

Do Banks have an Edge?

Juliane Begenau and Erik Stafford*

October 2019

ABSTRACT

Overall, no! We show that the level and time series variation in cash flows for most bank activities are well matched by capital market portfolios with similar interest rate and credit risk to what banks report to hold. Ignoring operating expenses, bank loans earn high returns and transaction deposits pay low interest rates, consistent with these activities having a potential edge. The edge among these activities is insufficient to cover the large operating expenses of banks. A large portion of the aggregate US banking sector closely resembles a tax inefficient passive mutual fund. The residual risks of bank activities, presumably generated by the unique components of the bank business model, generate systematic risks that are uncompensated.

* Begenau (begenau@stanford.edu) and Stafford (estafford@hbs.edu) are at Stanford and Harvard Business School. We thank our discussants Itamar Drechsler and George Pennacchi. We also thank Malcolm Baker, Joshua Coval, Jamie Dimon, Mark Egan, Daniel Green, Robin Greenwood, Sam Hanson, Ben Hebert, Arvind Krishnamurthy, Hanno Lustig, Tyler Muir, David Scharfstein, Andrei Shleifer, Emil Siriwardane, Jeremy Stein, Larry Summers, Adi Sunderam, Tuomo Vuolteenaho, and seminar participants at Arrowstreet Capital, Berkeley, Chicago Booth, Columbia, HBS, Stanford, Tepper CMU, UMD, UNC, USC, the NBER SI 2018, the 2018 BYU Red Rock Finance Conference, and the 2019 AFA meetings for helpful comments and discussions. Harvard Business School's Division of Research provided research support.

This paper evaluates the performance of the aggregate banking sector to study how banks operate and where they have a competitive advantage. Our approach, rooted in the competitive markets perspective developed by Black (1975), Fama (1985), Merton (1989, 1990, 1993), and Merton and Bodie (1993, 1995), measures the edge in banking relative to a tradable capital market alternative. Fama (1985) argues that since banks are required to invest in non-interest-bearing reserves in order to engage in deposit-taking, efficiency requires that they must have an edge somewhere in their business model to overcome this frictional cost. Since banks face other frictional costs relative to the capital market alternatives we consider, including an additional layer of taxes due to their corporate structure,¹ the edge should be sizeable to cover these costs.

Banks engage in activities with various degrees of complexity, ranging from holding U.S. Treasury (UST) bonds to executing complex trades on behalf of their clients. A simple traditional view of banks, based on their reported asset holdings and financing arrangements, is that banks resemble a levered bond portfolio, exposed to moderate amounts of credit and interest rate term structure risks. Through deposit insurance, banks may achieve more stable and lower cost funding than is available elsewhere in the capital market. Through proprietary information about borrowers, banks may earn higher returns on loans than are available elsewhere in the capital market. To this traditional view of banks, the recent theoretical banking literature adds the synergies associated with the joint provision of credit and deposits as a potential competitive advantage of banks (e.g., Diamond and Rajan (2000, 2001); Kashyap, Rajan, and Stein (2002); Dang, Gorton, Holmstrom, and Ordóñez (2017); Donaldson, Piacentino, and Thakor (2018)).

¹ A significant, and perhaps, underappreciated relative cost of the banking structure is taxes. As corporations, banks pay corporate taxes on their investment income, while capital market investment vehicles like mutual funds allow for the pass-through of investment income without incurring a corporate tax liability (Han, Park, and Pennacchi (2015)). The average effective corporate tax rate for the aggregate banking sector is 30%.

To empirically assess the edge in banking we take a simple path. From banks quarterly regulatory filings on asset holdings and liabilities, we gather information about the credit and interest rate risk for each measurable major bank activity (e.g. security portfolio, loan portfolio, transaction deposits, time deposits). We then compare banks' reported cash flows generated by each activity and compare them to the cash flows from passive capital market portfolios with similar amounts of interest rate and credit risk. This provides insights into how banks make money, which activities are advantaged, and how the risks of both the well-matched and the unexplained activities contribute to the overall risk. This is similar to the analysis in Fama (1985), whereby the return properties of 6-month bank certificates of deposit are compared to those of 6-month US Treasury bonds. We extend the spirit of this comparison to each component of the bank balance sheet, focusing on banks' interest rate and credit risk exposure.²

Before accounting for operating expenses, we expect bank activities with near perfect capital market substitutes, such as bearing interest rate risk via UST bonds, to earn similar returns and to exhibit similar risk properties. The cash flows of bank activities without a close capital market match can be distinct in two ways. First, they may share similar risk properties, but earn higher pre-expense returns because of their product differentiation. For example, bank deposits facilitate customer transactions more directly than any other short-term riskfree debt. Second, they may have fundamentally distinct risk properties, such that the capital market benchmark provides a poor time series match. Comparing banks' after-expense returns to capital market benchmarks allows us to measure whether the edge in banking is large enough to cover the expenses. Banks are fairly expensive to operate (Philippon (2015)). The average operating

² This analysis is based on a large theoretical (e.g., Diamond and Dybvig, 1983; Farhi and Tirole, 2012; Di Tella and Kurlat, 2017; Brunnermeier and Koby, 2018) and empirical literature (e.g., Flannery and James, 1984a,b; Begenau, Piazzesi and Schneider, 2015; English, Van den Heuvel and Zakrajsek, 2018; Gomez, Landier, Sraer, and Thesmar, 2019) in banking, wherein banks' role in maturity transformation exposes them to interest rate and credit risk.

expense ratio (operating expenses divided by assets) is 3.3% per year from 1997 to 2018,³ and fairly stable through time and across bank size categories. Since some bank activities compete closely with low-cost capital market alternatives, we expect the relatively differentiated activities to be responsible for covering these high operating expenses. Finally, we study financial stability differences between bank stocks and the capital market alternatives that are designed to bear similar interest rate and credit risks. We expect the risk properties of the well-explained activities to be similar across banks and traded capital market portfolios. This allows us to characterize the residual risk premium, representing the risks and returns associated with the unique components of banks, including synergies like liquidity provision, as well as government guarantees and support.

Our main empirical finding is that simple risk-matched passive capital market portfolios generate cash flows that are highly similar to those of banks. Before accounting for operating expenses or credit risk, the interest income generated by a simple maturity-matched portfolio of UST bonds explains the majority of bank cash flows for all activities. Consistent with the competitive markets prediction, the pre-expense cash flows generated by the aggregate bank securities portfolio nearly perfectly track the cash flows of a maturity-matched UST portfolio. This portfolio represents 30% of total assets. Similarly, the pre-expense cash flows paid on bank time deposits and non-deposit bank debt, representing 56% of aggregate bank debt funding, are nearly perfectly tracked through time by a passive maturity-matched UST portfolio. Consequently, the scope for an edge among bank activities is actually narrow, limited to the loan portfolio, transaction deposits, and the trading business plus services and synergies.

³ Hedge funds are capital market investment vehicles that make heavy use of leverage and have historically charged fees of 2% plus 20% of profits based on their equity capital. This fee structure averages 3% to 4% per year in total management fees on equity. The 3.3% expense ratio on assets is equivalent to 23% on equity for a bank that is levered 7x.

Before considering expenses, banks provide credit at high interest rates relative to a capital market benchmark. This is consistent with the empirical evidence provided by Schwert (Forthcoming). Interestingly, the time series pattern of banks' pre-expense loan returns is well-matched by our benchmark. After accounting for operating expenses, the cash flows to the aggregate bank loan portfolio are not meaningfully different from our benchmark. We estimate that the after-expense realized credit risk premium on the bank loan portfolio accounts for less than 20% of the total loan portfolio return, with the majority of the return coming from riskfree short-term interest and a small amount of interest term exposure. To the extent that there are additional risks related to the illiquidity and information asymmetries associated with the bank loan portfolio that create challenges for bank operations and funding in poor economic states, these risks should be compensated in the form of an additional risk premium. Since the benchmark does not include such a risk premium and because banks earn a highly similar risk premium to the capital market benchmark, banks appear to not earn an illiquidity risk premium on their loan portfolio.

We find that transaction deposits are the most unique component of the bank business model. They pay interest equal to roughly one-third of the short-term riskfree rate plus operating expenses that are fairly constant as a percent of deposits. These accounts effectively swap the short-term riskfree rate for a stable funding cost in the form of operating expenses that has a breakeven riskfree rate that we estimate to be about 2.5%. Over a long sample, this structure provides banks with a reliable cost advantage. Interestingly, since 2008, the short-term riskfree rate has been persistently below the breakeven rate of 2.5%. As a consequence, transaction deposits have been a relatively expensive funding source for the last decade of our sample.

Bank equity provides a comprehensive summary of all bank activities, reflecting operating expenses, corporate taxes, and the net contributions from un-modeled activities. This

makes the risk and return properties of both the matched and unmatched (or residual) components interesting to study. We create a synthetic analogue to bank equity by summing across the individually benchmarked activities, resulting in a levered bond portfolio that matches banks' reported net credit- and interest rate risk exposures. We find that the cash flows available to bank book equity are highly similar to those of the synthetic bank equity, with the majority of the time series variation explained by the capital market benchmark. The market value of bank equity averages about 1.7 times book equity over this sample, such that the cash flows available to market equity underperform the synthetic bank equity cash flows by about 40%. Additionally, we find that traded bank equities exhibit considerably more systematic risk than our capital market benchmark. Despite the government put (Kelly, Lustig, and Van Nieuwerburgh (2016)), bank equities experience higher losses during the 2008 financial crisis and recover more slowly than the synthetic bank portfolio. Because the benchmark captures the contributions of the passive interest rate and credit risks exposures traditionally viewed to be the core business of banking, the residuals contain everything else that is special about banks. These results suggest that the residual bank activities contribute systematic risk without providing adequate risk compensation.

Overall, our findings suggest that before accounting for costs banks do have an edge in loans and transaction deposits. After operating expenses, loans earn roughly an equivalent return to passive bond portfolios and transaction deposits offer a meaningful advantage so long as the short-term riskfree rate is not too low. Interestingly, the results push against the view that the synergies and other unique components of the bank business model contribute positively. Instead the results suggest that the passive components of the business model related to bearing interest rate and credit risk have not only generated the bulk of the returns, but that the unique components have added considerable systematic risk with no additional earned risk premium.

The primary concern about the empirical exercise, and therefore these inferences, is that the simple passive capital market benchmark portfolios do not accurately reflect the net bank exposures in terms of interest rate and credit risk. Our primary defense against this concern is that our benchmarks simply recreate what banks report to do and that these benchmarks are able to explain nearly all of the time series variation in most bank activities. We also conduct a number of analyses to directly address this concern, which have the additional benefit of providing a new lens from which to view some confusing aspects of bank performance measures. These analyses offer insights into the effectiveness of banks' hedging and what inferences can be drawn from the observation that banks have fairly stable net interest margins (NIM).⁴

I. Data Description

We obtain detailed bank-level data from quarterly regulatory filings of bank holding companies (BHC) collected by the Federal Reserve in form FR Y-9C.⁵ These data begin in 1986, but many important variables only become available in 1996. Most of our analysis covers the period 1997 to 2018. To obtain additional information on the maturity composition of bank balance sheets we link each BHC to its commercial banks that file forms FFIEC 031 and FFIEC 041 each quarter. We focus on the BHCs because they are more likely to be publicly traded, allowing us to examine stock market returns and valuations.

For a longer time-horizon, we also use aggregate data on FDIC insured commercial and savings banks in the United States from the FDIC Historical Statistics on Banking (HSOB). These data are reported at an annual frequency from 1934 through 2017 and include information

⁴ Net interest margin is a popular bank performance metric, calculated as interest income minus interest expense, all divided by assets.

⁵ A detailed description of our sample selection is in the Appendix.

on the number of institutions and some detail on their structure, as well as financial data from income statements and balance sheets.

We use stock market data, including returns and market capitalization of publicly traded BHCs, from the Center for Research in Security Prices (CRSP). The Federal Reserve provides a table for linking the bank regulatory data with CRSP. We also use a variety of additional capital market data on US Treasury (UST) bonds, US corporate bond indices, passive bond index portfolios available to retail investors through Vanguard, and other mutual funds. We obtain monthly yields on UST for various maturities from the Federal Reserve, monthly returns on the value-weighted stock market and the one-month US Treasury bill, as calculated by Ken French and available on his website. To calculate various bank debt alternatives, we use daily effective Federal Funds rates (converted to a monthly frequency) published by the Federal Reserve H.15 release and monthly yields on the BofA Merrill Lynch US Corporate AA bond index for different maturities.

II. The Scope for an Edge among Bank Activities

To determine which bank activities are potentially advantaged relative to capital markets, we compare the cash flows generated from various bank activities to the cash flows generated by a simple maturity-matched US Treasury bond portfolio. This preliminary benchmark makes no adjustments for illiquidity or credit risk. Additionally, in this initial analysis we do not subtract any operating expenses or corporate taxes to isolate the role of simple interest payments in the generation and distribution of banking cash flows. This section details how we define the various bank activities, how we calculate bank “accounting returns” as pre-expense cash flows scaled by book value, and describes the empirical results.

A. Components of the Aggregate Bank Balance Sheet

Figure 1 displays the quarterly asset and liability composition of total assets (Panel A) and as shares of assets (Panel B). Bank assets are comprised mostly of interest-bearing assets, including cash, securities, and various types of loans (e.g. business loans, mortgages, and consumer loans). Interest-bearing assets account for 81% of assets, on average, over the period 1997-2018. Most cash (including federal funds sold) earns interest over this time period. We group cash and securities into a single category that averages 30% of assets, generating interest income and some gains and losses from sale. Loans account for 50% of assets, generating interest income and losses. Banks also receive revenue from the services they provide. Some bank services are tied to trading assets, such as market making and market liquidity provision. However, others, such as fiduciary services, are not easily associated with a specific balance sheet position. Consequently, we group trading activities with other unclassified activities and measure the capital base from the accounting identity, total assets minus interest bearing assets equal trading & services.

We separately categorize time deposits (e.g. certificates of deposits) and transaction accounts. Transaction accounts are the sum of demand, money market, and savings accounts. Time deposits are then classified as total deposits less transaction deposits. Non-deposit debt is measured as interest-paying liabilities less total deposits. Note that we exclude non-interest-paying accounting positions, such as tax-liabilities, from bank debt. Finally, we calculate book equity as the residual from the accounting identity, assets less interest-paying debt and total deposits.

Bank assets have grown steadily over the period 1997-2018, while the asset shares of the various activities have remained fairly stable. One notable exception is that the transaction deposit share increases meaningfully following the financial crisis consistent with a liquidity

services view of transaction deposits (e.g. Gatev and Strahan (2006)). At the same time, cash and securities increase their share in the aggregate asset portfolio.

B. An Interest Rate Benchmark for Bank Activities

Since the majority of the aggregate bank balance sheet – whether differentiated or not – generates or distributes cash flows tied directly to interest payments, it is natural to first summarize the cash flow performance of each bank activity relative to the cash flows that can be generated from earning interest from a maturity-matched US Treasury portfolio. We assemble a maturity-matched capital market alternative for each of these activities and compare the level and time series patterns of returns over our sample. This involves three main steps, including determining the maturity distribution of each activity, modeling the interest rate exposure of these maturity distributions, and developing a means of comparing bank returns that are reported according to bank accounting rules with market returns that are calculated from traded prices.

We use granular information about the composition of bank level assets and their reported maturity distribution available since 1997. For fixed-rate contracts, banks have to report the remaining maturity, i.e., the time between the date of the filing (FR-Y-9C or equivalent) and the final contractual maturity. For floating rate contracts, banks have to report the time between the date of the filing and the next repricing date or the contractual maturity, whichever is earlier. Therefore, the reported maturities measure the period over which interest rates are contractually fixed, as opposed to the notional maturity of the asset. We begin with the methodology of English, den Heuvel, and Zakrajsek (2018), where the midpoint of the reported repricing intervals is used to calculate effective maturities (see row 2 of the table below). We make a further adjustment to these estimated repricing maturities to account for pre-payment and amortization, which meaningfully shortens the effective maturity of most bank assets (i.e. loans

and mortgage-backed securities), (see Hanson (2014)). To this end, we use the annual prepayment rate of 15% over our sample (FHFA, 2018) to calculate the effective maturity of each maturity bucket in the data. For example, with an annual prepayment rate of 15%, the average life (effective maturity) of a 30-year fixed rate mortgage portfolio shortens to around 7-years. We summarize the reported repricing data and these adjustments as follows:

Reported Maturity Category	<3mo	3mo-1yr	1yr-3yr	3yr-5yr	5yr-15yr	>15yr
Midpoint Maturity in Months	1.5	7.5	24	48	120	270
After Pre-payment & Amortization Adjustments	1	6	22	38	64	78

Second, we model this maturity distribution as a weighted average of the fraction of cash-equivalents (maturity category 1) and the average maturity (long-term average maturity) across the remaining categories. This distinction between cash-equivalents and longer maturity bonds is motivated by empirical evidence that suggests that the very short-end of the yield curve is considerably lower than the adjacent maturity would predict (Krishnamurthy and Vissing-Jorgenson (2012); Nagel (2016); Musto, Nini, Schwarz (2018)) and the relative pricing of longer maturity interest rate exposure is fairly consistent (see discussion below). Thus, we assume that the cash-equivalent share earns the riskfree rate (i.e. one-month US T-bill) and the long-term share earns the return on a UST bond portfolio with the same long-term average maturity.

The primary concern with comparisons of accounting values for bank assets (and liabilities) with the market values and returns associated with capital market substitutes is that the accounting rules allow for many asset values to remain at par value, while market values fluctuate based on changing economic conditions and investors' assessments of these conditions. Consequently, we do not expect to be able to recover interest rate term exposures (TERM) for the interest rate sensitive bank activities by simply regressing bank returns on a TERM factor due to the specifics of bank accounting. Instead, we construct a time series of returns to a simple

buy-and-hold portfolio of US Treasury bonds and then apply hold-to-maturity accounting to this portfolio so that these adjusted returns can be compared to the reported bank returns. This allows us to estimate the cash flows associated with similar effective maturity capital market portfolio, which can be scaled by the par value (or book value) of the portfolio to be comparable to the bank cash flows for each considered activity.

Specifically, we calculate the cash flows and returns to a passive investment strategy that each month simply purchases an h -year US Treasury (UST) bond and holds it until maturity. Thus, each month the portfolio has an inventory of bonds with an average maturity of $h/2$, which is matched to the average long-term maturity of the aggregated bank portfolio for each activity. We then mix this longer-term portfolio with cash to match the mix of cash-equivalent holdings and longer-term holdings of each bank activity. We calculate bond returns based on monthly yields to maturity (YTM) reported by the Federal Reserve. Our calculation requires that each month we have a term structure of YTM's with monthly increments, which we estimate by linearly extrapolating between values reported at fixed maturities. We calculate an accounting value (or book value (BV)) of the portfolio using the standard capital accumulation rule, $BV(t+1) = BV(t) + \text{interest income} - \text{purchases} + \text{proceeds}$, where purchases and proceeds are measured at market transaction value and interest income is earned periodically according to the bond coupon terms. Thus, the book value of this portfolio ignores the effects of fluctuating interest rates on the market values of the bonds in the portfolio, implicitly assuming that their values equal par, just as it is the case for banks.

C. Bank Cash Flow Performance Relative to Maturity-Matched US Treasuries

We begin with a joint test – in the spirit of Fama (1970) – of the basic premise that cash + securities, time deposits, and non-deposit debt will exhibit cash flow properties that are highly

similar to those generated by maturity-matched UST portfolios *and* of the effectiveness of our benchmarking methodology. As noted above, we initially assume that there are no overhead charges associated with managing the investment portfolios and therefore benchmark against a capital market portfolio that pays no management fees. We calculate bank “accounting returns” by activity type based on the income statement information and balance sheet values provided by the banks. As such, these accounting returns do not reflect capital gains and losses accruing through price changes except as realized from liquidations. Consequently, the accounting returns are effectively scaled cash flows. The accounting returns are calculated as the ratio of sums across banks, and therefore represent value-weighted portfolio returns. The results are summarized in Figure 2 and Table 1.

Figure 2 displays the quarterly accounting return time series for each bank activity along with its maturity matched UST portfolio. The top left panel displays the accounting returns for the aggregate bank cash + securities portfolio, which are tracked almost perfectly by the maturity-matched UST portfolio. Table 1 summarizes quarterly accounting return regressions of bank activity portfolios on their maturity-matched UST accounting returns. The regressions for the cash and securities portfolio produce an intercept that is statistically indistinguishable from zero, a slope coefficient that is statistically indistinguishable from one, and an R2 of 0.95, suggesting that, in the aggregate, this activity is not differentiated from the capital market and offers no potential for an edge, before considering costs or corporate taxes.

A similar result is produced for time deposits. The regression intercept is zero, the slope coefficient is statistically indistinguishable from one, and the R2 is 0.97. This confirms the early results from Fama (1985) and suggests that one should not ascribe a potential edge to all bank deposits, as the time deposits appear to offer no potential for an edge even before accounting for operating expenses.

The remaining bank activities are not as well explained by their maturity-matched UST counterpart, suggesting where the scope for an edge lies. Additionally, these activities may require an enhanced benchmark to account for their risk properties beyond interest rates. The next best explained category is non-deposit debt, which appears to pay a credit spread above its maturity-matched UST benchmark. Over the full sample, 1997 through 2018, non-deposit debt has paid 67bps more per annum than a maturity-matched UST portfolio. This credit spread averaged 37bps per year in the pre-crisis period, 1997-2006, and has averaged 92bps annually from 2007-2018. This is consistent with non-deposit bank debt offering no meaningful funding advantage, as these credit spreads are in line with similarly rated bank debt traded elsewhere in the capital market. Interestingly, non-deposit debt and time deposits together account for 56% of total bank debt (i.e. total bank debt = total deposits + non-deposit debt), leaving less than half of bank debt as a source of a potential funding edge.

Deposit transaction accounts pay considerably lower interest rates than the one-month US Treasury rate (2.08% p.a. less), before considering operating expenses. To calculate the interest rates banks pay on transaction accounts, we subtract the deposit fee income from the interest expense on transaction deposits and divide by the dollar amount of transaction deposits in the previous period. Interestingly, the time series pattern tracks the maturity-matched UST portfolio fairly closely. The accounting return regression R^2 is 0.87. This is clearly an activity that offers a potential edge that we investigate in more detail in the subsequent section.

The aggregate bank loan portfolio generates pre-expense cash flows that are reliably higher than those generated by a maturity-matched UST portfolio. The time series pattern is pretty well matched by the UST benchmark (R^2 is 0.79), but the realized losses during the 2008-2009 recession create a meaningful difference in returns between these two strategies. Loans account for 50% of aggregate bank assets and earn a pre-expense credit spread of 2.4% annually,

which is large when compared to the credit spreads earned in capital markets. Of course, a proper comparison requires adjusting for the specific risk properties and subtracting the associated operating expenses, which will be a focus in the next section.

The final activity, trading and services, is essentially a residual category that is messy to interpret before subtracting operating expenses. The pre-expense cash flows appear very high, but the aggregate operating expenses are also very high, averaging over 3% of assets each year. In addition to exhibiting considerable time series similarity to the short-term interest rate, the trading and services also appear to contribute some systematic risk to bank assets, as they are noticeably lower during the 2008-2009 recession.

Overall, the nearly perfect match of the simple maturity-matched UST benchmarking procedure for the activities that most directly earn or pay riskfree interest provides support for the notion that this methodology is helpful for understanding how banks generate their cash flows. Additionally, it has revealed where banks do and do not have a potential edge over capital markets and has confirmed that almost all bank activities generate cash flows that track interest earning (and paying) assets. Finally, it is interesting to note that an important component of the methodology is the calculation of accounting returns for the capital market portfolio. For example, the high correlation between the quarterly accounting returns for the cash + securities portfolio and the maturity-matched UST portfolio of 0.976 falls to 0.337 with the market returns for the same UST portfolio. This is an important feature of bank performance to keep in mind as we investigate the risk properties of these activities in the next section, as the accounting returns are a quite different economic object from the market returns that asset pricing analyses typically rely upon when making inferences about risk.

III. Measuring the Edge among Bank Activities

In this section, we build on the simple benchmark presented in section II to account for both operating expenses and risk premia beyond the interest rate maturity risk. We begin this section with an analysis of the risk properties of the passive maturity-matched UST portfolios to illustrate the important role of bank accounting in distorting measured risks.

A. Risk Properties of US Treasury Portfolios and Net Interest Margin

We explore the economic risks of US Treasury portfolios in the context of the commonly referenced bank performance measure called net interest margin (NIM). NIM is simply calculated as interest income minus interest expense, all divided by assets. For the aggregate banking sector, and for most individual banks, this ratio is remarkably stable over time. The stability of this ratio leads some practitioners and academic researchers to the conclusion that banks have effectively hedged their interest rate exposure.⁶

We show that the stability of NIM does not generally indicate that interest rate exposure has been hedged in a traditional asset pricing sense with a simple example based on a long-short portfolio of US Treasury securities. Consider a simple narrow bank that is long cash + securities, funded with 33% of equity and 67% time deposits to match the proportions of the aggregate banking sector. For actual banks, the quarterly NIM time series calculated from these two components averages 1.5% per year with 0.2% annual volatility. Figure 2 illustrates that each of these components is nearly perfectly tracked with a passive constant maturity-matched UST portfolio. Consequently, an investor seeking to target a constant NIM of 1.5% could invest in the

⁶ For example, the 2018 annual report of Bank of America states “interest rate risk represents the most significant market risk exposure to our banking book balance sheet. Interest rate risk is measured as the potential change in net interest income caused by movements in market interest rates.” Hence, a stable net interest margin (NIM) indicates that banks have no exposure to interest rate risk.

cash + securities benchmark portfolio and then choose a short-term funding strategy to minimize the expected NIM tracking error.

Figure 3 summarizes one such strategy. From quarter to quarter, the interest income on the portfolio of longer-term assets is highly predictable. Therefore, to achieve the target NIM one must simply determine how much short-term interest expense needs to be paid and then choose a funding strategy that will generate this expense. Each quarter, we choose the mix between debt and equity as well as the cash-share and the bond maturity of the debt to generate an expected NIM of 1.5%. The resulting funding strategy has an average equity-to-assets ratio of 36% with 52% of the debt funding at the riskfree rate and the remainder coming from shorting a portfolio of UST with an average maturity of 1.7 years. By design, this portfolio has an average NIM of 1.5% with a low annual volatility of just 0.14%. Panel A of Figure 3 shows that the NIM constructed from this strategy is similar to the aggregate banking sector NIM in terms of mean and time series stability.

However, the stability of NIM does not imply that interest rate risk has been hedged. As illustrated in Panel B of Figure 3, the equity value of our narrow bank declines by 5% if interest rates rise by 1%. This is slightly higher than the interest rate sensitivity of a 5-year UST bond portfolio. A regression of the equity excess return on a 5-yr TERM factor confirms that there is a statistically and economically large interest rate term exposure. The regression coefficient on the TERM factor is 1.07 (t-statistic = 8.1), rejecting the notion that a nearly constant NIM implies interest rate hedging. This feature of reported bank performance is especially important for understanding the behavior of transaction deposit rates.

B. Operating Expenses

Operating expenses for banks are large, averaging 3.3% of assets each year from 1997 to 2018, for the aggregate banking sector and being similar across bank size categories (see Table 2). In light of the evidence that large portions of the aggregate bank balance sheet offer no potential advantage over passive UST portfolios, it seems reasonable to expect that these activities should cost a similar amount to operate as a capital market mutual fund that provides a similar interest rate exposure. This logic implies that the remaining activities, which show some potential for an edge, must cover the remaining operating expenses. The capital market benchmark portfolio cash flows and returns are net of their management fees.

We assume that the activities that are most closely mimicked by UST portfolios, namely cash + securities, time deposits, and bank debt, cost 10 basis points per year to operate based on the actual expense ratios charged by the Vanguard index funds that we use to proxy for investable passive interest rate exposures. Together, these activities represent just over 78% of total assets, leaving operating expenses equal to 3.22% of bank assets to be covered by the potentially differentiated activities: transaction deposits, loans, and trading + services. For transaction deposits and loans, we assume that their expense ratios equal one-half the overall asset expense ratio, with trading + services accounting for the rest. This results in an annual expense ratio of 1.65% for both transaction deposits and bank loans, and 9.89% for trading + services. These expense ratios are economically large and will have a meaningful effect on returns. While the specific allocations are uncertain, it is clear that banks did incur these expenses.

C. Transaction Deposits

Bank deposits are widely viewed to be the most unique component of the bank business model. Importantly, the empirical evidence in the previous section demonstrates that only demandable bank transaction deposits pay below market rates. The rates paid on time deposits are nearly perfectly tracked through time by maturity-matched US Treasury portfolios with essentially identical means. Transaction deposits, and therefore any associated funding advantage, amount to around 40% of total bank funding.

The fact that the interest rate paid on transaction deposit accounts averages far below the rate earned on one-month US Treasury bills suggests the potential for these accounts to represent a significant funding advantage for banks in terms of overall cost. Additionally, the fact that the US Government guarantees these accounts may provide an additional benefit to banks in the form of increased financial stability in economic states that would otherwise lead to financial distress. Finally, these accounts may offer an interest rate hedge (Drechsler, Savov, and Schnabl, 2018), allowing banks to hold longer-term assets without bearing the interest rate risk that a capital market investor without access to these accounts as a funding source would find themselves bearing.

The interest rate paid on transaction accounts is approximately one-third of the 1-month US T-bill rate (see Panel A of Figure 4).⁷ The standard argument for why bank customers are willing to forgo a majority of the interest income they would earn by investing in an alternative riskfree short term security is that transaction deposits embed valuable transaction and liquidity services (e.g., Diamond and Dybvig (1983); Gorton and Pennacchi (1990); Diamond Rajan

⁷ A regression of the aggregate transaction deposit interest rate on the riskfree rate has a slope coefficient of 0.34 and an R2 of 0.94.

(2000, 2001); Krishnamurthy and Vissing-Jorgenson (2012)). Of course, supplying these liquidity services is costly. The bank has to run a payment system, an ATM network, pay wages for bank tellers and rents on branches, and comply with a regulatory framework. The full costs of transaction deposits are then the interest rate paid, net of the deposit servicing fees charged to customers, plus the expense ratio. Transaction deposit funding is cost advantaged so long as the bank expects its expenses on transaction deposits, net of the deposit fees charged, to be below two-thirds of the riskfree rate. The bottom panels of Figure 4 illustrate this point using our assumed transaction deposit expense ratio of 1.65% and the actual distribution of one-month US Treasury rates from 1960 through 2018.

As Figure 4 makes clear, the cost-advantage of transaction deposits is essentially a bet on whether the riskfree rate is going to average over around 2.5% per year.⁸ Over the period 1960 to 2018, the riskfree rate has averaged just over 4%, such that transaction deposit funding has provided banks with a reliable cost advantage overall. However, during the low interest rate environment of the last ten years of our sample, transaction deposits have cost banks more than riskfree capital market funding. Over this same period of no cost advantage, the aggregate banking sector has seen a meaningful inflow of transaction deposits, adding an interesting wrinkle to the traditional liquidity supply story. For example, Gatev and Strahan (2006) argue and provide evidence that liquidity provision by banks involves bank deposits becoming safer relative to their closest capital market substitutes in periods of poor economic conditions, while the demand for credit increases, allowing banks to experience relatively advantageous business opportunities in economic downturns. Also, at these times it appears that the cost advantage of transaction deposit funding can disappear.

⁸ With an expense ratio of 1.65%, the break-even riskfree rate is 2.5%, as derived from $R^* = (1/3) R^* + 1.65\%$.

An important implication of this view of transaction deposits, as effectively swapping a relatively stable expense ratio for a reduced interest payment, is that this technology does nothing to mechanically offset their asset interest rate exposure. This does result in a fairly stable funding cost, but precisely because it is essentially invariant to interest rates it will not be able to eliminate the consequences of interest rate shocks to the asset portfolio. It is useful to clarify two ways in which interest rates affect bank cash flows. One is the level of the short-term riskfree rate. The second is the value consequence for an interest rate sensitive security to a change in the term structure of interest rates, typically assessed via duration calculations and time series regressions of market excess returns on a TERM factor (e.g. the market return on a 5-yr UST portfolio in excess of the one-month US T-bill return). The point here is that funding with the short-term riskfree rate and funding at the full-cost of a transaction deposit account – that is mostly invariant to interest rates – results in essentially identical TERM exposures.⁹ As illustrated at the beginning of this section, removing the effects of the level of the short-term riskfree rate from the accounting returns can result in a nearly constant NIM if this objective was to be explicitly targeted, but this does not imply interest rate hedging in the traditional asset pricing sense.

Overall, the analysis suggests there is a reliable cost advantage to transaction deposits, although it has not realized as such over the very low interest rate period at the end of our sample. Nonetheless, this appears to be a relatively attractive bet with our assumed transaction deposit expense ratio of 1.65% and a long-term forecast of the riskfree rates resembling

⁹ For transaction deposits to effectively hedge the asset interest rate exposure, they would need to have an effective TERM exposure equivalent to 5-year bonds, but the interest rate paid on transaction deposits looks nothing like the implied interest rate on a portfolio of five-year bonds. Additionally, this would imply transaction deposit customers paying a much larger liquidity premium than conventional estimates (e.g., Krishnamurthy and Vissing-Jorgenson (2012); Nagel (2016)).

something close to its historical distribution. It is interesting that time deposits have such a large funding share, given that they appear to offer no advantage. Second, there is no evidence of a role for transaction deposits to effectively hedge asset interest rate exposure. Finally, there remains the possibility that transaction deposits, and potentially time deposits too, provide additional benefits in the form of financial stability, which we investigate in the next section.

D. Bank Loans

We build on the simple maturity-matched UST portfolio benchmark by adjusting for both operating expenses and credit risk. Subtracting the assumed expense ratio brings the mean average risk premium down to 0.75% per year, which is in-line with risk premia earned elsewhere in the capital market on portfolios of reasonably high-quality credit exposure over this period. The primary question is whether the nature of the bank loan credit losses is somehow materially different from other types of credit losses, which would create a unique risk profile for the bank loan portfolio.

Figure 5 displays the time series of credit losses for the three major categories of bank loans. The majority of the loan portfolio is classified as being backed by real estate, including both residential and commercial properties, followed by business loans, and consumer loans. Consumer credit includes both credit cards and auto loans. Business loans exhibit a somewhat different time series pattern than the other two series, realizing relatively large losses in both the 2001 and 2008 recessions, while the losses in the real estate and personal loan portfolios are concentrated in the 2008 recession. There are effectively two systematic components to the credit risk in the aggregate bank loan portfolio, one related to corporate assets and one related to real estate.

We examine the annual loss rates for investment grade and speculative corporate bonds from Moody's Investor Services to determine whether an appropriate mix can proxy for the bank business loan portfolio. A simple, constant weight portfolio, that mixes 70% investment grade corporate bonds with 30% speculative grade bonds has a similar loss pattern to the bank business loan portfolio and has the same average loss rate over this sample period.

It is interesting that the consumer loans appear to share a common risk profile with the real estate loans, perhaps because the balance sheet of the typical household is dominated by their real estate asset (Mian and Sufi, 2011; Keys, Piskorski, Seru, and Yao, 2014; Adelino, Schoar, and Severino, 2015). A regression of the time series of consumer loan loss rates on the real estate loss rates confirms a strong relation. Specifically, the intercept is 2.2%, the slope coefficient is 1.7, and the R2 is 0.84. Consequently, we view the consumer loan portfolio to be well proxied with a levered exposure to the real estate portfolio, leaving a large idiosyncratic loss rate averaging 2.2%.

To calculate a capital market benchmark for the aggregate loan portfolio, we estimate the credit risk premia for the corporate bond portfolio and a traded real estate loan portfolio, as well as the associated management fees, which we add to the maturity-matched UST portfolio calculated in the previous section. Calculating the accounting returns to these portfolios requires information on the portfolio loss rates. The details of these calculations are in the appendix.

Panel 2 of Figure 6 displays the time series of bank loan returns, net of operating expenses, along with our capital market benchmark that includes both a maturity and credit risk match, measured net of management fees. Table 3 reports results from regressions of the quarterly bank loan portfolio return on the capital market benchmark return. The regressions produce an intercept that is statistically indistinguishable from zero, a slope coefficient that is

statistically indistinguishable from one, and an R2 of 0.91, suggesting that, in the aggregate, the bank loan portfolio has covered its opportunity cost of capital, but has not earned reliably more.

E. Trading & Services

The mean accounting returns for the trading and services category are heavily impacted by our assumption about operating expenses. After subtracting operating expenses, the mean return is 2.7% per year. Figure 6 displays the time series of the accounting returns, along with the riskfree rate. It is not clear that the riskfree rate is the most appropriate benchmark for this category, as the meaningfully lower returns during the 2008 recession suggest there is a systematic risk component to these cash flows. The regression analysis reported in Table 3 confirms that this benchmark leaves most of the time series variation unexplained. Based on this benchmark, this category appears to be generating a reliable edge, generating 0.7% per year more than the benchmark. This is perhaps the result of additional benefits of the bank loan and deposit activities that are not reflected in the associated cash flows and perhaps partially because of the conservative benchmark. We revisit the risk properties of this category in the next section.

F. A Longer-Term Perspective

As a reality check on the analysis, we compare the loan returns and the deposit costs for the commercial banking sector using the aggregate annual data provided by the FDIC to maturity-matched US Treasury portfolios. The FDIC data begin in 1934, although to compare to maturity-matched US Treasury portfolios, this analysis begins in 1960. This allows us to compare returns through the interest rate spike in 1981 and to evaluate relative performance over the long-term decline in interest rates since then. The benchmark portfolios are defined based on the maturity distributions measured since 1997, so they are not necessarily accurate as we extend back in time. Additionally, the interest costs of total deposits are not separately available for transaction

and time accounts, so the combined deposits are assumed to have a similar proportion as in the recent sample when constructing the UST benchmark.

Figure 7 displays the annual pre-expense (and pre-tax) loan returns in Panel A, and the annual deposit rates in Panel B, each reported after subtracting the annual returns of a maturity-matched US Treasury portfolio. The pre-expense loan return, in excess of the maturity-matched UST portfolio return, measures the pre-expense credit risk premium for the aggregate loan portfolio. The figure also displays the assumed loan expense ratio (1.7%) as a point of reference. There is no meaningful trend in the loan risk premium. The overall mean of the pre-expense loan credit risk premium is 2.2% and has essentially the same mean in both halves of the sample. Assuming a constant expense ratio of 1.7%, the realized credit spread averages 50bps per year.

The total deposit rate paid minus the maturity-matched UST portfolio for total deposits (transaction + time) is referred to as the pre-expense deposit edge. The deposit edge has a clear downward trend over the sample. The overall pre-expense deposit edge is 2.1%, averaging 2.9% in the first half of this sample (1960-1988) and 1.4% in the second half of the sample (1989-2017). Although no specific model of deposits is well identified from these data, the time series pre-expense deposit edge is consistent with the notion that transaction deposits provide a funding advantage, so long as the short-term riskfree rate is over some break-even level, which we estimated to be 2.5%.

G. The Bottom Line

The overall impression from Figure 6 is that operating expenses and risk premia have had a significant impact in improving the explanatory power of the capital market benchmarks. The majority of the aggregate bank balance sheet is well explained by simple passive capital market portfolios comprised entirely of bonds that are easily tradable. The two categories that appear to

offer an edge are the transaction deposits and the trading + services. Of course, inferences about specific categories are sensitive to the allocation of operating expenses across bank activities.

A natural way to summarize these results is to examine the accounting return on equity, which effectively sums across all of these activities, thereby eliminating the need to assume how operating expenses should be allocated. We calculate the aggregate accounting return on equity as net income divided by book equity. Note that this also accounts for the corporate taxes paid by banks, which are not paid by the capital market benchmarks. The capital market equivalent return on equity is simply the weighted sum of the net cash flows generated by the assets, less the net cash flows paid by the liabilities, all divided by book equity. Another important distinction between the two portfolios is that the capital market portfolio trades at a market-to-book ratio of 1.0, while the aggregate banking sector equity portfolio trades at an average market-to-book ratio of 1.7 over this sample period, such that the return on actual bank equity is only 60% of the book equity return.

Figure 8 displays the time series of quarterly accounting returns on equity (annualized) for the aggregate banking sector and the capital market benchmark. The mean returns are similar, averaging 6.55% for the aggregate banking sector and 6.48% for the capital market portfolio. Adjusting for the difference in market-to-book ratios makes the average capital market benchmark return significantly more attractive than the bank return (i.e. the bank return falls to 3.9%). A regression of the bank returns on the capital market returns has a slope coefficient of 0.86 (not reliably different from 1), and an R² of 0.64, highlighting that this simple passive benchmarking methodology has explained the majority of the time series variation in banking sector net cash flows. The most notable failure of the benchmark to match the bank accounting

returns occurs during the 2008 recession, largely because the trading + services are benchmarked with the riskfree rate.¹⁰

The high R2 produced by the capital market benchmark portfolio comprised entirely of bonds pushes directly against the view that banks have either explicitly hedged their interest rate exposure with derivatives, or effectively hedged their interest rate exposure via a deposit channel. In particular, an implication of the view that a constant NIM indicates complete hedging predicts that this benchmarking methodology will produce an R2 near zero.

We also investigate more directly whether banks have explicitly hedged their interest rate exposure. To do so, we make use of disclosures on banks' hedging activities. From 2000 to 2006, banks had to report the impact on net income from hedging with derivatives. In a declining interest rate environment (from 2000Q1 – 2004 Q2), explicit hedging against interest rate risk exposure will lead to losses on the hedging derivative positions, thus lowering banks' net income. Instead, banks report that their hedging efforts *increase* net income over this period by 8 bps relative to assets, while the 5-year UST yield steadily declined from over 6.5% to under 3%. For a longer time series perspective on hedging activities, we look into the effective portion of banks' cash flow hedges in other comprehensive income for which we have data from 1998 until 2016. This allows us to calculate what net income would have been without banks' hedging activities. Again, over a period of declining interest rates, hedging activities increase bank net income. Our casual reading of annual reports suggests that much of the explicit interest rate hedging is designed to offset the *positive* relation between interest rate shocks and quarterly

¹⁰ This is an important property of the benchmark to keep in mind when we investigate the financial stability properties of the bank operating structure relative to a capital market investment portfolio. In the interest of transparency, we restrict the benchmark portfolio to be comprised entirely of bonds in this section, particularly because of the focus here is on accounting returns. We investigate whether an additional equity like systematic exposure improves the overall fit in the next section, where market returns will be the focus.

earnings, which *adds* interest rate exposure as defined in an investment context where one is concerned about the negative value consequence of a positive interest rate shock.¹¹ Rampini, Viswanathan, and Vuillemeys (2019) show that few banks actively hedge their interest rate exposure. Relatedly, Begenau, Piazzesi, and Schneider (2015) show that interest rate derivatives held for trading (as opposed to hedging) also *increase* the balance sheet interest rate exposure.

IV. The Relative Financial Stability offered by the Bank Operating Structure

In this section we investigate whether the bank operating structure is financially more stable than capital market investment vehicles that bear similar risks as banks.¹² Many theories of banking describe the situation where banks invest in illiquid longer-term assets, funded with short-term demandable debt, as liquidity provision (e.g. Diamond and Dybvig (1983), Gorton and Pennachi (1990), Diamond and Rajan (2001), Dang, Gorton, Holmström, and Ordonez (2017)).¹³ As a capital market investment strategy, one would expect to earn an illiquidity risk premium since liquidity tends to dry up during economic downturns. As a corporate business model, one would expect that capital providers demand a similar risk premium unless there were additional elements of the operating structure, presumably unavailable to the capital market investor, that mitigate these risks. Government-insured deposits offer a potential benefit to banks

¹¹ For example, see page 121 in the JP Morgan Chase & Co. Annual Report 2016, <https://www.jpmorganchase.com/corporate/investor-relations/document/2016-annualreport.pdf>.

¹² For example, it is often suggested that because bank deposits are guaranteed by the US government, banks are able to receive the benefits of higher leverage without incurring the costs of financial distress that would otherwise be incurred. Note that we are comparing to the costs of financial distress that would be incurred by a capital market investor rather than to a bank that does not have guaranteed deposits.

¹³ Shleifer and Vishny (1992) analyze the equilibrium aspects of illiquid assets for corporations and identify forced asset sales as a potential cost of financial distress. Shleifer and Vishny (1997) focus this insight on a capital market setting, showing how uncertainty over the value of illiquid assets can lead to difficulty securing funding at a time of good investment opportunities, which they label the limits of arbitrage.

as they allow for stable funding of illiquid assets. Note that the benchmarking procedure makes no adjustments for asset illiquidity.

Each month from January 1997 to December 2018, we form a value-weighted portfolio including all publicly traded stocks in the banking sector based on Fama and French (1997) industry definitions. We compare the risk properties of the bank stock portfolio to a variety of passive capital market risk exposures, or factor returns. Factor returns are zero-investment portfolios, typically calculated as excess returns (i.e. in excess of the one-month US T-bill rate). In the case of our credit factors, these returns are in excess of the returns of a maturity-matched US Treasury portfolio. To capture banks' term exposure, we consider a TERM factor, calculated as the return on a 5-year constant maturity US Treasury bond in excess of the one-month US T-bill rate. To capture the different nature of banks' credit portfolio we consider a MORTGAGE factor, calculated as the value weighted portfolio return on all mortgage-related mutual funds in excess of the riskfree rate; an IG factor, calculated as the return on the Vanguard Short-term Investment Grade corporate bond index in excess of the Vanguard Short-term UST bond index; and a HY factor, calculated as the Vanguard Intermediate-term High Yield corporate bond index in excess of the Vanguard Intermediate-term UST bond index. We also include the excess return on the value weighted aggregate stock market portfolio.

Figure 9 and Table 5 summarize the bond market factors. The first thing to note is that the TERM factor has experienced excellent investment performance over this period, while the credit factors (i.e. MORTGAGE, IG, and HY) have not. The TERM risk premium averages 2.6% per year over this period with an annualized standard deviation of 4% and has a worst drawdown of only -4%. Figure 9 shows that the TERM risk premium accumulated investor wealth at a greater rate than any of the other bond market risk premia over this sample period. The bulk of the credit risk in the aggregate bank loan portfolio is related to mortgages, which experiences the

lowest mean return among the capital market credit risk factors, averaging approximately zero per year over the 22-year sample period. The MORTGAGE risk premium realizes risks that are more severe than the investment grade corporate bond portfolio and less severe than the high yield investment grade bond portfolio. The IG portfolio has a very small CAPM beta of 0.06 and experiences a drawdown in 2008 of about -10%.¹⁴ The HY portfolios has a larger CAPM beta of 0.38 and experiences a worst drawdown of nearly -40%. The MORTGAGE portfolio has a CAPM beta of 0.09 and a worst drawdown of almost -20%. Both of the corporate bond risk premia portfolios realize positive mean returns.

We determine the risk exposures for the bank equity capital market benchmark as in the previous section, by summing the various risk exposures across each activity to produce portfolio weights for a bank-like mutual fund (see Table 4). The cash-equivalent portions of the total assets are nearly perfectly offset by the cash-equivalent portions of the liabilities. This leaves just interest rate term exposure and credit risk. We calculate the amount of TERM exposure per dollar of invested capital (i.e. equity) by netting cash-equivalent assets and liabilities and calculating the asset and debt deltas for the non-cash-equivalent components. Deltas measure the value sensitivity of an asset or portfolio to interest rate shocks, sometimes referred to as the dollar value of a basis point (DV01) in the context of bonds. Specifically, we calculate portfolio deltas as the value change caused by a 1% increase in the market interest rate (i.e. yield to maturity for each bond). These sensitivities are measured in dollars and are thus additive, allowing us to calculate net exposures, as is done in practice for hedging bond portfolios. We calculate that the bank equity is exposed to 2 units of the 5-year TERM factor. Similarly, we

¹⁴ The monthly drawdown time series is calculated as the current level of the total return index measured as a percentage difference from its historical maximum level.

calculate the credit exposure based on the composition of the aggregate loan portfolio, scaled by the share of book equity. Since, the consumer loans are modelled as a levered exposure to real estate, almost all of the credit risk exposure is to the MORTGAGE factor. Specifically, we estimate that the bank equity capital market benchmark is exposed to 3.06 units of the MORTGAGE factor, 0.53 units of IG, and 0.23 of HY.

The bank-like mutual fund generates attractive investment returns when evaluated by the CAPM risk model (Table 5). A regression of the portfolio excess returns on the excess returns of the aggregate value-weighted stock market has an annualized alpha (intercept $\times 12$) of 3.5% (t -statistic is 1.98) and a CAPM beta of 0.24. This compares favorably to the aggregate bank equity portfolio, which has an annualized alpha of -1% (t -statistic is -0.40) and a CAPM beta of 1.10. Additionally, during the 2008 recession, the bank-like mutual fund experiences a drawdown in the index of traded prices of about -50%, while the bank equity portfolio has a drawdown of about -75% (left panel of Figure 10).

It is interesting that the bank equity and the market returns to the benchmark portfolio trade so differently since the cash flows generated by the benchmark portfolio track those of the bank portfolio quite closely. A regression of the bank equity portfolio on the individual bond market factors reveals that bank equities trade as if they have no TERM, MORTGAGE, IG, or HY exposure, instead they trade like other stocks. The adjusted R^2 from a regression that includes only the stock market factor is 0.62 and does not increase with the addition of the bond market factors.

Of course, the benchmark portfolio does not perfectly explain all of the net cash flows to the banking sector. The unexplained component of the bank cash flows may contribute additional risks. The specific source of these risks is not clear, but the banking literature suggests they are related to illiquidity and the limits of arbitrage literature (Shleifer and Vishny (1992, 1997))

suggests they arise from fears over adverse selection due to information asymmetries about the asset portfolio and the costs of financial distress. To reconcile the large difference in CAPM betas, these omitted risks must have a highly systematic risk profile. In fact, the worst bank drawdown is 50% larger than that of the aggregate stock market, suggesting these risks may have some downside nonlinearity. Risks that are concentrated in especially bad economic states are expected to earn large risk premia. The corporate credit portfolios earn positive returns over this sample, the aggregate stock market earns positive returns over this sample, and other downside risks traded in the capital market tend to earn positive returns over this sample. For example, Jurek and Stafford (2015) show that put writing portfolios designed to mimic the systematic downside risk of an aggregate hedge fund index earn economically large risk premia over a similar sample period that includes the 2008 recession. A simple, and conservative, way to illustrate how bank equities appear to have not covered their risk-adjusted cost of capital is to force the bank-like mutual fund to also bear enough stock market risk to match the CAPM beta of the bank equity portfolio. This brings the risk properties of the capital market benchmark closer to those of bank equities, but also generates an additional 5.8% of annual risk premium, resulting in the same annualized CAPM alpha of 3.5% and a Sharpe ratio that is roughly double that of the bank equity portfolio (right panel of Figure 10 and Table 5).

Another interesting feature of the drawdown patterns is that the price level of the bank equity portfolio remains depressed for a relatively long period after both the aggregate stock market portfolio and the bank-like mutual fund portfolio recovered. This is inconsistent with the view that banks are able to exploit their privileged funding advantage at times of market stress when investment opportunities are best. Rather, this is more consistent with banks being relatively constrained when compared to other corporations or the benchmark portfolio designed to match their underlying exposures. The fact that banks were large issuers of equity following

the 2008 recession is also consistent with the notion that banks were relatively constrained (see Black, Floros, and Sengupta, 2016).

Another conventional view that is challenged by these results is that the government is taking the really bad risks off the table, lowering the required return for banks. The capital market portfolio – without the risk reducing insurance – appears to be bearing this credit risk more efficiently with less overall market exposure. This suggests that perhaps real-world banking frictions create additional risks that are not being properly compensated. Overall, these results push against the view that the bank operating structure mitigates the risks that a capital market investor would face with a portfolio comprised of highly similar risk exposures.

V. Conclusion

This paper studies the cash flow performance of each component of the aggregate banking sector balance sheet relative to passive capital market portfolios with similar interest rate and credit risk. Our empirical analysis identifies three categories of bank activities. First, the core activities of credit supply in the form of loans and facilitating consumer transactions through transaction deposits have a pre-expense edge. Bank loans account for approximately one-half of bank assets and transaction deposits account for approximately one-half of bank liabilities. Second, there is a large share of bank activities that are essentially equivalent to passive mutual funds with no pre-expense advantages. This large portion of the business model with no edge is subject to corporate taxes that are not incurred by mutual funds that allow for the tax-free pass-through of investment income. Third, there are the residual bank activities, not well described by simple interest rate and credit risk exposures, that contribute systematic risks and negative mean returns over our sample.

Overall, the edge in bank activities is too small to cover operating expenses. Fin-tech companies and other non-bank financial service providers are expanding (Buchak, Matvos, Piskorski, and Seru, 2018) and increasing the competitive pressures on banks. Thus, the prospects for the edge improving seem low, leaving reduced operating expenses as the more viable outcome to achieve efficiency in the sense of Fama (1985). The steady and unexpected decline in interest rates since 1981 (Fama, 2006) has been a significant tailwind for the bank business model that cannot be counted on to continue in the future. In addition, transaction deposits provide an advantaged funding source so long as the short-term riskfree rate exceeds some threshold, which we estimate to be around 2.5%. At the end of our sample, the yield on 30yr US Treasury bonds is around 2%, forecasting a long period of transaction deposits providing no funding advantage.

References

- Adelino, M., Schoar, A. and Severino, F., 2015. House prices, collateral, and self-employment. *Journal of Financial Economics*, 117(2), pp.288-306.
- Admati, Anat, Peter DeMarzo, Martin Hellwig, and Paul Pfleiderer, 2013. Fallacies, Irrelevant Facts, and Myths in the Discussion of Capital Regulation: Why Bank Equity is Not Socially Expensive. Stanford working paper.
- Baker, Malcolm and Jeffrey Wurgler, 2015. Do Strict Capital Requirements Raise the Cost of Capital? Bank Regulation, Capital Structure and the Low Risk Anomaly. *American Economic Review: Papers and Proceedings* 105, no. 5, 315-320.
- Begenau, Juliane, Monika Piazzesi, Martin Schneider, 2015. Banks' Risk Exposure. Stanford working paper.
- Black, Fischer, 1975. Bank Funds Management in an Efficient Market. *Journal of Financial Economics* 2, 323-339.
- Black, L., Floros, I.V. and Sengupta, R., 2016. Raising capital when the going gets tough: US bank equity issuance from 2001 to 2014. Federal Reserve Bank of Kansas City Working Paper, (16-05).
- Brunnermeier, M.K. and Koby, Y., 2018. The reversal interest rate (No. w25406). National Bureau of Economic Research.
- Buchak, G., Matvos, G., Piskorski, T. and Seru, A., 2018. Fintech, regulatory arbitrage, and the rise of shadow banks. *Journal of Financial Economics*, 130(3), pp.453-483.
- Cochrane, John, 2014. *Across the Great Divide: New Perspectives on the Financial Crisis*, Martin Neil Baily, John B. Taylor, eds., Hoover Press.
- Dang, T.V., Gorton, G., Holmström, B. and Ordonez, G., 2017. Banks as secret keepers. *American Economic Review*, 107(4), pp.1005-29.
- Di Tella, S. and Kurlat, P., 2017. Why are banks exposed to monetary policy? (No. w24076). National Bureau of Economic Research.
- Diamond, D.W. and Dybvig, P.H., 1983. Bank runs, deposit insurance, and liquidity. *Journal of political economy*, 91(3), pp.401-419.
- Diamond, D.W., 1984. Financial intermediation and delegated monitoring. *The Review of Economic Studies*, 51(3), pp.393-414.
- Diamond, D.W. and Rajan, R.G., 2000. A theory of bank capital. *The Journal of Finance*, 55(6), pp.2431-2465.

- Diamond, D.W. and R.G. Rajan., 2001. Liquidity risk, liquidity creation and financial fragility: a theory of banking. *Journal of Political Economy*, 109, pp. 287–327
- Donaldson, J.R., Piacentino, G. and Thakor, A., 2018. Warehouse banking. *Journal of Financial Economics*, 129(2), pp.250-267.
- Drechsler, I., Savov, A. and Schnabl, P., 2017. The deposits channel of monetary policy. *The Quarterly Journal of Economics*, 132(4), pp.1819-1876.
- Drechsler, I, Savov, A. and Schnabl, P., 2018. Banking on Deposits: Maturity Transformation without Interest Rate Risk, working paper.
- Egan, Mark, Lewellen S., and Sunderam, A., 2018. The cross section of bank value. No. w23291. National Bureau of Economic Research.
- English, W.B., Van den Heuvel, S.J. and Zakrajšek, E., 2018. Interest rate risk and bank equity valuations. *Journal of Monetary Economics*, 98, pp.80-97.
- Fama, Eugene F, 1985. What’s Different about Banks? *Journal of Monetary Economics* 15, 29-39.
- Fama, Eugene F, 2006. The Behavior of Interest Rates. *The Review of Financial Studies* 19, no. 2, 359-379.
- Fama, Eugene F, and Kenneth R. French, 1997. Industry Costs of Equity. *Journal of Financial Economics* 47, 153-193.
- Farhi, E. and Tirole, J., 2012. Collective moral hazard, maturity mismatch, and systemic bailouts. *American Economic Review*, 102(1), pp.60-93.
- Federal Housing Finance Agency. 2018. Fourth Quarter 2018 Prepayment Monitoring Report
- Flannery, M.J. and James, C.M., 1984. The effect of interest rate changes on the common stock returns of financial institutions. *The Journal of Finance*, 39(4), pp.1141-1153.
- Flannery, M.J. and James, C.M., 1984. Market evidence on the effective maturity of bank assets and liabilities. *Journal of Money, Credit and Banking*, 16(4), pp.435-445.
- Gatev, Evan and Philip Strahan, 2006. Banks’ Advantage in Hedging Liquidity Risk: Theory and Evidence from the Commercial Paper Market. *The Journal of Finance* 61, 867-892.
- Gomez, M., Landier, A., Sraer, D.A. and Thesmar, D., 2019. Banks' exposure to interest rate risk and the transmission of monetary policy. MIT working paper.
- Gorton, G., and G. Pennacchi, 1990. Financial intermediaries and liquidity creation. *The Journal of Finance*, 45, pp. 49–71.
- Han, J., Park, K. and Pennacchi, G., 2015. Corporate taxes and securitization. *The Journal of Finance*, 70(3), pp.1287-1321.

- Hanson, S.G., 2014. Mortgage convexity. *Journal of Financial Economics*, 113(2), pp.270-299.
- Hanson, S.G., Shleifer, A., Stein, J.C. and Vishny, R.W., 2015. Banks as patient fixed-income investors. *Journal of Financial Economics*, 117(3), pp.449-469.
- Jurek, Jakub, and Stafford, E. 2015, "The Cost of Capital for Alternative Investments," *The Journal of Finance* 70, 2185-2226.
- Kashyap, Anil K., Rajan, R., and Stein, J.C., 2002. Bank as Liquidity Providers: An Explanation for the Coexistence of Lending and Deposit Taking. *The Journal of Finance* 57, no. 1, 33–73.
- Kelly, B., Lustig, H. and Van Nieuwerburgh, S., 2016. Too-systemic-to-fail: What option markets imply about sector-wide government guarantees. *American Economic Review*, 106(6), pp.1278-1319.
- Keys, B.J., Piskorski, T., Seru, A. and Yao, V., 2014. Mortgage rates, household balance sheets, and the real economy (No. w20561). National Bureau of Economic Research.
- Krishnamurthy, Arvind, and Annette Vissing-Jorgensen. The aggregate demand for treasury debt. *Journal of Political Economy* 120, no. 2 (2012): 233-267.
- Merton, Robert C., 1989. On the Application of the Continuous-Time Theory of Finance to Financial Intermediation and Insurance. *The Geneva Papers on Risk and Insurance* 14, 225-261.
- Merton, Robert C., 1990. The Financial System and Economic Performance. *Journal of Financial Services Research* 4, 263-300
- Merton, Robert C., 1993. Operation and Regulation in Financial Intermediation: A Functional Perspective. in *Operation and Regulation of Financial Markets*, edited by Peter Englund, Stockholm, Sweden: The Economic Council, 17-67.
- Merton, Robert C. and Z. Bodie, 1993. Deposit insurance reform: a functional approach. In *Carnegie-Rochester Conference Series on Public Policy* (Vol. 38, pp. 1-34). North-Holland.
- Merton, Robert C. and Z. Bodie, 1995. A conceptual framework for analyzing the financial system. *The global financial system: A functional perspective*, pp.3-31.
- Mian, A. and Sufi, A., 2011. House prices, home equity-based borrowing, and the US household leverage crisis. *American Economic Review*, 101(5), pp.2132-56.
- Miller, Merton H, 1995. Do the M & M propositions apply to banks? *Journal of Banking & Finance* 19, no. 3, 483-489.
- Musto, D., Nini, G. and Schwarz, K., 2018. Notes on bonds: Illiquidity feedback during the financial crisis. *The Review of Financial Studies*, 31(8), pp.2983-3018.

- Nagel, S., 2016. The liquidity premium of near-money assets. *The Quarterly Journal of Economics*, 131(4), pp.1927-1971.
- Petersen, Mitchell A., and Raghuram G. Rajan. "The benefits of lending relationships: Evidence from small business data." *The journal of finance* 49, no. 1 (1994): 3-37.
- Philippon, Thomas, 2015. Has the US finance industry become less efficient? On the theory and measurement of financial intermediation. *American Economic Review* 105, 1408-38.
- Rampini, A.A., Viswanathan, S. and Vuillemeys, G., 2019. Risk management in financial institutions. Working paper.
- Schwert, Michael. Does borrowing from banks cost more than borrowing from the market? Forthcoming: *Journal of Finance*
- Shleifer, Andrei, and Vishny, R.W., 1992. Liquidation values and debt capacity: a market equilibrium approach. *The Journal of Finance* 47, 1343–1366.
- Shleifer, Andrei, and Vishny, R.W., 1997. The limits to arbitrage. *The Journal of Finance* 52, 35–55.
- Stafford, Erik, 2016. "Replicating Private Equity with Value Investing, Homemade Leverage, and Hold-to-Maturity Accounting." Harvard Business School Working Paper, No. 16-081

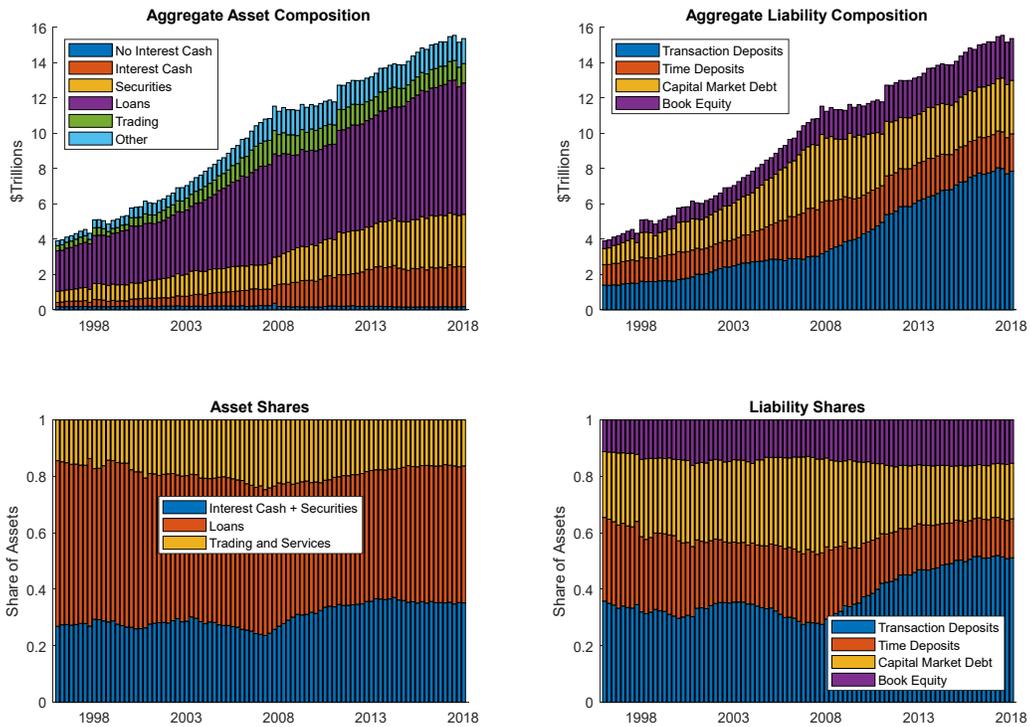


Figure 1. Aggregate Bank Balance Sheet (1997-2018).

The left panels display the dollar amount and shares of bank asset components reported quarterly from 1997Q1 through 2018Q4. Interest earning cash includes Federal funds sold. Loans are separately measured from Interest Bearing Assets. Trading & Services are calculated as the residual (Assets – Interest Bearing Assets). The right panels display the dollar amount and shares of bank liability components. Book equity is calculated as the residual (Assets – Transaction Deposits – Time Deposits).

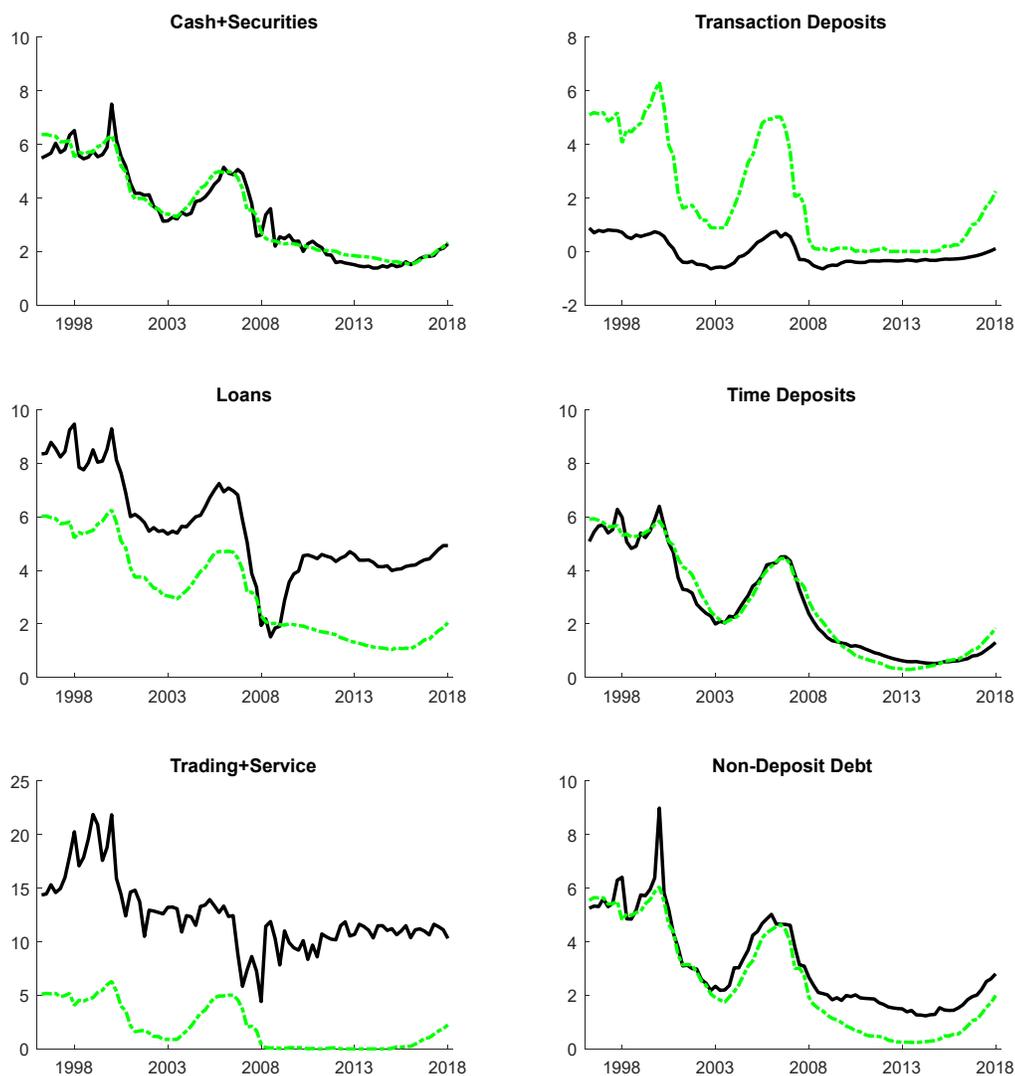


Figure 2. Pre-Expense Bank Activity Returns and Maturity-Matched US Treasury Bond Portfolio Returns (1997-2018).

This figure displays annualized quarterly pre-expense returns for bank activities and maturity-matched US Treasury (UST) portfolios. The UST portfolios are passive strategies that invest in cash and a constant maturity portfolio to match the maturity properties of each bank activity. The constant maturity portfolio invests each month in a h -period US Treasury bond and hold it until maturity, with the average maturity of the bonds in the portfolio equaling $h/2$. UST portfolio returns are calculated based on hold-to-maturity accounting whereby the periodic portfolio value for each holding is measured at historical cost and periodic cash flows are generated by the interest payments and eventual repayment of the holdings. All returns are calculated before subtracting operating expenses and corporate taxes.

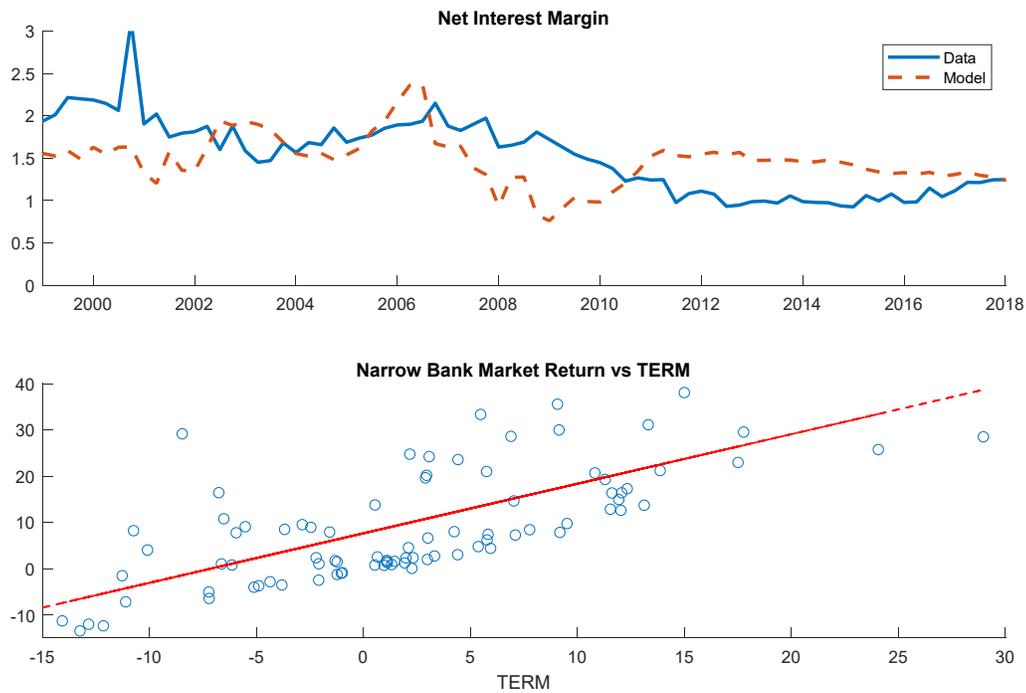


Figure 3. The Relation between a Stable Net Interest Market and Interest Rate Exposure.

This first panel in this figure displays the quarterly net interest margin (NIM) (annualized) based on the securities portfolio funded with time deposits for the aggregate commercial bank sector and for an investment strategy that explicitly targets a stable NIM with a mean of 1.5%. NIM is calculated as interest income minus interest expense, all divided by assets (value of securities). The strategy asset returns are calculated from a passive maturity-matched US Treasury (UST) portfolios. The UST portfolios are passive strategies that invest in cash and a constant maturity portfolio to match the maturity properties of each bank activity. The constant maturity portfolio invests each month in a h -period US Treasury bond and hold it until maturity, with the average maturity of the bonds in the portfolio equaling $h/2$. UST portfolio returns are calculated based on hold-to-maturity accounting whereby the periodic portfolio value for each holding is measured at historical cost and periodic cash flows are generated by the interest payments and eventual repayment of the holdings. The strategy funding comes from an optimization that minimizes the distance between the one-period forecasted NIM and the target NIM, allowing the mix of debt and equity, the cash share, and the longer-term maturity of the UST portfolio to be chosen. The second panel displays a scatter plot of the strategy equity market returns against the market returns of a 5-year UST portfolio.

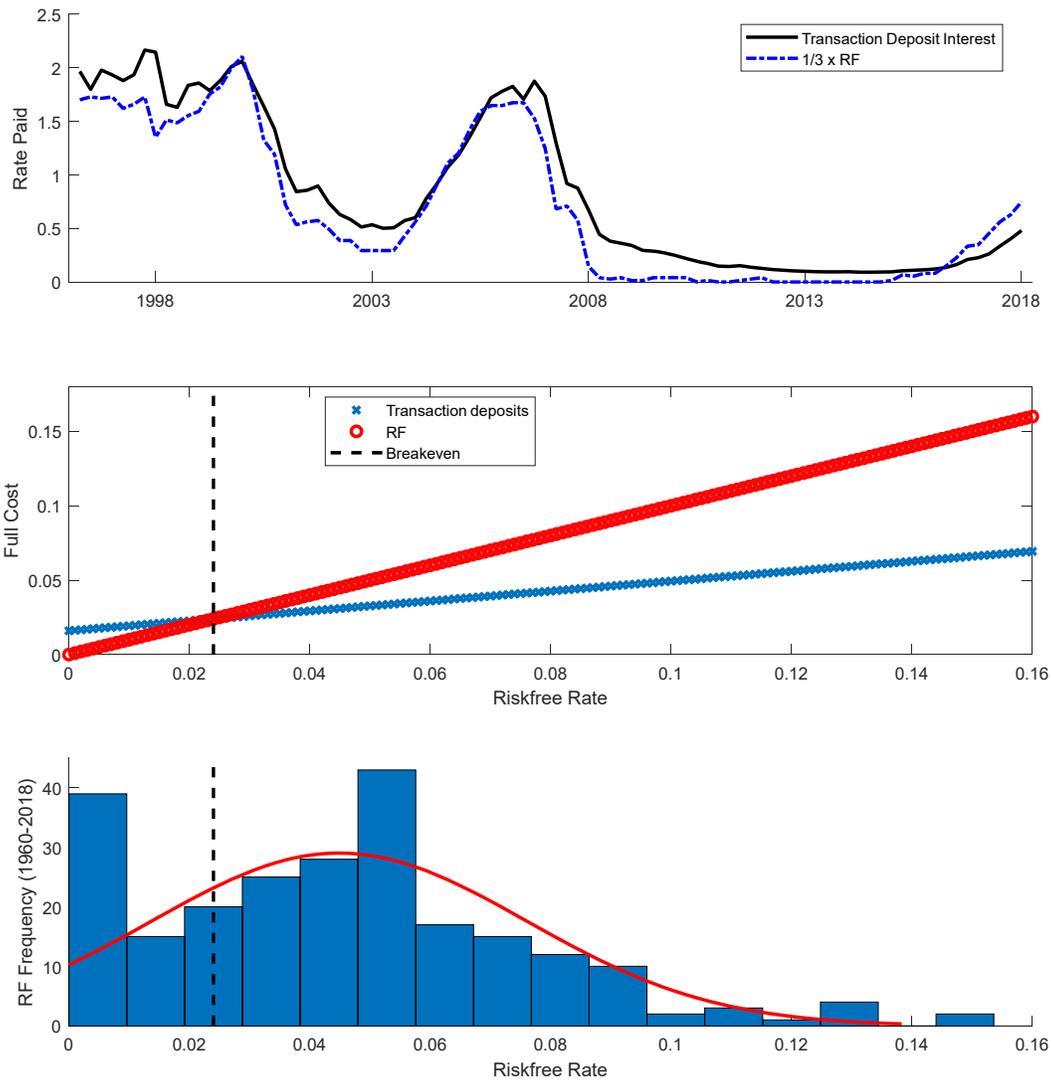


Figure 4. Transaction Deposit Account Costs.

This first panel displays the interest rate paid on the aggregate portfolio of transaction deposit accounts for US commercial banks, along with one-third of the one-month US Treasury bill rate over the period 1997 through 2018. The second panel displays the estimated full cost of funding via either the Riskfree Rate (RF, one-month US T-bill rate) or transaction deposit accounts. The full cost of transaction accounts is calculated as one-third of the riskfree rate plus a constant operating expense of 1.65% per year. These costs are displayed as a function of the level of the riskfree rate. The third panel displays a histogram of the historical riskfree rate over the period 1960 through 2018, and identifies the breakeven level of the riskfree rate, such that the full cost of transaction deposit accounts is lower than the alternative of the riskfree rate at all levels of the riskfree rate above this threshold.

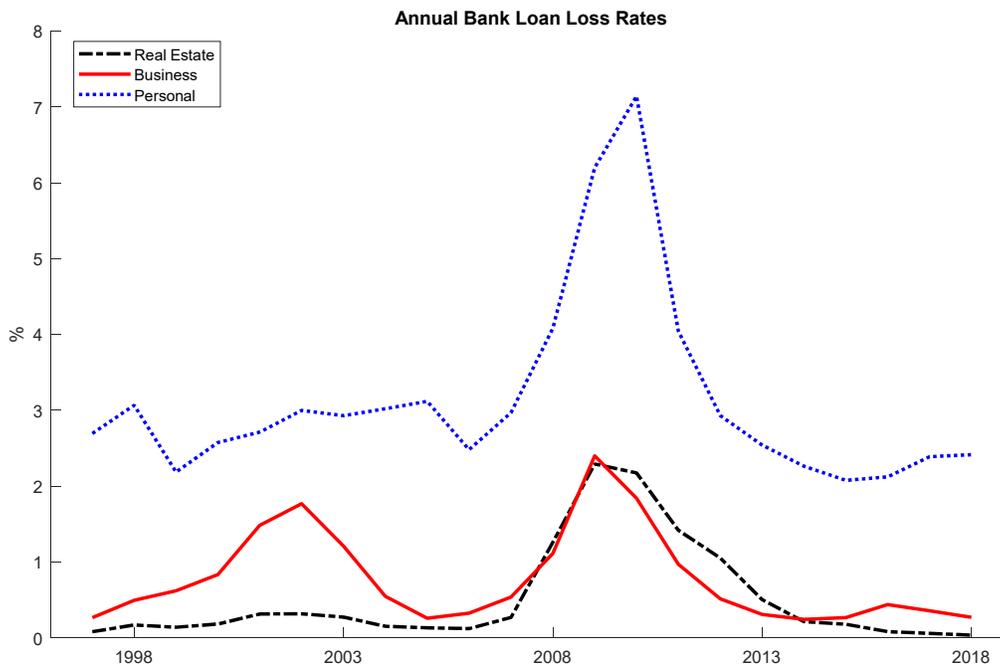


Figure 5. Annual Bank Loan Loss Rates by Loan Category.

This figure displays the annual loss rates (charge-offs less recoveries) in percent for the various loan categories of the aggregate bank loan portfolio. For each category, the quarterly loss rate is calculated as the provision for loan losses divided by the beginning of period gross loan value. The annual rate is calculated by summing the quarterly loss rates for the associated year.

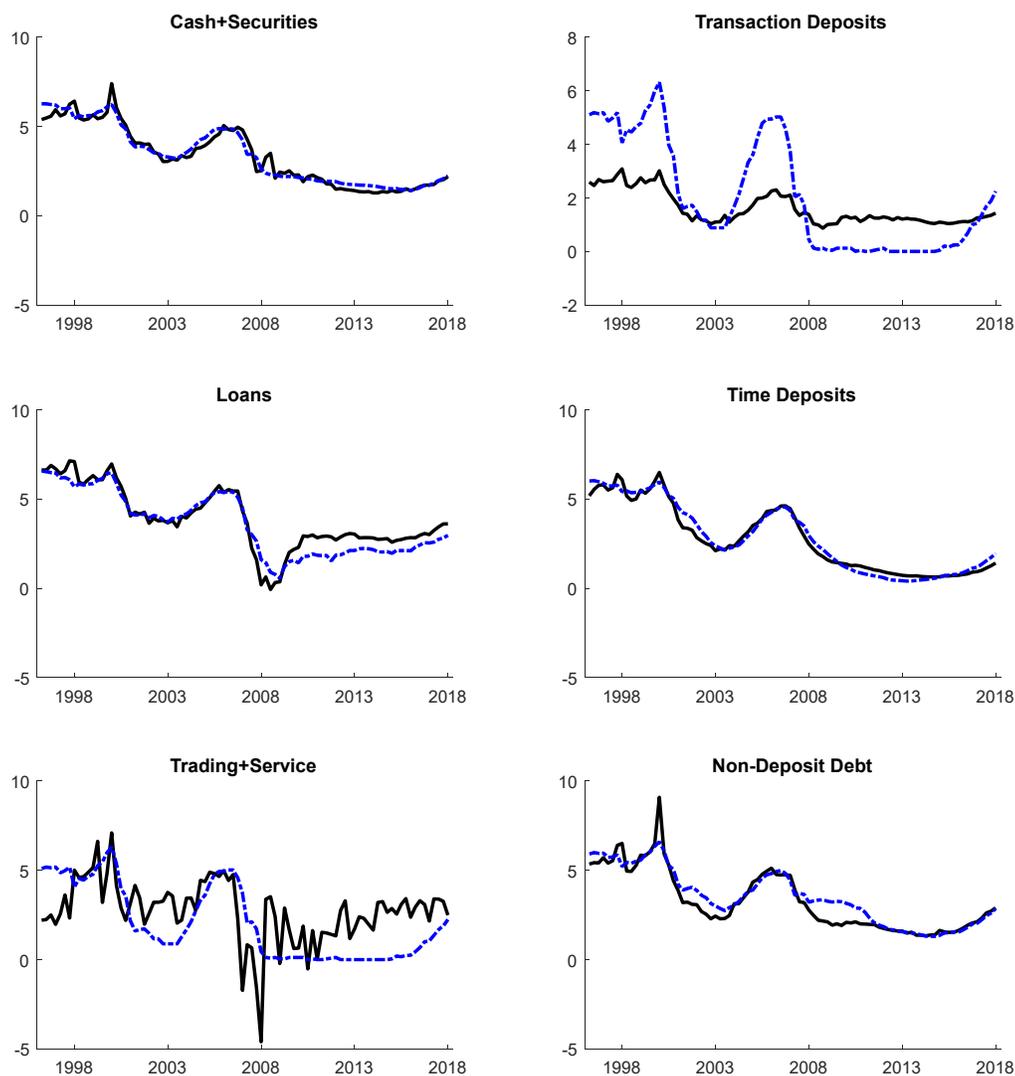


Figure 6. Bank Activity Returns and Capital Market Benchmark Returns (1997-2018).

This figure displays annualized quarterly accounting returns for bank activities and their capital market benchmarks. The capital market benchmark portfolios represent passive strategies that match the maturity and risk properties of each bank activity, and are measured after management fees.

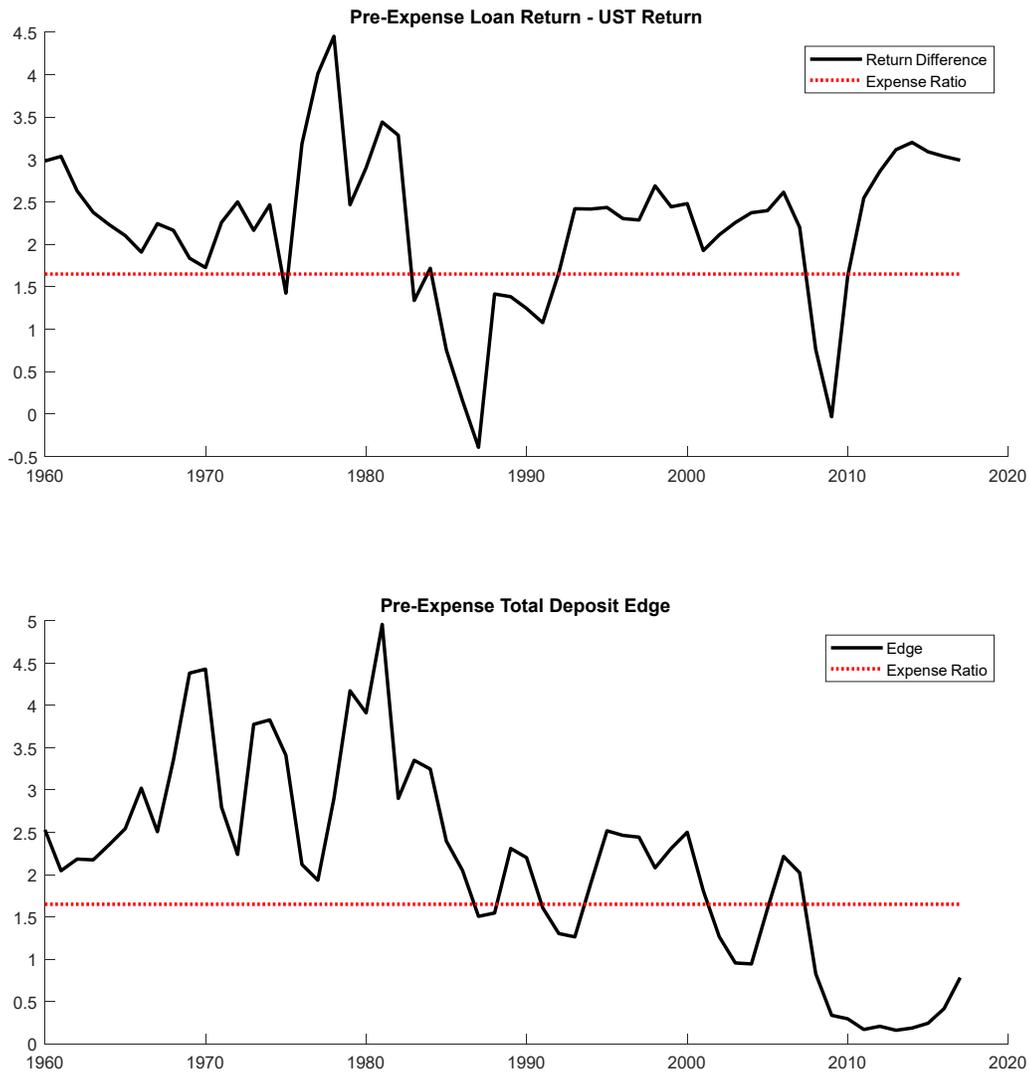


Figure 7. Pre-Expense Loan Returns and Deposits Rates (1960–2017).

This figure displays annual bank loan returns and deposit rates measured in excess of the returns of maturity-matched US Treasury portfolios. The annual bank data are from the FDIC historical aggregate statistics. The UST benchmark returns are based on distribution properties measures from the commercial banking sector over the period 1997 to 2018, and assumed to be stable historically. The expense ratio for both activities is plotted as a point of reference based on the average assumed cost of 1.7%.

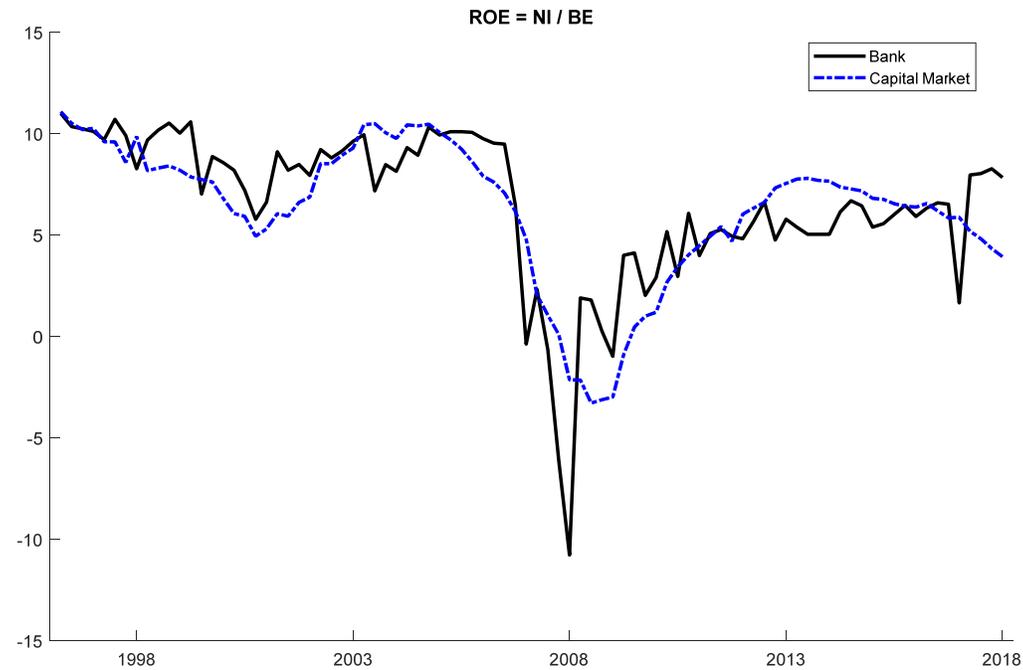


Figure 8. Accounting Return on Book Equity.

This figure displays the quarterly accounting return on equity (annualized) for the aggregate banking sector and for the capital market benchmark portfolio. The accounting return on equity is the aggregate net income divided by book equity. Net income for the banking sector is from the call reports. Net income for the capital market portfolio is the sum of the net of management fee cash flows for the asset benchmarks, minus the sum of the net of management fee cash flows for the liability benchmarks, all divided by book equity.

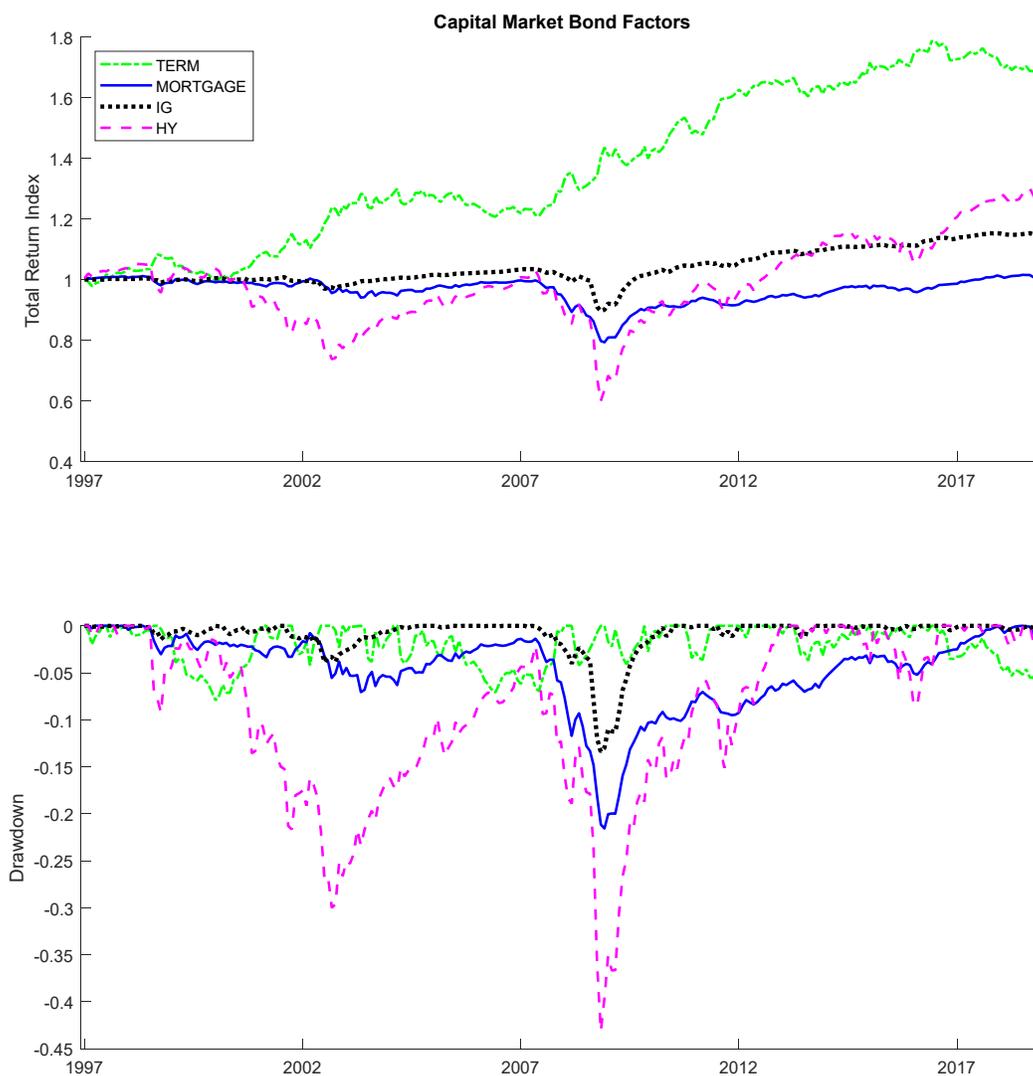


Figure 9. Bond Market Factor Returns.

This figure displays the monthly time series of bond market factor returns, reported as total return indices, and their drawdowns. The TERM factor is the return on a 5-year constant maturity US Treasury (UST) bond minus the one-month US T-bill rate. The MORTGAGE factor is the return on a value-weight portfolio of mortgage-focused mutual funds minus the return on a 4-year constant maturity UST bond. The IG factor is the return on the Vanguard Short-term Investment Grade Corporate Bond Index fund minus the return on the Vanguard Short-term UST Index fund. The HY factor is the return on the Vanguard Intermediate-term Investment Grade Corporate Bond Index fund minus the return on the Vanguard Intermediate -term UST Index fund.

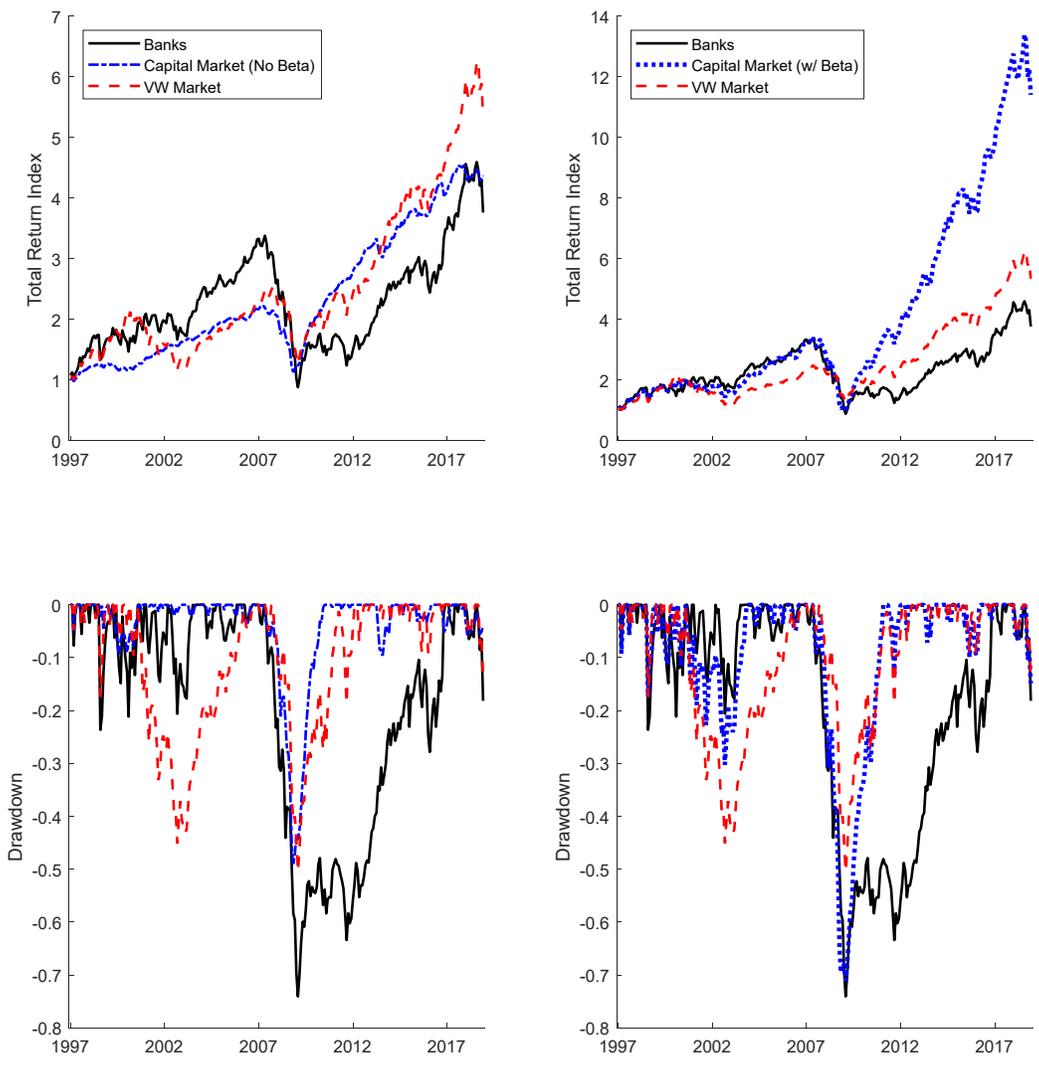


Figure 10. Market-Based Equity Portfolio Returns.

This figure displays monthly time series of various capital market portfolio total return indices and their drawdowns. The portfolios correspond to the value-weighted stock market (VW Market), the value-weighted bank equity index (Banks), and a bank-like mutual fund (Capital Market). The bank-like mutual fund with no beta is comprised of constant weight exposures of TERM, MORTGAGE, IG, and HY (displayed in the left panels) and the version with beta adds a MKT exposure to match the estimated CAPM beta of the Bank portfolio.

Table 1
Pre-Expense Returns by Bank Activity (1997 – 2018)

This table summarizes the returns on various bank activities for US bank holding companies. Panel A reports the asset share and the maturity composition of each category and compares the annualized mean return to that of a passive maturity-matched portfolio of US Treasury bonds. Panel B reports regressions of quarterly returns on aggregate bank activities on the returns to maturity-matched US Treasury bond portfolios. The regressions are of the form: $R(i,t) = b_0 + b_1 \times B(i,t)$, where $R(i,t)$ is the pre-expense return on the aggregate bank portfolio associated with activity i in quarter t , and $B(i,t)$ is the maturity-matched benchmark return for activity i in quarter t . Bank asset returns for each category are measured before subtracting operating expenses and corporate taxes. Trading & Services are calculated as the asset residual (Assets – Interest Bearing Assets). The mean returns on the benchmark are accounting returns. Each month, for each size category, the benchmark portfolio invests the cash-equivalent share in one-month US Treasury bills and the remaining in a h -period US Treasury bond that is held until maturity, where $h = 2 \times$ the long-term (LT) average maturity of assets in that size category, with the average maturity of the bonds in the portfolio equaling $h/2$. The t -statistics use standard errors calculated with a Newey-West adjustment for the autocorrelation in accounting returns. The table denotes the regression R-square (R2) and the number of quarterly observations as N.

	Cash + Securities	Loans	Trading + Services	Transaction Deposits	Time Deposits	Non- Deposit Debt
<i>Panel A: Summary Statistics</i>						
Share of Assets	30.5	50.4	19.1	37.7	21.1	26.5
Cash-Equiv Shr	45.6	47.9	100.0	100.0	29.2	57.9
LT Avg Maturity (Yrs)	4.7	3.6	0.0	0.0	1.3	1.6
Mean Pre-Expense Return	3.44	5.54	12.40	-0.05	2.65	3.17
Mean UST Return	3.49	3.14	2.04	2.04	2.70	2.50
Risk Premium	-0.05	2.40	10.36	-2.08	-0.05	0.67
t-statistic	(-0.49)	(10.76)	(16.36)	(-4.87)	(-0.60)	(4.79)
<i>Panel B: Quarterly Return Regressions</i>						
b0	0.0000	0.0062	0.0255	-0.0012	0.0002	0.0026
t-statistic	(-0.09)	(6.60)	(28.78)	(-10.34)	(0.92)	(11.48)
b1	0.9900	0.9800	1.0800	0.2100	0.9500	0.8500
t-statistic	(25.06)	(12.86)	(4.68)	(16.44)	(33.06)	(19.26)
R2	0.95	0.79	0.46	0.86	0.97	0.93
N	88	88	88	88	88	88

Table 2
Bank Operating Cost Allocation (1997 – 2018)

This table reports annual operating costs for US bank holding companies. We report value-weighted averages for each bank size category. The size categories are defined based on ranking of assets in the previous quarter, with the largest 5 banks identified as mega, the next 50 largest banks labeled large, the next 100 being labeled medium, and the remainder being considered small. We allocate operating expenses to loans and deposits based on their respective share of two times assets. We allocate the remaining operating expenses to trading & service activities.

	Small	Med	Large	Mega	All
Op Ex / A	3.2	3.2	3.5	3.2	3.3
Loan OpEx / Loans	1.6	1.6	1.8	1.6	1.7
Deposit OpEx / Deposits	1.6	1.6	1.8	1.6	1.7
Service Opex / Services	22.8	19.3	14.4	8.0	9.9
Loan OpEx / Total Opex	33.3	31.8	29.0	21.8	25.3
Deposit OpEx / Total Opex	24.0	24.1	22.4	15.9	18.8
Service OpEx / Total Opex	42.7	44.1	48.6	62.3	55.9

Table 3
Returns (Net-of-Expense) by Bank Activity (1997 – 2018)

This table summarizes the returns on various bank activities for US bank holding companies. Panel A reports the asset share and the maturity composition of each category and compares the annualized mean return to that of a passive maturity-matched portfolio of US Treasury bonds. Panel B reports regressions of quarterly returns on aggregate bank activities on the returns to maturity-matched US Treasury bond portfolios. The regressions are of the form: $R(i,t) = b_0 + b_1 \times B(i,t)$, where $R(i,t)$ is the pre-expense return on the aggregate bank portfolio associated with activity i in quarter t , and $B(i,t)$ is the maturity-matched benchmark return for activity i in quarter t . Bank asset returns for each category are measured before subtracting operating expenses and corporate taxes. Trading & Services are calculated as the asset residual (Assets – Interest Bearing Assets). The mean returns on the benchmark are accounting returns. Each month, for each size category, the benchmark portfolio invests the cash-equivalent share in one-month US Treasury bills and the remaining in a h -period US Treasury bond that is held until maturity, where $h = 2 \times$ the long-term (LT) average maturity of assets in that size category, with the average maturity of the bonds in the portfolio equaling $h/2$. The t -statistics use standard errors calculated with a Newey-West adjustment for the autocorrelation in accounting returns. The table denotes the regression R-square (R2) and the number of quarterly observations as N.

	Cash + Securities	Loans	Trading + Services	Transaction Deposits	Time Deposits	Non- Deposit Debt
<i>Panel A: Summary Statistics</i>						
Share of Assets	30.5	50.4	19.1	37.7	21.1	26.5
Cash-Equiv Shr	45.6	47.9	100.0	100.0	29.2	57.9
LT Avg Maturity (Yrs)	4.7	3.6	0.0	0.0	1.3	1.6
Mean Pre-Expense Return	3.34	3.89	2.73	1.60	2.75	3.27
Mean UST Return	3.39	3.64	2.04	2.04	2.80	3.50
Risk Premium	-0.05	0.25	0.70	-0.44	-0.05	-0.23
t-statistic	(-0.43)	(1.53)	(1.18)	(-0.96)	(-0.52)	(-1.34)
<i>Panel B: Quarterly Return Regressions</i>						
b0	0.0000	0.0012	0.0048	0.0026	0.0002	-0.0008
t-statistic	(-0.11)	(1.60)	(6.91)	(23.98)	(0.95)	(-1.52)
b1	0.9900	0.9400	0.4000	0.2700	0.9500	1.0300
t-statistic	(25.06)	(15.26)	(3.96)	(13.91)	(33.06)	(17.46)
R2	0.95	0.91	0.23	0.87	0.97	0.89
N	88	88	88	88	88	88

Table 4
Maturity Properties of Aggregate Bank Balance Sheet (1997 – 2018)

This table reports the average proportions of various components of the aggregate banking sector measured relative to effective assets. Effective assets are total book assets less no-interest cash, which is also subtracted from deposits. The difference between assets and liabilities is labeled book equity (BE). We use the maturity information reported by bank holding companies to determine the mix of short-term (Cash equivalent) and longer-term assets within each category. The Delta for the long-term portion of each category measures the sensitivity of value to an unexpected interest rate shock. The Dollar Delta is the product of the category weight times the long-term share times the long-term delta.

	Weight	Cash Share	Long-term Share	Long-term Avg Maturity	Long-term Delta	Dollar Delta
Investments	0.3050	0.4560	0.5440	4.70	-0.0439	-0.0073
Loans	0.5040	0.4790	0.5210	3.60	-0.0338	-0.0089
Other Assets	0.1910	1.0000	0.0000	0.00	0.0000	0.0000
Total Effective Assets	1.0000	0.5715	0.4285	3.25	-0.0304	-0.0162
Transaction Deposits	0.3770	1.0000	0.0000	0.00	0.0000	0.0000
Time Deposits	0.2110	0.2920	0.7080	1.30	-0.0134	-0.0020
Debt	0.2650	0.5790	0.4210	1.60	-0.0159	-0.0018
Total Liabilities	0.8530	0.5920	0.2610	0.70	-0.0070	-0.0038
Residual (BE)	0.1470					
					\$Delta A - \$Delta L	-0.0124
					(\$Delta A - \$Delta L) / BE	-0.0842

Table 5
Bank Equity Excess Returns (1997 – 2018)

This table summarizes the risk and return properties for various capital market investment portfolios. Panel A summarizes monthly excess returns (annualized) measured in excess of the one-month US Treasury bill rate, except where otherwise noted. Bank stocks are identified by the Fama and French (1993) industry classification. The value-weight (VW) stock market portfolio is calculated by Ken French. TERM is the excess return of a five-year constant maturity US Treasury (UST) bond portfolio. The MORTGAGE factor is the return on a value-weight portfolio of mortgage-focused mutual funds minus the return on a 4-year constant maturity UST bond. The IG factor is the return on the Vanguard Short-term Investment Grade Corporate Bond Index fund minus the return on the Vanguard Short-term UST Index fund. The HY factor is the return on the Vanguard Intermediate-term Investment Grade Corporate Bond Index fund minus the return on the Vanguard Intermediate-term UST Index fund. The bank-like mutual fund (no beta) portfolio excess return is comprised of 2 units of TERM and 3.1 units of MORTGAGE, 0.53 units of IG, and 0.23 units of HY. The version with CAPM beta includes 0.85 units of the VW stock market factor. The adjusted R-squared is denoted R2 and *t*-statistics are in parenthesis.

Panel A: Summary statistics

Portfolio	Mean Excess Return	Standard Deviation	Sharpe Ratio	CAPM Beta	Annual CAPM Alpha (%)	Worst Draw-down
TERM	2.57	4.11	0.62	-0.08	3.11	-4.03
MORTGAGE	0.04	2.61	0.01	0.08	-0.52	-17.15
IG	0.62	2.06	0.30	0.06	0.22	-10.68
HY	1.23	8.80	0.14	0.38	-1.36	-39.39
VW Stock Market	6.81	15.46	0.44	1.00	0.00	-50.39
Bank Stocks	6.36	21.45	0.30	1.10	-1.12	-74.06
Bank-like Mutual Fund (No Beta)	5.10	8.98	0.57	0.24	3.49	-49.22
Bank-like Mutual Fund (Bank-equiv Beta)	10.89	18.69	0.58	1.09	3.49	-71.13

Panel B: Bank equity portfolio excess return regressions

Intercept	TERM	MORTGAGE	IG	HY	MKT	R2 / N
0.008 (2.24)	-1.433 (-4.63)					0.072 264
0.005 (1.44)		0.157 (0.22)	-1.933 (-2.35)	1.573 (6.92)		0.282 264
0.003 (1.02)	0.739 (1.77)	0.956 (1.15)	-2.831 (-2.93)	1.734 (7.11)		0.288 264
-0.001 (-0.40)					1.098 (20.94)	0.625 264
0.000 (-0.16)	0.013 (0.04)	0.688 (1.14)	-1.234 (-1.74)	0.044 (0.21)	1.099 (15.32)	0.626 264

Appendix

A. Data:

Reporting requirements for form FR Y-9C are related to asset size and have changed over time. Specifically, in March 2006, the asset-size reporting requirement was increased from \$150M to \$500M, and in March 2015, it was increased from \$500M to \$1B. To create a more consistent sample over our sample period, we require banks to have assets exceeding a size cutoff rule defined as follows: \$1B in March 2015 deflated at the quarterly rate of 1.5%. Additionally, we restrict the sample to US banks with deposits equaling at least 20% of assets. This results in an average quarterly sample size of nearly 600 BHCs that is roughly constant through time. Despite the size-based sample restrictions, the resulting sample is heavily tilted towards small banks. Most banks are three orders of magnitude smaller than the largest three banks. The following exhibit shows the size distribution of the bank sample with categories based on average asset values measured at the end of 2005.

**Exhibit A: Size Distribution of US Bank Holding Companies
Based on Average Quarterly Assets (2005Q4).**

Size Category	Count	Mean	Min	Max	Share
Small	624	1,011,584	487,274	2,980,757	7%
Medium	100	5,830,890	2,762,966	14,642,982	7%
Large	45	54,556,556	12,103,390	209,465,000	28%
Mega	5	997,958,934	481,741,000	1,494,037,000	58%

B. Credit risk matching procedure of the loan benchmark portfolio:

Banks hold three major types of loans: business loans (commercial and industrial loans), real estate loans (mortgages), and consumer loan (e.g., credit cards, auto loans, student loans). To calculate the accounting return to the loan benchmark portfolio we need to subtract the actual credit losses that our benchmark portfolio experienced for holding real estate, business, and consumer risk from their estimated yields.

Over our sample period, 61% of the loans are real estate, 22% are business, and 17% are consumer loans. Figure 5 shows the loss rates banks reported for these three loan categories. While business loans and real estate loans have a distinct loss profile, consumer loans share a common risk factor with the real estate loans, but have a higher mean.

We approximate the business risk in banks' loan portfolio with the risk in corporate bond portfolios traded in the capital market. In particular, Moody's reports annual loss rates on investment grade and high yield corporate bonds. We choose a portfolio of 70% investment grade and 30% high yield corporate bonds in order to match the average loss rate on banks' business loans. The resulting loss rate time series looks nearly identical to the loss rate on business loans reported by banks. To arrive at a quarterly loss rate we divide the annual loss rates by 4.

Real estate loans are traded in the capital market. However, to our knowledge, loss rates on these traded real estate portfolios are not reported. For this reason, we apply banks' reported loss rates on real estate loans to our capital market benchmark portfolio.

As discussed in Section III.C., consumer loan share the same risk profile as real estate loans (see Figure 5) with a higher mean. We model consumer loan losses as a fitted regression from a projection on real estate losses. More precisely, we regress bank reported consumer loan loss rates on a constant and bank reported real estate loss rates. The intercept represents the idiosyncratic loss component, a 2.24% loss per year. The slope coefficient represents the exposure to a systematic risk factor that both real estate and consumer loans share. The slope coefficient is 1.72 (t-statistic is 10.45).

The combined loan portfolio loss rate is the weighted average of the loan categories' losses. We subtract these quarterly losses from the quarterly yield of our maturity matched capital market benchmark portfolio yield.

The benchmark yield adds a credit spread (free of interest rate term exposure) to the maturity-matched UST yield. For business loans, proxied by a mix of investment grade and speculative grade corporate bonds, we use the ICE BofAML Corporate Swap Spreads for 1 to 5 year maturities. We estimate the spread on a mortgage portfolio based on the observation that 30-year mortgages are priced relative to the 10-year UST yield. Specifically, a regression of weekly mortgage rates insured by Freddie Mac on the contemporaneous 10-year UST yield has an R² of 0.98. We use the average difference in these yields as the *ex-ante* credit spread, averaging 1.9% in our sample. Finally, we subtract estimated management expenses from these returns, assuming 1% annual fee for mortgages and 0.20% for corporate credit (the highest fee charged by Vanguard across their corporate bond mutual funds). Note that these yields are used to calculate accounting returns that can be compared to the bank loan portfolio return, but that we use actual traded portfolios to calculate market returns for credit exposure.