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How bad is a bad loan? Distinguishing inherent credit risk from inefficient lending (does the capital market price this difference?)

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How Bad Is a Bad Loan?

Distinguishing Inherent Credit Risk from Inefficient Lending

(Does the Capital Market Price This Difference?)

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ABSTRACT

We develop a novel technique to decompose banks' ratio of nonperforming loans to total loans into two components: first, a minimum ratio that represents **best-practice lending** given the volume and composition of a bank's loans, the average contractual interest rate charged on these loans, and market conditions such as the average GDP growth rate and market concentration; and, second, a ratio, the difference between the bank's observed ratio of nonperforming loans and the best-practice minimum ratio, that represents the bank's **proficiency at loan making**. The best-practice ratio of nonperforming loans, the ratio a bank would experience if it were fully efficient at credit-risk evaluation and loan monitoring, represents the **inherent credit risk** of the loan portfolio and is estimated by stochastic frontier techniques.

We apply the technique to 2013 data on top-tier U.S. bank holding companies. We divide them into five size groups. The largest banks with consolidated assets exceeding \$250 billion experience the highest ratio of nonperformance among the five groups. Moreover, the inherent credit risk of their lending is the highest among the five groups. On the other hand, their inefficiency at lending is one of the lowest among the five. Thus, the high ratio of nonperformance of the largest financial institutions appears to result from lending to riskier borrowers, not inefficiency at lending. Small community banks under \$1 billion also exhibit higher inherent credit risk than all other size groups except the largest banks. In contrast, their loan-making inefficiency is highest among the five size groups.

Restricting the sample to publicly traded bank holding companies and gauging financial performance by market value, we find the ratio of nonperforming loans to total loans is on average negatively related to financial performance except at the largest banks. When nonperformance is decomposed into inherent credit risk and lending inefficiency, taking more inherent credit risk enhances market value at many more large banks while lending inefficiency is negatively related to market value at all banks. **Market discipline appears to reward riskier lending at large banks and discourage lending inefficiency at all banks.**

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How Bad Is a Bad Loan?

Distinguishing Inherent Credit Risk from Inefficient Lending (Does the Capital Market Price This Difference?)

1. Introduction

The ratio of nonperforming loans to total loans a bank experiences reflects both the inherent credit risk the bank targets and the bank's proficiency at evaluating credit risk and monitoring the loans it has made. In our 2013 data on U.S. banks, we find that small community banks and the largest financial institutions on average experience the highest ratios of nonperforming loans. How much of this nonperformance is due to inherent credit risk and how much, to their proficiency at loan making? To answer this question, we develop a novel technique based on stochastic frontier estimation and apply it to data on large as well as small banks to compare their lending performance. The ratio of banks' nonperforming loans is decomposed into two components: first, a minimum ratio that represents **best-practice lending** given the volume and composition of a bank's loans, the average contractual interest rate charged on these loans, and market conditions such as the average GDP growth rate and market concentration; and, second, a ratio, the difference between the bank's observed ratio of nonperforming loans and the best-practice minimum ratio, that represents the bank's **proficiency at loan making**. The best-practice ratio of nonperforming loans represents the **inherent credit risk** of the loan portfolio – the nonperforming loan ratio a bank would experience if it were fully efficient at credit evaluation and loan monitoring. This best-practice minimum is obtained by estimating a stochastic lower envelope of nonperforming loan ratios conditioned on variables associated with inherent credit risk. The stochastic frontier estimation eliminates the influence of luck, statistical noise, and gauges systematic failure to achieve the best-practice minimum.

Stochastic frontier techniques have been applied in numerous studies of cost, production, and profit. Greene (2012) offers a textbook description while Kumbharkar and Lovell (2000) and Coelli, Rao, and Battese (1998) give an encyclopedic treatment. Hughes and Mester (2010, 2015) and Berger and Mester (1997) discuss how these techniques are applied to analyze the

performance of financial institutions. Hughes, Jagtiani, Mester, and Moon (2017) apply our technique to commercial and industrial loans and to commercial real estate loans made by community banks.¹ They find that large community banks are more efficient at lending for these two types of loans than small community banks.

We estimate the frontier over 710 banks of all sizes – privately held as well as publicly traded – that have a focus on lending. The size of these banks ranges from \$92.7 million to \$2.4 trillion in consolidated assets. At the largest banks, we uncover evidence of dichotomous lending strategies for maximizing value that differs between large and small banks. While the largest banks exhibit the largest ratio of nonperforming loans, we find that nonperformance at these institutions results from inherently more risky lending, not a lack of proficiency at credit evaluation and loan monitoring.

The publicly traded banks in our sample allow us to investigate whether capital market pricing distinguishes between inherent credit risk and lending inefficiency. We find that Tobin's q ratio is negatively related to the nonperforming loan ratio for all but the largest 9 banks. For 8 of the largest 9 banks, the relationship is positive and statistically significant. The dichotomy in the treatment of nonperforming loans by the capital market suggests that credit-risk strategies of the largest banks differ from those of smaller banks. When the nonperforming loan ratio is decomposed into the inherent credit risk (the best-practice minimum ratio) and the lending inefficiency ratio, a statistically significant positive relationship is found between Tobin's q ratio and inherent credit risk at many large banks. While the relationship is negative at many smaller banks, it is not statistically significant. The evidence that the capital market rewards higher credit risk at the largest banks is consistent with their higher ratio of nonperformance and suggests that market discipline may not enhance financial stability through the lending channel at these large banks. On the other hand, lending inefficiency undermines value at banks of all sizes.²

¹ An earlier version of this paper, Hughes, Jagtiani, and Mester (2016), has been superseded by Hughes, Jagtiani, Mester, and Moon (2017).

² Hughes, Mester, and Moon (2016) find a similar relationship between the equity capital ratio and financial performance based on market value measures. At the margin, the largest financial institutions improve financial performance by increasing financial leverage while smaller institutions, by reducing leverage.

2. The Data

To estimate the frontier, we start with data on 807 top-tier holding companies at year-end 2013 whose balance-sheet and income statement information is reported on the Y9-C report. The 807 companies are obtained after dropping one company with no nonperforming loans and all companies without data on small business loans (commercial and industrial loans with an origination amount under \$1 million). The data on small business loans are obtained by summing the loan amounts of subsidiaries of the top tier company from the Call Report data.³ In this section, we provide details on trimming the full sample to achieve a sample of banks whose focus on lending is sufficient to allow the estimation of a stochastic best-practice loan performance frontier.

The average ratio of total loan volume to consolidated assets is 0.636, bounded by a minimum of 0.055 and a maximum of 0.962. **Table 1** sorts the data by the ratio of total loan volume to consolidated assets for those companies with ratios less than 0.40. The 4 companies with the smallest loan ratios, less than 0.15, are not focused on the loan-making function of commercial banks and, thus, are trimmed from the data used to estimate best-practice loan making.

In addition, some companies exhibit unusually large ratios of nonperforming loans to total loans. Nonperforming loans include loans past due less than and more than 90 days plus nonaccruing loans, lease financing receivables, placements, and other assets (BHCK525+BHCK5524+BHCK5526)⁴; gross charge-offs (BHCK4635); and other real estate owned (BHCK2150). Since some banks are more aggressive in charging off past-due loans and, consequently, would appear to have a lower ratio of past-due loans, gross charge-offs are added to past-due loans to eliminate distortions caused by differences among banks in charge-off strategies. **Table 2** summarizes loan performance of banks with the highest nonperforming loan ratios. Those whose ratio exceeds 0.15 are trimmed to estimate the best-practice performance frontier. **Table 3** summarizes loan performance of banks with the lowest nonperforming loan ratios. Those whose nonperforming loans constitute a proportion less than 0.01 of total loans are also trimmed to estimate the best-

³ These data are used in Hughes, Jagtiani, Mester, and Moon (2017) and constructed by Quinn Maingi of the Federal Reserve Bank of Philadelphia.

⁴ The BHCK numbers refer to categories in the Y9-C regulatory reports filed by bank holding companies.

practice performance frontier. The log transformation of the volume of nonperforming loans is plotted in **Figure 1** against the log transformation of the volume of total loans for the trimmed sample of 710 top-tier holding companies. In **Figure 2**, where the ratio of nonperforming loans to total loans is plotted against the log transformation of total loans, a higher ratio of nonperformance for the largest banks is evident. In addition, the smallest banks also exhibit higher ratios of nonperformance.

Table 4 shows that banks in all but the largest category have similar mean and median values of the ratio of loans to assets. Banks in the largest group, whose consolidated assets exceed \$250 billion, allocate on average 51.74 percent of their assets to loans while banks in the other size groups allocate on average 63.22 to 66.78 percent of their assets to loans.

As suggested in **Figure 2**, the mean ratio of nonperforming loans to total loans is higher in the smallest size group, community banks with assets less than \$1 billion, and in the largest size group, banks whose consolidated assets exceed \$250 billion. On average 4.61 percent of loans at these small community banks are nonperforming while loans at the largest banks exhibit a mean nonperformance rate of 6.10 percent. In contrast, loans in the next largest group (assets between \$50 billion and \$250 billion) default at 3.07 percent. **Table 5** shows the details of nonperformance for the banks whose consolidated assets exceed \$50 billion.

The strikingly higher average ratio of nonperformance among the largest banks and, to some degree, among the small community banks, raises the question of whether these banks are on average less efficient at credit evaluation and loan monitoring or whether they may be lending to riskier borrowers who have a higher expected rate of default.

3. Best-Practice Loan Performance and the Efficiency of Lending

We use stochastic frontier techniques to distinguish between nonperformance due to less effective credit evaluation and loan monitoring and nonperformance due to the bank's choice of the overall credit risk of its loan portfolio. The frontier is a stochastic lower envelope of the nonperforming loan ratios conditioned on the volume of loans and the composition of the loan

portfolio by types of loans it holds. In addition, we include variables that characterize inherent credit risk, such as the average contractual loan rate, an index of market concentration, and the GDP growth rate in banks' local lending markets. As a stochastic lower envelope of nonperforming loan ratios, it eliminates the influence of luck, statistical noise, on loan performance and takes into account the observed loan performance of all banks in the sample. As such, it represents **observed best practice**, the minimum ratio of nonperforming loans a bank could obtain if it were fully efficient at credit evaluation and loan monitoring given its loan volume, the composition of its loan portfolio, its average contractual lending rate and the economic conditions in its local lending markets.

The control variables characterize banks' exposure to credit risk. Default probabilities differ by the type of loan, and so it is important to include variables that characterize the composition of the loan portfolio. In addition, the contractual interest rate charged on a loan includes a credit risk premium and, itself, influences the quality of loan applicants through adverse selection.⁵ In addition, conditions in the markets in which a bank lends, such as the macroeconomic growth rate and the bank's market power, influence loan performance. Petersen and Rajan (1995) find that a bank with market power is able to price a loan to a young business at a lower-than-competitive rate to reduce the probability of default. As the firm gains experience and continues to borrow from the bank, the bank recovers its implicit subsidy by lowering the loan rate but not as much as would occur in a competitive market. Thus, the degree of market concentration can influence loan performance.

The choice of specifying the frontier in terms of the ratio of nonperforming loans to total loans is motivated by the need to obtain an unbiased estimate of the best-practice minimum ratio of nonperforming loans to total loans, which will be used to gauge inherent credit risk. If the log transformation of the amount of nonperforming loans or the log transformation of the ratio were used as the dependent variable in the frontier estimation, an unbiased estimate of the degree of inefficiency can be obtained; however, the estimate of the minimum ratio of nonperforming loans to

⁵ Morgan and Ashcraft (2003) find that the interest rates charged by banks on business loans predict future loan performance.

total loans computed from the log transformation is not unbiased. Thus, we avoid the log transformation.

Defining the frontier in terms of the ratio of nonperforming loans provides two important advantages. First, it gives an unbiased estimate of inherent credit risk; and, second, it decomposes the nonperforming loan ratio into two ratios capturing inherent credit risk and lending inefficiency.

We use maximum likelihood estimation to estimate a *best-practice loan performance frontier* that determines the minimum of the nonperforming loan ratio, NP = nonperforming loan volume/total loan volume, conditional on the total loan volume (expressed in 100 billions), the average contractual interest rate, macroeconomic conditions and market concentration in the bank's markets, and the composition of the loan portfolio. That is,

$$NP_i = \alpha_0 + \alpha_1 (\text{Total loans}_i (100 \text{ billions})) + \mathbf{X} \cdot \boldsymbol{\beta} + \varepsilon_i. \quad (1)$$

where NP_i = ratio of nonperforming loans to total loans at bank i ,

and \mathbf{X} is a vector of other control variables:

x_1 = Contractual lending rate $_i$,

x_2 = Herfindahl index of market concentration across bank $_i$'s markets,

x_3 = GDP growth rate across bank $_i$'s markets,

x_4 = Small business loan volume $_i$ / Total loans $_i$,

x_5 = Total business loan volume $_i$ / Total Loans $_i$,

x_6 = Consumer loan volume $_i$ / Total Loans $_i$,

x_7 = Residential real estate loan volume $_i$ / Total Loans $_i$,

x_8 = Commerical real estate loan volume $_i$ / Total Loans $_i$,

and $\varepsilon_i = \nu_i + \mu_i$ is a composite error term.

The Herfindahl index of market concentration is a weighted average of banking market concentration in each state in which the bank operates. The weights are the proportions of deposits located in each state. The GDP growth rate is a 10-year weighted average state GDP growth rate in the states in which the bank operates. The weights are the same as those used to compute the Herfindahl index. The composite error term, $\varepsilon_i = \nu_i + \mu_i$, is the sum of a two-sided, normally

distributed error term, $v_i \sim \text{iid } N(0, \sigma_v^2)$, that captures statistical noise, and a term, μ_i , which is a positive, half-normally distributed error term, $\mu_i (\geq 0) \sim \text{iid } N(0, \sigma_\mu^2)$, that gauges systematic excess nonperformance.

Figure 3 illustrates the frontier. The frontier value, FNP_i , is defined by the deterministic kernel of the stochastic frontier,

$$FNP_i = a_0 + a_1 (\text{Total loans}_i (100 \text{ billions})) + \mathbf{X} \bullet \boldsymbol{\beta}, \quad (2)$$

and represents the ‘expected’ best-practice nonperforming loan ratio, conditional on the values of the control variables. This is the ratio that would be achieved were the bank totally efficient at credit evaluation and loan monitoring. As such, it represents the inherent credit risk of the bank’s loan portfolio.

The excess nonperformance is expressed as a proportion of total loans and is given by the difference between the observed nonperforming loan ratio adjusted for noise and the frontier value of the nonperforming loan ratio:

$$\text{Lending Inefficiency} = \mu_i = (NP_i - v_i) - FNP_i, \quad (3)$$

which measures the effectiveness of the bank’s credit evaluation and loan monitoring.

The excess, μ_i , cannot be directly measured so, following Jondrow, Lovell, Materov, and Schmidt (1982), we define bank-specific excess nonperformance or lending inefficiency by the expectation of μ_i conditional on ε_i :

$$E(\mu_i | \varepsilon_i) = E[\mu_i | (v_i + \mu_i)] = [NP_i - E(v_i | \varepsilon_i)] - FNP_i. \quad (4)$$

A bank’s best-practice value of nonperformance from the frontier indicates its inherent credit risk, given the size and composition of its loan portfolio and its market conditions such as GDP growth rate and market concentration. In the analysis that follows, the best-practice value of the nonperforming loan ratio will be obtained from the stochastic frontier. The stochastic frontier, $SFNP_i$, comprises the deterministic kernel and the two-sided error term:

$$\begin{aligned} \text{Best Practice Nonperforming Loan Ratio} &= SFNP_i = FNP_i + v_i \\ &= a_0 + a_1 (\text{Total loans}_i (100 \text{ billions})) + \mathbf{X} \bullet \boldsymbol{\beta} + v_i. \end{aligned} \quad (5)$$

This best practice ratio of nonperforming loans obtained from this frontier gauges the inherent credit risk of the loan portfolio. It takes into account the average contractual loan rate, the composition of the loan portfolio, and the weighted average market concentration and GDP growth rate in the markets in which the bank operates. The distance from the best-practice frontier of a bank's observed nonperforming loan ratio gauges its lending inefficiency.

The hypothetical bank whose loan performance is illustrated in **Figure 3** has total loans of 0.08 (expressed in 100 billions⁶) and experiences a nonperforming loan ratio adjusted for statistical noise, $NP_i - v_i$, of 0.025, which is an excess of 0.015 over the 'expected' best-practice minimum, FNP_i , of 0.01. Thus, its *lending* inefficiency is 0.015.

3.1 The Estimation of the Best-Practice Loan Performance Frontier

The sample is restricted to holding companies with a loan volume that exceeds 15 percent of consolidated assets and nonperforming loans, broadly defined, that are at least 1 percent and no more than 15 percent of the total loan volume. In addition, data on small business lending obtained from the Call Reports of subsidiaries of the holding company must be available. These restrictions yield a sample of 710 bank holding companies whose nonperforming loan ratios are plotted in **Figure 2**.

Table 6 shows the estimated parameters of the frontier specified in equation (1). We find that for any given volume of loans, a higher contractual interest rate is associated with a higher best-practice nonperforming loan ratio, while a higher GDP growth rate and a higher proportion of small business loans are associated with a lower best-practice ratio of nonperforming loans. The significantly positive coefficients on the proportions of total loans made up of residential real estate loans and consumer loans imply a positive correlation of residential real estate loans and consumer loans with the nonperforming loans ratio.⁷ The coefficients on the ratios of total business loans and

⁶ The Y9-C data report amounts in 1000s, and so 0.08 (in 100 billions here) corresponds to 8,000,000 (in thousands) in the Y9-C data report.

⁷ Since the proportion of assets allocated to lending is one of the control variables, a variation in any category of loans implies an offsetting variation in the omitted categories of loans. The exception is a variation in small business loans since the proportion of total business loans is a control variable. These omitted categories include leases, agricultural loans, loans to nondepository institutions, and other loans.

commercial real estate loans are all insignificantly positive. The negative coefficient on the Herfindhal index of market concentration is not significant; however, the sign is consistent with the hypothesis of Petersen and Rajan (1995).

In **Table 7**, the sample is partitioned into five size groups and summary statistics of lending inefficiency (4) and the stochastic frontier measure of inherent credit risk (5) are reported. The observed ratio of nonperforming loans is divided into the best-practice minimum ratio and the difference between the observed ratio and the best-practice ratio – the measure of lending inefficiency.

3.2 Credit Risk and Lending Efficiency at Community Banks

In **Table 7** both the mean and median values of the ratios of observed nonperforming loans to total loans is larger at small community banks (under \$1 billion in assets) than at the groups of other banks with assets less than \$250 billion. For example, the mean 0.0461 at these small banks exceeds the value 0.0383 at large community banks, 0.312 at banks with assets between \$10 billion and \$50 billion, and 0.0307 at banks with assets between \$50 billion and \$250 billion. The contrast of loan performance at small community banks with that at larger banks under \$250 billion raises the question of whether these banks are lending to riskier borrowers or whether they are less efficient at lending. The mean average contractual lending rate at small community banks is the highest of the groups of banks with assets less than \$250 billion, which suggests either that these community banks are lending to riskier borrowers or that they are pricing the loans to cover their relatively high default rate that could result from a lack of proficiency at lending.

The inherent credit risk of their loans can be gauged by the stochastic frontier nonperforming loan ratio – the best practice ratio of nonperforming loans given the volume of loans, their composition, their average contractual interest rate, and the GDP growth rate and concentration in banks' local markets. The mean value of inherent, best-practice credit risk at small community banks, 0.0123, is higher than the mean value, 0.0109, at large community banks and

0.0096 at banks in the range \$10 billion to \$50 billion. This pattern across size groups is similar to that of the average contractual lending rate.

The distance of the observed ratio of nonperformance from the minimum, best-practice ratio on the stochastic frontier constitutes lending inefficiency (4). The mean inefficiency, 0.0338, of these small community banks exceeds 0.0274 at large community banks, 0.0217 at banks in the range \$10 billion to \$50 billion, 0.0179 at banks from \$50 billion to \$250 billion, and 0.0186 at banks whose assets exceed \$250 billion. Thus, small community banks appear less efficient at lending.

3.3 Credit Risk and Lending Efficiency at the Largest Banks

The seven largest banks with consolidated assets exceeding \$250 billion experience the highest mean ratio of nonperformance, 0.0610, among the five groups. Moreover, the mean average contractual lending rate, 0.0538, and the mean inherent credit risk of their lending, 0.0424, are the highest among the five groups. On the other hand, their mean inefficiency at lending, 0.0186, is the second lowest among the five. Banks in the range \$50 billion to \$250 billion exhibit an inefficiency ratio, 0.0179; in the range \$10 billion to \$50 billion, 0.0217; in the range \$1 billion to \$10 billion, 0.0274; and less than \$1 billion, 0.0338. Thus, the high mean ratio of nonperformance of the largest financial institutions appears to result from lending to riskier borrowers rather than inefficiency at lending.

Table 8 shows the values of lending inefficiency, the best-practice ratio of nonperforming loans measuring inherent credit risk, and the observed ratio of nonperforming loans for large banks with consolidated assets greater than \$50 billion. Nonperforming loans as a percentage of total loans range from 7.16 percent for Bank of America to 1.46 percent for Comerica. The best-practice percentage spans from 5.89 percent for Bank of America to 0.17 percent for Northern Trust. The lending inefficiency ranges from 3.07 percent for PNC to 0.93 percent for Comerica.

3.4 Factors that Influence Lending Inefficiency

Factors that potentially explain a bank's lending inefficiency are explored in **Table 9** in regressions specified by the general-to-specific modeling strategy, which is a well-grounded method to search for the best model specification.⁸ It is statistically consistent in reaching the true model when the true model is included in the set of candidate models. The general specification generously includes many regressors to reflect the existing literature and our presumptions. From the pool of the general specification and all possible restrictive specifications, we then select the one with the smallest AIC – the specific specification. Maddala (2001, p. 483) aptly describes this approach as “intended overparametrization with data-based simplification.”

In the general specification we account for the asset size of the bank, which influences the diversification of credit risk and the techniques used to evaluate and monitor credit risk. We characterize size, first, by the log transformation of consolidated assets and its square and, second, by the number of states in which the bank operates and by the interaction of the number of states and the total number of branches. The economic conditions in a bank's lending markets are described by the 10-year weighted average growth rate of state GDP and by a weighted average of banking market concentration in each state in which the bank operates where the weights are the proportions of deposits located in each state. Additionally, we account for the proportion of total assets allocated to loans, which accounts in part for a bank's focus on lending and the lending experience it is likely to have developed. We include the ratio of Tier 1 equity capital to consolidated assets to account for the cushion protecting a bank from loan losses and, hence, a component of the opportunity cost of loan losses. Since the credit analysis and monitoring of some types of loans are more difficult than other types, we control for important categories of loans as proportions of total loans in the general specification. Moreover, we include the average contractual interest rate on loans to account for a bank's choice of credit risk. We find that it is important to allow for size effects and flexibility in the specification of the average contractual rate so we include the rate, the rate squared, and the interaction of the rate and the log transformation

⁸ Hendry (1983) provides the first complete application, and Campos, Ericsson, and Hendry (2005) survey this technique.

of assets, the interaction of the rate squared and the log transformation of assets, the interaction of the rate and the squared log transformation of assets, and the interaction of the squared rate and the squared log transformation of assets. The parameter estimates of all regressors in the general specification are reported in the second column of **Table 9**. The general specification is narrowed with an AIC-based search that estimates all possible specifications with all combinations of the above-mentioned regressors. The fourth column shows the parameter estimates of the regressors that survive the AIC-based search and define the specific specification.

The best specific specification reported in the fourth column of **Table 9** provides evidence that higher ratios of loans to assets and equity capital to assets as well as a higher GDP growth rate are associated with lower lending inefficiency. The magnitude of the coefficient estimate on the capital ratio is notable. The median capital ratio of the full sample is 0.0960, and the median inefficiency, 0.0216. Hence, an increase of 0.01 in the capital ratio is associated with a decrease of 0.0014365 in the inefficiency ratio, which is a 6.7 percent decline in inefficiency. On the other hand, lending inefficiency is positively related to the number of states in which a bank operates. While operating in more states may tend to diversify credit risk, it also increases organizational complexity and makes managerial control more difficult. An increase by 1.0 in the number of states on average increases lending inefficiency by 0.0023, which is an increase of 10.7 percent over the median value of inefficiency, 0.0216. Increasing the number of branches, controlling for the number of states, is associated with reduced lending inefficiency, but the effect is quite small in magnitude and does not seem economically significant. While an increase in total business loans as a proportion of total loans is associated with increased lending inefficiency, an increase in the proportion of small business loans, holding the proportion of total business loans constant, is associated with reduced lending inefficiency – this is a substitution of small business loans for larger business loans. The magnitude of these loan composition effects is small. For example, increase of 0.01 in the proportion of business loans implies an increase of 0.0004096 in lending inefficiency while a like increase in small business loans, a decrease of 0.0009910 in lending inefficiency. Given the median value of lending inefficiency for the full sample, 0.0216, the 0.01

increase in the business loan ratio implies an increase of 1.9 percent of the median inefficiency and the 0.01 increase in the small business loan ratio, a 4.6 percent decrease in the median inefficiency. The association of the average contractual interest rate with lending inefficiency is given by the derivative of inefficiency with respect to the interest rate.⁹ This derivative is positive for 704 of the 710 banks and statistically significant for 701; and, it is negative for 6 banks and statistically significant for 4 of the 6 banks. Thus, the higher credit risk associated with a higher contractual interest rate is also associated with higher lending inefficiency, which suggests these loans involving higher credit risk are more difficult to make and to monitor.

4. Do Capital Markets Distinguish between Inherent Credit Risk and Lending Efficiency

To obtain evidence on whether capital markets price inherent credit risk and lending inefficiency, in **Table 10** we compare lending characteristics and financial performance between banks in the halves of the sample with lower and higher observed ratios of nonperforming loans. The half that experiences lower ratios of nonperformance holds on average less total assets, makes more loans as a proportion of assets, charges a lower average contractual rate on loans, takes on lower inherent credit risk, and is more efficient at lending. The higher mean Tobin's q at these banks suggests capital markets price these lower ratios of nonperformance.

In **Panels A and B of Table 11** these two groups composed of banks with lower and higher ratios of nonperforming loans are each further divided into the more and less efficient at lending. In both groups, the more efficient experience significantly lower ratios of overall nonperformance; however, strikingly, there is little or no difference in the mean inherent credit risk and the contractual lending rate between the more and less efficient subsamples in each group although, as reported in **Table 10**, the group with a higher mean ratio of nonperformance is exposed to higher inherent credit risk and charges on average a higher contractual lending rate. While, in **Table 10**,

⁹ From Table 9, the derivative is given by $\partial(\text{lending inefficiency})/\partial(\text{contractual interest rate}) = 2.73758 + [-1.02265][\text{contractual interest rate}][\log(\text{Book Value Assets}(1,000s))]$.

publicly traded banks in the half of the sample with lower ratios of nonperformance on average experience a higher Tobin's q ratio, in **Table 11**, banks in the more efficient partitions on average obtain a higher Tobin's q ratio than those in the less efficient partitions.

These differences in the mean Tobin's q ratio raise the question of whether capital markets simply penalize differences in nonperformance or whether these markets distinguish and price differently inherent credit risk and lending proficiency. Before investigating this issue, we compare the efficient halves of the banks with lower and higher ratios of nonperformance in **Panel C of Table 11**. The efficient banks with a higher ratio of nonperformance are on average larger than the efficient banks with a lower ratio of nonperformance. Moreover, they assume higher inherent credit risk and charge a higher average contractual lending rate, and, while belonging to the more efficient half of the group with higher overall nonperformance, their mean lending inefficiency is significantly higher than that of the efficient half of the group with lower overall nonperformance. The lower q ratio in the efficient half of the group with a higher ratio of nonperformance suggests that nonperformance is penalized by capital markets.

4.1 Relationship of Financial Performance to Nonperforming Loans

To obtain evidence on whether the capital market prices inherent credit risk and lending inefficiency, the sample is restricted to 244 publicly traded, top-tier holding companies at year-end 2013. Financial performance is measured by the market value of assets, expressed by Tobin's q ratio. **Tobin's q ratio** is given by the ratio of the market value of assets to the replacement cost of assets, whose commonly used proxy is the sum of the market value of equity and the book value of liabilities to the book value of assets.¹⁰ Market value has the advantage over accounting measures of performance in capturing the market's expectation of the discounted value of the firm's current and future cash flow where the discount rate reflects the market's assessment of the relevant risk attached to the cash flow. In addition, market values permit investigation of investment incentives provided by the capital market.

¹⁰ See Hughes and Mester (2010, 2015) for a review of the finance literature that uses Tobin's q ratio to measure performance.

We first investigate the relationship of Tobin's q ratio to the nonperforming loan ratio. From Table 4, we learned that small community banks and the largest banks on average charge relatively high contractual loan rates and exhibit relatively high ratios of nonperformance compared to the other three size groups. Are these high average ratios of nonperformance associated with better financial performance, which is to ask if the higher average contractual interest rate associated with the riskier lending results in a higher discounted cash flow that more than compensates for higher expected loan losses. After answering this question, we investigate the relationship of financial performance to the decomposition of the nonperforming loan ratio into inherent credit risk and lending inefficiency. We are particularly interested in answering the question, is the higher inherent credit risk of the largest banks associated with higher market value.

The relationship of Tobin's q ratio to the nonperforming loan ratio is reported in **Table 12**. In the first column, the regressors of the general specification are listed and their parameter estimates and p -values, in the second and third columns. We include among the regressors the log transformation of the book value of assets and the square of this variable to control for differences among banks related to size, such as the potential for economies of scale due to better diversification, network economies, and spreading overhead costs. In addition, we account for the importance of lending in the business model of the bank by controlling for the ratio of loans to assets and the square of this ratio. We include the ratio of nonperforming loans to total loans and its square. And, we add its interaction with the log transformation of assets since size-related diversification may influence the risk associated with any given nonperforming loans ratio.

The general specification is narrowed with an AIC-based search that estimates all possible specifications with all combinations of the regressors in the general specification and declares the specification with minimum AIC the best specification. The fourth column shows the parameter estimates of the regressors that survive the AIC-based search and define the specific specification. The key parameter estimates are those of the nonperforming loan ratio, -2.8247 , and its interaction with the log transformation of assets, 0.1553 . The sign of the derivative of the q ratio with respect to the nonperforming loan ratio switches from negative to positive at assets equal to

\$79.3 billion. Thus, the derivative is positive for the 14 largest banks and negative for the 230 smaller banks; however, none of the 14 positive values of the derivative is statistically significant while 183 of the 230 negative values are statistically significant. Hence, financial performance and the nonperforming loans ratio are negatively related at 183 of the 244 banks.

The statistically insignificant positive relationship between the q ratio and the nonperforming loan ratio for the largest banks as well as their high average observed ratio of nonperformance suggests there may be dichotomous credit risk strategies for maximizing value that differ between larger and smaller banks, which are not captured by the imprecisely estimated derivative for the large banks. We seek to improve the precision of these estimates by adding an indicator variable for very large banks to the set of regressors of the general specification. To define this indicator variable, we see from **Table 4** that banks in the largest size group with assets exceeding \$250 billion exhibit a much higher average ratio of nonperformance than smaller banks in the other four size groups. When banks are sorted by asset size, the largest 9 banks range in size from \$175.4 billion to \$2.4 trillion. The next largest bank is \$129.7 billion. Thus, we set the lower bound on the indicator variable at \$170 billion, and we interact it with variables involving the nonperforming loan ratio and add these variables to the general specification. The general specification is described in the first column of **Table 13** and its parameter estimates, in the second column. The AIC based search over all possible specifications with combinations of variables taken from the general specification leads to the specific model in the fourth column. Based on the parameter estimates associated with the specific specification in the fourth column, the derivative of Tobin's q ratio with respect to the nonperforming loan ratio is given by

$$\begin{aligned} \partial \text{Tobin's } q / \partial (\text{nonperforming loan ratio}) = & -0.0391 [\ln (\text{Book Value Assets (1,000s)})] \\ & -14.3103 (\text{Indicator Variable Assets} > \$170 \text{ Billion}) \\ & + 0.8325 (\text{Indicator Variable Assets} > \$170 \text{ Billion}) [\ln (\text{Book Value Assets (1,000s)})]. \end{aligned} \quad (6)$$

The third term in the derivative is positive when banks hold assets in excess of \$170 billion, and it increases with the volume of assets. For the nine largest banks, the derivative is positive, and for 8 of the 9 banks, the derivative is statistically significant at stricter than 10 percent. Thus, the

relatively high average observed ratio of nonperforming loans among these banks is associated with a higher market value. In the case of these very large banks, market discipline appears to encourage greater risk-taking in lending and, in this respect, tends to work against financial stability. For the remaining 235 smaller banks, the statistically significant negative sign of the derivative suggests that a higher ratio of nonperformance is associated with poorer financial performance. In the case of these smaller banks, market discipline appears to discourage risky lending.

4.2 Relationship of Financial Performance to Inherent Credit Risk and Lending Inefficiency

The regressions in **Tables 12** and **13** provide evidence that the capital market rewards a lower nonperforming loan ratio at most banks and a higher ratio at the very largest banks. In regressions reported in **Table 14**, we investigate the degree to which the capital market distinguishes nonperformance due to inherent credit risk from that due to lending inefficiency. In the general specification, we substitute variables involving inherent credit risk and lending inefficiency for those involving the nonperforming loan ratio. The specific specification in **Table 14** results from an AIC-based search that estimates all possible specifications with all combinations of regressors in the general specification and declares the specification with minimum AIC the best specification. The relationship of market value to inherent credit risk, the best-practice (stochastic frontier) value of the nonperforming loans ratio, is given by the derivative of Tobin's q ratio,

$$\partial \text{Tobin's } q / \partial (\text{inherent credit risk}) = -6.9464 + 0.4625 [\ln(\text{Book Value Assets (1,000s)})]. \quad (7)$$

Panel A of **Table 15** reports that the sign of the derivative is negative at 140 smaller banks but the derivative is not statistically significant at stricter than 0.10 at any of them. The sign reverses and the derivative becomes positive at 104 banks larger than \$3.3 billion; however, it is statistically significant only at the largest 37 of these 104 banks. At these 37 banks, market discipline appears to encourage riskier lending.

Panel B of Table 15 lists 25 of these 37 banks. They are the largest banks. At these banks, making riskier loans is associated with improved financial performance. To evaluate the economic significance of these derivatives, consider the largest value, 3.047, obtained by JPMorgan Chase. From **Table 8**, the value of JP Morgan's inherent credit risk is 0.0496. An increase of 0.005 in this value, about 10 percent, is associated with an increase of 0.015235, about 1.49 percent, in its q ratio, 1.02368. This incentive to make riskier loans is strongest for the four largest banks.

The value of the derivative of Zions, the smallest of the 17 banks larger than \$50 billion that are subject to enhanced supervision under the Dodd-Frank Act, is 1.306, and for the smallest of the 37 banks exhibiting a positive, significant derivative, 0.783. Thus, the incentive to make riskier loans diminishes at smaller banks.

On the other hand, the statistically significant negative coefficient on lending inefficiency, -0.6145 , in the specific specification reported in **Table 14** indicates that the capital market penalizes a lack of proficiency in loan making at all banks.

The decomposition of the nonperforming loan ratio into inherent credit risk and lending inefficiency shows that the credit market rewards inherent credit risk at the largest banks and penalizes lending inefficiency at all banks. A bank's ratio of nonperforming loans reflects both the inherent credit risk it has assumed and its proficiency at evaluating credit and monitoring loans; hence, the relationship of its q ratio to its nonperforming loan ratio reflects the net influence of these two components. The evidence obtained on this net effect from the specific regression in **Table 13** shows a statistically significant negative derivative with respect to the nonperforming loan ratio for 235 out of 244 banks in the publicly traded sample. From the evidence of the specific regression in **Table 14**, it would appear that the influence of lending inefficiency dominates and accounts for these negative net value effects. For the 9 large banks with positive values of the derivative, the influence on financial performance of inherent credit risk dominates. When the influence of these two effects is modeled separately in the regressions in **Table 14**, the negative value effect of lending inefficiency is obtained by all banks. The positive value effect of making riskier loans appears at 104 banks and is statistically significant at 37 banks – all large banks.

Hence, the decomposition uncovers evidence of a risk-taking incentive for lending at many more banks than the incentive revealed by the aggregate nonperforming loan ratio.

In sum, the net value effect of the nonperforming loan ratio suggests a dichotomous lending strategy to maximize value that differs between the largest banks and smaller banks. The nonperforming loan ratio is positively related to value at the largest banks and negatively related at smaller banks. However, the positive net effect at the largest banks is associated with making riskier loans while the negative net effect at smaller banks is related to reducing lending inefficiency. The evidence of a dichotomous lending strategy that differs between the largest financial institutions and smaller institutions is similar to evidence of dichotomous capital strategies found by Hughes, Mester, and Moon (2016), which also differs between large banks that at the margin improve value by reducing their capital ratio and smaller banks that at the margin improve value by increasing their capital ratio. Marcus (1984) demonstrates that pursuing a low-risk investment strategy to minimize the probability of financial distress maximizes value at banks with high-valued investment opportunities while adopting a high-risk investment strategy to exploit the option value of explicit and implicit deposit insurance maximizes value at banks with low valued investment opportunities. Hughes, Mester, and Moon (2016) show that smaller banks experience higher valued investment opportunities than larger banks. McConnell and Servaes (1995) find similar results for nonfinancial firms which they interpret as capital structure that addresses the overinvestment problem at firms with low valued investment opportunities and the underinvestment problem at firms with high valued investment opportunities.

5. Summary and Conclusions

We develop a novel technique to analyze nonperforming loans and apply it to data on top-tier bank holding companies at year-end 2013. The ratio of banks' nonperforming loans to their total loans is decomposed into two components: first, a minimum ratio that represents the **best-practice nonperforming loans ratio** given the volume and composition of a bank's loans, the average contractual interest rate charged on these loans, and market conditions such as the average

GDP growth rate and market concentration; and, second, a ratio, which is the difference between the bank's observed ratio of nonperforming loans and the best-practice minimum ratio, that represents the bank's **inefficiency at lending**. The best-practice ratio of nonperforming loans represents the **inherent credit risk** of the loan portfolio.

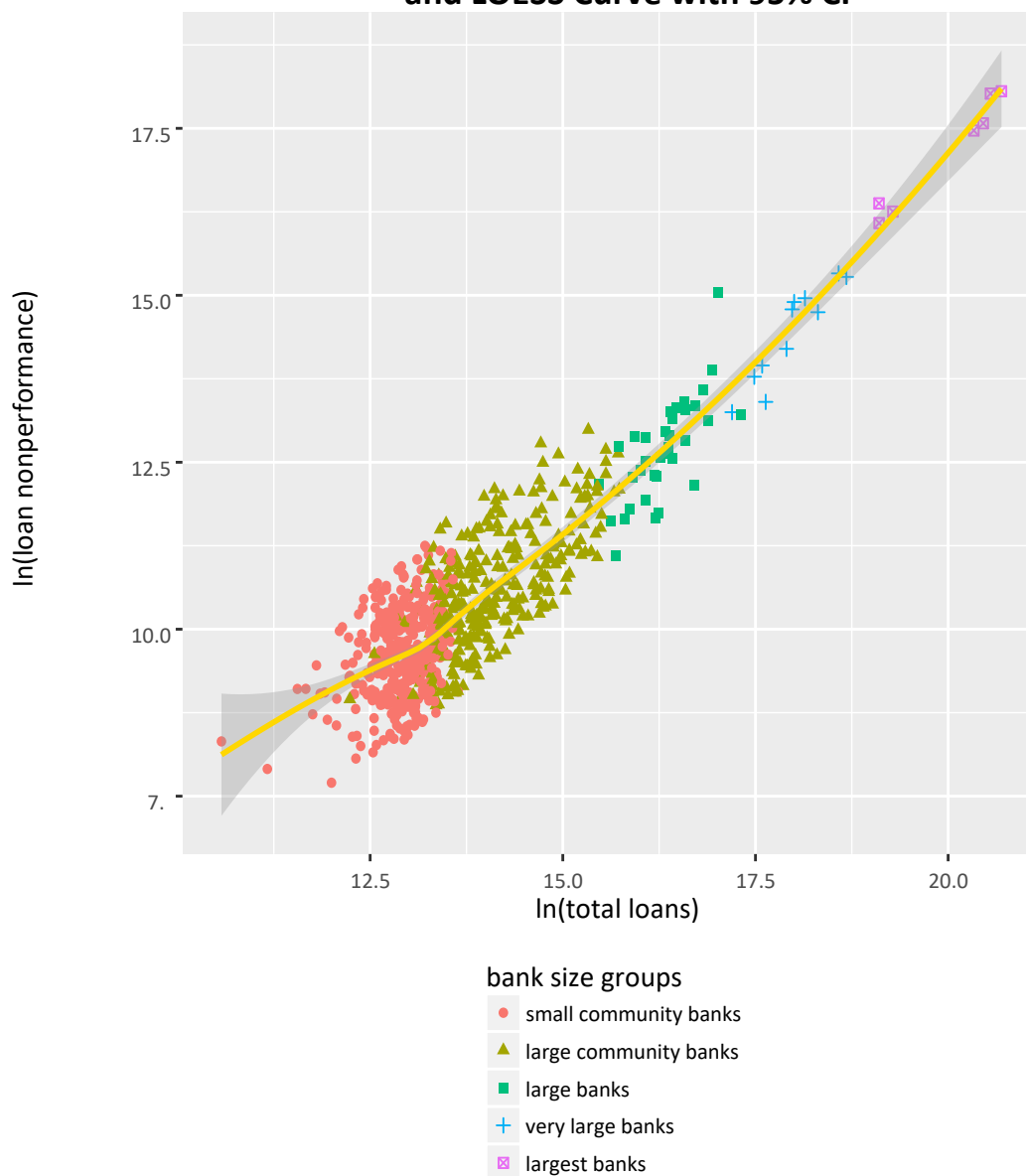
Bank holding companies are divided into five size groups. The largest banks with consolidated assets exceeding \$250 billion experience the highest ratio of nonperformance among the five groups. Moreover, the inherent credit risk of their lending is the highest among the five groups. On the other hand, their inefficiency at lending is one of the two lowest among the five. Thus, the high ratio of nonperformance of the largest financial institutions appears to result from lending to riskier borrowers, not from inefficiency at lending. Small community banks also exhibit higher inherent credit risk than all other size groups except the largest banks; however, their lending inefficiency is the highest among the five size groups.

When the sample is restricted to publicly traded bank holding companies, market values can be used to gauge how financial performance is related to nonperforming loans. In contrast to accounting measures of performance, market value reveals the market's expectation of future as well as current cash flows discounted by market-priced risk. The ratio of nonperforming loans to total loans is negatively related to financial performance except at the largest institutions, which suggests a dichotomous credit risk strategy for maximizing value that differs between the largest banks and smaller banks. The decomposition of this ratio into inherent credit risk and lending inefficiency shows that market discipline rewards riskier lending at large banks and discourages inefficient lending at all banks.

References

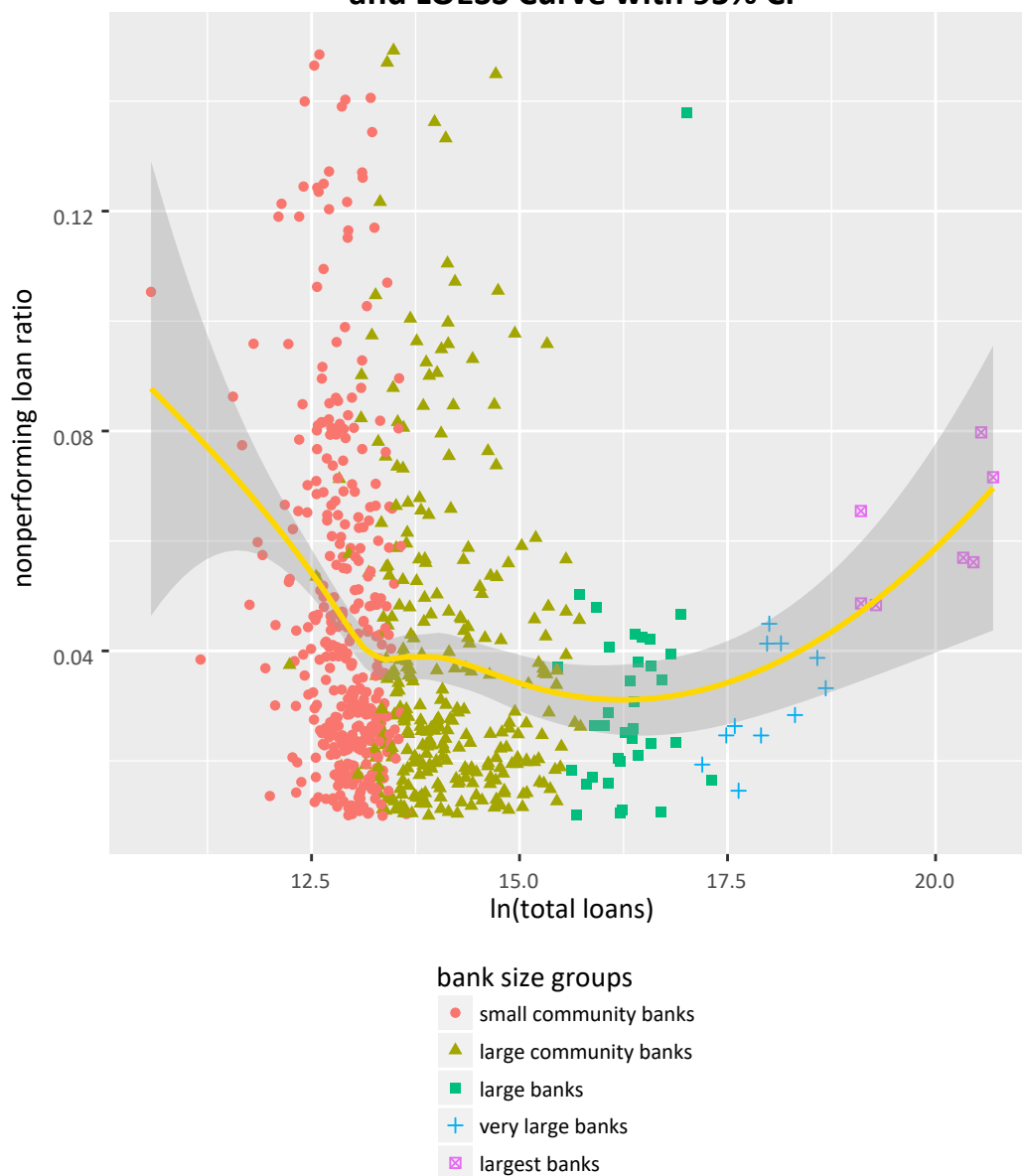
- Berger, Allen N., and Loretta J. Mester (1997), "Inside the Black Box: What Explains Differences in the Efficiencies of Financial Institutions," *Journal of Banking and Finance* 21, 895-947.
- Campos, J., N.R. Ericsson, and D.F. Hendry (2005), "Introduction," in J. Campos, N.R. Ericsson, and D.F. Hendry (eds.), *General-to-Specific Modelling*, Edward Elgar Publishing, Cheltenham, 1-18.
- Coelli, Tim, D. S. Prasada Rao, and George E. Battese (1998), *An Introduction to Efficiency and Productivity Analysis*, Kluwer Academic Publishers, Boston.
- Greene, William H. (2012), *Econometric Analysis*, 7th edition, Prentice Hall, Upper Saddle River, 435-436 and 839-845.
- Hendry, D.F. (1983), "Econometric Modelling: The 'Consumption Function' in Retrospect," *Scottish Journal of Political Economy* 30, 193-220.
- Hughes, Joseph P., Julapa Jagtiani, and Loretta J. Mester (2017), "Is Bigger Necessarily Better in Community Banking?" (supersedes, Federal Reserve Bank of Cleveland, Working Paper 1615).
- Hughes, Joseph P., and Loretta J. Mester (2010), "Efficiency in Banking: Theory, Practice, and Evidence," in *The Oxford Handbook of Banking*, edited by A.N. Berger, P. Molyneux, and J. Wilson, Oxford University Press, Oxford, 463-485.
- Hughes, Joseph P., and Loretta J. Mester (2015), "Measuring the Performance of Banks: Theory, Practice, Evidence, and Some Policy Implications," in *The Oxford Handbook of Banking*, second edition, edited by Allen N. Berger, Philip Molyneux, and John Wilson, Oxford University Press, Oxford, 247-270.
- Hughes, Joseph P., Loretta J. Mester, and Choon-Geol Moon (2016), "Market Discipline Working For and Against Financial Stability: The Two Faces of Equity Capital in U.S. Commercial Banking," Department of Economics, Rutgers University, Working Paper 201611.
- Jondrow, J., C.A.K. Lovell, I.S. Materov, and P. Schmidt (1982). "On the Estimation of Technical Efficiency in the Stochastic Frontier Production Function Model," *Journal of Econometrics* 19, 233-238.
- Kumbharkar, Subal C., and C. A. Knox Lovell (2000), *Stochastic Frontier Analysis*, Cambridge University Press, Cambridge.
- Marcus, A.J. (1984), "Deregulation and Bank Financial Policy," *Journal of Banking and Finance* 8, 557-565.
- McConnell, J.J. and H. Servaes (1995). "Equity Qwnership and the Two Faces of Debt," *Journal of Financial Economics* 39, 131-157.
- Morgan, Donald P., and Adam B. Ashcraft (2003), "Using Loan Rates to Measure and Regulate Bank Risk: Findings and an Immodest Proposal," *Journal of Financial Services Research* 24:2/3, 181-200.
- Petersen, Mitchell A., and Raghuram G. Rajan (1995), "The Effect of Credit Market Competition on Lending Relationships," *Quarterly Journal of Economics* 110:2, 407-443.

Figure 1
Scatter Plot of $\ln(\text{loan nonperformance})$ against $\ln(\text{total loans})$
and LOESS Curve with 95% CI



The log transformation of nonperforming loans is plotted against the log transformation of total loan volume for 710 top-tier bank holding companies at year-end 2013. These 710 companies represent banks whose loan volume exceeds 15 percent of consolidated assets and whose nonperforming loans (including gross charge-offs and foreclosed real estate) amount at least to 1 percent and no more than 15 percent of total loans. While it appears that, for any given volume of loans, the degree of nonperformance is wide, it is important to remember that some of this wide variation in nonperformance is due to differences in the average contractual interest rate, the composition of the loan portfolio, the GDP growth rate, and market concentration. LOESS curve (the thick curve in the above figure) and its 95% confidence interval (the shaded band) are included. LOESS is short for locally estimated scatterplot smoothing, which fits local polynomial regression model to scatter points. LOESS is one of the most popular local smoothing methods and is robust to a long-tailed error distribution while it is highly efficient when the error distribution is normal.

Figure 2
Scatter Plot of nonperforming loan ratio against $\ln(\text{total loans})$
and LOESS Curve with 95% CI



The ratio of nonperforming loans as a proportion of total loans is plotted against the log transformation of total loan volume for 710 top-tier bank holding companies at year-end 2013. These 710 companies represent banks whose loan volume exceeds 15 percent of consolidated assets and whose nonperforming loans (including gross charge-offs and foreclosed real estate) amount at least to 1 percent and no more than 15 percent of total loans. While it appears that, for any given volume of loans, the degree of nonperformance is wide, it is important to remember that some of this wide variation in nonperformance is due to differences in the average contractual interest rate, the composition of the loan portfolio, the GDP growth rate, and market concentration.

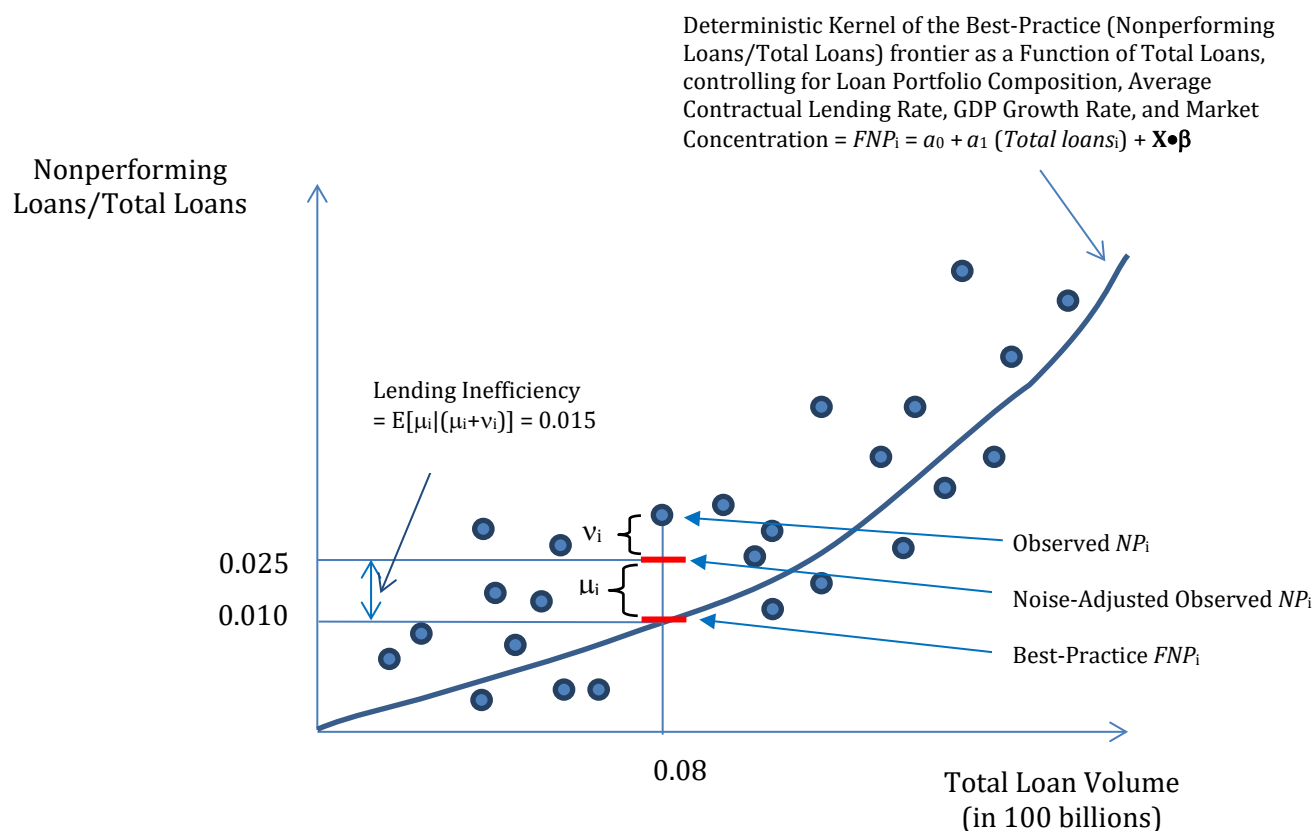
LOESS curve (the thick curve in the above figure) and its 95% confidence interval (the shaded band) are included. LOESS is short for locally estimated scatterplot smoothing, which fits local polynomial regression model to scatter points. LOESS is one of the most popular local smoothing methods and is robust to a long-tailed error distribution while it is highly efficient when the error distribution is normal.

Figure 3

Best-Practice Loan Nonperformance Frontier¹¹

This figure illustrates the best-practice minimum ratio of nonperforming loans to total loans that is obtained by stochastic frontier estimation of the relationship between the nonperforming loan ratio and total loans (expressed in 100 billions), controlling for the loan portfolio composition, the average contractual lending rate, and the GDP growth rate and market concentration in the bank's market. The error term, $\varepsilon_i = v_i + \mu_i$, is a composite term used to distinguish statistical noise, $v_i \sim \text{iid } N(0, \sigma_v^2)$, from the term, μ_i , which is a positive, half-normal error term, $\mu_i (\geq 0) \sim \text{iid } N(0, \sigma_\mu^2)$, that measures the systematic excess nonperformance from bank i 's best-practice minimum nonperforming loan ratio. The 'expected' best-practice minimum nonperforming loan ratio is given by the deterministic kernel of the estimated function, while the best-practice minimum nonperformance loan ratio is given by the stochastic frontier of the estimated function.

In this example, bank i has total loans of 0.08 (\$8 billions¹²) and experiences a nonperforming loan ratio adjusted for statistical noise, $NP_i - v_i$, of 0.025, which is an excess of 0.015 over the 'expected' best-practice minimum, FNP_i , of 0.010. Thus, its *lending inefficiency* is 0.015.



¹¹ Adapted from Hughes, Jagtiani, and Mester (2016)

¹² 0.08 (in 100 billions, here) = 8,000,000 (in thousands in the Y9-C data report) = 8 billions.

Table 1
Banks with the Lowest Ratio of Total Loans to Consolidated Assets at Year-End 2013

The initial data set includes 807 top-tier bank holding companies at the end of 2013. They are sorted in ascending order by the ratio of total loans to total assets up to 0.40. To estimate the best-practice loan performance frontier, the sample is trimmed of companies with a ratio less than 0.15, which eliminates 4 companies that are not focused on the typical functions of commercial banking.

	Name of Bank Holding Company	Book Value of Total Assets (1000s)	Total Loans/Total Assets
1	State Street Corporation	243,028,090	0.05549
2	Goldman Sachs Group, Inc., The	911,595,000	0.08951
3	Morgan Stanley	832,702,000	0.09235
4	Bank Of New York Mellon Corporation	374,310,000	0.13771
5	BRISCOE RANCH	1,246,790	0.16534
6	VILLAGES BC	1,579,895	0.17964
7	INDUSTRY BSHRS	2,480,503	0.18925
8	Stifel Financial Corp.	9,008,870	0.22830
9	FIRST CMNTY BSHRS	1,368,359	0.27399
10	FIRST TX BC	910,068	0.28382
11	Northern Trust Corporation	102,947,333	0.28544
12	FIRST BC	578,509	0.29945
13	INDEPENDENT BKR FC	2,188,247	0.30389
14	FARMERS ENT	694,668	0.30855
15	SECURITY BC TN	450,765	0.31137
16	JPMorgan Chase & Co.	2,415,689,000	0.31672
17	MIDWEST INDEP BSHRS	360,387	0.32309
18	EAST TX BSHRS	537,204	0.32400
19	FIRST AMER BK CORP	3,379,295	0.32498
20	COCONUT GROVE BSHRS	591,480	0.32878
21	SNBNY HOLD	6,672,456	0.33274
22	DICKINSON FC II	2,100,898	0.34222
23	N W SVC CORP	354,765	0.34324
24	Citigroup Inc.	1,880,382,000	0.36010
25	FIRST NM FC	427,134	0.36063
26	MIDLAND FC	653,403	0.36307
27	CU BK SHARES	568,135	0.36339
28	OTTAWA BSHRS	488,233	0.36534
29	Century Bancorp, Inc.	3,431,154	0.36861
30	PACIFIC COAST BKR BSHRS	545,753	0.37425
31	Westamerica Bancorporation	4,848,866	0.37694
32	STURM FNCL GROUP INC	2,059,318	0.37805
33	National Bank Holdings Corpora	4,914,115	0.37848
34	BLACKHAWK BC	1,101,428	0.38149
35	AMERICAN BC	1,000,668	0.38369
36	Umb Financial Corporation	16,911,852	0.38564
37	Cullen/Frost Bankers, Inc.	24,388,272	0.39021
38	RED RIVER BC	707,400	0.39058
39	CBS BANC CORP	1,482,676	0.39072
40	Southside Bancshares, Incorpor	3,445,663	0.39221
41	ROCKHOLD BANCORP	536,342	0.39785

Table 2**Banks with the Highest Proportion of Nonperforming Loans at Year-End 2013**

Nonperformance is measured by the following data from the Y9-C report at year-end 2013. Nonperforming Loans = past due loans less than and more than 90 days plus nonaccruing loans, lease financing receivables, placements, and other assets (BHCK525+BHCK524 +BHCK526); Nonperforming loans + Gross Charge-offs (BHCK4635); Nonperforming Loans + Gross Charge-offs + Other Real Estate Owned (BHCK2150); Total Loans (BHCK2122). Banks with a ratio (Nonperforming Loans + Gross Charge-offs + Other Real Estate Owned) / (Total Loans) > 0.15 are trimmed. The list below exhibits the 50 banks with the highest ratios.

	Name of Bank Holding Company	Book Value of Total Assets (1000s)	(Nonperforming Loans) / (Total Loans)	(Nonperforming Loans + Gross Charge-offs) / (Total Loans)	(Nonperforming Loans + Gross Charge-offs + Other Real Estate Owned) / (Total Loans)
1	BEACH CMNTY BSHRS	562,450	0.36595	0.37205	0.55477
2	BUILDERS FC	242,192	0.04101	0.04731	0.41082
3	NORTHWEST BC OF IL	280,762	0.02752	0.03207	0.40509
4	GEORGIA BSHRS	312,641	0.23661	0.24598	0.34973
5	HOMEBANCORP	706,902	0.30363	0.30389	0.30399
6	METROPOLITAN BK GRP	2,430,812	0.25052	0.25058	0.30245
7	SEAWAY BSHRS	556,584	0.24470	0.26986	0.29428
8	CAPITOL CITY BSHRS	286,974	0.15994	0.17402	0.27172
9	PUTNAM-GREENE FC	504,882	0.19133	0.20483	0.25619
10	Porter Bancorp, Inc.	1,076,121	0.15994	0.20590	0.24944
11	NORTHERN ST FC	392,412	0.11239	0.18098	0.24471
12	PERSONS BKG CO	361,270	0.12118	0.12901	0.22417
13	UNITED NAT CORP	2,344,689	0.04787	0.20891	0.20913
14	Doral Financial Corporation	8,493,455	0.17458	0.18714	0.20884
15	CAPITOL BC	915,264	0.11639	0.14365	0.20831
16	FMB BSHRS	556,134	0.07232	0.08801	0.20669
17	N W SVC CORP	354,765	0.10618	0.11956	0.20562
18	DIAMOND BANCORP	726,618	0.10409	0.12281	0.20537
19	HAMILTON ST BSHR	1,596,351	0.13725	0.14508	0.20074
20	ALIKAT INV	292,174	0.05005	0.10611	0.19372
21	HCSB FC	434,819	0.06310	0.09225	0.18964
22	LIBERTY SHARES	593,103	0.12969	0.14816	0.18950
23	CERTUSHOLDINGS	1,655,555	0.09777	0.11354	0.18216

	Name of Bank Holding Company	Book Value of Total Assets (1000s)	(Nonperforming Loans) / (Total Loans)	(Nonperforming Loans + Gross Charge-offs) / (Total Loans)	(Nonperforming Loans + Gross Charge-offs + Other Real Estate Owned) / (Total Loans)
24	TENNESSEE ST BSHRS	658,104	0.09991	0.11401	0.17705
25	Peoples Financial Corporation	762,264	0.11288	0.13985	0.16550
26	First Bancorp	12,656,925	0.09496	0.13891	0.15543
27	COMMUNITY FIRST	449,275	0.07813	0.08564	0.15255
28	DICKINSON FC II	2,100,898	0.02702	0.07734	0.14922
29	Village Bank And Trust Financial	444,091	0.07253	0.09172	0.14849
30	BRIDGEVIEW BC	1,008,007	0.05767	0.08269	0.14701
31	OXFORD FC	446,836	0.08085	0.08831	0.14648
32	EDUCATIONAL SVC OF AMERICA	2,665,828	0.14390	0.14466	0.14493
33	FIRST NAT BSHRS	671,885	0.11074	0.11899	0.14060
34	LINCO BSHRS	654,483	0.05586	0.07048	0.14026
35	SAINT LOUIS BSHRS	401,683	0.04763	0.05787	0.13994
36	F&M FC	495,791	0.10117	0.11801	0.13902
37	Popular, Inc.	35,749,000	0.09074	0.12530	0.13793
38	SOUTHERN BSHRS	2,269,581	0.10391	0.11409	0.13621
39	CHAMBERS BSHRS	751,058	0.03865	0.05735	0.13438
40	AMBOY BC	2,148,004	0.05589	0.05836	0.13324
41	CITIZENS NBC	504,803	0.08539	0.09090	0.12721
42	NEW PEOPLES BSHRS	684,711	0.08262	0.09488	0.12703
43	MESABA BSHRS	642,830	0.07810	0.08537	0.12608
44	United Security Bancshares, Inc	569,801	0.05266	0.09497	0.12498
45	SECURITY CAPITAL	500,191	0.04085	0.04499	0.12447
46	FLORIDA CAP GRP	410,618	0.06221	0.07526	0.12427
47	SEQUATCHIE VALLEY BSHRS	600,935	0.08466	0.09264	0.12352
48	INLAND BC	1,030,607	0.07774	0.10454	0.12168
49	BARABOO BC	632,567	0.06882	0.10252	0.12167
50	American Founders	276,706	0.05572	0.06602	0.12134

Table 3**Banks with the Lowest Proportion of Nonperforming Loans at Year-End 2013**

Nonperformance is measured by the following data from the Y9-C report. Nonperforming Loans = past due loans less than and more than 90 days plus nonaccruing loans, lease financing receivables, placements, and other assets (BHCK525+BHCK524 +BHCK5526); Nonperforming loans + Gross Charge-offs (BHCK4635); Nonperforming Loans + Gross Charge-offs + Other Real Estate Owned (BHCK2150); Total Loans (BHCK2122). Banks with a ratio (Nonperforming Loans + Gross Charge-offs + Other Real Estate Owned) / (Total Loans) < 0.01 are trimmed. The list below exhibits the 70 banks with the lowest ratios.

	Name of Bank Holding Company	Book Value of Total Assets (1000s)	(Nonperforming Loans) / (Total Loans)	(Nonperforming Loans + Gross Charge-offs) / (Total Loans)	(Nonperforming Loans + Gross Charge-offs + Other Real Estate Owned) / (Total Loans)
1	TOLLESON WEALTH MGMT	429,133	0.000510	0.000510	0.000510
2	FIDELITY HC	403,660	0.000000	0.000134	0.000596
3	AMERICAN BK INC	528,961	0.000724	0.000730	0.000730
4	MERCHANTS BC	1,179,418	0.000517	0.000869	0.001177
5	Cardinal Financial Corporation	2,894,230	0.001169	0.001260	0.001260
6	Merchants Bancshares, Inc.	1,730,936	0.000945	0.001297	0.001389
7	LEADER BC	658,722	0.002205	0.002571	0.002571
8	SNBNY HOLD	6,672,456	0.002503	0.002813	0.002813
9	CBX CORP	1,159,027	0.001387	0.003037	0.003037
10	FIRSTPERRYTON BC	963,592	0.002691	0.003063	0.003063
11	FINANCIAL CORP OF LA	631,803	0.002865	0.003328	0.003328
12	First Of Long Island Corp	2,399,892	0.003165	0.003795	0.003795
13	SIGNATURE BC	646,087	0.002682	0.004044	0.004044
14	CAMBRIDGE BC	1,533,711	0.004045	0.004110	0.004110
15	HOMETOWN BC	1,153,654	0.004148	0.004263	0.004263
16	FIRST TX BHC	1,299,111	0.003216	0.004281	0.004281
17	Access National Corporation	847,181	0.003563	0.004324	0.004324
18	INWOOD BSHRS	1,569,067	0.002431	0.002482	0.004384
19	State Street Corp	243,028,090	0.000062	0.000062	0.004439
20	POST OAK BSHRS	772,461	0.004011	0.004747	0.004747
21	LEACKCO BHC	581,422	0.002289	0.002801	0.004772
22	Pacific Premier Bancorp, Inc.	1,714,187	0.002338	0.003972	0.004926
23	CUMMINS-AMER CORP	1,200,777	0.004812	0.005275	0.005275
24	MIDLAND BSHRS	1,076,128	0.004980	0.005294	0.005294
25	Center Bancorp, Inc.	1,673,082	0.004812	0.005154	0.005383
26	FIRST BSHRS OF TX	826,012	0.004845	0.005601	0.005601
27	PLANTERS FNCL GRP	784,115	0.003947	0.005336	0.005840
28	INDEPENDENCE BSHRS	1,393,217	0.004581	0.005768	0.005847
29	HERITAGE GROUP	624,052	0.005856	0.005863	0.005863
30	GNB BC	495,827	0.005474	0.005563	0.005916

	Name of Bank Holding Company	Book Value of Total Assets (1000s)	(Nonperforming Loans) / (Total Loans)	(Nonperforming Loans + Gross Charge-offs) / (Total Loans)	(Nonperforming Loans + Gross Charge-offs + Other Real Estate Owned) / (Total Loans)
31	MBT BSHRS	562,965	0.000000	0.003311	0.005993
32	SECURITY NAT CORP	1,218,571	0.003863	0.004625	0.006190
33	Independent Bk Grp Inc	2,163,984	0.003535	0.004369	0.006293
34	MIDWEST BANC HC	614,586	0.003964	0.004108	0.006437
35	CITIZENS NAT BSHRS OF BOSSIER	745,840	0.004719	0.005762	0.006458
36	MVB FC	991,730	0.003913	0.006055	0.006580
37	RBB BC	723,410	0.002074	0.004106	0.006673
38	RED RIVER BSHRS	1,301,336	0.005064	0.005679	0.006726
39	FARMERS & MRCH BC	2,076,722	0.002915	0.003557	0.006879
40	DAKOTA CMNTY BSHRS	705,560	0.006696	0.007112	0.007112
41	LAURITZEN CORP	1,832,705	0.006729	0.007248	0.007302
42	Bank Of New York Mellon Corpor	374,310,000	0.006732	0.007062	0.007469
43	BOU BC	834,970	0.006925	0.007587	0.007587
44	MANHATTAN BC	1,099,989	0.007041	0.007790	0.007808
45	Century Bancorp, Inc.	3,431,154	0.006412	0.007846	0.007846
46	NORTHERN BC	1,096,296	0.007499	0.007916	0.007916
47	AMERICAN BC	1,192,869	0.006221	0.007910	0.007963
48	SECURITY NAT CORP	744,886	0.005745	0.006530	0.007970
49	Peapack-Gladstone Financial Co	1,966,948	0.006080	0.006740	0.007971
50	BPC CORP	662,640	0.001452	0.005943	0.008005
51	Northrim Bancorp, Inc.	1,215,006	0.003601	0.005288	0.008300
52	STATE BSHRS	2,946,169	0.006175	0.007173	0.008397
53	Bridge Bancorp, Inc.	1,896,640	0.005302	0.006206	0.008418
54	BANK OF HIGHLAND PK FNCL CORP	1,143,494	0.001941	0.004944	0.008699
55	Stifel Financial Corp.	9,008,870	0.006522	0.008648	0.008712
56	AMERICAN CENTRAL BANCORP	708,060	0.007100	0.007964	0.008730
57	AMERICAN BK HOLDING CORP	1,205,154	0.004398	0.006899	0.008782
58	FIRST MANITOWOC BC	1,060,887	0.003963	0.005174	0.008788
59	FARMERS ST CORP	562,783	0.008540	0.008726	0.008891
60	AVENUE FNCL HOLD	889,577	0.001020	0.003005	0.008971

	Name of Bank Holding Company	Book Value of Total Assets (1000s)	(Nonperforming Loans) / (Total Loans)	(Nonperforming Loans + Gross Charge-offs) / (Total Loans)	(Nonperforming Loans + Gross Charge-offs + Other Real Estate Owned) / (Total Loans)
61	Prosperity Bancshares, Inc.	18,651,693	0.007357	0.008063	0.009002
62	FIRST-WEST TX BSHRS	916,226	0.007154	0.008521	0.009006
63	METROPOLITAN BANCGROUP	800,678	0.003242	0.004446	0.009185
64	CITIZENS BSHRS	665,350	0.007725	0.008268	0.009511
65	IDA GROVE BSHRS	1,245,520	0.008319	0.009363	0.009531
66	Southern Missouri Bancorp, Inc	950,266	0.005302	0.005724	0.009688
67	OTTAWA BSHRS	488,233	0.006072	0.008381	0.009889
68	CENTRAL BC	162,259	0.007789	0.007985	0.009941
69	BANKWELL FNCL GRP	779,618	0.008426	0.008696	0.010013
70	RCB HC	2,117,679	0.006255	0.007095	0.010044

Table 4**Summary Statistics of Top-Tier Bank Holding Companies at Year-End 2013**

The data set includes 710 top-tier bank holding companies at the end of 2013. Nonperforming loans include past due loans less than and more than 90 days plus nonaccruing loans, lease financing receivables, placements, and other assets (BHCK525+BHCK5524 +BHCK5526); gross charge-offs (BHCK4635); and other real estate owned (BHCK2150). Banks whose nonperforming loans exceed 15 percent of total loans as well as those whose nonperforming loans are less than 1 percent of total loans are dropped. And banks with total loans less than 15 percent of consolidated assets are dropped. These restrictions reduce the initial sample of 807 banks to 710.

Panel A: Consolidated Assets < \$1 Billion

	<i>N</i>	Mean	Median	Std. Dev.	Minimum	Maximum
Book Value Assets (1,000s)	364	662,973	654,468	167,443	92,694	998,762
Loans/Assets	364	0.6400	0.6558	0.1267	0.2838	0.9142
(Nonperforming Loans) / Loans	364	0.0461	0.0370	0.0310	0.0100	0.1485

Panel B: \$1 Billion < Consolidated Assets < \$10 Billion

Book Value Assets (1,000s)	293	2,600,335	1,853,823	1,918,892	1,000,668	9,641,427
Loans/Assets	293	0.6414	0.6537	0.1229	0.1653	0.9216
(Nonperforming Loans) / Loans	293	0.0383	0.0280	0.0277	0.0100	0.1492

Panel C: \$10 Billion < Consolidated Assets < \$50 Billion

Book Value Assets (1,000s)	35	21,161,256	18,473,488	9,330,543	10,989,286	47,138,960
Loans/Assets	35	0.6322	0.6588	0.1366	0.3856	0.9621
(Nonperforming Loans) / Loans	35	0.0312	0.0264	0.0219	0.0102	0.1379

Panel D: \$50 Billion < Consolidated Assets < \$250 Billion

Book Value Assets (1,000s)	11	104,276,621	92,991,716	43,640,904	56,031,127	183,009,992
Loans/Assets	11	0.6678	0.6958	0.1388	0.2854	0.8290
(Nonperforming Loans) / Loans	11	0.0307	0.0283	0.0099	0.0146	0.0449

Panel E: Consolidated Assets > \$250 Billion

Book Value Assets (1,000s)	7	1,272,854,333	1,527,015,000	923,465,518	297,282,098	2,415,689,000
Loans/Assets	7	0.5174	0.5501	0.1409	0.3167	0.6656
(Nonperforming Loans) / Loans	7	0.0610	0.0569	0.0118	0.0483	0.0798

Table 5**The Largest Banks and Their Loan Performance at Year-End 2013**

Holding companies whose consolidated assets exceed \$50 billion are listed below. Nonperformance is measured by the following data from the Y9-C report at year-end 2013 divided by Total Loans (BHCK2122). Nonperforming = past due loans less than and more than 90 days plus nonaccruing loans, lease financing receivables, placements, and other assets (BHCK525+BHCK5524 +BHCK5526); Nonperforming loans + Gross Charge-offs (BHCK4635); Nonperforming Loans + Gross Charge-offs + Other Real Estate Owned (BHCK2150).

	Name of Bank Holding Company	Book Value of Total Assets (1000s)	(Nonperforming Loans) / (Total Loans)	(Nonperforming Loans + Gross Charge-offs) / (Total Loans)	(Nonperforming Loans + Gross Charge-offs + Other Real Estate Owned) / (Total Loans)
1	JPMorgan Chase & Co.	2,415,689,000	0.042777	0.052537	0.056131
2	Bank Of America Corporation	2,104,995,000	0.058744	0.069468	0.071591
3	Citigroup Inc.	1,880,382,000	0.033841	0.056329	0.056944
4	Wells Fargo & Company	1,527,015,000	0.067471	0.075102	0.079751
5	U.S. Bancorp	364,021,000	0.036162	0.044326	0.048340
6	PNC Financial Services Group,	320,596,232	0.037558	0.045575	0.048626
7	Capital One Financial Corp	297,282,098	0.037057	0.064881	0.065447
8	BB&T Corp	183,009,992	0.028152	0.036616	0.038728
9	Suntrust Banks	175,380,779	0.024413	0.031124	0.033224
10	Fifth Third Bancorp	129,685,180	0.017885	0.024993	0.028333
11	Regions Financial Corp	117,661,732	0.027746	0.039622	0.041359
12	Northern Trust Corporation	102,947,333	0.016903	0.018918	0.019324
13	Keycorp	92,991,716	0.018109	0.024203	0.024622
14	M&T Bank Corp	85,162,391	0.036329	0.040286	0.041329
15	Discover Financial Services	79,339,664	0.018484	0.044931	0.044931
16	Comerica Inc	65,356,580	0.010943	0.014293	0.014566
17	Huntington Bancshares Inc	59,476,344	0.018639	0.025698	0.026335
18	Zions Bancorporation	56,031,127	0.020123	0.023459	0.024635

Table 6**Estimation of Stochastic Best-Practice Loan Nonperformance Frontier**

The data set includes 710 top-tier bank holding companies at the end of 2013. Nonperforming loans include past due loans less than and more than 90 days plus nonaccruing loans, lease financing receivables, placements, and other assets (BHCK525+BHCK5524 +BHCK5526); gross charge-offs (BHCK4635); and other real estate owned (BHCK2150). Banks whose nonperforming loans exceed 15 percent or are less than 1 percent of total loans are dropped from the initial sample. Stochastic frontier techniques are used to estimate the best-practice minimum ratio of nonperforming loans to total loans for any given amount of total loans, expressed in 100 billions, controlling for the composition of the bank's loan portfolio, the average contractual interest rate charged on its loans, the ten-year average GDP growth rate and market concentration in the states in which the bank operates, where each state's datum is weighted by the proportion of the bank's total deposits located in the state. Parameters significantly different from zero at the 10 percent or stricter are given in **bold**.

Parameter	Variable	Coefficient Estimate	Robust Standard Error
α_0	Intercept	-0.011187	0.032787
α_1	total loans _i (100 billons)	0.005420	0.000000
β_1	Contractual lending rate _i	0.434162	0.000000
β_2	Herfindahl index of market concentration _i	-0.006387	0.394509
β_3	GDP growth rate _i	-0.000745	0.007770
β_4	(Small business loan volume _i) / (Total loan volume _i)	-0.026611	0.004986
β_5	(Total business loan volume _i) / (Total loan volume _i)	0.000923	0.587099
β_6	(Consumer loan volume _i) / (Total loan volume _i)	0.008051	0.052753
β_7	(Residential real estate volume _i) / (Total loan volume _i)	0.006539	0.046151
β_8	(Commercial real estate volume _i) / (Total loan volume _i)	0.007822	0.121623
σ_v	Two-sided, normally distributed error term, $v_i \sim \text{iid } N(0, \sigma_v^2)$	0.002120	0.000836
σ_μ	Positive, half-normally distributed error term, $\mu_i (\geq 0) \sim \text{iid } N(0, \sigma_\mu^2)$, that gauges excess nonperformance	0.040618	0.000000

Table 7**Best Practice Nonperformance and Lending Inefficiency**

The data set includes 710 top-tier bank holding companies at the end of 2013. Nonperforming loans include past due loans, gross charge-offs, and other real estate owned. Banks whose nonperforming loans exceed 15 percent or are less than 1 percent of total loans are dropped from the initial sample. Stochastic frontier techniques are used to estimate the best-practice minimum ratio of nonperforming loans to total loans for any given amount of total loans, controlling for the composition of the bank's loan portfolio, the average contractual interest rate charged on its loans, the ten-year average GDP growth rate and market concentration in the states in which the bank operates, where each state's datum is weighted by the proportion of the bank's total deposits located in the state. Lending Inefficiency is measured as the difference between the actual ratio and the best-practice minimum ratio of nonperforming loans to total loans.

Panel A: Consolidated Assets < \$1 Billion

	<i>N</i>	Mean	Median	Std. Dev.	Minimum	Maximum
Avg. Contractual Loan Interest Rate	364	0.0525	0.0511	0.0089	0.0352	0.1404
(Nonperforming Loans) / (Total Loans)	364	0.0461	0.0370	0.0310	0.0100	0.1485
Best-Practice Nonperformance	364	0.0123	0.0120	0.0045	0.0009	0.0529
Lending Inefficiency	364	0.0338	0.0237	0.0290	0.0007	0.1308

Panel B: \$1 Billion < Consolidated Assets < \$10 Billion

Avg. Contractual Loan Interest Rate	293	0.0494	0.0483	0.0086	0.0278	0.1329
(Nonperforming Loans) / (Total Loans)	293	0.0383	0.0280	0.0277	0.0100	0.1492
Best-Practice Nonperformance	293	0.0109	0.0104	0.0044	0.0017	0.0504
Lending Inefficiency	293	0.0274	0.0190	0.0256	0.0011	0.1390

Panel C: \$10 Billion < Consolidated Assets < \$50 Billion

Avg. Contractual Loan Interest Rate	35	0.0458	0.0445	0.0067	0.0352	0.0643
(Nonperforming Loans) / (Total Loans)	35	0.0312	0.0264	0.0219	0.0102	0.1379
Best-Practice Nonperformance	35	0.0096	0.0096	0.0035	0.0020	0.0206
Lending Inefficiency	35	0.0217	0.0168	0.0196	0.0031	0.1174

Panel D: \$50 Billion < Consolidated Assets < \$250 Billion

Avg. Contractual Loan Interest Rate	11	0.0453	0.0401	0.0223	0.0253	0.1100
(Nonperforming Loans) / (Total Loans)	11	0.0307	0.0283	0.0099	0.0146	0.0449
Best-Practice Nonperformance	11	0.0128	0.0110	0.0108	0.0017	0.0431
Lending Inefficiency	11	0.0179	0.0172	0.0082	0.0019	0.0304

Panel E: Consolidated Assets > \$250 Billion

Avg. Contractual Loan Interest Rate	7	0.0538	0.0444	0.0196	0.0401	0.0921
(Nonperforming Loans) / (Total Loans)	7	0.0610	0.0569	0.0118	0.0483	0.0798
Best-Practice Nonperformance	7	0.0424	0.0496	0.0162	0.0179	0.0589
Lending Inefficiency	7	0.0186	0.0240	0.0107	0.0040	0.0307

Table 8
Best Practice Nonperformance and Lending Inefficiency
for Banks with Consolidated Assets Greater Than \$50 Billion

The values of lending inefficiency, the best-practice ratio of nonperforming loans measuring inherent credit risk, and the observed ratio of nonperforming loans are shown for large banks with consolidated assets greater than \$50 billion. Nonperforming loans include past due loans, gross charge-offs, and other real estate owned. Stochastic frontier techniques are used to estimate the best-practice minimum ratio of nonperforming loans to total loans for any given amount of total loans, controlling for the composition of the bank's loan portfolio, the average contractual interest rate charged on its loans, the ten-year average GDP growth rate and market concentration in the states in which the bank operates, where each state's datum is weighted by the proportion of the bank's total deposits located in the state.

	Name of Bank Holding Company	Book Value of Total Assets (1000s)	Lending Inefficiency	Best-Practice Nonperformance	(Nonperforming Loans) / (Total Loans)
1	JPMorgan Chase & Co.	2,415,689,000	0.0065	0.0496	0.0561
2	Bank Of America Corporation	2,104,995,000	0.0127	0.0589	0.0716
3	Citigroup Inc.	1,880,382,000	0.0040	0.0530	0.0569
4	Wells Fargo & Company	1,527,015,000	0.0259	0.0538	0.0798
5	U.S. Bancorp	364,021,000	0.0262	0.0222	0.0483
6	PNC Financial Services Group,	320,596,232	0.0307	0.0179	0.0486
7	Capital One Financial Corp	297,282,098	0.0240	0.0414	0.0654
8	BB&T Corporation	183,009,992	0.0220	0.0167	0.0387
9	Suntrust Banks, Inc.	175,380,779	0.0206	0.0127	0.0332
10	Fifth Third Bancorp	129,685,180	0.0161	0.0122	0.0283
11	Regions Financial Corporation	117,661,732	0.0304	0.0110	0.0414
12	Northern Trust Corporation	102,947,333	0.0176	0.0017	0.0193
13	Keycorp	92,991,716	0.0172	0.0074	0.0246
14	M&T Bank Corporation	85,162,391	0.0300	0.0114	0.0413
15	Discover Financial Services	79,339,664	0.0019	0.0431	0.0449
16	Comerica Incorporated	65,356,580	0.0093	0.0053	0.0146
17	Huntington Bancshares Inc	59,476,344	0.0169	0.0094	0.0263
18	Zions Bancorporation	56,031,127	0.0144	0.0102	0.0246

Table 9
Factors Affecting Lending Inefficiency

The data set includes 710 top-tier bank holding companies at the end of 2013. Stochastic frontier techniques are used to estimate the best-practice minimum ratio of nonperforming loans to total loans specified in (1).

Lending Inefficiency, defined by (4), is measured as the difference between the actual ratio and the best-practice minimum ratio of nonperforming loans to total loans.

The regression is estimated with OLS, and standard errors are heteroscedasticity consistent. Parameter estimates in **bold** are significantly different from zero at stricter than 10%.

We apply the general-to-specific modeling strategy to identify the best specification for the lending inefficiency equation. The regressors of the general specification are given in the first column. The specific specification is obtained through a full AIC-based search over all possible specifications with all combinations of regressors derived from the general specification.

Variable	General Specification		Specific Specification	
	Parameter Estimate	Pr > t	Parameter Estimate	Pr > t
Intercept	-1.14127	0.2358	-0.06965	0.0003
log (Book Value Assets (1,000s))	0.13899	0.2577		
[log (Book Value Assets (1,000s))]²	-0.00442	0.2558		
Total Loans/Assets	-0.02389	0.0024	-0.02468	0.0012
Equity Capital/Assets	-0.13971	0.0036	-0.14365	0.0023
Contractual Interest Rate on Loans	41.97631	0.1661	2.73758	<.0001
(Contractual Interest Rate on Loans)²	-330.04581	0.1610		
[Contractual Interest Rate on Loans] x [log (Book Value Assets (1,000s))]	-5.07195	0.1917		
[Contractual Interest Rate on Loans]² x [log (Book Value Assets (1,000s))]	0.16053	0.1942	-1.02265	<.0001
[Contractual Interest Rate on Loans] x [log (Book Value Assets (1,000s))]²	41.64547	0.1700		
[Contractual Interest Rate on Loans]² x [log (Book Value Assets (1,000s))]²	-1.35212	0.1652		
Consumer Loans/Total Loans	0.06263	0.0146	0.05884	0.0163
Total Business Loans/ Total Loans	0.04302	0.0124	0.04096	0.0109
Small Business Loans/ Total Loans	-0.10344	0.0002	-0.09910	0.0001
Commercial RE Loans/ Total Loans	0.06081	<.0001	0.06109	<.0001
Residential RE Loans/ Total Loans	0.03825	0.0039	0.03818	0.0042
GDP Growth Rate	-0.00395	<.0001	-0.00405	<.0001
Number of States	0.00258	0.0203	0.00230	0.0013
[Number of States] x [Number of Branches]	-3.53221E-7	0.0057	-3.31649E-7	0.0105
Market Concentration	-0.01267	0.3103		

Table 10**Best Practice Nonperformance, Lending Inefficiency, and Financial Performance**

The data set consists of 710 top-tier bank holding companies, of which 244 are publicly traded, at year-end 2013. The sample is partitioned into the halves with the lower and higher ratios of observed nonperforming loans to total loans. Mean values in **bold** print are significantly different at stricter than 10 percent.

Panel A: Half of the Sample with a Lower Ratio of Nonperforming Loans to Total Loans

	<i>N</i>	Mean	Median	Std. Dev.	Minimum	Maximum
Book Value Assets (1,000s)	355	4,152,644	1,098,991	12,251,316	280,370	129,685,180
(Nonperforming Loans) / Loans	355	0.0208	0.0206	0.0061	0.0100	0.0325
Best-Practice Nonperformance	355	0.0095	0.0093	0.0029	0.0009	0.0223
Lending Inefficiency	355	0.0112	0.0110	0.0060	0.0007	0.0262
Average Contractual Loan Interest Rate	355	0.0476	0.0475	0.0059	0.0253	0.0750
Loans / Assets	355	0.6543	0.6735	0.1211	0.1892	0.9621
Tobin's <i>q</i> Ratio	129	1.0564	1.0554	0.0475	0.9580	1.3129

Panel B: Half of the Sample a Higher Ratio of Nonperforming Loans to Total Loans

Book Value Assets (1,000s)	355	29,089,290	864,288	214,309,437	92,694	2,415,689,000
(Nonperforming Loans) / Loans	355	0.0634	0.0549	0.0278	0.0325	0.1492
Best-Practice Nonperformance	355	0.0143	0.0132	0.0067	0.0023	0.0589
Lending Inefficiency	355	0.0491	0.0398	0.0269	0.0019	0.1390
Average Contractual Loan Interest Rate	355	0.0540	0.0525	0.0110	0.0366	0.1404
Loans / Assets	355	0.6246	0.6431	0.1297	0.1653	0.9216
Tobin's <i>q</i> Ratio	116	1.0360	1.0258	0.0621	0.9506	1.3058

Table 11
Comparison of Means between Groups Partitioned
by Nonperforming Loans Ratio and Lending Inefficiency

The data set consists of 710 top-tier bank holding companies, of which 244 are publicly traded, at year-end 2013. The sample is partitioned into the halves with the lower and higher ratios of observed nonperforming loans to total loans. Each of these halves is then partitioned into the more and less efficient halves by lending efficiency. The p -value represents the statistical significance of the comparison of means in the pairing. Pairs of means in **bold** are statistically different at stricter than $p = 0.10$.

	Panel A			Panel B			Panel C		
	Banks with Lower Ratios of Nonperforming Loans to Total Loans			Banks with Higher Ratios of Nonperforming Loans to Total Loans			(Nonperforming Loans) / (Total Loans)		
	More Efficient at Lending	Less Efficient at Lending		More Efficient at Lending	Less Efficient at Lending		Lower Ratio	Higher Ratio	
	<i>n</i> = 178 <i>n</i> * = 62	<i>n</i> = 177 <i>n</i> * = 67		<i>n</i> = 178 <i>n</i> * = 76	<i>n</i> = 177 <i>n</i> * = 40		<i>n</i> = 178 <i>n</i> * = 62	<i>n</i> = 178 <i>n</i> * = 76	
	Mean	Mean	<i>p</i>	Mean	Mean	<i>p</i>	Mean	Mean	<i>p</i>
Book Value Assets (1,000s)	3,153,030	5,157,905	0.12	56,597,667	1,425,498	0.02	3,153,030	56,597,667	0.02
(Nonperforming Loans) / Loans	0.0160	0.0256	<0.01	0.0432	0.0837	<0.01	0.0160	0.0432	<0.00
Best-Practice Nonperformance	0.0098	0.0092	0.05	0.0143	0.0143	0.98	0.0098	0.0143	<0.00
Lending Inefficiency	0.0062	0.0163	<0.01	0.0289	0.0693	<0.01	0.0062	0.0289	<0.00
Average Contractual Loan Interest Rate	0.0484	0.0467	<0.01	0.0533	0.0548	0.19	0.0484	0.0533	<0.00
Loans / Assets	0.6575	0.6511	0.62	0.6367	0.6124	0.08	0.6575	0.6367	0.12
Tobin's <i>q</i> Ratio*	1.0643	1.0490	0.07	1.0468	1.0155	0.01	1.0643	1.0468	0.05

Table 12

**Regression Analysis of Tobin's q Ratio with the Nonperforming Loans Ratio
as One of the Main Factors for the Construction of Regressors**

The data set includes 244 publicly traded top-tier bank holding companies at the end of 2013. The dependent variable is Tobin's q ratio. Regressions are estimated with OLS, and standard errors are heteroscedasticity consistent. Probability values are reported in parentheses under the parameter estimates. Parameter estimates in **bold** are significantly different from zero at stricter than 10%.

We apply the general-to-specific modeling strategy to identify the best specification for the q ratio equation. The regressors of the general specification are given in the first column. The specific specification is obtained through a full AIC-based search over all possible specifications with all combinations of regressors derived from the general specification.

	Dependent Variable: Tobin's q Ratio			
	General Specification		Specific Specification	
Variable	Parameter Estimate	Pr > t	Parameter Estimate	Pr > t
Intercept	-0.4160	0.049	-0.4616	0.027
\ln (Book Value Assets (1,000s))	0.1972	<.0001	0.1933	<.0001
$[\ln$ (Book Value Assets (1,000s))] ²	-0.0060	<.0001	-0.0059	<.0001
Loans/ Assets	-0.2794	0.196	-0.0587	0.045
(Loans/ Assets) ²	0.1756	0.288		
Nonperforming Loans/ Loans	-3.1918	0.125	-2.8247	0.088
(Nonperforming Loans/ Loans) ²	1.3889	0.775		
(Nonperforming Loans/ Loans) \times $[\ln$ (Book Value Assets (1,000s))]	0.1705	0.180	0.1553	0.177
	Adj. R Sq = 0.339	F=18.8	Adj. R Sq = 0.354	F=26.1

Table 13

Regression Analysis of Tobin's q Ratio with the Nonperforming Loans Ratio and the Mega Bank Dummy as Two of the Main Factors for the Construction of Regressors

The data set includes 244 publicly traded top-tier bank holding companies at the end of 2013. The dependent variable is Tobin's q ratio. Regressions are estimated with OLS, and standard errors are heteroscedasticity consistent. Probability values are reported in parentheses under the parameter estimates. Parameter estimates in **bold** are significantly different from zero at stricter than 10%.

The regressors of the general specification are given in the first column. The specific specification is obtained through a full AIC-based search over all possible specifications with all combinations of regressors derived from the general specification.

Mega Bank is the indicator variable of banks with assets greater than \$170 billion.

	Dependent Variable: Tobin's q Ratio			
	General Specification		Specific Specification	
Variable	Parameter Estimate	Pr > t	Parameter Estimate	Pr > t
Intercept	-1.5560	0.0002	-1.5617	<.0001
\ln (Book Value Assets (1,000s))	0.3425	<.0001	0.3327	<.0001
$[\ln$ (Book Value Assets (1,000s))] ²	-0.0106	<.0001	-0.0102	<.0001
Loans / Assets	-0.2678	0.2000	-0.0556	0.0502
(Loans / Assets) ²	0.1685	0.2888		
Nonperforming Loans / Loans	-0.6926	0.6281		
(Nonperforming Loans / Loans) ²	1.3889	0.5556		
(Nonperforming Loans / Loans) \times [\ln (Book Value Assets (1,000s))]	-0.0064	0.9447	-0.0391	<.0001
Mega Bank (=1 when book value assets > \$170 billion)	-0.0725	0.5551		
(Mega Bank) \times (Nonperforming Loans / Loans)	-11.1061	0.1622	-14.3103	0.0018
(Mega Bank) \times [(Nonperforming Loans / Loans) ²]	-33.1282	0.4794		
(Mega Bank) \times (Nonperforming Loans / Loans) \times [\ln (Book Value Assets (1,000s))]	0.8417	0.0108	0.8325	0.0004
	Adj. R Sq = 0.369	F=13.9	Adj. R Sq = 0.377	F=25.5

Table 14**Regression Analysis of Tobin's q Ratio with the Two Components of the Nonperforming Loans Ratio as Two of the Main Factors for the Construction of Regressors**

The data set includes 244 publicly traded top-tier bank holding companies at the end of 2013. The dependent variable is Tobin's q ratio. Regressions are estimated with OLS, and standard errors are heteroscedasticity consistent. Parameter estimates in **bold** are significantly different from zero at stricter than 10%.

The regressors of the general specification are given in the first column. The specific specification is obtained through a full AIC-based search over all possible specifications with all combinations of regressors derived from the general specification.

Variable	General Specification		Specific Specification	
	Parameter Estimate	Pr > t	Parameter Estimate	Pr > t
Intercept	-1.046	0.0019	-1.0806	0.0004
\ln (Book Value Assets (1,000s))	0.2778	<.0001	0.2734	<.0001
$[\ln$ (Book Value Assets (1,000s))] ²	-0.0087	<.0001	-0.0085	<.0001
Loans / Assets	-0.2430	0.2638	-0.0526	0.0646
(Loans / Assets) ²	0.1504	0.3682		
Best-Practice Nonperformance	-8.5872	0.0209	-6.9464	0.0038
(Best-Practice Nonperformance) ²	-17.7697	0.6429		
(Best-Practice Nonperformance) \times $[\ln$ (Book Value Assets (1,000s))]	0.5838	0.0175	0.4625	0.0016
Lending Inefficiency	-0.6120	0.7498	-0.6145	<.0001
(Lending Inefficiency) ²	0.6405	0.9013		
(Lending Inefficiency) \times $[\ln$ (Book Value Assets (1,000s))]	-0.0195	0.8735		
(Lending Inefficiency) \times (Best-Practice Nonperformance)	15.9534	0.5756		
	Adj. R Sq = 0.352	F=13.0	Adj. R Sq = 0.362	F=24.0

Table 15: Panel A**Significance Tests of Derivatives of Tobin's q Ratio with Respect to Each of the Two Components of the Nonperforming Loans Ratio**

In specific specification of **Table 14**, the derivatives of Tobin's q ratio with respect to the stochastic frontier nonperforming loans ratio and the lending inefficiency are given by

$$\partial(\text{Tobin's } q \text{ ratio})/\partial(\text{stochastic frontier nonperforming loans ratio}) = -6.94641 + (0.46254) \times [\ln(\text{Book Value Assets (1,000s)})].$$

$$\partial(\text{Tobin's } q \text{ ratio})/\partial(\text{lending inefficiency}) = -0.61452.$$

Derivative of Tobin's q ratio with respect to ...	> 0	> 0 and statistically significant	< 0	< 0 and statistically significant
stochastic frontier nonperforming loans ratio	104	37	140	0
lending inefficiency	0	0	244	244

Table 15: Panel B**Estimates of Derivatives of Tobin's q Ratio with Respect to Inherent Credit Risk, Individually for the Largest 50 Banks**

The derivative of Tobin's q ratio with respect to the stochastic frontier nonperforming loans ratio is derived from the specific specification of **Table 14**:

$$\partial(\text{Tobin's } q \text{ ratio})/\partial(\text{stochastic frontier nonperforming loans ratio}) = -6.94641 + (0.46254) \times [\ln(\text{Book Value Assets (1,000s)})].$$

Estimates of derivatives in **bold** are significantly different from zero at stricter than 10%.

	Name	Book-Value Assets (1000s)	$\partial(\text{Tobin's } q \text{ Ratio})/\partial(\text{stochastic frontier nonperforming loans ratio})$	p-value
1	Jpmorgan Chase & Co.	2,415,689,000	3.047	0.0011
2	Bank Of America Corporation	2,104,995,000	2.983	0.0011
3	Citigroup Inc.	1,880,382,000	2.931	0.0012
4	Wells Fargo & Company	1,527,015,000	2.835	0.0012
5	U.S. Bancorp	364,021,000	2.172	0.0022
6	Pnc Financial Services Group	320,596,232	2.113	0.0023
7	Capital One Financial Corp	297,282,098	2.078	0.0024
8	Bb&T Corporation	183,009,992	1.854	0.0035
9	Suntrust Banks, Inc.	175,380,779	1.834	0.0037
10	Fifth Third Bancorp	129,685,180	1.694	0.0049
11	Regions Financial Corp	117,661,732	1.649	0.0055
12	Northern Trust Corporation	102,947,333	1.587	0.0063
13	Keycorp	92,991,716	1.540	0.0071
14	M&T Bank Corporation	85,162,391	1.500	0.0080
15	Comerica Incorporated	65,356,580	1.377	0.0114
16	Huntington Bancshares Inc	59,476,344	1.334	0.0130
17	Zions Bancorporation	56,031,127	1.306	0.0142
18	Cit Group Inc.	47,138,960	1.226	0.0185
19	N Y Community Bancorp	46,688,287	1.222	0.0188
20	First Niagara Financial Group	37,643,867	1.122	0.0267
21	Popular, Inc.	35,749,000	1.098	0.0291
22	City National Corporation	29,717,951	1.013	0.0401
23	Bok Financial Corporation	27,021,529	0.969	0.0475
24	Svb Financial Group	26,417,306	0.958	0.0494
25	Synovus Financial Corp.	26,201,604	0.954	0.0502

Table 15: Panel B (Continued)				
Estimates of Derivatives of Tobin's q Ratio with Respect to Inherent Credit Risk, Individually for the Largest 50 Banks				
	Name	Book-Value Assets (1000s)	$\partial(\text{Tobin's } q \text{ Ratio}) / \partial(\text{stochastic frontier nonperforming loans ratio})$	p -value
26	East West Bancorp, Inc.	24,730,609	0.928	0.0557
27	Cullen/Frost Bankers, Inc.	24,388,272	0.921	0.0571
28	Associated Banc-Corp	24,226,920	0.918	0.0578
29	Firstmerit Corporation	23,912,451	0.912	0.0591
30	First Horizon National Corp	23,791,187	0.910	0.0597
31	Commerce Bancshares, Inc.	23,081,892	0.896	0.0630
32	First Citizens Bancshares, Inc	21,199,091	0.856	0.0735
33	Webster Financial Corp	20,856,659	0.849	0.0757
34	Hancock Holding Company	19,025,806	0.806	0.0894
35	Susquehanna Bancshares	18,473,488	0.793	0.0943
36	Tcf Financial Corporation	18,402,494	0.791	0.0949
37	Wintrust Financial Corp	18,097,783	0.783	0.0978
38	Umb Financial Corporation	16,911,852	0.752	0.1105
39	Fulton Financial Corporation	16,908,633	0.752	0.1106
40	Valley National Bancorp	16,156,541	0.731	0.1199
41	Bank Of Hawaii Corporation	14,127,598	0.669	0.1521
42	Privatebancorp, Inc.	14,085,746	0.667	0.1528
43	F.N.B. Corporation	13,563,405	0.650	0.1632
44	Iberiabank Corporation	13,365,550	0.643	0.1675
45	Bancorpsouth, Inc.	13,045,442	0.632	0.1746
46	International Bancshares	12,079,477	0.596	0.1991
47	Trustmark Corporation	11,790,383	0.585	0.2073
48	Texas Capital Bancshares, Inc	11,714,698	0.582	0.2096
49	Umpqua Holdings Corp	11,641,151	0.579	0.2118
50	Cathay General Bancorp	10,989,286	0.553	0.2330