Do Banks have an Edge?

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ABSTRACT

We decompose bank activities into passive and active components and evaluate the performance of the active components of the bank business model by controlling for passive maturity transformation strategies that can be executed in the capital market. Over the period 1960-2016, we find that (1) unlevered bank assets underperform passive portfolios of maturity-matched US Treasury bonds, (2) the cost of bank deposits exceeds the cost of bank debt, (3) bank equities have CAPM betas near one, while passive maturity transformation strategies have CAPM betas near zero, and (4) portfolios of bank equities consistently underperform portfolios designed to passively mimic their economic exposures. The very strong investment performance of passive maturity transformation strategies over this period may mask the underperformance of the specialized bank activities.

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This paper evaluates the performance of the aggregate banking sector from the competitive markets perspective developed in Black (1975), Fama (1985), Merton (1989, 1990, 1993), and Merton and Bodie (1993, 1995). The basic premise is that banks compete with other intermediaries in the market for financial services, specializing in the lending and deposit-taking segments of this market. The economic exposures inherent in the core activities of banks can be sourced passively in the capital market, providing an opportunity cost of capital for bank investors. Specialization and imperfect competition may allow banks to earn returns higher than their opportunity cost of capital, while poor execution may lead to lower returns (Black (1975)). Of course, good or bad luck will also contribute to returns, which we try to mitigate with a relatively long sample ranging from 1960 to 2015.

We begin with a simple analysis organized around the notion that most banking activities are built around the maturity transformation activity, whereby short-to-medium term interest rate sensitive assets are funded largely with very short-term debt. To do this, banks issue credit to consumers and small businesses, and fund these positions using deposits. Banks perform these activities because they are viewed to have an edge in each. In addition, banks may benefit from potential synergies that arise from simultaneously creating loans and deposits. A passive version of the maturity transformation investment strategy can be executed in the capital markets, and thus provides a simple and conservative starting point for benchmarking bank performance.

Since 1986, highly detailed information is available quarterly from the FDIC about the maturity structure of bank assets, the composition across asset types, and the structure of bank funding, with less detailed annual data available since the mid-1930s. The aggregate banking sector holds assets with an average maturity of three years across cash equivalents, securities, loans, trading assets, and other investments. Our initial analysis evaluates the unlevered aggregate bank asset portfolio return against maturity-matched investments in US Treasury

(UST) bonds. Specifically, we construct a simple buy-and-hold portfolio that each month purchases a six-year maturity UST and holds it to maturity, such that the three-year average maturity of this portfolio matches that of the aggregate banking sector. This is a highly conservative benchmark as it does not charge for the credit and illiquidity risk that banks have added to their asset portfolios, both of which realized positive risk premia in capital markets over this period. Remarkably, we find that the unlevered bank assets, inclusive of their share of operating expenses, underperform passive maturity-matched investments in US Treasury (UST) bond portfolios over the period 1960 to 2015. This suggests that the specialized asset-based activities of banks have contributed negatively to bank performance over this period.

A second analysis compares the average cost of bank deposits, inclusive of their share of operating expenses, to the average cost of non-deposit bank debt issued in the capital market. We find that the cost of deposits exceeds the cost of debt, suggesting that banks have a funding disadvantage associated with deposits relative to capital market debt. Additional analyses find that bank depositors forgo compensation for transaction deposits, but not for any other deposit product. For example, six-month certificates of deposits essentially offer the six-month capital market riskfree rate, while transactable accounts offer 1.5% less than the short-term riskfree rate. This effectively limits the scope for a bank funding advantage to around 40% of total funding, with a potential benefit of 1.5% per year. However, estimated costs of maintaining the deposit funding activity are around 3% per year, making this activity unprofitable relative to relying on capital market debt.

We also explore the risks of the banking sector and the consequences for bank equity holders through the lens of the passive maturity transformation strategy. Passive portfolios of maturity-matched UST levered with short-term debt to match the aggregate leverage of the banking sector would become insolvent at various points during the sample. Again, this is a conservative benchmark, in that it is free of the credit and illiquidity risk that banks add to their portfolios. Additionally, we show that passive maturity transformation portfolios have CAPM betas near zero, while portfolios of bank equities have CAPM betas exceeding one. Some of the systematic risk in bank equities appears to come from costs of financial distress, in that following periods of large losses in the passive capital market exposure-mimicking portfolio, relative bank performance is persistently poor, with the aggregate banking sector requiring equity issuance at relatively low prices. Together, these findings suggest that the active components of the bank business model appear to be the source of the systematic risk in banks and to have realized negative risk-adjusted returns offsetting the strong tailwinds associated with the underlying business model of maturity transformation over this sample.

To investigate empirically the relative performance of bank activities to their closest capital market offerings, we face several practical challenges. First, the comparison of banks' accounting returns and values to market returns and values requires adjustments for the accounting rules that are applied to bank financial statements, most notably the smoothness of reported balance sheet valuations. A second important issue is that operating costs of banks are economically large, averaging over 3% and never below 2% of assets from 1960 to 2015, but must be allocated across specific activities. This is a messy exercise because details about which activities generate the costs are not available, but nonetheless, important to do. For example, many inferences about the relative advantage of bank deposits over capital market debt appear to ignore the costs of developing and maintaining access to this source of funding, leading to biased estimates of the total and marginal costs of each funding source. We show that with a wide range of assumptions about the overall share of costs for the deposit-taking activity, deposits are a relatively expensive form of funding for banks over the period 1960 through 2015. Importantly, by examining all of the banks' activities, we are able to impose the realistic constraint that total operating expenses are fully allocated across activities.

This paper is organized as follows. Section 1 describes the data. Section 2 evaluates bank performance through the lens of passive maturity transformation strategies that can be executed in the capital market. Section 3 evaluates the relative costs of various bank funding types. Section 4 evaluates bank asset returns by asset class. Section 5 discusses the implications for bank equity. Section 6 concludes the paper.

I. Data Description

We 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 2016, and include information on the number of institutions and some detail on their structure, as well as financial data from income statements and balance sheets.

We use detailed bank-level data sourced from quarterly regulatory filings of bank holding companies (BHC) collected by the Federal Reserve in form FR Y-9C. [1] These data begin in 1986, but many important variables only become available in the mid-1990s. 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.

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

[1] A detailed description of our sample selection is in the Appendix.

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, and passive bond index portfolios available to retail investors through Vanguard. 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, as well as returns on a short-term investment grade corporate bond fund (VFSTX) and an intermediate term high yield fund (VWEHX). Both funds are available from Vanguard and available monthly since 1982 and 1979, respectively. 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, monthly yields on the BofA Merrill Lynch US Corporate AA bond index for different maturities, monthly secondary market rates on 6-month Certificates of Deposits (CDs) from the Federal Reserve (H.15) available since 1964, and quotes for 6-month CDs by banks from RateWatch since 1997.

II. Evaluating Bank Performance through the Lens of Maturity Transformation

Maturity transformation refers to the issuance of short-term debt claims against portfolios of longer-term bonds. This strategy exposes the investor, or the equity claim, to an interest rate term risk. The simplest version of this strategy is free of credit risk on the asset leg of the trade, and nearly free of credit risk after levering the underlying interest rate exposure, so long as the leverage remains modest relative to aggressively stress-tested price fluctuations.

We begin our investigation of bank performance with an analysis of the risks and returns of maturity transformation for two reasons. First, this simple strategy underlies many of the more specialized activities in which banks engage. In its simplest form, the cash and securities holdings of banks funded with short-term debt are essentially this strategy. As we will discuss in more detail later, extending loans (credit issuance activity) adds only a small amount of credit risk to the asset leg of this investment strategy, accounting for less than 15% of the return for these assets[2], such that a levered credit issuance strategy closely resembles a maturity transformation strategy. The literature on banking posits that a key economic function of banks is liquidity provision, which is typically associated with the deposit-taking activity of banks (Gorton and Pennacchi (1990)) and sometimes combined with the credit issuance activity (Kashyap, Stein, and Rajan (2002)). Thus, liquidity provision appears highly similar to the levered credit issuance strategy, but with potentially enhanced funding terms. Since the levered credit strategy is itself primarily a maturity transformation strategy, the strategy refinements implied by liquidity provision do not take this distinctive bank activity too far from a simple maturity transformation strategy.[3]

Second, the simplest version of the maturity transformation strategy has performed remarkably well for the past 35 years. Fama (2006) argues and provides empirical evidence that the behavior of US interest rates appears to exhibit a highly persistent pattern in the post-WWII period, relative to what was likely expected *ex ante*. He writes, "the long up and down swing in the spot rate [1-year UST yield] during 1952-2004 is largely the result of permanent shocks to the long-term expected spot rate that are on balance positive to mid-1981 and negative thereafter." The consequences for a maturity transformation strategy are economically

[2] The capital market credit risk premium on short-term high quality credit-sensitive securities is around 0.5% per year over the period 1997 through 2015, while similar maturity US Treasury bonds earned 3.7% over this period.

[3] Gatev and Strahan (2006) argue and provide evidence that liquidity provision by banks embeds some features that we would relate to market timing. Specifically, their story 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 for banks to experience relatively advantageous business opportunities in economic downturns. The parallel to a market timing opportunity within the levered credit issuance strategy, involves predictable variation in the attractiveness of potentially both the funding terms and the investment opportunities across economic states. What is not resolved is whether banks engaging in conditional liquidity provision, or market timing, earn risk-adjusted returns, as is implicitly assumed when these distinctive bank activities are viewed to be relatively efficient.

meaningful. In particular, the investment leg of the strategy is consistently priced to earn more than turns out to be required to protect against the possibility of future interest rate increases. Therefore, the investor in intermediate-term US Treasury bonds both earns a term premium if the short-term riskfree rate of interest remains constant (yield on 5-year bond minus yield on 1-month bond) and realizes the persistent unexpected benefit of lower short-term interest rates, which has the effect of persistently increasing the value of the inventory of bonds in the portfolio.

Given the centrality of maturity transformation to many banking activities, it is useful to characterize the risk and return properties of the components to passive capital market maturity transformation over our sample period, 1960-2016. The key to banks having an advantage in their distinctive activities beyond simple maturity transformation is that they will do better than this passive strategy.

A. The Historical Returns to Investing in US Treasury Bonds

As a first step to understanding the returns to maturity transformation, we examine the excess returns to the asset leg of this strategy. Specifically, we analyze the returns to a passive investment strategy that each month simply purchases an *h*-year US Treasury (UST) bond, where $h \in \{2, 4, 6, 8\}$, and holds it until maturity. Thus, each month the portfolio has an inventory of bonds with an average maturity of $h/2$. Following Fama (2006), we bifurcate our sample into pre and post June 1981, sub-samples. Bond returns are calculated based on monthly yields to maturity (YTM) reported by the Federal Reserve. Our calculation requires that each month we have a term structure of YTMs with monthly increments, which we estimate by linearly extrapolating between values reported at fixed maturities.

Figure 1 displays the time series of YTMs for the 5-year and 1-month UST securities, showing the steady rise and then decline in the level of interest rates turning in mid-1981. Additionally, the figure shows that the *gap* between yields, the so-called 5-year term spread, oscillates regularly around zero, averaging an annualized 0.13% in the pre-1981 period, while in the post-1981 period, the gap is consistently positive, averaging an annualized 0.85%. This pattern in interest rates has a significant consequence for a common bank performance metric called the net interest margin. By continuously investing in medium-term assets, each period banks earn the average of the historical medium-term interest rate, and since they finance this investment largely with short-term debt, each period they pay the short-term interest rate. The panels on the right of Figure 1 display the rolling five-year average rate on the five-year UST along with the one-month UST yield (top) and the resulting net interest margin (bottom), calculated as the difference in these interest rates. As the figure makes clear, the net interest margin benefits from both the large term spread and the steady decline in interest rates since mid-1981. The figure also highlights how the large unexpected increase in interest rates around 1980, leads to a multi-year negative net interest margin.

Table 1 reports CAPM-style regressions explaining the excess returns to the UST bond portfolios with the excess returns of the value-weight stock market, using both monthly and quarterly returns. Panel A reports results from the earlier sub-period, 1960 through mid-1981. The slope coefficients are reliably positive, although economically small, ranging from 0.03 to 0.11, while the intercepts are virtually all indistinguishable from zero. The regression intercepts measure the average unearned return, given the required risk premium, and are commonly called "alpha." We report annualized alphas in percent. Panel B reports regressions from the recent sub-period, mid-1981 through 2016. The slope coefficients (or market betas) are economically small and statistically indistinguishable from zero with quarterly returns, while marginally statistically significant with monthly returns. The alphas are statistically and economically large. For example, the bond portfolio with an average maturity of 2-years earns 2% per year more than was required according to the CAPM risk-adjustment. The estimated alphas are all highly statistically significant and are monotonically increasing in portfolio maturity over the range considered, highlighting the excellent investment performance of passive maturity transformation strategies since mid-1981.

B. The Historical Returns to Bank Assets

An empirical evaluation of bank asset returns requires us to (1) allocate a share of operating expenses to the asset-based banking activities (with the remaining clearly being allocated to the liability-based activities) and (2) adjust the accounting-based values and returns to make them comparable to market values and returns. We initially assume that 50% of operating expenses are associated with asset-based banking activities and then examine the robustness of inferences with different assumptions. 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. Our approach to this challenge is to measure and report the market values of our capital market replicating portfolios, but to also apply a simple hold-to-maturity accounting rule to these portfolios, such that the accounting values and returns should be more directly comparable. Specifically, we calculate an accounting value (or book value (BV)) of the portfolio using the standard capital accumulation rule, BV(t+1) = BV(t) + interest income – purchases + proceeds, where purchases and proceeds are measured at market transaction value and interest income is earned periodically according to the bond coupon terms.

This results in the portfolio book value ignoring the effects of fluctuating interest rates on the market values of the bonds in the portfolio, implicitly assuming that their values equal par.

We first illustrate the economically important transformation of returns that hold-to-maturity accounting applies to passive US Treasury bond portfolios. Specifically, for passive strategies that each month invest in *h*-period bonds and hold them to maturity, where $h \in \{2, 4, 6, 8\}$. We calculate both the current market value and the hold-to-maturity accounting value of the portfolio each month from 1960 through 2016. From the time series of portfolio values we calculate both monthly and quarterly returns and drawdowns, with drawdowns defined as the percentage change in the current value from its previous maximum value. Figure 2 displays the time series plots of these returns and drawdowns under both market-based and accounting-based valuation schemes. The figure shows that the deviations between market and accounting returns increase with the maturity of the bonds in the portfolio. The portfolio that buys-and-holds 2-year bonds, and therefore has an average bond maturity of 1 year, has economically small deviations between market and accounting returns. However, as the average maturity increases to 4 years, return deviations between accounting schemes become economically meaningful. For example, risk assessments based on accounting returns would suggest that there is no risk to any of these portfolios, as every quarterly return is positive leading to no drawdowns, while market returns to the longer maturity bond portfolio reveal significant risk with a minimum drawdown of -9.6% that would completely exhaust the equity of a portfolio levered 10.4x (i.e. assets =100, equity = 9.6).

We calculate the returns to aggregate bank assets with data from the FDIC Historical Statistics on Banking (HSOB), which reports annual values for various income statement and balance sheet items for the aggregate commercial banking sector. Specifically, we calculate the return on assets (ROA) as net income plus interest expense minus service charges on deposit accounts plus (1-*s*) times non-interest expense, all divided by the previous period assets, where *s* represents the share of non-interest expense (i.e. operating expense) that is allocated to asset-based activities. We report results for $s \in \{0.3, 0.5, 0.7\}$ and focus on $s = 0.5$ as our baseline. The mean annual return on bank assets over the period 1960 through 2015 is 5.3%, and the annual time series of returns is plotted in Panel A of Figure 3. For comparison, we also report the market and accounting returns for the three-year average maturity UST bond portfolio, which have average annual returns of 6.5% and 6.3%, respectively. The three-year average maturity is chosen to reflect the average maturity of bank assets that we calculate from more detailed data available since 1995, so this is not necessarily an accurate proxy for the maturity of the bank asset portfolio for the earlier part of the sample. The baseline result suggests that the asset-based activities (passive plus specialized) of the aggregate banking sector have underperformed a passive maturity-matched investment in US Treasury bonds by a full 1% per year over the period 1960 to 2015.

To assess the robustness of this result, we analyze the relative performance of aggregate bank assets and passive US Treasury bond portfolios with various assumptions about the share of operating expenses attributed to asset-based banking activities, with various assumptions about average asset maturity, and across sub-periods. We report the results from these analyses in Table 2. Across all considered UST benchmarks, the aggregate ROA of the commercial banking sector has lower mean returns in the full sample (Panel A). This result holds for both sub-periods as well, with the exception of the post-1981 sub-period, where with the low operating expense share of 30% and a UST benchmark with the short average maturity of 2-years, the aggregate ROA and the UST benchmark portfolio are essentially equal. Panel A also reports correlations between ROA and the UST benchmarks.[4] Interestingly, the correlations between aggregate bank ROA and the UST benchmark returns are systematically higher when the UST portfolio returns are calculated after applying the hold-to-maturity accounting scheme (BV) than when calculated with market values (MV). For example, the correlation between the baseline ROA, assuming 50% of operating expenses are due to asset-based bank activities, and the maturity-matched UST portfolio with an average maturity of three-years, is 0.73 based on market values and 0.89 based on accounting values. The higher correlation between bank ROA and the accounting-based UST portfolio return is consistent with the premise behind this analysis, namely that bank asset returns are likely to be highly related to a passive maturity transformation strategy after adjusting market-based returns to reflect the accounting rules for banks. These results are highly inconsistent with the notion of a bank edge, where the specialized activities of banks are executed in an advantaged manner relative to capital markets.

C. Comparing the Costs of Bank Deposits to the Costs of Capital Market Debt

Banks are widely believed to receive a funding advantage from their deposit-taking activity relative to capital market alternatives. For a representative example, consider Kashyap, Rajan, and Stein (2002), who develop a model to explain why the deposit-taking and credit issuance activities occur jointly within banks. They explicitly assume that bank deposits are cheaper than debt issued in the capital market and go on to develop and test several predictions of their model, but do not provide evidence to support their underlying assumption.

Developing a proper capital market benchmark for deposits initially appears daunting, as deposits provide banks with a highly distinct funding source with no direct substitutes.

[4] We do not report the entire correlation matrix to improve readability of the table. The results are highly similar for each of the two sub-periods.

Government restrictions on which intermediaries are able to offer transactable accounts and government deposit insurance make this a unique source of funding for banks. The counterfactual that we are after is the capital market cost for a bank issuing debt with no deposits, holding both its leverage and assets constant. A simple, but somewhat biased estimate comes from banks own debt. In addition to deposits, most banks also issue debt directly to the capital market. This debt is almost surely riskier than the debt in the ideal counterfactual because the majority of the deposits are insured by the FDIC, and therefore not bearing any of the risk of the assets. The actual bank debt rate reflects the required compensation for a junior claim, while the counterfactual debt rate would reflect the required compensation for both a senior and the same junior claim, and therefore would be expected to have a lower average rate. Moreover, these data are readily available from the FDIC Historical Statistics on Banking.

One key to this analysis is that we measure the cost of deposits, as opposed to simply the interest rate on deposits, and therefore add a share of the banks' operating expenses to the interest rate paid on deposits. The deposit-taking activity is a defining-feature of banks and likely to generate a large share of total operating expenses. To be consistent with our analysis of bank asset returns, we assume that 50% of operating expenses are attributable to the deposit-taking activity and then examine the robustness of inferences with different assumptions. We calculate the cost of deposits as deposit interest minus service charges on deposit accounts + $(1 - s)$ times non-interest expense, all divided by the previous period deposits. We calculate the cost of capital market debt as interest expense minus deposit interest, all divided by the previous period debt. We measure debt from the balance sheet identity, assets minus total equity minus deposits.

Panel B of Figure 3 displays the time series of annual deposit costs and capital market debt costs. For the baseline analysis, where $s = 0.5$, the cost of deposits exceeds the cost of debt in the full sample. In the first sub-period, from 1960 to 1981, the average cost of deposits is essentially equal to the average cost of debt for the aggregate commercial banking sector. The big cost difference comes in the second sub-period, from 1982 to 2015, when the cost of deposits averages a full 1% per year more than the average cost of debt. The figure also displays the time series of annual deposit "effective" interest rates, calculated as the interest on deposits less the service charges on deposit accounts. This measure is lower than the cost of debt, but a poor estimate of the economic cost of deposits as it assumes that 100% of the operating expenses are allocated to asset-based activities (s = 1.0).

Additional calculations are summarized in Table 3, which reports results based on assumptions that parallel those made in the analyses of asset returns. Over the full sample, the cost of deposits are roughly equal to the cost of debt when 70% of total operating expenses are allocated to asset-based activities. This result is driven by the second sub-period, as bank deposit costs are essentially equal to capital market debt costs in the first sub-period. The 70% allocation to asset-based activities is likely to be at the high end of the plausible range, and, of course, implies that the asset-based bank activities severely underperform maturity-matched US Treasury bond portfolios. For example, with this cost allocation bank assets underperform their conservative benchmark by 2% per year from 1982 to 2015. These results suggest that bank investors would be better off issuing capital market debt and completely foregoing the deposit-taking activity, if their asset portfolios could otherwise remain constant. While there are some issues to be addressed in subsequent sections regarding potential synergies between deposit-taking and asset-based activities, these results push strongly against the conventional view that deposits provide banks with a funding advantage over capital market debt in the post-1981 period.

D. Leverage and Equity Returns

Bank leverage is distinctively high and commonly viewed to provide an advantage to bank stakeholders. It is sometimes argued that high leverage allows banks to "hold less equity capital", which is viewed to be a fallacy from the perspective of standard theories of finance (e.g. Miller (1985), Admati, DeMarzo, Hellwig, and Pfleiderer (2013), Cochrane (2014)). The analysis in the previous sub-section highlights that the riskiest dollar of bank leverage is sourced in the capital market itself, so the *availability* of high leverage for banks is not really distinct from capital markets. More precisely, it is the *choice* by banks to use such high leverage that is distinct from other participants in capital markets. This choice potentially creates both private and social costs associated with financial distress, and, of course, has meaningful consequences for the risks and returns of bank equity (Modigliani and Miller (1958)).

Common measures of leverage (e.g. assets-to-equity or debt-to-assets) are high in the banking sector relative to other sectors. For example, the average ratio of book assets to book equity for the aggregate commercial banking sector averages 16.6x over the period 1960 through 2015, while it averages 3.8x for the aggregate non-banking sector. These estimates are from the sample of publicly-traded firms with data reported in CRSP and Compustat. Panel A of Figure 4 displays the time series of market and book leverage ratios for the bank and non-bank sectors. The market leverage is calculated assuming that book liabilities are a good proxy for the market value of liabilities (book debt equals market debt) and measures market equity (ME) as the product of share price and shares outstanding. The high leverage of the banking sector is presumably feasible because the risks of bank assets are considerably lower than the risks of non-bank assets.

Another perspective on bank leverage comes from the risks of the passive UST bond portfolios whose drawdowns are plotted in Figure 2. For example, the 3-year UST bond portfolio, which has the same average maturity as the aggregate banking sector in the later part of the sample, experiences a drawdown of -7.6%. Using this worst drawdown as a *shock* for a stress test, we calculate what would be the post-shock ratio of equity-to-assets, E* / A. Specifically, each month we calculate E* / A = (1+*shock*) – D / A.[5] This is not an especially severe stress test, as the shock size is based on the historical return series of UST bonds, while banks hold somewhat riskier portfolios. Additionally, this analysis uses the aggregate leverage, so there are many banks with higher leverage. The time series of (market and book value) post-shock equity to assets are plotted in Panel B of Figure 4. Based on both book and market leverage, a shock of this magnitude would exhaust the aggregate equity in most months.

Not all shock consequences are immediate, so banks may have an opportunity to react as the episode unfolds. However, many of the theories of banking and equilibrium financial distress (e.g. Shleifer and Vishny (1992, 1997)) highlight that capital market frictions can be high, so reactions that involve selling specialized assets and sourcing additional capital from capital markets may turn out to be costly. We explore this notion more carefully later in the paper, emphasizing the economic conditions where actual bank assets tend to experience losses and the capital market pricing of equity when actual bank equity is issued. These issues are going to add operating challenges and costs to this underlying risk of insolvency arising from the choice of high leverage relative to a conservative asset portfolio risk, as demonstrated with the historical returns realized on UST bond portfolios free of credit risk.

Equity is the residual claim, entitled to the cash flows remaining after all other liabilities have been paid. One attractive property of equity returns is that assumptions about how operating expenses should be allocated across activities can be completely skirted, as equity cash flows are

[5] This calculation relies on the accounting identity, E = A – D, and assumes that post-shock assets equal, A* = A (1+shock), while liabilities are unaltered, D* = D.

net of these expenses. There are also several empirical challenges in evaluating the performance of bank equity. First, not all banks in the FDIC HSOB are publicly-traded, so an analysis of market equity values and returns does not perfectly coincide with the aggregate assets and liabilities. Second, market equity values and returns reflect the combined realities of both asset-based and liability-based and synergy-based bank activities, not allowing for an easy decomposition.

One decomposition that can be done simply is to evaluate bank equity performance relative to a similarly levered passive maturity transformation portfolio. The premise of our notion of a bank edge is that bank equity should handily outperform this benchmark. However, as documented above, the investment performance of passive portfolios in 3-year average maturity UST bond portfolios have a market beta of zero and an annualized alpha exceeding 2%. In a frictionless capital market able to offer short-term riskfree debt to investors, a portfolio, P, with constant leverage, L, applied to it has a levered return, R_{Lever} = Rf + L x (Rp – Rf). If we assume that expected returns conform to the capital asset pricing model (CAPM), then the excess return on the unlevered portfolio is: Rp - Rf = a + b (Rm – Rf), which implies that the levered portfolio return is R_{Lever} – Rf = La + Lb (Rm-Rf). The levered alpha is simply, La, and the levered market beta is Lb. Since the 3-year UST bond portfolio has no market beta in the post-1981 sub-period, the levered market beta is also zero, while the levered alpha increases linearly with leverage. At the average market leverage ratio of the aggregate banking sector (1981-2015) of 11.9x, the estimated annualized alpha of the passive 3-year maturity transformation portfolio would be a whopping 33.1% (11.9 x 2.79%) with an estimated market beta of zero. Actual bank equities do not share these risk and return properties. Over the period mid-1981 to 2015, we create a value-weight portfolio of all publicly-traded bank stocks, as identified by Fama and

French (2003), and estimate the market beta to be 1.12 (*t*-statistic = 29.8) with an annualized alpha of -0.36% (*t*-statistic = -0.2).

From the perspective of the simple decomposition of bank equity into the levered returns of a passive maturity transformation portfolio and the returns on the remaining more specialized bank activities, the specialized bank activities appear to contribute the bulk of the systematic risk and to have realized reliably negative alpha over the period 1982-2015 to offset the strong positive alpha contribution from the passive portion of the business model. One possibility that we investigate in more detail later is that the choice of high leverage is itself, an important source of this market beta, contributing meaningful costs of financial distress in poor economic environments, as predicted by most standard theories in finance.

One potential concern is that capital market leverage is not frictionless, so we cannot reliably conclude that an investor desiring the leverage available through bank equity would be able to achieve her investment goals with investments in more realistically levered passive maturity transformation strategies. This turns out not to be a meaningful concern for many investors. Consider an investor who holds the market portfolio of public stocks. Now, restrict this investor from holding any bank stocks, but instead provide access to the *unlevered* passive maturity transformation portfolio. Assuming a one-for-one swap of these exposures (i.e. holding all other portfolio weights constant) the investor is better off in terms of higher realized mean return, lower portfolio volatility, higher Sharpe ratio, and higher terminal wealth.[6] Overall, these results are highly inconsistent with the view that bank equity investors are advantaged relative to capital market alternatives for passive maturity transformation strategies.

[6] Allowing the investor to re-optimize the portfolio will further improve performance. In general, the differential alphas ensures the improved welfare of the investor for whom the CAPM is a reasonable risk model (Sharpe (1966)).

III. The Relative Advantage of Bank Funding

Since Gorton and Pennacchi (1990), a bank funding advantage relative to capital markets is a common assumption and frequent conclusion in the banking literature. Recent papers like Stein (2012) and Hanson, Shleifer, Stein, and Vishny (2015) push the notion that all of the riskfree bank deposits may receive a money-premium, or funding edge over capital market funding alternatives. In contrast, Fama (1985) highlights that many of the insured accounts issued by banks compete with close substitutes in the capital market and provides some empirical evidence indicating that the rates paid by banks, gross of operating expenses, are similar for certificates of deposits (CDs) and maturity-matched US Treasuries.

This section analyzes the empirical validity of a bank funding advantage. To this end, we first explore whether bank customers accept below market investment returns on different debt-like claims issued by banks, e.g. short-term time deposits that do not offer transaction services, but are otherwise money-like (i.e. short-term and safe). The second issue we explore is whether deposits represent the lowest cost funding alternative for banks. That is, the question is whether banks can produce money-like claims at a sufficiently low cost such that they come out ahead of their alternative funding strategy of issuing debt directly in the capital market.

A. Assessing Customers' Acceptance of below Market Returns by Bank Funding Type

A.1 Transactable and Time-Deposits

Using the detailed maturity composition of various deposit account types reported in regulatory filings for each bank, we can classify deposits into transactable and time-deposit accounts and calculate the average maturity of each of these categories. The maturity of a deposit account stipulates the period for which depositors cannot withdraw funds. What we term "transactable accounts" is defined as withdrawable within a week and includes all checking accounts and savings accounts that allow for multiple withdrawals within a month. In addition to being demandable, checking and savings accounts (up to $250K) are also riskfree for investors through FDIC insurance. Time deposits up to $250K are also FDIC insured.

Figure 5 summarizes the quarterly maturity composition of bank deposits for the aggregate banking sector over the period 1998 through 2015. The majority of bank deposits, equivalent to roughly 40% of assets, are transactable deposit accounts. The remaining "term-deposit accounts" have an average maturity of nearly 15 months over this sample. The overall value weighted average maturity of deposits, including transactable deposits, averages just under 5 months.

There is considerable empirical support for the notion that customers are willing to pay for transaction services by accepting less than market interest on transactable deposits (Hannan and Berger (1991), Neumark and Sharpe (1992), O'Brian (2000), and Krishnamurthy and Vissing-Jorgensen (2012)). Additionally, the rate banks pay to customers on transactable accounts is relatively insensitive to changes in the market riskfree interest rate. We confirm these properties in our sample by comparing the deposit interest rate earned by customers on transactable accounts, inclusive of the fees charged to customers, to the one-month US Treasury bill rate. Panel B of Figure 6 displays these quarterly returns. Table 4 reports that the mean annualized rate earned by investors on transactable deposits between 1997 and 2015 is 0.97%, while investments in 1-month US Treasury bills earned 2.2% over this period. This significant difference in returns confirms that bank customers accepted less on their transactable deposit accounts than their closest capital market alternative investment.

To determine whether these properties extend to time deposits, we do two things. First, we compare the rates paid on newly issued 6-month certificates of deposit (CDs), secondary market rates on 6-month CDs, and 6-month US Treasury bills (T-bills). These monthly rates are displayed in Panel A of Figure 6. The rates on US T-bills and secondary market CDs are available from 1965 through 2015, while the newly issued CD rates, calculated as the average rate offered and reported by RateWatch, are available from 1997 through 2015. Clearly, 6-month CDs are well integrated into capital markets as they are traded in the secondary market. It appears that, on average, 6-month CDs have reliably higher rates than 6-month US T-bills in the secondary capital market, with their annualized rates averaging 0.7% higher. The quoted rates on newly offered 6-month CDs are indistinguishable from 6-month US T-bill yields.

This suggests that time deposits may be viewed by customers as having near perfect capital market substitutes and, as such, they are not willing to forgo market interest. To provide further evidence of this possibility, we compare the overall average rate paid to customers on time deposits to the return that would be earned on a portfolio of US Treasury bonds with an investment policy of each month purchasing newly issued 18-month bonds and holding them to maturity. This results in an average portfolio maturity of 9-months, which is somewhat below that of the aggregate portfolio of time deposits, estimated to be 15 months. To make this comparison of market returns comparable to the accounting returns available for banks, we apply the simple book value accounting scheme that we used earlier, to our capital market portfolio, whereby we maintain security values at par value and use interest income as it is earned. The results of this analysis are reported in Panel C of Figure 6 and in Table 4. In each quarter, the rate earned by customers on time deposits looks very similar to the rate earned by investors in a capital market portfolio of similar maturity with similar reporting. Additionally, the mean returns on time deposits and maturity-matched UST bond portfolios are statistically indistinguishable from each other with small periodic deviations. This suggests that (1) rates on time deposits are highly sensitive to changes in capital market interest rates[7] and (2) the scope for this funding type to provide an advantage for banks is limited because from the customers' perspectives time deposits have excellent capital market substitutes (Fama (1985) and Merton and Bodie (1993, 1995)). Customers appear to sacrifice market returns only for bank funding types that offer transaction services (except for equity, as discussed later).

A.2 Repo and Other Debt

The repo and other debt issued by banks is bought by the capital market, so it seems reasonable to expect that these claims enjoy no special pricing advantage relative to other capital market assets with similar maturity and risk. With the methodology used above, we evaluate empirically whether there is any evidence that questions the validity of this view.

From the customer's perspective, bank repo is a short-term investment, subject to the credit risk and potential liquidation risk of the aggregate banking sector. Our primary interest is ruling out that banks receive a funding advantage by offering fairly safe short-term debt, so we benchmark against one-month US Treasury bills. Panel A of Figure 8 and Panel C of Table 4 show that investors in bank repo earn reliably higher returns than investors in the shortest term US Treasury portfolio, with the average annualized repo rate a full 1% higher over the period 1997 through 2015. While we have not carefully calibrated this realized risk premium embedded in bank repo, there is little here to suggest that market investors in bank repo sacrificed market returns on these holdings.

[7] Our interpretation of this result contrasts somewhat with the interpretations of Drechsler, Savov, and Schnabl (2017) who find that accounting asset returns net of accounting liability returns are immune to interest rate exposure. We view the apparent insensitivity to interest rates to be primarily a consequence of the accounting treatment and that the economically-relevant interest rate exposures of both assets and liabilities are better estimated from maturity-matched portfolios of US Treasury bond portfolios, with maturities coming from the detailed reported distributions of maturities by asset and liability type at the bank level from regulatory filings.

The remaining bank debt includes a variety of debt types with imperfect reporting of each type's maturity distribution and interest expense, which prevents us from separately evaluating each type, and thus, requires us to make some assumptions. For example, the amount of commercial paper can be determined, but the interest expense associated with commercial paper is not reported. The various debt types are commercial paper, trading liabilities, other borrowed money (e.g. mortgages and long-term debt), and subordinated corporate bonds. Our approach is to model this overall category as a portfolio of 1-month US T-bills and a passive strategy that each month purchases a τ-maturity A-rated corporate bond. We assume that commercial paper, trading liabilities, and other borrowed money less than 1-year, representing 70% of this category, are equivalent to 1-month US T-bills. The remaining 30% has an estimated average maturity of 3-years, which we mimic by purchasing 6-year A-rated corporate bonds so that the average maturity of this portion of the portfolio is 3-years. We then adjust these returns to reflect the accounting treatment, as described earlier. Panel B of Figure 8 and Panel C of Table 4 show that investors in the other bank debt earned very similar returns to what they would have earned on a portfolio with similar risk and maturity characteristics.

Overall, it appears reasonable to conclude that the non-deposit debt claims issued by banks in the capital market are priced consistently with similar capital market alternatives. Thus, the scope for a potential funding advantage seems to be limited to transactable deposit accounts, as customers and investors appear to not sacrifice market returns for any other bank liability.

B. Assessing Bank Advantage by Funding Type

The previous subsection shows that the scope for a funding advantage is limited to transactable deposits, as these are the only claims for which customers sacrifice market returns.

The key question to be addressed in this section is whether banks are able to obtain a practical funding advantage from their transactable deposits, net of the production costs associated with supplying these claims and associated transaction services. In addition, we seek to clarify the scope for banks to obtain an advantage related to the amount of debt that they issue relative to their assets (i.e. leverage).

Banks issue large amounts of relatively safe short-term debt in the form of deposits. Maintaining these individual deposit accounts requires banks to incur ongoing operating costs, such as the staffing of branches and the maintenance of an ATM network. There is no data on how to allocate the total operating costs between deposits and asset-based activities. As a start, we attribute 50% of the total operating costs of banks to deposits, and the remaining 50% to asset-based activities. The question is whether customers' sacrificed market returns on deposits are large enough to justify these deposit-based operating costs, or if relying entirely on capital market funding would be cheaper.

Define the market returns sacrificed by deposit customers to be π, the cost of producing deposits to be ϕ, and the frictional cost of producing nearly riskfree short-term debt in the capital market to be θ. The condition for banks to have a funding advantage is $\phi - \pi < \theta$. We highlight this condition because the frictional cost of issuing nearly riskfree short-term debt in the capital market has declined significantly in the later part of the sample with advancements in technology. For example, portfolio margin,[8] first introduced around 2000, and becoming widely available to capital market participants in 2008, relies on real-time portfolio monitoring of market values, combined with portfolio liquidation rights to offer short-term loans to investors at

[8] In 1998, the Board of Governors of the Federal Reserve System amended Regulation T, allowing self-regulated organizations to implement portfolio margin rules (Federal Reserve System (1998)).

rates as low as 25 basis points (bps) over the Federal Funds rate.[9] The technology cost required to perform this activity was likely exorbitant in the early part of our sample, but has declined to the point where the frictional cost of short-term borrowing in the capital market appear to be below 25 bps ($\theta \leq 25$ bps). Moreover, the amount of leverage available with portfolio margin exceeds the typical deposit-based leverage (i.e. the average ratio of deposits to assets for small banks is 0.7 and 0.5 for the largest banks). The technology that enables portfolio margin is essentially continuously stress testing the portfolio to determine the required equity cushion to keep the loan nearly riskfree and allows for investors in broad-based indices to maintain loans 7x their marked-to-market equity value (e.g. A=100, L=86, E=14).

This contrasts with the persistently large production costs of deposits. Based on the baseline assumption of a 50% total operating costs allocation, the annual average aggregate production cost of deposits (i.e. the allocated operating expense divided by deposits) is 2.9%. This is large relative to the average annual market returns sacrificed by bank deposit holders, which average 1.25% for transactable deposits and 0% for non-transactable deposits. Thus, bank deposits are highly disadvantaged relative to capital market funding at the end of our sample.

We summarize the costs of bank deposits relative to capital market debt costs for the aggregate sample of bank holding companies, as well as by size-based categories of banks. Each quarter we categorize banks based on their asset value rank, with the largest 5 banks considered "mega", the next 50 banks being "large", the next 100 banks being "medium", and the remainder being "small." For each size category we calculate the value weighted average cost of deposits across various assumptions for *s*, the share of non-interest expenses attributed to asset-based activities. We benchmark these deposit costs against the cost of debt issued by these same banks

[9] For example, Interactive Brokers charges 0.25% per year over the Federal Funds rate on margin balances over $3 million, (https://www.interactivebrokers.com/en/index.php?f=interest&p=schedule), accessed September 25, 2017.

over the full sample period from 1997 through 2015 (Panel A), and by subperiods, 1997-2007 (Panel B) and 2008-2015 (Panel C). Additionally, in the latest subperiod, we also benchmark against the cost of portfolio margin, calculated as the Federal Funds rate plus 25bps. These results are reported in Table 5.

Deposit and debt costs are decreasing in bank size, operating expenses are essentially identical across size categories, and the share of assets funded with deposits is decreasing in bank size. This highlights that our calculations with constant s across size categories may not be directly comparable. For example, one possibility is that a 50% of operating expenses for small and medium banks should be scaled by the relative deposit-to-asset shares of the mega banks to smaller banks, such that the corresponding deposit share of operating costs is just over 30% (i.e. s=0.7). While it is not entirely clear what the proper share of operating expenses is for each size category, it is clear that deposit costs are larger than debt costs for all but the most extreme assumptions. As noted above, this is especially true in the later subperiod when compared to portfolio margin costs (reported in Panel C).

Short-term leverage is routinely supplied in capital markets. A capital market investor or entrepreneur able to otherwise obtain the asset exposures similar to banks, can obtain financial leverage by issuing corporate debt, repo, or borrowing via margin loan. This suggests that from the issuer perspective there are many close substitutes. The empirical results suggest that the most *distinctive* type of bank funding – bank deposits – are *dis*advantaged after costs, while repo and other bank debt appear to be priced equivalently to capital market alternatives.

IV. The Relative Advantage of Bank Asset Investments

Asset-based banking activities are viewed to have the potential for an advantage relative to capital markets through specialized credit issuance technology and through low cost sourcing of potential borrowers through their deposit-taking activities. In addition, they may have opportunities to provide additional specialized services to their banking customers, which would present as net income with little required capital. Following the approach developed earlier, we recognize that banking technologies for providing some asset-based economic functions are distinctive from those used elsewhere in the capital market, but we focus on evaluating whether these technologies are relatively efficient.

We first measure bank asset returns relative to passive maturity-matched US Treasury bond portfolios to determine the basic properties of the risk premia banks earn on their assets. The second issue we explore is whether banks are able to capture more attractive risk premia than are available elsewhere in the capital market.

A. Risk Premia on Bank Assets

Bank assets are comprised of cash, securities, various types of classified loans (e.g. business loans, mortgages, consumer loans), and various unclassified investments. On average, cash and securities account for approximately 30% of book assets, classified loans account for approximately 50% of book assets, with the remaining 20% of book assets being unclassified investments. Figure 8 displays the quarterly asset composition of these categories (Panel A) and as shares of total assets (Panel B). In addition, there is fairly rich data at the bank level describing the maturity distribution of assets, including information within the security and loan categories. Banks are required to report the remaining maturity on their assets for fixed interest rate contracts by reporting the amount of time remaining from the date of the filing (FR-Y-9C or equivalent) until the final contractual maturity of the instruments. For floating rate contracts, banks report the amount of 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. Figure 8 also displays the reported quarterly maturity distributions for securities and loans, and our estimates for total assets. To estimate the maturity distribution for assets, we assume (1) specific maturities for the maturity categories reported for securities and loans and (2) specific maturities for cash and other unclassified assets. The following table shows our maturity assumptions for the reported categories:

Reported Maturity Category	<3mo	3mo-1yr	1yr-3yr	3yr-5yr	5yr-15yr	>15yr
Assumed Maturity in Months	1	7	24	48	120	180

We assume that cash and Federal Funds sold have maturity of one-month (maturity category 1) and that the unclassified other assets have a maturity of seven months (maturity category 2). We view these assignments to be conservative, as the unclassified investments include unclassified loans and other relatively long-lived investments. This allows us to estimate the maturity distribution for total assets. For the benchmark portfolio, we model this maturity distribution as a weighted average of shortest-term maturity and the average maturity (long-term average maturity) across the remaining categories. The passive portfolio invests to achieve a similar maturity distribution by investing in one-month US T–bills and each month purchasing *h*-maturity bonds, where *h* is 2 times the long-term average maturity, and holding these until maturity to produce an average maturity similar to the long-term average maturity of bank assets. The bottom-left panel of Figure 8 displays the average asset maturity and the long-term average maturity. There is also considerable information about the income from each asset category, which allows us to construct the returns to various asset categories. We subtract the accounting returns from the associated maturity-matched passive portfolio strategies of US Treasury bonds to measure realized risk premia.

We calculate the *unlevered* return on assets by removing the effects of financing to isolate the net income earned on asset-based activities. Specifically, we calculate the return on book assets in quarter *t* as:

$$ROA_t = \frac{NI_t - (1-\tau)[DepositIncome_t - Interest_t - (1-s)OpEx_t]}{Assets_{t-1}}, \quad (1)$$

where *NI* is net income, *DepositIncome* is service charges on deposits, *OpEx* is non-interest expenses, *s* is the share of non-interest expenses allocated to asset-based activities, and τ is the tax rate assumed to be 0.3.[10] Aggregate bank assets have an average maturity of 2.84 years, comprised of 38.7% short-term assets with an average maturity of one-month and 61.3% longer-term assets with an average maturity of 4.52 years. With the baseline assumption that *s* = 0.5, the annualized return on aggregate bank assets averages 3.37% over the period 1997 to 2015. A passive portfolio designed to match this maturity distribution with buy-and-hold investments in US Treasury bonds earns 3.94% on average, producing a reliably negative realized risk premium for bank assets of -.47% per year (*t*-statistic = -3.35). Figure 9 displays the quarterly time series of these annualized returns, showing that the accounting returns on the simple benchmark portfolio track the asset returns well and that the gap in returns is not driven by the 2008 financial crisis, as the UST portfolio has higher returns in the pre-crisis period. This suggests that bank assets have not earned positive risk premia for the credit and illiquidity risks in their asset portfolios.

Table 6 summarizes these calculations for various assumptions about the share of operating expenses allocated to asset-based activities and across various bank size categories, as described earlier. It is useful to note that smaller banks tend to have longer reported maturities and larger allocations to loans than larger banks. The differences in maturity are captured in the

[10] We calculate the tax rate as, $\tau = 1 - \frac{NI}{NI+Tax}$. The time series average aggregate tax rate is 29.9%.

maturity-based benchmark, but the potential credit risk differences are not. With the assumption that only 30% of operating expenses are due to asset-based activities, the aggregate bank asset risk premium averages zero and is reliably negative for the medium and small banks. At all other considered asset-based activity shares of operating expenses, aggregate asset risk premium are reliably negative.

B. Bank Investment Returns by Asset Category

In light of the remarkable finding that the realized risk premium for bank assets has been zero with the most generous assumptions, and likely to have been reliably negative over the period 1997-2015, we investigate the realized risk premia by asset category. We view this exercise as providing some robustness checks on our basic methodology as we can evaluate whether the simple benchmark returns, adjusted for accounting rules, track returns well across asset types and bank size categories.

We first calculate bank returns by asset type and determine the benchmark strategy based on the maturity distribution of each asset type. The return on cash and Federal Funds sold is calculated simply as the quarterly interest income on these two categories divided by their beginning of period balances. The return on securities and on loans are calculated as follows:

$$Return\ on\ Securities_t = \frac{Interest\ on\ Securities_t + Gains(Losses) on\ Securities_t}{Securities_{t-1}}, \qquad (2)$$

$$Return\ on\ Loans_t = \frac{Interest_t^{CL} - Provisions\ _t^{CL} - s\left(\frac{CL_t}{Assets_{t-1}}\right)OpEx_t}{CL_{t-1}}, \qquad (3)$$

where CL denotes classified loans. We assume that there are no overhead charges associated with managing the securities portfolio. Since bank loans are issued with a distinctive specialized technology, the management of these investments is likely to generate some of the operating expenses. We assume that their share of operating expenses is proportional to their asset share,

$s\left(\frac{CL_t}{Assets_{t-1}}\right)$. This leaves the return on other assets to be defined as the residual unlevered income divided by beginning of period other assets. The results of these calculations, at the baseline assumption of *s* = 0.5, are summarized in Figure 12, which shows the relative investment performance across asset types by bank size category.

Figure 10 shows that the simple maturity-matched benchmark portfolios track the time trends in returns well except for the other assets. As expected, the security returns look very similar to their UST benchmarks and have similar means. The loan returns also look quite similar to the UST benchmarks and have similar returns, which indicates that they earn no risk premium for the credit and illiquidity risk they bear. This is driven by the loan returns of the mega banks, which are -0.5% per year lower than their benchmark with s = 0.5. The bank loan risk premia for all other size categories are reliably positive. The most striking returns are those associated with the other assets, which capture the profits from many of the most distinctive asset-based bank activities. These returns are reliably negative for all size categories and cost assumptions. These results push against the view that the synergies from combining deposit-taking and credit issuance are positive, as the economic returns from these synergies are a component of these returns.

C. Credit Risk Premia in the Capital Market

One natural concern is that the realized risk premia on bank assets that we have measured over the period 1997 through 2015 are biased down because of the 2008 financial crisis. During this period, banks realized credit losses that were large relative to what was expected, which could lead to realized returns that are considerably lower than what was expected *ex ante*. We investigate this possibility by examining the excess returns to passive credit portfolios available in the capital market. Specifically, we examine the returns to several Vanguard index funds that passively invest in either investment grade or high yield bonds and compare these funds to their maturity-matched UST index also managed by Vanguard. There are three different UST indices with maturities described as short-term, intermediate-term, and long-term. Since bank assets are relatively short-term, we do not consider the long-term portfolios.[11] Vanguard has a short-term investment grade portfolio and an intermediate-term high yield portfolio. The maturity-matched annualized excess returns are 0.52% and 0.53% for the investment grade and high yield portfolios, respectively. This is consistent with the notion that short- and intermediate-term credit risk premia were positive elsewhere in the capital market over this period.

V. Consequences and Implications for Bank Equity

The empirical evidence suggests that bank assets underperform US Treasury portfolios and that bank deposits are a relatively inefficient source of funding for banks, which together translate into bank equity underperforming its passive capital market opportunity cost. As demonstrated earlier, from the perspective of common equity risk models (e.g. CAPM) this underperformance can be masked by the strong performance of the passive components of the bank business model. Recall that an unlevered maturity-matched passive portfolio of US Treasury bonds had a market beta of zero and an annualized alpha of 2% from 1981 through 2015, while bank equity had a market beta over 1 and an annualized alpha of zero over this period.

[11] The Vanguard short-term US Treasury index has an annualized mean return of 3.7%, while the Vanguard intermediate-term US Treasury index has an annualized mean return of 5.5%. Our maturity-matched UST portfolio designed to match aggregate bank asset maturity has an annualized mean return of 4%, suggesting that the short-term maturity index is a better maturity-match than the intermediate-term index.

In the aggregate, bank assets are relatively safe, and the well-classified assets are mostly free of market beta.[12] This suggests that the source of the market beta may be the unclassified assets and banks' leverage policy itself, both of which can be viewed as highly distinctive relative to other capital market activities. To illustrate one possible way to reconcile the relatively high market betas of bank equities with the extremely low market betas of the classified bank assets is to model the unclassified assets as high yield bonds. Specifically, we consider a pseudo bank asset portfolio as being a combination of 30% short-term US Treasury bonds, 50% short-term investment grade bonds, and 20% intermediate-term high yield bonds, all proxied with Vanguard funds. This unlevered portfolio has a market beta of 0.066 (t-statistic = 6.9) and an annualized alpha of 1.8% (t-statistic = 3.3) over the period 1997 through 2015. In 2008, this unlevered pseudo-bank portfolio has a drawdown of nearly -9%, as illustrated in Panel A of Figure 11.

Consider how leverage affects the risk of the equity on this portfolio. In the period shortly before the financial crisis, the aggregate bank leverage based on book values was around 15x (see Figure 4). This drawdown levered 15x is expected to essentially exhaust the equity. To account for the fact that the drawdown is not experienced immediately, we calculate the levered equity returns to the pseudo-bank assuming both that the portfolio is levered 15x and 5x, maintaining these target leverages through monthly rebalancing. The cumulative equity returns are displayed in Panel B of Figure 11, along with the cumulative returns to the aggregate banking sector equity portfolio. We approximate the portfolio margin requirement as 15% of the portfolio's previous maximum value and plot this value along with the cumulative equity levels. In the depths of the financial crisis, the relatively small losses of the pseudo-bank asset portfolio

[12] A portfolio that invests 50% in short-term investment grade bonds and 50% in short-term US Treasury bonds has a market beta of zero over the period 1981 through 2015.

are translated into losses that trigger a sustained margin call for the pseudo-bank equity that is levered 15x.

A capital market portfolio approaching a margin call can (1) hope prices recover and do nothing; (2) sell assets; and (3) raise equity capital. Option (1) is clearly risky, but will sometimes work. Options (2) and (3) can be costly to equity investors, as asset sales of illiquid specialized assets may occur at fire sale prices, and the cost of equity capital may be especially high during periods of poor economic conditions. From this capital market perspective, it is not surprising to find that banks are forced to issue large amounts of equity at these times. Black, Floros, and Sengupta (2016) find that banks issue approximately $50 billion worth of equity in the last quarter of 2008. This is approximately 5% of the total market value of publicly traded bank equity in a single quarter, at a time when bank equities are trading at less than one-half their previous high values. This is especially perverse from the perspective of one who is inclined to believe that high leverage is a useful way for banks to avoid the frictional costs of issuing equity (e.g. Baker and Wurgler (2015)). It is also useful to note that the pseudo-bank levered 5x does not come close to a margin call and has mean equity returns that are nearly identical to those for actual banks with one-third of the market beta, over the period 1997 to 2015. This leads to a marginally reliable difference in annualized alphas of -11.5% (*t*-statistic = 1.88).

VI. Conclusion

This paper proposes that bank activities can be decomposed into passive and active components and that evaluation of the specialized active components of the bank business model can be performed by controlling for the passive components that can be executed in the capital market. The empirical analysis suggests that the aggregate US banking sector has been relatively inefficient over the period 1960 to 2015, earning less on its assets than maturity-matched US

Treasury bills and paying more to operate its deposit franchise than it benefited from reduced interest payments. Interestingly, the passive components of bank activities contribute little systematic risk, suggesting that it is the specialized activities that contribute these risks. One of the most distinctive components of the bank business model is the reliance on high leverage, presumably in the supply of liquidity, which appears to generate costs of financial distress that are not offset with other benefits.

Since 1960, banks appear inefficient in that they have not covered their opportunity cost of capital. An interesting question is whether this is due to banks relying on inefficient production technologies in the supply of their specialized financial services or whether this is primarily driven by over-investment. While answering this question is beyond the scope of this paper, the evidence hints that both may be at play. We document a rather remarkable underperformance of bank assets, bank deposits, and bank equity that appears to not be understood by banking experts. The analysis is simple and suggested by finance first principles. This suggests that banking experts may rely on a different set of beliefs that have allowed this result to occur.

The use of high leverage relative to market-based risk measures suggests an *ex ante* under-estimate of the costs of financial distress similar to the apparent under-estimate of normal operating costs. We show some economically important differences in market and book value metrics like ROE and net interest margin, consistent with the notion that a non-market focus may restrict efficient competition with other market participants. Casual empiricism of practitioner communications about the business of banking indicate that these book value metrics are relied upon as targets for compensation and business decisions. The regulatory structure appears to focus on credit risk and recently on illiquidity risk over interest rate risk, despite interest rate risk dominating overall risk. Forward looking, the costs of new production technologies embraced in capital markets are falling, which may further disadvantage banks relative to capital markets.

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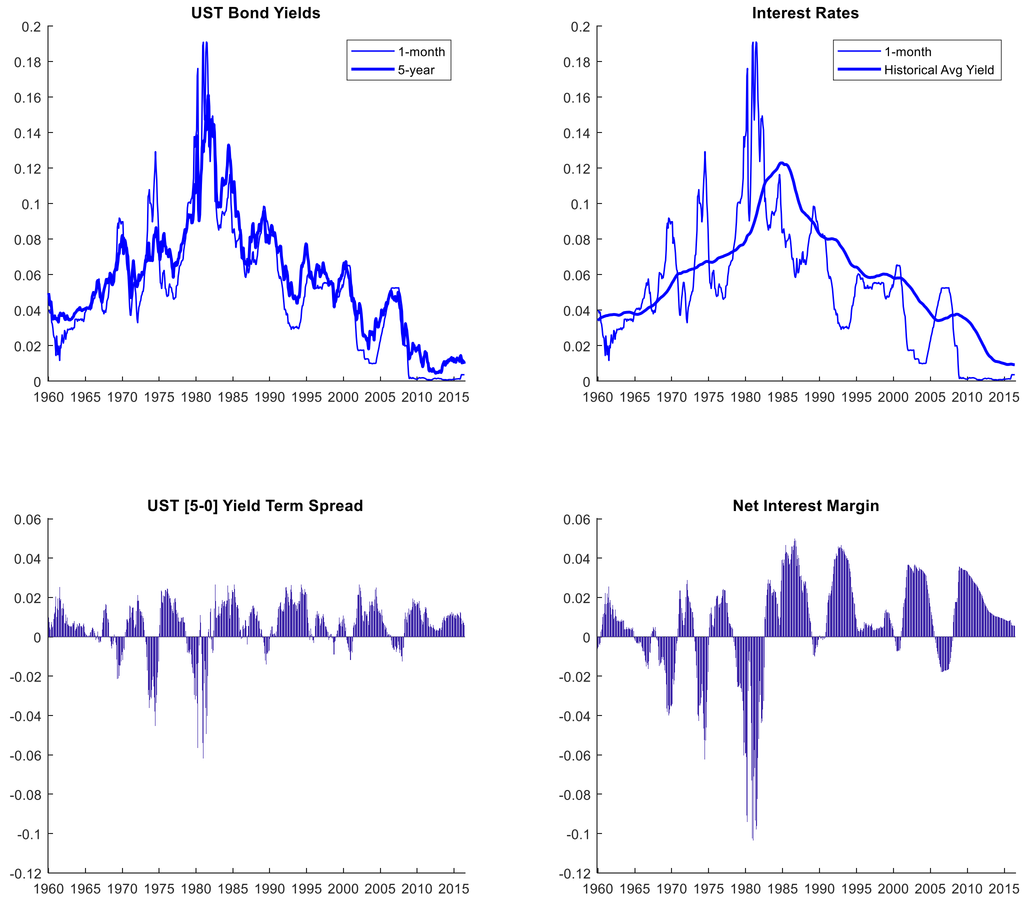


Figure 1. US Treasury Bond Yields and the Consequences for Banks (1960 – 2016).
This figure shows the monthly time series of five-year and one-month US Treasury (UST) bond yields (top left) and the difference is these two series, [5-0] Yield Term Spread (bottom left). The yields are from the Federal Reserve. The top right panel displays the five-year average of the five-year UST yield along with the one-month UST yield to represent the interest rates earned and paid on a maturity transformation portfolio, while the bottom right panel plots the difference in these interest rates, representing the net interest margin.

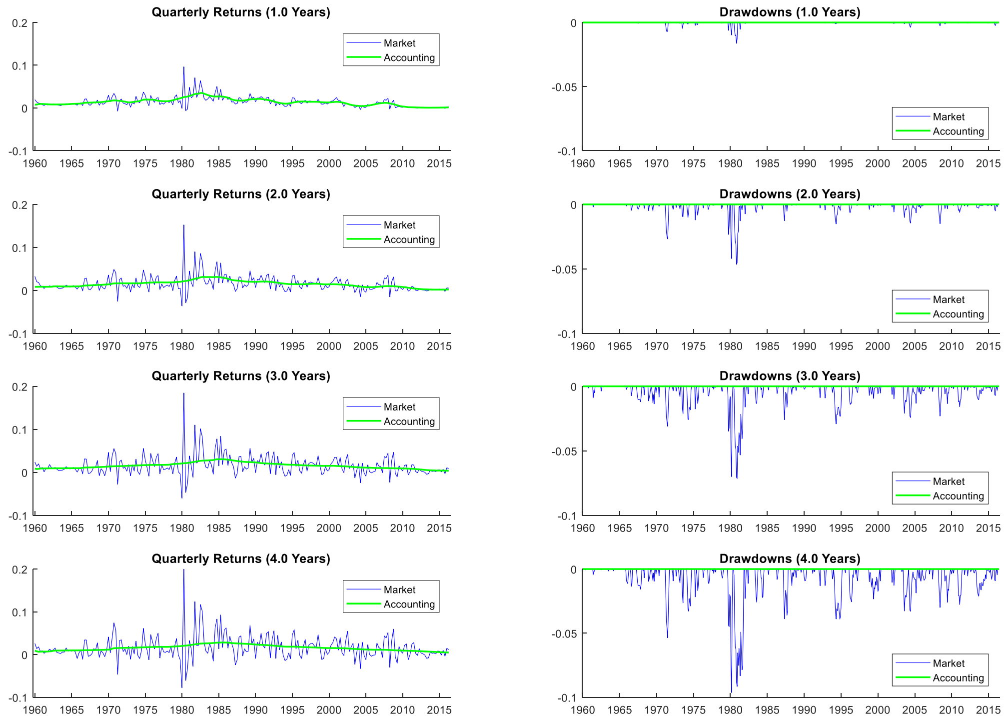
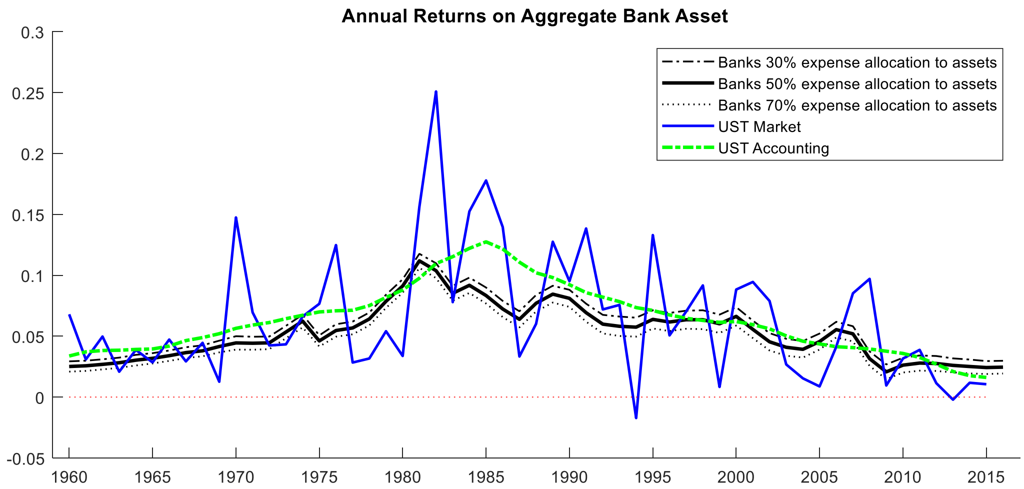


Figure 2. Effect of Hold-to-Maturity Accounting on Bond Portfolio Returns with Various Average Maturities.

This figure shows the quarterly returns and monthly drawdowns of passive portfolios of US Treasury bonds with various average maturities. Portfolios represent passive strategies that invest each month in a h-period US Treasury bond and hold it until maturity, where $h \in \{2, 4, 6, 8\}$, with the average maturity of the bonds in the portfolio equaling $h/2$. Returns and drawdowns are calculated from portfolio values that are reported under both market value and accounting value. Market value measures the portfolio value as the weighted sum of closing market prices, while accounting value measures periodic portfolio values of recently transacted holdings at their market value, but all other holdings at their historical cost. The drawdown is calculated as the current portfolio value measured as a percentage of its previous maximum value.



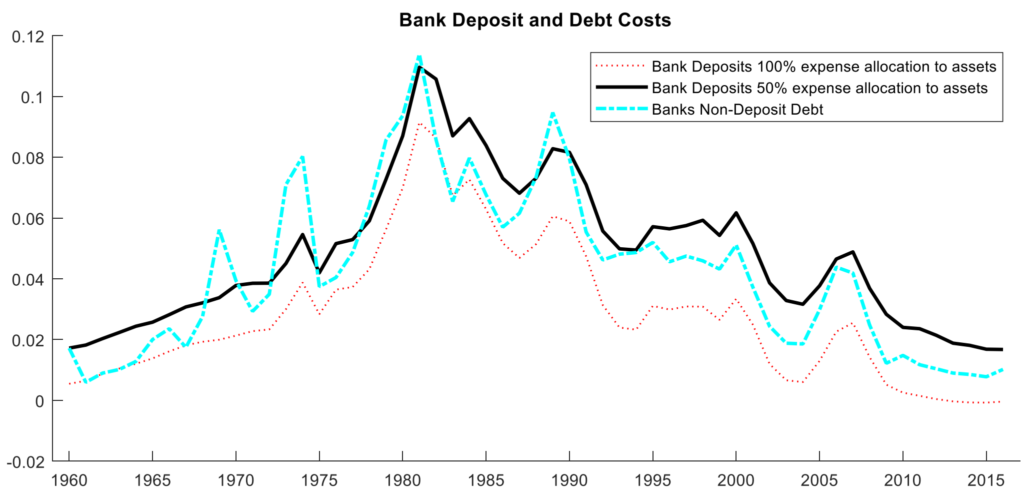
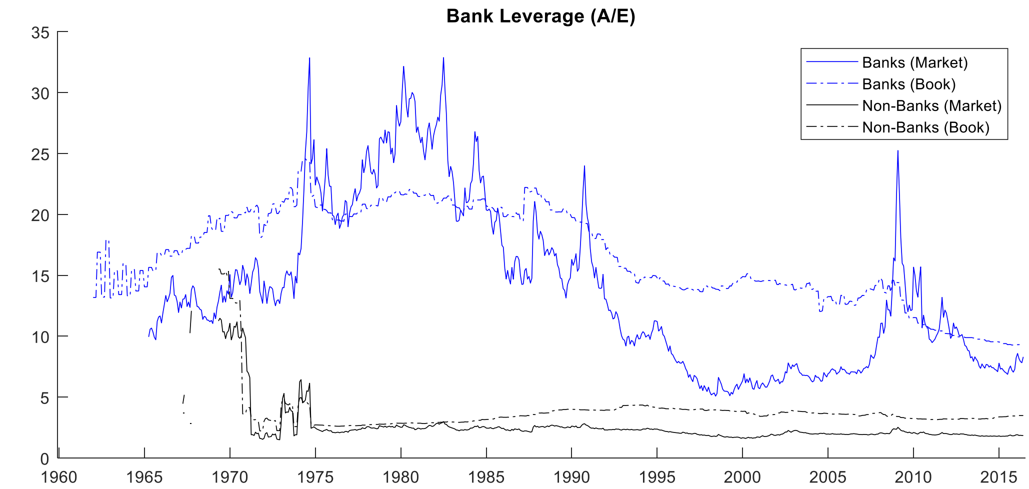


Figure 3. Annual Returns on Aggregate Bank Assets and Costs of Various Bank Debt.

This figure shows the annual asset returns and debt costs for the aggregate commercial banking sector. Panel A displays the return on assets, calculated as net income plus interest expense minus service charges on deposit accounts plus (1-s) times non-interest expense, all divided by the previous period assets, where s represents the share of non-interest expense allocated to asset-based activities. We consider $s \in \{0.3, 0.5, 0.7\}$ and focus on $s = 0.5$ as our baseline. Panel A also plots the market and accounting returns on a passive portfolio that invest each month in a six-year US Treasury bond and holds it until maturity with a three-year average maturity of the bonds in the portfolio. In Panel B, the annual cost of deposits is calculated as deposit interest minus service charges on deposit accounts + $(1 - s)$ times non-interest expense, all divided by the previous period deposits. We consider $s \in \{0.5, 1.0\}$. We calculate the cost of non-deposit debt as interest expense minus deposit interest, all divided by the previous period debt. We measure debt from the balance sheet identity, assets minus total equity minus deposits.



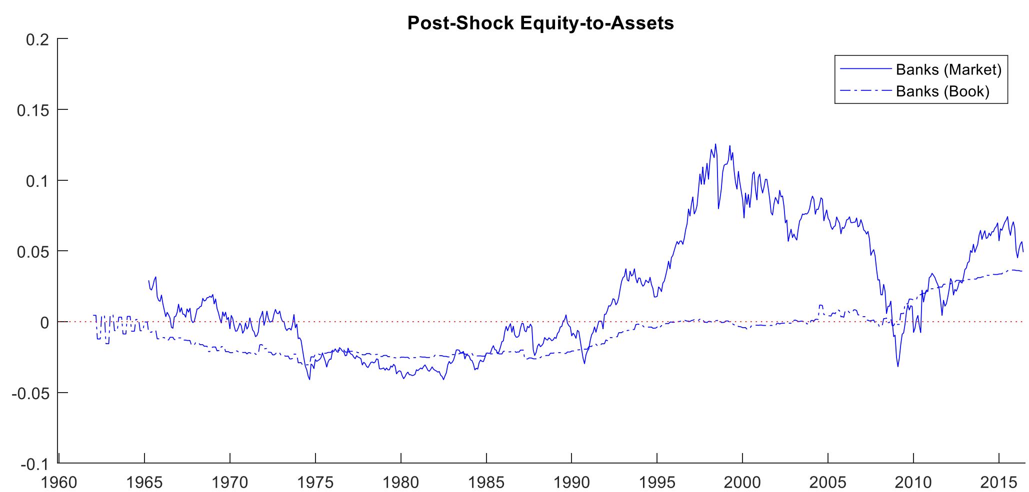


Figure 4. Commercial Banking Sector Leverage.

Panel A displays time series plots of aggregate leverage. Leverage is the ratio of aggregate assets to aggregate equity, calculated for the sample of publicly-traded firms covered in the CRSP-Compustat Merged Database. Banks are identified based on the criterion in Fama and French (1997), leaving all other firms as non-banks. Market (book) values of assets and equity are used to calculate market (book) leverage. Panel B displays the ratio of aggregate equity to aggregate assets resulting from a stress test, assuming that a *shock* to asset values were to occur. The *shock* is -7.64%, estimated as the worst realized drawdown for the three-year UST bond portfolio over the period 1960-2015, applied to the aggregate banking sector assets. Post-shock equity values are calculated as, E* = A (1+shock) – D.

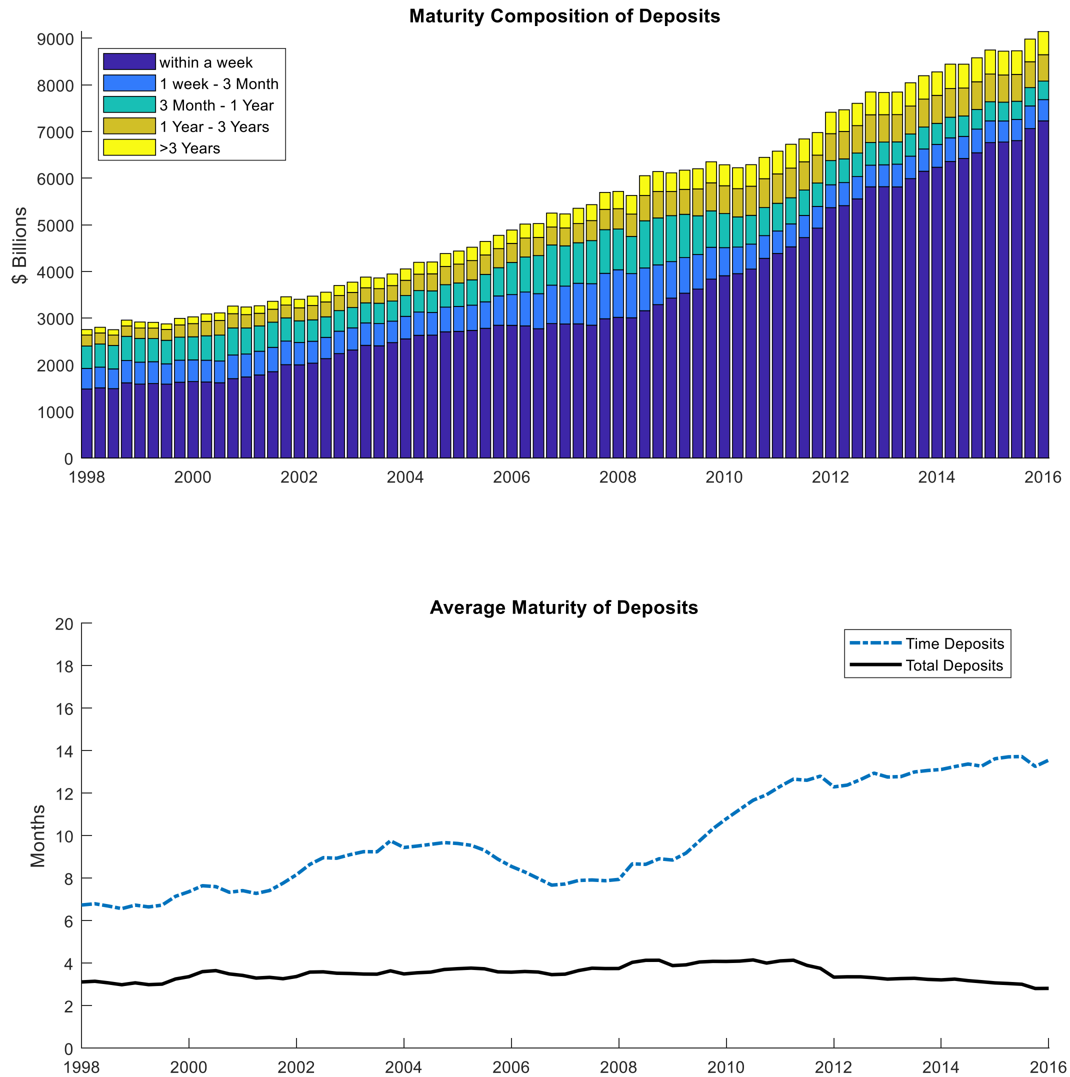


Figure 5. Maturity Composition of Bank Deposits (1997-2015).

Panel A displays the quarterly composition of maturities of deposit accounts for the sample of US bank holding companies. Panel B displays the value-weighted average maturity across all time deposits and across all deposits. Time deposits are defined as

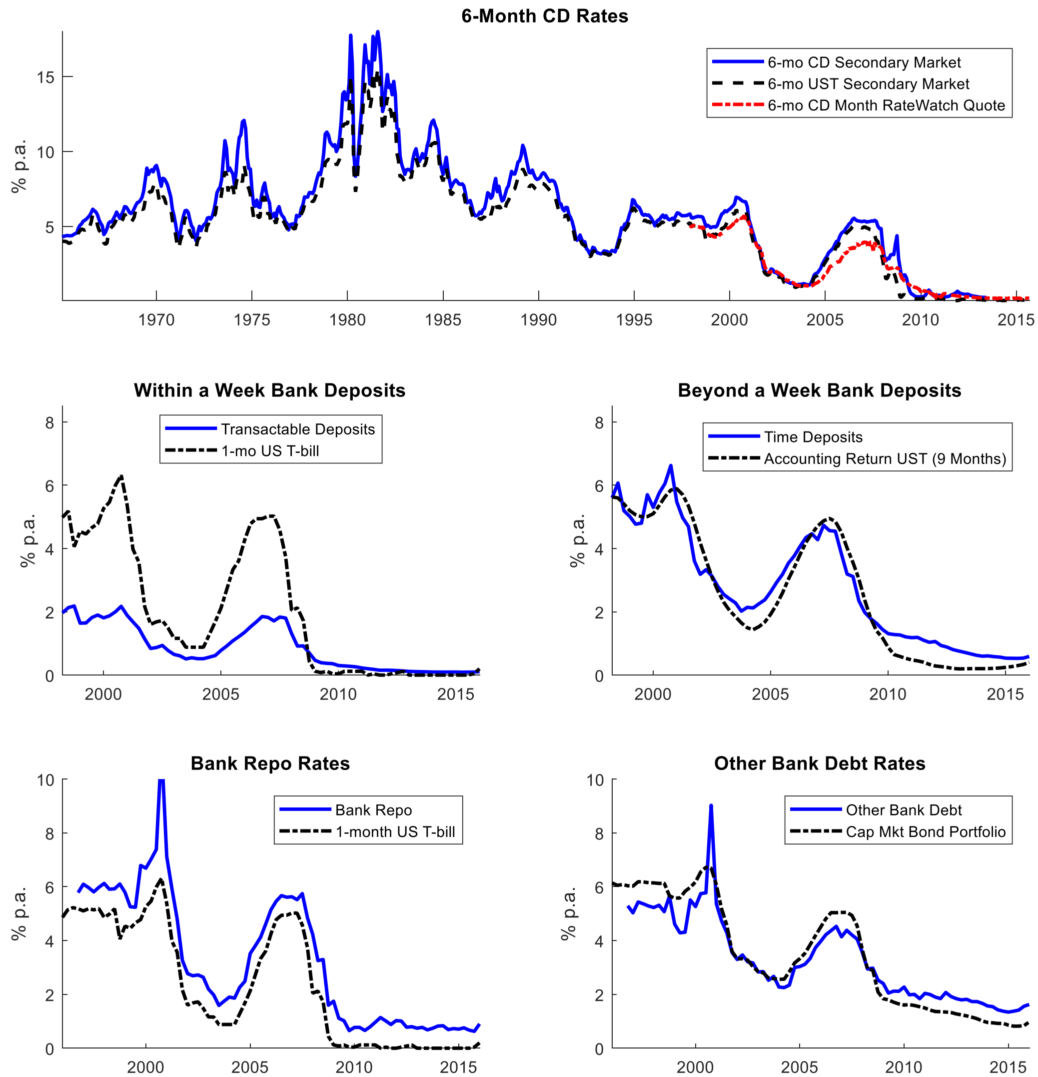


Figure 6. Rates on Bank Funding Compared to Customers' Capital Market Alternatives.

Panel A displays monthly annualized yields on 6-month certificates of deposit (CD) and 6-month US Treasury (UST) bonds trading in the capital market. The solid blue line corresponds to secondary market CD yields, the dashed (dash-dot) red line represents offers (quotes) for newly issued CDs, and the black dashed line shows the UST yield. The bottom panels compare annualized yields on transactable deposits (Panel B) and time deposits (Panel C) to the yields on maturity-matched UST portfolios. Transactable deposits are compared to one-month UST yields and time deposits are compared to the accounting returns on a passive portfolio that invest each month in 18-month UST bonds and holds it until maturity with a 9-month average maturity of the bonds in the portfolio. Panel D displays quarterly annualized rates on bank repo (blue line) and one-month US T-bills (dashed black line). Panel E displays quarterly annualized rates on other bank debt (blue line) and accounting returns on a passive portfolio that invest each month in 50% one-month US T-bills and 50% in two-year A-rated bonds that are held until maturity (dashed black line).

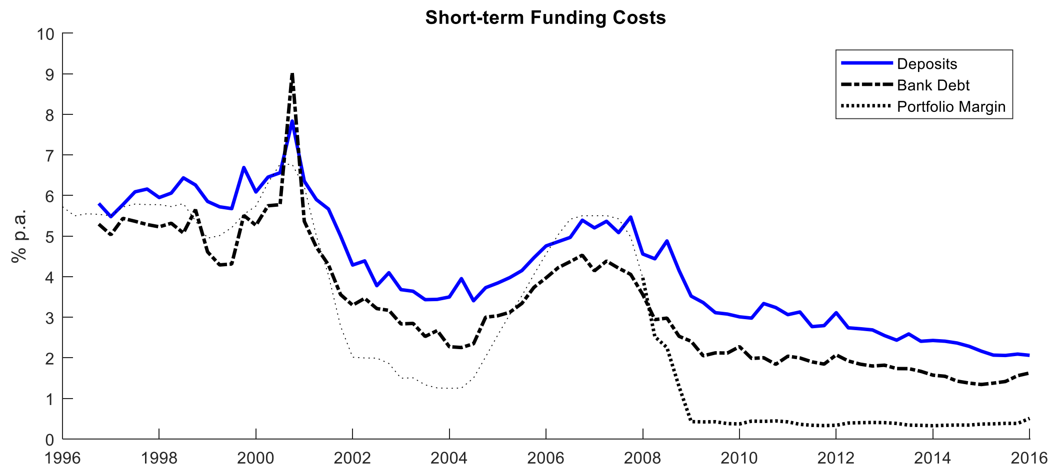


Figure 7. Short-term Funding Costs.

The annualized costs of deposits (blue line) are calculated each quarter as deposit interest minus service charges on deposit accounts + (1 – *s*) times non-interest expense, all divided by the previous period deposits, where *s*=0.5, is the share of non-interest expense that we allocate to asset-based activities. We calculate the cost of bank debt as interest expense minus deposit interest, all divided by the previous period debt. We measure debt from the balance sheet identity, assets minus total equity minus deposits. The portfolio margin rate is calculated as the annualized Federal Funds rate plus 0.25% (dotted black line), which is displayed over the entire sample period, but only becomes a feasible funding source beginning in 2008.

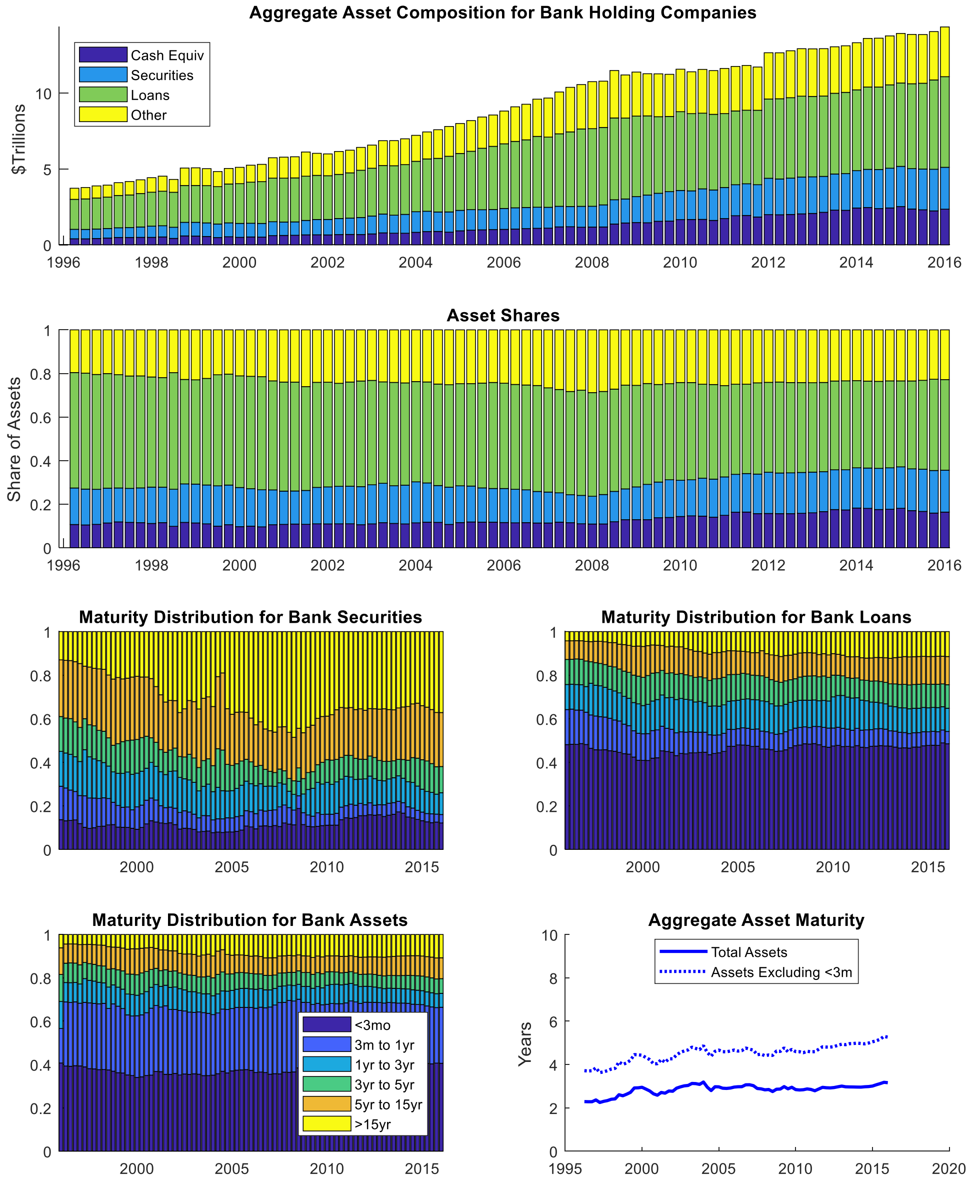


Figure 8. Aggregate Asset Composition and Maturity Distributions (1997-2015).

Panel A displays the dollar amount of bank assets components, and Panel B their share. Panel C shows the maturity distribution (calculated from the commercial bank level data set) for securities and loans. To calculate banks' assets maturity distribution and average asset maturity (Panel D), we use the maturity information given by the data and implied by short term instruments such as cash and Federal Funds sold, and assume a maturity of one month for the remaining share of assets.

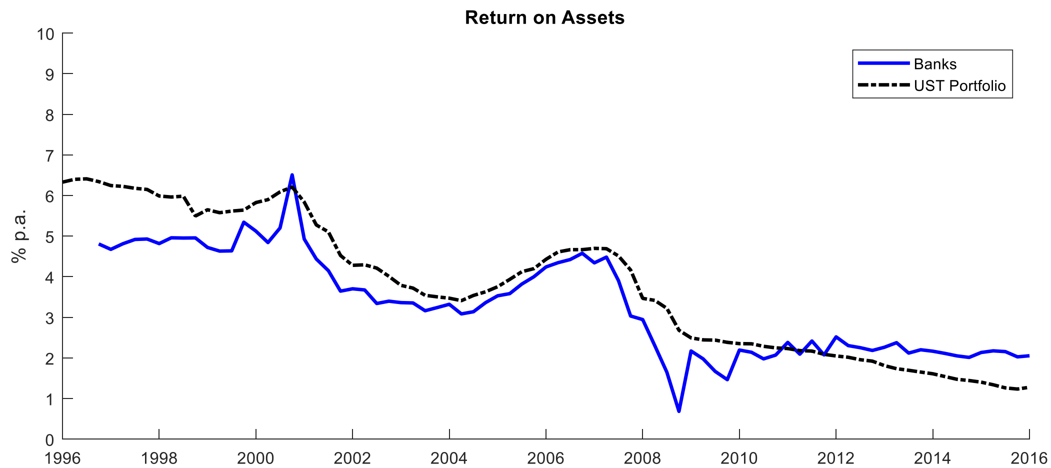


Figure 9. Aggregate Return on Bank Assets (1997-2015).

This figure depicts the unlevered return on aggregate bank assets as well as the accounting return on a UST portfolio with a maturity that is matched to the average maturity of bank assets. Aggregate bank assets have an average maturity of 2.84 years. The unlevered return is calculated

$$ROA_t = \frac{NI_t - (1-\tau)[DepositIncome_t - Interest_t - (1-s)OpEx_t]}{Assets_{t-1}},$$

where NI is net income, τ is the tax rate assumed to be 30%, *DepositIncome* represents the fees income from deposits, *s* is share of operating expenses allocated to asset-based activities, and *OpEx* represents operating expenses. We set $s = 0.5$.

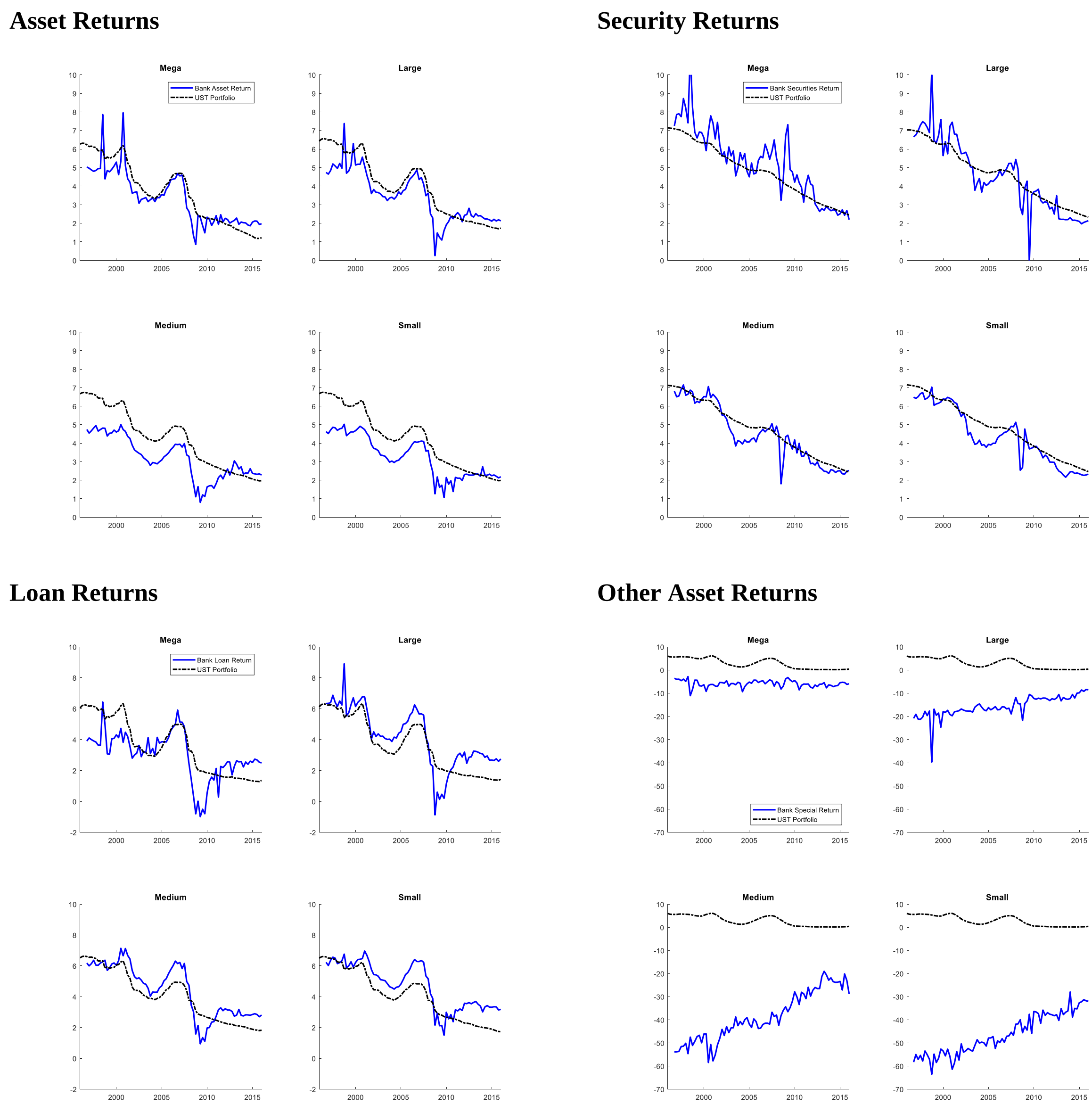
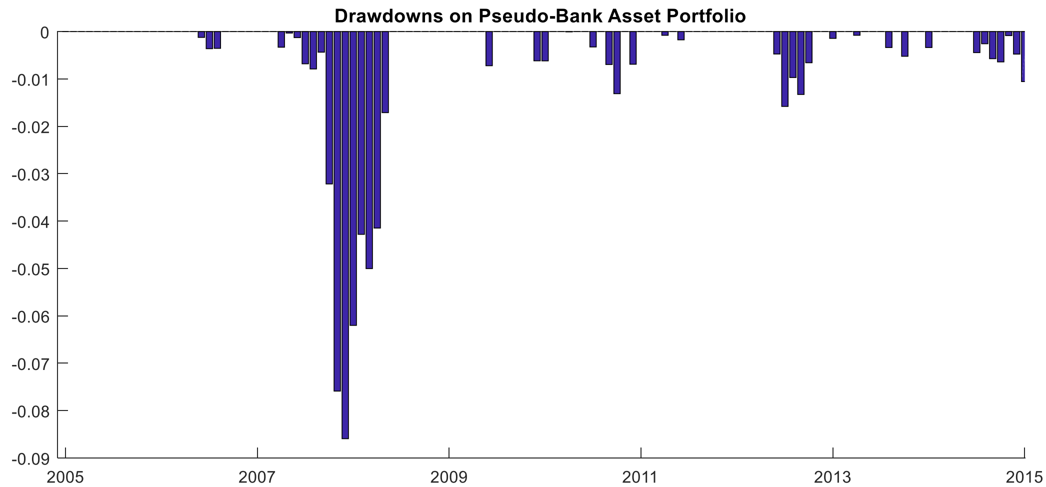


Figure 10. Various Bank Asset Returns by Size Category (1997-2015).

The top left panel compares the unlevered return on assets against the accounting return on a maturity matched UST portfolio for different bank size portfolio. 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. The top right and bottom left panel compare the return on securities and loans respectively against their maturity matched UST benchmark for different bank size portfolios. The return on securities is calculated as interest and gains and losses on securities over securities at the beginning of the period. The return on loans is calculated as interest earned on loans, less provisions for losses, less the operating expense share allocated to classified loans as determined by the asset share of classified loans over beginning of period classified loans. The bottom right panel depicts the return on other asset calculated as the residual unlevered income divided by the beginning of period stock of other assets.



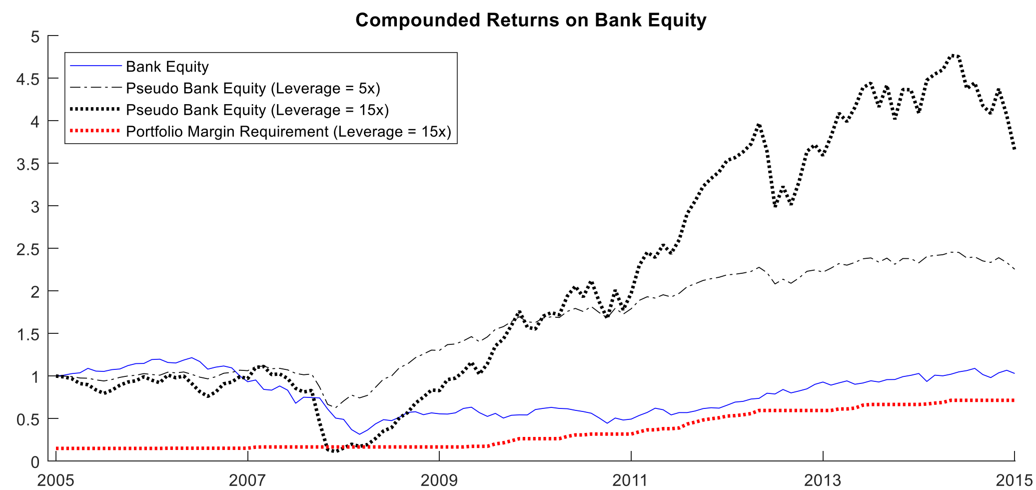


Figure 11. Effect of Leverage on Bank Equity.

The top panel presents the drawdowns on the assets of a pseudo bank with 30% short-term UST, 50% short-term investment grade bonds, and 20% intermediate-term high yield bonds available from Vanguard. The bottom panel depicts the cumulative bank equity return (available from CRSP) against that of the pseudo-bank levered 5x (available in capital markets) as well as 15x (aggregate banking sector leverage). The bottom panel also presents the portfolio margin requirement of the pseudo bank at 15x leverage calculated as 15% of the portfolio's previous maximum value.

Table 1
Regressions Explaining the Excess Returns to Portfolios of US Treasury Bonds

This table reports regressions of monthly and quarterly portfolio excess returns on the excess returns of the value-weight stock market. Portfolios represent passive strategies that invest each month in a *h*-period US Treasury bond and hold it until maturity, where $h \in \{2, 4, 6, 8\}$, with the average maturity of the bonds in the portfolio equaling *h*/2. Returns are measured in excess of the 1-month US Treasury bill rate, Rf_t. Regressions are of the form: $Rp_t – Rf_t = a + b\ (Rm_t – Rf_t)$. The regression intercepts, *a*, are annualized (x12 for monthly and x4 for quarterly) and reported in percent (x100). The number of observations is denoted *N*, the regression R-square is denoted R^2, and *t*-statistics are reported in parenthesis.

Panel A: 196001 - 198106

	Monthly			Quarterly		
Avg. Maturity	a	b	R^2 / N	a	b	R^2 / N
1.0	0.21	0.03	0.08	0.17	0.04	0.08
	(0.58)	(4.68)	258	(0.35)	(2.78)	86
2.0	0.06	0.05	0.07	0.01	0.07	0.09
	(0.10)	(4.41)	258	(0.01)	(2.80)	86
3.0	-0.47	0.07	0.07	-0.55	0.10	0.09
	(-0.59)	(4.53)	258	(-0.50)	(2.97)	86
4.0	-0.77	0.08	0.07	-0.86	0.11	0.09
	(-0.83)	(4.32)	258	(-0.66)	(2.92)	86

Panel B: 198107 - 201612

Avg. Maturity	a	b	R^2 / N	a	b	R^2 / N
1.0	1.17	0.01	0.01	1.20	0.00	0.00
	(6.39)	(2.23)	419	(4.71)	(0.31)	140
2.0	1.96	0.01	0.01	2.04	0.00	0.00
	(5.62)	(2.12)	419	(4.26)	(0.12)	140
3.0	2.66	0.02	0.01	2.79	0.00	0.00
	(5.24)	(2.02)	419	(4.04)	(-0.01)	140
4.0	2.99	0.02	0.01	3.18	0.00	0.00
	(4.61)	(1.99)	419	(3.64)	(-0.10)	140

Table 2
Comparison of Aggregate Banking Sector Return on Assets to US Treasury Bond Portfolio Returns

This table reports summary statistics for the annual aggregate banking sector return on assets and for various US Treasury bond portfolios over the period 1960 to 2015. Aggregate banking sector return on assets is calculated as net income plus interest expense minus service charges on deposit accounts plus (1-*s*) times non-interest expense, all divided by the previous period assets, where *s* represents the share of non-interest expense (i.e. operating expense) that is allocated to asset-based activities. We report results for $s \in \{0.3, 0.5, 0.7\}$. Mean denotes the time series average and Std denotes the time series standard deviation. The mean and standard deviation of returns to passive investment strategies that invest in US Treasury (UST) bonds are also reported under both market value (MV) and book value (BV) accounting. MV accounting reports periodic portfolio values at the value implied by closing market prices, while BV accounting reports periodic portfolio values of recently transacted holdings at their market value, but all other holdings at their historical cost. The UST portfolios have holdings with three different average maturities, two-years, three years, and four years. Return summaries are reported for the full sample (Panel A), the sub-period from 1960 to 1981 (Panel B), and the sub-period from 1982 to 2015 (Panel C).

	Return on Assets			2-Year UST Portfolio		3-Year UST Portfolio		4-Year UST Portfolio	
	s=30%	s=50%	s=70%	MV	BV	MV	BV	MV	BV
Panel A: Full Sample (1960 – 2015)									
Mean	0.0592	0.0532	0.0472	0.0622	0.0609	0.0648	0.0634	0.0659	0.0639
Std	0.0227	0.0222	0.0217	0.0455	0.0303	0.0522	0.0279	0.0593	0.0264
Correlations:									
UST_2yr_MV	0.7188	0.7279	0.7357						
UST_2yr_BV	0.8677	0.8754	0.8816						
UST_3yr_MV	0.6404	0.6441	0.6465						
UST_3yr_BV	0.8860	0.8875	0.8872						
UST_4yr_MV	0.5706	0.5715	0.5712						
UST_4yr_BV	0.8998	0.8974	0.8929						
Panel B: 1960 – 1981									
Mean	0.0535	0.0486	0.0438	0.0618	0.0604	0.0566	0.0581	0.0535	0.0566
Std	0.0227	0.0223	0.0218	0.0368	0.0202	0.0390	0.0182	0.0428	0.0196
Panel C: 1982 – 2015									
Mean	0.0629	0.0562	0.0494	0.0624	0.0613	0.0701	0.0668	0.0740	0.0686
Std	0.0222	0.0219	0.0217	0.0509	0.0356	0.0591	0.0324	0.0672	0.0293

Table 3
Bank Funding Costs on Deposits and Non-Deposit Debt

This table reports summary statistics for the annual aggregate banking sector funding costs for deposits and non-deposit debt over the period 1960 to 2015. The aggregate banking sector annual cost rate on deposits is calculated as deposit interest minus service charges on deposit accounts + $(1 - s)$ times non-interest expense, all divided by the previous period deposits. We consider $s \in \{0.3, 0.5, 0.7, 1.0\}$. We calculate the cost of non-deposit debt as interest expense minus deposit interest, all divided by the previous period debt. We measure debt from the balance sheet identity, assets minus total equity minus deposits.

	Annual Cost Rate on Deposits				
	s=30%	*s*=50%	*s*=70%	*s*=100%	Annual Debt Cost Rate
Panel A: Full Sample (1960 – 2015)					
Mean	0.0568	0.0489	0.0410	0.0291	0.0429
Std	0.0245	0.0237	0.0232	0.0228	0.0267
Panel B: 1960 – 1981					
Mean	0.0485	0.0428	0.0371	0.0286	0.0426
Std	0.0240	0.0232	0.0225	0.0215	0.0305
Panel C: 1982 – 2015					
Mean	0.0622	0.0528	0.0435	0.0294	0.0430
Std	0.0236	0.0236	0.0237	0.0239	0.0244

Table 4
Rates on Bank Debt Compared to Customers' Capital Market Alternatives

This table reports summary statistics for the rates earned by bank customers and investors on their holdings of bank debt along with the rate earned on each debt-types closest capital market alternative. The *t*-statistics use standard errors of the mean difference that are calculated assuming that the number of observations is based on the annual rather than monthly (Panel A) or quarterly (Panels B and C) frequency as an adjustment for the autocorrelation in rates.

	Mean	Std.	Mean Difference	*t*-statistic	N
Panel A: 6-month Certificates of Deposit (CDs)					
6mo CD Secondary (1965-2015)	6.03	3.46	0.70	(8.82)	582
6mo UST Secondary	5.33	3.08			
6mo CD Quote (1997-2015)	2.10	1.74	-0.04	(-0.25)	206
6mo UST Secondary	2.13	2.06			
Panel B: Annualized Rates on Bank Deposits (1997-2015)					
Transactable Deposits	0.97	0.81	-1.25	(-3.83)	78
UST Return (1-month T-bill)	2.22	2.17			
Non-Transactable Deposits	2.93	1.86	0.14	(1.04)	78
UST Return (9-mo Avg Maturity)	2.79	2.13			
Panel C: Annualized Rates on Non- Deposit Bank Debt (1997-2015)					
Repo	3.26	2.42	0.80	(6.73)	78
UST Return (1-month T-bill)	2.46	2.30			
Other Bank Debt	3.28	1.53	-0.06	(-0.40)	78
Capital Market Bond Portfolio	3.34	1.96			

Table 5
The Costs of Deposit Funding for Banks

This table reports annualized costs of bank deposits for US bank holding companies and measures these costs relative to two benchmarks representing capital market debt costs (bank debt issued in the capital market and portfolio margin. The costs for each bank size category are value-weighted averages. 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. Bank deposit costs are calculated each quarter as deposit interest minus service charges on deposit accounts + (1 – *s*) times non-interest expense, all divided by the previous period deposits, where $s \in \{0.3, 0.5, 0.1, 1.0\}$, is the share of non-interest expense allocated to asset-based activities. We calculate the cost of bank debt as interest expense minus deposit interest, all divided by the previous period debt. The portfolio margin rate is calculated as the annualized Federal Funds rate plus 0.25%, which becomes a feasible funding source beginning in 2008. The *t*-statistics use standard errors of the mean difference that are calculated assuming that the number of observations is based on the annual rather than quarterly frequency as an adjustment for the autocorrelation in rates.

Panel A: 1997-2015	**All**	**Mega**	**Large**	**Med**	**Small**
Bank Debt Cost	3.34	3.15	3.70	3.89	3.96
Bank Deposit Cost (s=0.3)	5.44	6.09	5.11	4.54	4.59
Advantage to Cap Mkt Debt	-2.11	-2.94	-1.41	-0.64	-0.63
t-statistic	(-20.92)	(-15.05)	(-12.46)	(-3.85)	(-4.51)
Bank Deposit Cost (s=0.5)	4.25	4.71	3.99	3.66	3.76
Advantage to Cap Mkt Debt	-0.91	-1.56	-0.29	0.23	0.20
t-statistic	(-10.42)	(-10.61)	(-2.97)	(1.43)	(1.43)
Bank Deposit Cost (s=0.7)	3.05	3.33	2.87	2.79	2.92
Advantage to Cap Mkt Debt	0.28	-0.17	0.83	1.10	1.04
t-statistic	(3.17)	(-1.46)	(8.08)	(7.05)	(7.18)
Bank Deposit Cost (s=1.0)	1.26	1.26	1.19	1.48	1.66
Advantage to Cap Mkt Debt	2.08	1.90	2.51	2.41	2.30
t-statistic	(17.63)	(13.07)	(17.75)	(15.74)	(15.31)
Panel B: 1997-2007					
Bank Debt Cost	4.35	4.08	4.78	5.04	5.08
Bank Deposit Cost (s=0.3)	6.49	7.41	6.15	5.23	5.40
Advantage to Cap Mkt Debt	-2.14	-3.33	-1.36	-0.19	-0.31
t-statistic	(-16.46)	(-13.48)	(-12.43)	(-1.27)	(-1.88)
Bank Deposit Cost (s=0.5)	5.21	5.89	4.93	4.37	4.55
Advantage to Cap Mkt Debt	-0.87	-1.81	-0.15	0.67	0.53
t-statistic	(-6.89)	(-8.95)	(-1.61)	(4.44)	(3.10)
Bank Deposit Cost (s=0.7)	3.94	4.37	3.71	3.51	3.71
Advantage to Cap Mkt Debt	0.41	-0.29	1.07	1.53	1.38
t-statistic	(3.01)	(-1.52)	(10.57)	(9.75)	(7.74)
Bank Deposit Cost (s=1.0)	2.04	2.10	1.89	2.23	2.44
Advantage to Cap Mkt Debt	2.31	1.99	2.90	2.82	2.64
t-statistic	(13.72)	(8.15)	(18.64)	(16.68)	(14.01)

Table 5 Continued

Panel C: 2008-2015	All	Mega	Large	Med	Small
Bank Debt Cost	1.96	1.88	2.22	2.32	2.42
Portfolio Margin Cost	0.64	0.64	0.64	0.64	0.64
Bank Deposit Cost (s=0.3)	4.02	4.29	3.69	3.59	3.50
Advantage to Cap Mkt Debt	-2.06	-2.40	-1.47	-1.27	-1.07
t-statistic	(-12.89)	(-11.84)	(-6.62)	(-6.85)	(-7.80)
Advantage to Portfolio Margin	-3.38	-3.65	-3.05	-2.95	-2.86
t-statistic	(-15.20)	(-14.26)	(-12.78)	(-16.25)	(-13.69)
Bank Deposit Cost (s=0.5)	2.93	3.10	2.70	2.69	2.67
Advantage to Cap Mkt Debt	-0.97	-1.21	-0.49	-0.37	-0.24
t-statistic	(-8.52)	(-8.54)	(-2.79)	(-2.30)	(-1.90)
Advantage to Portfolio Margin	-2.29	-2.46	-2.06	-2.05	-2.03
t-statistic	(-12.37)	(-12.26)	(-10.26)	(-12.34)	(-10.14)
Bank Deposit Cost (s=0.7)	1.84	1.90	1.72	1.80	1.84
Advantage to Cap Mkt Debt	0.12	-0.02	0.50	0.52	0.58
t-statistic	(1.61)	(-0.19)	(3.83)	(3.68)	(4.82)
Advantage to Portfolio Margin	-1.20	-1.26	-1.08	-1.16	-1.20
t-statistic	(-7.77)	(-8.23)	(-6.29)	(-7.39)	(-6.25)
Bank Deposit Cost (s=1.0)	0.21	0.11	0.24	0.46	0.60
Advantage to Cap Mkt Debt	1.75	1.77	1.97	1.86	1.82
t-statistic	(34.49)	(24.83)	(24.34)	(15.16)	(16.14)
Advantage to Portfolio Margin	0.43	0.53	0.40	0.18	0.04
t-statistic	(3.32)	(4.35)	(2.64)	(1.18)	(0.21)

Table 6
Bank Asset Returns and Risk Premia

This table reports annualized returns on bank assets for US bank holding companies and measures these returns relative to passive maturity-matched portfolios of US Treasury bonds. The returns for each bank size category are value-weighted averages. 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. Bank asset returns are calculated each quarter with various assumptions about *s*, the share of non-interest expense allocated to asset-based activities, where $s \in \{0.3, 0.5, 0.1, 1.0\}$. The mean returns on the benchmark are accounting returns. Each month, for each size category, the benchmark portfolio invests the short-term asset 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 x the long-term 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 of the mean difference that are calculated assuming that the number of observations is based on the annual rather than quarterly frequency as an adjustment for the autocorrelation in accounting returns.

	All	Mega	Large	Medium	Small
Short-term Asset Share (%)	37.69	38.81	39.04	28.73	28.3
Long-term Avg Maturity in Years	4.57	3.82	5.22	5.73	5.26
Loans to Assets (%)	46.3	38.98	53.25	61.03	63.69
US Treasury Benchmark Return	**3.94**	**3.72**	**3.99**	**4.26**	**4.27**
Bank Asset Return (s=0.3)	3.86	3.85	3.98	3.65	3.72
Average Risk Premium	0.02	0.23	0.09	-0.51	-0.46
t-statistic	(0.14)	(1.37)	(0.56)	(-2.91)	(-3.18)
Bank Asset Return (s=0.5)	3.37	3.37	3.47	3.20	3.25
Average Risk Premium	-0.47	-0.25	-0.43	-0.97	-0.92
t-statistic	(-3.35)	(-1.55)	(-2.63)	(-5.62)	(-6.35)
Bank Asset Return (s=0.7)	2.89	2.90	2.95	2.74	2.79
Average Risk Premium	-0.95	-0.73	-0.95	-1.42	-1.39
t-statistic	(-6.57)	(-4.48)	(-5.69)	(-8.41)	(-9.44)
Bank Asset Return (s=1.0)	2.16	2.18	2.17	2.05	2.09
Average Risk Premium	-1.68	-1.44	-1.72	-2.11	-2.08
t-statistic	(-10.77)	(-8.56)	(-9.86)	(-12.65)	(-13.90)

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 *ln* asset values measured over 2004-2005.

Exhibit A: Size Distribution of US Bank Holding Companies Based on Average Quarterly Assets (2004-2005).

Size Category	Count	Mean	Min	Max	Share
Small	499	1,310,176	528,473	5,017,250	9%
Medium	72	13,643,268	5,088,496	46,675,000	13%
Large	14	152,525,893	49,987,500	478,875,000	29%
Mega	3	1,224,125,000	1,083,625,000	1,455,000,000	49%