

Government Guarantees and the Valuation of American Banks*

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Abstract

Banks' ratio of market equity to book equity was close to one until the 1990s, then more than doubled during the 1996-2007 period, and fell again to values close to one after the 2008 financial crisis. [Sarin and Summers \(2016\)](#) and [Chousakos and Gorton \(2017\)](#) argue that the drop in banks' market to book ratio since the crisis is due to a loss in bank franchise value or profitability. In this paper we argue that the market to book ratio is the sum of two components: franchise value, and government guarantees. We empirically decompose the ratio between these two components, and find that a large portion of the variation in this ratio over time is due to changes in the value of government guarantees.

*All errors are ours.

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1 Introduction

Are banks safer today than they were in 2007? Book measures of leverage indicate that regulations post-crisis have shored up the US banking system (see [Yellen, 2017](#)), however market measures of leverage and bank credit risk are actually *higher* than pre-crisis levels ([Sarin and Summers, 2016](#)). Do book or market measures more accurately depict the safety of the US banking system? The answer depends on the quantitative drivers of the difference between the market and book values of bank assets. In this paper, we provide a decomposition of banks’ market to book values into a component driven by bank profitability, or “franchise value”, and a component driven by the value of explicit and implicit government guarantees. We find that, quantitatively, about half of the elevated market values of banks from the mid 1990’s to 2007 arose from the ability of bank equity holders to capitalize the value of the government safety net. Under current regulatory limitations on leverage, the ability of banks to capture the value of government guarantees is constrained, and, as a result, market to book ratios are lower.

The key to understanding the difference between book and market measures of bank leverage is a decomposition of the drivers of banks’ market (MVE) vs. book (BVE) values of equity into two components, franchise value, and the value of government guarantees. Building on this idea, we provide and apply a measurement framework to quantitatively assess the drivers of bank valuation and bank safety using market and accounting data. Our decomposition can be written simply as:

$$\frac{\text{MVE}}{\text{BVE}} = 1 + \underbrace{\frac{\text{FVE} - \text{BVE}}{\text{BVE}}}_{\text{franchise value}} + \underbrace{\frac{\text{MVE} - \text{FVE}}{\text{BVE}}}_{\text{government guarantees}}.$$

The first component of banks’ market to book equity ratios is the ratio of the gap between the fair value of bank equity (FVE) and the book value of bank equity divided by the book value of bank equity. We define the fair value of bank equity as the difference between the fair value of all of the bank’s assets and the fair value of all of the bank’s liabilities. Fair values are measured as the discounted present value

of all of the cash flows associated with bank assets and liabilities not considering the contribution to bank value from government guarantees. The difference between the fair value and book value of bank equity is then the gap between the market value and book value of the bank's business arms, which we refer to as the *franchise value* of the bank.

The second component is the ratio of the gap between the market value of bank equity and the fair value of bank equity to the book value of bank equity. The market value of bank equity includes the discounted present value of cash flows associated with taxpayer bailouts of banks in times of distress. By definition, this second component reflects the contribution to bank equity valuation from bank risk taking with the support of *government guarantees* for bank liabilities.

The implications of observations on the market to book values of equity for bank financial soundness depend critically on which of these two components, franchise value vs. government guarantees, accounts for most of the movement in bank equity valuation. As emphasized by [Keeley \(1990\)](#), [Sarin and Summers \(2016\)](#), and [Chousakos and Gorton \(2017\)](#), to the extent that the market to book value of equity is high because banks have high franchise value, a high market to book value of equity is a manifestation of economic capital not recorded on banks' balance sheets and banks have less risk of default in a crisis.

In contrast, to the extent that high market to book values of equity are due to high market to fair value of bank equity, then high valuations of bank equity are a signal of risk in banks and of a large taxpayer contingent liability for bank bailouts in a crisis. As we show in our model below, in this case, increases in book or regulatory capital should be expected to reduce bank market to book ratios and accounting profitability. The reduction in bank's market to book ratios has an upside, namely a lower liability forcing taxpayers to bailout bank debt and deposits in a crisis. A closely related point is made by [Admati and Hellwig \(2013\)](#) and [Admati et al. \(2013\)](#), who argue that, to the extent that leverage reduces banks' cost of capital, it is due to distortions from government subsidies to bank debt.

Our paper is closely related in its objective to that of [Haldane, Brennan, and Madouros \(2010\)](#). These authors ask whether the evolution of bank profitability and

valuation prior to the financial crisis reflected an increase in the economic profitability of bank loan making and deposit taking (what we term franchise value) or, instead, a return to bank owners from risk taking backed by government guarantees. They examine how increases in bank leverage and risk taking might account for the rise in bank accounting profitability from the mid 1990's until the financial crisis. We extend their analysis to provide a quantitative accounting of the evolution of US bank valuations and the relative contributions from franchise values and value from risk taking backed by government guarantees. Our accounting indicates that there has been a reduction in bank franchise values from before the 2008 crisis to now, mostly stemming from a lower fair value of core deposits. However, our main finding is that there has been an equally large decline in banks' capitalized values from government guarantees.

Our framework allows us to assess which channel for capturing the value of government guarantees, namely, risk taking, leverage, or prospects for growth of bank balance sheets, has declined in importance post-crisis.

It does not appear that regulation has succeeded in reducing risk taking by banks. In particular, our accounting indicates that bank equity would still be wiped out in a crisis of the magnitude observed in 2008. This finding is driven by two observations. First, bank accounting profitability is still quite high relative to available riskless rates of return even after adjustment for the fair value of bank assets and liabilities. This observation implies that banks' *assets* are still quite exposed to aggregate risk.¹ Second, the market signals from bank equity and debt reviewed by Sarin and Summers still signal considerable risk to subordinated claims on US banks, suggesting that the market perceives that bank equity and subordinated debt would still be wiped out in a crisis.

Instead, we find that the reduction of the value of government guarantees to bank equity is due primarily to the increase in bank regulatory capital and a reduction in the growth rate of bank balance sheets. With greater regulatory or book capital,

¹Meiselman, Nagel, and Purnanandam (2018) show that high rates of profit in good times measure bank exposure to tail risk in bad times, and apply this idea successfully to the cross section of US bank values during the crisis.

equity suffers more of the loss to bank assets in a crisis. Holding fixed the drop in bank asset values in a crisis, the taxpayer contribution required to honor deposit guarantees is smaller. Moreover, with lower expected growth, equity is not able to grow implicit guarantees in advance of the next crisis.

Our accounting model suggests that moves to lighten the regulatory burden on banks going forward should be met with caution. The value of government guarantees to bank equity is highly sensitive to small changes in the risk exposure of bank assets. If regulators allow even a moderate increase in risk taking by banks, we should see a significant jump in bank valuations and accounting profitability. The temptation will be to interpret this increase in bank valuations and accounting profitability as a restoration of bank franchise value previously damaged by regulation. Instead, we argue that it would properly be interpreted as a return to the days in which taxpayers had a large contingent liability to bail out banks in a crisis.

The remainder of our paper is organized as follows. In section 2, we document the facts on bank valuation and profitability that we focus on in our accounting exercise. In section 3 we present the model we use for measurement. We define the book and fair values of items on banks' balance sheets. We show that to construct a fair value balance sheet for banks, one must measure the fair values of bank loans and deposits, as well as banks' growth opportunities to earn future profits from originating new loans and acquiring new deposits. We establish the result that in the absence of government guarantees, the market value of bank equity is equal to the fair value of bank equity, regardless of the risk in the banks' assets and regardless of bank equity's decisions to default on bank subordinated liabilities in a crisis. In the presence of government guarantees, we show that equity holders obtain a market value in excess of fair value by taking on risk, boosting dividends in normal times and defaulting during crises.

The concept of the fair value of bank equity for banks is very similar to the concept of the value of equity absent violations of the [Miller and Modigliani \(1958\)](#) theorem from the familiar adjusted present value formula in corporate finance. The difference between the fair value of bank equity and the market value of equity stems from a non-zero net present value of banks' financing decisions. In particular, implicit

and explicit guarantees lead to a positive net present value of debt financing for US banks because of the injection of taxpayer funds into the bank in the event of a crisis. We use the terminology fair value of equity, or FVE for two reasons. First, our concept of fair value is related to that used in financial institution accounting. Second, we include the franchise value of a bank's deposit business in the fair value of equity, despite the fact that the value of the deposit business depends on its capital structure. Finally, we note that there are no deadweight costs in our model, but instead a bankruptcy benefit which is a transfer from taxpayers to banks.

The quantitative value of government guarantees depends critically on the risk neutral probability of a crisis state. In section 4, we use data on the realized returns on broad portfolios of corporate bonds from [Asvanunt and Richardson \(2016\)](#), as well as estimates of the credit risk premium from [Berndt, Douglas, Duffie, and Ferguson \(2017\)](#), to measure exposure to aggregate credit risk and to calibrate the risk neutral probability of a crisis. Based on these data, we calibrate the risk neutral probability of the crisis state to 5% on an annual basis. Under the assumption that marginal utility is high in the crisis state, 5% is an upper bound on the objective probability of a crisis, and crises are rare events.

In section 5 we use a stylized, two-state model of a bank to demonstrate that, under reasonable parameters describing bank leverage and aggregate credit risk, the observed drop in bank valuations since 2007 can easily be generated by a decline in the value of government guarantees to bank equity. The stylized bank issues liabilities insured with a government guarantee and holds only marketable securities exposed to aggregate credit risk. By definition, this bank has no franchise value. However, with guaranteed liabilities and *BBB* rated corporate bond assets, the bank trades at a market to book ratio of equity of two given book leverage of 90%. Leverage is key to this valuation. If book leverage is constrained to 85%, the market to book ratio of this bank falls from two to close to one. The entire decline is due to the reduction in the size of taxpayers' exposure to bailouts in the crisis state.

With confirmation of the quantitative plausibility of guarantees as main drivers of bank equity values in hand, we turn in section 6 to a complete accounting exercise. We construct estimates of book value, the fair value, and the market value of banks

in the 1970-1985, 1996-2007, and 2011-2017 time periods. We model each of these time periods as time periods in which only the “normal” state is realized. We collect data on the book value of items on bank balance sheets from bank regulatory reports. To construct a fair value version of banks’ balance sheets, we use banks’ reports of the fair value of their loans found in the footnotes of banks’ annual reports since the mid-1990’s as well as two measures of the fair value of bank deposits. The first is a measure of the fair value of bank deposits from the Portfolio Value Model developed by the Office of Thrift Supervision (OTS). The second is a measure of the fair value of deposits derived from the measure of *core deposit intangibles* recorded on bank books when one bank acquires another.² We then use a [Gordon \(1962\)](#) dividend growth model to value bank equity using observed accounting returns for banks, our calibration of the risk neutral probabilities of the normal and crisis states, and measures of the riskless interest rate and the growth rate of bank balances sheets in normal times from each of these three time periods.

The model accounts for observed market valuations of bank equity very well. We find that in the period 1970-1985, banks did not have large franchise values and they did not derive value from risk taking with government guarantees. Starting in the 1990’s, banks took on significantly more risk, as evidenced by significantly higher realized accounting returns in banking relative to riskless benchmarks. Evidence of risk taking continues past the 2008 crisis, however, due to changes in book leverage and the growth rate of bank assets over time, this increase in risk taking by banks had different impacts on the valuation of bank equity depending on the time period. From 1996 to 2007, banks’ market to book equity ratio was 2.1. Our calculations show that $\frac{FVE-BVE}{BVE} = 0.48$, and $\frac{MVE-FVE}{BVE} = 0.58$, i.e. roughly equal contributions from franchise value and government guarantees over this pre-crisis window. Post crisis, banks’ market to book equity ratios have averaged 1.19, with again about half of market in excess of book values coming from each source.

Finally, in section [7](#), we conclude. Our valuation estimates indicate that regulation-induced reductions in book leverage have succeeded in reducing the market value

²We impose the assumption that banks do not derive value from the opportunity to originate new loans or deposits.

of the funds that taxpayers will need to contribute in a bailout, consistent with the views of [Yellen \(2017\)](#), and the important contribution by [Admati and Hellwig \(2013\)](#) which provides strong arguments for lower bank leverage. On the other hand, we also show that the risk of equity and subordinated debt being wiped out has not gone down substantially, which explains the observations of high market leverage as well as market measures of bank credit riskiness in [Sarin and Summers \(2016\)](#).

2 Historical Data on the Valuation of US Banks

In this section we develop the main stylized facts describing changes in bank valuation, leverage, profitability and market credit risk measures. These facts motivate our study, and support the calibration of our model.³

Bank Valuation We measure the valuation of the banking sector in each time period as the ratio of market to book value of equity for the entire sector in each quarter from 1991 to 2017.⁴ We display this market to book value of equity for the US banks over the time period 1991-2017 in Figure 1.

This figure shows a substantial increase in the ratio of the market to book value of equity for US banks in the mid-1990's and a sharp reduction in this ratio after the financial crisis. In particular, we find that the market to book ratio in banking

³We collect financial information on bank holding companies from the Quarterly Trends for Consolidated U.S. Banking Organizations of the Federal Reserve Bank of New York and from the Holding Company Data of the Federal Reserve Bank of Chicago. To construct market prices, we merge this dataset with S&P's Compustat and the Center for Research in Security Prices (CRSP) databases using the CRSP-FRB links from the Federal Reserve Bank of New York. Our sample of public bank holding companies consists of 1,128 banks and 40,468 bank-quarter observations from 1986 to 2016 and covers 93% of total assets of all FDIC-insured institutions in the fourth quarter of 2016. To have a longer historical perspective, we also use the consolidated annual financial statements of FDIC-insured institutions from 1935 to 2016 available in the FDIC Historical Statistics on Banking. We obtain corporate bond credit spreads from the Lehman/Warga and Merrill Lynch (BAML) databases.

⁴We construct the market to book value of equity for the sector as the sum of the market value of equity across bank holding companies in our sample divided by the sum of the book value of equity across the same bank holding companies. This ratio corresponds to a value weighted average of the market to book value of equity across bank holding companies.

averaged 2.12 over the 1996-2007 time period and 0.97 over the 2011-2017 time period. This pattern of bank valuations over time is consistent with the findings in Chousakos and Gorton (2017) and Minton, Stulz, and Taboada (2017) regarding the valuation of bank equity relative to balance sheet benchmarks.

Keeley (1990) provides evidence on the valuation of banks in the 1970's. He finds that market to book values of bank equity were closer to one during that time period. To confirm that finding, in Figure 2, we examine the ratio of the market to book value of equity for the US financial sector from 1975 to the present together with our series for bank holding companies over the 1986-2017 time period.⁵ Note that the market to book value of equity for the US financial sector corresponds closely to that for bank holding companies over the time period for which we have data for both series. Figure 2 shows that the ratio of the market to book value of equity for the financial sector from 1975 into the early 1990's was close to one.

Consistent with the findings of Minton et al. (2017), we find similar patterns of bank valuations over time for large and small bank holding companies. In Figure 3, we show the ratios of the market to book value of equity for bank holding companies with assets over \$250 billion and those with assets from \$10 to \$250 billion.⁶ These data on the valuation of large and smaller banks suggests that fluctuations in bank market valuations are not driven by valuations of the investment banking activities of the largest bank holding companies.

Bank Financial Soundness In what follows, we consider the implications of the data on bank valuations presented above as an indicator of bank financial soundness. The connection to bank financial soundness is through bank leverage. It is common to evaluate bank leverage on both a book and a market basis.

Bank capital regulation is applied to banks' book leverage, i.e. the ratio of the book value of debt to the book value of assets (we abstract here from risk weighting of assets). Figure 4 shows book leverage for bank holding companies over the period

⁵CRSP-FRB link database starts in 1986. Therefore, we use financial firms with a standard industry classification code in between 6000 and 6999 to go back to 1975.

⁶We use the Gross Domestic Product Implicit Price Deflator with base year 2009 as the deflator.

from 1991-2017. Book leverage has declined steadily over this time period.

We plot market leverage for bank holding companies, defined as the ratio of the book value of debt to the market value of assets, over this time period in Figure 5.⁷ Bank market leverage shows a different pattern over time than book leverage. Specifically, bank market leverage was relatively low in the period before the 2008 crisis and it is high in the period since that crisis.

Bank Profitability Accounting measures of bank profitability are a key input into our accounting for the market valuation of banks. As we will show in our model, bank profits in normal times are driven both by banks' exposure to crisis risk, and by sources of franchise value. Here we document the accounting data that we target.

Figure 6 displays the accounting return on equity (ROE) for US bank holding companies over the period 1991-2017. ROE is measured as the ratio of bank net income to the book value of bank equity. Figure 6 shows that ROE for bank holding companies was high at just under 15% from the mid 1990's into 2007 and it has been substantially lower since the 2008 crisis.

Figure 7 shows the corresponding accounting profitability of bank holding companies over this time period measured in terms of bank return on assets or ROA (the ratio of net income to total book assets). Here we find that the ROA for bank holding companies was consistently above 1% from the mid 1990's into 2007 and has been below 1% since the 2008 crisis.

The high accounting profitability of banks in the period from the mid 1990's into 2007 was unusual in a longer historical perspective. In Figure 8, we show the return on assets (ROA) for commercial bank subsidiaries reported in the FDIC Historical Statistics on Banking from 1934-2017. This figure shows that ROA for banks was consistently under 1% until the mid 1990's. Then, as in the bank holding company data in Figure 7, banks had ROA consistently above 1% from the mid 1990's into 2007 and then lower ROA since the 2008 crisis.

⁷The market value of assets is defined as the book value of debt plus the market value of equity.

Spreads on Subordinated Debt As we apply our accounting model, we need to confirm that it is consistent with the evolution of market signals of the risk exposure of bank equity and subordinated debt to a crisis. [Sarin and Summers \(2016\)](#) is a convincing review of those equity and debt market signals that concludes that these signals have not improved from levels observed before the 2008 crisis. In our accounting model, we focus on matching data on spreads on banks’ subordinated debt. In [Figure 9](#) we present data on these corporate bond spreads from 1991 to 2017. For a sample of firms covered by the S&P’s Compustat database and the Center for Research in Security Prices (CRSP), we matched month-end secondary market option adjusted credit spreads of their outstanding senior unsecured bonds from the Lehman/Warga and Bank of America Merrill Lynch databases.⁸

In [Figure 9](#), the blue line corresponds to averages of the natural log⁹ of option-adjusted spreads on bank holding company bonds calculated by the Bank of America Merrill Lynch. The grey lines correspond to averages of option adjusted spreads on bonds of non-financial firms¹⁰ within a certain credit rating. Starting from the bottom and going up, these lines correspond to AAA- and AA-rated bonds together in one line, A-rated bonds, BBB-rated bonds, BB-rated bonds, and B-rated bonds. Thus, in this figure, we see how the level of bank bond spreads has evolved over time and how these spreads have moved relative to those of non-financial firms. We see that the level of bank bond spreads has risen both in absolute terms since before 2008 and in relative terms relative to non-bank bonds. Before the crisis, bank bond spreads were in line with those of A-rated firms. After the crisis, bank

⁸We eliminate all observations with credit spreads below 5 basis points and greater than 3,000 basis points. In addition, we drop very small corporate issues (equity market value of less than \$1 million) and all observations with a remaining term to maturity of less than 6 months or more than 20 years. Some firms tend to have many different corporate bond securities outstanding. To avoid overweighting firms that issue a lot of different securities, when different prices were available for the same firm, we keep only the security with time to maturity closest to 8 years (sample average). Financial, utility, and public administration firms are also excluded from the sample. Restricting to unique credit spreads monthly observations for each firm eliminates 45% of the dataset; other restrictions affect less than 5% of the rest.

⁹Option-adjusted spreads roughly follow a log-normal distribution with time-varying mean and standard deviation.

¹⁰We define non-financial firms as firms with a standard industry classification code not in between 6000 and 6999.

bond spreads are in line with those of *BBB*-rated firms. The average level of bank holding companies' corporate bond option-adjusted spreads was 93 basis points over the period 1996-2007 and 151 basis points over the period 2011-2017.

3 An Accounting Model

We now present the model we use to define the concepts of book, fair, and market values of equity and to establish the results that $FVE - BVE$ is a measure of the franchise value of the bank and $MVE - FVE$ is a measure of the market value of the taxpayer injections of resources needed to honor government guarantees of bank liabilities.

Time is discrete and runs forever. Every period a state s is drawn from some finite set S , representing aggregate shocks hitting the banking sector. The states are drawn independent over time according to the risk-neutral probability distribution $\{q(s)\}_{s \in S}$.

A representative bank operates a loan making arm and a government-guaranteed deposit taking arm.¹¹ Deposits are fully guaranteed by the government. Every period, the loan making arm makes new loans and the deposit arm takes in new government-guaranteed deposits. The bank also issues subordinated debt. Both the loan-making and the deposit-taking arms are subject to shocks: shocks to the prepayment rate and default rate of loans, to the withdrawal rate of deposits, and to the growth rate of the balance sheet achieved through origination of new loans

¹¹In the data, banks also manage a portfolio of marketable securities on both the asset and liability side of their balance sheet including Federal Funds and Repo (a securities arm) and conduct a wide range of fee-for-service business (a fee for service arm). Here we assume that the securities arm of the bank has no franchise value, but that it can contribute to the risk exposure of the bank and hence to the value of government guarantees. This assumption is in line with the assumptions used by the Bureau of Economic Analysis to construct their measure of value added in banking. See [Hood \(2013\)](#). We assume that the fee-for-service arm of the bank does not generate franchise value for the bank because the costs of labor and physical premises required to conduct these activities soaks up all of the revenue associated with these activities (in discounted present value). We discuss how we map the accounting items in bank holding company regulatory reports on their income statements and balance sheets (form FRY9C) into our accounting model when we do our full accounting in section 6.

and deposits. After observing the realized shocks, equity holders have the option to default. In that case, the subordinated debt holders take over the bank and auction it off immediately to new owners. The government makes a contribution of taxpayer funds to the sale sufficient to ensure that the new owners of the bank are willing to assume the bank's deposit liabilities and pay a non-negative price for the bank to the holders of the subordinated debt.

3.1 The Loan Making Arm

Let L denote the total face value, or book value, of the loans on the bank's balance sheet. Every period, every dollar of loan pays a coupon c_L , net of servicing cost. Then the face value of the loan is repaid with probability $\mu_L(s)$, and default on the face value of the loan occurs with probability $\delta_L(s)$. The fair value of the loans on the bank's balance sheet is $v_L \times L$, where the ratio of fair to book value for the stock of loans on the balance sheet solves the asset pricing equation

$$v_L = \frac{1}{1+i} \sum_s q(s) [c_L + \mu_L(s) + (1 - \mu_L(s) - \delta_L(s))v_L], \quad (1)$$

where i is the risk free rate. Solving for v_L we obtain:

$$v_L = \frac{c_L + \bar{\mu}_L}{i + \bar{\mu}_L + \bar{\delta}_L},$$

where the "bar" notation denotes the expectation given risk neutral probabilities, for example $\bar{\mu}_L = \sum_s q(s)\mu_L(s)$. That is, v_L is the present value of receiving the coupon c_L and the average prepayment $\bar{\mu}_L$, until the loan is either prepaid or defaulted on.

Next, let us calculate the fair value of the loan making arm of the bank. We assume that the bank grows at rate $g(s)$. To achieve that growth, the bank must make new loans at a rate

$$\mu_L(s) + \delta_L(s) + g(s),$$

so as to replace the principal prepaid, $\mu_L(s)$, and written down, $\delta_L(s)$, and achieve

net growth rate $g(s)$ in the book value of its loans. We assume that the bank incurs origination costs at rate $\phi_L > 0$, per dollar of new loans. Therefore, contribution to the bank dividend, or free cash flow, generated by the loan making arm is $DIV_L(s) \times L$, where the dividend rate is

$$DIV_L(s) = c_L + \mu_L(s) - (1 + \phi_L) (\mu_L(s) + \delta_L(s) + g(s)).$$

The first term is the coupon, the second term is the prepayment rate, and the third term is the sum of the principal and origination cost for new loans. The fair value of the loan-making arm is the risk-neutral expected present value of these free cash flows. Therefore, the fair value of the loan-making arm is $FVL \times L$, where the fair value ratio solves:

$$FVL = \frac{1}{1+i} \sum_s q(s) [DIV_L(s) + (1 + g(s))FVL]. \quad (2)$$

Taking the difference between the pricing equation for FVL , (2), and v_L , (1), we obtain:

$$FVL - v_L = \frac{1}{1+i} \sum_s q(s) [(\mu_L(s) + \delta_L(s) + g(s)) (v_L - (1 + \phi_L)) + (1 + g(s))(FVL - v_L)].$$

Solving for FVL , we obtain:

$$FVL = v_L + \frac{\bar{\mu}_L + \bar{\delta}_L + \bar{g}}{i - \bar{g}} (v_L - (1 + \phi_L)). \quad (3)$$

Profit maximization implies that the net value of issuing a new loan is non-negative, i.e. $v_L \geq 1 + \phi_L$. Thus, the fair value of the loan making arm exceeds the book value for two reasons. First, the present value of all the payments to be received from each outstanding loan, v_L , exceeds its book value. Second, each time the bank will issue a new loan, it will make a profit equal to $v_L - (1 + \phi_L)$.

3.2 The Deposit Taking Arm

Let D denote the total face value, or book value, of the deposits on the bank's balance sheet. Every period, every dollar of deposits costs the bank c_D , equal to the sum of the interest rate paid on deposits and of the servicing cost. The deposit is withdrawn with random probability $\mu_L(s)$. Hence, the fair value of the deposits on the bank's balance sheet is $-v_D \times D$, where the ratio of the fair to book value of deposits solves:

$$v_D = \frac{1}{1+i} \sum_s q(s) [c_D + \mu_D(s) + (1 - \mu_D(s))v_D] \Rightarrow v_D = \frac{c_D + \bar{\mu}_D}{i + \bar{\mu}_D}.$$

Next, let us calculate the fair value of the loan making arm of the bank. We again assume that the bank grows at rate $g(s)$. Hence, to achieve that growth, the bank must take new deposits at a rate $\mu_D(s) + g(s)$ so as to replace the deposits withdrawn, $\mu_D(s)$ and achieve net growth of the book value of deposits of $g(s)$. We assume that, when it originates new deposits, the bank incurs costs at rate ϕ_D . Therefore, the contribution to bank dividends, or free cash flow generated by the deposit taking arm is $-DIV_D(s) \times D$, where the dividend rate solves:

$$DIV_D(s) = c_D + \mu_D(s) - (1 - \phi_D)(\mu_D(s) + g(s)).$$

The fair value of the deposit taking arm is $-FVD \times D$, where:

$$FVD = \frac{1}{1+i} \sum_s q(s) [DIV_D(s) + (1 + g(s))FVD]. \quad (4)$$

Taking the difference between the equations for FVD and v_D , we obtain that:

$$FVD - v_D = \frac{1}{1+i} \sum_s q(s) [(\mu_D(s) + g(s))(v_D - (1 - \phi_D)) + (1 + g(s))(FVD - v_D)].$$

Solving for $FVD - v_D$, we obtain:

$$FVD = v_D - \frac{\bar{\mu}_D + \bar{g}}{i - \bar{g}} (1 - \phi_D - v_D).$$

Profit maximization implies that the net value of taking a new deposit is non-negative, that is $v_D + \phi_D \leq 1$. As before, this implies that the fair value of the deposit taking arm exceeds the book value for two reasons. First, the present value of the payment to be made on outstanding deposits is less than the face value. Second, each time the bank takes a new deposit, it makes a profit equal to $1 - v_D - \phi_D$.

3.3 Subordinated Debt and the Default Decision of Equity

In addition to deposits, we assume that the bank also issues subordinated debt.¹² We assume that subordinated debt take the form of one-period defaultable debt with face value $1 + i$. We denote the price of a unit of subordinated debt by v_B . To determine v_B , we need to study the default decision of equity.

The Default Decision of Equity Suppose that equity enters the period with L loans, D deposits, and B subordinated debt. If equity does not default, subordinated debt is paid principal and interest $(1 + i)B$ out of the bank's free cash flows $DIV_L(s)L - DIV_D(s)D$. In these states equity issues new subordinated debt in quantity $(1 + g(s))B$ at price v_B . Thus the dividend to equity in the event that equity does not default is $DIV_E(s) \times L$, where

$$DIV_E(s) = DIV_L(s) - DIV_D(s)\Theta_D - (1 + i)\Theta_B + v_B(1 + g(s))\Theta_B, \quad (5)$$

¹²In our model, we assume that the bank issues deposits that are default free. We do so because in our analysis we assume that the government guarantees these deposits. We include subordinated debt in the model to allow some of the liabilities of the bank to suffer losses in default. Subordinated debt is distinct from repo and derivatives exposures that are collateralized and hence protected in the event of bank failure by specific assets within the bank. A normal firm without government guarantees would have no deposits and all of its liabilities would be subordinated debt. In the data, banks issue very little subordinated debt, however the credit spreads on these bonds are informative about banks' financial soundness.

with $\Theta_D \equiv D/L$ and $\Theta_B \equiv B/L$. If, on the other hand, equity chooses to default, then it receives zero dividend and gives up all future claims on the bank. Hence, the default decision is obtained as the solution of the following Bellman equation

$$\text{MVE} = \max \frac{1}{1+i} \sum_s q(s) I(s) [DIV_E(s) + (1+g(s))\text{MVE}], \quad (6)$$

with respect to repayment decisions $I(s) \in \{0, 1\}$ in each state. Clearly, this implies that equity defaults if

$$DIV_E(s) + (1+g(s))\text{MVE} < 0. \quad (7)$$

The Valuation of Subordinated Debt Now let us turn to the valuation of subordinated debt. If there is default, $I(s) = 0$, then subordinated debt is not paid its principal and interest $1+i$. Instead, subordinated debt holders immediately re-sell the bank to new owners. The bank is sold inclusive of some government support $T(s) \geq 0$ per unit of asset. After purchasing the bank, new owners receive the current free cash flow from loans and deposits, and issue new subordinated debt at price $(1+g(s))v_B$. New owners do not have to repay current subordinated debt owners. All in all, this implies that the selling price of the bank is, per unit of asset:

$$R(s)\Theta_B = T(s) + DIV_E(s) + (1+i)\Theta_B + (1+g(s))\text{MVE}(s). \quad (8)$$

The first term, $T(s)$, is the government support. The second term, $DIV_E(s)$, is the free cash flow received by new owners. The third term adjusts free cash flow for the fact that new owners do not have to repay principal and interest, $(1+i)\Theta_B$, to current subordinated debt owners. The last term is the continuation value of new owners. We assume that the government support, $T(s)$, is chosen so that:

$$0 \leq R(s) \leq 1+i. \quad (9)$$

The left-hand inequality reflects limited liability for subordinated debt holders. The right-hand inequality imposes that the government does not pay more than principal

and interest on subordinated debt.

Given that, in case of default, subordinated debt holders re-sell the bank at price $R(s)$, the selling price of subordinated debt is:

$$v_B = \frac{1}{1+i} \sum_s q(s) [I(s)(1+i) + (1-I(s))R(s)]. \quad (10)$$

Finally, we can compute the fair value of the subordinated debt arm of the bank as before:

$$\text{FVB} = \frac{1}{1+i} \sum_s [I(s)(1+i) + (1-I(s))R(s) - (1+g(s))v_B + (1+g(s))\text{FVB}],$$

and one sees by direct comparison that $\text{FVB} = v_B$.

3.4 The Book, the Fair, and the Market Value of Equity

Book Value Banks hold loans and deposits on their books at face values. Banks hold subordinated debt on their books at market value. The book value of bank equity is the difference between the book value of bank assets and the book value of bank liabilities. Hence, the ratio of the book value of bank equity to the book value of bank assets is given by

$$\text{BVE} = 1 - \Theta_D - \Theta_B v_B$$

Define $\Theta = \Theta_D + \Theta_B v_B$. Then Θ is the book leverage of the bank. We thus have $\text{BVE} = 1 - \Theta$.

Fair Value The fair value of bank equity, on the other hand, is the difference between the fair value of bank assets and the fair value of bank liabilities not including the value of government guarantees. The ratio of the fair value of bank equity to the

book value of bank assets is given by

$$\text{FVE} = \text{FVL} - \Theta_D \text{FVD} - \Theta_B v_B \quad (11)$$

Since $\text{FVL} > 1$ and $\text{FVD} < 1$, it follows that the fair value of bank equity exceeds the book value.

Note that the difference between the fair value and book value of bank equity is given by

$$\text{FVE} - \text{BVE} = (\text{FVL} - 1) - \Theta_D(1 - \text{FVD})$$

which is the gap between the fair value and book value of the bank's loans and deposits. Accordingly, we define the *Franchise Value* of the bank (relative to total book assets) to be this difference between the fair value and book value of bank equity since this gap corresponds to the gap between the fair value and book value of the bank's business arms.

Market Value vs. Fair Value To compare the fair value to the book value we use a budget identity in the tradition of [Miller and Modigliani \(1958\)](#). We start from the observation that shareholders and subordinated debt holders do not make all payments on deposits: in a severe default, some of the payments are made by the government. Hence, we have the standard result that the sum of the market values of equity and subordinated debt are equal to the fair value of the bank's two business arms, plus the market value of all the payments made by the government:

$$\text{MVE} + \Theta_B v_B = \text{FVL} - \Theta_D \text{FVD} + \text{MVG},$$

where MVG is defined recursively from:

$$\text{MVG} = \frac{1}{1+i} \sum_s q(s) [(1 - I(s))T(s) + (1 + g(s))\text{MVG}]. \quad (12)$$

Subtracting the value of the bank's subordinated debt from both sides gives us:

$$\text{MVE} = \text{FVE} + \text{MVG}. \quad (13)$$

an identity that is straightforward to formally verify using equations (2), (3), (4), (5), (6), (10), (8), (11), and (12).

Equation (13) implies that, in the absence of government guarantees, the market value of bank equity is equal to the fair value of bank equity regardless of the risk in bank assets and bank equity's strategy for default.¹³ It follows from this decomposition that, as long as the bank defaults with positive probability and the government contributes resources to bail out bank liabilities, then the market value of bank equity exceeds the fair value of bank equity.

Given our definition of the market value of government guarantees, we have that:

$$\frac{\text{MVE}}{\text{BVE}} = 1 + \frac{\text{FVE} - \text{BVE}}{\text{BVE}} + \frac{\text{MVE} - \text{FVE}}{\text{BVE}} = 1 + \frac{\text{FVE} - \text{BVE}}{\text{BVE}} + \frac{\text{MVG}}{\text{BVE}}$$

Both the second and the third term are positive. The second term reflects the franchise value of the bank relative to the book value of bank equity. The third term reflects the market value of government guarantees relative to the fair value of bank equity.

3.5 Comparative Statics

We now provide comparative statics for the market-to-book ratio. All the changes in parameters we consider below induce a decrease in the market-to-book ratio. Yet, they can have opposite implications about bank safety.

We focus on the case in which the bank does not issue subordinated debt ($B = 0$). This case is appropriate because, in the data, banks issue very little subordinated

¹³For a bank with positive deposits (with no risk of default) to operate without government guarantees, we must allow for unlimited liability for subordinated debt in the event of default. Before deposit insurance, it was standard for bank investors to be liable to inject resources in the event of failure of the bank, either as partners or through double liability of bank shares. See for example Macey and Miller (1992).

debt. In this case, the cash injections from the government in the case of default by bank equity are whatever are needed to pay off depositors. In terms of the equations above, the cash transfer from the government in the event of default is

$$T(s) = -[DIV_L(s) - DIV_D(s)\Theta_D + (1 + g(s))MVE],$$

per unit of asset.

Risk-taking First, we consider the impact of an increase in risk taking, defined as follows. Assume that the shocks $x(s) \equiv (\delta_L(s), \mu_L(s), \mu_D(s), g(s))$ have a factor structure, that is $x(s) = \bar{x} + A\Sigma\varepsilon(s)$ for some vector of mean zero, unit variance, and contemporaneously independent shocks, $\varepsilon(s) = (\varepsilon_1(s), \varepsilon_2(s), \dots, \varepsilon_N(s))$, some $4 \times N$ matrix A , and some $N \times N$ positive diagonal matrix $\Sigma = \text{diag}(\sigma_1, \dots, \sigma_N)$. We define a decrease in risk taking as a decrease in σ_n , for some $n \in \{1, \dots, N\}$.

Lemma 1 (Risk taking). *Consider a decrease in risk taking. Then:*

- *the market-to-book ratio, $\frac{MVE}{BVE}$, decreases;*
- *the franchise value, $\frac{FVE - BVE}{BVE}$, stays the same;*
- *the government guarantee, $\frac{MVG}{BVE}$ decreases.*

The decrease in risk leaves the franchise value constant, because it only depends on the mean of shocks under the risk neutral probabilities. That decrease in risk decreases the market-to-book ratio value because of a usual option-valuation effect: the payoff of equity is convex, so a decrease in risk reduce the upside by more than the downside.

This comparative statics illustrates that the decrease in market-to-book ratio following the crisis can be interpreted, following [Yellen \(2017\)](#), as an increase in bank safety.

Average Profitability The second comparative static is with respect to a decrease in average profitability: formally, any change in parameter, beside growth

and leverage, that decreases the equity dividend rate in all states. This includes, for example, an decrease in loans coupon, c_L , an increase in average prepayment, $\bar{\mu}_L$, an increase in average default, $\bar{\delta}_L$, or a increase in deposits coupon, c_D .

Lemma 2 (Profitability). *Consider a decrease in average profitability. Then:*

- *the market-to-book ratio, $\frac{MVE}{BVE}$, decreases;*
- *the franchise value, $\frac{FVE-BVE}{BVE}$, decreases;*
- *the government guarantee, $\frac{MVG}{BVE}$ increases.*

It is intuitive that a decrease in profitability reduces both the market and the franchise value. The key point is that it reduces the franchise value by more. Indeed, for the franchise value, the decrease in profitability matters in all states $s \in S$. For the market value, it only matters in non-default states. On net, this implies that $MVE - FVE = MVG$ must increase.

This comparative statics illustrate that the decrease in market-to-book ratio following the crisis can be interpreted, following [Sarin and Summers \(2016\)](#), as an increase in bank riskiness.

Leverage The last comparative statics is with respect to leverage, Θ .

Lemma 3 (Leverage). *Consider a decrease in leverage. Then:*

- *the market-to-book ratio, $\frac{MVE}{BVE}$, decreases;*
- *the franchise-value, $\frac{FVE-BVE}{BVE}$, decreases;*
- *the government guarantee, $\frac{MVG}{BVE}$ decreases.*

To understand the comparative statics, notice that a decrease in leverage has two effects on banks safety going in opposite directions. On the one hand, it makes it less profitable to operate a bank, so it increases incentives to default. Correspondingly, we find that the franchise value decrease. On the other hand, it also increases the bank's equity cushion, so it reduces incentives to default. Correspondingly, we find that the government guarantee decreases.

4 Calibrating Aggregate Credit Risk

Our findings regarding the value of government guarantees to bank equity require that banks be exposed to aggregate risk that involves a small probability of a very negative outcome. We document that aggregate credit risk has this feature. Broad portfolios of corporate bonds experienced large negative realized excess returns in 2008. These portfolios earn a relatively small realized excess returns from their exposure to this risk in normal times.¹⁴

We build on existing studies of bank risk exposures. [Begenau, Piazzesi, and Schneider \(2015\)](#) is an important study of banks' exposures to interest rate and credit risk. They estimate the size of banks' exposures to these risks in terms of factor portfolios. They find that banks increased their exposures to both interest rate risk and credit risk in advance of the financial crisis. Building on their study, we model bank exposure to credit risk directly in terms of the excess returns on portfolios of corporate bonds with different credit ratings financed with risk-free debt.¹⁵

In our model, we abstract from the impact of interest rate risk on banks' profitability and valuation. There is a rapidly growing new literature on the interest rate risk inherent in banks' portfolios that argues that maturity transformation does not expose banks to significant interest rate risk, such as, [English, Van den Heuvel, and Zakrajsek \(2012\)](#), [Gomez, Landier, Sraer, and Thesmar \(2016\)](#), [Drechsler, Savov, and Schabl \(2017a\)](#), and [Drechsler, Savov, and Schabl \(2017b\)](#).¹⁶

In this section, we use data on the total returns on portfolios of corporate bonds in excess of returns on similar maturity bonds without credit risk to calibrate the risk neutral probabilities $q(s)$ of a crisis. To do so, we specialize the model to have two states $s \in \{s^n, s^c\}$, where we refer to s^n as the normal state and s^c as the crisis state. Our calibration of the risk neutral probability of the normal state $q(s^n)$ determines

¹⁴[Giesecke, Longstaff, Schaefer, and Strebulaev \(2011\)](#) present data on default rates for corporate bonds over the period from 1866 to 2008. They find evidence of repeated events of clustered defaults much worse than those experienced during the Great Depression. [Moody's \(2018\)](#) provides and update of these data.

¹⁵See also [Begenau, Bigio, and Majerovitz \(2018\)](#), which documents the magnitude of losses on the market value of bank equity in the 2008 crisis.

¹⁶See also [Di Tella and Kurlat \(2017\)](#).

the tradeoff investors face between exposure to negative realized excess returns in the crisis state s^c and reward in terms of positive realized excess returns in the normal state s^n .

Our calibration of the risk neutral probabilities $q(s)$ is based on the asset pricing equation for excess returns on any two fairly priced assets

$$q(s^n)(R(s^n) - R^f(s^n)) + (1 - q(s^n))(R(s^c) - R^f(s^c)) = 0. \quad (14)$$

To focus on credit risk, we let $R(s)$ denote the realized returns on a portfolio of corporate bonds with a given credit rating and $R^f(s^n)$ denote the realized returns on a similar duration portfolio of AAA bonds or Treasury bonds.

We also use information from recent studies of the expected credit risk premium on investment grade corporate bonds relative to similar duration Treasury bonds by [Asvanunt and Richardson \(2016\)](#) and [Berndt, Douglas, Duffie, and Ferguson \(2017\)](#). The expected risk premium on any asset relative to another asset is the expected value of the excess return under the physical probabilities $p(s)$. As long as realized excess returns on corporate bonds in the normal state are positive, estimates of expected risk premia on corporate bonds are a lower bound on the realized excess return on these bonds in the normal state. That is, under these assumptions we have the inequality

$$R(s^n) - R^f(s^n) \geq p(s^n)(R(s^n) - R^f(s^n)) + (1 - p(s^n))(R(s^c) - R^f(s^c)). \quad (15)$$

Corporate bonds are useful for studying the nature of aggregate credit risk as these bonds are traded and hence their returns can be easily measured for different credit ratings. We measure the credit risk in corporate bonds using BAML Total Return Indices for portfolios of bonds of different credit ratings.¹⁷ To measure credit risk, we examine the total returns on bonds rated *AA*, *A*, *BBB*, *BB*, *B* and the BAML High Yield Total Return index in excess of the total returns on bonds with a rating of *AAA*.¹⁸ As an additional measure of credit risk, we also examine the realized

¹⁷These indices are available on the St. Louis Federal Reserve Website FRED.

¹⁸Bonds with ratings of *AAA*, *AA*, *A*, and *BBB* are considered investment grade. Bonds with

	AA	A	BBB	BB	B	HY	VBIIX
BAML 2008	-4.89%	-11.34%	-16.31%	-25.91%	-37.84%	-35.24%	-6.11%
BAML 97-07 and 11-17	9bp	38bp	60bp	165bp	84bp	138bp	53bp
Model $q(s^n) = 0.95$	26bp	66bp	86bp	136bp	197bp	185bp	32bp

Table 1: Realized Annualized Excess Returns on Corporate Bonds

return on Vanguard’s Intermediate Term Investment Grade Bond Fund (VBIIX) in excess of the realized return on Vanguard’s Intermediate Term US Treasury Bond Fund (VFITX). See Table 1 for a presentation of these data.

The realized excess returns on the BAML portfolios for 2008 were increasingly negative as the rating of the bond portfolio declines, consistent with the hypothesis that bonds with a lower credit rating are more exposed to aggregate credit risk. For the most part, the realized excess returns on these bond portfolios in the non-crisis years of 1997-2007 and 2011-2017 are increasing as the credit rating of the bond portfolio declines, consistent with the hypothesis that investors were compensated for this aggregate risk.

To map these data to our model to calibrate the risk neutral probability $q(s^n)$, we use the realized excess returns on these various portfolios as a measure of the realized excess return on a portfolio of assets with the credit risk in corporate bonds in the crisis state s^c , which we denote by $R(s^c) - i$.¹⁹

To calibrate $q(s^n)$, we use equations (14) and (15) where we assume that the second asset is riskless, that is $R^f(s) = i$. We draw on three data sources: the average realized excess returns on the various bond portfolios outside of the 2008 crisis, estimates of the expected credit risk premium for bonds with different credit ratings by [Asvanunt and Richardson \(2016\)](#) for the period 1988-2014 for investment grade bonds, and estimates of the expected credit risk premium by [Berndt, Douglas,](#)

ratings of *BB* and below are considered High Yield.

¹⁹In our model, we abstract from interest rate risk. Clearly, the BAML portfolio of AAA bonds is not completely riskless because it is subject to interest rate risk, so its return does not correspond to the riskless rate i . Thus, we take the gap between the returns of these bond portfolios and the portfolio of AAA bonds to control for interest rate risk and use this measure of realized aggregate credit risk in the crisis state to calibrate $R(s^c) - i$ in our model.

	AA	A	BBB	BB	B	HY
BDDF 2002-2015	13bp	26bp	57bp	143bp	242bp	
AV 1988-2014	50bp for IG			248bp for HY		
Model $q(s^n) = 0.95$	26bp	66bp	86bp	136bp	197bp	185bp

Table 2: Credit Risk Premium AV = [Asvanunt and Richardson \(2016\)](#), BDDF = [Berndt, Douglas, Duffie, and Ferguson \(2017\)](#)

[Duffie, and Ferguson \(2017\)](#) over the 2002-2015 time period.

To measure the realized excess returns on exposure to aggregate credit risk in normal times $R(s^n) - i$, we examine the realized excess returns on our BAML portfolios and Vanguard bond funds averaged over the combined periods 1996-2007 and 2011-2017.²⁰ We present these realized excess returns in Table 1. From equation (14) we see that these data on average realized excess returns averaged over the periods 1996-2007 and 2011-2017 are consistent with the hypothesis that the risk neutral probability of the normal state is high. In Table 1, we present the model’s predictions for these realized excess returns in the normal state under the hypothesis that the risk neutral probability of the normal state is $q(s^n) = 0.95$.

Next, consider the evidence on the expected credit risk premium, which, through equation (15) puts a lower bound on the realized excess returns on corporate bonds in normal times. In Table 2, we present the expected credit risk premia estimated by [Asvanunt and Richardson \(2016\)](#) over the 1988-2014 time period and by [Berndt, Douglas, Duffie, and Ferguson \(2017\)](#) over the 2002-2015 time period.²¹ With $q(s^n) = 0.95$, the model satisfies the inequality for investment grade corporate bonds, which corresponds to the rating of bank holding companies.

Based on these observations, in what follows, we use a calibration of the risk neutral probability of the normal state of $q(s^n) = 0.95$.

²⁰For the BAML portfolios, we examine returns over the 1997-2007 time period because data for 1996 are not available for several portfolios.

²¹See Table 3 of [Berndt, Douglas, Duffie, and Ferguson \(2017\)](#) for the median credit risk premia by credit rating.

5 Applying the Model to a Stylized Bank

We now use our model to study the implications of government guarantees for the market valuation of a stylized bank that has no franchise value because all of its assets and liabilities are simply marketable securities. We do so to make a simple quantitative illustration of the two comparative statics results that we considered in Lemmas 1 and 3.

In particular, we first show that, in the presence of government guarantees, it is quantitatively plausible that observed variations in bank accounting profitability and market valuations in normal times can be accounted for by small changes in bank exposure to the aggregate credit risk in investment grade corporate bonds. We demonstrate that a bank with government guarantees and plausible amounts of book equity can capture enough value from government guarantees as in equation (13) to boost the ratio of the market to book value of its equity to two simply by investing in assets with the exposure to aggregate credit risk of *BBB* rated corporate bonds.

We then use this stylized model to demonstrate the result in Lemma 3 that a reduction in book leverage can result in a substantial decline in the accounting profitability and market valuation of the bank, even if it implies that the bank is becoming safer in the sense that the market value of the government guarantees is getting smaller. Specifically, this exercise demonstrates that higher regulatory capital standards should be expected to significantly reduce the accounting profitability and valuation of a risk taking bank.

Our stylized bank holds on its asset side a portfolio of marketable securities with exposure to the credit risk observed in corporate bonds with different credit ratings and finances its portfolio with wholesale deposits backed by a full government guarantee. Accordingly, because all of the bank's assets and liabilities are obtained through transactions in capital markets, we assume that the fair value of this bank's assets and liabilities are equal to their book values. That is, we assume that $v_L = v_D = 1$ and that there are no costs of originating new loans or deposits $\phi_L = \phi_D = 0$. The book leverage of the bank is Θ . Thus, the book value and the fair value of the

bank's equity is given by $1 - \Theta$.

The assets of this stylized bank earn gross returns $1 + R(s)$ realized in state s . We assume that the bank reinvests to have its portfolio of assets and liabilities grow at rates $g(s)$. With these assumptions the free cash flow of the bank is given by

$$DIV_E(s) = (R(s) - i) + (1 - \Theta)(1 + i) - (1 + g(s))(1 - \Theta).$$

The market value of this bank is given by equation (6). The decision of bank equity to default $I(s)$ is governed by equation (7). In this version of the model with only two states s , we have that the market value of bank equity if it chooses to default in the crisis state is given by

$$MVE = \left[\frac{q(s^n)}{1 + i - q(s^n)(1 + g(s^n))} \right] DIV_E(s^n) \quad (16)$$

and it is optimal for the bank to default in the crisis state if

$$\left[\frac{q(s^n)}{1 + i - q(s^n)(1 + g(s^n))} \right] \frac{DIV_E(s^n)}{1 - \Theta} > \frac{FVE}{BVE}. \quad (17)$$

These equations hold regardless of the ratio of the fair to book value of bank equity. For our stylized bank, this ratio $FVE/BVE = 1$.

We compute the accounting profitability of this stylized bank as follows. The return on assets of the bank (ROA) is equal to the ratio of its net income to the book value of its assets.²² Thus, we have

$$ROA(s) = (R(s) - i) + (1 - \Theta)i.$$

The corresponding return on equity of this bank is $ROE(s^n) = ROA(s^n)/(1 - \Theta)$. The bank dividend is related to bank profitability as follows

$$\frac{DIV_E(s^n)}{1 - \Theta} = ROE(s^n) - g(s^n). \quad (18)$$

²²We assume that the full return $R(s)$ on the bank's assets is measured in its income statement. This would be the case if these assets are held as trading assets.

5.1 Risk and Bank Valuation

We now examine the implications of our stylized model for the market valuation and accounting profitability of stylized banks that have different exposures to aggregate credit risk as indexed by their realized excess returns in the crisis state $R(s^c) - i$ and different levels of leverage Θ . We calibrate our stylized model to a risk neutral probability of the normal state of $q(s^n) = 0.95$ and hence a risk neutral probability of a crisis of $1 - q(s^n) = 0.05$. We set the risk free interest rate to $i = 5\%$ and the growth rate of the book balance sheet in normal times of $g(s^n) = 7.5\%$.²³

To model banks with different exposure to aggregate credit risk, we consider four banks that differ in their realized excess returns in the crisis state. We calibrate these crisis excess returns to those observed for the different BAML bond portfolios in 2008 discussed above in Table 1. We refer to these four banks with different risk profiles as the *AA*, *A*, *BBB*, and *BB* banks.

We now examine how the market valuation and accounting profitability of our four stylized banks varies with these banks' exposure to credit risk. We consider first a value for leverage in these banks of $\Theta = 0.90$.

With the parameters we have set we have that the realized accounting returns on equity for these banks in the normal state ($ROE(s^n)$) are rising sharply in bank exposure to credit risk. See the first row of Table 3. Thus, we see that it is quite plausible that large differences in banks' observed accounting returns on equity in normal times can be accounted for by differences in their exposure to the aggregate credit risk in investment grade corporate bonds.

Which of these banks chooses to default in the crisis state? From equation (17), we have that the banks with *A*, *BBB*, and *BB* rated assets would all choose to default in the crisis state. Only the safest bank, the bank with *AA* rated assets, would choose not to default.

Now consider the implications of our model for the market valuation of these

²³These values are representative of the values observed in the data for the 1996-2007 time period. With this calibration, if our stylized bank chooses to default in the crisis state, then its price dividend ratio in the normal state as given in equation (16) is equal to 33 regardless of the riskiness of the bank.

		Rating of Bank Assets			
		AA	A	BBB	BB
$\Theta = 0.90$	$ROE(s^n)$	7.5%	11.6%	13.6%	18.6%
	MVE/BVE	1	1.35	2.0	3.68
$\Theta = 0.85$	$ROE(s^n)$	6.6%	9.4%	10.7%	14.1%
	MVE/BVE	1	1	1.06	2.2

Table 3: Profitability and Valuation of Stylized Banks

banks. The safest bank, the bank with *AA* rated assets, does not default in the crisis state. Hence, the market value of its equity is equal to the fair value of its equity, which, in turn, is equal to the book value of its equity. Hence it trades at a market to book value of one.

To value the three riskier banks that choose to default in the crisis state, we use equation (16). From this equation we have that the bank with *A* rated assets trades at a market to book ratio of 1.35, the bank with *BBB* rated assets at a ratio of 2.00 and the bank with *BB* rated assets at a ratio of 3.68. (See the second row of Table 3.) Thus, we see that the market valuation of these banks rises sharply with their exposure to aggregate credit risk. Moreover, our stylized bank can attain a market to book ratio equal to 2 simply from exposure to the aggregate credit risk in *BBB* bonds.

The results in Table 3 from this simple numerical exercise makes clear the quantitative implications of Lemma 1. Specifically, we see that, in the presence of government guarantees, it is entirely plausible that large changes in banks' accounting profitability and market valuations can be accounted for by small changes in banks' exposure to the aggregate credit risk in investment grade corporate bonds.

5.2 Equity Capital, Bank Accounting Profits, and Valuation

We now illustrate the comparative static in Lemma 3. Specifically, we consider now the accounting profitability and valuation of our stylized banks with a value for leverage in these banks of $\Theta = 0.85$. Results are reported in the lower half of Table

3.

The realized accounting returns on equity for these banks in the normal state ($ROE(s^n)$) are substantially reduced relative to the example above with lower equity capital. Compare the first and third rows of Table 3.

Which of these banks chooses to default in the crisis state? From equation (17), we have that now only the two riskiest banks, the banks with BBB and BB assets would choose to default in the crisis state. The banks with AA and A assets would not choose to default in the crisis state.

This reduction in banks' exposure to risk of default has a striking impact on their market valuations. Compare the second and fourth rows of Table 3. Now, the banks with AA and A rated assets both trade at a ratio of the market to book value of equity of one. The BBB bank now trades at a market to book ratio of only 1.06 instead of 2.00. Although this bank continues to default in the crisis state (and hence with the same probability), with lower leverage the equity of this bank derives much less value from the government guarantees.

The results in Table 3 from this second simple numerical exercise highlight the quantitative implications of Lemma 3, that is, the prediction of our model that an increase in bank capital following a crisis should be expected to substantially reduce bank market valuations and accounting profitability relative to what was observed prior to that crisis.

5.3 Risk Taking and Accounting Profitability

As shown in Table 3, the accounting profitability of our stylized bank rises in the risk exposure of its assets.²⁴ This is a more general property of our model. To be specific, if a bank's assets have no risk, so that $R(s) = i$ for all s , then the accounting return on equity for that bank is given by

$$\overline{ROE} = i \left(\frac{FVE}{BVE} \right) - \bar{g} \left(\frac{FVE - BVE}{BVE} \right) \quad (19)$$

²⁴Meiselman et al. (2018) use a closely related model to study the accounting profitability of a bank as a measure of the risk to which its assets are exposed using cross section data.

We can use this benchmark for accounting profitability when bank assets have no aggregate risk to decompose the accounting profitability of banks observed in normal times into a component that is due to exposure to aggregate risk $ROE(s^n) - \overline{ROE}$ and a component that is due to the fair value of bank equity $\overline{ROE}$. From equation (19), we have that this benchmark for accounting profitability is increasing in the franchise value of the bank.

For our stylized banks in which $FVE = BVE$, we have $\overline{ROE} = i$, which we calibrate to $i = 5\%$. For each of our stylized banks, we see that they show accounting profitability in normal times in excess of this benchmark, with this gap increasing as the credit quality of the bank's assets is reduced. Note that this excess accounting profitability for the *BBB* bank with book leverage of $\Theta = 0.9$ is $860bp$. When book leverage is reduced to $\Theta = 0.85$, this excess profitability is reduced to $507bp$. The risk neutral expectation of the bank's accounting profitability, however, is unchanged at $\overline{ROE}$ regardless of risk taking. A bank that takes risks succeeds at raising its accounting profitability in normal times at the expense of reducing its profitability in the crisis state.

Our emphasis on large capitalized values of government guarantees follows a large literature on the impact of government guarantees on the value of bank debt and equity. [GAO \(2014\)](#) and [Acharya, Anginer, and Warburton \(2016\)](#) are recent studies of the impact of government guarantees on the pricing of bank bonds. [Schweikhard and Tsesmelidakis \(2012\)](#) study the impact of government guarantees on bank CDS spreads relative to equity based estimates of banks' probability of default. We include government bailouts for subordinated bondholders in our model to match evidence on spreads on bank subordinated bonds. [Gandhi and Lustig \(2015\)](#) and [Gandhi, Lustig, and Piazzzi \(2017\)](#) study the impact of government guarantees on the pricing of bank equity. [Kelly, Lustig, and Van Nieuwerburgh \(2016\)](#) study the impact of government guarantees on the pricing of options on bank equity. This paper highlights the impact of guarantees on option pricing due to guarantees against an aggregate or systemic shock to the financial sector as opposed to an idiosyncratic shock to an individual bank.

6 Accounting for the Valuation of US Banks

In this section, we use our model to provide a full accounting of the evolution of the market valuation of banks for three time periods: 1970-1985, 1996-2007, and 2011-2017. We choose these time periods to correspond to “normal” states as opposed to crisis states. We omit the time period between 1986 and 1995 because this was a period of rapid change in the regulatory environment and business models for banking and of substantial volatility in bank earnings and valuations. We omit the years 2008 – 2010 as these correspond to a crisis period in banking. Table 4 summarizes all the parameters and results of this section. Our accounting proceeds in two steps.

In the first step, we construct a measure of the fair value of bank equity, using data on the book value of items on banks’ balance sheets together with data reported in the footnotes of banks’ annual reports and results from the Portfolio Value Model created by the Office of Thrift Supervision. We do so using equations (3), (4), and (11). The inputs required here are the values of the ratio of the fair to book value of loans v_L , the ratio of the fair to book value of deposits v_D , and an assumption regarding the value of growth opportunities in loan making, $FVL - v_L$, and deposit taking, $FVD - v_D$. This first step gives us a measure of the ratio of the franchise value of banks relative to the book value of bank equity implied by $FVE/BVE - 1$.

In the second step, we construct a measure of the market value of bank equity. This measure is the maximum of the fair value of bank equity and the value of bank equity conditional on equity defaulting in the crisis state.²⁵ The inputs required here are measures of the riskfree interest rate i , a measure of the growth rate of the bank balance sheet in normal times $g(s^n)$, a measure of the bank’s free cash flow to equity in the normal state $DIV_E(s^n)$ given observed accounting profitability, and our calibration of the risk neutral probability of the normal state $q(s^n) = 0.95$. In this second step, we construct a model-implied estimate of the market value of bank equity MVE. Hence, this second step gives us a measure of the ratio of the market value of government guarantees to the fair value of bank equity implied by

²⁵The default decision is given in equation (16).

MVE/FVE $- 1$.

6.1 First Step: FVE

Measurement of Franchise Value in Banking. From equation (11), the fair value of bank equity, and hence the franchise value of the bank, is determined by the fair value of the current stock of bank loans relative to its book value v_L , the fair value of the current stock of deposits relative to its book value v_D , the leverage of the bank Θ_D , and the value of the bank’s opportunities to originate new loans and deposits. Note that the subordinated debt of the bank is recorded on the balance sheet at its market price, so we are able to read $\Theta_B v_B$ off of bank balance sheets.

To measure v_L , our paper relies on banks’ estimates of the fair value of their loans presented in the footnotes to the financial statements in their Annual Reports.²⁶ To measure v_D , we rely on estimates of the fair value of bank deposits from a model developed by the Office of Thrift Supervision. We assume that banking is competitive in the sense that banks earn zero profits on the origination of new loans and deposits, that is, $\phi_L = (v_L - 1)$ and $\phi_D = (1 - v_D)$. This implies that the gap between the fair value and book value of bank equity relative to the book value of bank assets is given by $(v_L - 1) - \Theta_D(1 - v_D)$.

The methods that banks and the OTS use to estimate the fair value of loans and deposits are related to the internal cost accounting models banks develop to evaluate the risk versus the profitability of their lending and deposit taking units. This methodology is commonly referred to as *Funds Transfer Pricing* (FTP).²⁷ This methodology is also related to the methodology that the Bureau of Economic Analysis uses when it measures value added in banking. In particular, the BEA’s methodology attributes a portion of banks’ net interest income to implicit charges for service

²⁶For background information on these reports on loan fair values, see Nissim (2003), Nissim (2007), Tschirhart et al. (2007), Calomiris and Nissim (2014), and Knott et al. (2014).

²⁷Hutchison and Pennacchi (1996), Jarrow and Deventer (1998), Janosi, Jarrow, and Zullo (1999), O’Brien (2000), and Sheehan (2013) develop fair value models for loans and deposits. For a discussion of banks’ models for Funds Transfer Pricing, we refer to Wyle and Tsaig (2011) from Moody’s Analytics, Grant (2011), and Dermine (2012).

provision which they refer to as *Financial Intermediation Services Implicitly Measured* (FISIM).²⁸

Loan Fair Values First consider our data on the fair value of bank loans. Banks have been required since the mid-1990’s to also report an estimate of the fair value of their loans in the footnotes to their Annual Reports. We collected data from the footnotes in bank annual reports on the fair and book values of bank loan portfolios for the period 1995-2016 for 19 large bank holding companies.²⁹ We compute a ratio of the fair to book value of loans for the banking sector by taking the sum of loan fair values across these banks divided by the sum of loan book values. The resulting ratios from these data are shown in Figure 10. In normal times, these ratios range between 1 and 1.02. Thus, consistent with the finding of [Begenau \(2018\)](#) that bank assets have not substantially outperformed passive portfolios of securities and according to bank models of loan fair values, the gap between loan fair and book values is small.

The coefficient v_L in our model refers to the ratio of the fair value to book value of all of bank assets. To obtain an estimate of v_L to be used in our model, we must convert the figure for the ratio of the fair to book value of bank loans to a fair to book value of all bank assets. We do so as follows. We treat all earning bank assets that are not loans as having fair values equal to book values.³⁰ We also treat all non-earning bank assets as having fair values equal to book values.³¹ If we denote the ratio of fair to book value of bank loans taken from bank annual reports by

²⁸[Wang, Basu, and Fernald \(2008\)](#) and [Basu, Inklaar, and Wang \(2011\)](#) study the measurement of FISIM and [Hood \(2013\)](#) and [Akritidis \(2017\)](#) discuss the methods used in the US and elsewhere to conduct this measurement. [Haldane, Brennan, and Madouros \(2010\)](#) focuses on the impact of risk taking on measurement of FISIM in banking.

²⁹Bank of America, Citigroup, JP Morgan Chase, Wells Fargo, AIG, MetLife, American Express, Huntington Bank Shares, Fifth Third Bank, Washington Mutual, Suntrust Banks, Regions Financial, PNC Financial Services, National City Bank, Zions Bank, Countrywide, Comerica, Keycorp, and US Bancorp.

³⁰These assets include Cash and Deposits Due, Securities, Trading Assets, Fed Funds Sold and Reverse Repo.

³¹Bank non-earning assets such as premises, other real estate owned, intangible assets such as goodwill, and tax related assets are all recorded at book values. We treat the fair value of these assets to be equal to the book value of these assets. This is likely an overstatement of the fair value of these assets.

$\tilde{v}_L$ and the ratio of bank loans in the data to total assets in the data by $\tilde{L}$, these assumptions give us that v_L in our model is given by

$$v_L = 1 + (\tilde{v}_L - 1) \tilde{L}.$$

We report the implied values of v_L in Table 4. We do not have data for the 1970-1985 time period. We set $v_L = 1$ for this time period.

Deposit Fair Values Now consider our data for the fair value of bank deposits. Banks do not report on the fair value of their deposits. Instead, we rely on estimates of the fair value of deposits constructed by the Office of Thrift Supervision in their Portfolio Value Model.³² Their estimate of the ratio of the fair to book value of deposits (which they refer to as the intangible value of deposits) is an estimate of the interest savings to the bank that arise if current depositors leave their funds in their demand accounts and/or rollover their funds in time deposits at rates below prevailing wholesale interest rates.

The Office of Thrift Supervision published estimates of the fair value of selected assets and liabilities on a quarterly basis from 1997 to 2011.³³ We use the OTS estimates of the intangible value of retail certificates of deposit, transaction accounts, money market accounts, passbook savings accounts, and non interest bearing accounts to construct an estimate of the fair value of deposits in banks in the data, which we denote by $\tilde{v}_D$.³⁴

We check the results from the OTS Portfolio Value Model for the intangible value of deposits against accounting data on the core deposit intangibles that banks record when one bank purchases another bank. Davis (2017) chart 3 reports on average core deposit intangibles recorded from whole bank transactions from 2000-2017. Core deposit intangibles were in the range from 2.5% – 3% in the early 2000’s

³²See OTS (2000) for a description of that model. See also Sheehan (2013).

³³These estimates are available on the website of the Office of the Comptroller of the Currency at <https://www.occ.gov/publications/publications-by-type/other-publications-reports/ots/ots-asset-liability-price-tables.html>

³⁴The aggregation of these OTS fair value estimates requires considerable judgement on our part. With more time, perhaps a more precise estimate could be constructed.

and have fallen to roughly 1% since the crisis. These estimates imply a large drop in the gap between the book value and fair value of deposit liabilities across these two time periods. This finding is consistent with the discussion in [Fine and Rohde \(2013\)](#).

As with loans, the concept of v_D in our model corresponds to the ratio of the fair value to book value of all bank liabilities. In addition to deposits, bank liabilities include Fed Funds Purchased, Repo and Trading liabilities.³⁵ We assume that these liabilities are all carried on the books at fair value. Hence, if $\tilde{D}$ denotes the ratio of deposits to total assets in the data, our model concept of v_D is given by

$$v_D = 1 - (1 - \tilde{v}_D) \frac{\tilde{D}}{\Theta}$$

where $\tilde{D}/\Theta$ is the ratio of deposits to total liabilities in the data.

We report the implied values of v_D in Table 4. Again, we do not have data for the 1970-1985 time period. We set $v_D = 1$ for this time period.

We find significant gaps between the fair and book values of bank deposits, particularly during the 1996-2007 time period.³⁶

Bank Leverage The sources we use to measure bank leverage Θ (and accounting profitability and growth of assets) are as follows. For the 1970-1985 time period, we use data from the FDIC's Historical Statistics on Banking. This source provides data on bank income statements and balance sheets on an annual basis from 1934 through 2017. For the 1996-2007 and 2011-2017 time periods, we use data on bank holding companies from The Federal Reserve Bank of New York's Quarterly Trends for Consolidated US Banking Organizations. This source provides quarterly data on bank holding company income statements and balance sheets on a quarterly basis from 1991 through 2017Q3.

³⁵Recall that we handle subordinated debt separately.

³⁶This finding is consistent with the findings of [Egan, Lewellen, and Sunderam \(2017\)](#) regarding the importance of variation in the productivity of deposits in explaining the cross section of bank valuation. Similarly, [Furlong and Kwan \(2006\)](#) study the determinants of bank valuation in the cross section.

The FDIC data gives estimates of bank leverage Θ of 0.939 for 1970-1985. Using the Federal Reserve Bank of New York data for bank holding companies, the corresponding values of leverage Θ are 0.918 for 1996-2007, and 0.889 for 2011 – 2017. The values of the ratio of the fair value of bank subordinated debt to total assets (Θ_{BV_B}) for these three time periods are 0.41%, 1.33%, 1.74% respectively.³⁷ These data are presented in the top panel of Table 4.

Results on Bank Franchise Values These parameters give us the following results for the ratio of the fair value of bank equity to the book value of bank equity. We estimate that the ratio of fair value of bank equity relative to the book value of bank equity was 1.48 for bank holding companies in the 1996-2007 time period and 1.10 for bank holding companies in the 2011-2017 time period. Thus, our estimates imply that bank franchise values have fallen considerably relative to bank book equity — from 48% in 1996-2007 to 10% in 2011-2017. These results are presented in the bottom panel of Table 4.

6.2 Second Step: MVE

Market Value of Equity We now turn to the second step of our accounting, that of measuring the model’s implications for the market value of bank equity. For this step, from equation (16) we require measures of the following parameters $q(s^n)$, i , $g(s^n)$, and $DIV_E(s^n)$. These parameters are presented in the top panel of Table 4.

We use our calibration of the risk neutral probability of the normal state of $q(s^n) = 0.95$ for all time periods that we consider.

To calibrate the level of the riskless interest rate i for each of our three “normal” time periods, we consider the constant maturity yield on five-year Treasury securities. This gives values of i equal to 9.11% for 1970-1985, 4.80% for 1996-2007, and 1.34% for 2011 – 2017.

To calibrate the growth rate of assets in the normal state $g(s^n)$, we examine the average of the growth rate of bank total assets in the time periods under considera-

³⁷Line 19 from form HC on the bank holding company FRY-9C reports.

tion. We use values of the growth rate of banks in normal times $g(s^n)$ of 10.0% for 1970-1985, 7.0% for 1996-2007, and 2.4% for 2011 – 2017.

To compute dividends to equity in normal times $DIV_E(s^n)$, we use the formulas for $DIV_L(s)$ and $DIV_D(s)$ in section 3 to derive the result that

$$DIV_E(s^n) = ROA(s^n) - (1 - v_B)\Theta_B - g(s^n)BVE.$$

To estimate the market price of subordinated debt v_B , we use data on banks' bond spreads as described in Section 2. We have that $v_B = \frac{1+i}{1+y}$ where y is the yield on subordinated debt. We calibrate the spreads on bank subordinated debt $y_B - i$ to 93bp for 1996-2007, 147bp for 2011-2017. We do not have data for the 1970-1985 time period. We use a spread of 100bp for this time period. This calibration implies values of v_B equal to 0.991 for 1970-1985 and 1996-2007 and 0.986 for 2011-2017.

6.3 Results

Our results are presented in the bottom panel of Table 4.

Our model predicts that during the 1970-1985 time period, banks would not choose to default in the crisis state and hence they derived no value from government guarantees. This implies that the market to book ratio of banks during this time period should equal the ratio of the fair value to book value of equity and that government guarantees did not add to the market value of bank equity.

Our model predicts that during the 1996-2007 time period, banks would choose to default in the crisis state and that the model implied ratio of market to book value of equity was 2.06. This value is quite close to the observed average value in the data of 2.12. As a result, we argue that our model can account for observed bank valuations during the 1996-2007 time period. Since the predicted ratio of the fair to book value of equity during this time period was only 1.48, our model implies that banks derived a substantial portion of their market value of equity from government guarantees (roughly 58% of their book value of equity).

Our model predicts that during the 2011-2017 time period, banks would choose to default in the crisis state and that the model implied ratio of market to book

value of equity was 1.19. This figure is close to the model’s predictions for the ratios of the fair to book value of bank equity of 1.10 discussed above. Hence, our model predicts that banks currently do not derive much of their market value from government guarantees. Our model actually overpredicts the ratio of the market to book value of bank equity relative to the data. In the data, this figure averages 0.98 over this time period.

What forces drive our finding that the market value of government guarantees was large relative to the book value of bank equity in the period 1996-2007 but not in the other two time periods? The forces that we focus on here are changes in the book value of bank leverage and the risk in bank assets.

We have seen that the book value of bank leverage has declined steadily across the three time periods that we study. This raises the question of why the market value of government guarantees was not high in the 1970-1985 time period?

The answer lies in the amount of aggregate risk in bank assets. To derive this answer, we use equation (19) to measure the excess accounting return on equity of banks in normal times for these three time periods.³⁸ We find a value of $ROE(s^n) - \overline{ROE}$ of only 262bp in the 1970-1985 time period. This excess accounting return to equity contrasts sharply with the value of 781bp in the 1996-2007 time period and the value of 596bp for the 2011-2017 time period. Based on this evidence, we argue that risk taking by banks in terms of the exposures in bank assets rose sharply from the 1970’s and early 1980’s in the 1990’s and beyond. This evidence suggests that the risk in bank assets has declined only modestly since the crisis of 2008.

We do not directly address changes in the regulatory and economic environment that would account for the changes in bank risk taking and value derived from government guarantees that we document here. There is a large literature on the changes in the regulatory environment that increased the incentives for banks to take risks and become too big to fail. See for example [Boyd and Gertler \(1994\)](#), [Feldman and Rolnick \(1998\)](#), [Stern and Feldman \(2004\)](#), and [Mishkin \(2006\)](#). There is also a literature that examines the impact of equity based incentives for CEO’s on bank risk taking. See for example [Chesney, Stromberg, and Wagner \(2012\)](#), [Larcker,](#)

³⁸To implement this formula, we set $\bar{g} = i - 0.03$.

Ormazabal, Tayan, and Taylor (2014) and Boyallian and Ruiz-Verdu (2017).

7 Conclusion

In this paper, we have shown that the evolution of bank valuations, from 1970 the present can be explained by a model in which banks hold assets with exposure to aggregate credit risk, backed by liabilities subsidized by government guarantees. By increasing leverage and exposure to losses in credit crisis states, banks increase the capitalized value of government guarantees. We show that changes in the capitalized value of these guarantees, driven mainly by changes in bank leverage and the growth rate of banks balance sheets, have been at least as important as banks' true franchise values in determining the value of US banks over time.

Our paper has important implications for bank regulation. Indeed, we show that very small changes in banks' exposure to aggregate credit risk, as well as small changes in bank leverage, have very large effects on the taxpayer liability to bail out banks in a crisis. Currently, bank book leverage is lower than pre-crisis levels. The larger bank equity cushion has reduced the value of taxpayers' liability. However, data on bank profitability and market measures of bank credit risk indicate that banks have not reduced their exposure to aggregate credit risk. As a result, current data suggest that bank equity and subordinated debt would again be wiped out in a credit crisis of the magnitude of 2008.

To conclude, recent work in macroeconomics emphasizes the important role of the financial soundness of the banking sector in determining the state of the US macroeconomy. However, despite a large amount of theoretical work emphasizing bank financial soundness as a key driver of the state of the macroeconomy, the question of how to measure banks' financial soundness has remained an open question. We argue that decomposing banks' market to book ratios of equity into the component due to franchise value, and the part due to capitalized government guarantees sheds light on whether an elevated market to book equity ratio signals bank health or bank risk taking. We provide a measurement framework based on this idea. When calibrated to market and accounting data, our model quantitatively explains the evolution of

bank market to book equity ratio from around one in 1970, to two in the mid 1990's, back down to near one today.

CALIBRATION

	1970-1985	1997-2007	2011-2017	name	source
Θ	93.86%	91.80%	88.87%	leverage	FRY-9C Reports 1-RC28/RC12
$\Theta_B v_B$	0.41%	1.94%	0.73%	subordinated debt	FRY-9C Reports RC19/RC12
i	9.11%	4.81%	1.34%	risk-free rate	5-year Treasury yield
$g(s^n)$	10.4%	7.0%	2.4%	expected growth of balance sheet	
v_L	1	1.003	1.002	fair to book value of loans	annual reports
v_D	1	0.96	0.99	fair to book value of deposits	OTS estimates
$ROA(s^n)$	0.717%	1.15%	0.845%	return on assets in s^n	FRY-9C Reports RI14/A

RESULTS

	1970-1985	1997-2007Q2	2011-2017	name	source
MVE/BVE	1	2.06	1.19	market to book value of equity	accounting model
$\frac{FVE-BVE}{BVE}$	0	0.48	0.10	franchise value/ book equity	accounting model
$\frac{MVE-FVE}{BVE}$	0	0.58	0.09	MVG/ book equity	accounting model

Table 4: Calibration and Results

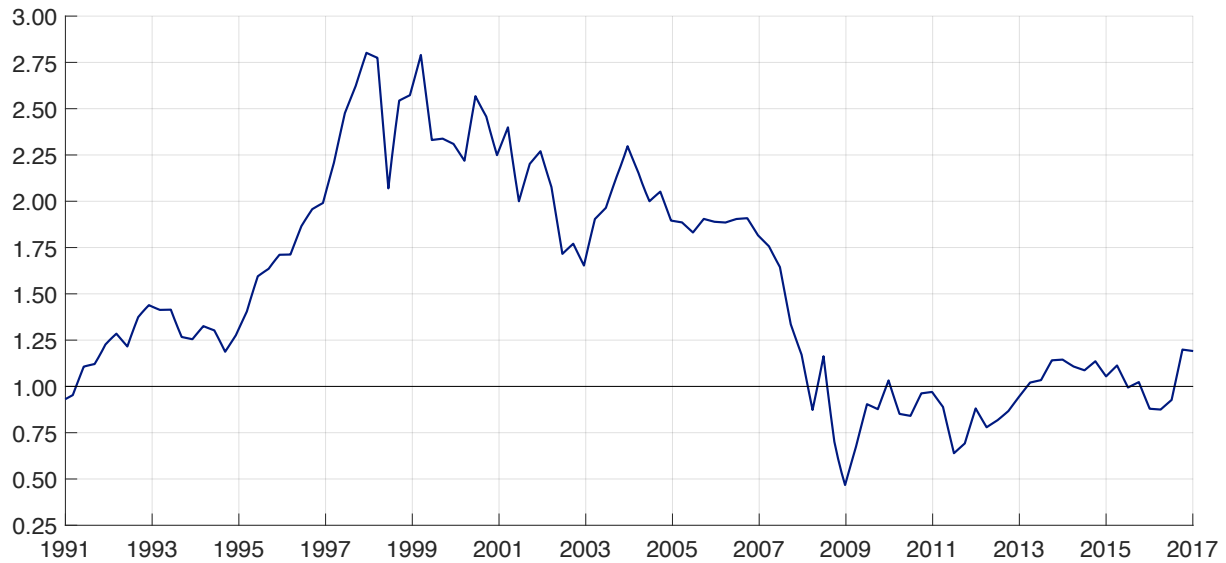


Figure 1: Market to Book Value of Equity for Bank Holding Companies

The ratio is computed as the sum of the market value of equity across bank holding companies divided by the sum of the book value of equity across bank holding companies. The book value of equity comes from the Holding Company Data of the Federal Reserve Bank of Chicago and corresponds to item 28 of the Schedule HC from FRY-9C reports. The market value of equity comes from the Center for Research in Security Prices (CRSP) database.

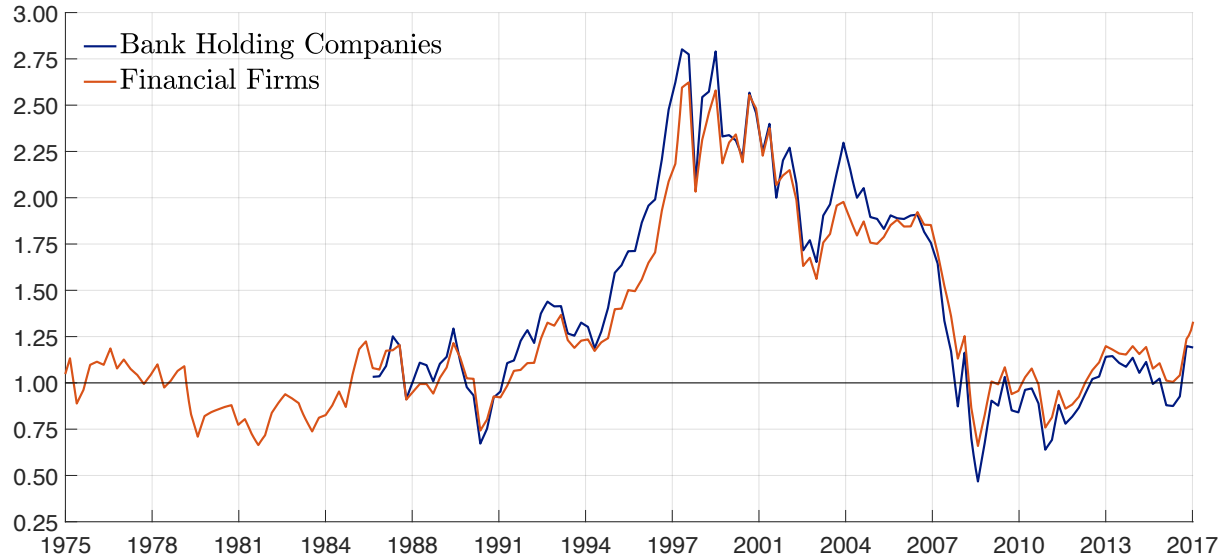


Figure 2: Market to Book Value of Equity for Bank Holding Companies and Financial Firms The ratio is computed as the sum of the market value of equity across bank holding companies divided by the sum of the book value of equity across bank holding companies. The book value of equity comes from the Holding Company Data of the Federal Reserve Bank of Chicago and corresponds to item 28 of the Schedule HC from FRY-9C reports. The market value of equity comes from the Center for Research in Security Prices (CRSP) database. We use financial firms with a standard industry classification code in between 6000 and 6199 to go back to 1975.

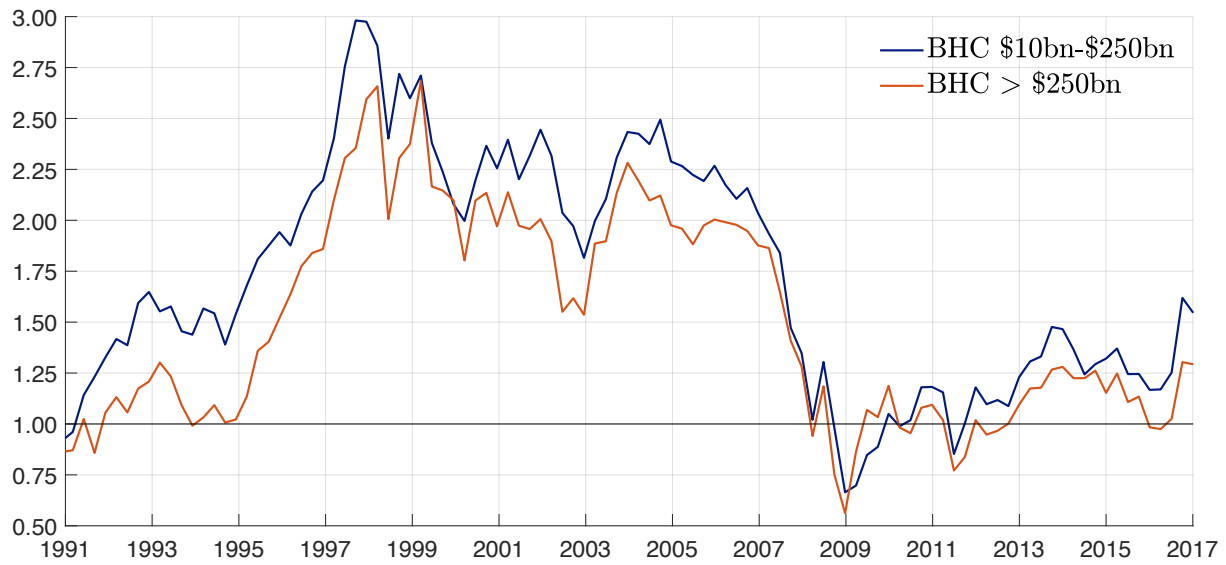


Figure 3: Market to Book Value of Equity for Bank Holding Companies
 We use the Gross Domestic Product Implicit Price Deflator with base year 2009 as the deflator of the \$205 billion threshold. We then take the average of the ratios of market to book value of equity within each group. We use the same data as in Figure 1.

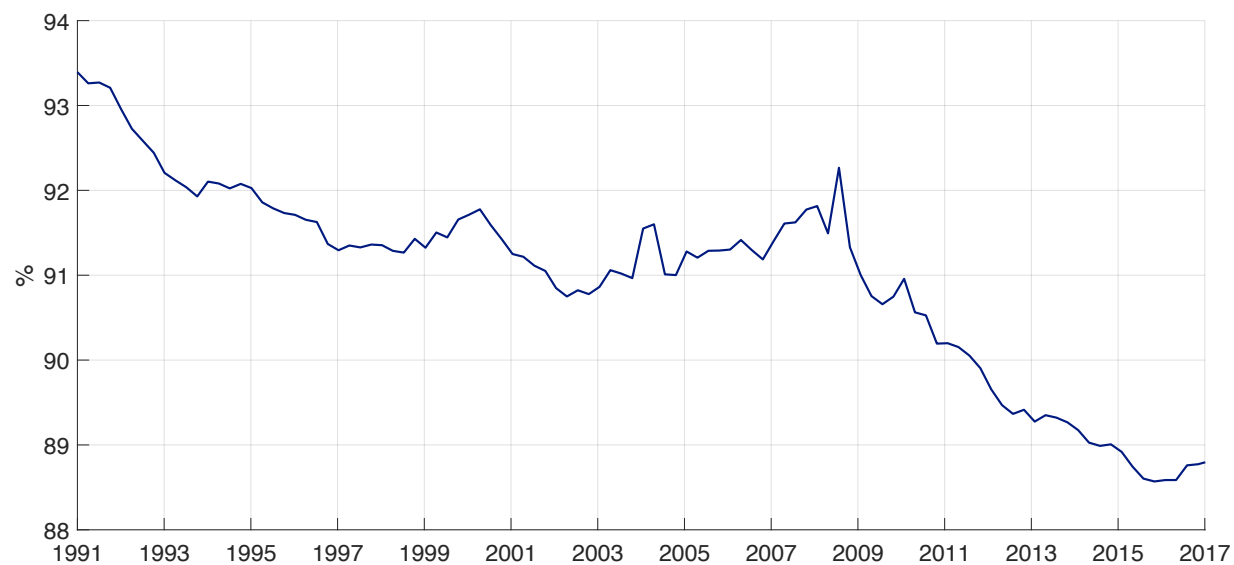


Figure 4: Book Leverage for Bank Holding Companies This figure reports book leverage from the Quarterly Trends for Consolidated U.S. Banking Organizations of the Federal Reserve Bank of New York. The ratio is computed as the sum of liabilities across bank holding companies divided by the sum of total assets across bank holding companies.

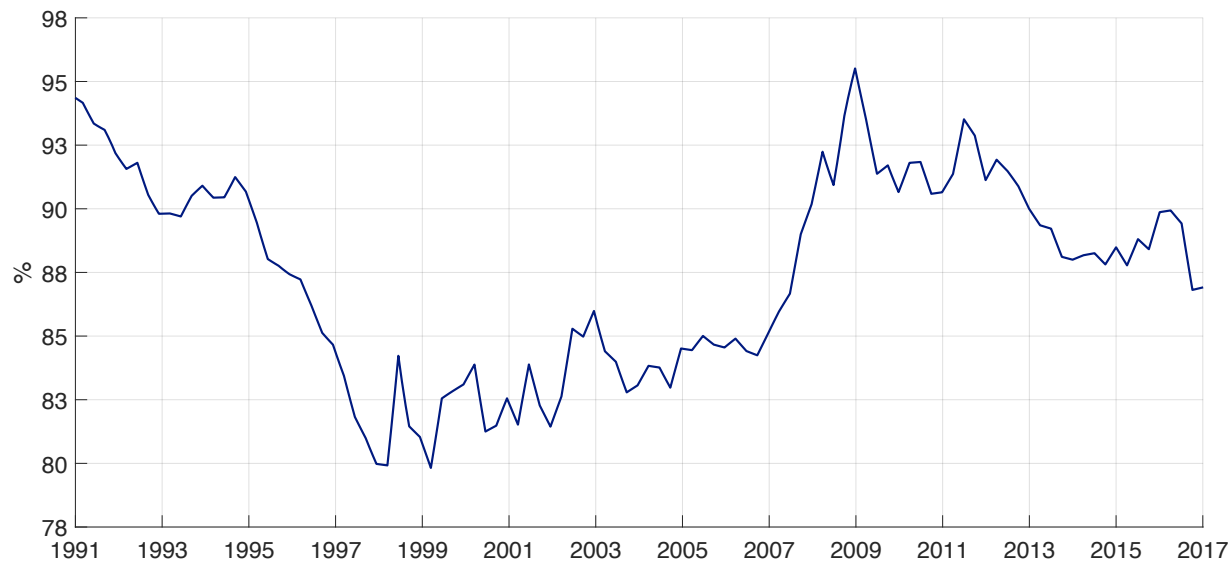


Figure 5: Market Leverage for Bank Holding Companies The ratio is computed as the sum of the book value of liabilities across bank holding companies divided by the sum of the market value of total assets across bank holding companies. The book value of liabilities comes from the Holding Company Data of the Federal Reserve Bank of Chicago and corresponds to item 21 of the Schedule HC from FRY-9C reports. The market value of assets is calculated as the sum of the book value of liabilities and the market value of equity coming from the Center for Research in Security Prices (CRSP) database.

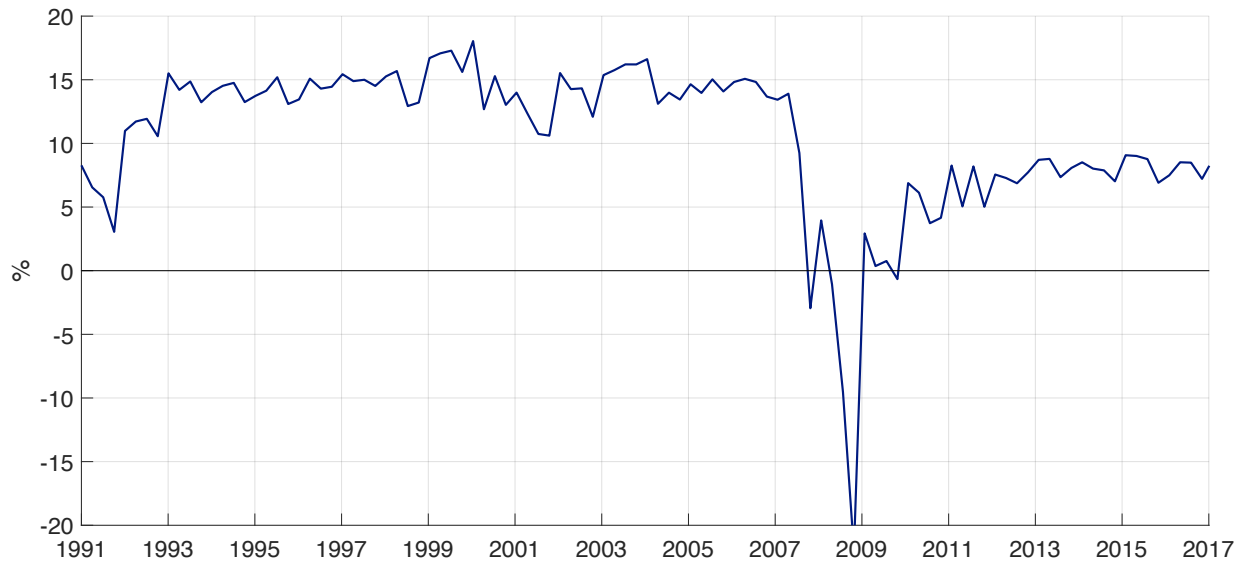


Figure 6: Return on Equity for Bank Holding Companies This figure reports the quarterly annualized return on equity from the Quarterly Trends for Consolidated U.S. Banking Organizations of the Federal Reserve Bank of New York. The ratio is computed as the sum of net income across bank holding companies divided by the sum of total equity across bank holding companies. Net income corresponds to item 14 of Schedule HI from FRY9-C reports. The book value of equity corresponds to item 28 of the Schedule HC from FRY-9C reports.

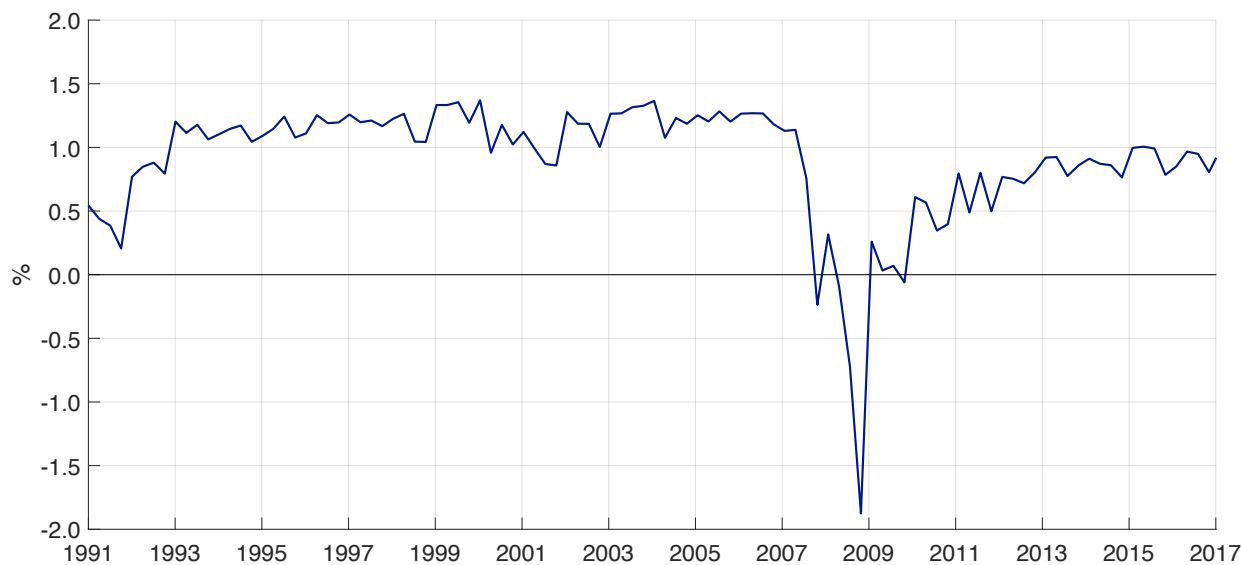


Figure 7: Return on Assets for Bank Holding Companies This figure reports the quarterly annualized return on assets from the Quarterly Trends for Consolidated U.S. Banking Organizations of the Federal Reserve Bank of New York. The ratio is computed as the sum of net income across bank holding companies divided by the sum of total assets across bank holding companies. Net income corresponds to item 14 of Schedule HI from FRY9-C reports. The book value of assets corresponds to item 12 of the Schedule HC from FRY-9C reports.

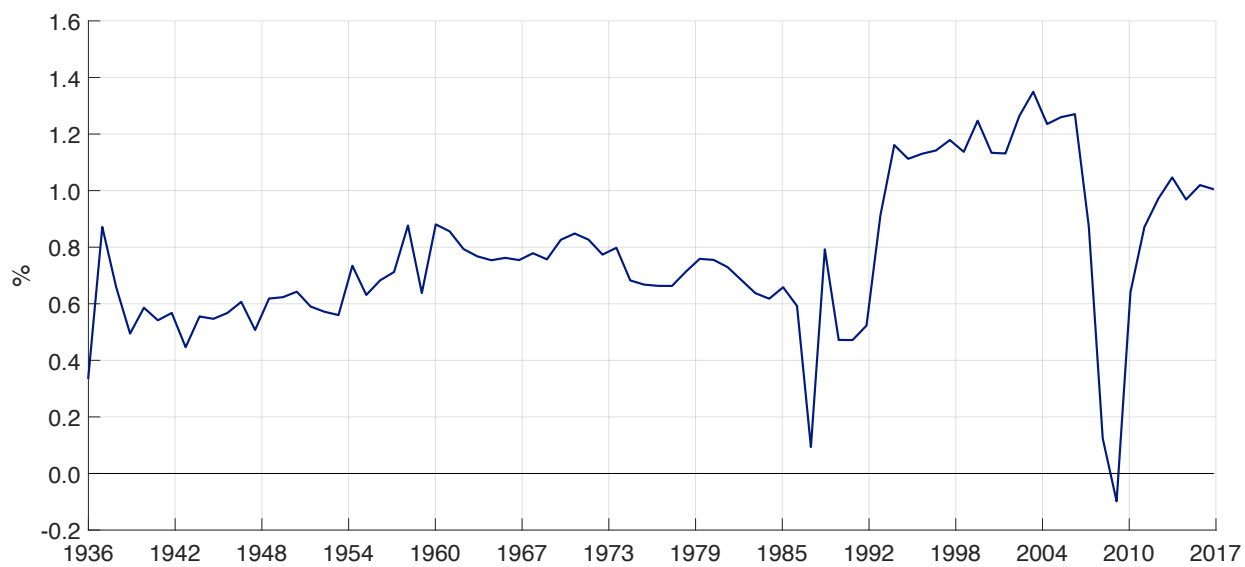


Figure 8: Return on Assets for FDIC-Insured Banks This figure reports the return on assets from the consolidated annual financial statements of FDIC-insured institutions. The ratio is computed as the sum of net income across FDIC-insured institutions divided by the sum of total assets across FDIC-insured institutions.

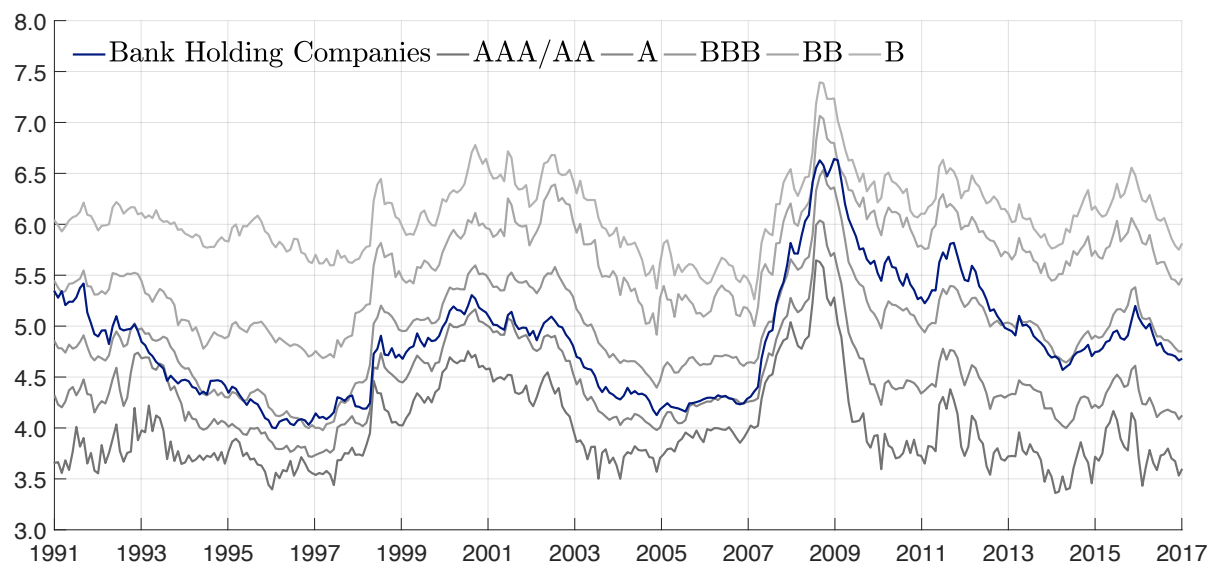


Figure 9: Corporate Bond Log Option-Adjusted Spreads The blue line is the average corporate bond log option-adjusted spread of publicly traded bank holding companies from the Lehman/Warga and Merrill Lynch databases from 1986 to 2016. The grey line show the average for publicly traded non-financial firms withing rating groups AAA or AA, A, BBB, BB, and B.

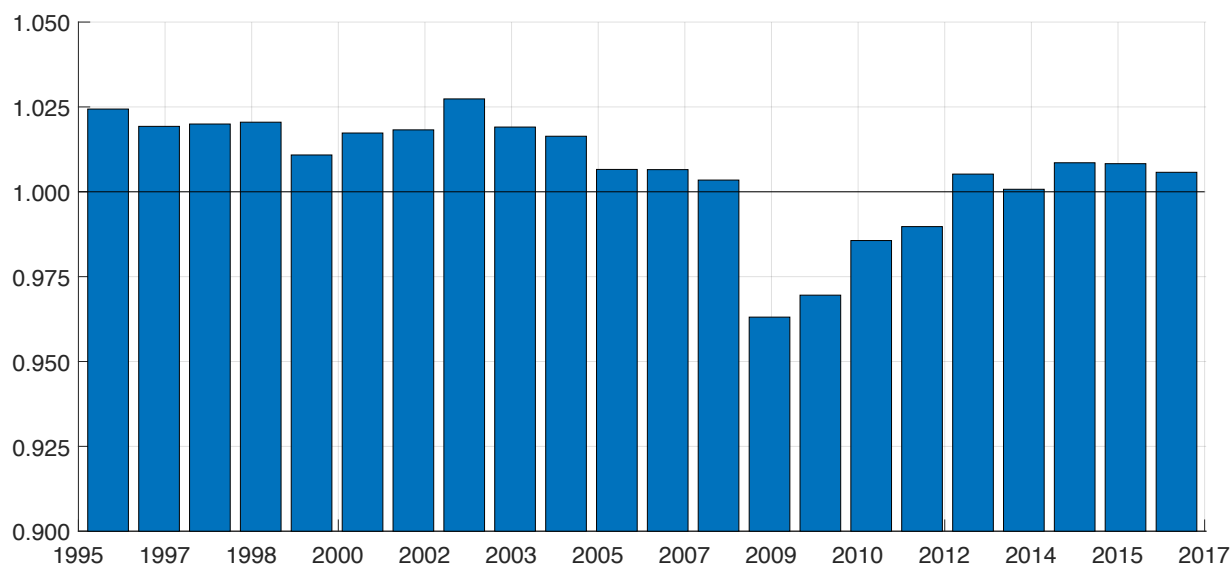


Figure 10: Fair to Book Value of Loans The ratio is computed as the sum of the fair value of loans across bank holding companies divided by the sum of the book value of loans across bank holding companies. Observations of fair value of loans come from notes in the annual reports of bank holding companies. See for example NOTE 22 Fair Value of Financial Instruments page 208 of the 2016 Bank of America Annual Report. We collected observations for Bank of America, Citigroup, JP Morgan Chase, Wells Fargo, American International Group, Metlife, American Express, Huntington Bancshares, Fifth Third Bank, Washington Mutual, SunTrust Banks, Regions Financial Corporation, PNC Financial Services, National City Corporation, Zions Bancorporation, Countrywide Financial, Comerica, KeyCorp, and U.S. Bancorp.

A Omitted Proofs

A.1 Proof of Lemma 1

Recall the equation for MVE

$$\text{MVE} = \frac{1}{1+i} \mathbb{E} [\max \{0, \text{DIV}_E(s) + (1+g')\text{MVE}\}] \quad (20)$$

where $\mathbb{E}[\cdot]$ denote risk-neutral expectation. Subtract $(1+\bar{g})/(1+i)$ from both side to obtain:

$$(i - \bar{g}) \text{MVE} = \mathbb{E} [\max \{-(1+g(s))\text{MVE}, \text{DIV}_E(s)\}].$$

The left-hand side is strictly increasing in MVE, is equal to zero when $\text{MVE} = 0$, and goes to infinity as $\text{MVE} \rightarrow \infty$. The right-hand side is decreasing and positive. Hence, there exists a unique solution.

By definition, an increase in risk taking keeps $\bar{g}$ the same, so it leaves the left-hand side the same. It is easy to see that it increases the right-hand side. Indeed, rewrite the right-hand side as:

$$\begin{aligned} & -\frac{1+\bar{g}}{1+i} \text{MVE} + \mathbb{E} [\max \{0, \text{DIV}_E(s) + (1+g(s))\text{MVE}\}] \\ &= -\frac{1+\bar{g}}{1+i} \text{MVE} + \mathbb{E} \left[\max \left\{ 0, a + \sum_{n=1}^N k_n \sigma_n \varepsilon_n(s) \right\} \right], \end{aligned}$$

for some coefficients a and k_n since the dividend is an affine function of shocks and the shocks affine functions of the ε 's. Now it is easy to see that, for any mean zero random variable, the function $\sigma \mapsto \mathbb{E} [\max \{0, a + b\sigma\varepsilon\}]$, is increasing in σ , so the result follows.

A.2 Proof of Lemma 2

It is clear from the Bellman equations that a decrease in profitability decreases both MVE and FVE. Since $BVE = 1 - \Theta$ is not impacted by profitability, it follows that both MVE/BVE and FVE/BVE decrease. To sign the impact on MVG, recall the Bellman equation for FVE:

$$FVE = \frac{1}{1+i} \mathbb{E} [DIV_E(s) + (1+g(s))FVE].$$

Subtract this Bellman equation for FVE to the Bellman equation for MVE, (20).

$$\begin{aligned} MVE - FVE &= \frac{1}{1+i} \max \{ -DIV_E(s) - (1+g(s))FVE, (1+g') (MVE - FVE) \} \\ &= \frac{1+\bar{g}}{1+i} (MVE - FVE) \\ &\quad + \frac{1}{1+i} \max \{ -DIV_E(s) - (1+g(s))FVE - (1+g') (MVE - FVE), 0 \}. \end{aligned}$$

Let $\rho \equiv (MVE - FVE)/BVE$ and recall that $BVE = 1 - \Theta$. Dividing through both sides by $1 - \Theta$ and rearranging, we obtain:

$$\rho(i - \bar{g}) = \max \left\{ -\frac{DIV_E(s) + (1+g(s))\frac{\overline{DIV}_E}{i-\bar{g}}}{1-\Theta} - (1+g')\rho, 0 \right\}, \quad (21)$$

where we used that $FVE = \overline{DIV}_E/(i - \bar{g})$. The left-hand side is strictly increasing in ρ and the right-hand side is weakly decreasing. It is clear that any parameter that decrease dividends in all states, beside growth and leverage, increases the right-hand side. This implies that ρ decreases.

A.3 Proof of Lemma 3

Start from the right-hand side of (21). Let

$$N(\Theta, s) \equiv DIV_E(s) + (1+g(s))\frac{\overline{DIV}_E}{i-\bar{g}}.$$

It is clear from the expression of $DIV_E(s)$ that $N(\Theta, s)$ is decreasing in Θ , and that $N(\Theta, s) < 0$ whenever the right-hand side of the Bellman equation (21) is positive. Therefore:

$$\frac{\partial}{\partial \Theta} \left(\frac{N(\Theta, s)}{1 - \Theta} \right) = -\frac{\partial N(\Theta, s)/\partial \Theta}{1 - \Theta} - \frac{N(\Theta, s)}{(1 - \Theta)^2} > 0,$$

whenever the right-hand side is positive. This implies that a decrease in Θ decreases ρ .

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