Intermediary Asset Pricing during the National Banking Era

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Abstract

Financial intermediary balance sheets matter for asset returns even when these intermediaries do not directly participate in the relevant asset markets. I show that, during the National Banking Era, liquidity conditions for the New York Clearinghouse (NYCH) banks forecast excess returns for stocks, bonds, and currencies. The NYCH banks could not own stocks and had limited participation in bond and foreign exchange markets; their main link to these markets was through their provision of loans to margin traders. Liquidity conditions are important for asset prices because they affect future credit growth of the NYCH banks, in turn affecting the discount rates of marginal investors. I present additional evidence in favor of this mechanism.

Keywords: Liquidity management, Margin loans, Intermediary asset pricing, National banks

1   Introduction

Intermediary asset pricing models assume that the health of financial intermediaries affects asset prices because the intermediaries directly trade the assets. Yet, the robust empirical relationship between intermediary balance sheets and risk premia that has been documented is based on a set of intermediaries–dealer banks–that perform a number of roles in financial markets (Duffie, 2010).[1]   Therefore, it is difficult to verify in a modern setting if direct participation in asset markets is a necessary condition for intermediary balance sheets to price risk.

I study the relationship between bank balance sheets and asset prices in an historical setting with a set of banks that did not directly participate in most asset markets. These banks were still connected to asset markets through the supply of loans to other traders. During the National Banking Era in the U.S. (1863-1913), commercial banks with a national charter (national banks) could not directly purchase equities, held a limited amount of corporate bonds (less than 5 percent of corporate bonds outstanding in 1912), and did not trade foreign exchange until after 1900. Despite this, the New York City national banks had an intimate connection with asset markets, as a large portion of their loans were on stock and bond collateral to finance the trading activities of brokers and other investors. In addition, growth of these loans was sometimes limited by a binding reserve requirement of 25 percent of deposits.

I find that the balance sheet conditions of the New York City banks still matter for asset prices, even though these banks have limited participation in asset markets. Specifically, I hand-collect key balance sheet items for the New York City Clearinghouse (NYCH) Banks– of which the New York City national banks were the primary members–at a monthly frequency between 1868 and 1913.[2]   Given the importance of NYCH loans for money markets and security purchases, I focus on predictors of future loan growth as the relevant balance sheet

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[1]Dealer banks not only purchase securities for their own account but also for clients; a large share of their assets are also loans on security collateral (repurchase agreements).

[2]A few members of the NYCH had state charters, but their assets were a small fraction of the total.

items for asset returns. I first show that higher growth in cash reserves and lower growth in the loan-to-deposit ratio (which both forecast higher loan growth over the next year) for the NYCH banks predict higher excess returns for stocks, corporate bonds, and lower excess returns for the dollar relative to other currencies over several quarters.[3] This relationship holds while controlling for several other variables that have been used to forecast returns in previous studies. Additionally, the economic significance is sizable: for instance, a standard deviation increase in reserve growth forecasts an annualized excess return for stocks that is five percentage points higher two quarters ahead.[4]

Next, I explore the mechanisms underlying these initial findings. Changes in NYCH bank conditions forecast returns because they represent changes in the discount rate of the marginal investor and not because they predict future cash flows. Indeed, the balance sheet variables do not forecast annual dividend growth. Further, the forecasting relationship holds for high-grade corporate bond returns, where there is little risk of default, and so future cash flows do not change in expectation. Next, I see whether the NYCH banks are effectively a veil, where changes in their balance sheet are driven by changes in marginal investors' risk aversion rather than the opposite direction.[5] I present evidence against this proposition by showing that the predictive power only holds when the NYCH banks are close to their minimum reserve requirement, consistent with the NYCH banks facing a liquidity management problem that constrains their loan supply. Further, the forecasting relationship holds in low-reserve states even if one controls for actual output growth over the forecast horizon. This again supports a specific mechanism, banks' ability to fund margin traders, over models where bank balance sheets simply provide information about future consumption growth.

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[3]Even though I have balance sheet and asset price data at the monthly frequency I run the forecasting regressions at a quarterly frequency to incorporate a larger range of macroeconomic predictors. The predictive power also holds at the monthly horizon without the macroeconomic controls.

[4]Jordà et al. (2017) find similar bank balance sheet variables–specifically the loan-to-deposit ratio–help predict the timing of financial crises.

[5]For example, in the model of Santos and Veronisi (2019), banks issue more loans precisely because investors have grown less risk averse and thus increased their asset demand.

These findings have stark implications for the intermediary asset pricing literature. Previous empirical papers have studied intermediaries that directly participate in asset markets (examples include Adrian, Etula, Muir, 2014; Adrian, Moench, Shin, 2019; and He, Kelly, Manela, 2017) or relied on direct participation to test for the importance of intermediaries in asset pricing (Baron and Muir, 2018; Haddad and Muir, 2018). In contrast, I show that even intermediaries that do not trade a given set of assets still face constraints that matter for those assets' prices. The key detail is that these are the intermediaries that fund traders.[6]

Baron and Muir (2018) similarly find that commercial banks' asset growth forecasts stock returns even when commercial banks do not have high levels of participation in stock markets using a long time series of returns and bank balance sheets across three countries. They also find that commercial banks' asset growth retains its predictive power even when controlling for growth in margin loans; however, it is important to note that this set of commercial banks includes those with greater levels of direct participation in stock markets. Additionally, Baron and Muir (2018) use lower frequency data in order to cover a much longer time period and a larger set of countries than in this paper. In contrast, many of the key results presented in this paper are for forecast horizons of less than a year. Additionally, I study specific constraints on banks' loan growth and how these relate to asset prices. For these reasons, I consider our findings distinct and complementary.

The importance of margin trading for asset prices has been studied in several theoretical papers (Brunnermeier and Pedersen, 2009; Gârleanu and Pedersen, 2011; Geanakoplos, 2010). Indeed, the role of margin constraints also motivates empirical intermediary asset pricing studies (Adrian, Etula, Muir, 2014). However, this literature typically abstracts from any constraint on those agents providing the margin loans. An important exception is Piazzesi and Schneider (2018), who build a model where banks' liquidity management

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[6]This distinguishes the NYCH banks from the modern intermediaries that do not participate in certain asset markets other studies use as a placebo test. Typically, the balance sheets of these intermediaries do not price any asset class or forecast these assets' future returns, but loans to investors are not a core business for the placebo test banks.

affects asset prices through margin traders' funding costs.[7] My results confirm that these constraints have important asset pricing effects. He, Kelly, Manela (2017) provide a related argument for why the balance sheet of bank holding companies may be more important than that of the broker-dealer subsidiary in explaining their results.[8] However, these hypotheses are difficult to test in a modern context. The historical setting of this paper, where the marginal investors were not part of large financial conglomerates, offers a cleaner test of the argument that the balance sheet health of those providing funding affects risk pricing.

Finally, a large literature has used institutional features of the National Banking Era in the U.S. to study a broad range of questions such as how interbank networks transmit shocks across the banking system (Anderson, Paddrik, Wang, 2019; Calomiris and Carlson, 2017) and the effects of liquidity regulations (Gorton and Muir, 2016). In this paper, I exploit the limited participation of the national banks in financial markets to test theories of intermediary asset pricing. Because I link bank balance sheets with asset prices, my paper closely resembles Chabot (2011) and Hanes and Rhode (2013). In contrast to these papers, I focus on return predictability and explicitly provide evidence for why NYCH bank balance sheet health forecasts risk premia.

I organize the rest of the paper as follows. Section 2 provides further background on the NYCH banks, their role in money markets, and the national bank system. Section 3 reviews the leading theories linking financial intermediaries to asset prices and motivates the specific balance sheet variables used in this paper. Section 4 describes the empirical strategy and the data before presenting the main results regarding predictability and the evidence in favor of constraints on NYCH bank loan supply as the mechanism creating predictability. Section 5 traces the implications of the results for intermediary asset pricing models. Section 6 reviews the results, policy implications, and directions for future research .

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[7]The financial frictions present in Piazzesi and Schneider (2018) have been studied in related contexts by Bianchi and Bigio (2018), Bigio and Sannikov (2019), d'Avernas, Vandeweyer, and Pariès (2019), and Drechsler, Savov, Schnabl (2018).

[8]They argue that losses originating in a different arm of the holding company–if they are "severe enough to impair internal capital flow" will end up "reducing risk bearing capacity in the broker-dealer arm" even if "the dealer's balance sheet does not reflect ill health" (He, Kelly, Manela; 2017).

2 19th-Century Commercial Banks, the National Banking System, The Call Money Market

It is useful to review the features of the 19th-century U.S. commercial banking system and the relation of these banks to asset markets in order to understand the choices made in the empirical analysis. I begin by reviewing bank-level balance sheet decisions before discussing broader institutional features of the national banking system in the U.S.[9]

The balance sheet of a typical national bank would stand out particularly for its lack of diversification on the asset side. Banks tilted their asset portfolios heavily towards loans and discounts, and most loans were short-term commercial loans. Partially, this reflected regulations imposed by the National Bank Acts (NBA) of 1863 and 1864, as will be discussed below. But, to a large extent, this simply followed from the prevailing wisdom at the time. For instance, a prominent scholar noted in 1908 that "selling stocks and bonds, underwriting the purchase and sale of corporate issues...are not banking" (Cleveland, 1908). Indeed, even as bankers gradually recognized the benefit of holding a "secondary reserve" of bonds towards the end of the 19th century, bonds never topped 10 percent as a share of national bank assets prior to 1913. Similarly, foreign exchange trading was primarily done by private banks in New York City until around 1900, when national banks across the U.S. began creating foreign departments to trade foreign exchange (Myers, 1931). Equities were generally viewed as too risky an investment and were illegal to own directly in the case of the national banks. Furthermore, the NBA also outlawed real estate loans, though national banks in rural areas did not always abide by this restriction.

On the liabilities side, national banks had two key sources of funding, though one source grew dominant over the time period. First, national banks funded themselves through the issue of bank notes.[10] The second and more important source of funding was demand

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[9]This section draws heavily on James (1978). Other excellent sources for understanding the relationship between banks, the money markets, and stock exchanges are Myers (1931) and Griffiss (1925). Hanson et al. (2015) also offer a detailed description of 19th-century commercial bank activity in the U.S.

[10]Indeed, one of the supposed motivations for the creation of the national banking system was to establish

deposits, which grew from five percent of GDP in 1864 to nearly 25 percent by 1912 (Jaremski and Rousseau, 2018). Deposits could either come from individuals or from other banks. For the NYCH Banks, the latter category was especially important.

The practice of banks depositing funds in other banks emerged prior to the national bank system, but the NBA effectively institutionalized this system. Initially, rural banks found it convenient to hold deposits in banks in commercial and financial centers to help settle balances incurred as a result of international and inter-regional trade, creating a widespread correspondent banking network (Moen and Tallman, 2003). New York City, as the largest commercial and financial hub, attracted a large amount of these bankers' deposits. The NBA, through their reserve requirements, cemented the necessity of a correspondent banking network and created a pyramid structure of national bank reserve holdings. Rural and small town banks (classified as country banks by the NBA) had to hold 15 percent of their deposits as reserves, but three-fifths of these reserves could be deposits in reserve city or central reserve city national banks. Reserve city banks (national banks in cities with populations greater than 50,000) had to hold reserves equal to 25 percent of deposits, but half could be held as deposits in central reserve city banks. Finally, national banks in the central reserve cities of New York, Chicago, and St. Louis had to hold 25 percent of their deposits as reserves in the form of gold or legal tender. As a result, a large portion of national bank reserves ended up as deposits in New York City national banks.

Given that banker deposits were especially prone to withdrawals on short notice, the NYCH banks needed a particularly liquid and safe set of investments.[11] The best option available was margin loans made to brokers and other stock and bond traders that could be called at any time (hence the name "call loans"). Since call loans were made on stock or bond collateral, they were viewed as relatively safe–and in normal times they were (Moen

a uniform national currency.

[11]This was especially true because interbank borrowing by central reserve city was generally small. According to James (1978): "Such borrowing would have been inconsistent with their position as banks of deposit for other banks." Even in times of financial strain, banks in central reserve city banks still tended to be net lenders of interbank funds (James, 1978).

and Tallman, 2003). As a result, call loans were the single largest category of loans held by the NYCH banks: for the majority of the National Banking Era, call loans averaged around half of NYCH banks' loans (James, 1978). In turn, the NYCH banks were the dominant source of funds in the call loan market before 1900 (Moen and Tallman, 2003).[12] Finally, call loans were the main source of liquidity for the stock exchanges in New York City, as margin loans available with fixed maturities proved to be far less popular.

The absence of a central bank in the United States affected the New York money market in two important ways. First, both money demand and the money supply varied seasonally with the movement of crop exports. Demand for money peaked in the autumn as banks in the interior of the U.S. withdrew money from NYCH banks, producing a strain on New York money markets especially because there was no central bank to meet this increased demand for currency (Goodhart, 1969). Second, without a central bank to rediscount money market instruments (as the Bank of England did, for example), the liquidity of call loans, time loans, and commercial paper (the three main money market instruments) was far less than their foreign equivalents (Coleman, 2012). As a result of these two facts, short-term interest rates in the U.S. were generally higher than in many major European countries, and these interest rate differentials varied with liquidity conditions in the U.S.

3 Intermediary Constraints–Past and Present

Studies modeling the importance of intermediary balance sheets for determining asset prices have typically relied on one of two types of financial frictions: net worth constraints from agency frictions or debt constraints resulting from binding margin requirements or Value-at-Risk (VaR) constraints. Importantly, both sets of frictions affect the leverage or equity ratio (one is the inverse of the other) of the intermediary, so empirical studies testing these theories have examined the relationship between leverage (or inversely the equity ratio) and

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[12]The emergence of a set of private investment banks in New York City known as "trust companies" with a level of resources similar to the NYCH banks in the late 1890s weakened NYCH bank control of the call loan market.

asset prices. I depart from previous studies and do not focus on the relationship between leverage and asset returns, for reasons outlined below.

First, all previous studies–regardless of the type of intermediary constraint–assume that the intermediaries directly trade the assets, making them the marginal investor in all asset markets. As discussed in the previous section, this was not true for the NYCH banks: they could not purchase or sell equity shares and their footprint in corporate bond markets was minuscule. Since they were not asset traders, this immediately rules out margin requirements as the binding constraints. Net worth and VaR constraints limit banks' asset growth more generally, so this fact does not make them less relevant for the NYCH banks.

Instead, other institutional characteristics of the national banking era limit the importance of the typical equity and debt constraints emphasized in the literature. First, as noted by He, Kelly, Manela (2017), equity constraint models may better describe modern commercial banks that have access to stable deposit funding and can thus choose any level of debt financing. What makes deposits stable for these modern banks? The obvious answer is deposit insurance provisions. In contrast, deposits in national banks were uninsured, and bank runs were a fairly common feature of the national banking era. Turning to debt constraints, previous work has appealed to risk-based leverage constraints imposed by regulation or emerging endogenously. The NBA did not directly regulate leverage: capital requirements set an absolute amount of paid-in capital that depended only on the population of the town or city where the national bank was organized. Further, the notion of Value-at-Risk did not exist during the national banking era; it was an innovation in the latter half of the 20th century.

Outside of conceptual issues, I choose not to focus on leverage and asset returns for one other practical reason: data constraints. Market values for bank equity are nearly impossible to obtain for NYCH banks, as their stocks were rarely, if ever, traded on the stock exchanges during the national banking era (Gorton and Tallman, 2016). There may also be mismeasurement of book equity values if, as one example, losses are not immediately

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recognized and written down during banking panics.[13]

Rather than equity or risk-based debt constraints limiting NYCH banks' loan growth, reserve constraints likely stopped NYCH banks from issuing more loans. Because their deposits were subject to withdrawal shocks, the NYCH banks kept a fraction of their assets in cash reserves as insurance against these shocks. As noted previously, legal reserve requirements set the minimum level of reserves that needed to be held in proportion to deposits, but the principle of keeping a reserve of liquid assets applied more generally. The relevance of the reserve constraint can be seen in the content of a leading banking textbook at the time: "the necessity of maintaining a certain minimum reserve fixes a limit to the ability of the bank to increase its securities [loans and bonds]...If, then, the reserve were already as low prudence would allow, or were threatened by approaching heavy demands from depositors, no increase of securities could be made without serious risk" (Dunbar, 1891).

I therefore focus on NYCH banks' liquidty as the relevant balance sheet item. I rely on two measures of NYCH banks' liquidity: year-over-year growth in cash reserves or year-over-year growth in the loan-to-deposit (LtD) ratio.[14] I use year-over-year changes to deal with the seasonality of NYCH bank balance sheets. The NYCH banks published their balance sheets weekly, as was required for clearinghouse membership.[15] The weekly reports showed values for the major balance sheet items averaged across the week (to help prevent banks from "window-dressing" their balance sheets at the end of the week). I collect the aggregate balance sheet information at the end of each month between 1867 and 1909 using the *Statistics for the United States, 1867-1909* published by the National Monetary Commission. For the years 1910-1913, the balance sheets are collected from the *Commercial and Financial Chronicle.*

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[13]Baron and Muir (2018) raise this issue for their historical sample more generally–not just for U.S. commercial banks.

[14]Contemporary accounts suggest that these were important harbingers of credit growth. I provide quotes from leading investment guides from the national banking era related to NYCH bank balance sheets in the Appendix.

[15]The only exception was during banking panics, after the NYCH banks had suspended convertibility of their liabilities into cash. Then, only the balance sheet aggregated across all NYCH banks was published.

I now provide evidence that NYCH bank liquidity conditions affected future loan growth at the monthly frequency.[16] First, as can be seen in Figure 1, peaks in reserve growth and troughs in LtD ratio growth tend to occur just prior to peaks in NYCH bank loan growth. Conversely, in the month before NYCH loan growth reached a trough, reserve growth also reached a trough and LtD ratio growth peaked. Formally, Granger causality tests, for which the p-values are reported in Table 1, confirm these visual patterns. Depending on the selection criteria, the appropriate number of lags included in the vector autoregression is either two or 12 months. I report the p-values for both specifications. These p-values show that we can overwhelmingly reject the null hypothesis that cash reserve changes or LtD ratio changes provide no information about future values of loan growth regardless of the number of lags included.[17] Year-over-year growth in the LtD Ratio and cash reserves also provide information about the future cost of borrowing; both variables individually Granger cause both call loan rates and year-over-year changes in the call loan rate, with p-values reported in Table A2 of the Appendix.

4 NYCH Balance Sheets & Return Predictability

I first test whether NYCH bank balance sheets are relevant for asset prices by seeing whether some component of NYCH balance sheets forecasts excess returns across different asset classes.[18] Specifically, I see if NYCH balance sheet conditions predict quarterly excess returns

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[16]Banks outside of New York City could also invest directly in call loans. This could present a problem for the argument that NYCH loan growth mirrors growth in the volume of call loans. Suppose a country bank switches from holding its excess reserves as deposits in NYCH banks to directly investing them in call loans. Such a switch would reduce NYCH reserves and therefore their loans, but the volume of call loans would be relatively unaffected. However, the volume of call loans generally tracked the amount of bankers deposits in NYCH banks, suggesting reductions in NYCH call loans due to reserve losses were not offset by increases in call loans from out-of-town banks (James, 1978).

[17]Additionally, the unreported p-values for Granger causality tests in the other direction (from loan changes to either cash reserve changes or LtD ratio changes) are either insignificant in the case of cash reserves or larger for LtD ratio changes.

[18]Previous papers studying intermediary asset pricing through the lens of return predictability are Adrian, Etula, Shin (2015); Adrian, Moench, Shin (2019); Baron and Muir (2018); Correa and Demarco (2019); and Haddad and Muir (2018). Although they focus primarily on cross-sectional tests, He, Kelly, and Manela (2017) also show that their intermediary equity forecasts returns.

for stocks, high-grade corporate bonds, and currencies, while controlling for a host of other traditional predictors used in the finance literature. In line with the existing intermediary asset pricing literature, I focus on relatively near-term return predictability, since this is the period over which binding intermediary constraints are likely to matter for asset prices. I therefore run the following predictive regressions for the three asset classes mentioned above:

$$R_{t+h} = \alpha + \beta \Delta Bank_t + \gamma' z_t + \varepsilon_{t+h} \tag{1}$$

where R_{t+h} is the cumulative excess return from quarter t to quarter $t + h$ for $h \in [1, 12]$ expressed at an annualized rate. Stock returns are calculated using quarter-end values of the Cowles Commission common stock price index, which was the precursor to the S&P stock price index in the U.S. Bond returns use quarter-end values of the index of high-grade railroad bond prices based on the bonds used in Macaulay (1938). The risk-free rate used to calculate excess returns for stocks and bonds is the open market discount rate in London.[19] The currency excess return index was hand-collected for this study and is the excess return on a short-term dollar investment relative to an equally-weighted portfolio of the four currencies that could be traded in the New York City markets: the British pound, the French franc, the German mark, and the Dutch guilder.[20] Further details on the construction of this index and all other variables can be found in the Appendix.[21]

The main predictor of interest is $\Delta Bank_t$, which measures the year-over-year change in either NYCH banks' end-of-quarter cash reserves or end-of-quarter LtD ratio. The control variables, z_t, are other common return predictors studied in the literature for which data

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[19]There were no short-term U.S. government debt instruments at the time, and U.S. money market rates were not necessarily risk-free. Baron and Muir (2018) make a similar argument for using real returns instead of excess returns. Figure A1 in the Appendix reports similar results using real stock and bond returns as the outcome variables in the predictive regressions. Alternatively, one could use the risk-free rate for the U.S. estimated by Goyal and Welch (2008) to compute excess returns, but again the results are similar to those reported in the main text.

[20]Foreign exchange markets were relatively undeveloped in the U.S. at this time. Most foreign exchange trading was done in London with conversions of foreign currencies to British pounds.

[21]Currency returns are constructed in this paper in the opposite direction relative to most existing studies (e.g. He, Kelly, Manela, 2017 or Baron and Muir, 2018). I focus on the excess return of a dollar investment because it makes the role of liquidity risk in the New York money market more apparent in the results.

are available during the national banking era. The first predictor is the one-quarter excess return at time t, meant to capture the momentum factor in asset markets. The second predictor is year-over-year growth in real GNP to control for how broader macroeconomic developments affect risk premia. The last two predictors are common measures of the value of stocks relative to their cash flows, and likely reveal information about investors' discount rates: the dividend yield and the earnings-price ratio.[22] See Table A1 in the Appendix for data sources.

Figure 2 shows the effects of a standard deviation increase in either NYCH banks' LtD ratio growth or cash reserve growth on cumulative excess returns for stocks, bonds, or currencies, based on estimates of (1). Across all asset classes, NYCH bank balance sheets are a statistically significant predictor of excess returns for several quarters. The effects are strongest at relatively short horizons: peak effects occur between one and two quarters ahead, with estimates becoming noisier as the forecast horizon increases. Furthermore, effects are in the expected direction for each asset class. For stocks and bonds, higher growth in the LtD ratio forecasts lower cumulative excess returns for all three asset classes, while higher growth in cash reserves forecasts higher excess returns. Both suggest that, when NYCH banks can (and do) extend more loans to speculators in the future, this pushes up stock and bond prices.

For currencies, the signs on the NYCH bank balance sheet variables are opposite of what they are for stocks and bonds but still consistent with liquidity conditions being priced into assets. Recall that currency excess returns were calculated as the excess return of a short-term dollar instrument relative to a short-term foreign currency rate, net of dollar depreciation. Consider the example of an increase in LtD ratio growth. This is associated with strained funding liquidity and an increase in money market rates. The positive coefficient on LtD ratio growth at time t suggests that the increase in the short-term dollar-foreign

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[22]Another important predictor that is unavailable for a significant portion of the National Banking Era is the volatility of the stock market. Data for this measure begin in 1885. The general conclusions hold when including lagged stock market volatility as an additional regressor.

currency interest rate differential at time t is not simply compensation for an increase in the expected dollar depreciation over the forecast horizon. Instead it likely reflects the pricing of additional liquidity risk in the New York money market and the absence of this liquidity risk in foreign money markets. I review an alternative explanation based on unrealized dollar depreciation and the evidence against this explanation in the Appendix.

I see how much additional information the NYCH balance sheet variables provide for forecasting by comparing the adjusted R^2 from regressions including just the control predictors to the adjusted R^2 from regressions with the control predictors and the balance sheet variables. For stocks, the greatest increase in adjusted R^2 comes at a forecasting horizon of five quarters. The LtD ratio growth and cash reserve growth contribute an additional 4.5 percent and five percent to the adjusted R^2 relative to the baseline with just the control predictors, respectively. This effect is similar to the effects found in Baron and Muir (2018), who find that banks' asset growth adds five percent to adjusted R^2 for cumulative stock real returns at a forecast horizon of two years. For currencies, the peak increase in adjusted R^2 with the inclusion of NYCH bank cash reserve growth is even larger at six percent for a forecast horizon of two quarters. For bonds, the peak increase in adjusted R^2 is smaller at only three percent with the inclusion of NYCH bank LtD ratio growth (at a two-quarter horizon), but this is still a sizable effect.

Finally, the economic significance of the balance sheet variables is also large. For the stock market, a standard deviation increase NYCH banks' cash reserve growth today predicts cumulative excess returns that are 5.2 percentage points higher two quarters ahead. This is over 1.5 times the mean cumulative excess return for stocks at this forecast horizon. Likewise, for high-grade railroad bonds, a standard deviation decrease in the change in NYCH banks' LtD ratio today predicts an excess return that is 1.8 percentage points higher the next quarter. Again, considering that the mean excess return for bonds is -1.6 percent, this is a substantial excess return. Lastly, for currencies, a standard deviation increase in LtD growth today forecasts cumulative excess returns that are higher by 47 basis points two quarters in

the future. For context, the standard deviation for cumulative currency excess returns at this horizon is 1.42 percent. Across all asset classes, NYCH bank balance sheet conditions forecast substantial excess returns. Further, the estimated effects are relatively stable across time, as shown in Figure A3 of the Appendix, which plots estimated coefficients for stock and bond excess returns using rolling sample windows.

Mechanism Evidence

So far, I have presented results showing that changes in NYCH banks' LtD ratio growth or changes in the growth in their cash reserves simply predict excess returns. I now discuss evidence for why this predictability occurs.

First, I demonstrate that NYCH balance sheet variables do not help predict future cash flows, so their predictive power for asset returns must be coming through discount rate changes. I regress annual dividend growth on lagged changes in the end-of-year loan-deposit ratio for NYCH banks or their end-of-year cash reserves as well as lagged values of annual real GNP growth, the dividend yield, and the earnings price ratio.[23] The results in Table 2 show that NYCH balance sheets contain no marginal information useful for forecasting dividends. The results hold when including lagged values of dividend growth in the regression, as seen in Columns (2) and (4). Further evidence against the cash flow story is the predictability for high-grade bond returns at short horizons. The railroad bonds that compose this index were never in default while they were included in the index, nor were they ever really in danger of defaulting. Therefore, NYCH bank balance sheets provide no information about cash flows for high grade bonds. Since NYCH balance sheets forecast bond excess returns, they must be affecting investor discount rates.

I also show that it is changes in the balance sheets of the NYCH banks specifically that matter for asset prices. I do this by testing whether changes in the cash reserves of country national banks also predict excess returns. Generally, because of the structure of the

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[23]I use annual values because the original dividend data is at an annual frequency.

national banking system, country bank behavior affected the balance sheets of the NYCH banks. However, because country banks could hold reserves either in the form of cash *or* deposits at reserve city banks, changes in country bank cash reserves are not mechanically linked to changes in NYCH reserves. Indeed, changes in cash holdings of country banks are only weakly correlated with the changes in cash reserves for the NYCH banks. Additionally, in a quarterly vector autoregression, lagged values of country banks' cash reserve growth are negatively correlated with their loan growth, and, in a vector autoregression with one lag, country bank cash growth Granger causes loan growth.[24]

Country bank cash reserve growth is not a useful predictor for asset prices, as seen in Table 3. For both stocks and bonds, and over the same horizons that NYCH bank reserve growth predict excess returns, cash reserve growth for country banks is not related to excess returns in a statistically significant way. Further, given that country banks' cash reserve growth is a predictor of their loan growth, this suggests that country bank loan growth does not affect asset prices. This undermines the argument that growth in bank credit conditions more generally are what matter for asset prices. Instead, it is the NYCH banks that are important for asset returns.

I now turn to providing evidence for a specific channel through which NYCH bank balance sheets affect asset returns: the supply of call loans, which affects the risk-bearing capacity of speculators. First, I show that, for stocks and bonds, it is only when the NYCH banks are near the minimum reserve requirement that changes in the LtD ratio and cash reserves forecast excess returns.[25] This is important because this is when reserves are scarce and NYCH banks' margin lending is constrained. Therefore, changes in reserve or LtD ratio growth in these times should either lead to the tightening or relaxation of margin traders'

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[24]The null hypothesis of no Granger causality is rejected at the five percent level of statistical significance.
[25]I focus only on stock and bond excess returns because the quarters when there were no foreign exchange quotes for at least one of the currencies are typically the quarters with low reserves. Exchange quotes were most frequently available for the British pound, and Figure A2 in the Appendix shows that NYCH bank balance sheets primarily forecast excess returns for the British pound when the NYCH banks are near the minimum reserve.

borrowing constraints in future periods.[26] Figure 3 shows the additional excess returns one to four quarters ahead predicted by a standard deviation increase in cash reserve growth for stocks and LtD ratio growth for bonds when the NYCH bank reserve-deposit ratio is below or above its median value (approximately 27 percent) at time t. Note that, for both asset classes, the predicted effects are generally statistically significant only for the below-median reserve-deposit ratio sample. The unique predictive power in low-reserve states also holds for stocks and bonds when I reduce the bound for the low-reserve state, as shown in the Appendix in Table A3.

While it is important that the results only hold when the NYCH banks are near the reserve requirement, this does not necessarily mean constraints on the supply of margin loans are what determine risk premia in these low-reserve states. In general, the findings so far could be consistent with broader consumption-based asset pricing models. Balance sheet changes could be correlated with future consumption growth, and low-reserve states could be correlated with times when broad risk aversion is high for reasons unrelated to NYCH banks' ability to supply loans.[27] The latter would therefore make the effects of a given change in future consumption growth on risk premia stronger, accounting for the finding of the previous paragraph.

Informally, the time series of the NYCH bank balance sheet variables suggest that correlation with consumption growth does not drive the predictability results. Figure 4 shows NYCH banks' year-over-year change in quarterly cash reserves and LtD ratio with solid vertical lines denoting business cycle peaks, and dashed vertical lines denoting troughs.[28] While business cycle peaks often coincide with periods of high LtD ratio changes and contractions in cash reserves, these are not the only times when reserves contract and the LtD ratio grows larger. Likewise, business cycle troughs often align with peaks in cash growth and troughs

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[26]Similarly, Myers (1931) notes "[c]all rates rose as reserves fell but when the reserve ratio approached closely to the legal minimum, the rise in call rates [was] greatly accelerated."

[27]One potential reason for high risk aversion is a low level of current consumption relative to past values. This is an important mechanism in external habit models (Campbell and Cochrane, 1999).

[28]The dates are the NBER dates for peaks and troughs prior to 1884 and the dates provided by Romer (1994) afterwards.

in the LtD ratio, but these are not only times when these balance sheet peaks and troughs occur. Similarly, Figure 5 shows that periods with low reserves do not always occur during recessions, either, making it less likely that low-reserve states are simply proxying for periods when consumption is relatively low.

Formally, I show that the predictability using NYCH bank balance sheets holds even after controlling for *future* output growth or the phase of the business cycle. Importantly, the predictability results again only hold when the NYCH banks are near the minimum reserve and their loan supply is likely constrained. Specifically,including GNP growth over the forecast horizon in the predictive regressions does not dampen the statistical or economic significance of the coefficient on the balance sheet variables, as shown in Table 4. As suggested above, this result specifically holds for the short-horizon forecasts only when reserves are low, so the results reported in Table 4 use only this constrained sample. The peak effects are similar in magnitude to those reported above for the full sample without controlling for future GNP growth: at two quarters, a standard deviation increase in reserve growth (computed for the below-median reserve-deposit ratio sample) predicts cumulative excess returns that are 6.8 percentage points higher for stocks and 47 basis points lower for dollars, respectively. Likewise, at one quarter, a standard deviation increase in the LtD ratio's growth rate forecasts excess returns that are 2.7 percentage points lower for high-grade railroad bonds. I report similar results using an indicator variable for whether quarter t contains a business cycle peak or trough instead of GNP growth over the forecast horizon in Table A4 of the Appendix.[29]

Several caveats need to be applied in interpreting these results as evidence against NYCH bank balance sheets merely indicating future consumption growth. First, I have used GNP growth rather than aggregate consumption growth due to data availability, although these two variables are likely correlated. Further, it is not aggregate consumption growth

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[29]NYCH bank balance sheets still forecast excess returns in low-reserve states when using other measures of real activity over the forecast horizon. Controlling for growth in either business failures, real railroad earnings, or pig iron production over the forecast horizon does not diminish the forecasting power of the NYCH bank balance sheet variables.

that is important, but the consumption of the marginal investor, who is likely to be a wealthy Wall Street trader. Again, it is difficult to know how different their consumption growth would be relative to the aggregate and how it correlated with GNP growth. That said, with asset prices as a leading indicator for the business cycle, it is hard to imagine that their wealth and consumption growth would differ too strongly from GNP growth. Another caveat that is harder to dismiss is that these regressions use actual changes rather than expected changes in future growth. It might be the case that investors expected large drops in consumption that did not materialize when NYCH bank balance sheets changed. At the same time, this would imply that investors made systematic errors regarding the relationship between NYCH bank balance sheets and future growth over a 40-year period, without ever updating their beliefs.

I summarize the evidence presented above. First (1), the balance sheet variables do not predict future cash flows, pointing to to their relevance for discount rates. Second (2), cash reserve growth of country national banks–which predicts their future loan growth–does not predict excess returns. Third (3), the forecasting results for NYCH bank cash reserve growth and LtD ratio growth only hold when the banks are near the minimum reserve-deposit ratio. A binding reserve requirement constrains the composition of banks' assets, particularly limiting their loan growth. Fourth (4), balance sheets continue to be significant predictors in low-reserve states of the world even after controlling for *future* real economic activity. All these facts support the argument that NYCH banks affect the risk-bearing capacity of margin traders, and thus asset returns, through their supply of margin loans, which is sometimes constrained by minimum reserve requirements.

5   Theoretical Implications

The findings of this paper present two key departures from the results of conventional inter-mediary asset pricing models (e.g. He and Krishnamurthy, 2013 or Adrian and Boyarchenko,

2012), reviewed below. Given the vast institutional differences between the National Banking Era and today's financial system, I also discuss the empirical relevance of these departures. Finally, I stress that the implications of this paper are not entirely novel; rather, the mechanisms they highlight deserve greater attention in intermediary asset pricing models.[30]

The first aspect that differs from existing models is the role for constraints on intermediaries that do not trade assets to affect risk pricing. Indeed, the stylized model presented by Haddad and Muir (2018) to test intermediary asset pricing theories requires that intermediaries participate in asset markets to matter for prices.[31] Although the NYCH banks did not typically trade either stocks or bonds, note that the predictability results are generally strongest for stock returns, especially when banks approached their reserve requirement, and the NYCH banks could not trade stocks by law. The NYCH banks performed a role similar to the unconstrained financiers in Brunnermeier and Pedersen (2009), whereas the intermediaries highlighted in previous studies (e.g. Adrian and Boyarchenko, 2012) are more closely related to the funding-constrained speculators in their model. Thus, the key implication of my findings are that funding constraints on both intermediaries trading and intermediaries providing funding matter for asset prices.

The second departure from existing intermediary asset pricing models is the type of frictions facing intermediaries. As noted in Section 3, the constraint on NYCH banks appears to be distinct from the frictions studied in most other intermediary asset pricing theories. Specifically, the NYCH banks featured a liquidity mismatch on their balance sheets, so they faced a liquidity management problem. Loans were relatively illiquid, while deposits could be redeemed at any time and were prone to withdrawal shocks. Banks therefore kept some of their assets as cash reserves, with the exact level affected to some degree by law. Banks' liquidity position therefore affected their ability to issue loans, in turn affecting margin

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[30]For example, Gârleanu and Pedersen (2011) note that during the financial crisis of 2007 "banks unable to fund their operations closed down, and the funding problems spread to other investors, such as hedge funds, that relied on bank funding." However, frictions on those that fund investors have generally not been explicitly modeled in intermediary asset pricing theories.

[31]Effectively, in their model there needs to be a cost for households to trade in asset markets that intermediaries do not face.

traders demand for risky assets. The general liquidity management mechanism has recently been studied in models by Bianchi and Bigio (2018), d'Avernas et al. (2019), Drechsler et al. (2018), and Piazzesi and Schneider (2018), with the latter three drawing some conclusions about how liquidity management affects the price of risky assets.[32] Broadly, these papers find that reserves pay a convenience yield when banks face withdrawal shocks; altering the amount of bank reserves in the system changes the convenience yield which then spills over into other asset prices. The results presented here provide evidence that this is a potentially important mechanism whereby intermediary balance sheets affect asset returns.

To see the modern relevance of these findings, consider the dealer banks that are typically studied for intermediary asset pricing. Dealers fund much of their operations through repos, with money market funds or other banks often the counterparty for these repo transactions. These other intermediaries face their own set of funding shocks and regulatory constraints that affect their ability to participate in repo markets. Ideally, one would want to know whether the relationship between dealers' balance sheets and asset prices is due to constraints imposed directly on the dealer (like a VaR constraint) or due to shocks on the funding sources that in turn affect dealers' leverage. The repo market additionally reveals the continued importance of banks' liquidity management as a key friction affecting funding markets. Repo markets experienced a brief stress episode in September 2019, with low reserves at the key lending institutions for repo markets a proposed explanation for the market turmoil (Avalos, Ehlers, Eren; 2019). While the effects for this most recent episode did not spread to other asset markets, one need only look back as far as the Global Financial Crisis (GFC) to see how repo market troubles can affect broader asset prices (Gorton and Metrick, 2012).

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[32]Modeling of the liquidity management problem can be traced back to Bhattacharya and Gale (1987).

6 Concluding Remarks

This paper provides evidence that intermediary frictions still affect asset returns even when these intermediaries are not the marginal investors using the NYCH banks during the National Banking Era as a test case. The key feature is that these intermediaries provided funding to the marginal investors. Measures of the NYCH banks' ability to expand their loan supply forecast excess returns for stocks, bonds, and currencies. As evidence that this relationship is indeed a result of constraints on NYCH banks' balance sheets affecting discount rates, I show that NYCH bank balance sheet conditions do not forecast dividend growth, and generally only forecast excess returns when the NYCH banks were near the reserve requirement. Additionally, the same balance sheet conditions for other commercial banks provide no information for future returns. Finally, the forecasting relationship is unlikely to be due to NYCH bank balance sheets' information content regarding future consumption, as the predictive power remains even after controlling for future GNP growth.

The results of this paper also have implications for modern-day banking regulations, in particular those governing the liquidity of banks' assets. Since the GFC, governments have imposed a host of liquidity regulations on a wide range of financial intermediaries. Relative to other forms of bank regulation, such as capital requirements, liquidity regulations have been understudied (Allen and Gale, 2017; Diamond and Kashyap, 2016). Much like the minimum reserve requirement faced by NYCH banks, banks today must maintain fixed amount of high-quality liquid assets relative to another quantity on their balance sheet (reserve requirements regulate a ratio between reserves and liabilities, while the new regulation fixes liquid assets to total assets.) My results suggest that these types of regulations have consequences for the pricing of risk in the economy. Future work should study whether current liquidity regulations also affect risk premia. Generally, these regulations exist to prevent financial crises; however, it is an open question whether these regulations serve their intended purpose and whether there are any economic costs from these regulations that outweigh the benefits. My findings indicate asset price effects are one of the costs that need to be considered.

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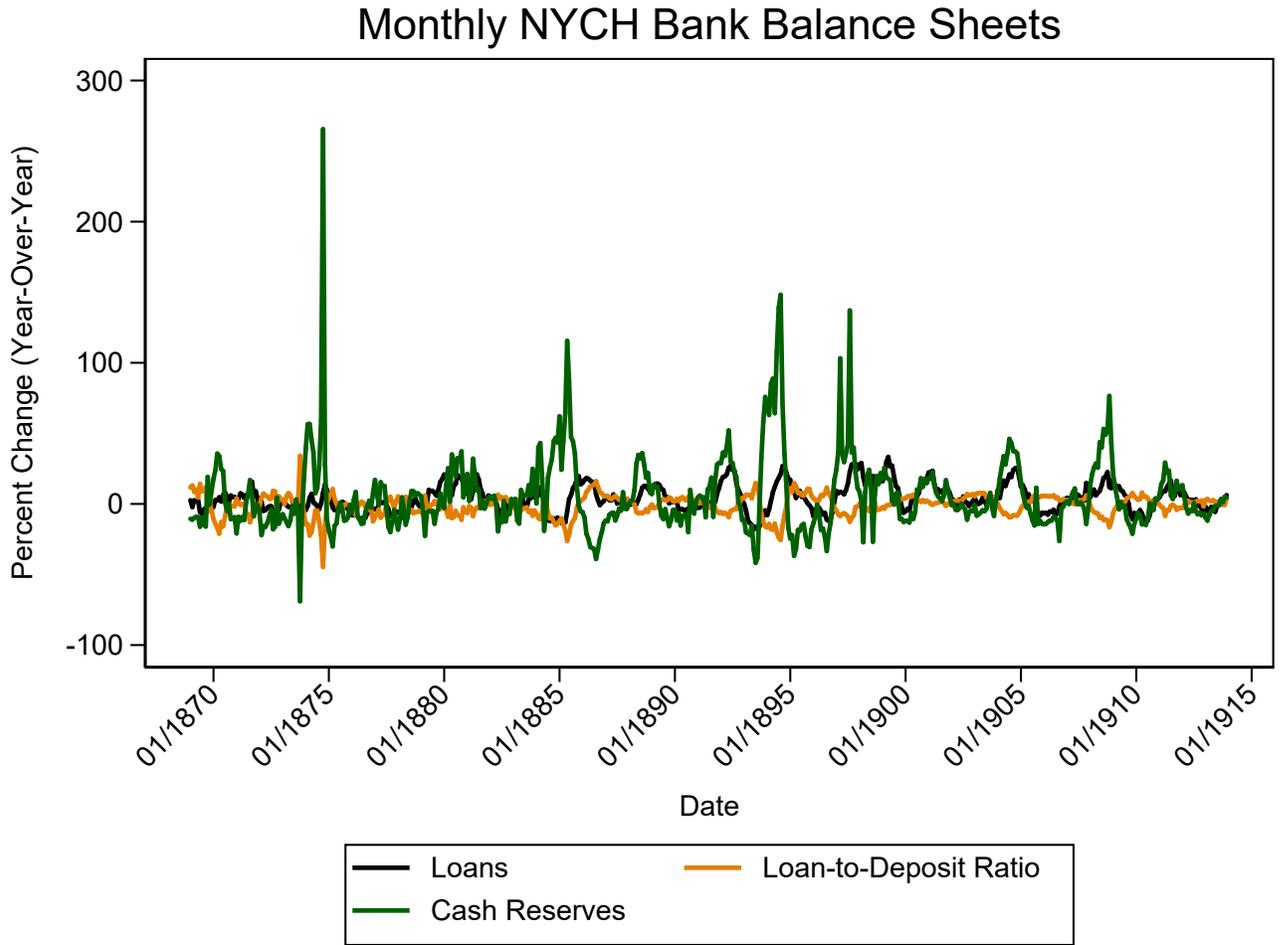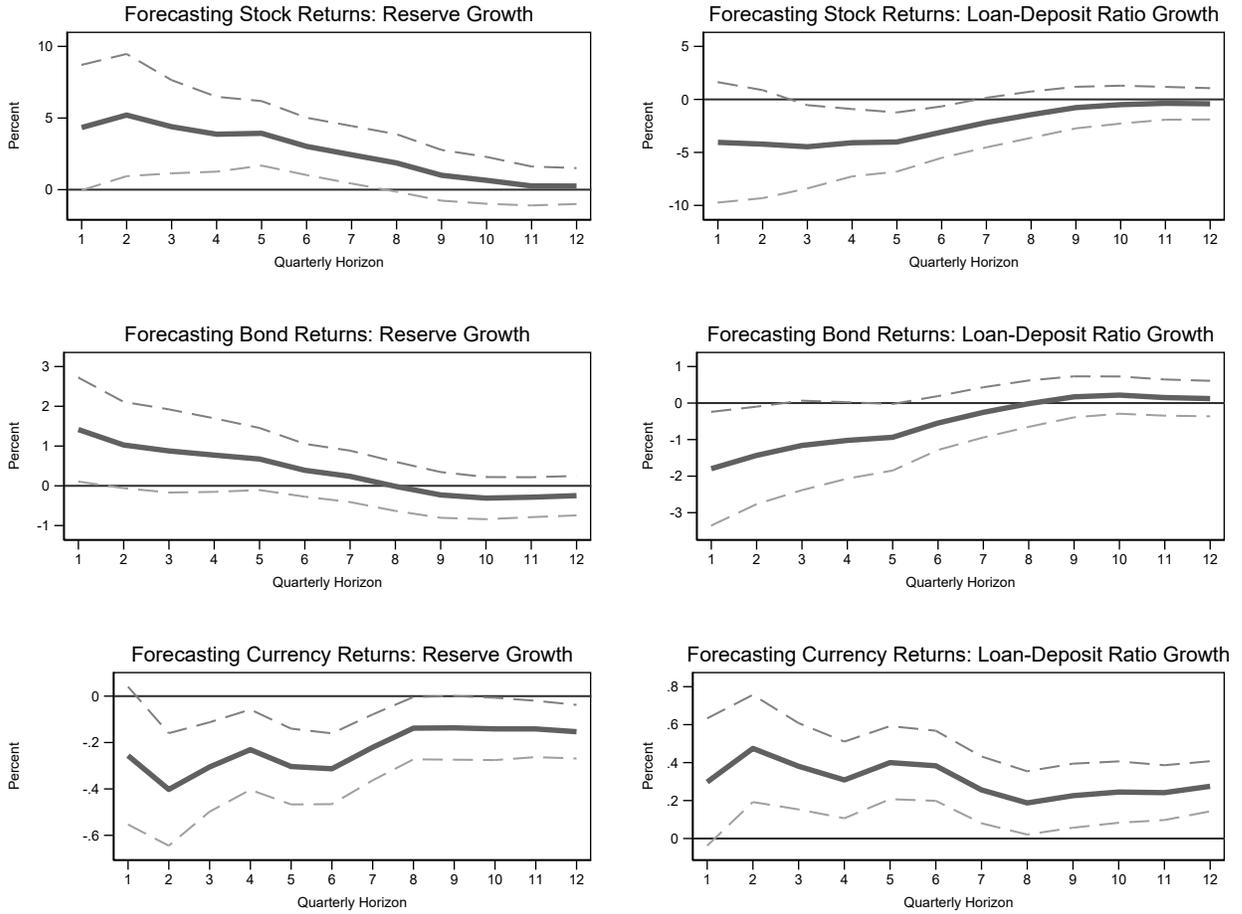
Figure 1:

Monthly NYCH Bank Balance Sheets

Figure plots monthly year-over-year percent changes in NYCH banks' loans, cash reserves, and loan-to-deposit ratio from 1869 to 1913.

Figure 2: Excess Return Forecasts at Quarterly Horizons

Each panel shows the additional cumulative excess return at quarterly horizon $t + h$ for a specific asset class predicted by a standard deviation increase in a given NYCH bank balance sheet variable at time t: year-over-year cash reserve growth or year-over-year loan-to-deposit ratio growth. Estimates are based on equation (1), with controls for year-over-year RGNP growth, one-quarter excess return, dividend yield, and earnings-to-price ratio, all measured at time t. Dashed lines are 90% confidence bands computed using Newey-West standard errors with four lags.

Figure 3: Excess Return Forecasts When Reserve-Deposit Ratio Is Below or Above Median
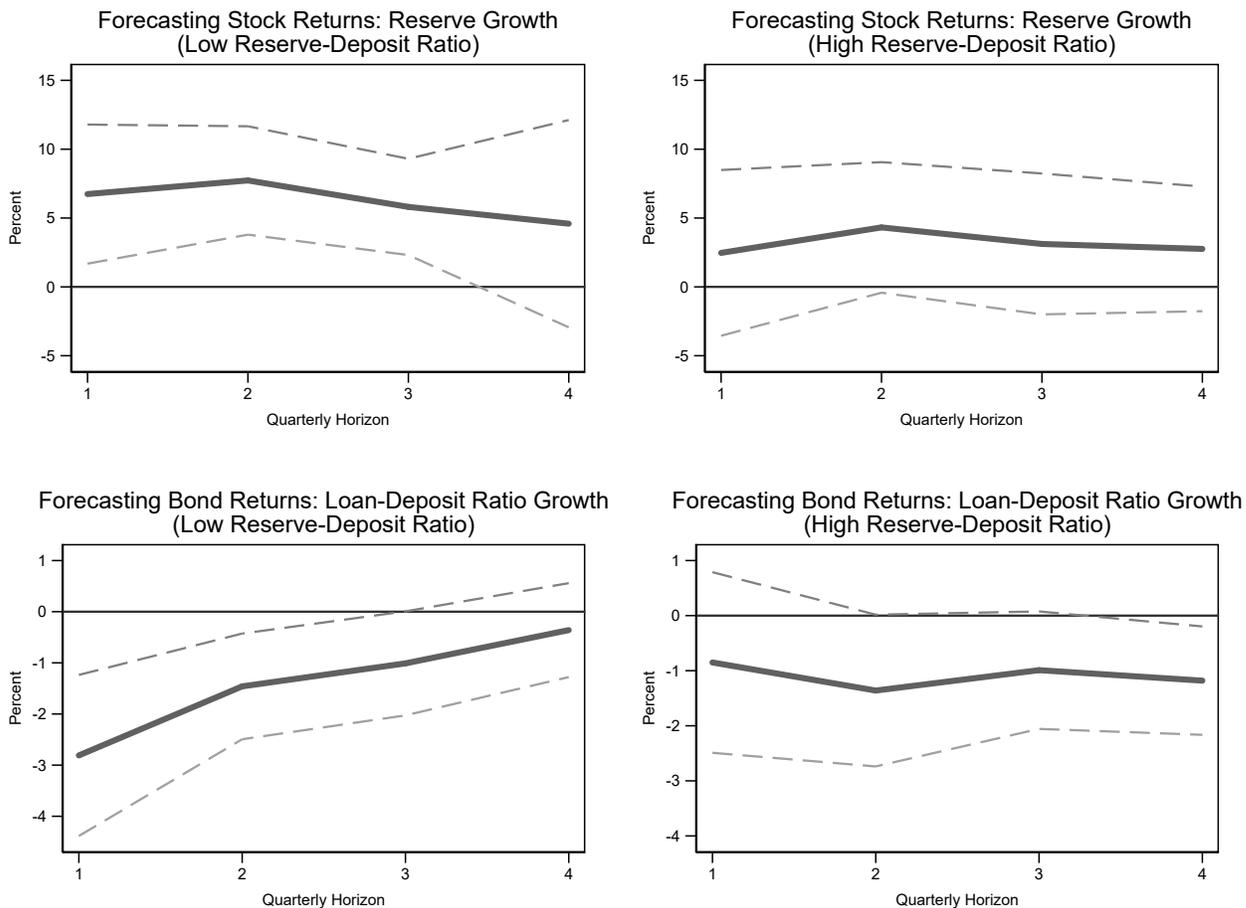
Each panel shows the additional cumulative excess return at quarterly horizon $t + h$ for a specific asset class predicted by a standard deviation increase in a given NYCH bank balance sheet variable at time t: year-over-year cash reserve growth or year-over-year loan-to-deposit ratio growth. Estimates are based on equation (1) across two sample splits: when the NYCH bank reserve-deposit ratio is below its median value for the estimation period at time t and when the reserve-deposit ratio is above its median value at time t. Standard deviations for NYCH bank balance sheet variables are calculated separately for each sample split. Dashed lines are 90% confidence bands computed using Newey-West standard errors with four lags.

Figure 4:

Quarterly NYCH Bank Predictors and Business Cycle Dates
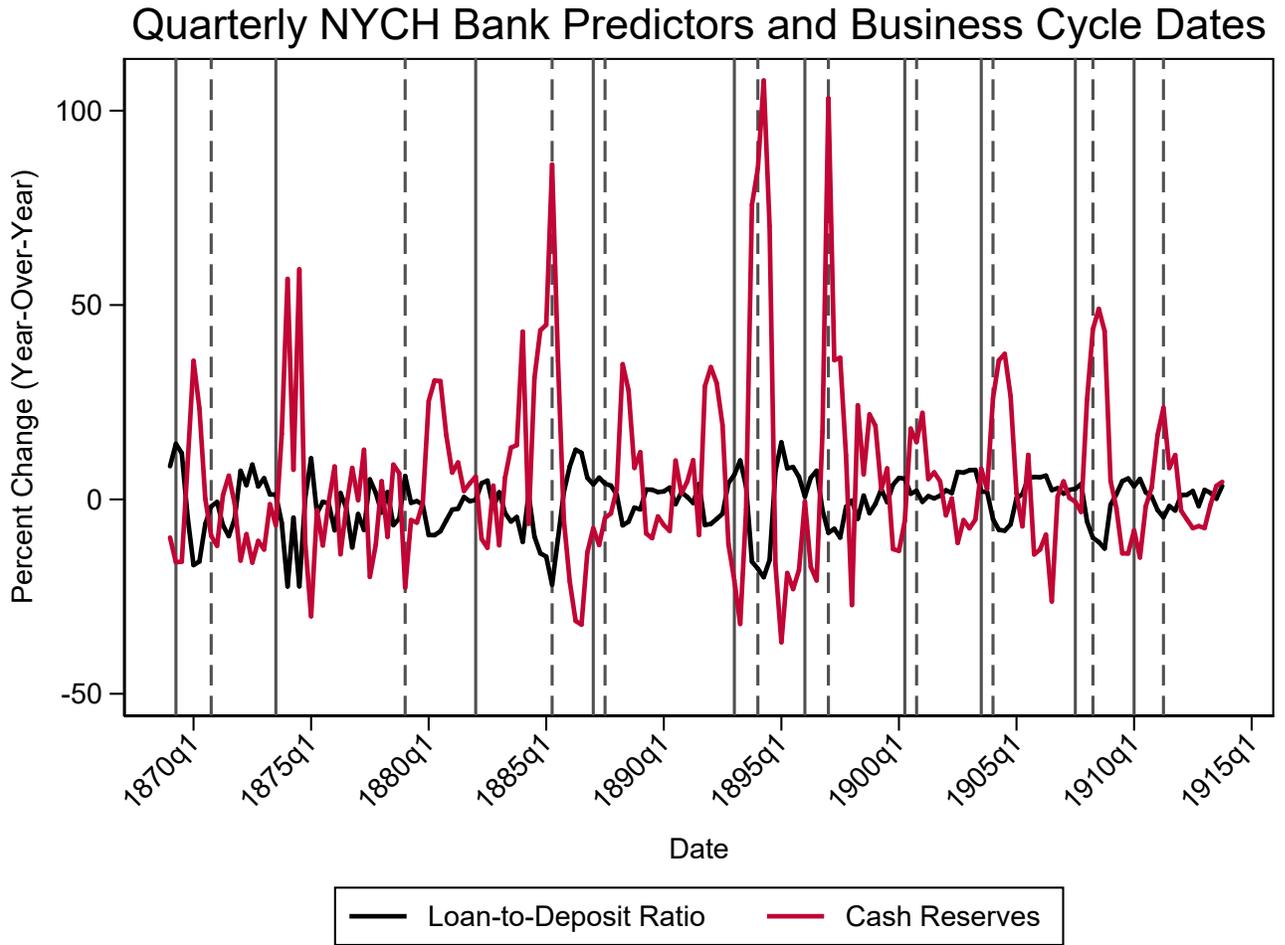
Figure plots quarterly year-over-year percent changes in NYCH banks' cash reserves and loan-to-deposit ratio. Solid vertical lines are quarters with business cycle peaks according to NBER or Romer (1994). Dashed vertical lines are quarters with business cycle troughs according to NBER or Romer (1994).

Figure 5:

NYCH Reserve-Deposit Ratio and Business Cycle Dates

Figure plots end of quarter reserve-deposit ratio for NYCH banks. Horizontal line marks 25th percentile for this ratio. Solid vertical lines are quarters with business cycle peaks according to NBER or Romer (1994). Dashed vertical lines are quarters with business cycle troughs according to NBER or Romer (1994).

Table 1: Granger Causality Test P-Values

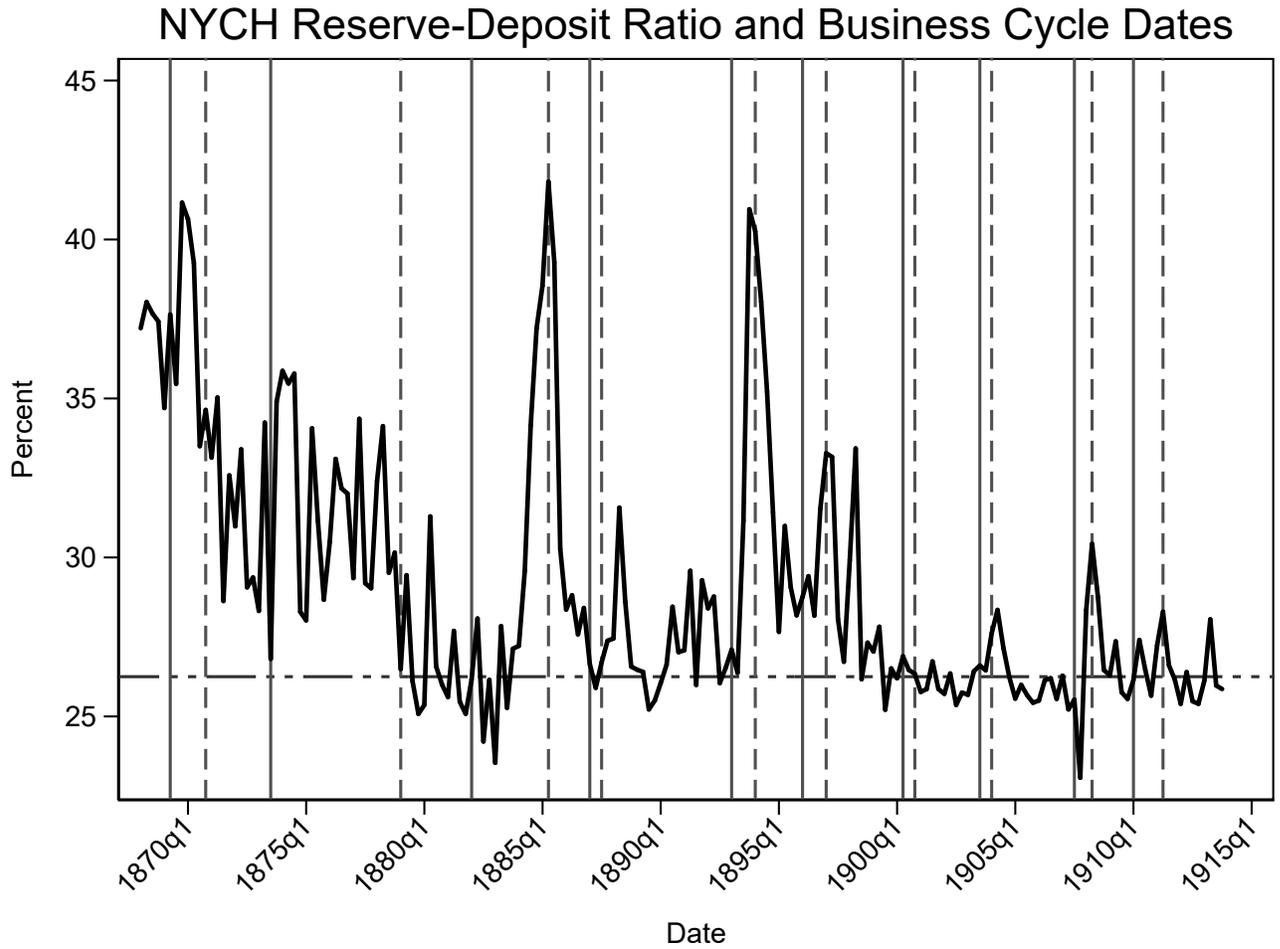|	2 Lags	12 Lags
LtD Ratio	0.000	0.000
Cash Reserves	0.000	0.000

Notes: Reported p-values are for null hypothesis each variable does not Granger cause year-over-year percentage change in NYCH bank loans and discounts. Monthly vector autoregressions (VARs) are run separately with NYCH bank loan growth and either NYCH bank loan-to-deposit ratio year-over-year changes or NYCH bank cash reserve year-over-year percent changes as the second variable in the system. Column "2 lags" is for a VAR with 2 lags; Column "12 lags" is for a VAR with 12 lags.

Table 2: Forecasts of Dividend Growth with Predictor Variables

	(1)	(2)	(3)	(4)
Loan-to-Deposit Ratio	-1.34	-0.23		
	(1.42)	(1.15)		
Cash Reserves			2.27	0.52
			(1.87)	(1.56)
Lagged Dividend Change?	N	Y	N	Y

Notes: This table reports results of regressions of annual dividend growth (in percentage terms) on the lagged value of the end-of-year NYCH bank loan-to-deposit ratio change (Columns (1) and (2)) or end-of-year NYCH bank cash reserve percent change (Columns (3) and (4)), as well as the lagged annual growth rate of real GNP, the lagged dividend yield, and the lagged earnings-price ratio. Columns (2) and (4) also include the lagged percentage change of the dividend as a regressor. Reported coefficients are for a standard deviation increase in the NYCH bank variable. Dividends are for all stocks listed on the New York Stock Exchange. Newey-West standard errors using four lags in parentheses. ***$p<0.01$, **$p< 0.05$, *$p<0.1$.

Table 3: Forecasts Using Country Bank Cash Reserve Growth

	1Q-Ahead	2Q-Ahead	3Q-Ahead	4Q-Ahead	5Q-Ahead	6Q-Ahead
Stocks	0.19	-0.03	-0.50	-0.63	-0.30	-0.34
	(3.15)	(2.67)	(2.49)	(2.23)	(1.99)	(1.82)
Bonds	1.10	0.30	0.31	0.27	0.10	-0.02
	(0.86)	(0.68)	(0.61)	(0.57)	(0.53)	(0.51)

Notes: This table reports coefficients for predictive regressions based on estimating equation (1), replacing the NYCH bank balance sheet variable with the year-over-year percent growth in quarterly country bank cash reserves. All other predictor variables remain the same. Coefficients are reported for a standard deviation increase in country bank cash reserve growth. Newey-West standard errors using four lags in parentheses. ***$p<0.01$, **$p< 0.05$, *$p<0.1$.

Table 4: Return Predictability with Low Reserves and Future GNP Growth

	1Q-Ahead	2Q-Ahead	3Q-Ahead	4Q-Ahead
Stocks (LtD)	−5.43*	−5.49**	−2.98	−2.43
	(3.24)	(2.46)	(2.15)	(1.79)
Stocks (Cash)	5.93**	6.76***	4.69**	3.99***
	(2.95)	(2.17)	(1.87)	(1.55)
Bonds (LtD)	−2.67***	−1.46**	−0.99	−0.35
	(0.96)	(0.64)	(0.63)	(0.57)
Bonds (Cash)	1.66*	0.93	0.70	0.15
	(0.89)	(0.59)	(0.57)	(0.51)
Currency (LtD)	0.34	0.47***	0.38**	0.30**
	(0.22)	(0.18)	(0.16)	(0.13)
Currency (Cash)	−0.39*	−0.47***	−0.32**	−0.23*
	(0.20)	(0.17)	(0.15)	(0.13)

Notes: Table reports coefficients for estimates of equation (1) when the NYCH bank reserve-deposit ratio is below its median value at time t with real GNP growth over the forecast horizon included as an additional regressor. Rows are for different asset class-NYCH balance sheet variable pairs. (LtD) means the NYCH bank balance sheet variable is the year-over-year change in the end-of-quarter loan-to-deposit ratio. (Cash) means the NYCH bank balance sheet variable is the year-over-year percentage growth in end-of-quarter cash reserves. Coefficients show effect of standard deviation increase in NYCH bank balance sheet variable. Standard deviations for balance sheet variables calculated using only dates with a below-median reserve-deposit ratio. Newey-West standard errors using four lags in parentheses. ***p<0.01, **p< 0.05, *p<0.1.

A   Appendix

Bank Balance Sheets and Asset Prices: Contemporary Accounts

Contemporaries of the National Banking Era recognized the importance of credit conditions for asset prices, with the health of the NYCH banks explicitly emphasized by many. One way to observe this is in the content of guides to Wall Street and investing. Both Pratt (1912) and Selden (1917) contain individual chapters dedicated to banks and bank statements, for instance. In both cases, the focus is primarily on the NYCH banks, with each guide claiming that the weekly statement of the NYCH banks is only rivaled by the Bank of England's weekly statement in terms of importance. Why give so much weight to the bank statement? Pratt (1912) argues: "as a general rule, any shortage in the supply of credit checks stock speculation and produces declines in prices...If the contraction is so extreme as to make it impossible to arrange loans, large blocks of securities, which can not be carried, are dumped on the market for what they will bring, and the Street then has a panic. Wall Street therefore scrutinizes the bank statement with the utmost care."

What aspects of the bank statement received the most attention by investors? According to Selden (1917), "The figures most closely watched by Wall Street are the surplus reserve and the relation between 'Net Demand Deposits' and 'Loans, Discounts, Investments, etc.'" For the NYCH national banks, reserves had to be held either in the form of specie or legal tender. Pratt (1912) notes "More significant than all the other items of a bank statement therefore are those representing cash holdings. Credit may be the vital air of the whole financial system, but money is the oxygen in the air, without which there would be suffocation and death...An increase in cash increases the credit-giving power of the banks. A decrease in cash involves a contraction of credit." Likewise, Selden (1917) argues that the strength of a bank's cash position is "carefully watched as an index to the supply of money available for loans." In addition, for Selden (1917), "...if deposits exceed loans, a very strong position is shown; but when the loans begin to show a large excess over deposits the situation

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will bear watching."

Even without separate chapters on the NYCH banks, other investment guides acknowledged the role credit conditions play in determining asset prices. Again, they placed emphasis on NYCH banks' cash reserves and the ratio of loans to deposits as important barometers for credit. On the importance of reserves, Hall (1909) simply states "When reserves have fallen below the legal limit, the loaning power of the banks is ended for the time being. If reserves show a deficit, the banks are perforce obliged to call in a part of their loans. Stock speculators are then obliged to throw overboard a part of their loads in order to raise funds wherewith to repay their loans. Selling of this compulsory character invariably means a slump in the stock market and possibly a long decline." Similarly, for the relationship between loans and deposits, Hall (1909) emphasizes the excess of deposits relative to loans (surplus deposits). He argues that "when surplus deposits are dangerously low, a situation is revealed which may and commonly does foreshadow a serious decline in stocks or an actual crisis. The catastrophe may be postponed for a year or more, but it is sure to arrive." Chamberlain (1911) also emphasized the loan-to-deposit ratio, as it represented "the ratio of the demand for to the supply of credit...High ratio means necessity for liquidation by borrowers; low ratio, power for accumulation."

The relationship between the banking system and financial markets also received special attention by commissions called by multiple levels of government after the Panic of 1907, a severe financial crisis in the U.S. One publication produced by the National Monetary Commission was Hollander (1911), aptly titled *Bank Loans and Stock Exchange Speculation*. The fifth chapter specifically focuses on "speculative purchases of stock exchange securities" financed especially by "demand loans obtained from banking institutions and secured by such securities as collateral" (Hollander, 1911). Similarly, in 1909, the governor of New York appointed a commission to study speculation in securities and commodities. The report by this commission also discussed the relationship between the money market and stock exchange speculation (Pratt, 1912).

Data Sources and Construction

Table A1: Data Sources

Variable	Details
NYCH Bank Cash Reserves, Loans, Deposits	Sources: *Statistics for the United States, 1867-1909*: pp. 75-118 and *Commercial and Financial Chronicle*: various issues. Cash reserves are "specie and legal tender." Loans are the "loans and discounts" line. Deposits are "net deposits."
Country Bank Cash Reserves	Source: NBER Macrohistory database series m14011. Variable is "lawful money held, national banks, country districts."
Stock Price Index	NBER Macrohistory database series m11025a. Variable is "Index of All Common Stock Prices" constructed by the Cowles Commission.
High-Grade Bond Price Index	NBER Macrohistory database series m11016. Variable is "American Railroad Bond Prices, High Grade" based on the series of high-grade railroad bonds used by Macaulay (1938).
Risk-free rate	NBER Macrohistory database series m13016. Variable is "Open Market Rates of Discount for London, Great Britain."
Dollar Exchange Rates	Exchange rates are for British pound, French franc, German mark, Dutch guilder. Source: *Commercial and Financial Chronicle*, various issues. Each exchange rate is average of high and low quotes for exchange on demand by leading banks. All quotes taken at end of month. Exchange rates expressed as dollars per unit of foreign currency.
Short-Term U.S. Interest Rate	Variable is average of the high and low quotes for double-name choice 60-90 day commercial paper for the last week of the month. Sources: *Financial Review*, various years (1868-1889, 1914); *Statistics for the United States, 1867-1909* pp. 119-138.
Foreign Short-Term Interest Rates	Interest rates are open market rates of discount for London, Paris, Berlin, and Amsterdam. For London, the discount rate is for 3-month bank bills. Source: *Economist*, various issues. Variables use average of high and low quotes for the last week of each month.
Real GNP	Source: Balke and Gordon (1989).
U.S Price Index	Price index is GNP deflator. Source: Balke and Gordon (1989).
Dividends and Earnings	Dividend and Earnings Indices constructed by Cowles Commission at annual frequency. Shiller (2000) constructs monthly series using linear interpolation. Source: Goyal and Welch (2008).
Call Loan Interest Rate	NBER Macrohistory database series m13001a. Variable is "U.S. Call Money Rates, Mixed Collateral."

Excess returns for stocks and bonds are constructed in the usual way. Currency excess returns are computed from the perspective of a U.S. investor borrowing in foreign currency through a foreign country's discount market, converting to dollars, and then lending these dollars in the U.S. money market. At the end of the holding period, the U.S. investor then converts the proceeds of the dollar loan into foreign currency to repay the initial foreign loan. The U.S. money market instrument is double-name choice commercial paper. The dollar return index is constructed as an unweighted geometric average of the dollar's excess return against each currency in a given quarter. This construction is the opposite of what most of the existing empirical intermediary asset pricing literature has used for studying U.S. intermediaries, as mentioned in the main text. However, for the purpose of illustrating the role of liquidity risk in U.S. money markets, it is better to construct dollar returns. This way it is clear in the results that an improvement in liquidity conditions for the NYCH banks (increase in cash growth or decrease in LtD ratio growth) forecasts a decrease in dollar excess returns. Dividend yield and earnings-price ratio constructed as in Goyal and Welch (2008).

Additional Results

This section presents five additional sets of results. First, I show that the Granger causality from NYCH Bank liquidity positions to loan quantities extends to loan prices as well in Table A2. I do this using the call loan interest rate for the New York market. Second, I show in Figure A1 that the predictability patterns for excess returns generally carry over when using cumulative real returns as the outcome variable, except for currencies (not shown). Third, I show that splitting the sample at a lower level of the reserve-deposit ratio does not generally affect the finding that predictability comes from periods when the NYCH banks were closer to hitting the minimum reserve requirement. Fourth, the set of results shown in Table A4 repeats the exercise of Table 4 but replaces future GNP growth with two dummy variables: one denoting when business cycle peaks occur and the other marking business cycle troughs. Again, controlling for an indicator of future economic conditions does not

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weaken the predictive power of NYCH bank balance sheets when the banks are near the reserve requirement. Finally, Figure A3 shows the relative stability of the coefficients for stock and bond excess returns estimated across different sample periods using two different methods. The left panels show coefficients estimated using rolling 10-year windows beginning in 1880:Q1. The right panels show coefficients estimated with a recursive rolling window starting in 1880:Q1 initially with a size of 10 years. The window then expands by one quarter until reaching 1913:Q4. Across asset classes and sample periods, the coefficients generally retain the expected sign and are stastically significant.

Table A2: Call Loan Granger Causality Test P-Values

	Levels	Changes
LtD Ratio	0.001	0.000
Cash Reserves	0.057	0.001

Notes: Reported p-values are for null hypothesis each variable does not Granger cause either the call loan interest rate or year-over-year changes in the call loan rate. Monthly vector autoregressions (VARs) include 12 lags and are run separately with either NYCH bank loan-to-deposit ratio year-over-year changes or NYCH bank cash reserve year-over-year percent changes as the second variable in the system. Column "Levels" is for a VAR with the call loan rate in levels; Column "Changes" is for a VAR with year-over-year changes in the call rate.

Figure A1: Cumulative Real Return Forecasts at Quarterly Horizons
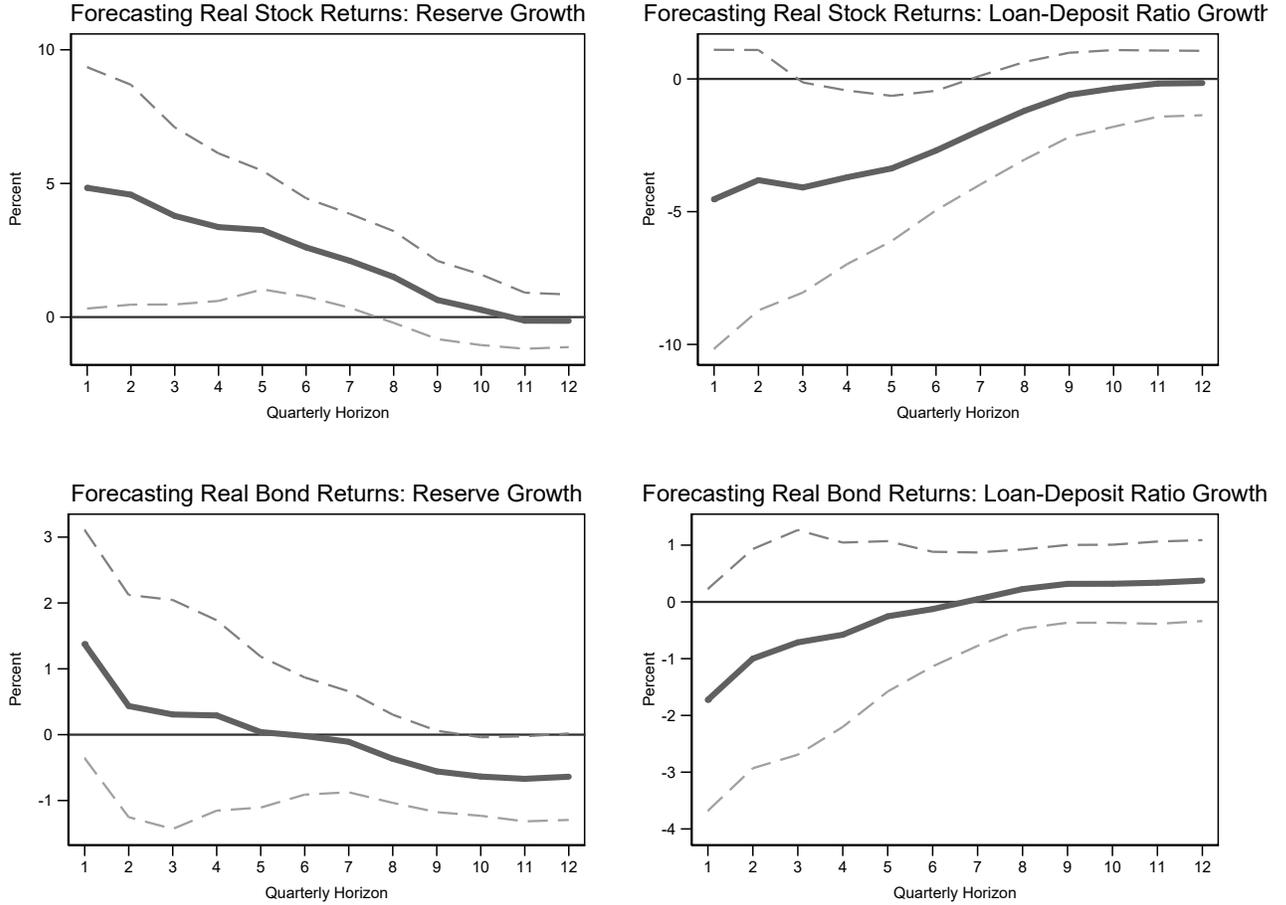
Each panel shows the additional cumulative real return at quarterly horizon $t + h$ for a specific asset class predicted by a standard deviation increase in a given NYCH bank balance sheet variable at time t: year-over-year cash reserve growth or year-over-year loan-to-deposit ratio growth. Estimates are based on equation (1), with controls for year-over-year RGNP growth, one-quarter excess return, dividend yield, and earnings-to-price ratio, all measured at time t. Dashed lines are 90% confidence bands computed using Newey-West standard errors with four lags.

Table A3: Return Predictability When Reserve-Deposit Ratio Is Low or High

	1Q-Ahead (Low)	1Q-Ahead (High)	2Q-Ahead (Low)	2Q-Ahead (High)	3Q-Ahead (Low)	3Q-Ahead (High)	4Q-Ahead (Low)	4Q-Ahead (High)
Stocks (LtD)	−6.33	−2.03	−5.83**	−3.20	−3.99*	−3.40	−3.41	−3.39
	(4.02)	(3.48)	(3.03)	(2.98)	(2.28)	(2.53)	(2.12)	(2.20)
Stocks (Cash)	5.08	3.27	5.24*	5.01**	3.97*	3.64*	3.90**	3.18*
	(3.79)	(3.04)	(2.77)	(2.56)	(2.06)	(2.18)	(1.88)	(1.90)
Bonds (LtD)	−2.39**	−1.47	−1.77**	−1.32*	−1.40*	−1.01	−0.85	−0.99
	(1.13)	(0.95)	(0.74)	(0.78)	(0.72)	(0.67)	(0.67)	(0.61)
Bonds (Cash)	0.95	1.40*	1.05	1.03	1.10*	0.76	0.66	0.71
	(1.05)	(0.83)	(0.68)	(0.68)	(0.65)	(0.58)	(0.60)	(0.53)

Notes: Table reports coefficients for predictive regressions based on equation (1) estimated across two sample splits: when the NYCH bank reserve-deposit ratio in the bottom third of the sample distribution for the estimation period at time t and when the reserve-deposit ratio is in the top two-thirds of the sample distribution at time t. Rows are for different asset class-NYCH balance sheet variable pairs. (LtD) means the NYCH bank balance sheet variable is the year-over-year change in the end-of-quarter loan-to-deposit ratio. (Cash) means the NYCH bank balance sheet variable is the year-over-year percentage growth in end-of-quarter cash reserves. Coefficients show effect of standard deviation increase in NYCH bank balance sheet variable. Standard deviations are calculated separately for each sample split. Newey-West standard errors using four lags in parentheses. ***p<0.01, **p< 0.05, *p<0.1.

Figure A2: Pound Excess Return Forecasts When Reserve-Deposit Ratio is Below or Above Median
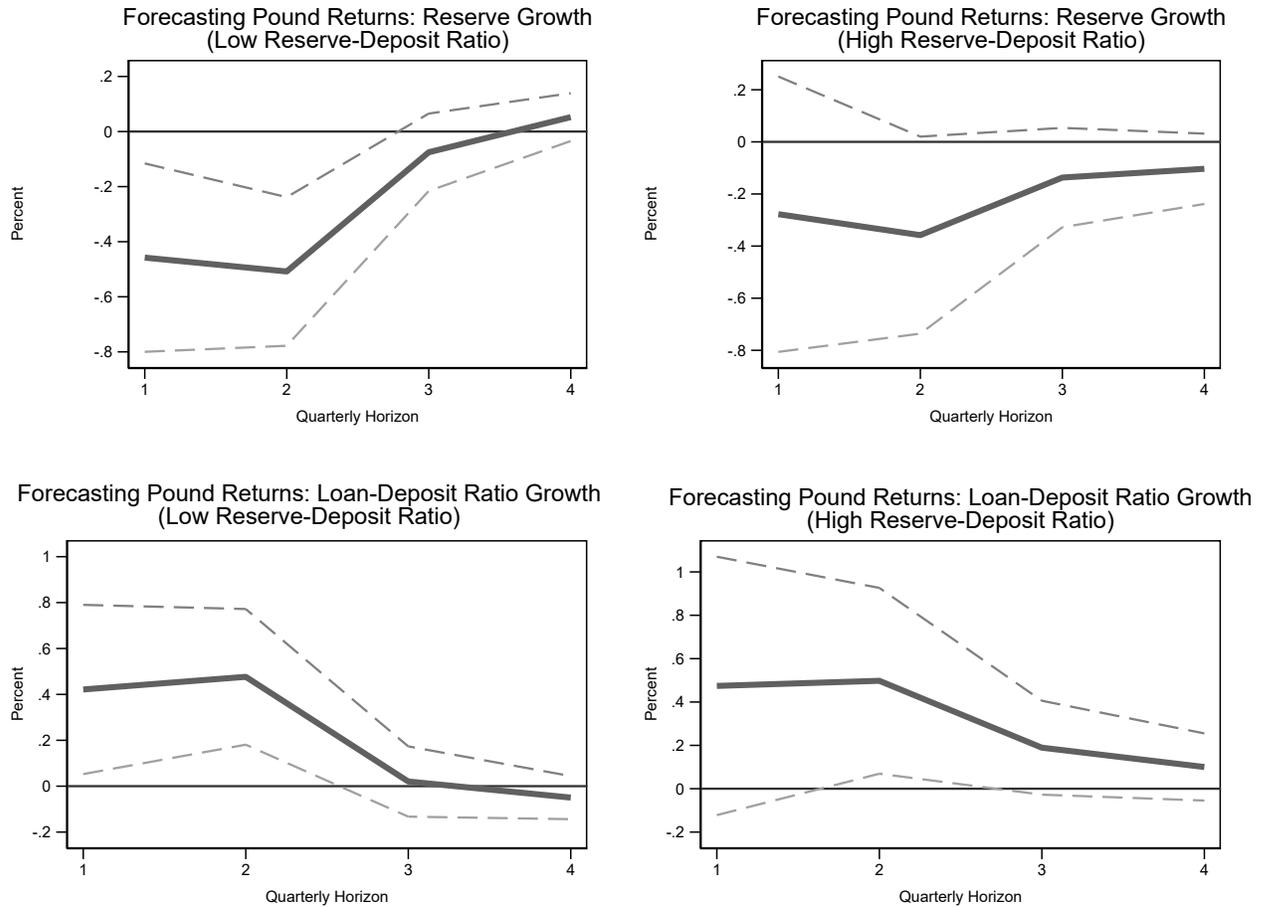

Each panel shows the additional cumulative excess return at quarterly horizon $t + h$ from borrowing in British pounds, lending in U.S. dollars, and converting back to British pounds at the end of the quarter predicted by a standard deviation increase in a NYCH bank balance sheet variable at time t. Balance sheet variables are year-over-year growth in either cash reserves or loan-deposit ratio. Estimates are based on equation (1) estimated across two sample splits: when the NYCH bank reserve-deposit ratio is below its median value for the estimation period at time t and when the reserve-deposit ratio is above its median value at time t. Standard deviations for NYCH bank balance sheet variables are calculated separately for each sample split. Dashed lines are 90% confidence bands computed using Newey-West standard errors with four lags.

Table A4: Return Predictability with Low Reserves and Business Cycle Turning Points

	1Q-Ahead	2Q-Ahead	3Q-Ahead	4Q-Ahead
Stocks (LtD)	-6.87^{**}	-7.65^{***}	-5.58^{**}	-4.66^{**}
	(3.41)	(2.67)	(2.33)	(2.04)
Stocks (Cash)	7.04^{**}	8.21^{***}	6.12^{***}	4.93^{***}
	(3.07)	(2.38)	(2.07)	(1.61)
Bonds (LtD)	-3.21^{***}	-1.69^{***}	-1.23^{**}	-0.57
	(0.97)	(0.64)	(0.62)	(0.56)
Bonds (Cash)	1.95^{**}	1.00^{*}	0.76	0.20
	(0.89)	(0.59)	(0.56)	(0.51)
Currency (LtD)	0.34	0.45^{**}	0.28^{*}	0.22^{*}
	(0.22)	(0.19)	(0.16)	(0.13)
Currency (Cash)	-0.41^{**}	-0.45^{***}	-0.24	-0.16
	(0.20)	(0.17)	(0.15)	(0.13)

Notes: Table reports coefficients for estimates of equation (1) when the NYCH bank reserve-deposit ratio is below its median value at time t with dummies taking values of 1 if time t is a business cycle peak or trough, respectively included as additional predictors. Rows are for different asset class-NYCH balance sheet variable pairs. (LtD) means the NYCH bank balance sheet variable is the year-over-year change in the end-of-quarter loan-to-deposit ratio. (Cash) means the NYCH bank balance sheet variable is the year-over-year percentage growth in end-of-quarter cash reserves. Coefficients show effect of standard deviation increase in NYCH bank balance sheet variable. Standard deviations for balance sheet variables calculated using only dates with a below-median reserve-deposit ratio. Quarters with business cycle peaks or troughs identified by NBER and Romer (1994). Newey-West standard errors using four lags in parentheses. ***p<0.01, **p< 0.05, *p<0.1.

Figure A3: Forecast Coefficients from Rolling Estimations
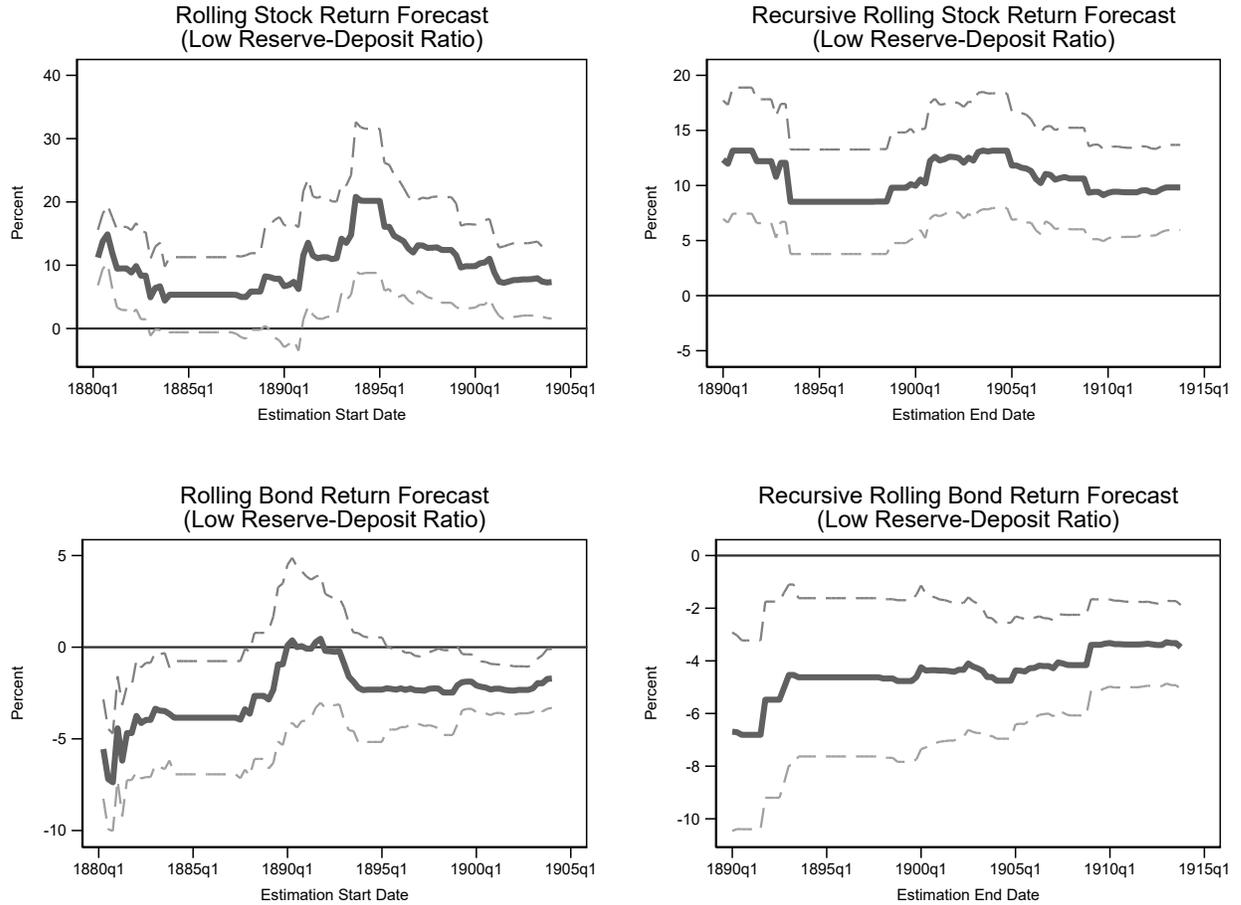
Each panel plots the coefficient for a standard deviation increase in a NYCH bank balance sheet variable on cumulative excess returns from a set of rolling regressions. In each panel and sample period, the sample is always restricted to dates when the NYCH bank reserve-deposit ratio is below its median value. The upper left panel shows the additional cumulative 2-quarter ahead stock excess returns forecast by a standard deviation increase in year-over-year NYCH bank cash reserve growth over rolling 10-year windows beginning with 1880:Q1. The upper right panel reports coefficients for the additional cumulative 2-quarter ahead stock excess return forecast by a standard deviation increase in year-over-year NYCH bank cash reserve growth over a recursive rolling sample beginning with a 10-year window in 1880:Q1. The bottom left panel shows the additional 1-quarter ahead bond excess returns forecast by a standard deviation increase in year-over-year NYCH bank loan-deposit ratio growth over rolling 10-year windows, beginning with 1880:Q1. The bottom right panel shows the additional 1-qarter ahead bond excess returns forecast by a standard deviation increase in year-over-year NYCH bank loan-deposit ratio growth over a recursive rolling sample beginning with a 10-year window in 1880:Q1. Left panels are from regressions of excess returns on NYCH bank balance sheet changes only. Regressions for right panels include full set of controls. Dashed lines are 90% confidence intervals using Newey-West standard errors with four lags.

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The Link Between NYCH Banks and Currency Returns

I argue in the main text that tightening of liquidity conditions for NYCH banks forecast higher currency excess returns because of higher liquidity risk premia on U.S. money market instruments. An alternative explanation is that changes in NYCH bank liquidity conditions correlate with changes in depreciation expectations, but the expected depreciation does not materialize. For a substantial portion of the National Banking Era, the U.S. did, in fact, experience a "peso problem" where people expected the dollar to depreciate against most major currencies, but this depreciation never occurred (Hallwood et al., 2000). The possibility of a dollar devaluation was driven by the "Free Silver Movement", a political faction that advocated unlimited coinage of both silver and gold at a mint price ratio that would have resulted in the devaluation of the dollar against gold. The Free Silver Movement never succeeded in enacting their preferred policy, and, by the late 1890s, the movement had effectively died out. Importantly, changes in dollar depreciation expectations due to developments related to the Free Silver Movement affected bank liquidity conditions–including in New York City (Fulford and Schwartzman, 2019; Weiss, 2019).

I test whether unrealized depreciation expectations from silver coinage agitation drive the forecasting relationship between NYCH bank balance sheets and currency returns by running the forecasting regressions only in periods with a lower probability of dollar depreciation. In particular, I exclude all quarters beginning in 1890 and ending in 1896. Fulford and Schwartzman (2019) and Weiss (2019) both present evidence that depreciation expectations were most prominent and volatile during this period. The beginning and end dates correspond to the passage of the Sherman Silver Purchase Act in 1890 and the defeat of the Free Silver candidate William Jennings Bryan in 1896. Both NYCH bank cash reserve growth and LtD ratio growth continue to forecast dollar excess returns even after excluding these dates in a similar manner as in the unrestricted sample. This suggests that the peso problem created by silver coinage agitation is not behind the forecasting ability of NYCH bank balance sheets for currency excess returns.

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