# Death of a Reserve Currency*

Stephen Quinn[a] and William Roberds[b]
[a]Texas Christian University
[b]Federal Reserve Bank of Atlanta

The Dutch bank florin was the dominant currency in Europe over much of the seventeenth and eighteenth centuries. The florin, a fiat money, was managed by an early central bank, the Bank of Amsterdam. We analyze the florin's loss of "reserve currency" status over the period 1781–92, using a new reconstruction of the Bank's balance sheet. The reconstruction shows that by 1784, accommodative policies rendered the Bank policy insolvent, meaning that its net worth would have been negative under continuation of its policy objectives. Policy insolvency coincided with the Bank's loss of control over the value of its money.

JEL Codes: E58, F33, N13.

## 1. Introduction

The U.S. dollar reigns as the dominant reserve currency today. The British pound occupied a similar status in the nineteenth and early twentieth centuries. Preceding the British pound in this leading role

*Views expressed are those of the authors and not necessarily those of the Federal Reserve Bank of Atlanta or the Federal Reserve System. The authors are grateful for comments on earlier drafts provided by Joost Jonker, Elizabeth Klee, James Nason, Angela Redish, Catherine Schenk, Peter Stella, Larry Wall, Warren Weber, seminar participants at the Asian Development Bank Institute, Bank of Japan, De Nederlandsche Bank, the Federal Reserve Banks of Atlanta and New York, Tokyo University, and participants in the All-UC Conference on "Central Banking in Historical Perspective," the Bundesbank conference on "Turning Points in History: How Crises Have Changed the Tasks and Practice of Central Banks," the Caltech Early Modern Group, and the Dutch-Belgian Finance and History Workshop. The authors are also indebted to Christiaan van Bochove and Joost Jonker for sharing their data on East India Company bond prices. Research assistance was provided by Pamela Frisbee. Data collection for this project was conducted while the second author was a visiting scholar at De Nederlandsche Bank. Author e-mails: s.quinn@tcu.edu; william.roberds@atl.frb.org.

was the Dutch guilder, also known as the florin. This paper explores the florin's loss of reserve currency status over the period 1781–92, employing a new data set assembled from archival sources.

This historical episode is of continued relevance because the reserve-currency florin was in many ways a modern construct. The "florin" in question was not a coin. It existed only as ledger entries in the accounts of an early central bank, the Bank of Amsterdam (or "Bank"). And, unusually for the time, the Bank's money was not inherently redeemable in coin, nor was its value defined by any specific coin. To call it by its modern name, the florin was fiat money.

As a supplier of fiat money, the Bank of Amsterdam engaged in many of the same activities as central banks today. The Bank operated a large-value payment system; it provided liquidity to the Amsterdam money market through repo-like arrangements; it engaged in open-market operations to stabilize market conditions; it lent to selected counterparties; and it returned seigniorage to its sponsoring government, the City of Amsterdam ("City"). The main policy objective of the Bank was to stabilize the market price of its money relative to high-quality collateral—the large-denomination "trade coins" circulating among merchants in Amsterdam—while smoothing short-term fluctuations in the stock of Bank money. The Bank's adherence to this goal of "price stability" made the florin into a bellwether money for much of the seventeenth and eighteenth centuries.

When confronted with a major crisis in 1781, the Bank reacted in a manner that may also seem familiar to modern observers. Responding to the outbreak of war between the Dutch Republic and Britain (the Fourth Anglo-Dutch War), the Bank embarked on a policy of aggressive open-market purchases. This policy was paired with an unprecedented increase in the Bank's lending activity to a large government-sponsored enterprise called the Dutch East India Company ("Company"). This last policy was especially daring, as wartime disruptions to the Company's operations soon meant that it was in no position to repay its debts. By 1783, the value of the florin began to suffer. The Bank then reacted by reversing the direction of its open-market activity, but it lacked adequate reserves with which to conduct defensive operations.

The Bank's difficulties soon ran deeper than illiquidity, however. Our data show that by 1784, non-performance of the Bank's credit portfolio had caused it to become "policy insolvent," meaning that

its net worth was negative under its policy objectives (Stella and Lönnberg 2008). A lasting solution to the Bank's problems required either a fiscal intervention or a policy shift, but neither option was pursued at this stage.

Pressure on the bank florin grew acute in 1790, following the outbreak of the French Revolution. The Bank responded by attempting to enforce a sudden 9 percent reduction in the value of its money relative to silver. Protests from market participants led the City to instead inject capital into the Bank over 1791–92. The recapitalization temporarily halted the decline in the value of the florin, but it was unable to restore the Bank's credibility over the longer term. The reconstructed data show that the capital injection failed to remedy the Bank's policy insolvency, in large part because the City did not give up its claim on the Bank's future income. The data also reveal that much of the injection was immediately diverted back to the City's own fiscal needs.

The end of a currency's reserve status is a rare event, and the florin's downfall teaches that preeminence of a central bank does not necessarily guard against fiscal over-exploitation or a sudden loss of market confidence. Our reconstruction offers a precise narrative of a dominant currency's quick transition from a reserve asset to a monetary also-ran. The transition is punctuated by two large monetary shocks—the wartime crises of 1781 and 1790—and two mismanaged policy responses. The first response—the expansionary bravado of 1781–83—undermined market confidence in the Bank. The second—the belated and ineffective recapitalization of 1791–92—helped ensure that this loss of confidence would be permanent.

The rest of this paper is organized as follows. Section 2 reviews some relevant literature. Section 3 lays out the structure and policies of the Bank. Section 4 provides a detailed analysis of the florin's collapse. A concluding section considers the implications of this episode for modern central banking practice.

## 2. Connections to the Literature

The narrative history of the Bank of Amsterdam's decline is known from the classic works of Mees (1838) and van Dillen (1925, 1964). Van Dillen (1934) provides an English synopsis of this history and year-end summaries of the Bank's accounts. Our analysis

extends this literature by providing the first detailed, high-frequency (monthly) breakdown of the Bank's balance sheet over this period (1775–92), presented in a manner compatible with modern central bank accounting. Examination of the details provides new insights, e.g., the course of the Bank's open-market operations, the extent of its insolvency, and the failure of the City's attempted recapitalization.

A precise reconstruction is possible because virtually complete records of the Bank have been preserved for this sample. Certain income items are only recorded annually; otherwise the quality of the accounting information approximates that of a present-day central bank. In earlier periods of the Bank's existence (see Quinn and Roberds 2014b for 1666–1711), records concerning asset holdings are very incomplete, so the composition of the Bank's assets has to be guessed at from changes in the Bank's liabilities (i.e., ledgers).

Central bank accounting and central bank solvency in particular are studied in a large body of literature, recently surveyed in Archer and Moser-Boehm (2013). A prominent theme of this literature is that standard concepts of solvency are difficult to apply to central banks, which, because of the unique monetary status of their liabilities, are often able to operate with thin or even negative levels of equity (assets minus liabilities). Below we will show that the Bank of Amsterdam offered no exception to this rule, as its equity was virtually always negative. Fry (1993) argues that net worth (equity adjusted for "off-balance-sheet" items including discounted future seigniorage income[1]) provides a better measure of the sustainability of a central bank's policies than does conventional equity.[2] Intuitively, a central bank with positive net worth can meet its financial commitments by issuing debt claims against future income. Negative net worth is problematic, since it indicates a central bank may be forced to compromise its policy goals in order to meet expenses.

Fry's conclusions have been echoed in subsequent papers, theoretical and empirical (see, e.g., Stella 1997, 2005; Ize 2005; Buiter

[1] Archer and Moser-Boehm (2013, p. 7) call this "comprehensive net worth."

[2] The empirical relevance of this distinction is easily seen from figures compiled by Archer and Moser-Boehm (2013, p. 11) for the European Central Bank (€411 billion equity versus €5.1 trillion estimated net worth in 2010) and the Federal Reserve System ($134 billion equity versus $4.1 trillion estimated net worth in 2010).

2008; Klüh and Stella 2008). Our data set will offer some additional confirmation. Del Negro and Sims (2014) emphasize, however, that estimates of a central bank's net worth can vary widely with projections of money demand and with expectations of policy. This is an issue that is present in our calculations, as will be seen below.

A related theme of this literature is the importance of fiscal backing for the effectiveness of central banks, and particularly of mechanisms for recapitalization under certain scenarios. Sims (2004) lays out the essential policy dilemma, arguing that a central bank without credible fiscal backup will either miss its policy targets or be forced to amass politically unsustainable amounts of reserves (to fend off speculative attacks). Below we describe how the Bank of Amsterdam traditionally confronted this dilemma by using market funding. Its continuous rollover of market-supplied reserves both anchored policy targets and prevented the City from depleting this category of reserves. Confidence in this solution met its limits in 1781–83 when the Bank was called upon to provide emergency funding to the cash-strapped Dutch East India Company. The inadequate recapitalization of 1791–92 made the Bank's lack of fiscal underpinnings all the more evident to contemporary observers.

Recently there has been an upsurge of interest in the topic of central bank accounting, stemming from the rapid expansion of central banks' balance sheets since the 2008 crisis (see Fawley and Neely 2013 for a survey). A number of studies (as of this writing, Stella 2009; Christensen, Lopez, and Rudebusch 2013; Greenlaw et al. 2013; Hall and Reis 2013; Del Negro and Sims 2014; Carpenter et al. 2015) have considered the effects of the Federal Reserve's quantitative easing (QE) programs on its equity position going forward.[3] One message of this literature is that the unwinding of QE could diminish the Federal Reserve's equity by as much as $100 billion under unfavorable scenarios, although book equity must remain non-negative under the Federal Reserve's accounting rules.[4] Even potential losses of this magnitude, however, are dominated by other components of the Federal Reserve's net worth, estimated in trillions

[3]Comparable exercises for the European Central Bank can be found in Buiter and Rahbari (2012) and Hall and Reis (2013).

[4]If the Federal Reserve's income were to be insufficient to cover expenses, its accounting rules call for the creation of reserves against a "deferred asset," which is a claim against future remittances by the Federal Reserve to the U.S. Treasury.

of dollars when potential income from note seigniorage is included in the calculation (Buiter and Rahbari 2012; Del Negro and Sims 2014). Equity impacts from the unwinding of QE are thus seen as unlikely to constrain the Federal Reserve's future policy decisions.

The discussion below will make clear that while the design of the Bank of Amsterdam was in many respects comparable to modern central banks (including the Federal Reserve), one major difference was that it did not issue circulating notes backed by a transparently funded government debt. In the eighteenth century this was a new concept of central banking, one that was still being worked out by the Bank of England (Clapham 1970a) and other institutions. The corresponding lack of access to a stable stream of earnings had negative implications for the Bank of Amsterdam's financial stability. As will be seen below, the Bank did have other sources of income, which, though adequate in normal times, proved insufficient during the circumstances of 1781–92.

The demise of the Bank of Amsterdam ushered in a long period of currency dominance for the British pound. The passing of the torch from the florin to the pound in the 1780s has a number of parallels with the better-known transition from the pound to the dollar in the 1920s and 1930s (Eichengreen and Flandreau 2009, 2010). These include the pound's loss of trade dominance to the dollar in the early twentieth century, the initial weakening of the pound by the fiscal pressures of World War I, followed by a second crisis and the removal of the pound from the gold standard in 1931 (Kindleberger 1984). There are also some significant differences. Chief among these is that the pound survived (though in a diminished role) while the bank florin did not. France's military conquest of the Dutch Republic in 1795 brought about the last phase of the florin's collapse. After the Napoleonic period, the remnant portion of the Bank of Amsterdam was liquidated, and its functions were taken over by a national institution of the newly established Kingdom of the Netherlands, De Nederlandsche Bank (Jonker 1996).

## 3. Some (Very) Old-Style Central Banking

This section describes the Bank of Amsterdam's structure and balance sheet. Additional details are provided in van Dillen (1934), Dehing (2012), and Quinn and Roberds (2014b).

**Table 1. Balance Sheet of the Bank of Amsterdam (Eighteenth Century)**

| **Assets** | **Liabilities** |
|---|---|
| Coins under Receipt (Those Eligible for Repurchase)<br>Unencumbered Coins (Not Eligible for Repurchase)<br>Loans | Account Balances<br>Equity |

The Bank was founded in 1609 and liquidated in 1820. It was owned by the City of Amsterdam and was directed by an appointed commission of merchants, bankers, and former municipal magistrates ('t Hart 2009, p. 154). The principal objective of the Bank was to provide a stable money for the settlement of bills of exchange payable in Amsterdam. As noted above, this involved stabilizing the value of the bank florin relative to trade coins. This stability made payment by book-entry transfer of Bank balances popular with the international bill market, and use of Bank money generated revenue for the City.

### *3.1 Balance Sheet Structure*

Table 1 gives a stylized balance sheet for the Bank of Amsterdam during our era of interest.

Table 1 reveals two fundamental differences between the Bank and modern central banks. The first is on the asset side, where the traditional "building blocks" of the Bank's portfolio were not government securities but silver (much less often, gold) coins.[5] The

[5]There were several reasons why the Bank used coins rather than government bonds as its principal backing asset. Public finance in the Dutch Republic was relatively advanced for its era, but unlike contemporary Britain, there was no unified national debt (de Vries and van der Woude 1997, chapter 4). The debt of the largest province, Holland, played a somewhat similar role to a national debt (Gelderblom and Jonker 2011), but secondary markets for Holland debt were generally quite thin (van Bochove 2013). Finally, the charter of the Bank did not incorporate any explicit role for the Bank in public finance. The coins held by the Bank may be compared to foreign exchange assets held by many modern central banks; see the discussion below.

second is on the liability side, where the Bank's monetary liabilities existed only as balances on its books, never as circulating notes.[6]

Assets in modern central banks' portfolios are often held under repurchase agreements. The Bank did not engage in repurchase agreements, but it did create money through a comparable mechanism, famously described by Adam Smith in *The Wealth of Nations* (1937, pp. 446–55). Anyone with an account at the Bank could sell high-quality, large-denomination coin (known as "trade coin"[7]) to the Bank at a fixed price, receiving in return a credit in their account with the Bank, and a *receipt.* The receipt entitled its holder to repurchase the same coin within a six-month interval at the same price they sold it for, plus a small fee (1/4 percent for most silver coins and 1/2 percent for gold coins).[8] Receipts were issued in the name of the party selling the coin, but were fully negotiable.[9] Receipts could also be rolled over at six-month intervals, at the same cost as a redemption. In practice, most receipts were eventually redeemed, so they functioned much like "term repos" between the Bank and its account holders. Table 2 gives an example of how this type of transaction is recorded.

In the table 2 example, the Bank's records show that the firm of Elmenhorst & Kerkoff delivered 2,000 silver *driegulden* coins to the

[6]This mattered because it meant that the Bank's money was a "wholesale" product used primarily by wealthy merchants. During our era of interest, there were approximately 2,000 accounts at the Bank, held by about 1 percent of Amsterdam's population (van Dillen 1925, p. 985). The average value of a payment over the Bank's books was 2,500 florins (Dehing 2012, pp. 82, 140); a typical laborer's daily wage was about 1 florin (de Vries and van der Woude 1997, p. 616). Payments through the Bank thus resemble payments over today's large-value settlement systems (Fedwire, TARGET2, etc.).

[7]Trade coins had special liquidity value as the preferred medium of exchange for transactions in foreign markets. Both foreign and domestic trade coins were eligible for sale against receipts at the Bank.

[8]That is, in modern terms, a receipt was an American call option on the coin sold, the strike price being the original sale price plus the fee. A receipt was also a put option on the bank florin. Coins under receipt were tested for quality and held in standardized, numbered bags. In the original implementation of this system, someone redeeming a receipt received literally the same bag of coins that were sold to generate the receipt. Later on, the Bank appears to have allowed some substitution of fungible bags across receipts.

[9]Unfortunately very few prices of receipts have survived, so these cannot be employed in the analysis below.

**Table 2. Receipt Transactions on the Balance Sheet, in Bank Florins**

| Assets | | Liabilities and Equity | |
|---|---|---|---|
| *July 26, 1776* | | | |
| Coins under Receipt | +5,650 | +5,650.0 | Accounts |
| *January 31, 1777* | | | |
| | | –14.1 | Accounts |
| | | +14.1 | Equity |
| *July 3, 1777* | | | |
| Coins under Receipt | –5,650 | –5,650.0 | Accounts |
| | | –14.1 | Accounts |
| | | +14.1 | Equity |
| | 0 | 0 | Net Change |

**Source:** Amsterdam Municipal Archives.

Bank in the summer of 1776. The Bank credited the firm 5,650 bank florins and gave them a receipt. Six months later, the firm paid 25 basis points (= 14.1 florins) to the Bank (from other funds it had on account) to extend the receipt for another half-year. Then, in the summer of 1777, the firm used the receipt to repurchase the coins, paying another 25-basis-point fee (again from other funds). The last line of the table gives the cumulative net impact over all balances recorded in the ledgers, including the balance in the Bank's own master account.

A curious quality of the Bank's liabilities (i.e., account balances), of great fascination to Adam Smith and other contemporary observers, was their fiat nature (Smith 1937, p. 450). After the introduction of the receipt system in 1683, Bank balances *could no longer be redeemed for coin without a receipt.* This led to the creation of a daily secondary market in Bank funds, in which Bank money could be traded against (the equivalent of) circulating coin or "current money." Bank money, which was backed predominantly by trade coins, almost always went at a premium (called the *agio*) to

current money, which consisted of a mixture of coins of varying quality. The distinction between Bank money and current money gave rise to two legally distinct, parallel units of account in the Dutch Republic, known as the *bank florin* or bank guilder, and the *current florin* or current guilder. For expositional shorthand, we will often use the term "florins" for bank florins and "guilders" for current florins.

In the table 2 example, each coin brought to the Bank had an official value of 3 current guilders and also an official value of 2.825 bank florins, so, for these transactions, the Bank used an (implicit) exchange rate of 1.062 guilders per florin. The secondary market, however, typically offered an exchange rate of 1.05 or less.[10] If instead Elmenhorst & Kerkoff had sold its coins to a private broker or "cashier" for bank florins at an agio of 5 percent, then the firm would have gained an extra 64 bank florins but no receipt. Most people chose the extra money, and the receipt business in *driegulden* coins was thin. Indeed, we use that coin in table 2 precisely because its infrequency allows us to connect individual transactions. In contrast, another Dutch silver coin, the *ducaton*, had a bank exchange rate of 1.05 and a substantial receipt business.

In addition to coins held under receipt arrangements, the Bank held coins not encumbered by receipts. These might consist of coins for which receipts had expired, but more commonly these were coins acquired through the Bank's open-market operations, i.e., through purchase of coin in the daily market for Bank funds. In the eighteenth century, such operations were generally conducted in small-denomination coins (*gulden* coins with a nominal value of one current guilder each). These coins were not recognized as trade coins and were thus ineligible for sale to the Bank against receipts. To ease monetary conditions, the Bank would on occasion purchase such coins (by crediting the seller's account with Bank funds, much as central banks today) at the going price (always less than one bank florin per guilder for a positive agio). Such open-market purchases

[10]That is, in modern terminology, the Bank often applied a small haircut to the coins purchased at its receipt window. The size of the haircut was determined by the difference between the market and official values of the coins bought. In the table 2 example, the implied haircut would have been $100 \times [(1/1.05) - (1/1.062)] = 1.08$ percent.

**Table 3. Open-Market Operations on the Balance Sheet, in Bank Florins**

| Assets | | Liabilities and Equity | |
|---|---|---|---|
| *January 30, 1778* | | | |
| Unencumbered Coins | +39,952.38 | +40,000.00<br>–47.62 | Accounts<br>Equity |
| *February 11, 1778* | | | |
| Unencumbered Coins | –39,857.14 | –40,000.00<br>+142.86 | Accounts<br>Equity |
| | +95.24 | +95.24 | Net Change |
| **Source:** Amsterdam Municipal Archives. | | | |

expanded the stock of Bank funds, in the same way that central bank open-market purchases do today. To tighten, the Bank would sell guilder coins into the market.[11]

An example may be instructive. At the start of 1778, the Bank purchased 42,000 *gulden* coins at a premium or agio of 4⅞. The next month, the Bank sold the same coins at 4⅝. Table 3 gives the balance sheet effects. Note that, by convention, the Bank always recorded coin purchases and sales in its account balances "as if" these transactions occurred at a 5 percent premium (i.e., at 40,000 florins in this case). Each operation therefore requires a profit or loss adjustment to correct for the difference between actual transaction price and the benchmark 5 percent price of Bank money (for details see Quinn and Roberds 2014a).[12]

[11]Guilder coins were purchased with bank florins at a market price, rather than a fixed price as with trade coins. Also, no receipts were given for purchased guilders, so that someone who sold their guilders to the Bank had no right to withdraw coin from the Bank without the purchase of a receipt from someone who had sold trade coins to the Bank. This is somewhat analogous to the situation with modern central banks, where a party that sells collateral to a central bank in a repo may (and is expected to) later repurchase that same collateral at a fixed price, but a party that sells a security outright to a central bank may not then expect a return of that security at a prearranged price.

[12]We suspect this accounting convention was adopted to simplify bookkeeping. For lack of practical alternatives, our reconstruction reluctantly follows this

The unencumbered coin residing in the Bank's vault was a source of revenue for the City. Annually, the City paid itself a seigniorage "dividend" by removing the Bank's profit from the previous year, so the Bank had no retained earnings. Occasionally, the City would take more coin and call it a loan to prevent the Bank from having to acknowledge its negative equity position. The City paid neither interest nor principal to the Bank. Throughout this paper, we treat City "loans" as takings and adjust the Bank's equity accordingly.

The charter of the Bank prohibited lending activity. In practice, however, the Bank routinely lent to the Dutch East India Company. For most of the eighteenth century, Bank lending to the Company took the form of short-term loans that allowed one year's trading fleet to be dispatched while the previous year's fleet was still on its return voyage from Asia. These loans provided a regular source of income to the Bank (Uittenbogaard 2009). Occasional loans to the Province of Holland added a minor source of income.

To give an example of this type of transaction, in April 1775, the Company borrowed 100,000 unencumbered florins from the Bank at 3 percent.[13] Eighteen days later, the loan was repaid with interest. Table 4 gives the balance sheet effects (in this example, the Company has sufficient funds available to repay the interest and principal on the loan).

Putting the elements together, the Bank of Amsterdam was an amalgam of two structures. The receipt system created a "narrow bank" with 100 percent reserves that could be withdrawn on demand. This portion of the bank generated fee income. At the same time, a fractional reserve bank made loans backed by unencumbered coins. This portion generated interest income and profits from open-market operations. Reflecting this dual structure, we find it convenient to divide Bank balances into those matched by an unexpired coin receipt ("encumbered balances") and other balances ("unencumbered balances"). It should be emphasized, however, that this is

convention. For much of our sample, this results in some undervaluation (on the order of 1/2 percent) of the Bank's total assets relative to market value. This distortion is, however, swamped by fluctuations in the value of the Bank's credit portfolio.

[13]That is, the Company received the loan as balances in its Bank account. This was the usual type of loan, although on rare occasions, the Company would also borrow coin from the Bank.

**Table 4. East India Company Borrowing on the Balance Sheet, in Bank Florins**

| Assets | | Liabilities and Equity | |
|---|---|---|---|
| *April 6, 1775* | | | |
| Loans | +100,000 | +100,000 | Accounts |
| *April 24, 1775* | | | |
| Loans | –100,000 | –100,000<br>–150<br>+150 | Accounts<br>Accounts<br>Equity |
| | 0 | 0 | Net Change |

**Source:** Amsterdam Municipal Archives.

an artificial distinction that never occurs in the Bank's accounts: the right to redeem Bank balances in coin was bound to receipts rather than the balances themselves.[14]

### *3.2 Monetary Policy*

As a central bank in an open economy, the Bank of Amsterdam was subject to the constraints of the standard policy trilemma—mutual incompatibility of fixed exchange rates, absence of capital controls, and control over the money stock. The Bank generally attempted to resolve the trilemma by ceding control over its money, with some qualifications. By offering to "repo" trade coins, the Bank anchored (within arbitrage bands) the value of its balances vis-à-vis silver, which served as the metallic standard for most of eighteenth-century Europe. There were no capital controls, and apart from occasional

[14]This dual structure invites comparison to the Bank of England following the passage of Peel's Act in 1844. This law split the Bank of England into Banking and Issue departments, constrained the size of the former, and enforced a 100 percent marginal backing requirement on the latter (Clapham 1970b). Bank florins matched with a receipt similarly had 100 percent backing. However, all Bank of England liabilities (notes and accounts) retained an inherent right of redemption whereas Bank of Amsterdam accounts did not.

open-market interventions, the stock of Bank money ebbed and flowed according to market conditions.

In very approximate terms, the operation of the Bank's receipt window may be compared to a modern "corridor" or "channel" system for the implementation of monetary policy (e.g., Keister, Martin, and McAndrews 2008). In Amsterdam, the corridor's "ceiling" or lending interest rate was given by the 1/4 percent six-month redemption fee for receipts, or slightly more than 1/2 percent annualized. The Bank could afford to offer credit on such generous terms since, by structuring redemption of a receipt as an optional repurchase (rather than a loan repayment), the Bank had an airtight claim on the coin collateral, comparable to that of a funds seller in a modern repo transaction (see, e.g., Gorton and Metrick 2010). The "floor" or deposit rate for the policy corridor was always zero, since the Bank levied no charges for simply holding money in an account, nor did it pay interest to account holders.

Unlike modern central banks, the Bank had no mechanism for shifting this corridor as a way of tightening or loosening policy. Also, credit extended by private lenders would have been at interest rates above the corridor; the historical literature (e.g., Mees 1838, pp. 136–40) indicates that the receipt contract was a special type of credit arrangement only available through the Bank. Secured loans against various types of collateral were common, but since private lenders' claims on collateral were subject to bankruptcy stay and thus to liquidity risk (e.g., de Jong-Keesing 1939, pp. 124–5), higher haircuts and higher interest rates resulted.[15] Nonetheless the ready availability of funds through the Bank's receipt window exerted downward pressure on the cost of credit in Amsterdam's money markets.

The general design of the Bank is reminiscent of a modern currency board, but again there are some notable differences. First, the Bank did not offer to buy and sell foreign exchange at fixed prices, but instead offered fixed terms for the equivalent of repo transactions in trade coins, both foreign and domestic. Second, the Bank's operational target was not a foreign exchange rate, but rather the market value of the bank florin's domestic exchange expressed through the

[15]Private-sector repos of East India Company stock were common from the mid-seventeenth century (Petram 2011; Koudijs and Voth 2014). The market risk of such transactions meant that a haircut of about 20 percent was applied.

agio. Throughout most of the eighteenth century, the agio remained within the 4½ to 5 percent range that was embodied in the coinage laws of the Dutch Republic. These assigned two official values to each trade coin, one in bank florins and a slightly higher one in current guilders (Polak 1998, pp. 73–74). An agio within this range signaled a stable value of the bank florin relative to circulating money. Third, maintenance of the agio appears to have been a largely informal objective, as an explicit target band is not mentioned in the Bank archives until 1782 (van Dillen 1925, pp. 433–4). Informality of its target band allowed the Bank to engage in operations to smooth short-term fluctuations in its money (Quinn and Roberds 2014b). The Bank was also sometimes willing to tolerate deviations of the agio from its target range during periods such as the Seven Years' War (1754–63), when heavy wartime demand for coin depressed the agio to around 2 percent.

A fourth and final difference between the Bank and modern currency boards is that the latter typically operate with a 100 percent (or greater) "backing ratio" of external assets to central bank money. The Bank, on the other hand, often operated with a backing ratio that was substantially lower, averaging 80 percent over its lifetime (Dehing and 't Hart 1997, p. 49). One reason the Bank may have felt comfortable with this lower ratio was the relatively lax, informal nature of its policy target. Another reason may have been the apparent safety of the receipt system: account holders could not threaten the Bank with a classic bank run, since the Bank did not traditionally redeem its balances except against a receipt, and the total stock of receipts was always less than the stock of bank florins. The market value of the bank florin could suffer, however, and for the Bank, the safety of the receipt system ultimately proved more apparent than real.

### *3.3 Reserve Currency Role*

Modern-day reserve currencies serve as backing assets for other currencies. In the eighteenth century, it would have been impossible for any bank liability to play this role, for two reasons. In the case of Amsterdam, one reason was operational: the City limited ownership of Bank accounts to local residents (in practice, merchants and wealthy individuals), its own treasury, and government-sponsored

entities such as the Dutch East India Company. The other was conceptual: in the eighteenth century, the only universally acceptable backing asset for money was precious metal.

Even so, Amsterdam's combination of steady exchange rates, absence of capital controls, and low interest rates conferred something of a "reserve currency" status on the bank florin, in the sense of a "vehicle currency" or preferred medium of exchange (Devereux and Shi 2013). For example, it was fairly commonplace for, say, a merchant in, say, London to pay for goods imported from, say, Gdansk with a bill drawn on Amsterdam.[16] Bills drawn on Amsterdam and payable through the Bank were a liquid form of short-term credit readily available in most European commercial cities (Flandreau et al. 2009, Dehing 2012). The bank florin was a "reference" unit of account for commercial transactions over much of Europe (Gillard 2004 calls it "the European florin"), and top-quality bills on Amsterdam were a reliable and liquid store of value.[17] At the center of this network, in Amsterdam's capital markets, the bank florin served both as numeraire and the most liquid medium of exchange. The Bank was seen as a bulwark of financial stability and attracted favorable reviews from observers such as Adam Smith, William Paterson (who proposed the design of the Bank of England), and Alexander Hamilton (Smith 1937, p. 451; Paterson 1694, p. 14; and Hamilton 1851, p. 164).

By 1770 or so, however, Europe's financial center of gravity was clearly shifting toward London (Carlos and Neal 2011). Amsterdam's markets nonetheless continued to thrive during the 1770s. Quantitative indicators such as the level of Bank balances and payments activity show relatively modest declines from peak values observed in the 1760s (Dehing 2012, p. 82).

[16]Available payment statistics support the claim that the florin served as a vehicle currency. The annual value of payments made through the Bank peaked in the 1760s at about 1.5 times the Dutch Republic's annual GDP. For a preindustrial economy this seems a respectable level of activity; similar ratios for the United Kingdom in 1868 and the United States in 1955 are 3.6 and 2.7, respectively (Kahn, Quinn, and Roberds 2014).

[17]Bills of exchange drawn on merchant banks served this role rather than deposit accounts in banks or government securities. Deposit banking existed in eighteenth-century Amsterdam but was underdeveloped relative to contemporary Britain (Jonker 1996, pp. 233–6). By contrast, bills on reputable merchant banks were widely available and easily traded in secondary markets.

### *3.4 Equity, Income, and Net Worth*

As explained above, the Bank did not hold a portfolio of government securities, nor did it issue circulating notes. This meant that the Bank did not have access to the most common source of revenue for modern central banks, which is seigniorage income from notes backed by government bonds. The Bank did have other streams of income, however, and it was solidly profitable for most of its existence. This section presents a summary of the Bank's income and expenses, and describes how these impacted the evolution of its net worth. Full details are given in Quinn and Roberds (2014a).

In basic terms, the Bank's equity at time $t$ is the value of its stock of unencumbered coin plus its loan portfolio, minus its "unencumbered accounts" (those accounts not matched by receipts). The Bank's time-$t$ net income (or profit) is given by the sum of income from loans, losses on purchases (gains on sales) of coin, fee income from receipts, and other fee income; less loan write-offs, operating expenses, and profit taking by the City.[18]

Following the literature reviewed in section 1, the *net worth* of the Bank is given by the value that a hypothetical, fully informed outside investor would place on the Bank. Operationally, net worth is derived by adjusting book equity for off-balance-sheet income and expenses. For the Bank of Amsterdam, expected profits from fees, expected interest on certain short-term credits,[19] and expected operating expenses are off balance sheet until realization. In contrast, the expected income from annuity-style debts is on balance sheet because the future value of the income streams are embedded within asset values on the balance sheet. Our estimates of net off-balance-sheet incomes assume (i) that such profits follow a random walk, and (ii) that going forward, the City does not take the Bank's profits,

[18] Equity, profit, and net worth are denominated in bank florins. Standard practice in the literature would be to deflate these by a price index to obtain real values. We do not do this for two reasons. First, monthly price series are not available for this time period. Second, available data (van Zanden 2013) suggest that inflation was largely negligible in the Dutch Republic over most of the eighteenth century. Measured annual inflation averages 0.5 percent for 1700–92, and for our specific period of interest, 1781–92, annual inflation averages 0.4 percent. These rates are close enough to zero that it did not seem worthwhile to deflate with an interpolated monthly price series.

[19] As detailed in the next section, these items include future interest on Company anticipations and future interest from the Municipal Loan Chamber.

so that the entirety of such profits can be incorporated into net worth as a "deferred asset."

For simplicity, our net worth calculations apply risk-neutral pricing to these income streams, using a constant risk-free annual interest rate of 3 percent. This is the average implicit rate for a bill of exchange (i.e., an unsecured debt claim) drawn on a high-quality counterparty (often a merchant bank) during our sample period, comparable to AAA commercial paper in a modern context.[20] Thus, with sufficiently positive net worth, the Bank could have hypothetically made its account holders whole by issuing debt at this favorable rate, assuming that the new debt holders would have first claim to the Bank's income. Negative net worth is taken as an indication of the unsustainability of the Bank's policies.

In addition to the Bank's net worth, two other quantities of interest are the Bank's *overall reserve ratio* and its *unencumbered reserve ratio*. The overall reserve ratio $\rho$ (or "cash ratio" or "backing ratio") is the ratio of all metal assets (encumbered plus unencumbered coin) to all account liabilities. The unencumbered reserve ratio $\rho_u$ is the ratio of unencumbered coin to unencumbered accounts.

## 4. Data

The Bank of Amsterdam did not operate in an era of central bank transparency, and it never published balance sheets or income statements. However, many of the original records of the Bank are preserved at the Amsterdam Municipal Archives (AMA), and these can be used to reconstruct the Bank's financial statements. To piece together the Bank's history over the period January 1775–January 1792, data were collected from original documents.[21] Our data set

[20] Bills were unsecured and bore a certain degree of credit, liquidity, and foreign exchange risk; nonetheless, bills on prominent merchants were generally viewed as low-risk instruments. We use the bill rate as a benchmark rate rather than a rate on government debt, since the debt issues of the Dutch Republic and its provinces were rarely traded.

[21] These documents are the general ledgers of the Bank (AMA 5077/507–603), detailed breakdowns of the Bank's master account (AMA 5077/1402–19), and accounts of the Municipal Loan Chamber (AMA 5077/38–40). The Bank's master account is roughly comparable to the Federal Reserve's System Open Market Account (SOMA) and analogous accounts at other modern central banks.

starts in 1775 to provide a five-year baseline of pre-crisis activity by the Bank and ends in 1792 because this is the last year that specialized data is available for the Bank's master account.

The balance sheet of the Bank involves twenty-two categories of assets and liabilities that can enter at a daily frequency, potentially yielding over 4,200 daily observations on the Bank's condition. For clarity in presentation, these data were condensed to more manageable series of 204 monthly observations. Because some income items only show up at a yearly frequency, income data were further condensed to annual series. Details of the data reconstruction are given in Quinn and Roberds (2014a). Agio data are taken from Gillard (2004) and exchange rate data are from Schneider, Schwarzer, and Schnelzer (1991, pp. 122, 150).[22]

### *4.1 Reconfiguration: 1781–83*

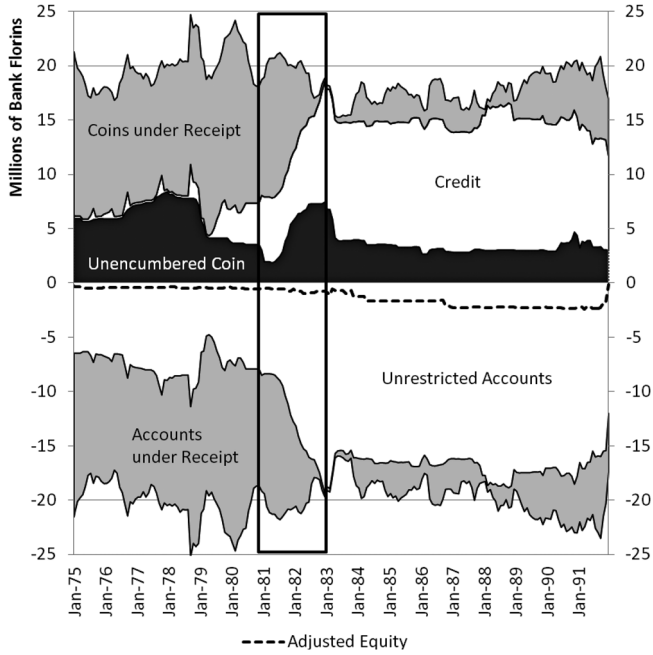
The Bank's initial loss of credibility occurred during the Fourth Anglo-Dutch War (declaration in December 1780; ceasefire in January 1783). This section traces the fundamental changes experienced by the Bank during the wartime period.

Figure 1 shows the Bank's balance sheet over our data sample. The aggregate size of the balance sheet stays roughly constant at about 20 million florins.[23] What changes markedly is the composition of the Bank's assets. Lending replaces coins held under receipt, and this dramatic change mostly occurred during the Fourth Anglo-Dutch War. Figure 1 shows that the stock of encumbered coin held at the Bank began falling with the threat of hostilities in 1780 and continued to fall throughout the course of the war. People rapidly abandoned receipts, a funding stream that had been continuously rolled

[22]These are rates in London and Hamburg for sight bills drawn on Amsterdam. These rates can move in slightly different directions because England was de facto on a gold standard at this time, while Hamburg was on silver. Missing observations in the data series were interpolated using a Kalman smoothing routine. Our exchange rate index is the geometric average of London and Amsterdam series, with the January 1781 index value normalized to 100.

[23]This is perhaps 10 percent of contemporaneous Dutch GDP, which does not seem excessive given the low interest rates inherent in the receipt system. By comparison, the central bank liabilities/GDP ratio for the United States was about 24 percent at year-end 2013.

**Figure 1. The Bank of Amsterdam's Assets and Liabilities, 1775:M1–1792:M1**




**Source:** Amsterdam Municipal Archives.
**Notes:** The Fourth Anglo-Dutch War is highlighted. Note that the top scale applies to the Bank's (negative) equity. Equity is adjusted by treating City loans as subtractions from equity rather than credits.

over for 100 years. The level of coins under receipt (and accounts under receipt) collapsed from 17 million florins in March 1780 to a mere 0.3 million by January 1783.

We conjecture that this collapse was a run motivated by fear that fiscal distress might imperil receipt claims. Account holders might have worried that the Bank would not promptly return high-value collateral, or that the Bank would retroactively hike the fees for redeeming a receipt. Such fears would have been amplified by uncertainty over the outcome of the war and worries that coins could be subject to military seizure. Functionally, the "repo run" observed on the Bank is the opposite of that experienced by Lehman Brothers in

2008, when repo investors in Lehman Brothers unwound positions for fear that funds sold might not be returned (Copeland, Martin, and Walker 2011). Here, people returned funds for collateral.[24]

The overall balance sheet, however, did not collapse, because the Bank simultaneously built its asset holdings with loans and open-market purchases.[25] During the war, the credit portfolio grew by 7.6 million and the level of unrestricted coins by 3.8 million. Both activities created unencumbered accounts, so total monetary liabilities remained relatively stable despite the run. This balance sheet reconfiguration remained the norm through the remainder of the sample.

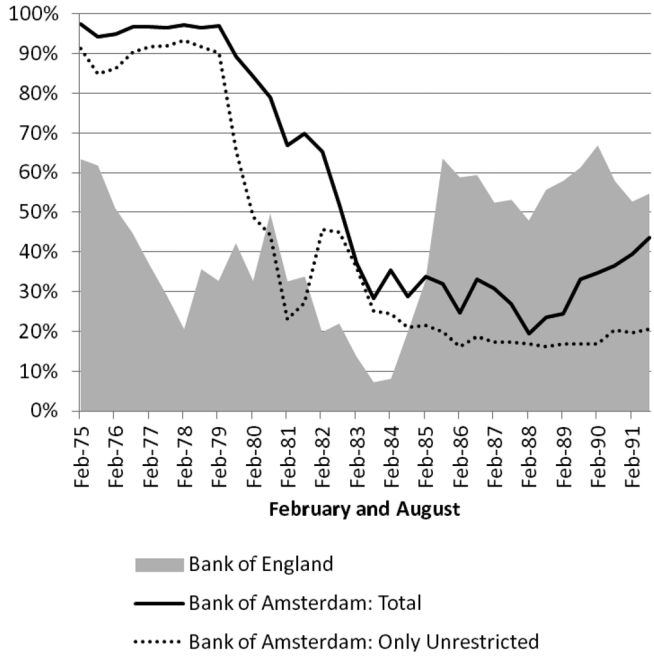
To underscore the transformation, figure 2 reports the Bank of Amsterdam's reserve ratio $\rho$ over our sample period. From 1775 through 1779, the average was 95 percent, and even the ratio of unrestricted coins to unencumbered accounts $\rho_u$ was 87 percent. For comparison, the Bank of England's average ratio was 42 percent over the same period (Clapham 1970a, pp. 296–97). By 1783, the Bank of Amsterdam's ratio fell to 37 percent, and the unencumbered ratio was nearly identical because so few coins were under receipt. At war's end, Amsterdam was still above London's ratio of 14 percent, but the remainder of the decade shows a new pattern. From 1785 through 1791, the Bank of England rebounded to an average of 55 percent while the Bank of Amsterdam retained an average of 31 percent. In other words, Amsterdam experienced a persistent shift from minimal to substantial fractional reserves.

Figure 3 details the composition of the Bank's new lending. Before the war, its credit activity was dominated by loans to the East India Company called anticipations. Anticipations were short-duration, seasonal loans secured on the return of fleets from Asia, typically toward the end of the year. The longest maturity for

[24] Like the 2008 run on Lehman, however, the run on the Bank was a "wholesale" phenomenon. The typical Bank purchase or sale of trade coins was for thousands of florins, well beyond the reach of an ordinary Amsterdam household at the time.

[25] Also, in July 1782, the City put coins worth 85,714.3 bank florins into the Bank. That sum is about one year's operating profit and is the only capital injection of coins that we know of over the Bank of Amsterdam's entire two-century existence.

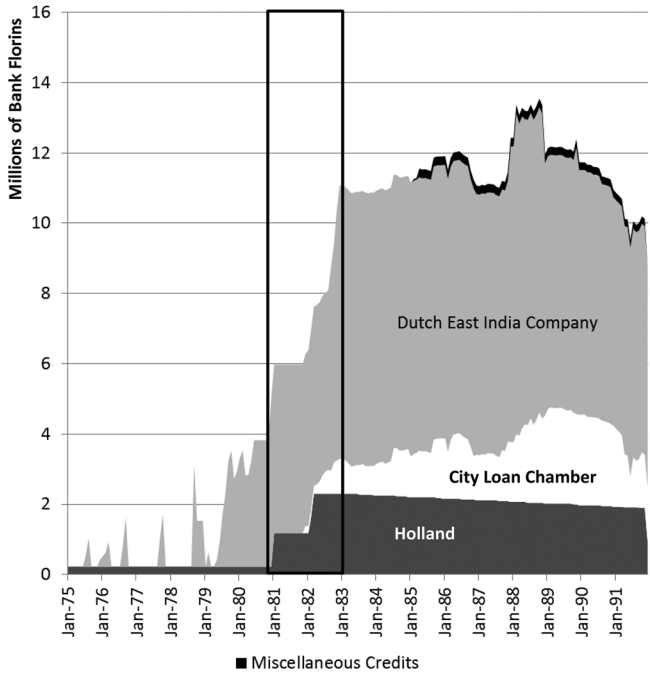
**Figure 2. Reserve Ratios (precious metal to monetary liabilities)**




**Sources:** Amsterdam Municipal Archives and Clapham (1970a, pp. 296–97).
**Notes:** The Bank of England's ratio is bullion over notes in circulation plus accounts. The Bank of Amsterdam's ratios are (i) total coins over total accounts and (ii) unrestricted coins over unrestricted accounts. The February and August dates conform to available Bank of England observations.

anticipations during the first three years of our sample was four months. In 1779, however, the Company delayed some repayments for over a year, after borrowing heavily. In 1780, the Company again borrowed heavily and failed to repay any of these anticipations, but it did manage intermittent interest payments. War then reduced shipments to and from Holland to their lowest levels in a century (de Korte 1984, appendix 8C). In February 1781, the largest division ("chamber") of the Company received permission from the province of Holland to suspend payment on its anticipations (Steur 1984, p. 116). The Bank stopped new lending to the Company in 1781, and

**Figure 3. The Bank of Amsterdam's Loans Outstanding**




**Source:** Amsterdam Municipal Archives.
**Note:** The Fourth Anglo-Dutch War is highlighted.

receipt holders began to "run" the Bank, with the extent of the run limited by the stock of outstanding receipts.[26]

In 1782, near the end of the run, the Company offered to convert its suspended debt into Company bonds that, in theory at least, were guaranteed by the States (Parliament) of Holland (de Korte 1984, p. 81). To participate in the swap, however, current creditors of the Company had to loan it an additional 50 percent. In May, the City formally sanctioned Bank participation in this conversion (van Dillen 1964, p. 417), and the Bank loaned the Company an additional

[26]Steur (1984) emphasizes that this period was marked by great legal uncertainty, stemming in part from the fact that contemporary Dutch bankruptcy law did not provide for potential insolvency of entities such as the East India Company; it was apparently seen as "too big to fail."

2.5 million. By year-end, total Company debt at the Bank was 7.7 million florins.[27]

During the war, the City also used the Bank to fund City lending to the Province of Holland.[28] The City took 2 million florins from the Bank and lent it to Holland in exchange for obligations paying 3 percent. Perhaps to reclaim some credibility for the Bank's balance sheet, the City committed to redirect the expected interest toward amortization. Instead of becoming the non-performing City loan, these debts became zero-interest obligations that were scheduled to be amortized over four decades.

The war also saw credit expanded through another channel, a City-operated lending facility known as the Loan Chamber (van Dillen 1964, p. 418).[29] The Loan Chamber was entirely funded by the Bank and provided credit to local merchants. By January 1783, this facility owed 1 million florins. After the war, the Loan Chamber's debt rose to over 2 million florins and became an important source of income for the Bank.

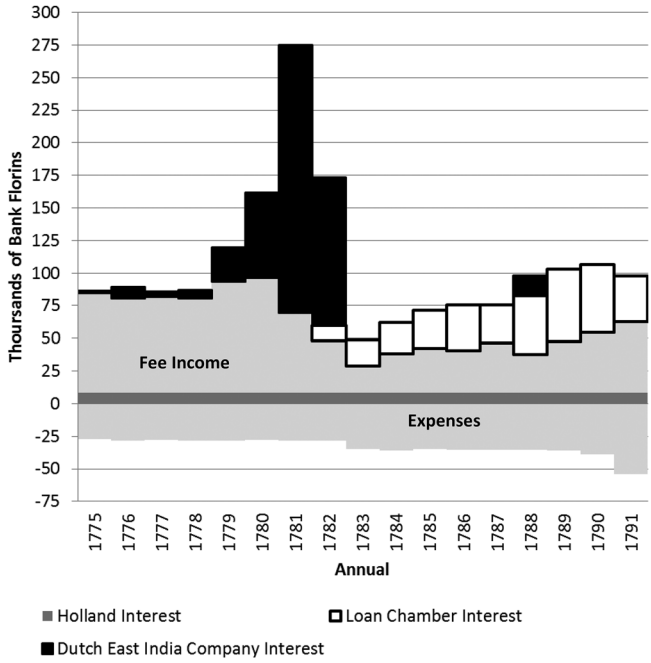
From figures 1 and 3, we see lending to the East India Company and to the Loan Chamber directly created unencumbered account balances to replace the loss of balances matched by a receipt. The Bank added more unencumbered balances with aggressive open-market operations. From May 1781 to July 1782 (the nadir of the receipt run), purchases added 7.1 million in unencumbered balances to the balance sheet. Besides creating bank money, this incoming coin more than offset the coins removed by the City. The City's depletions caused the Bank's adjusted equity (i.e., equity net "loans" to the City), which started off slightly negative at –482,001 florins

[27]Even abstracting from concerns about credit risk, the 1782 debt swap was potentially problematic for the Bank, since it resulted in a significant maturity mismatch between its assets (which now included many long-term bonds) and its liabilities (in theory, readily convertible to trade coin at a stable agio).

[28]The Bank started the war already holding a small perpetual Holland annuity with a principal of 227,000 bank florins.

[29]The Municipal Loan Chamber was originally created in response to the financial crisis of 1772–73 (Breen 1900, de Jong 1934). Creation of the Loan Chamber was necessary because direct lending to merchants was seen as a violation of the Bank's charter. At that time the Loan Chamber saw only light use, and it was closed within a few months. Loss of credit availability during the Fourth Anglo-Dutch War resulted in the Chamber's reopening.

**Figure 4. The Bank of Amsterdam's Income and Expenses**




**Source:** Amsterdam Municipal Archives.

in January 1780, to decline to –778,200 by the end of the war and to –2.3 million by 1791.

Finally, the rapid restructuring of the balance sheet altered the Bank's flow of income: earnings flipped from being primarily derived from people using the receipt facility to being heavily reliant on interest from loans. Figure 4 breaks down the Bank's income by source and shows that before the crisis, the Bank made most of its revenue from usage fees. The run greatly reduced fee income, so interest income became dominant. Massive lending to the East India Company initially resulted in a substantial rise in the Bank's profits—until the Company stopped paying. Thereafter, interest from the Loan Chamber rivaled fee income.[30]

[30]Low interest rates implicit in the receipt system and non-performance of credits to the East India Company cause the Bank's profitability to be quite low

### *4.2 Decline: 1784–89*

The armistice of January 1783 effectively ended the Fourth Anglo-Dutch War (the treaty arrived in May 1784), but peace did not return the Bank to its pre-war condition. This section describes the extent of the problems faced by the Bank, and its attempts at recovery before the outbreak of a second crisis in 1790.

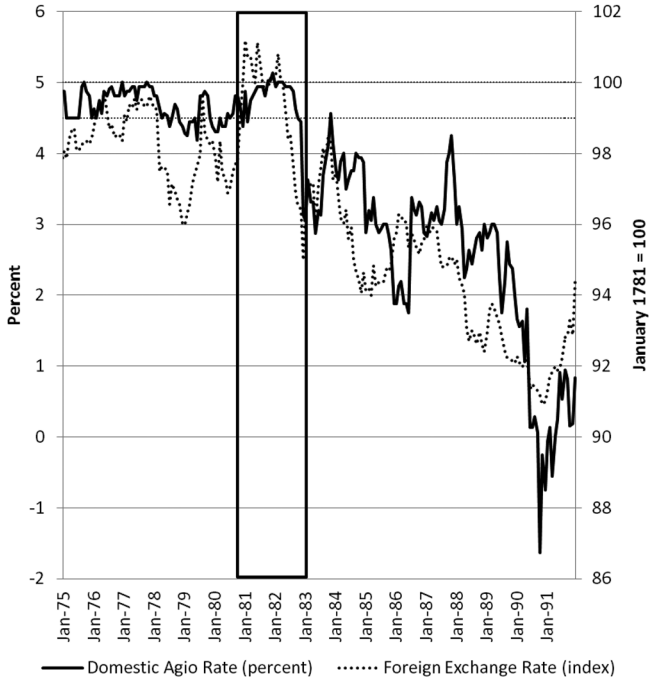
The disruptions of the Fourth Anglo-Dutch War to the Company's operations were severe, and as a condition of peace, the British gained permanent free trade access to the Dutch East Indies, undermining an important source of the Company's profit. Costs to equip outbound ships exceeded the Company's revenue from traded goods in every year from 1780 until the end of the Dutch Republic in 1795 (de Korte 1984, p. 85). At war's end, the Company's total debt was 38 million guilders (20 percent held by the Bank; de Korte 1984, p. 87 and appendix 1E), and subsequent government injections inflated the Company's total debt to 91 million guilders by 1790, by which time 81 million was in arrears (de Korte 1984, p. 84).

The immediate consequence of this for the Bank was that its largest debtor completely failed to perform for three years. By early 1783 this situation began to erode the value of the bank florin (figure 5). A directive from the governing commission of the Bank, dated April 1782, instructed Bank employees to try to hold the agio between 4 and 5 percent through open-market operations, when these could be undertaken without significant losses to the Bank (van Dillen 1925, pp. 433–34). By early 1783, however, figure 5 shows that the agio on the bank florin was already trading in the 3 percent range. Moreover, the foreign exchange value of the florin fell by about 5 percent over the course of the war. The Bank responded to these depreciations through a "tightening operation": selling 3.5 million florins' worth of guilder coins into the market during the first half of 1783. This policy seems to have had some beneficial effect: by January 1783 the slide in the agio abated, and by year-end the agio briefly returned to the 4 percent range. Trade coins trickled back into the Bank (figure 1).

---

compared with modern central banks, with an average return on assets of only 0.38 percent over our sample. For comparison, the average return on assets for central banks during the Great Moderation was about 1.5 percent (Klüh and Stella 2008).

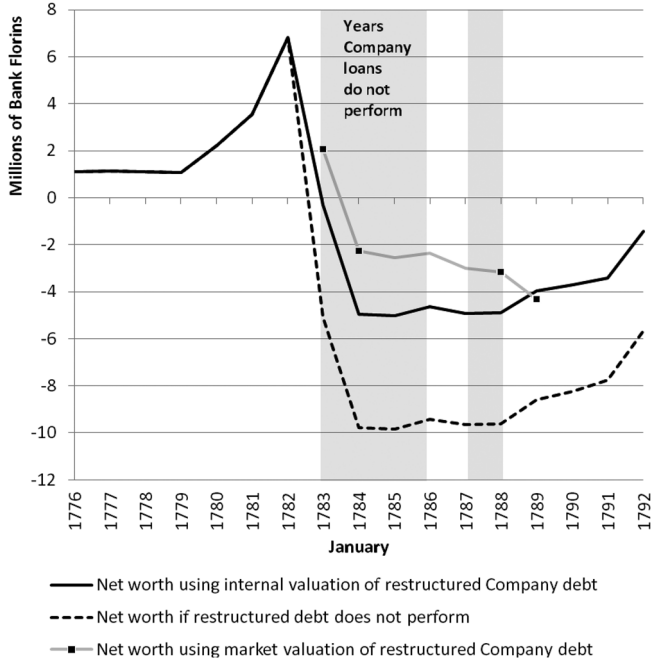
**Figure 5. The Bank Florin Agio and Exchange Rate**




**Sources:** Schneider, Schwarzer, and Schnelzer (1991), and Gillard (2004).
**Note:** The Fourth Anglo-Dutch War is highlighted. The agio's traditional trading range is horizontally highlighted at 5 and 4.5 percent.

Yet the Bank could not sustain this policy. By the summer of 1783, the Bank's stock of unencumbered coins fell to 4.4 million florins, leaving its overall reserve ratio at a perilously low 28 percent (figure 2). This ratio had been 97 percent just four years earlier. Open-market sales of silver were abruptly interrupted. The Bank's problems, however, extended beyond illiquidity, for the continued non-performance of loans to the Company, combined with the cumulated effects of its earlier monetary expansions, caused the Bank to become policy insolvent. As long as its profits were taken by the City, the Bank had no way to offset its losses on loans to the Company. And even if the Bank had started to retain all of its earnings, it is doubtful that these would have proved sufficient to return the Bank to solvency.

**Figure 6. The Bank of Amsterdam's Net Worth by Scenario**




**Sources:** Amsterdam Municipal Archives and authors' calculation.
**Note:** The net worth using market valuations relies on auction prices of new Company debt issued in March 1783, December 1783, April 1788, and February 1789, and linear interpolations between auction dates.

### *4.2.1 Policy Insolvency*

Figure 6 charts the evolution of the Bank's net worth in January of each year in the sample under different scenarios. As noted above, calculation of net worth requires at each date an adjustment for "franchise value," i.e., for the value of future net income not reflected in book assets.

The net worth estimates also require an evaluation of the Bank's credit portfolio. The Bank recorded loans as their principal due, but this can differ substantially from what an investor might pay for the Bank's long-term assets. For example, the 1781 and 1782 loans to the City did not pay interest, so we have revalued them

as the present value of the expected amortization payments (see Quinn and Roberds 2014a for details). The more difficult valuation is the restructured Company debt that did not pay interest *and* had a substantial credit risk. So figure 6 reports how insolvent the Bank of Amsterdam became, based on three ways of assessing the restructured Company debt held by the Bank.

Our first estimate of net worth applies four price observations from auctions of new Company debt.[31] There was little or no secondary market for these instruments, so such data points are rare. The prices were the percent of principal the buyer was willing to pay, but the maturities of the bonds were not recorded, so we assume that they were similar to the thirty-three-year maturity held by the Bank.[32] If the auctioned debt was actually of a shorter maturity, then the implied default probability would be greater, and the insolvency worse, than that shown in figure 6. The auction prices suggest that the Bank's insolvency in 1784 was –2 million florins, but market perceptions of the Company worsened over time, causing the Bank's insolvency to double by 1789. The decline corresponds with years the Company did not pay anything to the Bank, or presumably to other creditors.

A second approach views the restructured debt from the Bank's internal perspective. When the Company did start making payments again, the Bank received only amortization payments. The internal valuation line uses this as the expected reality of the restructured debt. It calculates the present value of these payments for each year starting in 1783, and it produces the Bank's net worth if the Company met its thirty-three-year amortization schedule but never paid interest. This view of the restructured debt puts the net worth below –4 million florins half a decade before the market does.

Finally, as a lower bound, a third approach (dashed line in figure 6) reports the Bank's net worth if the restructured debt fails entirely and irrevocably. Under this scenario, the Bank's net worth goes to almost –10 million in January 1784. This would have been the most prescient valuation, since the Company was in default over most of

[31] These data were generously supplied by Christiaan van Bochove and Joost Jonker.

[32] Other bonds mentioned in de Korte (1984, p. 87) were of a similar maturity: thirty-three years in 1781 and thirty years in 1791.

our sample, and completely so after seizure of its ships by the British navy in 1795 (de Korte 1984, p. 91).

Thus, under all three scenarios depicted in figure 6, the Bank was insolvent by 1784. The actual shortfalls faced by the Bank would have been larger than those shown in the figure, since the City never fully gave up Bank profits as a source of revenue.

#### *4.2.2 Attempts at Self-Repair*

Although the Bank did not publish its balance sheets, the market priced the Bank's weakness over the rest of the 1780s. The agio and the foreign exchange rate continued to decline (figure 5) and the Bank did not engage in defensive open-market operations. And new initiatives indirectly acknowledged the Bank's credibility problem. For example, the City attempted to limit dividends beyond yearly profit by treating them as actual loans. In 1783, the City opened a line of credit with the Bank and repaid 800,000 florins (with interest!) of the 1.4 million borrowed. The effort, however, soon ended as the remaining principal returned to non-performance in 1784. Over the rest of our sample, the City took out an additional 943,714 florins in non-performing loans.

The Bank's accounting treatment of Company debt also shifted in 1783. The Company suspended all payments for three years and the Bank stopped accruing interest on Company debt. The Bank, however, rolled over, or "evergreened," the debt principal. When a 3 percent coupon payment did show up 1786, after a three-year abeyance, the City then used the funds to shift bonds from the Bank's balance sheet and, presumably, to the City's balance sheet. From the Bank's perspective, the process slowly amortized the principal but ignored interest due. The process led to an incremental improvement of the Bank's net worth under the second scenario shown in figure 6 (solid black line).[33]

Amortization reduced the Bank's vulnerability to future Company non-performance at the expense of immediate gains. If the Bank instead accounted for Company payments as interest income

[33]Resumption of payments seems to have allowed the Bank to reopen some short-term lending to the Company. The Bank made three new loans, each of which the Company repaid in full. One loan, a 1788 loan for 700,000 florins, was even repaid with interest.

on a perpetual debt, then the Bank's net worth would have increased substantially: discounted at 3 percent, these payments would have added a present value of 7.65 million. The City would have benefited as well, by taking the income as dividends. Instead, principal was reduced. As a result, the amount of potential insolvency was made less each passing year. This amortization policy would have helped the Bank only *if* the Company's long-term credibility were highly suspect. At the time, Holland was subsidizing the Company with vast sums, and the Company's unsubsidized outlook remained bleak. With this policy, the City chose to slowly reseparate the bank florin from the Company rather than accept a florin built on a massive, undiminishing Company debt. This variation on a strategy of "extend and pretend" was, however, insufficient to remedy the Bank's insolvency.

Sustained growth in receipt balances (figure 1) brought a different sort of relief for the Bank in 1789. This coincides with the political instability of the French Revolution, but we cannot track where coins are coming from. Still, the influx of new coin types from Brabant, Prussia, Russia, and Sweden suggest a new pattern at work. Also, the bank florin continued to weaken both in terms of the agio and relative to London and Hamburg, so the inflows are unlikely to have come through those traditional channels. A contemporary observer attributed the florin's weakness to sovereign loans made by Amsterdam merchant banks to Russia, Sweden, and Austria in the amount of 40 million florins (van Dillen 1964, p. 420).

### *4.3 Crisis: 1790–91*

The appearance of another crisis in 1790 led the Bank to undertake a series of unconventional policies designed to restore its credibility. This section describes the nature and extent of these policies.

Beginning in 1790, the Bank attempted to use the renewed inflow of trade coins to stabilize the rest of the Bank and halt the decline in the agio. First, the Bank acquired encumbered silver coins by purchasing receipts on the market instead of purchasing coin outright as it had in the past. From June 1790 to May 1791, the Bank converted 3.7 million in silver coin from encumbered to unencumbered. The logic behind this operation may have been to reduce the scope of a possible run by diminishing account holders' ability to redeem

Bank balances in coin. From a modern perspective, however, a policy of purchasing receipts is seen as the Bank buying a large number of put options on its own currency. Not surprisingly, this intervention proved ineffective.

The agio dropped below zero by November 1790 (figure 5). In a desperate move to halt the florin's slide, the Bank then offered to redeem the balances of large account holders in silver bars at a price of 26.75 florins per silver mark (van Dillen 1964, p. 421). This was a de facto devaluation of 9–10 percent over the traditional (implicit) silver value of the florin, of 24.1–24.25 florins per mark. No one took the Bank up on this offer. Instead, in January 1791, prominent account holders filed a formal protest with the City, accusing the Bank of having increased its money stock in an "unnatural fashion" without "backing of saleable specie or coin material" (van Dillen 1964, p. 422). The protesters demanded that all accounts be made directly convertible to (silver) specie at the former value, as had occurred prior to the introduction of the receipt system.

The data show that the Bank made two additional policy moves in early 1791. The first of these was to raise the bank price of gold coins by 2.5 percent, effectively a reduction in the Bank's "haircut" when people used gold as collateral: a backdoor devaluation. The second move, an apparent response to the account holders' protest, was to set a price floor for the agio by using unencumbered silver coins to fund a traditional (i.e., non-receipt) process of withdrawal, an option that has been in abeyance for over a century. The Bank made the new facility available only to dealers in the agio market and set the initial withdrawal agio to –1 percent. This means people got 99 current guilder coins per 100 bank florins in account. At that below-market rate (figure 5), dealers withdrew 344,000 bank florins in two weeks. Perhaps feeling overly confident, the Bank then raised the withdrawal agio to zero percent (just above market rates), and 1.6 million left in two weeks. Belatedly realizing that it had been funding a run, the Bank abandoned this effort to stabilize the agio in mid-February 1791. The Bank had proved unable to restabilize itself.

### *4.4 Recapitalization: 1791–92*

Over an eight-year span beginning in 1783, the Bank was too far from solvency to reestablish credibility. Efforts to introduce a meaningful,

**Table 5. Recapitalization of April 1791–January 1792 (quantities are bank florins)**

| | Full Company Performance | No Company Perfomance |
|---|---|---|
| Initial Equity | –2,303,300 | –8,805,800 |
| Initial Net Worth | –40,477 | –6,542,977 |
| Change in Accounts (Liabilities) | –6,076,893 | |
| *Balance Sheet Effects:* | | |
| Change in Equity due to Recapitalization | +2,418,438 | |
| *Other Changes in Balance Sheet:* | | |
| Change in Loans (Assets) | | |
| Holland (Performing) | –952,381 | |
| Loan Chamber (Performing) | –999,741 | |
| East India Company (No Interest) | 0 | |
| Change in Coins (Assets) | –1,706,333 | |
| Equity after All Changes | –145,590 | –6,418,590 |
| Net Worth after All Changes | 1,310,865 | –4,962,135 |

**Sources:** Amsterdam Municipal Archives and authors' calculation.

if devalued, peg for the florin failed. Efforts to improve loan performance were likewise unsuccessful. Indeed, the City continued to take operating profits, and more, from the Bank. Under pressure from market participants, the City finally attempted to recapitalize the Bank in 1791. This section describes the recapitalization.

On February 17, 1791, the City Council authorized a bond issue of 6 million florins (van Dillen 1964, p. 422) for recapitalization, with prominent merchant banks agreeing to support the issue. Calculations shown in figure 6 suggest that this was, on its face, a reasonable move given the extent of the Bank's accumulated losses. Examination of the Bank's ledgers confirms that from April 1791 through January 1792, the City gave over 6 million florins in balances to the Bank for destruction.

The Bank's reconstructed balance sheet shows why the recapitalization did not succeed in restoring the bank florin. The City did not restrict the use of the injected funds to restoring equity. As table 5 shows, 40 percent went to increasing the Bank's equity,

but the remainder was diverted. Almost one-third went to retire self-amortizing loans secured by Holland bonds and by interest-earning loans to the City Loan Chamber; 28 percent was taken out by the City as coin. During the operation, the agio appreciated 1.4 percentage points (from –.56 to .84) and the exchange rate appreciated 2.8 percent. The Bank's reserve ratio rose to 48 percent, a ratio similar to the Bank of England's. At the same time, the non-performing East India Company debt remained, and this means that the Bank was insolvent with a net worth of –4.96 million florins under the increasingly probable no-recovery scenario. Again, even that estimate of net worth assumes the City would have stopped taking all future earnings, which seems unlikely given the City could not resist taking 1.7 million in coin from the Bank's recapitalization.

### *4.5 Epilogue: 1793–95*

The Bank of Amsterdam's decline did not stop in January in 1792. Unfortunately, the records of the Bank's master account are not available after that date, so we are unable to continue our data reconstruction. The basic story of the Bank's further decline is described in the literature, however, and table 6 summarizes that story using 1793–95 fiscal year-end (January) data compiled by van Dillen (1934, p. 122).

By this time, the international strength of the bank florin was gone, and its exchange rate continued to deteriorate. Some metal returned to Amsterdam in late 1792, and van Dillen (1964, p. 425) attributes this to an influx of Spanish silver and to continued capital flight from the consequences of the French Revolution. The agio briefly climbed to the 2 percent range in late 1793 after war broke out with France, only to return to negative territory by August 1794. Encumbered coin left the Bank and the Republic soon thereafter. The bank florin departed the world stage when the French army reached Amsterdam in January 1795.

## 5. Conclusion

The above calculations indicate that accommodative policies pursued by the Bank of Amsterdam over 1781–83 caused it to become

**Table 6. The Bank of Amsterdam, 1792–95**

| Date | Exchange Rate Index (1781:M1 = 100) | Agio (Percent) | Coin (Bank Florins) | Reserve Ratio (Percent) | Profits and Losses (Bank Florins) |
|---|---|---|---|---|---|
| 1792:M1 | 94.4 | 0.84 | 8,408,441 | 48 | 68,696 |
| 1793:M1 | 93.9 | 0.81 | 13,238,010 | 60 | –27,955 |
| 1794:M1 | 90.7 | 1.91 | 8,471,075 | 48 | –10,402 |
| 1795:M1 | 85.9* | −25.00 | 2,506,046 | 21 | –155,314 |

**Sources:** van Dillen (1934, p. 122), Schneider, Schwarzer, and Schnelzer (1991), and Gillard (2004). 1792 financials are from authors' calculations.
**Note:** * denotes December 1794 value.

policy insolvent by 1784 at the latest. The extent of the insolvency remained hidden from public view, but the markets sensed that something was wrong and kept the bank florin under pressure until its full collapse in 1795.

We conclude by considering the implications of this episode for modern central banks. The florin's downfall illustrates three types of policies that have been identified in the literature as detrimental to central banks' net worth and credibility more generally. The Bank's first policy error (see, e.g., Cukierman 2011, p. 36) was its decision to support a large, bankrupt government-sponsored enterprise (the Dutch East India Company) while trying to maintain an indefensible policy target (the agio peg of 4–5 percent). Negative impacts on the Bank's net worth were amplified by a second policy error (Archer and Moser-Boehm 2013), which was the City of Amsterdam's practice of keeping Bank profits to itself and allocating losses to the Bank. The first two mistakes eroded the net worth of the Bank until a fiscal bailout offered the only feasible way to restore the Bank's reputation. A third policy error, of inadequate fiscal backup (Sims 2004), was manifested in the City's botched recapitalization of 1791–92. Applied in isolation, any of these policies would have worked to undermine the Bank. A key lesson seems to be that a combination of all three was particularly toxic.

Was the florin's collapse inevitable? To some extent "yes": the groundwork for the collapse was laid as early as 1683 with the introduction of the receipt system and the subsequent decision by the City to regularly remove the Bank's profits (see Quinn and Roberds 2014b and section 3 above). This system worked well for almost 100 years, however, in part because the strong demand for Bank funds at the receipt window obscured the Bank's negative equity position. Seasonal credit exposures to the Company were small and unproblematic, and the need for any fiscal support from the City must have seemed remote. Confidence in the institutional structure of the Bank was reinforced by Amsterdam's experience in earlier crises, in 1763 (Quinn and Roberds 2015) and 1772–73 (Breen 1900, Koudijs and Voth 2014), where use of the receipt window ballooned as panicked market participants demanded extraordinary amounts of Bank money. In these episodes, people ran to the Bank rather than from it.

Modern central bank accounting shows that despite these earlier successes, by 1784 the Bank's fiscal capacity had been breached. At the time, however, the intractability of this situation may not have been so apparent. The 1781–83 receipt run (see figure 1) in particular may have appeared to the Bank's managers as a one-off shock from which recovery was imminent. The Bank's participation in the 1782 debt swap and its reluctance to seek fiscal support suggest an unwillingness or inability to grasp the severity of its predicament. From an ex ante perspective, it may thus be a bit unfair to judge the Bank on an inadequate response to an almost unimaginable "tail event." But central banking is an activity in which the unthinkable can sometimes come to pass.

## References

Archer, D., and P. Moser-Boehm. 2013. "Central Bank Finances." BIS Paper No. 71 (April).

Breen, J. C. 1900. "Eene Amsterdamsche Crediet-instelling uit het laatst der achttiende eeuw." *Tijdschrift voor Geschiedenis* 15 (2): 137–55.

Buiter, W. 2008. "Can Central Banks Go Broke?" CEPR Policy Insight No. 24 (May).

Buiter, W., and E. Rahbari. 2012. "Looking into the Deep Pockets of the ECB." Citigroup *Global Economics View*, February 27.

Carlos, A. M., and L. Neal. 2011. "Amsterdam and London as Financial Centers in the Eighteenth Century." *Financial History Review* 18 (1): 21–46.

Carpenter, S., J. Ihrig, E. Klee, D. Quinn, and A. Boote. 2015. "The Federal Reserve's Balance Sheet and Earnings: A Primer and Projections." *International Journal of Central Banking* 11 (2): 237–84.

Christensen, J. H. E., J. Lopez, and G. Rudebusch. 2013. "A Probability-Based Stress Test of Federal Reserve Assets and Income." Working Paper No. 2013-38, Federal Reserve Bank of San Francisco (December).

Clapham, J. 1970a. *The Bank of England, A History*, Vol. I. Cambridge: Cambridge University Press.

———. 1970b. *The Bank of England, A History*, Vol. II. Cambridge: Cambridge University Press.

Copeland, A., A. Martin, and M. Walker. 2011. "Repo Runs: Evidence from the Tri-Party Repo Market." Staff Report No. 506 (July), Federal Reserve Bank of New York.

Cukierman, A. 2011. "Central Bank Finances and Independence: How Much Capital Should a Central Bank Have?" In *The Capital Needs of Central Banks*, eds. S. Milton and P. Sinclair, 33–46. London and New York: Routledge.

Dehing, P. 2012. *Geld in Amsterdam: Wisselbank en wisselkoersen, 1650–1725.* Hilversum: Uitgeverij Veloren.

Dehing, P., and M. 't Hart. 1997. "Linking the Fortunes, Currency and Banking, 1550–1800." In *A Financial History of the Netherlands*, ed. M. 't Hart, J. Jonker, and J. L. van Zanden, 37–63. Cambridge: Cambridge University Press.

de Jong, A. M. 1934. "The Origin and Foundation of the Netherlands Bank." In *History of the Principal Public Banks*, ed. J. G. van Dillen, 319–34. The Hague: Martinus Nijhoff.

de Jong-Keesing, E. E. 1939. *De Economische Crisis van 1763 te Amsterdam.* Amsterdam: N.V. Intern. Uitgevers en h. Mij.

de Korte, J. P. 1984. *De Jaarlijkse Financiële Verantwoording in de Verenigde Oostindische Compagnie.* Leiden: Martinus Nijhoff.

Del Negro, M., and C. A. Sims. 2014. "When Does a Central Bank's Balance Sheet Require Fiscal Support?" Staff Report No. 701, Federal Reserve Bank of New York (November).

Devereux, M. B., and S. Shi. 2013. "Vehicle Currency." *International Economic Review* 54 (1): 97–133.

de Vries, J., and A. van der Woude. 1997. *The First Modern Economy: Success, Failure and Perseverance of the Dutch Economy, 1500–1815.* Cambridge: Cambridge University Press.

Eichengreen, B., and M. Flandreau. 2009. "The Rise and Fall of the Dollar (or When Did the Dollar Replace Sterling as the Leading Reserve Currency?)" *European Review of Economic History* 13 (3): 377–411.

———. 2010. "The Federal Reserve, the Bank of England and the Rise of the Dollar as an International Currency, 1914-39." BIS Working Paper No. 328 (November).

Fawley, B. W., and C. J. Neely. 2013. "Four Stories of Quantitative Easing." *Review* (Federal Reserve Bank of St. Louis) 95 (1): 51–88.

Flandreau, M., C. Galimard, C. Jobst, and P. Nogués-Marco. 2009. "Monetary Geography before the Industrial Revolution." *Cambridge Journal of Regions, Economy and Society* 2 (2): 149–71.

Fry, M. J. 1993. "The Fiscal Abuse of Central Banks." IMF Working Paper No. 93/58 (July).

Gelderblom, O., and J. Jonker. 2011. "Public Finance and Economic Growth: The Case of Holland in the Seventeenth Century." *Journal of Economic History* 71 (1): 1–39.

Gillard, L. 2004. *La Banque d'Amsterdam et le florin européen au temps del la République Néerlandaise (1610–1820).* Paris: École des hautes-études en sciences sociales.

Gorton, G., and A. Metrick. 2010. "Regulating the Shadow Banking System." *Brookings Papers on Economic Activity* (Fall): 261–303.

Greenlaw, D., J. D. Hamilton, P. Hooper, and F. S. Mishkin. 2013. "Crunch Time: Fiscal Crises and the Role of Monetary Policy." Mimeo.

Hall, R. E., and R. Reis. 2013. "Maintaining Central-Bank Solvency under New-Style Central Banking." Mimeo.

Hamilton, J. C., ed. 1851. *The Works of Alexander Hamilton*, Vol. I. New York: Charles S. Francis & Company.

Ize, A. 2005. "Capitalizing Central Banks: A Net Worth Approach." *IMF Staff Papers* 52 (2): 289–310.

Jonker, J. 1996. *Merchants, Bankers, Middlemen: The Amsterdam Money Market during the First Half of the 19$^{th}$ Century.* Amsterdam: NEHA.

Kahn, C. M., S. Quinn, and W. Roberds. 2014. "Central Banks and Payment Systems: The Evolving Trade-off between Cost and Risk." Mimeo.

Keister, T., A. Martin, and J. McAndrews. 2008. "Divorcing Money from Monetary Policy." *Economic Policy Review* (Federal Reserve Bank of New York) 14 (2): 41–56.

Kindleberger, C. P. 1984. *A Financial History of Western Europe.* Second edition. Oxford: Oxford University Press.

Klüh, U., and P. Stella. 2008. "Central Bank Financial Strength and Policy Performance: An Econometric Evaluation." IMF Working Paper No. 08/176 (July).

Koudijs, P., and H.-J. Voth. 2014. "Leverage and Beliefs: Personal Experience and Risk Taking in Margin Lending." Working Paper No. 3103, Stanford Graduate School of Business (February).

Mees, W. C. 1838. *Proeve eener Geschiedenis van het Bankwezen in Nederland geduerende den Tijd der Republiek.* Rotterdam: W. Messcuert.

Paterson, W. 1694. *A Brief Account of the Intended Bank of England.* Made available in digital format by Early English Books Online/Text Creation Partnership.

Petram, L. 2011. *The World's First Stock Exchange: How the Amsterdam Market for Dutch East India Company Shares Became a Modern Securities Market, 1602–1700.* Ph.D. dissertation, University of Amsterdam.

Polak, M. 1998. *Historiografie en Economie van de "Muntchaos."* Amsterdam: NEHA.

Quinn, S., and W. Roberds. 2014a. "Death of a Reserve Currency." Working Paper No. 2014-17, Federal Reserve Bank of Atlanta (September).

———. 2014b. "How Amsterdam Got Fiat Money." *Journal of Monetary Economics* 66 (September): 1–12.

———. 2015. "Responding to a Shadow Banking Crisis: The Lessons of 1763." *Journal of Money, Credit and Banking* 47 (6): 1149–76.

Schneider, J., O. Schwarzer, and P. Schnelzer. 1991. *Historische Statistik von Deutschland. Band XII: Statistik der Geld- und Wechselkurse in Deutschland und im Ostseeraum (18. Und 19. Jahrhundert).* St. Katharinen: Scripta-Mercuratae-Verlag.

Sims, C. A. 2004. "Fiscal Aspects of Central Bank Independence." In *European Monetary Integration*, ed. H.-W. Sinn, M. Vidgrén, and M. Köthenberger, 103–16. Cambridge, MA: MIT Press.

Smith, A. 1937. *The Wealth of Nations.* New York: Modern Library.

Stella, P. 1997. "Do Central Banks Need Capital?" IMF Working Paper No. 97/83 (July).

———. 2005. "Central Bank Financial Strength, Transparency, and Policy Credibility." *IMF Staff Papers* 52 (2): 335–65.

———. 2009. "The Federal Reserve System Balance Sheet: What Happened and Why It Matters." IMF Working Paper No. 09/120 (May).

Stella, P., and Å. Lönnberg. 2008. "Issues in Central Bank Finance and Independence." IMF Working Paper No. 08/37 (February).

Steur, J. J. 1984. *Herstel of ondergang: de voorstellen tot redres van de Verenigde Oost-Indische Compagnie 1740–1795.* Utrecht: Hes Uitgevers.

't Hart, M. 2009. "Corporate Governance." In *The Bank of Amsterdam*, ed. M. van Nieuwkerk, 144–55. Amsterdam: Sonsbeek.

Uittenbogaard, R. 2009. "Lending by the Bank of Amsterdam (1609–1802)." In *The Bank of Amsterdam*, ed. M. van Nieuwkerk, 120–31. Amsterdam: Sonsbeek.

van Bochove, C. 2013. "Configuring Financial Markets in Preindustrial Europe." *Journal of Economic History* 73 (1): 247–78.

van Dillen, J. G. 1925. *Bronnen Tot de Geschiedenis der Wisselbanken.* The Hague: Martinus Nijhoff.

———. 1934. "The Bank of Amsterdam." In *History of the Principal Public Banks*, ed. J. G. van Dillen, 79–124. The Hague: Martinus Nijhoff.

———. 1964. "Ondergang van de Amsterdamse Wisselbank 1782–1820." In *Mensen en Achtergronden, Studies uitgegeven ter gelegenheid van de tachtigste jaardag van de schrijver*, ed. J. G. van Dillen. Groningen: J. B. Wolters.

van Zanden, J. L. 2013. "Prices and Wages and the Cost of Living in the Western Part of the Netherlands, 1450–1800." International Institute of Social History. Available at http://www.iisg.nl/hpw/brenv.php.