Inefficient Banking

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ABSTRACT

The core banking activities of extending and monitoring loans and issuing low yielding short-term liabilities are functionally similar to investing in high quality credit and maturity spread trades funded with short-term brokerage loans in the capital market. We find that the unlevered return on assets for the US aggregate banking sector has averaged 2.7% per year over 1999-2015, while similar exposures sourced passively in the capital market earn 3.7% per year. Banks that underperform their size and asset risk matched peers tend to use higher leverage to increase their return on equity. The stock market rewards these banks with high valuations.

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The economic activities of banks are widely viewed to be special relative to other areas of the capital market. Banks invest in specialized knowledge (Leland and Pyle (1977)) and monitoring technologies (Diamond (1984)) to overcome the difficulties of credit provision to a large number of heterogeneous borrowers. These activities are funded primarily through deposits, which are believed to provide a funding advantage relative to alternative forms of short-term borrowing (e.g. Gorton and Pennacchi (1990), Diamond and Rajan (2000, 2001). Practitioner explanations of bank leverage choices are difficult to reconcile with standard tradeoff theories of capital structure and the pricing of systematic risks (Admati, DeMarzo, Hellwig, and Pfleiderer (2013)), suggesting that managers view themselves to be optimizing over real world frictions outside of these neoclassical models, further confirming the perceived specialness of banks.

The essence of banks' specialness is that it allows banks to execute various forms of maturity spread trades, involving illiquidity and high quality credit risk, more efficiently than others using less specialized technologies. This paper investigates the possibility that banks are no longer special relative to capital markets and that the widespread belief that they are special leads to the functional inefficiency of banking.

We evaluate the performance of the aggregate banking sector from the functional perspective of capital markets (Merton and Bodie (1993, 1995)) and the law of one price. We assume that the economic exposures inherent in the core activities of banks can be sourced passively in the capital market. Similar exposures should be priced similarly, such that our passive exposures can be viewed as capital market based opportunity costs. Specialization may lead banks to require higher returns due to their concentrated exposures (Merton (1987)) and allow banks to earn economic rents, such that bank returns, net of costs, should be at least as

large as their closest capital market substitutes. We also explore how these passive exposures can be further levered through common brokerage loans and margin accounts to evaluate the performance of bank equity.

We find that the aggregate value-weighted banking sector significantly underperforms its closet capital market substitutes. The unlevered after-tax return on bank assets earn 2.7% per year over the period 1999-2015. A passive portfolio constructed from low cost index funds and conservatively matched in terms of maturity and credit risk earns 3.7% per year over this same period. The loan portion of the aggregate asset portfolio outperforms its capital market benchmark by 1.5% per year, before costs, while the securities portion of the asset portfolio barely keeps pace with its capital market substitute, before costs. In addition, to the high operating costs of the banking sector, investment income earned through a bank is tax disadvantaged relative to pass-through investment vehicles, such as mutual funds.

The mean return on our equity replicating portfolio is three times higher than the equity return on actual banks (25% versus 6%). We create bank-like equity with leverage of 14x (matching leverage of the aggregate banking sector) sourced from the capital market with a small funding disadvantage (Federal funds rate). An equity replicating portfolio that uses leverage of just 5x and pays the actual financing terms available to relatively small investors through a brokerage loan earns 8% per year with zero market beta and lower volatility than the actual bank equity portfolio. Importantly, the wedge between the Sharpe ratio of after-tax bank assets and the Sharpe ratio of bank equity is much larger than the wedge for the replicating bank assets and equity, suggesting that bank equity investors experience a funding disadvantage relative to what is available in the capital market.

The evidence of significant underperformance of the banking sector leans against the notion that bank behavior reflects optimization over market frictions outside of the standard finance framework, and calls into question many practitioner explanations of bank behavior. Admati, DeMarzo, Hellwig, and Pfleiderer (2013a) highlight the fallacy in many perceived "best practices" from the perspective of standard theories and express concern that banks exploit their privileged access to deposit insurance to capture private benefits while creating large social costs. In addition, we propose that many of these "best practices" may reflect a failure to rely upon appropriate opportunity costs of capital due to misplaced beliefs about systematic risks and leverage shared by bank practitioners and those pricing their stocks, leading to significant private costs to risk-bearing capital providers. Consequently, bank performance and bank equity performance could be improved by adopting many of the prescriptions of the standard theory, in addition to limiting the externalities associated with financially distressed banks.

We find that the stock market essentially values banks based on return on equity (ROE). The R2 from a univariate cross-sectional regression of pre-crisis average valuation multiples on average quarterly ROE is nearly 0.7. A decomposition of ROE into unlevered pre-tax ROA, borrowing costs, and leverage reveals that while there is some variation in ROE related to asset profitability, the bulk of its variation is due to leverage and thus a majority of the variation in valuation multiples is due to higher leverage leading to higher ROE. This evidence strongly supports practitioner claims that the stock market rewards the use of leverage.

Interpreting these cross sectional regressions in the light of the evidence of aggregate underperformance highlights the potential to "miss the forest for the trees." The strong relation between valuation multiples and leverage (or deposits as a share of assets) can easily be interpreted as evidence that deposits provide an important funding advantage for banks over the

capital market if one assumes that the stock market is efficient. However, informed with the evidence that the aggregate banking sector reliably underperforms capital market alternatives, the variation in valuation multiples appears implausibly large relative to the actual variation in bank specialness. Thus, one is inclined to interpret the stock market valuation rule as being inefficient, perhaps encouraging some banks to distort their operating policies to garner relatively high market valuations.

Since the stock-market values bank leverage, less profitable banks have an incentive to increase their leverage in order to garner a higher stock market valuation. Indeed, we find a strong tendency for banks with negative risk-adjusted returns to use relatively high leverage. Moreover, higher leverage-induced ROE, despite poor asset performance, commands relatively high valuation multiples. Variation in the realized risks of bank assets during the 2008 crisis is predictable with pre-crisis ratios of risk-weighted assets to assets and leverage. Consequently, realized equity risks and returns are predictable with these same measures and dominate the explanatory power of market equity betas.

We find that the banks with the riskiest equity, as measured by the ratio of RWA / Tier 1, tend to issue equity at low prices. This highlights the fallacy of choosing high leverage to reduce the equity cost of capital. Both in theory, and reality, the use of high leverage by banks that also choose relatively high asset risks tends to force equity issuance in poor economic states when the cost of equity capital is expected to be, and actually is, expensive. This also highlights an important distinction between the implicit cost of capital measured in normal market environments and the actual cost of capital measured at the time of issuance.

Finally, we demonstrate that an investor armed with the insights about risk from the standard theory, the evidence from the functional perspective of capital markets, and the

willingness to believe that the stock market prices banks inefficiently, would find large predictable risk-adjusted returns. Specifically, the returns to an investment strategy that shorts banks that appear to be using leverage to compensate for underperforming assets to obtain high valuation multiples and buys bank stocks with low valuation multiples despite relatively strong asset performance and low leverage earns reliably positive excess returns with essentially no market exposure, averaging 10% annually over the sample period.

This paper is organized as follows. Section 1 describes the data. Section 2 presents evidence on the specialness of banks from the function perspective of capital markets by assessing aggregate bank performance relative to close capital market substitutes. Section 3 investigates the stock market valuation of banks and the potential for inefficient operating policies to garner high market valuations. Section 4 discusses the robustness of the analyses and the interpretations, especially regarding the role of large banks and luck. Section 5 concludes the paper.

I. Data Description

The primary data for this study come from Federal Reserve form FR Y-9C. This is a quarterly report collected by the Federal Reserve to assess and monitor the financial condition of bank holding companies (BHCs), and is equivalent to the Call Report for commercial banks.

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 time 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. The majority of the 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%

Some analyses focus on the subset of bank holding companies with publicly traded stock. These analyses make use of stock return and market capitalization data from the Center for Research in Security Prices (CRSP). Additionally, we use monthly returns on the value-weighted stock market and the one-month US Treasury bill, as calculated by Ken French. The Federal Reserve provides a table for linking the bank regulatory data with CRSP.

We characterize the activities of US bank holding companies by their financial statements. Table 1 reports various balance sheet and income statement variables for the aggregate banking sector, averaged over the period 2004 through 2005. This snapshot is fairly representative of the full sample asset and liability mix as the aggregate balance sheet composition is quite stable through time, and fairly representative of the pre-crisis income

statements. Given the extreme variation in bank size, we summarize these statistics separately for each of the four size categories defined earlier.

Deposit accounts fund nearly 50% of the largest bank holding companies and 78% for the typical small bank. Deposits fund slightly more than loans on average. The mega-bank average loan balance is 42% of assets, and the small bank average is 68%. Regardless of size, banks allocate roughly 30% of their assets to securities, including both cash and repurchase agreements. The largest banks also allocate 17% to trading assets and 11% to other uncategorized assets, while small banks have negligible trading and other assets. Larger banks issue more non-deposit liabilities than small banks and tend to maintain lower Tier 1 capital ratios, and thus higher leverage ratios. Small banks have leverage ratios averaging 11.7x, while the largest banks have leverage of 18x.

Despite the meaningful differences in asset and liability mix across banks of different size, the average unlevered after-tax profitability is quite similar across size categories, averaging about 75 basis points per quarter. Over this period, the one-month US Treasury bill rate averages 50 basis points, highlighting the low profit margin of the banking business. We calculate the quarterly unlevered return on assets (ROA) as net income plus interest expense, divided by assets. These unlevered profits are net of taxes, so the tax advantage of high leverage is included in this measure. This measure of unlevered ROA reflects what is available to all of the bank's capital providers, namely, deposit-holders, debt holders, and equity investors. The pre-tax unlevered ROA, calculated by adding back taxes, averages 83 basis points per quarter. The wedge between the pre-tax and after-tax ROA implies an effective tax rate of around 13.5%.

The funding advantage is meant to capture the benefit that banks accrue by being able to borrow below the riskfree rate through their deposit franchise. We define the notion of an

effective bank riskfree rate as the weighted sum of the deposit rate, the short-term liabilities rate, and one-month LIBOR. The deposit rate is calculated from interest expense on deposits, scaled by deposits. The rate on non-deposit short-term liabilities is calculated similarly. Deposits and other short-term liabilities average about 75% of total assets, so the remaining roughly 25% is assumed to be funded at LIBOR. The riskfree rate is defined as the one month US Treasury bill return. The difference between the one-month US Treasury bill (our definition of the riskfree rate) and the effective bank riskfree rate is the return on the funding advantage, with the product of this spread and assets representing the dollar value of the funding advantage. Another version of this calculation uses the difference between the 5-year US Treasury rate (UST) and the effective bank riskfree rate, recognizing that from the banks' perspective these funds are effectively much longer term than their demandability allows. The funding advantage relative to 5-year UST averages about 50 basis points per quarter and is slightly smaller for the largest banks due to their lower deposit shares of total capital. When measured relative to the one-month UST, the funding advantage ranges from 7 to 10 basis points for all but the largest banks, and due to the relatively small deposit shares in the capital structure of mega-banks, the funding advantage for the largest banks is slightly negative. It is important to note that these figures are *gross* of the required expenses to maintain the deposit franchises that allow for these low borrowing rates.

The return on loans is calculated as the sum of interest income on loans less provisions for loan losses, divided by the loan amount on the balance sheet. The return on securities is calculated as interest income on securities plus gains (losses) on securities, divided by the securities amount on the balance sheet. The return on trading assets is calculated as the net revenue on trading assets divided by the trading asset balance.

Loans are typically reported at cost net of a provision for expected losses. When held to maturity, securities are reported at costs (20% of all securities during 2004-2005), otherwise at fair value. Trading assets are reported at fair value. For all banks, the operating expenses required to generate the *gross* returns on actively managed loans, securities, trading assets, and deposits are large, averaging roughly 80 basis points per quarter when scaled by assets. Additionally, banks are able to charge various fees associated with transactions and deposit accounts. Fees, measured as non-interest income divided by assets, are generally increasing in bank size, although slightly lower for the mega-banks than for the large banks. Large banks earn 86 basis points per quarter in fees, while the smallest banks average 29 basis points per quarter. We also report the net of fees and costs scaled by assets, which we will analyze in the next section.

The quarterly return on equity (ROE), calculated as net income divided by Tier 1 capital, is increasing across bank size categories. Given that the unlevered profitability is constant across size categories, the relation between ROE and size appears to be driven by leverage. Finally, the ratio of Tier 1 to RWA falls across size categories, suggesting that equity risk is increasing across size categories.

II. Aggregate Bank Performance

A. Mapping Bank Activities into Risk Exposures

The basic premise being investigated is how special banks are relative to capital markets, which requires a mapping of the core banking activities into their closest capital market substitutes. The use of short-term liabilities used to fund longer-term investments, known as maturity transformation, is a key exposure of banks. Essentially all of the banks' investments

embed this exposure (Begenau, Piazzesi, and Schneider (2015)). The securities component of the asset portfolio is a relatively pure form of a maturity spread trade, as these investments are primarily guaranteed by the US government, thereby virtually free of default risk. The loan portfolio combines some credit risk and illiquidity to the maturity spread trade.

Over the period 1996-2015, the weighted average maturity of the aggregate security portfolio held by US bank holding companies averaged just over 8 years, while the loan portfolio averaged just under 3.5 years. Exhibit B shows the maturity distribution for both securities and loans. In addition to securities, banks hold cash and Federal funds, which are essentially zero maturity. The weighted average maturity of securities plus cash equivalents is around 5 years.

Exhibit B: Portfolio Maturity Distribution of US Bank Holding Companies

Maturity Category	Maturity in Years	Securities	Loans
<3M	0.13	9%	47%
3M-1Y	0.63	6%	7%
1-3Y	2.00	14%	13%
3-5Y	4.00	13%	12%
5-15Y	10.00	28%	11%
>15Y	15.00	30%	10%
Weighted Average Maturity		8.15	3.44

Interest rates declined steadily over this sample period, such that maturity spread trades performed well. One might be concerned that banks hedge their interest rate risk, thus partially undoing their maturity transformation. However, Begenau, Piazzesi, and Schneider (2015)) show that banks do not hedge the interest rate risk exposure on their balance sheets in our sample period. In fact, the aggregate net interest rate derivative exposure mimics a maturity spread trade, increasing in value when interest rates fall. Banks' derivative exposure is the largest component of their trading assets, which appear to functionally source a maturity spread trade from the

capital markets. For this reason, we benchmark banks' trading assets similarly to their securities position.

Consequently, a reasonable benchmark for the aggregate securities portfolio is the Vanguard short-term US Treasury (UST) fund (VFISX), which has an average maturity around 3 years. This fund invests in short-term debt issued directly from the US Government in the form of Treasury bills and notes and is managed for a fee of 20 basis points per year. The top left panel in Figure 1 displays the aggregate US bank holding company securities portfolio compounded return, plotted against the Vanguard short-term UST portfolio from 1998Q4 to 2016Q1. The compounded return patterns are highly similar, consistent with the notion that banks passively source these exposures from the capital market. We focus on compounded returns because the bank return data are highly smoothed. The accounting for bank securities allows for many of these to be valued at cost until maturity (hold-to-maturity accounting). Fair market pricing of these securities implies that banks are underperforming on this allocation since this investment income is taxed at the corporate level before being available to capital providers, while these same holdings held in a mutual fund are not taxed before being available to investors.

The top right panel of Figure 1 displays the aggregate bank loan portfolio compounded return, plotted against the Vanguard short-term investment grade (IG) corporate bond portfolio (VFSTX) over the same period. This index fund is designed to provide investors with exposure to high and medium quality short-term credit through investments in corporate and US

Government bonds and pools of consumer loans, managed at a fee of 20 basis points per year.[1] The aggregate bank loan portfolio return is *gross* of the expenses required to actively screen and monitor the credit exposure. We choose the short-term IG corporate bond portfolio primarily to match the credit risk of the loan portfolio. Moody's reports that bank loans are equivalent to BBB-rated bonds, which are IG.[2] Consistent with this notion of risk, we find that the average loan loss rate during the financial crisis of 2008, for the aggregate loan portfolio is 8%, which matches the corporate bond loss rate reported by Moody's. We define loan losses as total loan charge-offs (bhck4635) net of total recoveries (bhck4605), converting the data from year-to-date into quarterly observations. The value weighted loan loss rate is 7.83% during the crisis period from 2008Q2 to 2011Q4. To calculate that rate, we divide the sum of loan losses over that period by the cross-sectional sum over each banks' average loan balance. The pre-crisis loan loss rate was 2.26%. The equal-weighted loan loss rate is 83 bps pre crisis and 4% during the crisis.

Banks should have an "edge" in their loan portfolio when evaluated gross of expenses. In addition, the somewhat restricted tradability of bank loans is likely to also require an illiquidity premium since the corporate bonds are more liquid than the bank loans. As expected, the aggregate bank loan portfolio performs well relative to the passive capital market benchmark, gross of expenses and taxes.

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[1] Alternative versions of both of the index funds are introduced during our sample with lower management fees of just 10 basis points per year. We do not use these lower cost funds, but this highlights the improving efficiency over time in sourcing these exposures from the capital market.

[2] The instructions for schedule HC-R (regulatory capital) in the FR-Y-9C provide guidelines on how to map risk weights into rating categories. A 20% risk weight stands for an AAA or AA rating, a 50% risk weight for an AA rating, and a 100% risk weight for a BBB rating. A balance sheet position with a risk weight of 200% is mapped into B rated loans but not broken out. It is multiplied by two and reported in the 100%.

The demand for the money-like claims offered by deposits allows banks to borrow below the capital market cost, creating a *gross* funding advantage. We are unable to isolate the operating expenses incurred in the management of the deposit franchise, but document that the total operating costs, presumably allocated mostly between managing deposits and the loan portfolio, average 80 basis points per quarter. From the banks' perspective, the funding advantage represents a cost of capital benefit, to potentially be passed along in the form of lower prices on loans in the presence of high bank competition, to be captured by bank management (and labor), or to be earned as excess compensation by the risk-bearing capital providers. Since deposits bear no risk, this activity increases the risk-bearing burden of other claims. The bottom left panel of Figure 1 plots the quarterly bank effective riskfree rate along with the quarterly average Federal funds rate. Most brokerage loans offered to investors with margin accounts are tied to the Federal funds rate. The Federal funds rate averages 46 basis points above the one-month US Treasury bill rate annually over the period 1999 through 2015. We also consider the consequences of an additional funding friction by adding 25 basis points to the Federal funds rate, typical of the standard brokerage loan offered to relatively small margin account holders.[3] In the pre-crisis period, banks face a lower effective short-term borrowing rate than the capital market offers, but this reverses in the post-crisis period.

Finally, the bottom right panel of Figure 1 plots the quarterly aggregate banks fees (non-interest income) less operating costs (non-interest expenses), measured relative to aggregate bank assets. While the specialized activities of banks allow them to charge extra fees for transactions

[3] For example, the interest rate charged on margin loan balances at Interactive Brokers for loans exceeding $3 million is Federal funds plus 0.25%, https://www.interactivebrokers.com/en/index.php?f=1595.

and services, the costs of offering the unique bank activities are substantial. Operating expenses average over 3% of assets per year, and average 30 basis points per quarter when netted with fee income. Since the passive benchmarks sourced from the capital market are all measured net of fees, the residual fees less costs are zero.

B. A Passive Portfolio to Replicate the Risks of Bank Assets

Banks engage in active and costly forms of financial intermediation. A key question is whether these activities generate enough compensation to justify the costs and risks they incur. We approach this question with the observation that passive exposures to high quality credit and to the maturity spread between longer-term securities and short-term securities can be accessed directly in the capital market. Leveraged exposures can also be directly accessed via brokerage loans. Consequently, we construct a simple passive portfolio of mutual funds to replicate the aggregate bank asset portfolio and lever this portfolio via a brokerage account to replicate the aggregate bank equity portfolio. We can then assess the risks of the well-marked replicating portfolio and compare the risk and return properties to the return properties of actual bank assets and equity.

Specifically, we construct a passive bank asset replicating portfolio comprised of 50% invested in the Vanguard short-term investment grade corporate bond fund (VFSTX) and 50% invested in the Vanguard short-term US Treasury securities fund (VFISX). The 50% allocation to short-term IG credit is determined by the aggregate loan-to-asset ratio of roughly 50%. The remaining 50% allocation to short-term UST securities reflects our choice to conservatively benchmark the somewhat longer-term bank securities portfolio (30%), trading assets (10%), and unclassified assets (10%). As will be shown, inferences will be robust to the mix between these

two exposures. Moreover, passive capital market benchmarks with additional maturity risk earn higher returns than our chosen benchmarks over this sample, emphasizing the conservative nature of our benchmarks. We rebalance the portfolio daily to maintain constant portfolio weights.

Table 2 reports a summary of the aggregate bank performance over the period 1999 through 2015. The table reports mean annualized returns, returns in excess of the one-month US Treasury bill rate, annualized standard deviation of returns, Sharpe ratio calculated as excess return divided by standard deviation, quarterly alpha and CAPM beta measured form excess return regressions on the stock market excess return. The first panel reports various capital market benchmarks. Over the relatively long sample period, annualized mean returns are increasing in risk. Sharpe ratios do not increase monotonically in risk, especially for the stock market, which has slightly higher mean returns, but annual volatility an order of magnitude higher than the various bond portfolios. This highlights that the returns to bond-heavy portfolios realized relatively good returns over this period. The reliably positive quarterly alpha estimates for the bond portfolios confirm this interpretation.

Panel B of Table 2 summarizes the unlevered return on the replicating bank asset portfolio, along with two hypothetical bank equity portfolios. The replicating bank asset portfolio averages 3.65% per year, which is 1.46% above the average one-month US Treasury bill rate. The annualized volatility is 2.02%, producing a Sharpe ratio of 0.87. Given the strong performance of the underlying components of the replicating bank assets, the quarterly alpha is 0.45% (*t*-statistic = 3.96). Interestingly, there is little relation to the stock market, as the estimated CAPM beta of -0.018 is statistically indistinguishable from zero. The short-term IG

portfolio has a small positive beta, while the short-term UST portfolio has an offsetting negative beta, netting to roughly zero.

Panel C of Table 3 summarizes the returns to the actual aggregate banking sector. The central variable is the after-tax unlevered return on assets, which averages 2.68% with an annualized volatility of only 70 basis points. Taking the highly persistent reported profitability as given, the Sharpe ratio is 1.11, the CAPM beta is an economically small 0.007, and the quarterly CAPM alpha is 19 basis points.

The replicating bank asset portfolio is designed to approximate the underlying capital market exposures of the unlevered aggregate banking sector asset portfolio. To the extent that it does this, the actual risks of these exposures are likely to be more accurately measured via the replicating portfolio given its underlying components are actively traded in the capital market. In addition, these two portfolios are expected to earn similar returns. The mean annual return difference between the actual banks and the passive asset portfolio is an economically large -1% (*t*-statistic = -2.18). This suggests that the active management of the aggregate banking sector has underperformed the primary passive economic exposures embedded in their business model over this 17 year sample. The appendix shows that the magnitude of this differential performance holds in the pre-crisis, crisis, and post-crisis periods, although statistical significance requires the length of the full sample period. This point can also be seen in Figure 2, which is discussed below.

The performance of the components of the aggregate bank asset portfolio is as expected. Specifically, the pre-tax securities portfolio is well-matched by the short-term UST portfolio consistent with the notion that this exposure is passively sourced from the capital market, but then subject to a tax disadvantage. The loan portfolio return averages 1.25% per year more than

the short-term IG portfolio (*t*-statistic = 1.96), reflecting a combination of an illiquidity premium and the returns to specialized credit, gross of expenses. This outperformance is essentially reduced by half after-taxes, but before expenses, and is no longer statistically distinguishable from zero. The net of fees minus operating costs averages -1.2% per year before taxes and -1% after taxes, while the passive portfolio does not incur these active management costs.

Finally, the effective short-term borrowing rate of banks relative to the passive replicating portfolio are reliably lower, averaging 41 basis points per year relative to the Federal funds rate. It is interesting to note that the aggregate bank funding advantage is essentially zero from 2009-2015. The funding advantage does not directly influence the unlevered return on assets. The unlevered return on assets represents the actual profits generated by banks before their interest expenses. The relatively low unlevered profitability of banks suggests that some of this funding advantage goes to those who borrow from banks and perhaps those working for banks.

The picture that emerges for the aggregate bank asset portfolio is that the portions of the portfolio sourced from the market earn a market rate on a pre-tax basis, while the specialized activities of loans and deposits do, in fact, realize better than capital market rates. However, the costs of the specialized activities more than offset these benefits and are reduced further by corporate taxes. Competition and/or agency problems appear to divert the funding advantage from the risk-bearing capital.

C. The Risks and Returns of Bank Equity

The cost of equity capital is central to practitioner discussions of banking and the amount of equity capital relative to the risks of bank asset portfolios is a primary focus of banking

regulation. The replicating bank asset portfolio represents a feasible alternative investment to the asset-side of the aggregate banking sector. To match the risks of the aggregate bank equity portfolio, the replicating bank can be levered to match the aggregate leverage of the banking sector. There is a small funding friction incurred to create the levered investment, as brokerage loans are typically tied to the Federal Funds rate, which averages 46 basis points higher than the one-month T-bill rate in this sample period.

Given that the replicating bank asset portfolio performs well in this sample, the bank equity should too, so long as the funding frictions are not too severe. Panel B of Table 2 reports the levered portfolio returns under two different financing arrangements. The first targets the average aggregate bank leverage of 14x (assets to equity), where margin loan balances accrue interest daily at the effective federal funds rate. The second calculation targets a leverage of 5x with the goal of remaining under 6.67x, which is the margin limit imposed by Interactive Brokers, with margin loan balances accruing interest daily at the federal funds rate plus 25 basis points. To maintain roughly constant leverage, dividends are distributed when the equity-to-asset ratio exceeds 1.25x its target.

The bank equity portfolio with 14x leverage has a mean annual return over 25% per year with 30% annual volatility and a Sharpe ratio of 0.81. The Sharpe ratio is slightly below the asset portfolio because of the wedge introduced from the federal funds margin loan rate being higher than the one-month US Treasury bill rate. The small negative asset portfolio CAPM beta remains slightly negative, allowing for an economically large quarterly alpha of 6.1% (*t*-statistic = 3.51), highlighting the attractive realized investment opportunity set offered by this sample period. The equity for the bank portfolio levered 5x paying the higher brokerage loan rate also performs well in this sample. The mean annual return is 8.6%, essentially representing CAPM alpha since its

market exposure is minimal. The quarterly CAPM alpha is 1.73% (*t*-statistic = 3.1). The assumed additional funding friction further reduces the Sharpe ratio to 0.71. The much lower leverage of this portfolio has an annual volatility of just 9.4%.

We calculate the value-weight equity portfolio for the subsample of publicly-traded bank holding companies and report summary statistics in Panel C of Table 2. Despite the low measured asset beta of the aggregate bank asset portfolio, the equity portfolio has a CAPM beta of 0.995 (*t*-statistic = 8.2), which is not statistically indistinguishable from 1. The appendix shows that this estimate fluctuates over the sample, averaging about 0.65 pre-crisis and 1.4 post-crisis, which is interesting because, as we discuss later, bank risk has fallen in the post-crisis period. Unlevering the estimated equity beta of 1 with the average leverage of 14x, implies an aggregate asset beta of approximately 0.07 (1 / 14). The statistically small positive quarterly CAPM alpha indicates that bank equity has covered its CAPM cost of capital. The aggregate bank equity return has annual volatility of 26%, producing a Sharpe ratio of 0.16.

The replicating bank equity with leverage chosen to match that of the aggregate banking sector earns returns nearly 20% higher per year over the sample. The quarterly return difference has a *t*-statistic of -2.04 and the monthly return difference is -2.39. The replicating bank equity with target leverage of 5x earns over 2% higher returns per year than the aggregate bank equity portfolio although the difference is not reliably positive. Both replicating portfolios have Sharpe ratios that are at least four times larger than the actual aggregate bank equity portfolio.

Figure 2 displays the compounded bank asset returns, equity returns, and the ratio of equity-to-assets. The top panel shows the actual aggregate unlevered asset return and the replicating bank asset return, highlighting the attractive market environment for the core activities of banking over this period, despite the financial crisis. The second panel plots the

actual aggregate bank equity performance along with each of the two replicating equity portfolios. The final panels plot the ratio of equity-to-assets. The left figure shows that the aggregate banking sector has lowered its leverage in the post-crisis period (through equity issuance), while the replicating bank has distributed periodic dividends to maintain similar average leverage. The right figures in the bottom two panels show that the bank with 5x leverage is able to live inside its 15% margin requirement over this sample, and after paying a relatively high funding cost of federal funds plus 25 basis points, delivers a higher equity return than the much more highly levered aggregate bank equity portfolio.

D. Do Specialized Bank Activities Manufacture Systematic Risk Exposure?

Understanding the nature of the systematic risks of bank assets is important because these assets are levered 12x to 18x on average. The systematic asset risks may be small, but the use of high leverage magnifies these systematic exposures into economically meaningful quantities. The analysis in the previous subsection demonstrates that high quality credit exposure has a small, but reliable positive systematic risk exposure, while maturity transformation has an offsetting negative systematic risk exposure, such that the passive replicating bank portfolio has essentially zero net systematic risk exposure in this sample period. At the same time, the aggregate bank equity portfolio has a large positive systematic risk exposure, suggesting that bank actual assets may contain some systematic risk.

The highly smoothed reported bank profits reveal little systematic risk via traditional excess return regressions. At the same time, bank profitability falls meaningfully during the market downturn in 2008. To investigate the nature of the relation between bank profitability and aggregate risk, we analyze the time series patterns in the drawdown in bank profitability

measures compared to the aggregate stock market drawdown. We calculate the drawdown for a variable as the current value as a percentage of its maximum value over the previous three-years. In addition, we normalize the drawdown measure by the standard deviation of the profitability measure, calculated over the previous three-years, which we refer to as a Z-score. We also analyze these patterns for the replicating bank asset portfolio.

Figure 3 displays these downside risk patterns for the aggregate unlevered after-tax profits, unlevered after-tax ROA, unlevered pre-tax ROA, and the replicating bank asset portfolio. All three of the aggregate bank profitability measures share a strong relation to the aggregate stock market, especially when plotted in Z-scores. Previous analysis of the well-marked replicating bank asset portfolio produced considerably higher volatility and no measured market beta. Consistent with the previous analysis, the time series of the Z-score for the replicating bank asset portfolio exhibits little relation to that of the aggregate stock market.

The overall risks of bank assets are small, but appear to have a systematic component, generated from the loan and trading portfolio and a brief collapse in fee income (shown in Figure 1). Given the small systematic risk exposure in bank assets, leverage is expected to magnify the exposure and does. Figure 4 plots the time series of aggregate bank profitability for various leverage categories. The top panel shows the unlevered ROA. The second panel plots the return on net assets, calculated as the unlevered profitability less interest on deposits, scaled by assets net of deposits. The third panel plots the returns to risk-bearing capital, which nets out non-deposit short-term liabilities relative to the net asset return, under the premise that the short-term liabilities are essentially riskfree. The final panel plots the return on equity, calculated as net income divided by Tier 1 capital. The pattern of profitability decline in 2008 is shared by all

measures and is increasing in leverage, indicating that leverage magnifies systematic risks not just in theory, but in practice too.

Overall, the analyses in this section suggest that the opportunity set for banks in this sample was highly attractive. Passive portfolios exposed to the core bank activities of high quality credit investments and maturity transformation are able to capture the benefits of the attractive opportunity set, while actual banks and their investors do not. Another interesting result is that the active components of banking appear to induce positive systematic risk exposure beyond those inherent in passive exposures.

III. The Specialness of ROE in Bank Valuation and Operating Policies

In the aggregate, banks appear to significantly underperform their opportunity costs as measured by passive capital market alternatives to their economic exposures. We investigate the possibility of a joint inefficiency, whereby the stock market values banks based on ROE with little regard for variation in systematic equity risk across banks, such that some banks view their cost of equity capital to be invariant to systematic asset risks and leverage. Specifically, we explore the possibility that high leverage masks underperformance when the stock market focuses on ROE. This requires both a tendency for banks with underperforming asset portfolios to rely on relatively high leverage and for the capital market to reward this behavior with high valuations.

A. Stock Market Valuation of Banks

A popular valuation multiple for banks is the ratio of market equity to Tier 1 capital (for example, Damodaran (2006)). A simple regression of the average valuation multiple over the pre-crisis period, 2004-2005, on average quarterly ROE measured over the same window reveals

a tight link between these two variables. Figure 5 displays a scatter plot and regression line of valuation multiples against ROE, where the dot sizes are in proportion to bank assets. The R2 from this univariate regression is 0.69, with highly similar results over other pre-crisis sub-periods.

The bottom panels of Figure 5 display the relation between valuation multiples and the components of ROE, namely unlevered ROA and leverage. The relation between valuation multiples and unlevered ROA is statistically indistinguishable from zero at conventional significance levels (*t*-statistic = 1.7), while the relation between valuation multiples and leverage is highly statistically significant (*t*-statistic = 7.0). The scatter plots show that the largest banks share the same patterns as the full bank distribution.

These regressions provide strong support for the practitioner view that the stock market rewards the use of leverage. Assuming that the stock market is efficient, these regressions suggest that market equity is a significant beneficiary of the banks' funding advantage available through deposits. However, informed by the evidence in the previous section, these regressions suggest that the stock market pricing rule for banks is likely highly inefficient.[4] The "good" contribution to ROE from asset profitability is not highly valued, while the "bad" contribution from leverage is valued as if a scarce resource, despite the fact that short-term leverage can be obtained more efficiently in other areas of the capital market.

[4] Fahlenbrach, Prilmeier, and Stulz (2016) find that the equity returns of banks with high loan growth rates subsequently underperform their slower growing peers. They further show that analyst appear to be surprised by the poor performance of fast growing banks, suggesting that they underappreciated the risks of high loan growth strategies.

B. Relation between Asset Profitability & Leverage

To investigate the central premise of this section, we want to estimate the relation between risk-adjusted performance and leverage. We first calculate the expected asset profitability for each bank, conditional on its size and risk level. Specifically, for each bank at each quarter, we measure the two-year average RWA/A and the two-year average assets for all banks. We define a peer group for each bank as all banks within +/- 5 percentiles of the size and risk level distributions of that bank. The average unlevered pre-tax ROA over the subsequent quarter is taken as the expected profitability for the bank and abnormal profitability is calculated as the difference between actual and expected profitability. We then calculate the average abnormal unlevered pre-tax ROA for each leverage decile, where leverage is measured as the two-year average leverage ratio of assets to Tier 1 capital.

Table 3 reports the results from this analysis, along with an alternative risk-adjustment based simply on risk level deciles, again measured as the prior two-year average. Over the full sample period, there is a strong relation between leverage and abnormal profitability, with highly levered banks realizing lower future risk-adjusted profits than relatively low leveraged banks. Highly levered banks have quarterly unlevered pre-tax ROA that averages 3 basis point below their size and risk-matched peers (*t*-statistic = -3.9), while banks with the lowest leverage have profitability that averages 3 basis point above their peer group (*t*-statistic = 4.0).

We conduct this same analysis at the level of bank loan portfolios instead of the entire bank asset portfolio. Specifically, we define the relevant risk ratio for each bank's loan portfolio as the risk-weighted loans divided by loans and measure the return on the loan portfolio as interest income on loans less the provision for loan losses, divided by loan balance. The results

are qualitatively similar with highly levered banks having negative risk-adjusted loan portfolio returns and relatively low levered banks having positive risk-adjusted loan portfolio returns.

For context in evaluating the economic significance of the 6 to 10 basis point spread in asset and loan returns across low to high leverage quintiles, we report the average pre-crisis risk-return tradeoff for both assets and loans without conditioning on leverage. Figure 6 displays the average quarterly asset return by asset risk quintile, loan return and loan yield by loan risk quintile, and the average one-month T-bill rate, all measured over the period 1999 through 2006. The loan return is gross of expenses. Average loan yields increase across risk categories, but loan returns do not. This suggests that bank loans are priced as if loan risk is not systematic, thus requiring no compensation beyond the actual losses that were realized over this period. This is somewhat surprising in that realized losses in the pre-crisis period were likely smaller than what was expected *ex ante*, and the credit risk inherent in loan losses are likely to be more severe in economic downturns than in economically benign periods. Bank asset returns increase across asset risk categories, with the top risk quintile assets earning 10 basis points more per quarter than the assets in the bottom risk quintile. Much of this relation is driven by variation across banks in their allocations to relatively high risk loans versus low risk securities.

Table 3 also reports the mean quarterly ROE for each leverage quartile. In the pre-crisis period, ROE is monotonically increasing across leverage categories. In the full sample period, the relation between ROE and leverage is hump-shaped, as the banks with the highest leverage experience very poor performance in the crisis, bringing their overall average profitability below banks with lower leverage. Overall, these results are consistent with the notion that underperforming banks rely on leverage to increase their return on equity and that banks

generally do not view variation in risk-weights to be informative about variation in systematic risks.

C. Do Risk-Weights predict Systematic Risks?

Our analyses of risk-adjusted asset and loan returns implicitly assume that risk-weights measure relevant risks. The results from these analyses suggest that, on average, banks do not view risk-weights to measure systematic risks. Given the nature of bank assets being relatively safe debt claims, portfolio level risks are expected to realize infrequently. Therefore, we focus on the risks that realize during the 2008 financial crisis, which present themselves slowly on bank balance sheets, and study their relation to pre-crisis risk measures. Specifically, we regress the average return on assets over the period 2008Q3 through 2010Q2 on the average asset risk ratio (RWA/A) measured from 2004 through 2005. We also run regression of this form for return on loans, return on equity, and stock market returns.

Table 4 reports regression results explaining crisis period realized returns on assets, loans, Tier 1 capital, and stock returns. The independent variables are the risk ratio (assets, loans, or equity), the natural logarithm of assets, and beta (assets for assets and loans, equity beta for Tier 1 and stock returns). The asset risk ratio is RWA/A, the loan risk ratio is risk weighted loans to loans, and the equity risk ratio is RWA/Tier 1. The risk ratios are highly statistically significant in all specifications, with higher risks predicting lower crisis period returns, consistent with risk weights measuring systematic risk exposures. There is a tendency for ln(assets) to predict lower crisis period returns, hinting that the largest banks may take actions to minimize their stated risk weights relative to their actual risks. Pre-crisis betas are unreliably related to

crisis period returns, although they do have the expected sign. This suggests that the stock market is unable to predict risks, despite the public availability of these regulatory risk measures.

IV. The Case for Inefficient Banking

In this paper, inefficient banking refers to a system of banking that is functionally inefficient relative to highly similar capital market offerings, privately inefficient from the perspective of the risk-bearing capital providers, supported by inefficient capital market pricing of banks. Clearly, there is also concern about the social costs created by the externalities of economically important institutions that choose to become operationally constrained too often.

The underlying driver of these inefficiencies is likely to be the misplaced view that banks are indeed special. US banks were likely special relative to the capital market one-hundred years ago, but this distinctiveness has diminished over time. However, the banking literature has slowly evolved to incorporate the advancement of US capital markets.

This view of inefficient banking involves the stock market falsely believing that bank leverage is valuable, some banks choosing high leverage to achieve high stock market valuations at the expense of asset profitability, and banks generally not charging for systematic risks or enough to cover opportunity costs. Consequently, there are two additional predictions. First, banks that choose high leverage on top of high asset risk without charging for the associated private costs of financial distress will be surprised to discover they face a relatively high equity cost of capital, preferring to attribute this to bad luck coinciding with an economic downturn (Merton Miller (1995)). Second, trading against the stock market's misplaced view of leverage should earn positive risk-adjusted returns.

A. The Equity Dependence of High Risk Banks

One stated motivation for high leverage is to reduce the overall cost of capital by minimizing the reliance on equity funding, which is viewed to be inefficiently expensive. Admati, DeMarzo, Hellwig, and Pfleiderer (2013) highlight the fallacy embedded in this view. Even earlier, Merton Miller (1995) notes, "An essential message of the M & M Propositions as applied to banking, in sum is that you cannot hope to lever up a sow's ear into a silk purse. You may think you can during the good times; but you'll give it all back and more when the bad times roll around."

We illustrate these dynamics in Figure 7. Specifically, we rank publicly traded banks based on their average equity risk (RWA/Tier 1) over the pre-crisis period of 2004 through 2005. We classify the top quintile of this distribution as high equity risk banks and the bottom quintile as low equity risk banks. We then plot the time series averages of ROE, net equity issuance, and stock price index by type. The first panel plots the ROE for both bank types showing that high equity risk banks have higher ROE in the pre-crisis period and lower ROE during the crisis. The second panel plots the quarterly net equity issuance by risk type. The quarterly net equity issuance for all banks with publicly traded equity is the percentage change in the market value of a bank's equity in excess of the bank's quarterly stock return, scaled by the quarterly average market capitalization. Negative values of net equity issuance indicate that the bank is repurchasing their shares, while positive values reflect equity issuance. High equity risk banks issue more equity during the crisis than low equity risk banks. The bottom panel plots the values of equally-weighted portfolios of high and low equity risk banks, indexed to 1.0 at the end of 2005. On average, bank stocks experience large stock price declines during the financial crisis.

High equity risk banks experience larger stock price declines and tend to issue more equity at their lower prices than low equity risk banks.

One rationalization of the practitioner view that the cost of capital for banks with low risk assets can be reduced with leverage is that the low risk anomaly in stocks suggests that the actual cost of equity set in markets appears to be higher than the required returns implied by common models of capital market equilibrium (Baker and Wurgler (2015)). This interpretation is challenged from the evidence presented here. Highly levered banks issue more equity at lower prices than banks with large equity shares in their capital structure. There appears to be an important distinction between the implicit cost of equity calculated as the average realized return over long periods and the actual prices of large equity issuance transactions, which tend to occur at highly depressed prices for highly levered banks.

B. Trading against Leverage-Induced Market Valuations

The previous results suggest that the basic insights of Modigliani and Miller (1958) and the CAPM regarding asset risk and leverage hold, but that the stock market does not charge for risks accordingly. Many bank managers, perhaps due to catering to the stock market, appear to rely on leverage to boost underperforming asset portfolios. This suggests that a trading strategy that buys banks with relatively strong profitability and relatively low multiples due to low leverage is an attractive investment relative to a portfolio of banks with poor profitability and high valuation multiples due to high leverage. This strategy is essentially long "cheap" ROE generated through profitability and short "expensive" ROE generated through leverage.

Each quarter, we identify banks with two-year average equity risk below the median, two-year average abnormal ROA above the median, and current valuation multiple below the

median as stocks for the long portfolio. Similarly, we identify banks with high valuation multiples, high equity risk, and negative abnormal ROA as stocks for the short portfolio. All variables requiring data from financial statements are lagged one quarter. The mean quarterly return to the long position is 4.2% while the mean quarterly return to the short portfolio is -0.5%. Both portfolios have market betas around 0.4, so the long-short portfolio is essentially market neutral with a quarterly alpha of 4.6% (*t*-statistic = 5.0).[5] Figure 8 plots the compounded returns to these portfolios, which illustrates that the long portfolio does better than the short portfolio in the pre-crisis period and continues to outperform after the 2008 financial crisis.

V. Conclusion

This paper studies the functional and private efficiency of banking relative to capital markets by examining the performance, valuation, and operating policies of US bank holding companies. We find considerable support for the notion that the aggregate banking sector is functionally inefficient relative to highly similar exposures available to unspecialized investors in the capital market. This suggests that efforts to rationalize bank behavior and the specialness of banks may be misplaced.

We also provide evidence that bank policies that appear to be at odds with standard theories of capital structure and the pricing of systematic risks, are likely to be privately inefficient from the perspective of risk-bearing capital providers. The tendency to target ROE independent of systematic asset risks and leverage appears to lead some banks to overpay for

[5] A long-short portfolio based solely on valuation multiples below and above the median does fairly well over this period, but valuation multiples do not drive this result. The quarterly alpha from the valuation multiple based long-short portfolio is 1.2% (*t*-statistic = 1.9).

high risk assets, thus producing negative risk-adjusted returns, and to simultaneously choose high leverage. This behavior is claimed to be motivated by reducing the equity cost of capital, but in both theory and reality, is actually costly, as equity issuance for these banks tends to occur in poor economic states when equity costs of capital are high.

Finally, we provide evidence that the stock market valuation of banks is inefficient. Stock market valuation of banks is strongly related to the return on equity, with no apparent adjustment for variation in equity risk. Bank leverage is highly valued by the stock market despite its functional inefficiency relative to short-term brokerage leverage.

The picture that emerges is one where the standard theories of systematic risks and leverage receive empirical support, but many bank managers and stock market participants behaving as if they are unaware of these relations, leading to a highly inefficient sector. The management of banking activities is costly and appears to actually constrain banks from engaging in core functions when the opportunity set is especially attractive. Overall, the evidence suggests that the belief in bank specialness relative to capital markets is not only misplaced, but perhaps contributes to the inefficiency of banking.

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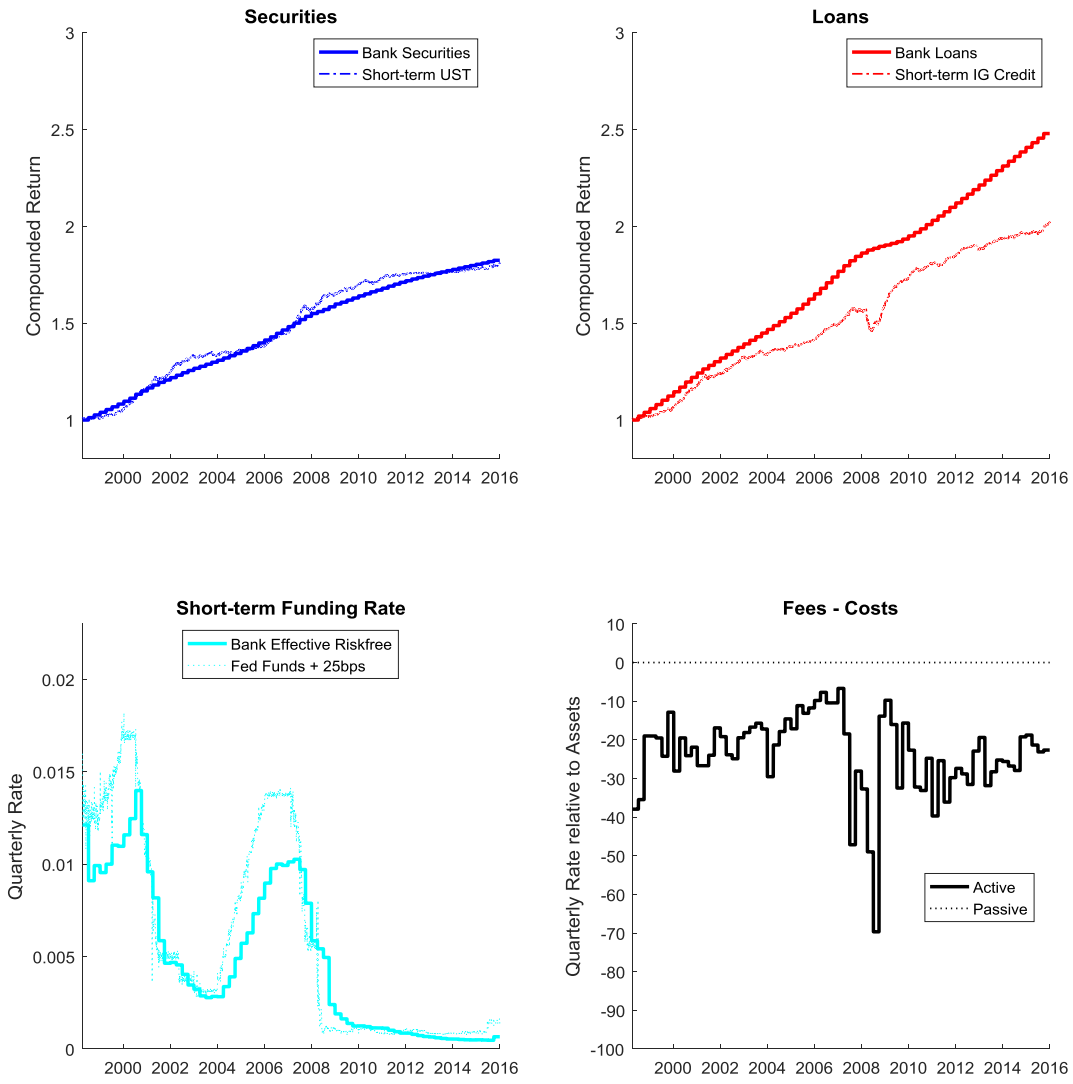

Figure 1. The Business of Banking
This figure plots summaries of the core activities of the aggregate US banking sector. The aggregate values represent value-weighted returns, calculated as the ratio of sums across all banks. The unlevered return on assets (ROA) for the aggregate banking sector is the ratio of quarterly unlevered net income to bank assets. Unlevered net income is quarterly net income plus interest expense. The return on loans is loan interest income less loan loss provisions divided by the loan balance for the quarter. The return on securities is securities interest income plus gains from securities divided by the quarterly average securities balance. The short-term funding rate represents the bank's equivalent short-term borrowing rate, which is calculated as the weighted sum of the deposit rate, short-term non-deposit interest expense, and the quarterly average of the one-month LIBOR. The Fees – Costs are calculated as non-interest income less non-interest expenses, divided by assets. The Short-Term UST return is the daily compounded return on the Vanguard short-term US Treasury securities fund. The Short-Term IG return is the daily compounded return on the Vanguard short-term investment grade corporate securities fund. The short-term funding rate available in the capital market is calculated as the Federal Funds rate plus 25 basis points.

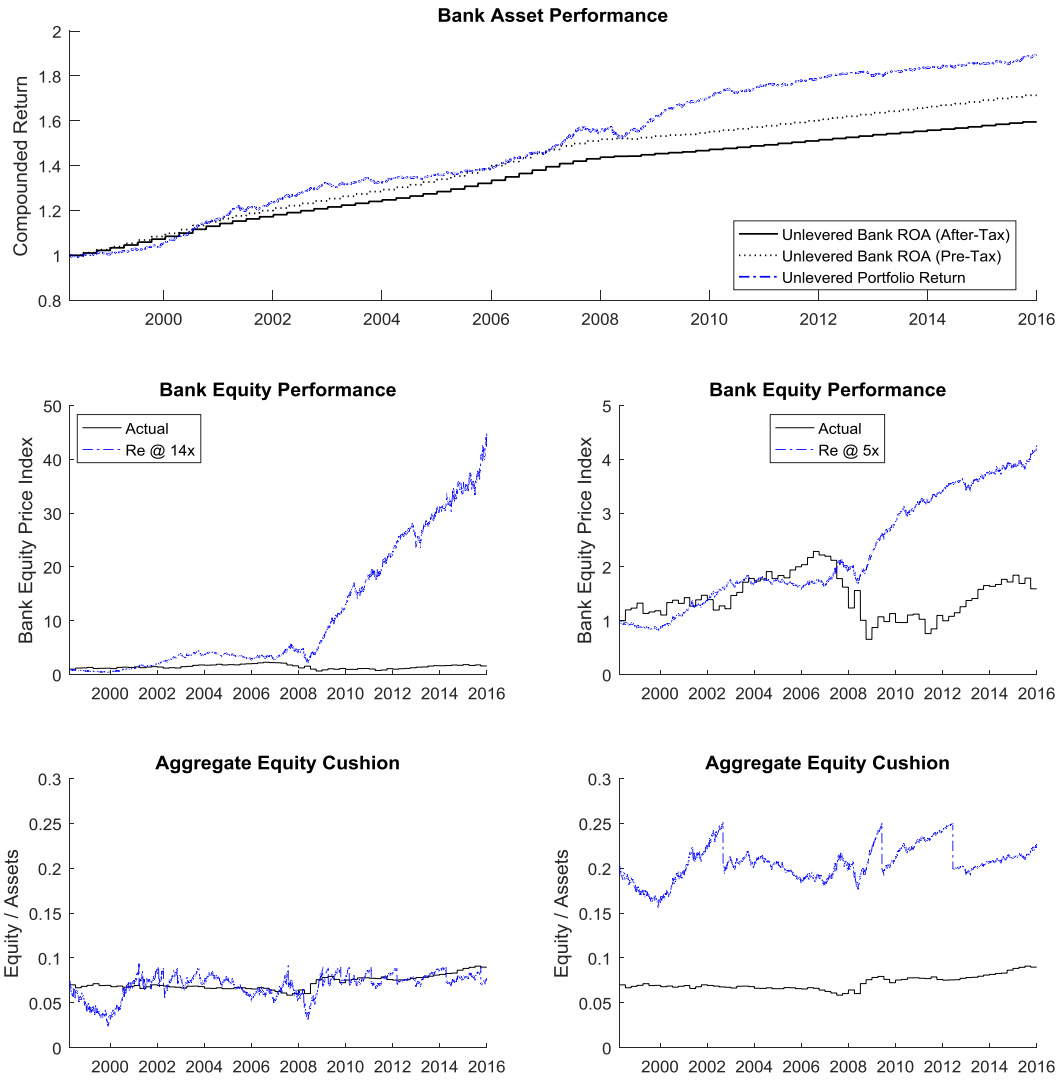

Figure 2. Bank Asset and Equity Performance
This figure displays the cumulative performance of the aggregate US banking sector assets and equity compared with the performance of a hypothetical passive portfolio designed to mimic the economic exposures of the core banking activities. Panel A displays the unlevered return on assets (ROA) for the aggregate banking sector, calculated as the ratio of the sum of quarterly unlevered net income to the sum of bank assets. Unlevered net income is the sum of quarterly net income plus interest expense. The replicating bank (unlevered portfolio) is a portfolio comprised of 50% invested in the Vanguard short-term US Treasury securities fund and 50% invested in the Vanguard short-term investment grade corporate securities fund. The portfolio is rebalanced daily to maintain these weights. Panel B displays the compounded return to a value-weight portfolio of US bank holding company stocks and the levered replicating bank return. The replicating bank targets a leverage (Assets-to-Equity) level of 14x and distributes dividends when the ratio of equity to assets exceeds twice the target. The levered portfolio return represents the equity return to the replicating bank portfolio. Panel C displays the ratio of the sum of Tier 1 bank capital across all banks to the sum of assets, along with the ratio of replicating bank equity to assets.

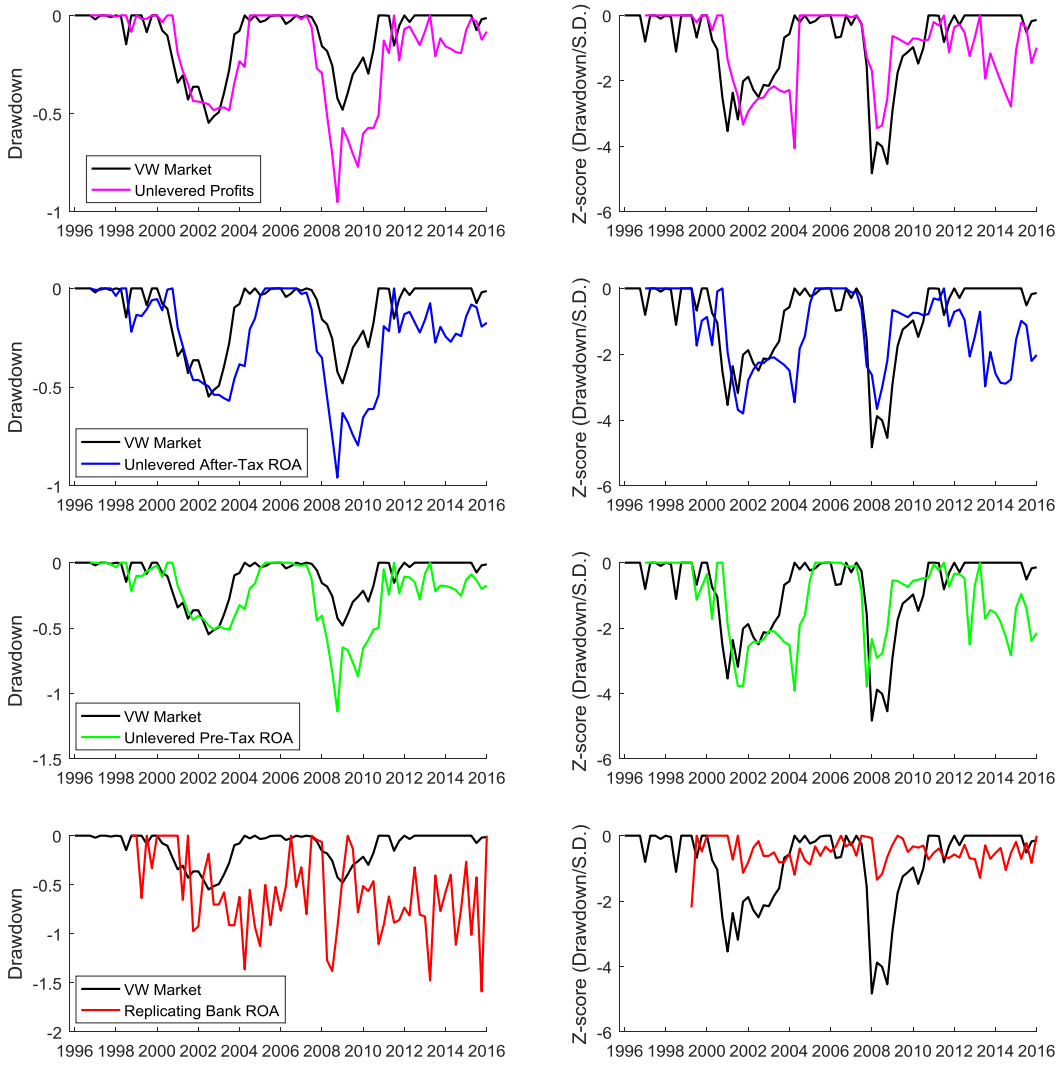

Figure 3. Systematic Exposure in Bank Assets
This figure displays aggregate downside risk measures of US bank profitability. All aggregate profitability measures are calculated as the ratio of sum of income across banks to the sum of capital across banks. The drawdown is calculated as the current value divided by the maximum value measured over the previous three years. The Z-score is the drawdown divided by the standard deviation of the underlying variable measured over the previous three years. The top panel shows the unlevered after-tax profits, calculated as the sum of net income plus interest expense. The second panel shows the unlevered after-tax return on assets (ROA), calculated as the unlevered after-tax profit divided by assets. The third panel shows the pre-tax return on assets, calculated by adding taxes to the unlevered after-tax profit. The fourth panel shows the return on the replicating bank asset portfolio. All figures plot the value-weight CRSP stock market index.

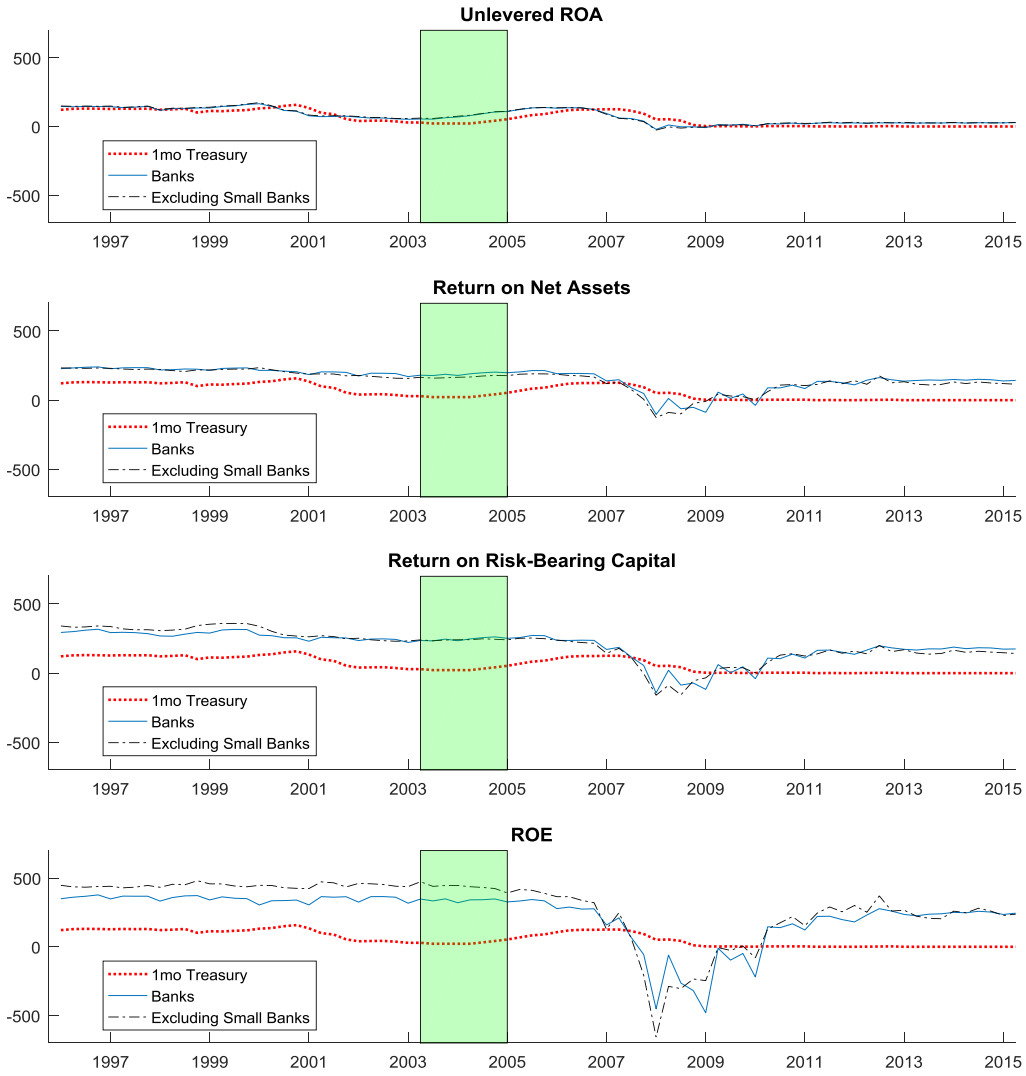

Figure 4. Systematic Exposure and Leverage
This figure displays various aggregate US bank profitability measures order by their leverage amounts. All aggregate profitability measures are calculated as the ratio of sum of income across banks to the sum of capital across banks. The top panel shows the unlevered return on assets (ROA), calculated as the sum of net income plus interest expense plus the dollar funding advantage, divided by assets. The second panel shows the return on net assets, where assets are measured net of deposits and the associated income is the unlevered income less deposit interest. The third panel shows the return on risk-bearing capital, calculated as assets less deposits and non-deposit short-term liabilities, with the associated income measured as unlevered income less deposit interest and non-deposit short-term interest expense. The fourth plot displays the return on equity, calculated as net income divided by Tier 1 capital. All panels also plot the one-month US Treasury bill return.

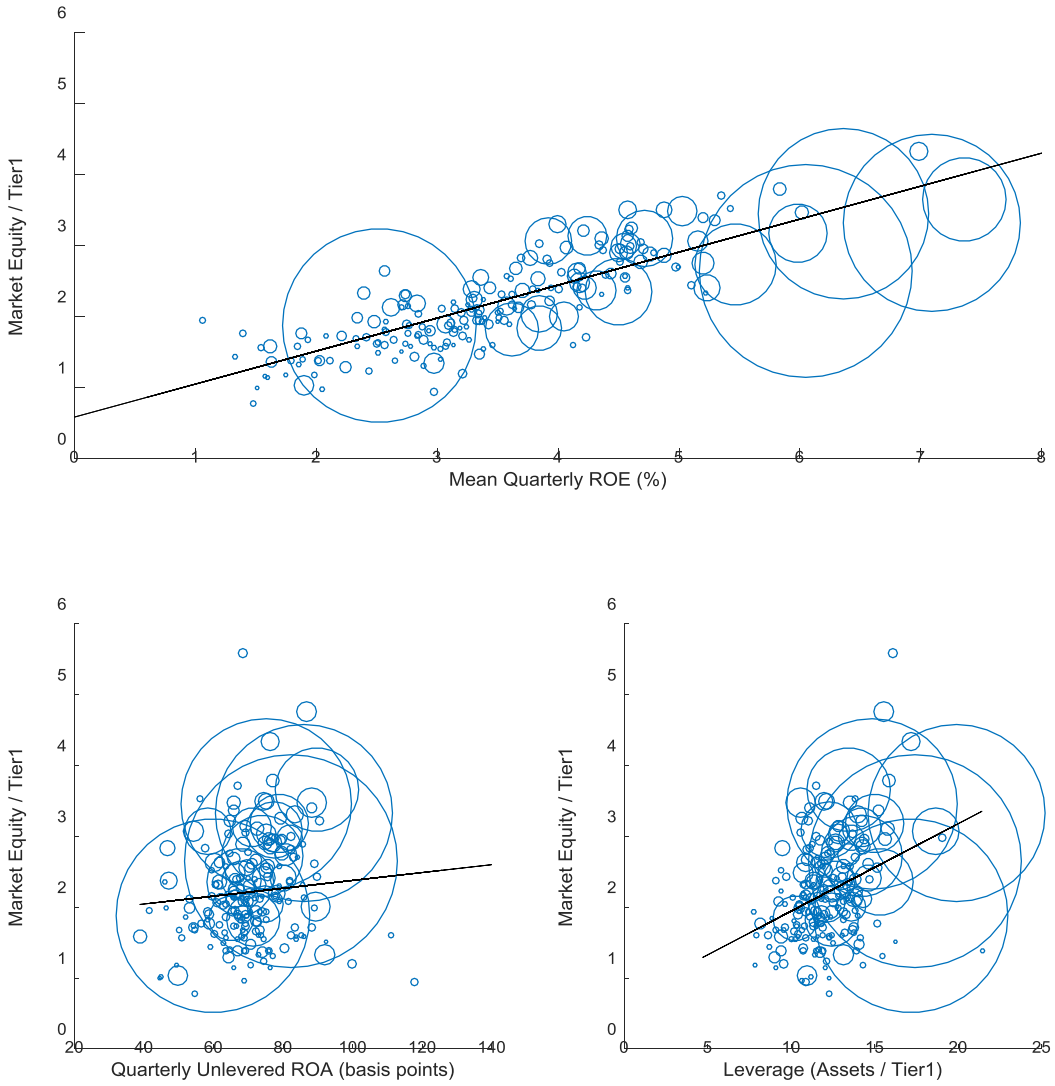

Figure 5. Valuation Multiples and Bank ROE (2004-2005).
This figure displays the relation between stock market bank valuation multiples and bank return on equity (ROE) and the components of bank ROE. All variables are quarterly averages over the period 2004 through 2005. Valuation rmultiples are calculated as the ratio of market capitalization divided by Tier 1 capital. ROE is calculated as net income divided by Tier 1 capital. Unlevered return on assets (ROA) is calculated as the sum of net income plus interest expense, divided by assets. Leverage is the ratio of assets to Tier 1 capital. The dot sizes are proportional to bank assets.

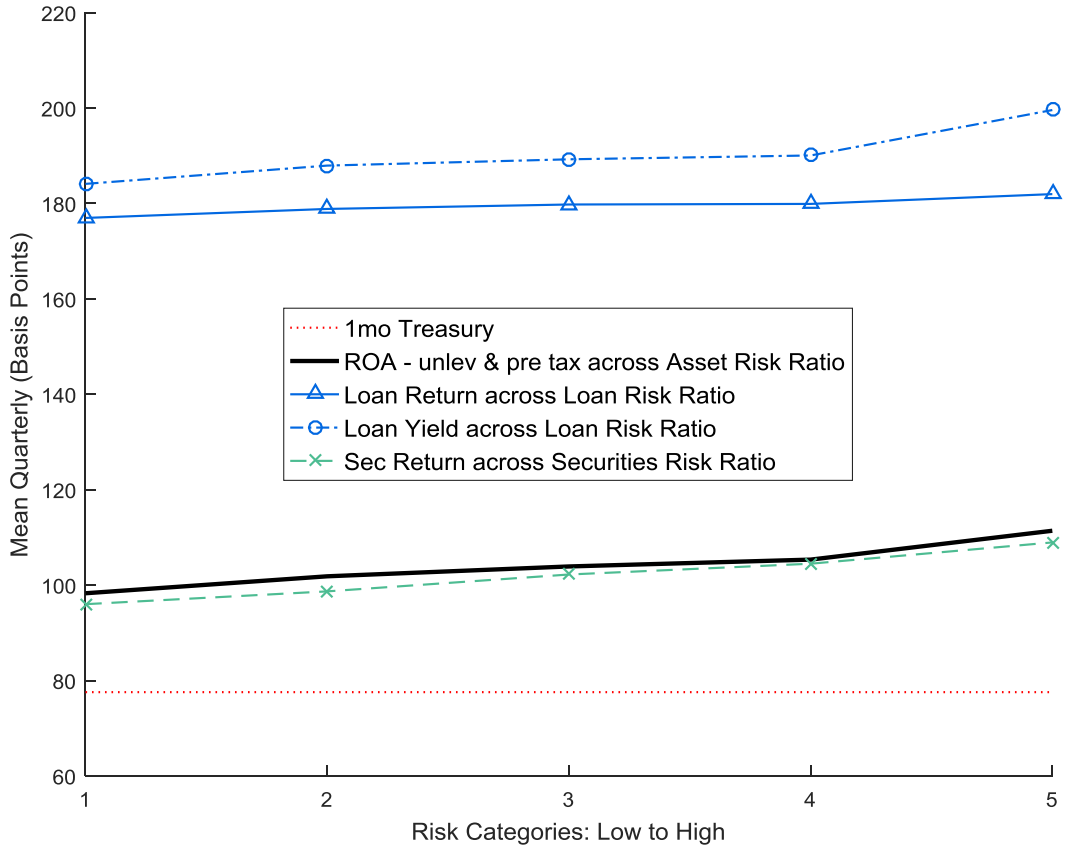

Figure 6. Risk-Return Relation for Bank Assets and Loans (1999-2006).
This figure displays the mean quarterly return for various bank assets by risk category. The unlevered return on assets (ROA), is calculated as the sum of net income plus interest expense plus taxes, divided by assets. The asset risk ratio is defined as risk weighted assets divided by assets. Risk categories are based on quintiles of the risk ratio. The loan return is calculated as loan interest less loss provisions, divided by loans. The loan yield is calculated as loan interest divided by loans. The loan risk ratio is defined as risk weighted loans divided by loans.

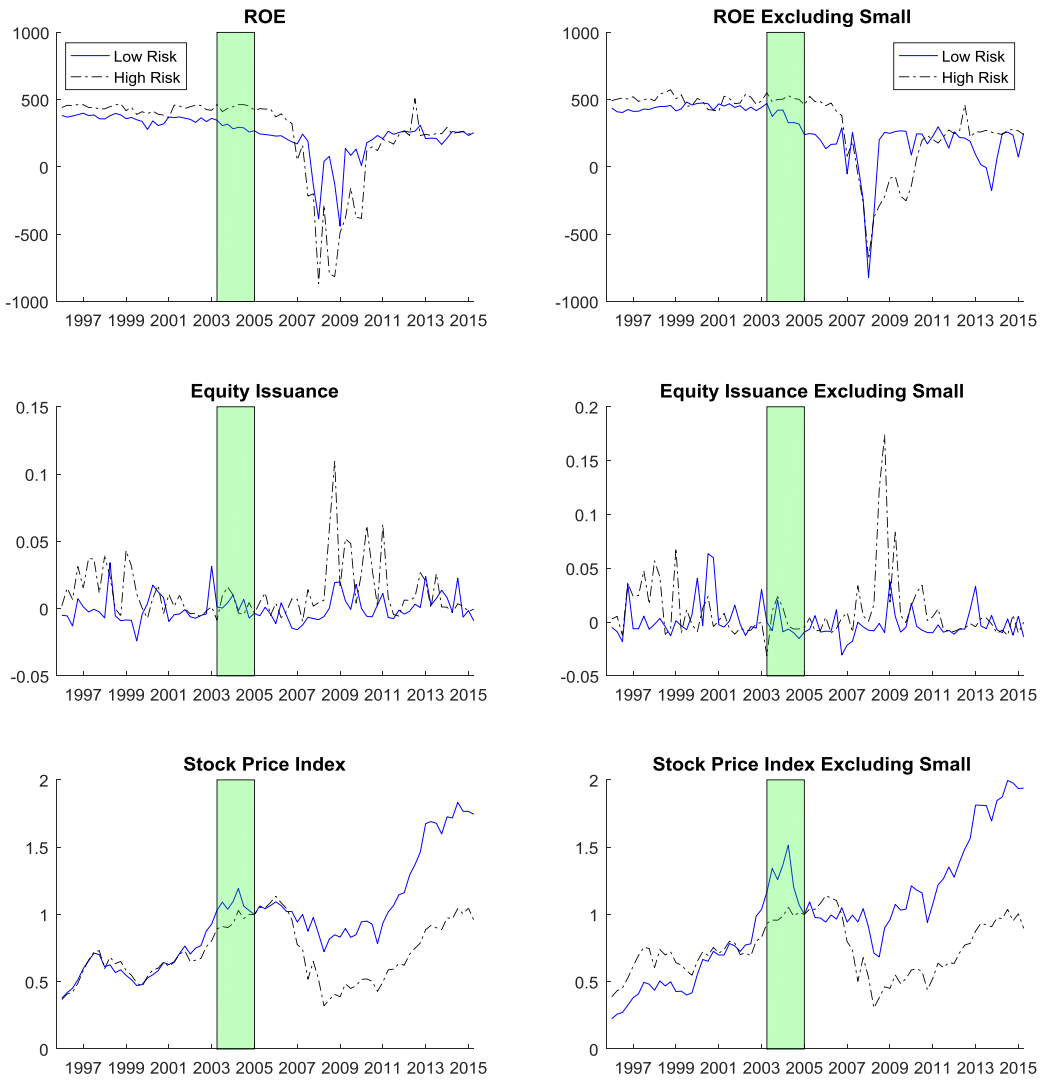

Figure 7. Net Equity Issuance for US Bank Holding Companies (1996-2015).
This figure displays the net equity issuance for publicly traded banks and the times series of the associated stock price index for these banks. The top panel displays quarterly return on equity for publicly traded banks. The middle panel displays net equity issuance, calculated as the quarterly change in market capitalization minus the market return, divided by the average quarterly market capitalization. The left panels show results for the full sample of banks and the right panels show results after excluding the smallest banks. The bottom panels display the stock price index, normalized to 1 at the end of 2005. Each graph displays two measures based on the average equity risk ratio over 2004 through 2005. The equity risk ratio is defined as risk-weighted assets divided by Tier 1 capital.

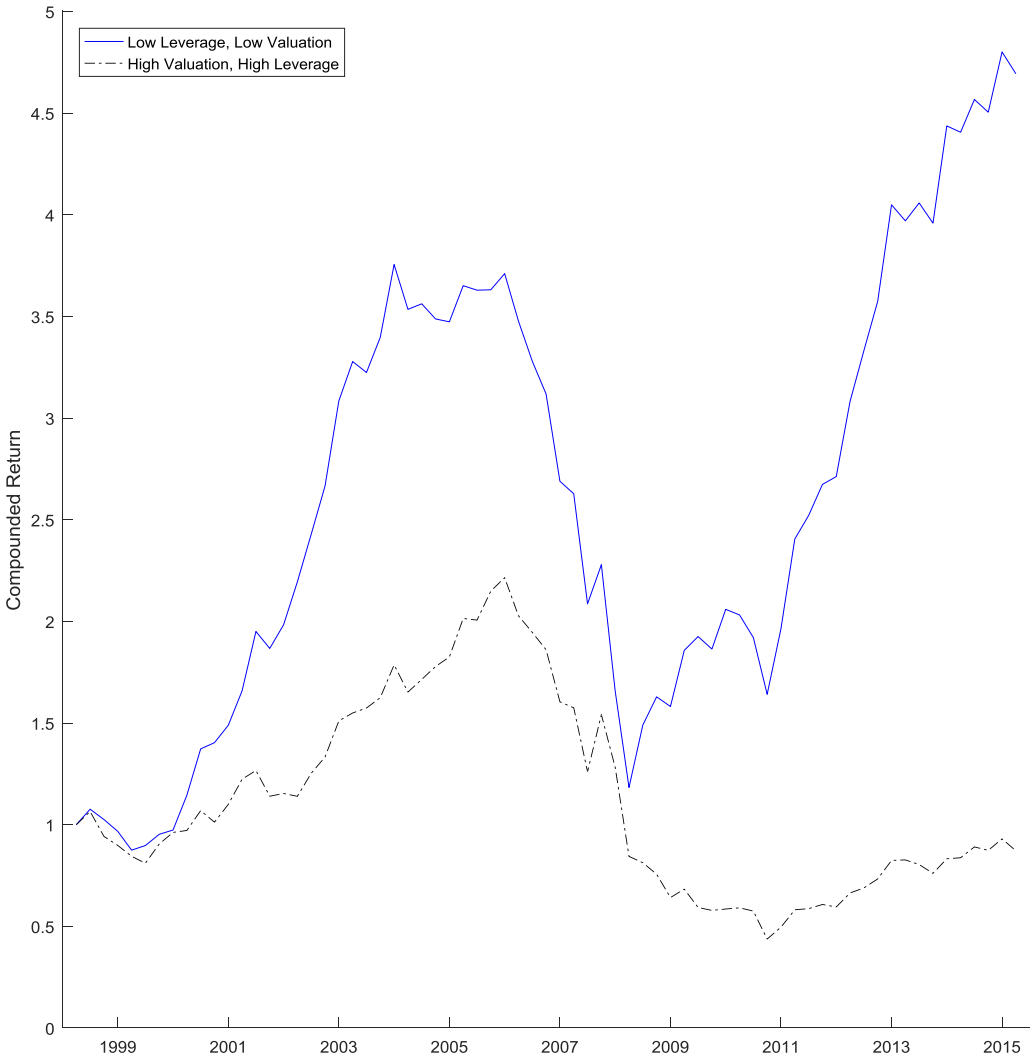

Figure 8. Betting Against Leverage-Driven ROE

This figure displays the compounded quarterly returns of two portfolios over the period 1999Q4 through 2016Q1. The first portfolio is constructed each quarter by buying all stocks that have valuation multiples below the median for bank holding companies, two-year average ROE above the median, and two-year average leverage below the median. The second portfolio is constructed each quarter by buying all stocks that have valuation multiples above the median for bank holding companies, two-year average ROE below the median, and two-year average leverage above the median.

Table 1
Aggregate US Bank Holding Company Balance Sheet & Income Statement Summary (2004-2005)

This table reports the quarterly average of various balance sheet and income statement variables for US bank holding companies measured over the period 2004 through 2005. The balance sheet asset and liability category values are scaled by total assets.

	Small		Medium		Large		Mega	
	Mean	Std	Mean	Std	Mean	Std	Mean	Std
Pre-Tax Unlevered ROA	0.83%	0.16%	0.89%	0.17%	0.98%	0.24%	0.87%	0.18%
Tax Rate	13.73%	9.50%	15.77%	8.38%	19.29%	2.59%	11.21%	5.99%
Unlevered ROA	0.71%	0.14%	0.74%	0.15%	0.79%	0.20%	0.76%	0.14%
ROE	3.33%	1.36%	4.16%	1.36%	5.23%	1.13%	5.22%	2.40%
Loan Return	1.58%	0.20%	1.54%	0.41%	1.40%	0.22%	1.49%	0.29%
Security Return	0.86%	0.20%	0.90%	0.16%	0.82%	0.16%	0.86%	0.23%
Trading Return	13.90%	34.55%	6.69%	5.27%	4.00%	3.78%	1.15%	0.02%
Funding Adv 5yr	0.49%	0.08%	0.50%	0.11%	0.52%	0.04%	0.41%	0.07%
Funding Adv 1mo	0.07%	0.08%	0.08%	0.11%	0.10%	0.04%	-0.01%	0.07%
Costs / Assets	1.07%	0.54%	1.15%	0.80%	1.02%	0.26%	0.96%	0.21%
Fees / Assets	0.29%	0.60%	0.40%	0.41%	0.86%	0.72%	0.64%	0.10%
Fees-Costs / Assets	-0.66%	0.25%	-0.34%	0.12%	-0.34%	0.09%	-0.33%	0.11%
Loans / Assets	0.676	0.126	0.613	0.146	0.604	0.195	0.402	0.057
Securities / Assets	0.275	0.123	0.305	0.114	0.275	0.200	0.299	0.021
Trading / Assets	0.009	0.016	0.010	0.015	0.021	0.026	0.190	0.069
Other / Assets	0.052	0.023	0.074	0.047	0.097	0.028	0.110	0.006
Deposits / Assets	0.778	0.085	0.695	0.117	0.634	0.066	0.450	0.073
OthShortLiab/ Assets	0.064	0.054	0.127	0.099	0.106	0.059	0.214	0.014
Other Debt/ Assets	0.072	0.050	0.096	0.057	0.178	0.041	0.279	0.079
RWA / Assets	0.737	0.114	0.716	0.126	0.842	0.172	0.659	0.069
Leverage (A/E)	11.7	2.2	12.8	2.1	13.8	3.4	18.2	1.5
Tier 1 / RWA	0.126	0.045	0.117	0.032	0.096	0.035	0.084	0.003

Table 2
Summary of Bank Performance (1999-2015)

This table reports summary statistics for various bank profitability measures for US bank holding companies over the period 1999 through 2015. RF corresponds to the return on one-month US Treasury bills. MKT corresponds to the CRSP value-weight index return. Unlevered Bank ROA (return on assets) is calculated as the sum of net income and interest expense across all US bank holding companies divided by the sum of assets. Publicly traded equity is the return to a value-weight portfolio of all publicly traded US bank holding companies. The Replicating Bank portfolio is a passive portfolio comprised of 50% Vanguard short-term investment grade (IG) corporate bond fund and 50% Vanguard short-term US Treasury (UST) securities, rebalanced daily to maintain constant weights. The replicating portfolio borrows funds from a broker at the Federal Funds rate, which is paid daily and denoted as the Broker Debt Return. The replicating portfolio targets a leverage (Assets-to-Equity) level of 15.0 or 5.0 and distributes dividends when the ratio of equity to assets exceeds 1.25x its target. The levered portfolio return represents the equity return to the replicating bank portfolio.

	Annualized Mean	Excess	Annualized Std	Sharpe	Quarterly Alpha	t-stat	CAPM Beta	t-stat
Capital Market Benchmarks								
One-month UST (Rf)	1.90%	0.00%	1.02%	0.000	0.00%	na	0.000	na
Fed Funds (Rd)	2.35%	0.46%	1.09%	0.417	0.11%	(15.88)	0.000	(-0.22)
Fed Funds + 25 bps (Rd plus)	2.60%	0.71%	1.09%	0.651	0.17%	(24.91)	0.000	(-0.22)
Vanguard short-term UST (Securities)	3.35%	1.46%	2.26%	0.645	0.40%	(3.95)	-0.064	(-5.78)
Vanguard short-term IG (Loans)	3.97%	2.07%	2.63%	0.789	0.50%	(3.23)	0.028	(1.66)
Vanguard intermediate-term UST	5.06%	3.17%	5.24%	0.604	0.89%	(3.46)	-0.166	(-5.92)
Vanguard intermediate-term HY	5.82%	3.92%	7.50%	0.523	0.81%	(2.38)	0.287	(7.69)
CRSP value-weight index (Rm)	4.25%	2.36%	18.16%	0.130	0.00%	na	1.000	na
Replicating Bank								
Unlevered return on assets	3.65%	1.76%	2.02%	0.869	0.45%	(3.96)	-0.018	(-1.45)
Equity: 14x leverage @ Fed Funds	25.56%	23.67%	29.18%	0.811	6.10%	(3.51)	-0.305	(-1.61)
Equity: 5x leverage @ Fed Funds + 25bps	8.57%	6.67%	9.35%	0.714	1.73%	(3.08)	-0.098	(-1.60)
Aggregate Bank Holding Companies								
Unlevered return on assets (After-Tax)	2.68%	0.78%	0.70%	1.111	0.19%	(8.08)	0.007	(2.51)
Unlevered return on assets (Pre-Tax)	3.09%	1.20%	0.81%	1.483	0.29%	(12.01)	0.008	(2.80)
Security portfolio	3.45%	1.56%	0.72%	2.160	0.39%	(13.59)	0.004	(1.16)
Loan portfolio	5.22%	3.33%	0.87%	3.842	0.83%	(28.64)	0.007	(2.14)
Trading portfolio	5.11%	3.21%	1.19%	2.705	0.79%	(11.13)	0.016	(2.05)
Effective short-term borrowing rate	1.94%	0.05%	0.63%	0.075	0.01%	(0.36)	0.004	(1.32)
Fees - Costs / Assets	-0.87%	-2.77%	0.13%	-21.470	-0.70%	(-12.36)	0.014	(2.26)
Publicly traded equity	6.14%	4.25%	25.91%	0.164	0.47%	(0.43)	0.995	(8.20)

		Pre-Tax			After-Tax (13.4% Rate)		
	Benchmark	Actual	Diff	*t*-stat	Actual	Diff	*t*-stat
Unlevered return on assets	3.65%	3.09%	-0.56%	(-1.24)	2.68%	-0.97%	(-2.18)
Security portfolio	3.35%	3.45%	0.10%	(0.21)	2.99%	-0.36%	(-0.75)
Loan portfolio	3.97%	5.22%	1.25%	(1.96)	4.53%	0.56%	(0.87)
Trading portfolio	3.35%	5.11%	1.76%	(2.86)	4.43%	1.08%	(1.79)
Effective short-term borrowing rate	2.35%	1.94%	-0.41%	(-3.37)	1.68%	-0.67%	(-4.83)
Fees - Costs / Assets	0.00%	-1.17%	-1.17%	(-37.20)	-1.01%	-1.01%	(-37.20)
Publicly traded equity vs 14x	25.56%				6.14%	-19.42%	(-2.04)
Publicly traded equity vs 5x	8.57%				6.14%	-2.43%	(-0.36)

Table 3
Risk-Adjusted Profitability and Leverage (1999-2015)

This table reports average abnormal quarterly profitability by leverage quintile for US bank holding companies over the period 1999 through 2015. Quarterly unlevered pre-tax return on assets (ROA) is calculated as the sum of net income interest expense and taxes, divided by assets. Abnormal ROA (abnROA) is the difference between actual and expected ROA, reported in basis points (x10000). Expected ROA is calculated as the mean quarterly ROA for a peer group. Abnormal Loan Return (abnROL) is calculated similarly. The loan return is calculated as loan interest income less loan loss provisions, divided by the loan balance. Peer group 1, reported in panel A, is defined as being within 5 percentiles of a bank's two-year average assets and two-year average risk level. The asset risk level is the ratio of risk-weighted assets to assets. The loan risk level is the ratio of risk-weighted loans to loans. Peer group 2 (reported in Panel B) is defined as sharing a two-year average risk level decile. Leverage is the ratio of asset to Tier 1 capital. The mean return on equity (ROE) for each leverage quintile is reported in Panel E. ROE is the ratio of net income to Tier 1 capital. The standard error of the mean is used to calculate *t*-statistics, which are reported in parenthesis.

	Leverage Quintile				
	Low	2	3	4	High
Panel A: Abnormal ROA with peer group defined by risk level and size					
Pre-crisis (1999-2007)					
Mean abnROA | Risk & Size	2.59	-0.89	-0.15	-0.38	-0.91
t-statistic	(4.20)	(-2.20)	(-0.30)	(-1.01)	(-1.35)
Full sample (1999-2015)					
Mean abnROA | Risk & Size	3.15	0.17	0.31	-0.10	-5.11
t-statistic	(4.19)	(0.36)	(0.77)	(-0.31)	(-5.52)
Panel B: Abnormal ROA with peer group defined by risk level decile					
Pre-crisis (1999-2007)					
Mean abnROA | Risk decile	2.59	-0.89	-0.15	-0.38	-0.91
t-statistic	(4.20)	(-2.20)	(-0.30)	(-1.01)	(-1.35)
Full sample (1999-2015)					
Mean abnROA | Risk decile	4.44	-0.46	-0.02	-0.48	-5.25
t-statistic	(8.42)	(-1.15)	(-0.04)	(-1.61)	(-4.50)

Panel C: Abnormal Loan Return with peer group defined by risk level and size					
Pre-crisis (1999-2007)					
Mean abnROL | Risk & Size	0.41	-0.65	0.04	-0.35	-0.29
t-statistic	(0.41)	(-0.85)	(0.06)	(-0.62)	(-0.46)
Full sample (1999-2015)					
Mean abnROL | Risk & Size	4.26	1.06	-0.49	-1.02	-4.29
t-statistic	(4.57)	(1.61)	(-0.89)	(-2.30)	(-3.90)
Panel D: Abnormal Loan Return with peer group defined by risk level decile					
Pre-crisis (1999-2007)					
Mean abnROL | Risk decile	2.48	1.43	-1.11	-1.53	-1.51
t-statistic	(2.96)	(2.87)	(-2.36)	(-4.09)	(-2.91)
Full sample (1999-2015)					
Mean abnROL | Risk decile	5.59	1.78	-0.76	-1.98	-6.48
t-statistic	(6.89)	(3.34)	(-1.99)	(-5.28)	(-5.24)
Panel E: Return on Equity by Leverage Quintile					
Mean ROE (1999-2007)	2.90%	3.17%	3.29%	3.58%	3.83%
Mean ROE (1999-2015)	2.13%	2.22%	2.39%	2.48%	1.53%

Table 4
Regressions Explaining Crisis Period Returns with Pre-Crisis Risk Measures

This table reports regressions of average quarterly returns over the crisis period, 2008Q3 through 2010Q2, on pre-crisis risk measures, averaged over 2004 through 2005. All specifications include the risk ratio associated with the asset (assets, loans, or equity), the natural logarithm of assets, and the associated asset beta (or equity beta). The asset risk ratio is the risk weighted assets to assets. The loan risk ratio is the risk weighted loans to loans. The equity risk ratio is the risk weighted assets to Tier 1 capital. We report ordinary least squares *t*-statistics in parenthesis.

Intercept	Risk Ratio	*ln*(Assets)	Asset Beta	R2 / N
		Panel A: Return on Assets		
0.0091	-0.0074			0.0591
(8.70)	(-5.27)			427
0.0092		-0.0004		0.0168
(4.78)		(-2.88)		427
0.0148	-0.0075	-0.0004		0.0773
(6.94)	(-5.37)	(-3.06)		427
0.0036			-0.0108	0.0054
(8.02)			(-1.43)	194
0.0110	-0.0095	0.0000	-0.0088	0.0865
(3.74)	(-4.35)	(-0.21)	(-1.19)	194
		Panel B: Return on Loans		
0.0243	-0.0162			0.0663
(9.57)	(-5.59)			427
0.0262		-0.0011		0.0936
(10.90)		(-6.71)		427
0.0436	-0.0182	-0.0012		0.1775
(12.56)	(-6.66)	(-7.65)		427
0.0101			-0.0145	0.0076
(18.32)			(-1.57)	194
0.0420	-0.0190	-0.0011	-0.0020	0.1924
(8.71)	(-4.53)	(-5.38)	(-0.24)	194

Intercept	Equity Risk Ratio	*ln*(Assets)	Equity Beta	R2 / N
		Panel C: Return on Equity		
0.0415	-0.0056			0.0420
(3.65)	(-4.42)			423
0.0115		-0.0013		-0.0014
(0.39)		(-0.64)		423
0.0277	-0.0058	0.0011		0.0403
(0.94)	(-4.39)	(0.51)		423
-0.0096			-0.0061	-0.0035
(-1.31)			(-0.58)	192
-0.0518	-0.0101	0.0093	-0.0185	0.0728
(-1.29)	(-3.93)	(3.03)	(-1.69)	192
		Panel D: Stock Returns		
0.0534	-0.0404			0.0478
(0.54)	(-3.67)			249
-0.0216		-0.0192		0.0040
(-0.11)		(-1.41)		249
0.0787	-0.0398	-0.0021		0.0440
(0.39)	(-3.37)	(-0.15)		249
-0.2543			-0.0913	0.0089
(-6.80)			(-1.69)	210
-0.0032	-0.0479	0.0120	-0.0987	0.0574
(-0.01)	(-3.48)	(0.73)	(-1.76)	210