two are made simultaneously). *See* Geva, *supra* note 40, at 646. Historical practice was more diverse, as reflected by U.C.C. § 4A-405(c). *See id.*

47. *See* Appendix, Balance Sheet 3.

48. *See* Perry Mehrling, *The Central Bank as a Clearinghouse*, B.U.: MONEY & BANKING LECTURES (last visited Oct. 16, 2022), https://sites.bu.edu/perry/mb-lectures/section-1/5-the-central-bank-as-a-clearinghouse/ [https://perma.cc/X3J8-J4AN]. The proposal advanced by Morgan Ricks in his book, THE MONEY PROBLEM, would in fact eliminate the need to clear. RICKS, *supra* note 7, at ch. 9.

49. According to the famous balance sheet equation, *Shareholders' Equity = Assets – Liabilities*. A bank increasing its liabilities without gaining an asset of the same amount would have its equity reduced by the same amount.

million claim against the Buyer's Bank (in jargon, such claim is often booked as "due from banks").[50] This claim is a new asset that balances the new liability (deposit to Seller). This accounting can be understood intuitively. By crediting the Seller's account with a deposit, the Seller's Bank is doing the Buyer's Bank a favor, namely, it is making it possible for the Buyer's Bank to "pay" its deposit to the Buyer. The $1 million claim against the Buyer's Bank is the price of that favor. This is the obligation that now needs to be "cleared," and as noted above, daily clearing volume measures in the trillions per day.

Clearing can take place in two different ways. Those are known as "settlement" and "setoff" or "netting."[51] Settlement generally means payment in public (state issued) money. For banks, this public money comes in the form of "reserves" with the Federal Reserve System. Like the cash we use in retail payments (Federal Reserve notes), reserves are issued directly by the Federal Reserve, but instead of being issued as paper notes, they are balances (book entries) in accounts commercial banks hold with the Federal Reserve.[52] This is an instance of the Fed's role as a "bankers' bank," meaning that commercial banks maintain accounts with the Fed just like retail depositors maintain accounts with commercial banks. Reserve balances have legal characteristics that are similar to the legal tender quality of cash discussed above. A transfer of reserves constitutes final payment between banks.[53]

Fed creation of reserves—at the writing (January 2022), nearly $4 trillion—occurs when the Fed purchases assets (so called "open market operations") or when it makes loans.[54] Throughout the course of each

50. For a more nuanced discussion of the synchronization of the different steps, see *supra* note 46.

51. For definitions of these terms, see COMMITTEE ON PAYMENT AND SETTLEMENT SYSTEMS, BANK FOR INT'L SETTLEMENTS, A GLOSSARY OF TERMS USED IN PAYMENTS AND SETTLEMENT SYSTEMS (2003) https://www.bis.org/cpmi/glossary_030301.pdf [https://perma.cc/8XHY-FBBT] [hereinafter GLOSSARY].

52. Commercial banks also keep accounts with each other, an arrangement known as "correspondent" banking. For discussion of historical significance, see *infra* Section II.

53. The statutory basis of the legal tender quality of Federal Reserve notes and reserve in a Federal Reserve account is different. While the former derives from U.S.C. § 5103, the latter derives from a combination of U.C.C. § 4A and Federal Reserve Regulation J, 12 C.F.R. 211, Subpart B, § 210.30. *See* Geva, *supra* note 40, at 653; 12 C.F.R. § 211.20-211.30 (2022).

54. Data from *Reserves of Depository Institutions: Total*, FED. RSRV. BANK OF ST. LOUIS, https://fred.stlouisfed.org/series/TOTRESNS [https://perma.cc/ETA5-LMS4]

business day, banks use the Fed's payment system—Fedwire—to transfer reserves to each other in settlement of payments. For 2020, the average value of daily Fedwire transfers was over $3 trillion.[55] The key to appreciate here is that for the commercial banking system, the Fed is in fact able to operate as a single large bank, where a payment from the Buyer's Bank to the Seller's Bank simply means a debit of reserves in the Buyer's Bank's Fed account, and a credit of reserves to the Seller's Bank's account.[56] Settlement in reserves is so important because it shows us that bank money creation ultimately rests on the availability of public money to settle in.[57]

The second way to clear is called "netting" or "setoff" of obligations. The idea is simple. A typical bank is sometimes in the position of needing to make payments to other banks (when its depositors are initiating transfers) and is other times in the position of receiving payments (when its depositors are receiving transfers). That is, throughout the course of the day, a bank is sometimes like the Buyer's Bank, and other times like the Seller's Bank. Netting or setoff is a legal concept that—provided certain conditions are met—allows a debtor to reduce the amounts it owes by the amounts it is owed. Assume that a certain bank has $500 million in payment obligations and $400 million in claims to receive payment. Where netting is permissible, $400 million can be canceled (or "netted"), and only the remaining balance of $100 million will need to be settled in public money (reserves transferred through Fedwire).

Sounds simple enough, but the basic arithmetic understates the legal and institutional complexity that netting involves. The right of setoff is governed by state law that typically incorporates two common law requirements: for obligations to have "matured" and for there to be

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(last viewed Jan. 22, 2022) [hereinafter *Reserves*]. For legal authorities, *see* Federal Reserve Act, 12 U.S.C. §§ 226, 14 (open market purchases), 10B (lending to member banks), and 13(3) (lending during unusual and exigent circumstances).

55. *See* BIS RED BOOK, *supra* note 37. Daily volumes are averaged across 260 business days. *See also Fedwire Funds Service – Annual Statistics*, FED. RSRV., https://www.frbservices.org/resources/financial-services/wires/volume-value-stats/annual-stats.html [https://perma.cc/KFU4-CGVK] (last visited Jan. 22, 2022) [hereinafter *BIS Statistics*].

56. *See* Mehrling, *supra* note 48 at 5.

57. For this hierarchy between deposits and reserves, see generally Perry Mehrling, *The Inherent Hierarchy of Money*, *in* SOCIAL FAIRNESS & ECONOMICS: ECONOMIC ESSAYS IN THE SPIRIT OF DUNCAN FOLEY (Lance Taylor, Armon Rezai & Thomas Michl eds., 2015).

"mutuality" between parties.[58] Maturity means that both obligations are already due. Where Bank A owes Bank B now, but Bank B owes Bank A tomorrow, there can generally be no setoff.[59] Mutuality means that obligations must be owed between the same parties.[60] A situation where Bank A owes $1 million to Bank B, and Bank B owes $1 million to Bank C, does not meet the requirement for mutuality, so Bank B would have to pay Bank C, and be paid by Bank A. To fulfill these rather strict requirements, banks can operate as members of a clearinghouse. Clearinghouse rules determine that all obligations are due at the end of the day (thereby fulfilling the maturity requirement) and all obligations are owed to and from the clearinghouse (thereby fulfilling the mutuality requirement).[61] The largest payments clearinghouse in the U.S. dollar is called CHIPS and during 2020 it cleared about $1.5 trillion daily.[62] Because it seems like reserves are not required for netting,[63] netting appears to represent a kind of independence of bank money creation from public money. As discussed below, this mindset, emphasizing the importance of private arrangements, sits comfortably within the conventional view, and is one of the reasons for its abstraction from clearing.

To summarize, without clearing there can be no deposit transfers, and without deposit transfers, deposits cannot serve to settle payments between bank customers. The volume of clearing is enormous—for 2020, nearly $5 trillion per business day (about one third of the outstanding deposits during that time) and some $1,200 trillion over one year

58. *See* Peter M. Mortimer, *The Law of Set-off in New York*, INT'L FIN. L. REV., May 1983, at 24, 27 ("In addition to the requirement that the debt against which the set-off is effected be mature, the law of setoff generally requires that the debts be between the same parties.").

59. The requirement for matured obligations has exceptions, most importantly under the U.S. Bankruptcy Code. Note, however, that in the context of clearing, the restriction on setoff goes beyond even the requirement for maturity. With clearing, it is not simply that a later obligation exists, but has not yet matured (B owes A tomorrow) but that the obligation itself has not yet been created (B may, or may not, owe A at a later point depending on a flow of payments that is yet unknown).

60. *See* Benjamin Geva, *The Clearing House Arrangement*, 19 CANADIAN BUS. L.J. 138, 142 (1991).

61. *See id.* at 143 (for the mutuality requirement).

62. *See BIS Statistics*, *supra* note 55 (CHIPS clearing volume for 2020 was $382 trillion, divided by 260 business days).

63. In Part III below, this Article argues reserves continue to play a crucial role in netting schemes.

(meaning that every $1 in deposits supports, on average, about $80 in payments over one year).[64] Given the centrality of clearing, one would expect that an account of bank money creation would begin by explaining how banks are able to successfully clear their obligations. As we now turn to discuss, that is not the path taken by the conventional view.

B. THE CONVENTIONAL VIEW ABSTRACTS FROM CLEARING

The conventional view's account of bank money creation has no clearing in it. That account focuses instead on the individual decisions depositors make as to the trustworthiness of their bank. Left out of the picture are the financial relationships between the banks themselves, and with them, the need for governance or central authority. This abstraction relegates governance to the modest role of correcting occasional market failures (depositor bank runs) rather than allowing money creation from the onset. The following paragraphs take a closer look at these themes by breaking the conventional view into three basic steps.[65]

The first step is locating the moneyness of deposits in private contractual arrangements. As we have seen, a deposit contract includes a bank's promise to pay the depositor money—cash—on demand. As the argument goes, if the depositor trusts the bank's ability to redeem, the bank's promise—the deposit—can become as good as money itself. It is common,

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64. *See Deposits*, *supra* note 1 (total deposit figures for 2020 were $13.2 trillion (Jan. 1) and $16.1 trillion (Dec. 30)); and BANK FOR INTERNATIONAL SETTLEMENTS, *supra* note 42 (2020 clearing figures totaling $1,222 trillion avaeraged across 260 business days). The payments-per-deposit ratio of about 80 is calculated as $1,222 trillion divided by $14.5 trillion (rough average of deposits for 2020).

65. My focus in this Article is with narrative descriptions of the conventional account, but the same basic approach can be seen in the three foundational formal models of bank deposits. *See, e.g.*, Charles W. Calomiris & Charles M. Kahn, *The Role of Demandable Debt in Structuring Optimal Banking Arrangements*, 81 AM. ECON. REV. 497, 508 (1991) (commitment device models); Gary Gorton & George Pennacchi, *Financial Intermediaries and Liquidity Creation*, 45 J. FIN. 49 (1990) (information asymmetry models); Douglas W. Diamond & Philip H. Dybvig, *Bank Runs, Deposit Insurance, and Liquidity*, 91 J. POL. ECON. 401 (1983) (consumption insurance models). In the second and third models (information asymmetry device and consumption insurance models) the "banks" being models do not make obligations to pay in money, but rather in a consumption good. With no dollar obligations, there is no question of clearing. In the first model (commitment device) the bank's obligation is denominated in dollars, but the model explicitly assumes away any transactions between depositors, i.e., it assumes away the monetary use of a deposit that gives rise to clearing. The model also assumes a single monopolist bank, which makes clearing unnecessary. For a typology of these models, see generally Ricks, *supra* note 8.

for example, to speak of the origins of banking as a warehousing arrangement.[66] According to that account, early depositors found it inconvenient to use coin (which is subject to theft, erosion, etc.) so they exchanged it for certificates of deposit with a currency warehouse. Given their convenience, people gladly accepted the certificates in payment, knowing they could always redeem them for coin when needed. Over time, the currency warehouse noticed few of the certificates were ever redeemed, so its coin was lying idle. The clever warehouse management decided it could benefit from this fact by offering loans. The warehouse would now issue new certificates (promises to pay coin on demand) and lend them in return for the borrower's own promise for future payment.[67] Interest on these loans is a profitable business for the warehouse. As more loans are made, the amount of coin at the warehouse would become smaller in proportion to the growing number of certificates. Gradually, the warehouse's balance sheet acquires the typical shape of a bank discussed above, with long-term loans funded through short-term liabilities (the certificates). In jargon, we also speak of banks as operating on a "fractional–reserve" basis, meaning that the coin reserve is a fraction of the certificates.

The details of such accounts vary, but they all attribute a sense of agency to individual decisions in making deposits function as money. What drives these accounts is ultimately the convenience a depositor attributes to the certificate,[68] and their confidence in the bank's ability to redeem. At the outset, that trust hangs on prudent conduct by the banker. The loans the banker makes need to be sound; the banker needs to have adequate capital to absorb losses[69] and to maintain an adequate cash

66. *See* George Selgin, *Those Dishonest Goldsmiths*, 19 FIN. HIST. REV. 269, 270-72 (2012) (The Article, which offers a critique of the warehouse origins story, begins by documenting the ubiquity of that warehouse origins story in leading works in economics); Ricks, *supra* note 8, at 55-57; *see also* The Economist, *Could Digital Currencies Put Banks Out of Business?*, YOUTUBE (May 8, 2021), https://www.youtube.com/watch?v=fpb-qJv6dBs [https://perma.cc/3J36-NU4N].

67. In some accounts, instead of issuing new certificates, the warehouse lends out a portion of its bullion.

68. This line of thinking resonates with current efforts (both outside and inside the banking system) to use blockchain technology in creating means of payment that are faster, more efficient, etc. *See, e.g.*, *Our Story*, RIPPLE, https://ripple.com/company/ [https://perma.cc/326A-FTZE] (last visited Jan. 22, 2022); *J.P. Morgan Creates Digital Coin for Payments*, J.P. MORGAN: ONYX (Feb. 1, 2021), https://www.jpmorgan.com/solutions/cib/news/digital-coin-payments [https://perma.cc/LE6Z-5GDX].

69. In banking regulation, "capital" is roughly synonymous with "shareholders' equity," which is the difference between assets and liabilities. *See supra* note 49. Capital

reserve for occasional withdrawals. When these conditions are met, deposits are assumed to acquire "moneyness" through the countless optimizing decisions of depositors, bankers, and borrowers. This image soon acquires a normative significance—it is perceived as efficient and desirable. After all, the depositor enjoys a more convenient medium to transact in, and the borrower enjoys new credit. These benefits are possible thanks to the bank's incentives to expand the money supply and lend to maximize profit.

Things would be simple if this were all, but the conventional view is deeply aware that bank money creation is unstable. The second step is an occasional market failure that disrupts the efficient arrangements described above. Enter the bank run. The run is commonly (though not exclusively) understood as a coordination failure among depositors.[70] Recall that a defining feature of banking is the bank's maturity transformation and its operation on a fractional reserve. This business model exposes the bank to liquidity risk. If more than a small fraction of depositors simultaneously demands cash payment, the bank will exhaust its small reserve, and will have to suspend further payments. Depositors are aware of this, and their awareness may drive them to run and redeem before the cash reserve is depleted. The result is a self-fulfilling prophecy, where the fear of a run is sufficient to generate a run. The initial reason for the run may involve doubts over the bank's performance. At the same time, the history of bank runs in the United States reveals that even solvent banks are vulnerable to run dynamics, especially in an environment of panic and financial contagion. As shown by the Great Depression, the results of these runs to the real economy can be devastating.

This is where the third and final step comes in. To avoid disastrous runs, the state steps in to protect the moneyness of deposits.[71] Lender-of-last-resort support by the central bank provides banks with immediate

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thus represents loss absorption capacity that protects a corporation's creditors. For capital requirements under U.S. law, see 12 U.S.C. §§ 1831 and 5371.

70. *See, e.g.*, E. GERALD CORRIGAN, FED. RSRV. BANK OF MINNEAPOLIS, MINN., ARE BANKS SPECIAL?, ANN. REPS. 1982 (1983), http://www.bu.edu/econ/files/2012/01/Corrigan-Are-Banks-Special_main-text.pdf; Diamond & Dybvig, *supra* note 65; Ricks, *supra* note 8, at 62-73; Baradaran, *supra* note 9, at 1314. For further discussion of runs see Orian Peer, *supra* note 9, at 378-81.

71. Daniel K. Tarullo, Member, Bd. of Governors of the Fed. Rsrv., Remarks at The Clearing House 2014 Annual Conf.: Liquidity Regul. (Nov. 20, 2014) (transcript available at https://www.federalreserve.gov/newsevents/speech/tarullo20141120a.pdf [https://perma.cc/WP69-NT52]); *see* CORRIGAN, *supra* note 70.

cash against collateral, thereby helping meet the immediate obligation to redeem.[72] Federal deposit insurance goes even further, guaranteeing depositors would maintain their moneyness even in the event of bank failure.[73] At present, the deposit insurance cap is $250,000 and total deposits insured are about $9.5 trillion, around one half of total deposits.[74] Because insured depositors are indifferent to a bank's failure, they do not run. That was precisely the goal, but it also creates a side-effect in the form of moral hazard. After all, if insured depositors may rationally choose to stay with a risky bank, what is preventing that bank from taking outsized risks? Bank shareholders would enjoy any outsized profits, and the government would absorb any outsized losses.[75]

Following this way of thinking leads to the role of modern banking regulation. As the largest potential creditor of the banking system, the government steps in to require that banks comply with prudential regulation.[76] In this way, the state's regulatory role is understood to mimic the behavior of private depositors in a counterfactual world without public crisis supports. This leads to the limited role of public policy in banking discussed in the Introduction. Because the state is merely addressing a market failure (depositor runs), its interventions must be narrowly tailored to address that failure, while trying to minimize interference with the underlying private activity. An important consequence of this approach is limiting public policy to prudential regulation (adequate levels of risk). Exceptions to this notion are so narrow they highlight the norm. The Community Reinvestment Act ("CRA"), to take one example, requires banks to affirmatively promote the credit needs of low- and moderate-income ("LMI") communities, that make 43 percent of the U.S. population.[77] While there are certain

72. *See* Federal Reserve Act, 12 U.S.C. §§ 10B, 13(3); Orian Peer, *supra* note 9.

73. *See* 12 U.S.C. § 16 (Fed. Deposit Ins. Corp.).

74. *See Deposit Insurance FAQs*, FED. DEPOSIT INS. CORP. (Dec. 8, 2021), https://www.fdic.gov/resources/deposit-insurance/faq [https://perma.cc/X4CM-8E75]; *Quarterly Banking Profile: Third Quarter 2021*, 15(4) FDIC Q. 1, 24 (2021).

75. *See* MICHAEL BARR ET AL., FINANCIAL REGULATION: LAW AND POLICY 248-49 (2016).

76. *See, e.g.*, Tarullo, *supra* note 71, at 3 ("Regulatory requirements were imposed to guard against the moral hazard that both programs [lender of last resort and deposit insurance] could create.").

77. *See Low- and Moderate-Income Residences Can Help Modernize the U.S. Electric Grid*, NAT'L RENEWABLE ENERGY LAB'Y (Apr. 25, 2018), https://www.nrel.gov/news/program/2018/lmi-residences-can-help-modernize-us-electric-grid.html [https://perma.cc/TW6B-3XPJ].

difficulties quantifying the total proportion of bank resources dedicated to CRA compliance, the percentage of loans earning CRA credit is strikingly small, under 3 percent of bank assets funded through deposits.[78]

Looking at the conventional view, one is left to wonder how banking regulation—and banks' social responsibilities—could have been differently understood if the question of clearing came to the fore. It is important to understand that abstraction from clearing is not generally the result of ignorance. Most authors are familiar with the basic aspects of clearing, and some have done highly sophisticated work on various aspects of clearing. The issue is not lack of awareness of clearing per se. It is maintaining the knowledge of clearing and the account of bank money creation separate from each other. The next Part turns to examine how the conventional view fills this gap between its theoretical account and the institutional reality.

II. SIDESTEPPING THE QUESTION: ASSUMPTIONS BEHIND ABSTRACTION FROM CLEARING

The conventional view's abstraction from clearing is an "as if" proposition. Authors are aware that banks need to clear but believe one could describe the fundamental causes of bank money creation (market forces) "as if" clearing was not an important concern. Three assumptions, often quite subtle and implicit, are behind this "as if" proposition: first, that netting is freely available to banks; second, that the law of large numbers prevents clearing drains; and third, that interbank markets can solve drains if they do arise. This Section elaborates on each of these assumptions. It explains why they are difficult to test in a modern setting, and sets the stage to examine them in the historical case study in Part III.

78. The under 3 percent figure reflects the sum of around $334 billion "earning CRA credit [in 2018]" divided by total commercial bank deposits of about $12 trillion for 2018. *See* Laurie Goodman et al., *Under the Current CRA Rules, Banks Earn Most of Their CRA Credit Through Community Development and Single-Family Mortgage Lending*, URB. INST.: URB. WIRE (July 9, 2020), https://www.urban.org/urban-wire/under-current-cra-rules-banks-earn-most-their-cra-credit-through-community-development-and-single-family-mortgage-lending [https://perma.cc/6YKR-CWA5]; *Deposits*, *supra* note 1. As Goodman et al. note, due to data limitations, their data does not include CRA investments (which are distinct from CRA loans). Adding investments to the numerator would likely result in a figure larger than 3 percent. That said, CRA investments often tap into other public subsidies, e.g., Low-Income Housing Tax Credits and New Markets Tax Credits.

A. NETTING IS FREELY AVAILABLE TO BANKS

The first assumption is that banks can freely use netting to minimize their need for reserves. Remember that, over the course of the day, a bank is sometimes in the position of owing other banks, and is other times in the position of being owed. The net figure of these payments is considerably smaller than the "gross" figure (total outgoing payments). By netting these payments a bank can dramatically reduce its need for reserves, which is to say, its need for state provided money.[79] This makes clearing seem far less challenging or worthy of analysis.

While netting is indeed an important concept, speaking of netting as a mere matter of arithmetic—payments in offsetting payments out—misses crucial aspects of the legal arrangements that netting requires. This abstraction from law creates a sense that netting is a free lunch. In reality, netting creates risks that someone has to bear. At a basic level, netting involves an extension of credit between banks. Instead of paying immediately, the hour of settlement is extended until the end of the day, allowing banks that happen to run morning deficits to recover them over the course of the day. These deficit banks, however, can also default at any time during the day, meaning someone would have to bear that risk. As the historical case study demonstrates, default risk in the clearinghouse triggered a liability on behalf of surviving banks, and that liability could have further led to a cascading default.[80] The modern image of netting as a free lunch takes attention away from default risk and the daily governance that is necessary to manage it.

Modern commentators' assumption that netting is freely available is a product of modern central bank practice. Central banks remove much of the risk involved in clearing from banks by assuming it themselves. The obvious case in point is Fedwire, that accounts for over two-thirds of daily clearing volume in the United States. Fedwire is not formally a clearinghouse. But while Fedwire does not provide banks with netting in a legal sense, it certainly provides them with the practical benefits of netting. Here is how it works: Fedwire is a Real Time Gross Settlement ("RTGS") system.[81] This means that a bank lacking reserves in its Fed account during the morning cannot simply go ahead with the payment and net it out against incoming payments in the afternoon. That bank would be

79. For an empirical example from NYCHA practice, see *infra* Section III.A.

80. *See infra* Section III.A.

81. *See* BIS RED BOOK, *supra* note 37; *see also* GLOSSARY, *supra* note 51, at 41.

stuck, and other banks relying on the incoming reserves to make payments would be stuck as well.[82] This potential gridlock poses a problem to the Fed, which is interested in facilitating smooth payments. That problem was especially acute in the pre-GFC era, where the supply of reserves was very low compared to today-only a few tens of billions compared to nearly $4 trillion (January 2022).[83] To address this gridlock, the Fed provides banks short of reserves with so-called "intraday loans" or "daylight overdrafts."[84] These are loans that can be taken during the day and paid back from incoming payments before the close of the day.[85]

Note how by coupling RTGS with daylight overdrafts, the Fed is replicating the benefits of clearinghouse netting to banks, but it does so without them having to take any risk of default. If a bank defaults during the day, the default will not affect banks who have already received payments, because payment in reserves is final, and all risk is borne by the Fed (in its capacity as intraday lender to the defaulting bank).[86] By removing risk from banks, the Fed is also removing any need for them to engage in collective action to avoid default in the first place. The result is a system that seems more privatized than it really is.

But what about CHIPS? Unlike Fedwire, CHIPS *is* a clearinghouse, and *does* operate a netting system. Presumably, CHIPS would involve the kind of default and cascading default risk mentioned above, as well as the

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82. *See* Morten L. Bech, *Intraday Liquidity Management: A Tale of Games Banks Play*, 14 ECON. POL'Y REV. 7, 8 (2008).

83. *See Reserves*, *supra* note 54. The rise in reserves was a result of the Federal Reserve's Large-Scale Asset Program (LSAP) in the aftermath of the GFC, and similar policies since March 2020. Rising reserves were a side-effect rather than the goal of these policies. *See* Stefania D'Amico et al., *The Federal Reserve's Large-Scale Asset Purchase Programs: Rationale and Effects*, (Fin. and Econ. Discussion Series, Fed. Rsrv. Bd., Working Paper, 2012).

84. *See generally* Douglas Evanoff, *Daylight Overdrafts: Rationale and Risks*, FED. RSRV. BANK CHICAGO: ECON. PERSPECTIVES, May-June 1988, at 18.

85. *See* Federal Reserve Regulation J, 12 C.F.R. § 210.28 (2022); BD. OF GOVERNORS OF THE FED. RSRV. SYS., FEDERAL RESERVE POLICY ON PAYMENT SYSTEMIC RISK (2021), https://www.federalreserve.gov/paymentsystems/files/psr_policy.pdf [https://perma.cc/QQU3-ESSQ] [hereinafter POLICY]. The demand for daylight overdrafts has fallen substantially since the rise of reserves in the post-GFC era (discussed in Bech, *supra* note 82). For data, see *Daylight Overdrafts and Fees*, BD. OF GOVERNORS OF THE FED. RSRV. SYS. (Feb. 4, 2020), https://www.federalreserve.gov/paymentsystems/psr_data.htm [https://perma.cc/RJB2-57A2].

86. *See* Regulation J, 12 C.F.R. § 210.31 (2022); E.J. Stevens, *Risk in Large-Dollar Transfer Systems*, ECON. REV.: FED. RSRV. BANK OF CLEVELAND, Fall 1984, at 2, 4; Geva, *supra* note 40, at 652-53.

need for governance to manage them. The complicated answer is that the modern CHIPS differs in important ways from the traditional netting systems that many commentators still have in mind. Since 2001, CHIPS relies on liquidity available through Fedwire, so much so, that it can virtually eliminate default risk altogether.[87] While formally still a netting system, CHIPS is more akin to a sophisticated algorithm that benefits from central bank liquidity. Even prior to the 2000s, policymakers highlighted the ways in which settlement on CHIPS was indirectly benefiting from central bank liquidity to settle netted positions.[88] As it turns out, under modern conditions, there is no way to disentangle the workings of netting systems that reduce the need for reserves from central bank practice to flexibly provide those reserves as needed.

B. THE LAW OF LARGE NUMBERS PREVENTS DRAINS

While the first assumption is that netting is freely available to banks, the second assumption concerns its enormous power. Specifically, authors discuss the way in which the law of large numbers ("LLN") reduces large clearing flows to a small and predictable net position. Scholars note that the LLN enables banks to engage in maturity transformation with only a small reserve.[89] Implicit in this position is the assumption that the workings of the LLN prevent clearing drains—days and weeks where a bank experiences exceptionally large negative clearing positions. In this way, reliance on the LLN leads to an underestimation of

87. *See* BIS RED BOOK, *supra* note 37, at 490; Stacy Panigay Coleman, *The Evolution of the Federal Reserve's Intraday Credit Policies*, FED. RSRV. BULL., Feb. 2002, at 67, 74; James McAndrews & Samira Rajan, *The Timing and Funding of Fedwire Funds Transfers*, 2000 FRBNY ECON. POL'Y REV. 17, 26 (2000). For context to these reforms, see *infra* discussion in text accompanying notes 141 and 143.

88. *See* Panigay Coleman, *supra* note 87, at 68 (for reliance on intraday liquidity); *see* Stevens, *supra* note 86 (for reliance on lender-of-last-resort).

89. *See* ERIC A. POSNER, LAST RESORT: THE FINANCIAL CRISIS AND THE FUTURE OF BAILOUTS 11 (2018) ("The key to maturity transformation is a statistical law—the law of large numbers."); Manmohan Singh & Peter Stella, *Money and Collateral* (International Monetary Fund, Working Paper 12/95, 2012)("Owing to the law of large numbers, banks have—for centuries—been able to safely conduct this business [maturity transformation] with relatively little liquid reserves, as long as basic confidence in the soundness of the bank portfolio is maintained."); Anat R. Admati & Martin F. Hellwig, *Bank Leverage, Welfare, and Regulation* 5 (Rock Ctr. for Corp. Governance at Stan. U., Working Paper No. 235, 2019); RICKS, *supra* note 7, at 758.

the risk to which banks are subject, and the real-life mechanisms used to protect against that risk.

The law of large numbers is a foundational theorem in probability. It states that when an experiment is repeated many times, the average of the observed results would converge to the expected value. For example, a fair coin (equal probability of heads and tails) flipped many times should come close (though not identical) to 50 percent heads.[90] The LLN could be translated into a highly stylized clearing arrangement. Consider two banks, Bank A and Bank B, each with 500 deposits of $1.[91] A coin is tossed 1,000 times, representing transactions taking place between depositors over the day. When the coin comes out as heads, a depositor in Bank A is receiving a transfer from a depositor in Bank B, resulting in a clearing inflow of *+$1* to Bank A. Conversely, when a coin comes out as tails, a depositor in Bank A is making a transfer to a depositor in Bank B, resulting in a clearing outflow *-$1* to Bank A. The expected clearing position in this experiment for Bank A would be zero.[92] With a large enough deposit base (a large number of coin tosses) the observed result over the clearing day should approach that expected zero.

In its basic form, the application of the LLN to clearing is insightful. Surely, the LLN is significant to banks' ability to engage in maturity transformation. At the same time, the way authors use the LLN has a basic limitation insofar as it goes the extra step to assume the LLN works to prevent clearing drains all together. This position is rarely stated explicitly, but it is heavily implied. Expositions often describe the enormous power of the LLN in enabling maturity transformation, then move on to state that in a run, banks can no longer count on the LLN—because deposits transfers are no longer random. The general notion conveyed is that outside of crisis, the LLN compresses the net clearing position to a figure so small it is nearly trivial.[93] As discussed below, the

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90. *See* Richard Routledge, *Law of Large Numbers*, BRITANNICA, https://www.britannica.com/science/law-of-large-numbers [https://perma.cc/3ALZ-M4HU] (last visited Jan. 29, 2022). The LLN applies to events that are identically and independently distributed ("i.i.d."). It is an interesting question whether or not clearing flows can actually be characterized as i.i.d., but this inquiry is beyond the scope of this Article.

91. The example is highly stylized in that the real-life banking system has multiple banks, of various sizes, and the size of deposits and potential transfers within each bank varies considerably as well.

92. *=0.5*$1 + 0.5*(-$1)*

93. *See* RICKS, *supra* note 7, at 58; KEYNES, *supra* note 30.

pre-GFC practice, when banks held reserves of under 1 percent of their deposits, has surely contributed to that impression.

One cause for suspicion is the lack of detailed analysis specifying how small exactly the reserve can be. Here, note that the LLN does not speak of the observed value (the net clearing position) being identical to the expected value (zero). It speaks merely of convergence given a "large number" of observations. But what counts for a large enough number of deposit transfers that would make the clearing position sufficiently close to zero? And how close exactly does it have to be? And at what level of confidence can we expect it to be so close? Expositions of bank money creation rarely engage with these questions, let alone provide empirical tests of real-life clearing positions.[94] The lack of empirical analysis is partly attributable to data limitations. Public Fedwire data is provided on a highly aggregated basis, often consolidating the clearing activity of all participating banks, and averaging it across long periods of time.[95] The clearing position of an individual bank on an individual day is proprietary information and is not generally observable to researchers.[96] Without this kind of empirical calibration, it is difficult to rule out that on some days, some banks would be subject to clearing drains that would put them under serious pressure. What is more, even if such data were readily available, the staggering institutional complexity of the modern system would have made it somewhat difficult to interpret.

An important benefit of the historical case study is that the NYCHA ledger offers data on the individual clearing positions of member banks on individual days. Further, the relative institutional simplicity of the system around that time makes the data simpler to interpret. As discussed below,[97] the empirical findings from the 1905 ledger demonstrate large clearing drains did in fact occur. The findings, in my view, do not necessarily indicate a problem with the application of LLN to clearing per se, but with

94. For discussion of earlier theoretical (rather than empirical) work on these issues, see generally J.H.G. Olivera, *The Square-Root Law of Precautionary Reserves.*, J. POL. ECON. 1095 (1971).

95. *See Fedwire Funds Service – Annual Statistics*, FED. RSRV., https://www.frbservices.org/resources/financial-services/wires/volume-value-stats/annual-stats.html [https://perma.cc/UPV6-A8FS] (last visited Jan. 29, 2022).

96. There are exceptions with respect to data availability, especially for researchers working in, or collaborating with, central banks. See discussion of studies in note 142, *infra*. Despite data availability, these studies did not utilize institution–level data for the purposes envisioned here.

97. *See infra* Section III.C.

the specific way in which it is currently used. As discussed below, a different way of applying the LLN to clearing actually supports the conclusion that large drains are inevitable given a sufficiently large number of banks and clearing days.

C. INTERBANK MARKETS CAN SOLVE DRAINS

The third assumption used to abstract from clearing is the confidence in well-functioning interbank markets. Where the second assumption asserts that the law of large numbers prevents drains, the third assumption acknowledges the occurrence of drains but asserts these drains can be effectively handled through contracting between banks.[98] In practice, the two assumptions are often intermingled, namely, clearing drains are rarely a concern, but if they are, interbank markets stand ready to handle them.[99]

In the United States, since the GFC, the Federal reserves' program of Large-Scale Asset Purchases (colloquially known as quantitative easing, or "QE") has brought reserves up to $4 trillion, around 20 percent of commercial bank deposits. This large amount of reserves is a sharp departure from the pre-GFC era, where reserves were often below 1 percent of deposits.[100] In an environment with such little reserves, the interbank market—the so-called federal funds market—was essential to the system's ability to clear. As previously explained, over the day, banks needing to make payments in excess of their available reserves would use daylight overdrafts, but come evening, any remaining balances had to be paid back to the Fed.[101] To acquire the necessary reserves, deficit banks turned to the federal funds market, where they could borrow from banks with excess reserves.[102] In the decade preceding the GFC, about $200 to

98. *See, e.g.*, Zoltan Jakab & Michael Kumhof, *Banks Are Not Intermediaries of Loanable Funds–And Why This Matters* 10 (Bank of Eng., Working Paper No. 529, 2015).

99. For a summary of the literature, see Admati & Hellwig, *supra* note 89, at 5.

100. *See Reserves*, *supra* note 54, and *Deposits*, *supra* note 1 (e.g., for Jan. 2007, 45 billion in reserves over $6.1 trillion in deposits).

101. The discussion in these paragraphs builds on Perry Mehrling's microstructure approach to monetary policy implementation. *See* Perry Mehrling, *Monetary Policy Implementation: A Microstructure Approach*, *in* DAVID LAIDLER'S CONTRIBUTIONS TO ECONOMICS 212, 224-25 (Robert Leeson ed., 2010).

102. As Mehrling discusses, the Eurodollar market and the repo market provide additional mechanisms to "resolve a payment imbalance at the end of the day." *Id.*

$340 billion worth of transactions were negotiated in the federal funds market every day.[103]

This interbank market brings up the alluring image of a banking system that is autonomous from the central bank, and the public money it issues (reserves). After all, if one bank needs to make a payment, another bank must be receiving it. It follows that by accounting identity, for every bank short of reserves there is a bank with excess reserves somewhere in the banking system. For an interest rate, the deficit and surplus banks can arrive at a mutually beneficial trade (often with the help of a broker), thereby minimizing the need for reserves provided by the central bank.[104] For example, Bank A in need of $10 million in reserves could borrow that amount from Bank B with a surplus of the same amount (see example in **Balance Sheet 4**).[105]

If we follow this line of thinking to its logical conclusion, the demand for reserves at the end of the day would be a perfect zero. And with a zero demand for reserves, it is market trading among banks, not public money supplied by the central bank that is doing the daily work of clearing.[106] The central bank can of course force banks to hold reserves by imposing regulatory reserve requirements, or by use of other tools with similar effects.[107] But experts highlight that reserve requirements are just an

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103. *See* Morten Bech & Enghin Atalay, *The Topology of the Federal Funds Market*, 389 PHYSICA A: STAT. MECHS. & ITS APPLICATIONS 5223, 5227 (2010). A large proportion of trading volume–about half—reflected banks acting as dealers, borrowing funds earlier in the day, and lending them (at a mark-up) later in the day. *See* Gara Afonso & Ricardo Lagos, *An Empirical Study of Trade Dynamics in the Federal Funds Market* 19 (Fed. Rsrv. Bank of N.Y., Working Paper No. 550, 2010).

104. *See* Timo Henckel et al., *Central Banking Without Central Bank Money* 15-16 (Int'l Monetary Fund, Working Paper No. 99/92, 1999).

105. *See* Appendix, Balance Sheet 4.

106. A 1999 IMF Working Paper discusses this exact hypothetical:

> Should the money market always clear at the end of the day as a closed system (i.e., without net liquidity injections or contractions by the central bank) a private broker–rather than a central bank—could, in principle, facilitate the recycling of liquidity and post for such transactions an interest rate band that might differ from that of the central bank.

Henckel et al., *supra* note 104, at 24.

107. These other tools include open market purchases of securities and clearing of incoming payments to the Treasury account.

intervention into a well-functioning market for reserves, something that a private system of banks left to their own devices could likely do without.[108] This view of the efficiency of interbank markets predictably leads to the conclusion that reserves are not truly necessary for settlement.

But can banks, left to their own devices, truly trade away their clearing drains in an efficient market? Here again, the modern system makes it difficult to meaningfully address that question. The reason is that the modern interbank market is in fundamental ways the product of central bank design and receives ongoing central bank support. The remarkable efficiency of interbank markets could be attributed to that ongoing support rather than the power of markets per se. Specifically, modern central banks target the overnight rate at which banks trade reserves with each other (in the United States, that is the "fed funds rate").[109] This targeting of overnight rates is the traditional tool through which the central bank implements its monetary policy.[110] It is well understood that maintaining the target rate requires the central bank to accommodate any unmet demand in the market for reserves.[111] When such demand causes the overnight rate to exceed the central bank's target rate, the central bank would increase the supply of reserves so as to bring the overnight rate back down to its official target. Notice the implications of this policy for banks' ability to trade in an interbank market. Banks are trading in an environment where an adequate supply of reserves is essentially guaranteed, and the rate of borrowing reserves is predictable.

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108. *See* Henckel et al., *supra* note 104, at 27. Mervyn King, then Deputy Governor (later Governor) of the Bank of Eng. (2003-2013), has cited this point in agreement. *See* Mervyn King, Deputy Governor, Speech: Challenges for Monetary Policy: New and Old (Aug. 27, 1999) at 26, https://www.bankofengland.co.uk/-/media/boe/files/speech/1999/challenges-for-monetary-policy-new-and-old.pdf [https://perma.cc/B58J-KS3B].

109. Since the rise in reserves during the GFC, the supply of reserves is overabundant, and the targeting of the overnight rate takes place primarily through the payment of interest on reserves. *See* Jane E. Ihrig et al., *Monetary Policy 101: A Primer on the Fed's Changing Approach to Policy Implementation* (Bd. of Governors of the Fed. Rsrv. Sys., Working Paper No. 2015-047, 2015); Federal Reserve Act, 12 U.S.C. § 19(b)(12).

110. *See* Ihrig et al., *supra* note 109.

111. The insight that central banks must accommodate banks' demand for reserves originated in the highly innovative work of Post-Keynesian economists in the 1980s, especially BASIL J. MOORE, HORIZONTALISTS AND VERTICALISTS: THE MACROECONOMICS OF CREDIT MONEY (1988). It has since become integral to the central banking literature. *See, e.g.*, Ulrich Bindseil & Philipp J. König, *Horizontalists and Verticalists: An Appraisal 25 Years Later*, 1 REV. KEYNESIAN ECONS. 383 (2013). And it has more recently been included in legal scholarship. *See* Hockett & Omarova, *supra* note 6, at 1162.

That is hardly the kind of setting that would usually pass for a real-life private market.

An important benefit of the historical case study here is the way it allows us to examine whether banks would trade in an interbank market in the absence of ongoing support by a central bank.[112] As discussed below,[113] the case study answers this question in the negative. There is no evidence NYCHA traded reserves in an interbank market. On the other hand, these banks heavily relied on non-market mechanisms: high levels of reserves of public money (coin and legal tender notes) and a carefully coordinated system of "secondary reserves" they created (by internally recycling call loans to stockbrokers). The historical practice is therefore fundamentally at odds with the conventional view that casts bank money creation as the product of individual decisions.

We can now summarize our discussion up to this point. While clearing is essential to bank money, the conventional view's account has no clearing in it. The gap between the practical significance and theoretical disregard is filled by the three assumptions. These assumptions—that netting is freely available, that the LLN prevents drains, that interbank markets can handle drains—are meant to explain why bank money creation can be understood "as if" clearing did not exist. The result is a vision of bank money creation that in ordinary times revolves entirely around market forces. The Article's argument in this Part was that data limitations, and even more basically, modern central banks' deep involvement in the payments system, make these assumptions extremely difficult to assess. In the next Part, we move to examine these assumptions through the historical case study of the pre-Fed NYCHA.

III. ADDRESSING THE QUESTION: DAILY GOVERNANCE IN THE NEW YORK CLEARING HOUSE ASSOCIATION

The New York Clearing House Association was established in 1853 by private agreement between the city's main banking institutions.[114] As stated in its Constitution, the goal of the NYCHA was "effecting at one

112. This question has not been at the center of discussions in the Post-Keynesian literature, nor has it been discussed in the legal literature on money building on it. *See also* discussion *infra* notes 200 and 201.

113. *See infra* Section III.C.

114. 1 MARGARET MYERS, THE NEW YORK MONEY MARKET: ORIGINS AND DEVELOPMENT 95 (Benjamin Haggott Beckhart ed., 1931).

place of the daily exchange between the various Associated Banks, and the payment at the same place of balances resulting from such exchanges."[115] That Constitution is an important legal source, providing the detailed rules governing the clearinghouse over some twenty pages. The discussion in this Part focuses on the operation of the NYCHA at the turn-of-the-century, with quantitative data drawn from 1905.[116] That period was chosen for its proximity to the creation of the Federal Reserve System in 1913, while still preceding the 1907 Panic and the changes it brought into New York banking practice.[117]

While financial historians have fruitfully studied the pre-Fed NYCHA, their work has focused on the NYCHA banks' collective action during periods of crisis.[118] This approach is analogous to the conventional view that limits the role of governance to crisis time, while assuming that in ordinary times bank money creation occurs through simple private transactions. In distinction, the history presented in this Part seeks to identify the challenges that clearing presented to the NYCHA banks on a daily level, and the way these challenges were addressed in practice. The discussion is organized around the three "as if" assumptions used to justify the abstraction from clearing: the free availability of netting, the LLN's prevention of drains, and the capacity of interbank markets. As discussed below, the history calls all three assumptions into question.

During 1905, the ranks of the NYCHA included 52 banks, holding national and state charters, with total deposits of about $1,100 million.[119]

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115. CONST. OF THE N.Y. CLEARING HOUSE ASSOC., § 2, https://babel.hathitrust.org/cgi/pt?id=wu.89099412611&view=1up&seq=3&skin=2021 [hereinafter NYCHA CONSTITUTION].

116. The case study is intended primarily as a snapshot of NYCHA practice around 1905. It is not generally meant to describe its historical origins.

117. Some of these changes, like the rise of outside lending in the call loan market, have already been on the rise since around 1900.

118. *See, e.g.*, GARY GORTON, SLAPPED BY THE INVISIBLE HAND: THE PANIC OF 2007 (2010); Gary Gorton, *Clearinghouses and the Origin of Central Banking in the United States*, 45 J. ECON. HIST. 277 (1985); Ellis W. Tallman & Jon R. Moen, *Liquidity Creation Without a Central Bank: Clearing House Loan Certificates in the Banking Panic of 1907*, 8 J. FIN. STABILITY 277 (2012); Ellis W. Tallman & Jon R. Moen, *Why Didn't the United States Establish a Central Bank Until After the Panic of 1907* (Fed. Rsrv. Bank Atlanta, Working Paper No. 99-16, 1999). In distinction from the prevalent focuson crisis dynamics, my emphasis on daily routines builds on works like MYERS, *supra* note 114, and Mehrling, *supra* note 101.

119. New York Clearing House Association, *Statement of the Associate Banks of the City of New York from Reports to the New York Clearing House --- for Week Ending*, Harvard Social History/Business Preservation Microfilm Project, Project 3; 90037 (Jan.

The size of these banks could be divided into three tiers: the "Big Six" banks (deposits of $50 to $190 million) held about one half of total members' deposits,[120] with the remainder divided roughly equally between 15 medium-sized banks (deposits of $15 to $35 million) and 31 smaller banks (deposits below $10 million). The NYCHA was part of a broader system of clearinghouses that existed in dozens if not hundreds of cities across the United States. Like other clearinghouses, membership in the NYCHA was limited to local city banks, but the significance of the NYCHA went far beyond this local scope. Over half of NYCHA banks' deposits—nearly $600 million—were not held by individuals, but by out-of-town banks for whom the NYCHA banks acted as correspondents.[121] The out-of-town banks used these so called "bankers' balances" to settle their inter-regional payments.[122] The NYCHA therefore stood at the apex of the U.S. payments systems. The only modern counterpart in its sense of significance would be Fedwire.

A. NETTING WAS NOT FREELY AVAILABLE

When the Constitution of the NYCHA speaks of "effecting at one place of the daily exchange between the various Associated Banks, and the payment at the same place of balances resulting from such exchanges" it is speaking of a system of multilateral netting.[123] Described in Part I, such a system would allow banks to net their obligations throughout the day, and across all clearinghouse members. Prior to the creation of the Fed, this system was the legal infrastructure that actually allowed banks to enjoy the benefits of the law of large numbers. This Section argues that netting in this way was not freely available as we have come to assume, but involved the banks taking on substantial risk exposure towards one

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7, 1905) statement [hereinafter *NYCHA Weekly Statements*]. The size of deposits waned and waxed with seasonal cycle with the 1905 peak being around $1,200 million and through being around $1,000 million.

120. The Big Six were National City (#8), National Bank of Commerce (#23), Hanover National Bank (#33), National Park Bank (#54), First National Bank (#65), and Chase National Bank (#74). The numbers in parentheses represent the banks' identifying numbers on the clearinghouse ledger and weekly statements discussed below.

121. *See* MYERS, *supra* note 114, at 241.

122. *See* LEONARD LYON WATKINS, BANKERS' BALANCES BEFORE AND SINCE THE FEDERAL RESERVE SYSTEM 102 (1926).

123. NYCHA CONSTITUTION, *supra* note 115 § 2.

another. We can understand this risk exposure by following the daily routine of netting, as well as the procedures set out in the event of default.

In 1905 netting was a corporeal experience. Every morning around 09:45 a.m., clerks of the various NYCHA banks would enter the gallery of the elegant clearinghouse building at the corner of Nassau and Cedar Street. At 10:00 a.m. sharp, the clearinghouse manager sounded the gong, and a curious ritual began: "four columns of young men moving simultaneously like a military company in step."[124] At the center of the clearinghouse gallery were 52 desks, each assigned to one of the member banks. Standing behind the desks were "settling clerks" that each bank had sent to receive packages from the other banks. Rotating around these same desks were "delivery clerks" that each bank had sent to deliver packages to the various settling clerks. The contents of these packages were all of the checks drawn against the settlement clerk's bank that were received in the delivery clerk's bank within the past 24 hours. All in all, each morning some 2,652 packages between 1,326 pairs of banks were handed this way from the delivery to the settlement clerks.[125]

To each package was appended an "exchange slip" summing the total dollar amount of checks delivered.[126] These exchange slips were important because they represented credits to the delivery clerk's bank, and amounts owed by the settling clerk's bank. A bank's clerks would rapidly sum all the exchange slips given and received to and from the other 51 banks. In jargon, one speaks of the difference between credits and debits within each pair of banks (one of the 1,326 pairs) as a "bilateral net." As discussed in Part 1, in the absence of a clearinghouse, each one of these bilateral net positions would have had to be settled

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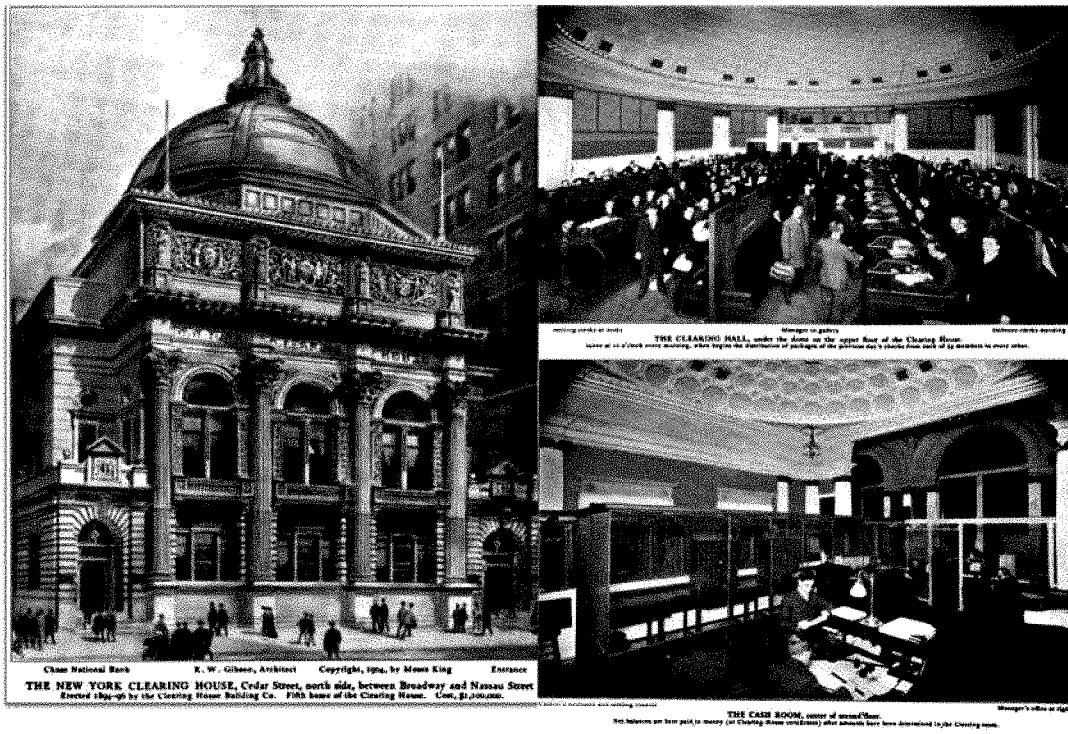
124. J.G. CANNON, CLEARING-HOUSE METHODS AND PRACTICES, S. Doc. No. 491(1910) *reprinted in* CLEARING HOUSES AND CREDIT INSTRUMENTS 195 (1911). The author, J.G. Cannon, was a contemporary New York banker who had started his career as a clearinghouse clerk. The description that follows draws heavily on his account in Chapter XIV of the book.

125. Where n is the number of NYCHA banks (52), the number of pairs (1,326) is denoted by $n(n-1)/2$. While not a member of the NYCHA, the U.S. Treasury also participated in the daily exchanges of the NYCHA.

126. To the best of my knowledge, daily exchange slips are not available at the NYCHA archive at Columbia University. *Rare Book & Manuscript Library Acquires Archive of the Clearing House Association*, COLUM. U. LIBRS. https://library.columbia.edu/about/news/libraries/2014/rare-book---manuscript-library-acquires-archive-of-the-clearing-.html [https://perma.cc/Q3XR-BVTA] (last visited Jan. 29, 2022).

individually.[127] The key advantage of the clearinghouse system was that on regular days that bilateral net was meaningless. The agreement to engage in multilateral netting allowed NYCHA banks to setoff all credits from all banks against amounts owed to all banks. Only the difference between the two, the so called "daily balance," would then have to be settled in actual reserves. **Figure 1** provides photographs of the NYCHA building, the morning exchanges, and settlement in the "Cash Room."

Figure 1: NYCHA Building on Cedar Street (left); The 10:00 a.m. Exchanges in the Clearinghouse Gallery (top right); Settlement by 01:30 p.m. in the Cash Room[128]



127. To reduce the cost and complexity involved in such settlement, New York banks prior to 1853 often resorted to a system of drafts banks drew on each other. *See* CANNON, *supra* note 125, at 150 for discussion of that system and its disadvantages.

128. WILLIAM JAY GILPIN & HENRY E. WALLACE, CLEARING HOUSE OF NEW YORK CITY: NEW YORK CLEARING HOUSE ASSOCIATION, 1854-1905 6, 13, 17 (Moses King ed., 1904).

A look at 1905 data helps appreciate how substantial the compression of the clearings to daily balances was. For 1905, the total NYCHA bank deposits of $1,100 million produced a daily average of $302 million (some 27 percent of deposits) in checks between customers, representing the contents of the boxes handed by the delivery clerks. On the highest days, this so-called "clearings" figure rose to nearly $700 million—63 percent of total deposits.[129] And this is still an average across the 52-member banks. Individual banks may experience gross amounts that constitute an even larger percentage of their deposits. With multilateral netting, this enormous clearing figure was reduced to an average total daily balance of $13 million, just 1 percent of total NYCHA deposits, and 4.3 percent of average daily clearings.[130] The highest recorded total daily balance was $42 million, still only 3.5 percent of total deposits, and under 7 percent of the very highest clearing figure.[131]

At first sight, this data is consistent with the conventional view's assertion that netting reduces the need for settlement in actual reserves. What is left out of the conventional view, however, is the mutual risk exposure that clearing banks were subject to as part of the netting process.[132] The Constitution of the NYCHA[133] required banks with negative daily balances to settle their indebtedness by 1:30 p.m., and to settle it in reserves (specie and legal tender notes) delivered to the clearinghouse manager in a specially designated room.[134] That Constitution also provided procedures for the expulsion or suspension of members by a simple majority vote.[135] It is likely that such procedures were initiated against members failing to settle by 1:30 p.m., thus making it practically impossible

129. *See* CANNON, *supra* note 124, at 217, 222 ($686 million figure for Jan. 3, 1906). For total deposits of $1,100 million see *supra* note 119.

130. *See* CANNON, *supra* note 124, at 221.

131. *Id.* at 222.

132. To clarify, my argument is not that multilateral netting increases risk exposures compared to a bilateral netting system as its baseline. Rather, my argument is that multilateral netting, considered on its own, involves considerable risk that is not sufficiently discussed and analyzed in the literature on bank money creation.

133. NYCHA CONSTITUTION, *supra* note 115 at § 12.

134. To avoid the inconvenience in movement and counting of specie and legal tender, balances were often settled in clearinghouse certificates that were backed 100 percent by the above. *See* NYCHA CONSTITUTION, *supra* note 115, at § 17. These regular 100 percent backed certificates are not to be confused with clearinghouse loan certificates discussed in Section III.C.1 below.

135. NYCHA CONSTITUTION, *supra* note 115 at §§ 20-21.

for them to continue business operations.[136] Even more importantly for our purposes are the immediate consequences of default to the other (non-defaulting) members. Section 13 of the Constitution provided the basic rule on default, in pertinent part:

> Should any one of the Associated Banks fail to appear at the Clearing House at the proper hour prepared to pay the balance against it, the amount of that balance shall be immediately furnished to the Clearing House by the several banks exchanging at that establishment with the defaulting bank, in proportion to their respective balances against that Bank, resulting from the exchange of the day . . . .[137]

The meaning of this highly technical rule is that a default would have exposed banks owed a bilateral net balance from the defaulting bank to loss of that balance. To take a stylized example, assume that on a given day, Bank A defaulted on its $10 million daily balance. On most days, the 2,652 exchange slips produced by the clerks would be totaled and could then be thrown away (after all, multilateral netting means that only grand totals matter). But with a default occurring, these slips now determine how the loss will be allocated. Each bank will calculate its bilateral net towards the defaulting bank, reflecting the difference between the exchange slip given to that bank, and the one received from it. Assume that it was found that three of the banks—Bank B, Bank C and Bank D—had an excess of checks delivered to the defaulting Bank A over checks received from it, e.g., $1 million positive net balance to Bank B, $2 million to Bank C, and $7 million to Bank D. Each of these banks would have to then "immediately furnish" these amounts to the clearinghouse.

It is important to appreciate the distinct ways in which this default management procedure affects the capital and the liquidity position of the surviving banks now subject to Section 13. Capital reflects the difference between a bank's assets (mainly loans) and liabilities (mainly deposits), and is a safety cushion protecting creditors in the event of a loss to assets.

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136. While it seems that banks occasionally defaulted in the clearinghouse, detailed discussions of defaults are difficult to come by. *See, e.g.*, CANNON, *supra* note 125, at 209. Future research on this matter will likely require work in the NYCHA Archive. *See supra* note 126.

137. In a strange coincidence of legal history, the original section in the Federal Reserve Act providing lender-of-last-resort authority was also numbered Section 13 of the Federal Reserve Act. *See* discussion *supra* note 53. The original discount window authority in § 13(2) has become antiquated, and since the New Deal the two main authorities are found in §§ 10B and 13(3).

When Section 13 is triggered, banks like B, C, and D have to pay the balance immediately (a new liability), but they can try to recover that amount against the defaulting bank outside the clearinghouse, e.g., by filing an insolvency claim (a new asset). Whether or not the surviving banks will suffer a capital loss ultimately depends on the success of those collection efforts, which might play out over a significant period of time.

Far more immediate are the liquidity implications of the default. This means bringing these amounts in actual reserves to the clearinghouse manager, just as if the amount had to be settled as a regular negative daily balance. If that bank happens to be flush with reserves on that day, that might not be a problem. But if that bank was already in the position of having to settle a negative daily balance, it might simply be unable to settle the new and aggravated balance. If so, that bank too would have to default. And once it defaults, Section 13 would be activated yet again, leading to a new group of banks that have to "immediately furnish" their net bilateral balance. In modern jargon, this is the risk of a "cascading default."[138]

The default management procedure laid out in Section 13 shows us that while multilateral netting shrinks the obligations between banks, bilateral risk exposures are not eliminated entirely, and resurface in the event of default.[139] Defaults not only impose losses on individual surviving banks, but also risk a cascading default that threatens clearinghouse members as a whole. The threat of a cascading default in multilateral netting systems like CHIPS emerged as a growing source of anxiety in central banking circles since the rise of financial globalization in the 1970s and 1980s.[140] While that story is beyond the scope of the current Article, the anxiety felt by central bankers in the late twentieth century informs our understanding of the concern such cascades have

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138. *See generally* Fariba Karimi & Matthias Raddant, *Cascades in Real Interbank Markets*, 47 COMPUTATIONAL ECON. 49 (2016).

139. In modern practice, it is common for clearinghouses—especially derivatives clearinghouses, or "CCPs"—to have guarantee funds that mutualize losses across clearinghouse members in the event of default. *See* Richard Squire, *Clearinghouses as Liquidity Partitioning*, 99 CORNELL L. REV. 857 (2014). For reasons that go beyond this Article, I do not believe loss mutualization solves the risk exposure involved in multilateral netting.

140. *See, e.g.*, BANK FOR INT'L SETTLEMENTS, REPORT OF THE COMMITTEE ON INTERBANK NETTING SCHEMES OF THE CENTRAL BANKS OF THE GROUP OF TEN COUNTRIES 29 (1990), https://www.bis.org/cpmi/publ/d04.pdf [https://perma.cc/4U9Z-YARQ]; BANK FOR INT'L SETTLEMENTS, REPORT ON NETTING SCHEMES (1989), https://www.bis.org/cpmi/publ/d02.pdf [https://perma.cc/3387-UDKE].

posed at the turn of that century.[141] Modern work in economics demonstrates the enormous risk that cascading defaults presents.[142] These concerns were so significant they led central banks around the world to reform their payments infrastructure over the ensuing decades.[143] In many ways, the system we inhabit today is a creature of those reforms.

The turn away from netting systems underscores that cascading defaults are an existential risk to clearinghouse members, and to the broader financial system. The understanding that netting is not freely available—that it comes with considerable fragility—is a good starting point for a theory of bank money creation. It focuses our attention on the drains that can lead to the default, and on the actual means banks have to meet those drains. At an even deeper level, the threat of a cascading default starts to build the intuition that clearing banks cannot approach each other as profit maximizing individuals in arms-length transactions. They have to consider the way that their actions

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141. It is worth noting that while default procedures in the NYCHA and 1970s CHIPS were similar, they were not identical. CHIPS' so called "unwind" rule provided for complete removal of the defaulter's positions from the day's clearings, followed by a recalculation of all positions. *See* Robert T. Clair, *The Clearing House Interbank Payments System: A Description of its Operation and Risk Management*, FED. RSRV. BANK DALLAS' HIST. LIBR. 130 (1989). By reducing the default amount to the multilateral net, the historical NYCHA rule seems to slow the reach of a cascade compared to the CHIPS unwind rule. While interesting to pursue in future work, a more detailed comparison between the two rules (and potential reasons for the difference) is beyond the scope of this Article.

142. *See* David B. Humphrey, *Payments Finality and Risk of Settlement Failure*, *in* TECHNOLOGY AND REGULATION OF FINANCIAL MARKETS: SECURITIES, FUTURES, AND BANKING 97 (Anthony Saunders & Lawrence J. White eds., 1986). Later studies have arrived at different conclusions. *See, e.g.*, P. Angelini, G. Maresca & D. Russo, *Systemic Risk in the Netting System*, 20 J. BANKING & FIN. 853 (1996); Morten L. Bech & Kimmo Soramäki, *Systemic Risk in a Netting System Revisited* (draft, 2005) https://www.suomenpankki.fi/globalassets/en/financial-stability/payment-and-settelement-system-simulator/events/sempaper04-bech-sormaki.pdf [https://perma.cc/5JJR-JRQL]. All of these studies (including the Humphrey study) focus on a bank's capital position rather than their liquidity position. This focus, in my view, leads to a considerable underestimation of the risk of cascades.

143. One strand of these reforms included a shift away from traditional netting systems like the NYCHA to RTGS operated by the central bank. *See supra* Section I.A. The situation in the United States was different, given that Fedwire has been in operation for decades prior to the global shift in perspective. A second strand of these reforms made any remaining netting systems (like CHIPS) safer. This was achieved through fundamental changes to their legal architecture and an increase of their reliance on reserves. *See supra* note 83 and accompanying text.

affect the possibility of another bank's default. The next Sections of the case study further continue to explore these themes.

B. CLEARING DRAINS DID OCCUR

This Section presents evidence that clearing drains did in fact occur in the NYCHA. In so doing, it calls into question the conventional view's assumption that the law of large numbers prevents drains in ways that make clearing seem easier than it is. Drains exposed banks to the risk of default, and as discussed above, the default of any one member bank could pose a risk to others through the liability imposed by Section 13. The underestimation of drain risk results in an underestimation of the challenges involved in clearing, and the governance designed to address them. This Section studies two distinct types of drains to which banks were subject: daily and weekly. A daily drain is as an abnormally large negative daily balance at the clearinghouse, while a weekly drain reflects the accumulation of smaller but persistent negative daily balances throughout the clearing week. Daily drains can be studied empirically through the NYCHA daily ledger. Weekly drains are far more challenging to study empirically, but as discussed below, we can gain much insight into their occurrence through a simple theoretical model.

Before immersing in the study of drains, it is important to gain an intuitive understanding as to why the conventional view underestimates their significance. The problem is not with the LLN per se, but with the specific way in which the LLN is applied.[144] As we saw above, multilateral netting was able to reduce the $302 million average in clearings to an average total daily balance of $13 million, just 1 percent of total NYCHA deposits. At first sight, that might sound close enough to the notion that the LLN eliminates drains. But on closer look, such figures are highly limited by virtue of being averages: an average across days, and an average across banks. Averages mean little in practice, because each individual bank must stand ready to meet its own individual balance, and it must stand ready to meet it on every single clearing day. Looking at the LLN at the level of the single bank on a single day is fundamentally different from looking at the LLN across banks and across time. At the level of the single day, it is indeed correct that the LLN predicts small negative balances. Our stylized bank in a two-bank system (each with $500 in deposits) is expected to

144. My assumption here is that payment flows by depositors are i.i.d., and generally do follow the LLN. An additional line of inquiry could examine that assumption. *See* discussion *supra* note 90.

lose under 4 percent of deposits 9 out of 10 days, and its probability of losing 10 percent or more of deposits on a given day is 1 in 1,000.[145] But that risk dramatically grows once we consider that multiple banks need to clear on multiple days. The NYCHA had 52 banks that each cleared about 300 days a year. With 15,600 observations, the expected number of 1 in 1,000 drains (i.e., drains that amount to 10 percent of a bank's deposits) is 15.6. That is more than once monthly, i.e., not very rare at all.[146] With the intuition in place, we turn to look at the drains more closely.

1. Daily Drains

Assessment of real-life drains requires disaggregated data for specific banks on specific days. Today, such data is extremely difficult to find due to its proprietary nature. Even if found, it would be difficult to interpret given the institutional complexity of the modern financial system.[147] In contrast, the ledger of the New York Clearing House provides exactly such disaggregated data and to the best of my knowledge, has not been previously studied with this purpose in mind. The ledger is challenging to work with. Its handwriting and sheer physical size make it difficult to digitize, and the nearly 16,000 entries per year make it difficult to study without digitization. Nevertheless, with the help of some heuristics, we can look for evidence of some drains, knowing the imperfect nature of the search could easily miss out on others. To be sure, much future

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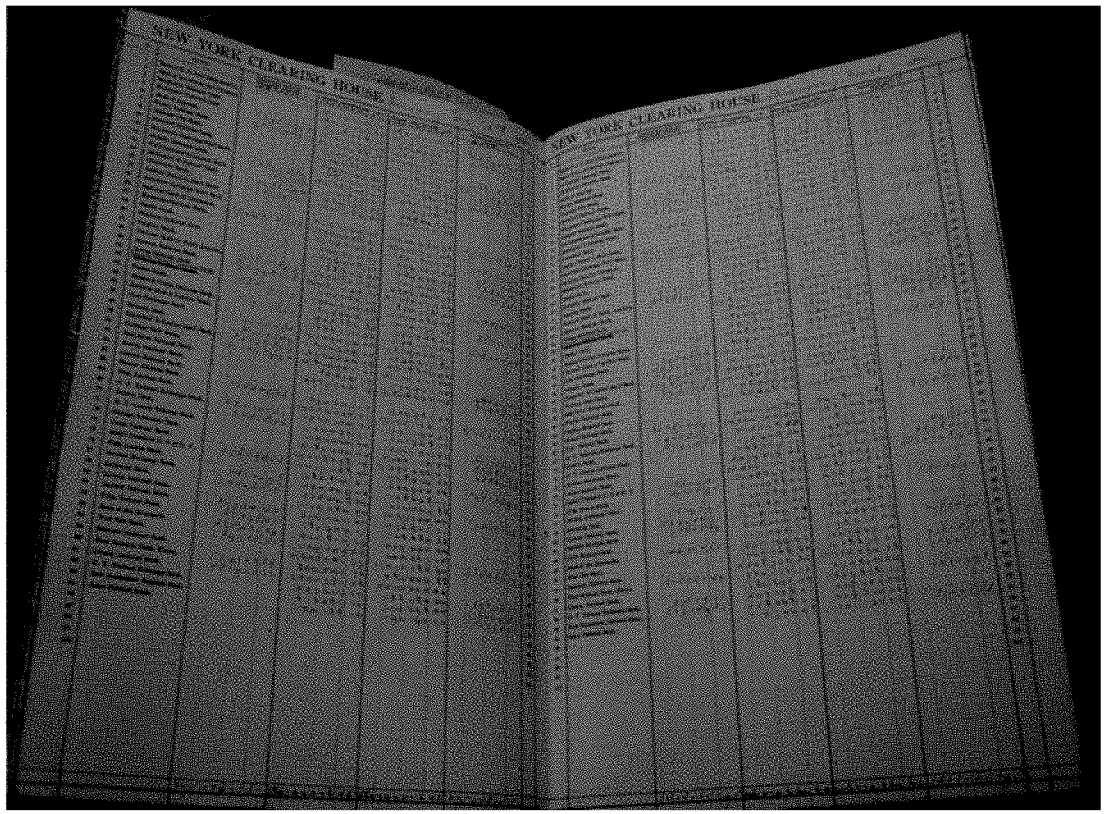
145. *See supra* Section I.I.B; *see also* Maciej Kowalski, *Coin Flip Probability Calculator*, OMNI CALCULATOR (Aug. 17, 2021), https://www.omnicalculator.com/statistics/coin-flip-probability [https://perma.cc/BF6M-QV6P] [hereinafter OMNI CALCULATOR]. "Number of flips" set to 1,000. First calculation: "I want to have at least" set to 480 heads; chances of success are 90.3 percent. Second calculation: "I want to have at most" set to 450 heads; chances of success are 0.0865 percent.

146. *15.6 = 0.001*300* clearing days **52* banks. Similarly, the probability of any one of the 52 banks experiencing a 1-in-1,000 drain on a given day is about 5 percent (*0.05 = 1- (1-0.001)^{52}*); The probability of any one of the 52 banks experiencing a 1-in-1,000 drain on a given week is about 26 percent (*0.26 = 1 - (1 - 0.05)^{6}*); The probability of any one of the 52 banks experiencing a 1-in-1,000 drain over the course of a year (52 weeks) is greater than 99.9 percent (*0.999999 = 1 - (1-0.26)^{52}* weeks) essentially certain.

147. Modern studies, like those mentioned in note 140, *supra*, have used datasets that are conceptually similar to the ledger (often through central bank affiliation). The goal of these studies was different, namely, assessing the risk of cascades as opposed to the occurrence of drains per se. Using these datasets to study drains would require extensive controls for the wide array of modern liquidity management tools that obscure the underlying flow of depositor payments.

work remains to be done with the ledger, including through more refined research methods and controls (see **Figure 2** for an image of a page from the ledger).

Figure 2: Page from the NYCHA Ledger[148]



My study into daily drains in the ledger involved several steps. The first step was to define the size of the negative daily balance that would qualify as a drain. The size chosen for these purposes was a daily balance of about 10 percent or more[149] of a bank's deposits (deposit data is drawn

148. Columbia University, *Rare Book & Manuscript Library Acquires Archive of the Clearing House Association*, COLUM. U. LIBRS.

149. The heuristic used in the initial phase of the search was to normalize drains by deposits and circulating notes on the first week of the quarter. Once an entry has been identified, Tables 2-4 in the Appendix notes the level of deposits and circulating notes on the week prior to the drain (W-1). This two-stage process led to a few entries where the proportion is slightly lower than 10 percent, but these entries do not change the overall results.

from NYCHA weekly statements).[150] While the percentage is somewhat arbitrary, this threshold was chosen for two reasons. First, as noted above, losing 10 percent or more of deposits on a single day should be a small, one-in-a-thousand probability.[151] It's precisely the kind of small probability event that the conventional view abstracts from. Second, NYCHA banks held reserves of slightly over 25 percent of their deposits, which they were required to maintain under the National Banking Act.[152] A daily drain greater or equal to 10 percent of deposits means losing at least 40 percent—nearly one half—of the required reserve amount. This is a serious liquidity event, about one additional drain from default. The occurrence of such daily drains would go a long way in explaining the need for NYCHA banks' relatively high reserve ratios. Importantly, it will do so in ways that are based on the obligations banks routinely incur to each other, rather than demand for cash from depositors, or the binding legal nature of the reserve requirements.[153] Daily drains of this magnitude also highlight banks' need to promptly replenish their reserve to pre-drain levels, an important question to be addressed in the next Section.

The second step was to search 1905 ledger entries for these drains. As noted above, the search had to be incomplete due to the use of heuristics, and the non-digitized format. A notable limitation of the study in this respect is the focus on medium-sized and larger banks, to the exclusion of the smaller banks that represent about 25 percent in total deposit volume, and about 30 out of 52 of the total banks in number. This is a conservative decision that understates the true number of drains in the ledger. Searched in this fashion, the ledger produced a total of 45 observations for daily drains. These observations are summarized in Table 1 in the Appendix.

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150. *See supra* note 120 and accompanying text. Note that deposits reported in those statements reflect weekly average rather than a snapshot of a specific day.

151. *See supra* note 145 and accompanying text.

152. *See* National Banking Act of 1864, 12 U.S.C. § 38; Sess. 1 ch. 106 §§ 6, 7; 13 Stat. 99 38th Congress, 1st Session, ch. 106, § 31, 13 Stat. 99 (codified as amended in scattered sections of 12 U.S.C.). Reserve requirements applied to both deposits and national bank notes issued under N.B.A. § 21 (these notes are not to be confused with legal tender notes discussed in note 168, *infra*). For completeness, the 10 percent threshold discussed above includes these notes in the denominator. For simplicity, this Section abstracts from discussion of reserve requirements under New York state law, because the share of deposits by state banks in NYCHA was small (around 10 percent).

153. While runs decrease the total reserve available to banks, clearinghouse balances reallocate a given total reserve across different banks.

Importantly, however, not all 45 observations—and not even the majority of them—represent true daily drains. This is where the third and final step comes in. The main analytical challenge of working with the ledger is the realization that daily balances do not represent only the underlying flows between deposits, but can also reflect proactive attempts by clearing banks to affect their daily liquidity. These proactive attempts, and the system of governance necessary to sustain them, will be discussed in detail below.[154] For now, what is important to understand is that drains resulting from this kind of proactive action are not a threatening shock to the bank (like a true drain), but intentional attempts to reduce overabundant reserves. To make the results conservative, and prevent overestimation, these entries had to be controlled for. The control stage of the study included classifying the 45 entries into three groups:

Table 2: Results of Search in the Ledger

	Significance of finding	# of observations
Group 1	High level of confidence that the drain is a true drain[155]	7
Group 2	Indication of a true drain, but lesser level of confidence[156]	6

154. *See infra*, Section III.C.2.

155. "High level of confidence" reflects instances where (a) there was no positive balance on the day preceding the drain (T-1) that exceeded about 50 percent of the drain amount; (b) at least 70 percent of the drain was recouped in the day following the drain (T+1; in one of the seven cases, T+2 was used as well); (c) T and T+1 both fall within the same week, and the same month, thereby virtually eliminating the possibility that the drain was motivated by reserve cycle management concerns. See *infra*, Section III.C.1.

156. "Indication of a true drain, but lesser level of confidence" reflects instances where: Group 1, Condition (a) was met; (b) a considerable portion (75 percent or more) of the drain was recouped within a period of up to 6 days or shorter from the drain (T+6); (c) there is no strong indication that the negative drain on T was incurred to offset positive balances in the preceding days (T-3; the highest sum of T-1, T-2, and T-3 for Group 2 is about 54 percent of the negative balance on T); ; (d.) because recoupment periods are longer, and sometimes straddle two different clearing weeks, or go across months, it is possible (though not necessary) that reserve cycle maintenance has played a role. Also note that end-of-month periods may also involve heightened clearing volume due to heightened payments activity (e.g., payment of wages).

Group 3	The drain is unlikely to be a true drain[157]	32
Total		45

Classified this way, Group 1 (high level of confidence) includes seven findings, from five distinct banks: four medium-sized banks, and one large bank. Taken together, these banks account for $310 million in deposits, some 27 percent of total NYCHA deposits.[158] In their relative size, the drains vary from 36 percent to 55 percent of the relevant bank's required reserves on the week prior to the drain (average of 45 percent).[159] These Group 1 findings go a long way in corroborating the intuitive argument above, that even if the probability of an individual drain is small, a very large number of clearing events would produce a meaningful number of these drains (in that highly stylized model, 15.6 events).[160] In addition to these seven Group 1 observations, Group 2 includes six additional observations with indications of a true drain, while at the same time acknowledging a lesser level of confidence given their more complex nature. These observations include four additional banks, not included in Group 1, and represent an additional $122 million in deposits over the Group 1 banks.[161] The size of these drains varies from 38 percent of required reserves to a staggering 80 percent (average of 58 percent). The 13 entries from Groups 1 and 2 are summarized in **Tables 3-4** in the Appendix. These findings suggest a substantial share of NYCHA banks, by number, and deposit size, experienced a drain over the period of only one year. They stand in stark contrast to the image conveyed by the annual averages across the year and across banks where the daily balance is only 4 percent of required reserves (1 percent of total deposits). By looking at

157. Group 3 is a residual category for observations that did not meet the Group 1 or Group 2 conditions. For a large subset of this group, there is an indication that the negative balance was not a true drain, with the T-1 balance being relatively high, and the T+1 balance being relatively low. Readers may detect these entries by looking through Table 1 in the Appendix.

158. *See* Appendix, Table 3.

159. For methodological aspects, see discussion *supra* notes 155, 156, and 157.

160. To be clear, the model is so stylized that the empirical findings are not meant as any kind of corroboration. This Section merely indicates the relative similarity of the results.

161. *See* Appendix, Table 3. One of the banks, Bank #1 (Bank of New York), appears twice in Group 1, and once in Group 2. One of the reasons for this might be that, given its place on the first line of the ledger, the entries more easily jump out.

individual ledger entries we see the average underestimates the stress to which a specific bank may be subject by a factor of 10 or more.

2. Weekly Drains

Where daily drains represent an abnormally large negative balance on a given day, weekly drains are the accumulation of several smaller negative balances over the week. Unlike daily drains, weekly drains are not directly observable. To find a weekly drain, one cannot simply look at a given bank's daily balances over the course of a week, and sum-up the result. One reason is practical—the difficulties of digitizing the ledger make such study extremely labor intensive. More fundamentally, even if the data were conveniently available, the results would likely not be reflective of the underlying flows of deposits between bank customers. The reason is that—as discussed below[162]—NYCHA banks developed a system to proactively influence their daily balances across the week through call loans to brokers. A bank facing a negative daily balance could improve its next day balance by calling back loans, and narrative accounts suggests that such practice was routine. To this extent, a simple summation of balances across the week will bring results far closer to zero than to the "real" weekly drain, leading to a serious underestimation of the risk they posed.[163]

While weekly drains are difficult to observe directly, we can use a highly stylized model to understand their basic logic. If we set aside proactive actions by banks, a weekly drain could be modeled using a simple binomial distribution. Each day of the week, a bank goes to the clearinghouse where, with equal probability, it may "win" by having a +$*x* positive daily balance, or "lose" by having -$*x* negative daily balance. We may define a draining week as one of six consecutive losses, leading to a total loss of $6*x* in reserves. While somewhat arbitrary, this six-day period stands for the proposition that in the very short-run a bank has very little ability to improve its balances by reducing loans to clients or selling assets at acceptable prices.[164] In this basic model, the probability of a bank facing

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162. *See infra* Section III.C.3.

163. Call loan data is not available at the individual bank level, so the original clearing position cannot be reverse engineered.

164. This assumption is common in modeling demand for reserves. *See, e.g.*, William Poole, *Commercial Bank Reserve Management in a Stochastic Model: Implications for Monetary Policy*, 23 J. FIN. 769, 770 (1968):

> In the very short-run, the banks reserve manager takes as given the fluctuations in deposits and reserves caused by the clearing of checks

a draining week on any given week is 1-in-64 (0.5^6) or 0.015 (see Appendix, **Figure 3**). The next question is how severe would a $\$6x$ drain be to a bank, that is, how does it scale to the size of its deposits and reserve. A point of departure for estimating x would be to look at average negative balances at the clearinghouse as a whole. As noted above, the 1905 average was $13 million. To keep things simple, assume (counterfactually) that all clearinghouse members had the identical average deposit size of $23 million (=$1,200/52). Each day, 26 members receive a negative balance (x) of $0.5 million (=$13 million/26) or a positive balance of the same. With x as $0.5 million, the weekly drain is $3 million, which is 13 percent of the average bank's deposits and about half of the required reserves. In other words, the weekly drain has about the same impact noted as the daily drain discussed above.

This model, and the parameter used are admittedly very stylized. On the one hand, the probability for a weekly drain is likely to be lower than 1-in-64. This is because the daily balance is a continuous rather than discrete variable.[165] On the other hand, the potential size of a weekly drain is likely to be somewhat greater. This is because the variance in daily balances to which individual banks are exposed is greater than the clearinghouse-wide annual average used as the parameter for x.[166] While the development of a more nuanced model is beyond our current scope, it makes the basic logic of weekly drains intuitive to grasp. As discussed below, an important historical indication of the existence and magnitude of these weekly drains was the call loans held by NYCHA banks, a total of

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> and the activities of the bank's loan department. The reserve manager's job is to adjust to these fluctuations. The model presented here concentrates on these very short-run adjustments. However, it is obvious that the bank must make further adjustments if it experiences persistent reserve drains or accretion.

165. Payment flows between depositors are not a discrete, but a continuous variable, and likely one following a normal distribution. On most days, the daily balance would fall relatively close to the mean (zero); occasionally, the balance would be substantial, like the x's that make up a weekly drain; very rarely, it would be very large, like the daily drain. As a result, a more nuanced model would show that the probability of a weekly drain is lower than 1-in-64 in the binomial distribution. Another consideration is that a continuous model would need to account for weekly drains resulting from a combination of daily balances of various sizes (some even positive). All things equal, such combination would have the effect of increasing the probability of a weekly drain, though it is difficult to estimate by how much.

166. This is a result of the law of large numbers. *See supra* Section I.C.2.

about $400 million. With its $3 million weekly drain across 52 banks, our stylized model can account for $156 million, a substantial portion of that amount.

C. INTERBANK MARKETS WERE ABSENT

So far, our discussion has shown that default at the clearinghouse posed a risk to other members, and that clearing drains were large, highlighting the possibility of default. These findings challenge the conventional view, but they would be of little significance if drains could be handled through simple trading in interbank markets. The history declines to put that assumption into effect. On the one hand, there is no evidence of an interbank market between NYCHA member banks. On the other hand, there is strong evidence these banks relied on two alternative tools to handle clearing drains: reserves and call loans. These tools followed a strict division of labor. Large reserves of state money were used to avoid immediate default by allowing settlement of daily drains. The system of call loans to brokers was used to recover reserves following a daily drain, as well as to avoid weekly drains. We take these issues in turn.

1. The Use of Reserves

As we have seen, the Constitution of the NYCHA required that daily balances be settled in actual reserves. Reserves consisted of two forms of publicly issued money: specie and legal tender notes. Specie referred to gold coin minted by the U.S. Mint, a bureau within the Treasury Department.[167] Legal tender notes, also known as "greenbacks," referred to paper money issued directly by the Treasury.[168] Despite their apparent differences, both types of public money enjoyed formal legal tender status under the law. That is, they were both legally defined to redeem debt at its nominal value, the same legal attribute Federal Reserve notes and reserves (account balances with the Fed) enjoy today.[169] As a private

167. *See* Coinage Act of 1873, ch. 131, 17 Stat. 424.

168. *See* Legal Tender Act of 1862, 12 Stat. 345 (1862); discussion *supra* note 137. Legal tender notes are not to be confused with a second type of paper money, national bank notes issued under the National Bank Act of 1864. National bank notes did not enjoy legal tender status under the law, did not qualify for reserve requirements, and were not used in settlement of clearinghouse balances.

169. *See, e.g.*, 17 Stat. 424 §§ 14-15; 12 Stat. 345 § 1; Knox v. Lee, 79 U.S. 457 (1871). Since 1879 legal tender notes have been convertible into coin on demand at the

association, the NYCHA Constitution could have theoretically opted for a broader definition of money to settle daily balances in. It did not, opting instead for the very narrowest definition of money under the law.

The ongoing use of reserves in settlement marks a fundamental reliance of clearing on publicly supplied money. This role has not been sufficiently appreciated in the financial history literature for two reasons. The first reason concerns the literature's intense focus on the exceptional use of an instrument known as "clearing house loan certificates."[170] The issuance of clearinghouse loan certificates was a measure NYCHA banks took during financial panics. In these periods, the NYCHA banks experienced large withdrawals of reserves from their depositors, first and foremost, the out-of-town that they served as correspondents who were experiencing liquidity pressures themselves due to seasonal strains.[171] To economize on their reserves, the NYCHA banks issued the loan certificates that could be formally used in settlement of the daily balance in lieu of reserves. Banks short of reserves could procure these certificates by providing a special clearinghouse committee with collateral that would back the loan certificates. The loan certificates were jointly guaranteed by all NYCHA banks, so the banks that held them were not exposed to credit risk from any individual bank. Financial historians have correctly interpreted the issuance of loan certificates as an early form of lending-of-last-resort, preceding the creation of the Federal Reserve. But while financial historians have studied loan certificates in great detail, they have spent little time studying the use of actual reserves during ordinary times. The result is an unbalanced account that understates the difficulties of clearing in ordinary times, and the way that reserves—not loan certificates—allowed banks to meet those difficulties day-in and day-out.

The second reason for underestimation of the role of reserves concerns the significance of regulatory reserve requirements. There is a prevalent conception that reserves are held primarily to meet these regulatory requirements. In this view, reserves are a relatively idle stock. Their role is to allow banks to redeem deposits in the rare occasions demand for cash rises, so a run can be avoided.[172] For the NYCHA, these

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Treasury, but their legal tender status clearly did not depend on redemption. *See* Specie Payment Resumption Act of 1875, ch. 15, 18 Stat. 296 (1875).

170. *See, e.g.*, GORTON, *supra* note 118; Awrey, *supra* note 9.

171. *See* Orian Peer, *supra* note 9, at 380.

172. *See, e.g.*, BARR ET AL., *supra* note 75, at 238; Joshua N. Feinman, *Reserve Requirements: History, Current Practice, and Potential Reform*, 1993 FED. RSRV. BULL.

depositors were, again, the out-of-town banks who subjected the NYCHA to seasonal strains around fall. The role of the seasonal cycle is certainly important to understanding crisis dynamics under the National Banking Era, but here again, it results in an unbalanced picture on the role of reserves. Reserve requirements were not only about run mitigation, but about meeting the far more common clearing drains to which NYCHA banks were subject. Regulatory reserve requirements actually promoted this role through the particular way in which they were calculated.[173] NYCHA banks' regulatory reserve requirements were not binding at every moment, but reported as an average across time. The standard regulatory practice was for averaging of reserve requirements over 30 days.[174] The NYCHA Constitution followed an even tighter schedule by publishing a statement of members' average weekly reserves every Saturday.[175] This time signature explains how NYCHA banks could use reserves to meet clearing drains.

Assume a bank began its clearing week with reserves of 25 percent of deposits. On Tuesday that bank suffers a large drain of 15 percent of deposits, i.e., 60 percent of its reserves. The reserve was large enough to absorb that drain, and averaging across the week meant the bank could build back its reserve position in time for the Saturday statement. A 15 percent decline in reserves on a single day would reduce the weekly average by only 2.5 percent. A bank could recoup this drop by inducing

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569, 569 (1993). As Feinman notes, with the creation of the central bank, the significance attributed to reserve requirements has shifted from run prevention (that could now be cured by central bank lending-of-last-resort) to monetary policy. The role reserve requirements played in monetary policy has been the subject of some controversy. For discussion, see Scott T. Fullwiler, *The Social Fabric Matrix Approach to Central Bank Operations – An Application to the Federal Reserve and the Recent Financial Crisis* (2009), https://ssrn.com/abstract=1874795; Ihrig et al., *supra* note 109. In contrast to earlier views on a "reserve multiplier," the accepted view today is that the only significance of the quantity of reserves is in helping the Fed implement its target policy rate. That role has changed in the aftermath of the GFC—see discussion *supra* note 83–and the transition to abundant reserves. Since March 26, 2020, reserve requirements have been set at zero, making them ineffective. *See Federal Reserve Actions to Support the Flow of Credit to Households and Businesses*, BD. OF GOVERNORS OF THE FED. RSRV. SYS., (Mar. 15, 2020).

173. My analysis here builds on Fullwiler, *supra* note 174, on the importance of reserve maintenance periods in modern liquidity management.

174. *See, e.g.*, GEORGE MATHEWES COFFIN, HAND-BOOK FOR BANK OFFICERS 22 (McGill & Wallace eds., 1896) ("In each report of condition, a [national] bank is required to state its average reserves on deposits for the preceding 30 days.").

175. NYCHA CONSTITUTION, *supra* note 115, at § 16.

positive daily balances on the day or days subsequent to the drain.[176] The mechanism to induce the adjustment of balances in this way was the use of call loans, which we move to discuss in the next Section. As far as reserves are concerned, the key is to appreciate their role as an immediate shock absorber against daily drains. This shock absorber quality depends on their legal tender status. A bank pressed to settle a large balance within a couple of hours does not need to trade or contract in order to avoid default. It simply transfers the one asset under the law that would unconditionally redeem its debt.

2. The Use of Call Loans

Reserves enabled NYCHA banks to settle a daily drain, but to survive, a bank must ensure its reserve position over time. This includes replenishing the reserve following a daily drain, and avoiding the accumulation of medium-sized negative balances into a weekly drain. Here again, there is no evidence to suggest NYCHA banks resorted to interbank markets, but there is ample evidence of the system of "secondary reserves" they developed. That system was designed around call loans that the NYCHA banks made to brokers on the New York Stock Exchange (NYSE) at the corner of Nassau Street, just a few moments' walk from the clearinghouse building. Banks never used call loans to borrow, not from each other, and not from the brokers. The banks were always lenders to the brokers, and they devised an elegant way to shift the loans among themselves.

In its basic terms, the historical call loan resembles the modern-day repurchase agreement or "repo."[177] The call loan was an overnight loan, secured by collateral (stocks and bonds) actively trading on the stock exchange.[178] The NYSE brokers used these loans as a cheap and abundant source of funding to purchase securities for their own account, and

176. In the empirical study (III.B.) the difference between these two possibilities (recoupment the subsequent day, and recoupment over several days) would largely map on to the difference between Group 1 and 2.

177. For a discussion of the repo market, see Perry Mehrling, *supra* note 101.

178. Like modern repo, call loans had a "haircut" being a small excess in the value of collateral over the amount of the loan. Also like modern repo, call loans had a market-to-market provision that required borrowers to ensure a sufficient amount of collateral in the face of price movements. For discussion, see Nadav Orian Peer, A Constitutional Approach to Shadow Banking: The Early Shadow System, Ch. 2 (2016) (unpublished S.J.D. dissertation, Harvard Law School) (on file with author).

especially, for their brokerage customers.[179] At about $400 million, these loans constituted over one third of NYCHA banks' total loans, a staggering proportion.[180]

Contemporary accounts by Wall Street figures highlight the role of the call loan market as the grounds for the daily recycling of reserves among the banks. In 1908, Thomas Woodlock, member of the NYSE and editor of the Wall Street Journal remarked:

> At about 11 o'clock the banks in New York City know more or less what their balances are as a result of that day's clearings, and by that time they have called such loans as they need to call in order to meet their requirements if they have such requirements.[181]

A congressional testimony by J.G. Cannon (Fourth National Bank) a few years later clearly states the daily logic of this recycling. "Deposits decrease, and you call in your money. It is the leeway, you might say, of the banks."[182] The same principle held for the surplus banks:

> Mr. Untermeyer[:] On the other hand, when you have a surplus outside[183] your credit balance in the clearing house, you lend it in the Street from day to day, do you not?
>
> Mr. Cannon[:] We lend it in the Street from day to day; yes, sir.[184]

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179. In this respect, the NYSE brokers were like modern day broker-dealers who borrow in the repo market to lend to the hedge funds they serve as prime brokers. *See id.*

180. *See* MYERS, *supra* note 114, at 270 (call loans were one third of NYCHA banks' total loans), 272 (graph showing NYCHA's banks' call loans at about $400 million for 1905); *NYCHA Weekly Statements*, *supra* note 120(total NYCHA deposits at a range of $1,000-$1,200 million during 1905).

181. Thomas F. Woodlock, *The Stock Exchange and the Money Market*, *in* THE CURRENCY PROBLEM AND THE PRESENT FINANCIAL SITUATION: A SERIES OF ADDRESSES DELIVERED AT COLUMBIA UNIVERSITY 1907–1908 19, at 31 (Edwin R.A. Seligman ed., 1908).

182. *See* WASH. GOV'T PRINTING OFF., MONEY TRUST INVESTIGATION: INVESTIGATION OF FINANCIAL AND MONETARY CONDITIONS IN THE UNITED STATES UNDER HOUSE RESOLUTIONS NOS. 429 AND 504 BEFORE A SUBCOMMITTEE OF THE COMMITTEE ON BANKING AND CURRENCY, HOUSE OF REPRESENTATIVES, 62D CONG. 1865–1974 348-49 (1913), https://fraser.stlouisfed.org/title/money-trust-investigation-80/part-5-23662 [https://perma.cc/Q3HM-NX4L].

183. The word "outside" seems to be an error in the transcription. From the context, it is clear that Untermeyer is referring to a bank's clearinghouse balance.

184. *See Investigation of Financial and Monetary Conditions in the United States: Hearing on H.R. 429 and H.R. 504 Before a Subcomm. of the H. Comm. on Banking and*

By mapping such narrative accounts to the mechanics of the morning exchanges we can draw a detailed picture of the role that call loans played. Call loans could never help an NYCHA bank settle today's balance. That role was strictly fulfilled by reserves. What call loans could do was to proactively improve tomorrow's daily balance in light of today's loss.

Here is how it worked (see Appendix, **Balance Sheet 5**; **Figure 4**). Every morning, after the daily balance at the clearinghouse became known, banks could use their call loans to lean against the wind and essentially offset the day's loss or gain in the next morning's exchanges. Banks facing a negative daily balance—"deficit banks"—could improve the next day's balance by "calling in" loans from brokers. This meant demanding the brokers repay their loan by check drawn on a New York bank before the end of the day. Consider the case where a deficit bank demanded payment of $\$x$ in call loans from the brokers. The next day at the clearinghouse, that bank would include a check for $\$x$ in the packages its delivering clerk handed over, thereby increasing its total credits, and its daily balance by that amount. Meanwhile, banks learning of a positive daily balance—"surplus banks"—would do the opposite. Consider the case where a surplus bank incurred a $\$x$ million positive balance. That bank would instruct its representatives on the NYSE to increase its lending to the brokers by $\$x$.[185] This means the surplus banks would cause the brokers' bank accounts to be credited with newly created balances for that amount. The brokers would use these newly lent balances to write checks to repay the loans called back by the deficit banks. The next morning at the clearinghouse, the checks would be handed by the deficit bank's delivery clerk to the surplus bank's settling clerk. This would increase the surplus bank's due to's and reduce its daily balance by the same amount. This carefully coordinated system achieved something remarkable. It allowed the NYCHA banks to avoid weekly drains, and recover from daily drains, without having to face each other in any kind of interbank market.[186]

Used this way, call loans provided a powerful tool for liquidity management. A bank facing a daily drain could replenish its reserve the very next day by calling in loans for the same amount. Just as importantly,

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Currency, 62d Cong. 348-49 (1913) [hereinafter *Monetary Conditions Hearings*] (statement of James G. Cannon, President, Fourth National Bank).

185. *See* text accompanying *supra* note 184.

186. This made the kind of interactions described in Balance Sheet 4 in the Appendix unnecessary.

through daily leaning against the wind, the NYCHA banks could have eliminated much of the weekly variance in their reserve position. Loss of deposits that would have otherwise caused a decrease in reserves could be absorbed as a decrease in call loans instead. To see how, we can return to our stylized model[187] of the daily balance as a discrete variable +$*x*, or -$*x* with equal probability. Imagine it is Monday 10:40 a.m., and Bank A just learned of a negative daily balance of -$*x* at the clearinghouse. Bank A knows that tomorrow's daily balance would be determined by deposit transfers that are, by definition, random. But by calling in a call loan for $*x*, Bank A could proactively increase tomorrow's daily balance by that amount, no matter what the forces of chance bring. If Tuesday's random flows from deposit transfers produced another -$*x*, Bank A's Tuesday clearinghouse balance would not show -$*x*, but a flat zero (-$*x* from random payment flows, +$*x* from yesterday's call loans). Conversely, if random flows brought +$*x*, Tuesday's balance would show +$2*x* (being +$*x* from random flows, and +$*x* from call loans). Following this way of thinking it could be shown that the maximum change in a bank's reserve position over the week could be limited to the narrow bend of -$*x*/+$*x*, rather than the far wider -$6*x*/+$6*x* bend it would have otherwise been subject to (**Figure 5**).[188] Used this way, call loans address the problem of the weekly drain much the same way that reserves address the problem of the daily drain.

The role that call loans played in liquidity management required considerable discipline from surplus banks in daily (or close to daily) recycling of their reserves back into the market. That is, it required a kind of implicit day-to-day cooperation between the various banks who happened to have surpluses and deficits on any given day.[189] This is the case for two distinct reasons. The first reason has to do with the relationship between funding liquidity and market liquidity that has been at the center of post-GFC scholarship in finance.[190] In a nutshell, funding liquidity refers to the availability of debt finance to actors wishing to purchase securities, while market liquidity refers to the ability to trade in securities markets without causing rapid disruption in a security's price.

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187. *See supra* Section III.B.1.

188. *See* Appendix, Figure 5.

189. I am not necessarily suggesting that reserves were mechanistically recycled every single day. On days when balances were relatively small, banks may have behaved more flexibly. Nevertheless, the low amount of excess reserves and the weekly reporting of average weekly reserves likely meant recycling operated on a near daily basis.

190. *See* Markus K. Brunnermeier & Lasse Heje Pedersen, *Market Liquidity and Funding Liquidity*, 2008 REV. FIN. STUD. 22; MEHRLING, *supra* note 18.

For much of its history, the NYCHA banks were the main lenders in the call loan market, i.e., the main providers of funding liquidity to the NYSE brokers.[191] If surplus banks had not recycled their reserves, the total quantity of call loans would have gone down. The size of a single day's average clearing balance of $13 million was small in comparison to the roughly $400 million in themarket.[192] But that daily balance often ran in the tens of millions, and even average daily balances, if accumulated over a single week, would amount to $78 million, a substantial portion of total call loan funding.

As highlighted by the modern literature, such a large drop of funding liquidity could have had serious implications.[193] Like disruptions in the modern repo market during 2009, call loan funding enabled trading that was central to day-to-day price formation and liquidity at the stock exchange. The evaporation of funding liquidity could have led traders to liquidate positions, putting considerable pressure on prices, and leading to an evaporation of market liquidity.[194] In turn, dislocations in the stock exchange would have had serious consequences for the NYCHA banks. Recall that a third of these banks' assets were secured by stock exchange collateral. The call loan system was premised on the assumption that if a broker happened to default on their loan, the lending NYCHA bank could quickly sell the collateral on the NYSE and increase its daily balance the very next day. If a drop in call loan funding led to dislocations in the stock market, there would be no way for a bank to liquidate the collateral, so the banks' call loans would become frozen. Financial historians Jon Moen and Ellis Tallman emphasized that the fear of such scenarios provided a strong incentive for NYCHA to cooperate and "insure" the call loan market during crisis time.[195] While that is correct, it is equally important

191. For the rise in "outside lending" starting the 1890s, see generally discussion in Jon Moen & Ellis Tallman, *Outside Lending in the New York City Call Loan Market: Evidence from the Panic of 1907*, 26 FIN. HIST. REV. 43 (2019).

192. This is taking call loans by NYCHA banks. As noted by Moen and Tallman, the overall size of the call loan market is difficult to estimate. Moen & Tallman, *supra* note 186.

193. *See* Brunnermeier & Pedersen, *supra* note 189.

194. For historical call loans as well as modern repo, a key piece of the transmission between funding and market liquidity are market-to-market provisions mentioned in *supra* note 178.

195. Moen & Tallman, *supra* note 191. Moen & Tallman argue that 1907 marked a break with earlier tradition because by that time the presence of "outside lenders" (non-

to recognize that discipline in the recycling of reserves prevented these same dynamics from occurring day-in and day-out.

The second reason why prompt recycling by surplus banks was necessary is subtler and takes us back to the mechanics of clearing. Assume that an NYSE broker had their loan called by a deficit bank and was somehow able to secure an alternative loan from some outside lender, not a NYCHA surplus bank. In this case, the outside loan allows the broker's funding to remain stable, so the risk is not that the securities market would suffer a dislocation of the kind outlined above. Rather, the problem is that the deposits the outside lender is lending to the broker would not necessarily be drawn on an account with a surplus bank (whether the outside lender's bank happens to be a surplus or deficit bank on a given day is entirely random). Now, if the funds happen to be transferred from a bank that is already a deficit bank, that bank would increase its due to's at the clearinghouse the next morning, thereby reducing its daily balance. This means that while one deficit bank (the one that called the loan) was able to improve its position, another deficit bank's position (the outside lender's bank) has deteriorated as a result. The deficit as a whole is not being eliminated, but merely moved around. For the call loan system to help bring reserves to equality, banks could not have left things to chance, meaning surplus banks would have had to cooperate.

Financial historians, like many contemporaries of the call loan market, have criticized the panic prone and seemingly irrational reliance of the NYCHA banks on call loans for their liquidity.[196] That view highlights the Hobson's choice that NYCHA banks faced when met with redemptions of bankers' balances by out-of-town banks. One option individual NYCHA banks faced was calling in their loans from brokers, but of course, the improvement in one bank's reserve position came at the expense of amother bank, so the overall reserve position remained largely the same, while a shrinking quantity of call loans threw the stock exchange into disarray.[197] The second option (often following the failure of the first) was to suspend payments. This had the effect of throwing the banking apparatus into disarray and causing fractures in the interregional

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NYCHA banks) in the call loan market was too large for NYCHA banks to handle effectively. *Id.*

196. *See id.* at 55; Orian Peer, *supra* note 9, at 397-406.

197. For a more nuanced account on the mechanism, see CHARLES GOODHART, THE NEW YORK MONEY MARKET AND THE FINANCE OF TRADE, 1900–1913 (1969).

payments system.[198] The desire to avoid these recurring banking crises was an important part of the impetus for the creation of the Federal Reserve. Under its original design, the system of commercial paper discounting by the Federal Reserve was in large part meant to replace the reliance on call loans.[199] Told from this perspective, the story of the call loan market is one about the failure of call loans in preventing occasional runs, highlighting the necessity for a public lender-of-last-resort. While this story is true, it is also looking at the glass half-empty. Day-in and day-out, the call loan market, and more specifically, NYCHA banks cooperation in recycling reserves through the call loan market, provided NYCHA with extraordinary liquidity. This system addressed a very real challenge these banks were facing in their daily affairs. As with the case of NYCHA banks' dependence on reserves issued by the state, the call loan market helps us appreciate bank money creation as a daily governance project, not merely a decentralized private market subject to occasional failure.

We can now summarize our discussion of NYCHA practice, and assess on its significance. The first finding concerned the workings of netting. In the conventional view, netting of obligations between banks appears as a simple affair, a kind of "free lunch" that allows them to engage in fractional–reserve banking. In contrast, the case study demonstrates that netting involved a structural risk-exposure between the banks. A default in the clearinghouse would trigger the liability of other banks, and such defaults could potentially cascade through the clearinghouse. The second finding concerned the occurrence of drains. In the conventional view, the law of large numbers makes clearing drains disappear, obviating the need to consider how banks meet those drains. Meanwhile, the case study provides evidence that drains occurred with considerable frequency: 7 to 15 times in 1905 alone, and likely more, given the conservative nature of the study. This finding is not in tension with the LLN, but actually underscores it. We can count on small–probability events to occur given a large-enough number of trials. Daily clearing among many banks generates that large number of trials. Finally, the conventional view considers that drains, if they do occur, could be managed through simple trading in interbank markets. For an interest rate, a surplus bank would lend balances to a deficit bank. This would make

198. *See* Ellis Tallman & Jon Moen, *The Transmission of Financial Crisis in 1907: An Empirical Investigation*, 12 CLIOMETRICA 277, 278 (2018).

199. *See* Orian Peer, *supra* note 9, at 406-12.

reserves unnecessary for interbank settlement, though they might still be required to avoid bank runs, meeting regulatory requirements, or other extraneous purposes. In practice, the case study demonstrated interbank markets between NYCHA banks are nowhere to be found, while their reliance on large amounts of reserves and carefully recycled call loans was ubiquitous.

This last finding requires a brief explanation. Why were interbank markets so conspicuously absent from NYCHA practice? While a detailed response to this question lies beyond the scope of this Article, the following provide the contours of such response.[200] Interbank markets were absent from NYCHA practice because in the absence of a central bank, interbank markets would have been ridden with strategic behavior. A deficit bank could easily find itself hostage to a competitor bank, whose surplus position can give it an effective monopoly over the funds.[201] Meanwhile, the default of a deficit bank exposes the clearinghouse to the risk of a cascading default, and could itself generate a hostage dynamic where surplus banks are pressed to lend or else risk the consequences of a cascade. This double-bind—the monopoly power of surplus banks, and the moral hazard of deficit banks—makes a very poor environment for an interbank market to develop in. Meanwhile, the reliance on reserves on call loans overcomes these problems by creating clear guidelines as to the maximum size of deficits that banks can incur without requiring the consent of their competitors. Outlining the extraordinary challenges that interbank markets would have to face in the absence of a central bank highlights that bank money creation cannot ultimately be understood as originating from pairwise decisions between banks. Bank money creation is inherently and fundamentally about the availability of a medium in which obligations can be settled, and the provision of that medium is unavoidably the stuff of governance.

CONCLUSION

Every day, trillions of dollars of payments between depositors flow through the banking system. These payments become obligations between banks and require banks to clear them within hours. My argument here has been that clearing is not the simple and easy process it is so often taken for. Rather, clearing presents serious risks and depends

200. For an extended version of this argument, *see* Orian Peer, *supra* note 178, at 102-106.

201. *See* Henckel et al., *supra* note 104, at 19.

on governance for its daily completion. In the historical practice of the NYCHA, that governance was provided through the state (as the issuer of reserves used in settlement) and through cooperation among the NYCHA banks (in carefully recycling these reserves). In modern times, we see analogous functions provided by central banks, whether in operating the RTGS systems, providing daylight liquidity, backstopping interbank markets, or (since the GFC) issuing a large supply of reserves.

The historical case study teaches us these are not mere interventions in an otherwise viable system of decentralized private action. Instead, the central bank's daily role in clearing addresses fundamental challenges that have historically been addressed through other forms of governance. To be sure, much remains to be studied and theorized about these challenges. The history of the NYCHA provides the seeds from which a more general theory can be developed: the threat of cascading defaults, the high probability of drains, and the inadequacy of interbank markets, likely due to strategic behavior among banks. While developing that theory remains beyond the scope of this Article, the apparent consistency between historical and modern practice is striking. The specific institutions evolve over time; the challenges and the need for governance remain the same.

How should this proposed understanding of clearing inform our understanding of banking regulation? The methodological individualism of the conventional approach—the notion that bank money creation is the sum of individual decisions and preferences—limits banking regulation to the role of market failure collection. The goal, in that view, is to minimize intervention into otherwise efficient private arrangements. In contrast, accounting for the governance that is integral to clearing casts bank money creation in a more public light. The daily clearing arrangements on which bank money creation depends arise not from individual preferences, but from collective decisions. This calls into question the presumption of market efficiency that is so central to the conventional view, and its narrow vision of bank regulation.

What, then, would banking regulation become if instead of methodological individualism, we started with the premise that bank money creation is to an important degree a creature of governance? Starting from such premise, it would be natural to think of how banking is implicated, or can play a constructive role in, the pressing challenges society is facing in financial stability, civil rights, climate policy, and financial technology. And it would be natural to borrow concepts from legal areas like utility regulation, public–private partnerships, or (in

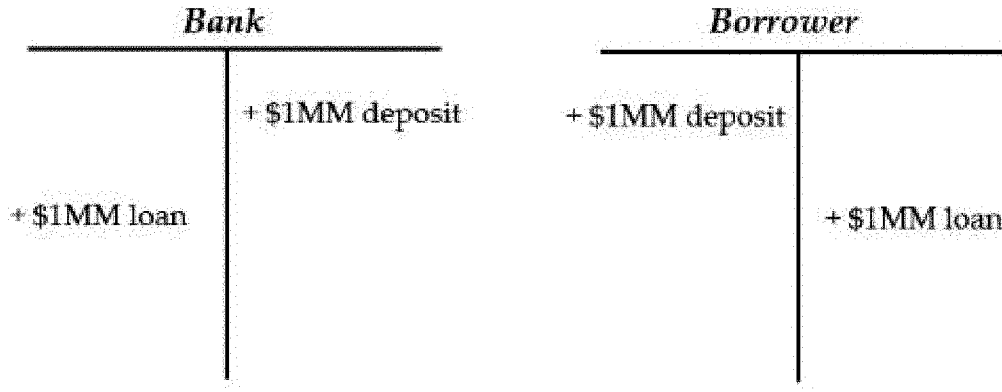
political theory terms) social contract theory. In other words, such a view of banking regulation would resemble the one gradually being developed by the new legal literature on bank money creation. Reasonable people will of course divide—at times, sharply—about a given proposal under consideration. That is natural and desirable. An understanding of the public aspects of bank money creation does not require the adoption of any particular proposal. It carves out the room for substantive discussion that has long been preempted by an over-simplistic theory of bank money's private origins.

APPENDIX

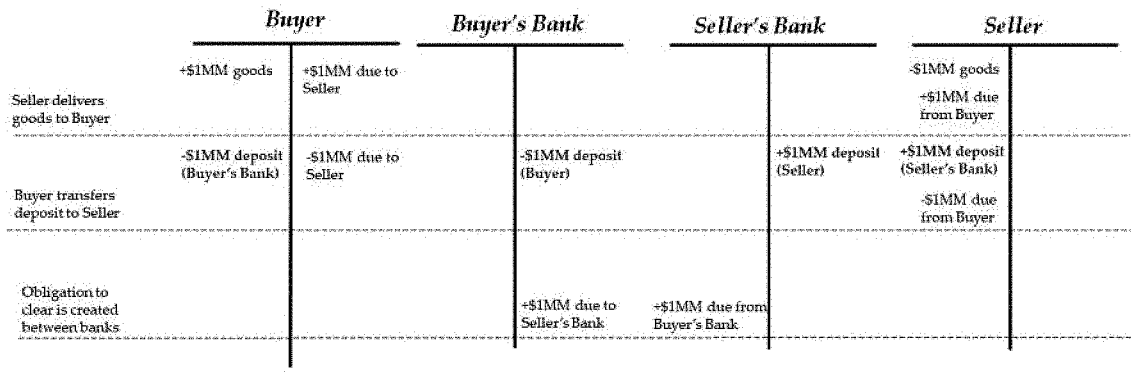
1. BALANCE SHEETS

*(Millions of dollars are abbreviated to "MM".)

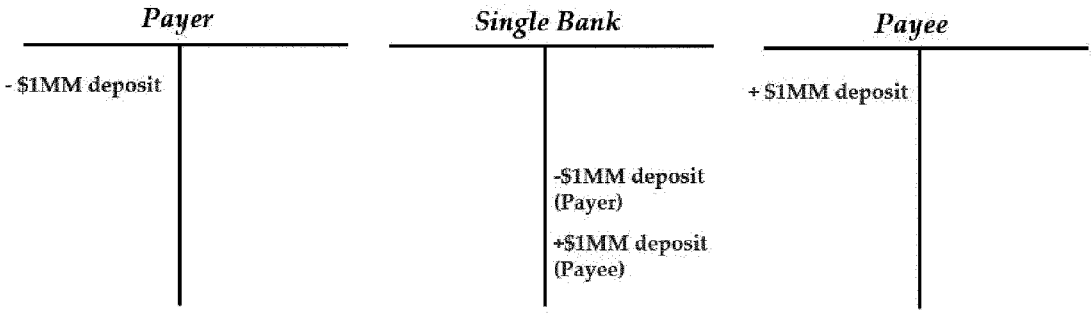
Balance Sheet 1: *The Typical Deposit Creation Process*



***Balance Sheet 2**: Payments Between Depositors Become ObligationsBetween their Banks*



***Balance Sheet 3:** Payments in a Single Bank*



Balance Sheet 4: *The Intuition that Interbank Markets Could Eliminate the Need for Reserves*

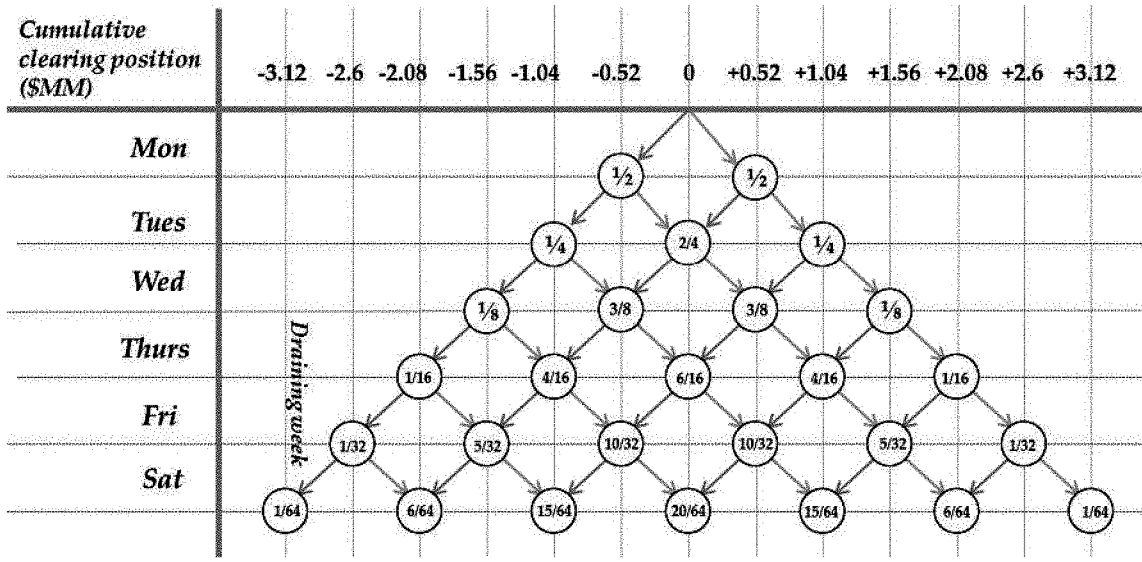
	Surplus Bank		***Deficit Bank***	
Daily balance becomes known around 10:40am	+$x daily balance due @01:30pm			+$x daily balance due @01:30 pm
		+$x due to DB @01:30 pm	*+$x due from SB @01:30 pm*	
Interbank loan sometime between 10:40am—01:30pm	*+$x due from DB tomorrow (%)*			*+$x due to SB tomorrow (%)*
Setoff at 01:30pm	~~$x daily balance due @01:30pm~~	~~*$x due to DB @01:30 pm*~~	~~*$x due from SB @01:30 pm*~~	~~$x daily balance due @01:30 pm~~

Balance Sheet 5*: Daily Reserve Recycling in the Call Loan Market*

	Surplus Bank		***NYSE Broker***		***Deficit Bank***	
Tuesday. Daily balance Becomes known @10:40AM	+$x daily balance					+$x daily balance
Briefly after 10:40AM Deficit Bank calls in loan and receives a check				-$x call loan (%) +$x check to DB	-$x call loan (%) +$x check from Broker	
Around 11:00AM Surplus Bank lends to Broker	+$x call loan (%)	+$x deposit to Broker	+$x deposit	+$x call loan (%)		
Wednesday morning at the clearinghouse the Broker's check clears		+$x due to			+$x due from	

II. FIGURES

Figure 3: *A "Draining" Clearing Week for an Individual Bank (Stylized Example)*



See Article III.C.2. for discussion of assumptions.

Green arrows represent a daily balance of +$0.52MM; **red arrows** represent a daily balance of -$0.52MM; "the cumulative clearing position" (*x* axis) marks the aggregation of daily balances across days of the week. Probabilities for each cumulative position are encircled.

Figure 4: *Clearing Timeline for Use of Call Loans*

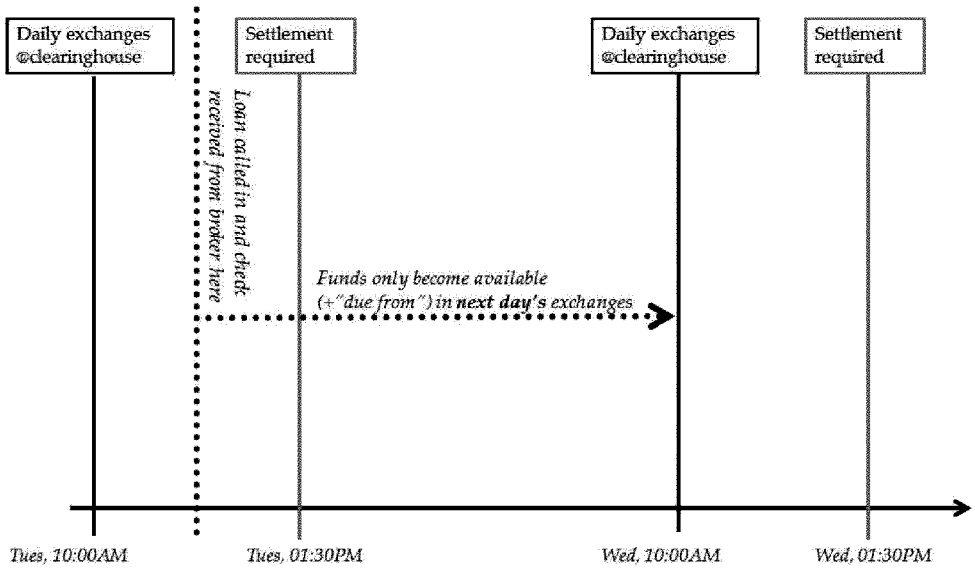
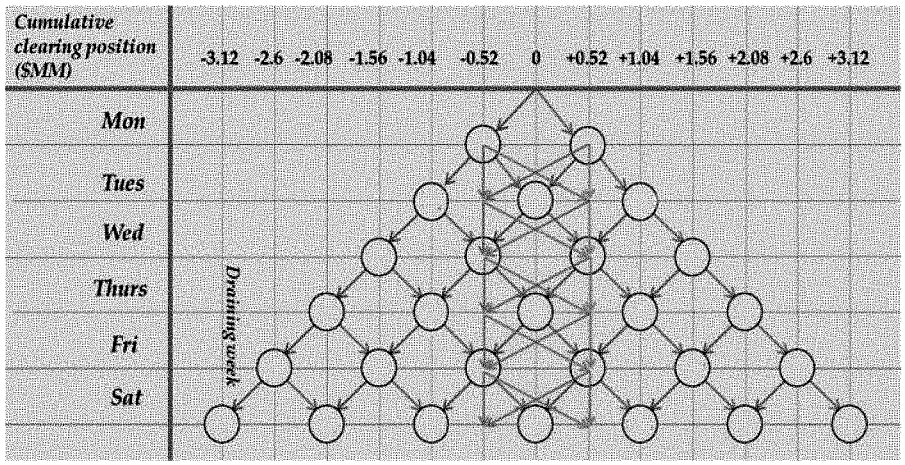


Figure 5: *Using Call Loans to Prevent Weekly Drains*



III. TABLES

Table 1: *Initial observations of large negative balances (1905 ledger).*

1. Image number	2. Date (1905)	3. Weekday	4. Bank #	5. Balance (negative, millions)	6. Deposits + Circulation (W-1, millions)	7. Specie + Legals (W-1, millions)	8. Required reserves (W-1)	9. Actual reserve Ratio (W-1)	10. Balance /Required Reserves	11. T-1 balance (millions)	12. T (millions)	13. T+1 balance (millions)
364	4-Jan	Wednesday	2	$ 3.8	$ 34.7	$ 10.2	$ 8.68	29%	44%	$1.3	($3.8)	$1.0
364	4-Jan	Wednesday	21	$ 5.1	$ 28.8	$ 6.8	$ 7.20	24%	71%	$2.4	($5.1)	$1.3
365	5-Jan	Thursday	4	$ 2.9	$ 23.4	$ 6.3	$ 5.85	27%	50%	($1.0)	($2.9)	$2.1
367	11-Jan	Wednesday	3	$ 2.3	$ 16.7	$ 4.3	$ 4.18	26%	55%	$0.2	($2.3)	$2.0
367	11-Jan	Wednesday	53	$ 2.1	$ 21.9	$ 5.5	$ 5.48	25%	38%	$0.5	($2.1)	($0.2)
371	19-Jan	Thursday	6	$ 2.3	$ 26.8	$ 7.5	$ 6.70	28%	34%	($1.1)	($2.3)	$1.0
375	26-Jan	Thursday	3	$ 2.9	$ 19.3	$ 5.1	$ 4.83	26%	60%	$2.8	($2.9)	$1.1
376	28-Jan	Saturday	3	$ 2.4	$ 19.3	$ 5.1	$ 4.83	26%	50%	$1.1	($2.4)	($1.9)
376	30-Jan	Monday	80	$ 2.2	$ 16.5	$ 4.0	$ 4.13	24%	53%	$0.2	($2.2)	$0.1
379	6-Feb	Monday	6	$ 2.3	$ 30.8	$ 8.7	$ 7.70	28%	30%	$2.9	($2.3)	$0.4
384	18-Feb	Saturday	3	$ 3.8	$ 18.9	$ 4.7	$ 4.73	25%	80%	($0.1)	($3.8)	$0.7
388	28-Feb	Tuesday	23	$ 18.0	$ 158.5	$ 37.1	$ 39.63	23%	45%	$2.2	($18.0)	($3.5)
388	1-Mar	Wednesday	21	$ 2.6	$ 26.0	$ 5.4	$ 6.50	21%	40%	$3.5	($2.6)	($0.9)
401	28-Mar	Tuesday	21	$ 2.5	$ 25.0	$ 5.4	$ 6.25	22%	40%	($0.2)	($2.5)	$2.0
404	4-Apr	Tuesday	6	$ 2.6	$ 24.7	$ 5.9	$ 6.18	24%	42%	$5.1	($2.6)	($0.1)
404	4-Apr	Tuesday	21	$ 2.1	$ 25.6	$ 5.6	$ 6.40	22%	33%	$2.5	($2.1)	$0.8
406	6-Apr	Thursday	1	$ 1.7	$ 19.0	$ 4.6	$ 4.75	24.2%	36%	$0.6	($1.7)	$2.0
408	11-Apr	Tuesday	21	$ 2.4	$ 25.1	$ 5.2	$ 6.28	21%	38%	$2.4	($2.4)	($0.2)
412	21-Apr	Friday	4	$ 2.4	$ 22.1	$ 5.8	$ 5.53	26%	43%	$2.7	($2.4)	$0.4
414	26-Apr	Wednesday	1	$ 2.1	$ 18.3	$ 4.2	$ 4.58	23%	46%	$0.7	($2.1)	$1.6
417	2-May	Tuesday	4	$ 3.6	$ 24.8	$ 7.2	$ 6.20	29%	58%	$2.0	($3.6)	($0.7)
418	5-May	Friday	80	$ 3.5	$ 15.2	$ 3.6	$ 3.80	24%	92%	$0.2	($3.5)	($0.0)
422	15-May	Monday	21	$ 2.9	$ 30.4	$ 7.7	$ 7.60	25%	38%	$3.0	($2.9)	($0.1)
424	18-May	Thursday	21	$ 2.1	$ 30.4	$ 7.7	$ 7.60	25%	28%	$6.3	($2.1)	($0.1)
425	20-May	Saturday	32	$ 2.2	$ 14.9	$ 3.8	$ 3.73	26%	59%	($1.4)	($2.2)	($0.0)
426	23-May	Tuesday	21	$ 2.9	$ 31.4	$ 8.6	$ 7.85	27%	37%	($0.5)	($2.9)	($0.3)
427	26-May	Friday	21	$ 2.4	$ 31.4	$ 8.6	$ 7.85	27%	31%	$5.0	($2.4)	($0.3)
429	1-Jun	Thursday	3	$ 2.1	$ 16.9	$ 4.4	$ 4.23	26%	50%	$2.8	($2.1)	$3.3
430	2-Jun	Friday	8	$ 20.2	$ 223.7	$ 57.7	$ 55.93	26%	36%	($9.1)	($20.2)	$19.3
430	3-Jun	Saturday	3	$ 2.7	$ 16.9	$ 4.4	$ 4.23	26%	64%	$3.3	($2.7)	$0.6
430	3-Jun	Saturday	61	$ 2.2	$ 22.8	$ 5.9	$ 5.70	26%	39%	$0.2	($2.2)	($0.1)
442	1-Jul	Saturday	1	$ 2.2	$ 18.0	$ 4.7	$ 4.50	26%	49%	$1.0	($2.2)	$2.4
443	3-Jul	Monday	4	$ 6.8	$ 25.6	$ 8.1	$ 6.40	32%	106%	($1.7)	($6.8)	($0.7)
443	5-Jul	Wednesday	21	$ 3.5	$ 27.6	$ 6.3	$ 6.90	23%	51%	$1.1	($3.5)	$0.5
454	31-Jul	Monday	80	$ 2.2	$ 14.4	$ 3.6	$ 3.60	25%	61%	($0.1)	($2.2)	($0.3)
455	2-Aug	Wednesday	4	$ 3.1	$ 23.3	$ 5.8	$ 5.83	25%	53%	$0.3	($3.1)	$0.6
468	29-Aug	Tuesday	23	$ 15.5	$ 159.9	$ 37.0	$ 39.98	23%	39%	$3.5	($15.5)	$3.0
469	31-Aug	Thursday	21	$ 4.2	$ 25.0	$ 5.5	$ 6.25	22%	67%	$1.9	($4.2)	$1.7
470	2-Sep	Saturday	4	$ 2.5	$ 23.2	$ 5.6	$ 5.80	24%	43%	$2.1	($2.5)	($0.9)
471	6-Sep	Wednesday	21	$ 2.5	$ 27.8	$ 6.5	$ 6.95	23%	36%	$0.7	($2.5)	$1.0
484	3-Oct	Tuesday	23	$ 37.7	$ 140.3	$ 32.0	$ 35.08	23%	107%	$6.0	($37.7)	($0.8)
485	5-Oct	Thursday	6	$ 3.5	$ 25.3	$ 6.2	$ 6.33	25%	55%	$1.0	($3.5)	$2.4
498	2-Nov	Thursday	4	$ 3.9	$ 19.5	$ 4.9	$ 4.88	25%	80%	$1.6	($3.9)	$0.8
510	1-Dec	Friday	21	$ 3.9	$ 25.6	$ 5.1	$ 6.40	20%	61%	$5.2	($3.9)	($1.9)
514	12-Dec	Tuesday	3	$ 2.3	$ 14.1	$ 3.8	$ 3.53	27%	65%	$0.4	($2.3)	($0.2)

***Table 3**: Group 1 Summary ("high level of confidence that the drain is a true drain")*

1. Image number	2. Date (1905)	3. Weekday	4. Bank #	5. Balance (negative, millions)	6. Deposits + Circulation (W-1,	7. Balance/ (Deposits+Circulation)	8. Specie + Legals (W-1, millions)	9. Required reserves (W-1)	10. Actual reserve Ratio (W-1)	11. Balance /Required Reserves	12. T-1 balance (millions)	13. T (millions)	14. T+1 (millions)
367	11-Jan	Wed	3	$ 2.3	$ 16.7	13.8%	$ 4.3	$ 4.18	25.7%	55%	$0.2	($2.3)	$ 2.0
401	28-Mar	Tues	21	$ 2.5	$ 25.0	10.0%	$ 5.4	$ 6.25	21.6%	40%	($0.2)	($2.5)	$ 2.0
406	6-Apr	Thurs	1	$ 1.7	$ 19.0	8.9%	$ 4.6	$ 4.75	24.2%	36%	$0.6	($1.7)	$ 2.0
414	26-Apr	Wed	1	$ 2.1	$ 18.3	11.5%	$ 4.2	$ 4.58	23.0%	46%	$0.7	($2.1)	$ 1.6
426	23-May	Tues	21	$ 2.9	$ 25.6	11.3%	$ 5.6	$ 6.40	21.9%	45%	$0.5	($2.9)	$ 5.0
430	2-Jun	Fri	8	$ 20.2	$ 223.7	9.0%	$ 57.7	$ 55.93	26%	36%	($9.1)	($20.2)	$ 19.3
485	5-Oct	Thurs	6	$ 3.5	$ 25.3	13.8%	$ 6.2	$ 6.33	25%	55%	$1.0	($3.5)	$ 2.4

*As noted in the Article (note 155), the T+1 entry for image #426 is a T+2 balance.

***Table 4**: Group 2 Summary ("Indication of a true drain, but lesser level of confidence")*

1. Image number	2. Date (1905)	3. Weekday	4. Bank #	5. Balance (negative, millions)	6. Deposits + Circulation (W-1, millions)	7. Balance/(Deposits+Circulation)	8. Specie + Legals (W-1, millions)	9. Required reserves (W-1)	10. Actual reserve Ratio (W-1)	11. Balance /Required Reserves	12. T-3 balance	13. T-2 balance	13. T-1 balance (millions)	14. T (millions)	15. T+1 balance (millions)	16. Recoupment
364	4-Jan	Wed	2	$ 3.8	$ 34.7	11.0%	$ 10.2	$8.7	29%	44%	$0.6	($0.4)	$1.3	($3.8)	$1.0	By T+5
367	11-Jan	Wed	53	$ 2.1	$ 21.9	9.6%	$ 5.5	$5.5	25%	38%	$0.4	$0.2	$0.5	($2.1)	0.2	75% within T+4
384	18-Feb	Sat	3	$ 3.8	$ 18.9	20.1%	$ 4.7	$4.7	25%	80%	$0.9	$1.0	($0.1)	($3.8)	0.7	Full by T+2
425	20-May	Sat	32	$ 2.2	$ 14.9	14.8%	$ 3.8	$ 3.7	25.5%	59%	($0.7)	$2.3	($1.4)	($2.2)	($0.0)	Full by T+2
442	1-Jul	Sat	1	$ 2.2	$ 18.0	12.2%	$ 4.7	$ 4.5	26%	49%	($0.6)	$0.0	$1.0	($2.2)	$2.4	Full by T+1
498	2-Nov	Thurs	4	$ 3.9	$ 19.5	20.0%	$ 4.9	$ 4.9	25%	80%	($0.3)	$0.2	$1.6	($3.9)	0.8	Full by T+6

Notes & Observations