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# **Policy Uncertainty and Bank Stress Testing**

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## **Policy Uncertainty and Bank Stress Testing**

by

Paul H. Kupiec<sup>1</sup>

July 1, 2019

### Abstract

The 2011 Dodd-Frank Act requires the Federal Reserve Board to conduct supervisory stress tests to assess the capital adequacy of the largest U.S. banking institutions and yet the accuracy of stress-test capital projections is undocumented. I compare pre-crisis stress test forecasts to the performance of 14 large US banks during the financial crisis. Each bank calibrates its stress test models using the bank's own historical data while the regulator compares bank projections with estimates from a representative bank model. I consider three modelling methodologies: a multi-equation CLASS-style approach, a model based on Bayesian averaging, and a parsimonious Lasso model. Representative bank model forecasts differ dramatically from the forecasts from bank-specific models and from actual outcomes. The Lasso methodology is most accurate approach but there is no guarantee it will be in other samples, and it is impossible to identify the superiority of the Lasso model *ex ante*. The results highlight the policy uncertainty inherent in using stress tests, both to set minimum bank capital requirements and to assess the capital adequacy needed to maintain banking system stability.

Key Words: bank stress test model accuracy

JEL Codes: C11, C53, C58, G17, G21, G28

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## **Policy Uncertainty and Bank Stress Testing**

"It's tough to make predictions, especially about the future." — Yogi Berra

## 1. Introduction

What you are about to read is a true story about a stress test that never happened. Imagine it is Wednesday August 20, 2008. It is a relatively calm day only weeks before the climax of the subprime financial crisis. For weeks, the stock market has been trading in a narrow range. Fannie Mae and Freddie Mac preferred shares are still A-rated by Moody's.<sup>2</sup> Yet, in a handful of days these government-sponsored enterprises will be placed into conservatorship, investment banks presumed to be "too-big-to-fail" will fail, and stock markets will freefall as the financial system begins a meltdown of epic proportion.

Inside the Marriner S. Eccles building, senior Federal Reserve officials are being briefed on the results of a stress test exercise the Fed initiated in June. Fed staff constructed a three-year dynamic stress test scenario that simulates a severe recession accompanied by financial market turmoil. By sheer genius, divine inspiration, or dumb luck—and completely unknown to anyone at the time—the Fed's stress scenario exactly matches the macroeconomic and financial market conditions that unfold over the next three years.

Using historical data, Fed economists built econometric models to link bank quarterly income to macroeconomic and financial market variables. Staff then used these models to project individual bank performance over the three-year stress scenario. The Fed-model forecasts are compared to stress scenario forecasts that banks themselves produce in a process designed to assess the capital adequacy of the largest U.S. banks.

To ensure that the exercise is robust, three separate econometric modeling approaches are used to construct stress test forecasts. One approach uses multiple equations, each including macroeconomic, financial market and bank-specific explanatory variables. Each equation is estimated using stepwise regression. A second approach uses the same explanatory variables to build a single-equation model calibrated using Bayesian model averaging. A third approach is especially parsimonious. It uses a single equation, includes only macroeconomic and financial

<sup>&</sup>lt;sup>2</sup> <u>https://www.moodys.com/research/Moodys-cuts-Fannie-Maes-and-Freddie-Macs-preferred-stock-ratings--PR\_161632</u>

market explanatory variables, and is calibrated using the least absolute shrinkage and selection (Lasso) methodology of Tibshirani (1996).

Fourteen large banks agreed to participate in this Fed stress test exercise. They used modelling methodologies identical to those implemented by the Fed's staff, but each applied the methodologies to their own historical data. Each bank calibrated its own stress test models and used them to project the bank's stress scenario performance.

The Fed staff presents the results from the alternative stress test model, but is reluctant to reach any conclusions regarding the capital adequacy of these 14 institutions. The Fed's own regression-based stress test model projects that six of the fourteen participating banks will fail, meaning that the banks' capital positions are projected to fall below the stress-test minimum equity-to-asset ratio of 6 percent. The Fed's own representative bank model suggests that these six banks will need almost \$925 billion in additional equity capital to pass the stress test. In contrast, when the banks run their own regression-based stress test models, two of the banks project that their capital will fall below the 6 percent minimum threshold.<sup>3</sup> Combined, banks' own internal stress test estimates suggest that the failing banks will need about \$29 billion in additional equity to pass the stress test.

The results from the Bayesian model averaging methodology are almost as discordant. Estimates from the Fed's own Bayesian representative bank model indicate that four banks will fail the stress test and will need, in aggregate, an additional \$482 billion in equity to pass the test. In contrast, the banks' internal Bayesian stress test model forecasts project that all fourteen banks will pass the test without the need for any additional equity capital.

The results from the Lasso models further cloud the outlook. The Fed's Lasso representative bank model indicates that all banks will pass the test. Meanwhile, two banks report Lasso model stress test losses that, should they occur, will render the banks undercapitalized. The individual bank Lasso models indicate that the total equity capital shortfall for the two failing banks is about \$3 billion.

The results of the stress test exercise are "all over the map". Depending on the modelling approach and the data used to calibrate the model, the estimates suggest that, should the stress

<sup>&</sup>lt;sup>3</sup> Both of these banks also failed using the Fed model forecast.

scenario materialize, somewhere between zero and six banks may fail<sup>4</sup>. The evidence from several modelling approaches suggests that JPMorgan Chase, Bank of America, Citibank and HSBC are the likely to experience capital shortfalls but these predictions are contradicted by the forecasts from other models. In reality, only Bank of New York and HSBC fail to maintain equity-capital ratios above 6 percent when these ratios are calculated using stress test operating assumptions.

Unfortunately, there is no way for the Fed's staff to rank the forecasting accuracy of the alternative stress test modelling approaches. The total amount of additional capital required to ensure that all fourteen banks survive the stress scenario with equity-asset ratios of at least 6 percent is somewhere between \$0 and \$925 billion, but exactly where within that wide range is anyone's guess. Given the range of estimates, it is understandable that the Fed's staff is reluctant to reach any firm conclusions regarding the capital adequacy of these fourteen very large banks.

In this paper I show that, among the annals of stress testing, this is a true story that never happened. The results described are exactly the results the Federal Reserve would have produced had it run the same exact set of stress tests in the summer of 2008 using the only data available— data from bank regulatory reports. The stress test exercise would have been costly, for both the banks and the Fed, but it would not have revealed any new information that accurately identified which of the fourteen participating banks were undercapitalized against impending stresses or how much additional capital in aggregate these banks would need to ensure their continued solvency. The social value-added associated with the stress test exercise is far from clear, even on the eve of a financial crisis, and even when the hypothetical stress scenario exactly anticipates the actual economic and financial market conditions that will prevail over the next three years.

A more clinical description of the analysis conducted in this paper follows. Using actual macroeconomic and financial market data from September 2008 through June 2011 as the stress test scenario, I compare alternative stress test model forecasts for fourteen large US banks. One set of forecasts are from a "representative bank model," a hypothetical average bank with data constructed as the asset-weighted averages of the data reported by all individual banks in each quarter. Bank characteristics and performance data are taken from the quarterly Consolidated

<sup>&</sup>lt;sup>4</sup> Meaning less than 6 percent equity-asset ratio.

Report of Condition and Income regulatory filings.<sup>5</sup> Alternative stress test forecasts are constructed from bank-specific stress test models. These models use exactly the same calibration approaches as those use to estimate the representative bank model, but they are estimated using the historical data for each individual bank.

I consider three alternative approaches for calibrating bank stress test models. One approach closely mimics the process used to estimate the Federal Reserve Bank of New York's CLASS model (Hirtle, et. al., 2015), a model used in the 2009 Supervisory Capital Assessment Program (Bhanot, Hirtle, Kovner, and Vickery, 2014). The CLASS-style model uses multiple equations to forecast bank quarterly income. Each equation includes macroeconomic, financial market, and bank specific explanatory variables and is estimated using step-wise regression. A second stress test modeling approach includes an identical set of explanatory variables, but uses a single equation and Bayesian model averaging to estimate the parameters of the model. A third approach models bank quarterly income using a single equation that includes only macroeconomic and financial market explanatory variables and is calibrated using Lasso.

I compare equity-to-asset ratio forecasts from the representative bank models to forecasts from the individual bank models and to baseline estimates over the first three years of the financial crisis. For the twelve quarters between September 2008 and June 2011, I use each bank's reported income before tax and extraordinary items to project a baseline estimate of the bank's equity-to-asset ratio under a passive management operating assumption. This baseline is an estimate of the equity-to-asset ratio the bank would have had if it maintained its initial risk profile<sup>6</sup>, paid no taxes or dividends, had no share repurchases, asset sales, mergers that impacted its equity-to-asset ratios, or capital injections including any capital injections associated with the Troubled Asset Relief Program (TARP) over the stress scenario. I compare each bank's baseline capital ratio estimates of the estimates of the capital ratios implied by bank income forecasts from the alternative stress test models. Since baseline estimates are derived from banks' reported quarterly income, the baseline is impacted by mergers that occur during the stress scenario. To ensure comparability, bank stress test period. I develop procedures to merger-adjust stress test

<sup>&</sup>lt;sup>5</sup> These reports are colloquially referred to as "Call reports".

<sup>&</sup>lt;sup>6</sup> The bank is assumed to maintain its initial asset and liability mix.

forecasts so that *ex ante* stress test forecasts can be made comparable to individual banks' baseline outcomes.

In order to "pass" the stress test, I assume that institutions are required to sustain, without any capital injections or asset sales, equity-asset ratios of at least 6 percent in every stress test quarter.<sup>7</sup> The baseline estimates suggest that two of the fourteen institutions I examine fail the stress test. For these institutions, a minor amount of additional equity capital (\$151 million) is needed to mitigate the capital shortfall in the baseline estimates of both institutions.

The opening paragraphs summarize the results of the alternative stress test models. These tests require a significant amount of computation and yet the exercise provides a discordant assessment of the capital adequacy position of each of the banks. Among the models analyzed, the merger-adjusted individual bank Lasso models produce the most accurate forecast of the banks' baseline results. They correctly identify the two banks with baseline projections that fail the stress test, but the individual bank Lasso models overestimate the capital shortfall in both cases. Unfortunately, it is impossible to identify the superiority of the individual bank Lasso methodology *ex ante*, and I make no claim that the Lasso modeling approach will be the most accurate approach in other settings. There is, to the best of my knowledge, no way to generalize the results of this one-off experiment. Still, the results of this analysis highlight the high degree policy uncertainty that is inherent in using dynamic stress tests to set minimum bank capital requirements.

An outline of this paper follows. Section 2 reviews the data used to conduct the stress tests. Section 3 presents the three alternative modeling approaches used to construct stress tests. Section 4 reviews the alternative stress test model estimates. Section 5 explains the methodology used to construct individual estimates of the banks' baseline equity-to-asset ratios and project the equity-to-asset ratios consistent with the alternative stress test forecasts. Section 6 discusses the stress test results. Section 7 concludes the paper.

## 2. The Data

The data used in this analysis are taken from publically available sources. Quarterly data on financial market and economic conditions are taken directly or derived from data reported in

<sup>&</sup>lt;sup>7</sup> I provide each bank's projected stress test equity-asset ratios, so the reader can immediately see the implication of choosing a different required minimum equity-asset ratio.

the Federal Reserve Bank of Saint Louis FRED database. Data on real home prices are from the American Enterprise Institute Center for Housing Markets and Finance.<sup>8</sup> The macroeconomic and financial market explanatory variables included in stress test model regressions are reported in Table 1 along with summary statistics for these data.<sup>9</sup> Quarterly data on balance sheet, income statement and other individual bank characteristics are from the Consolidated Reports of Condition and Income downloaded from the FDIC public website. The list bank-specific variables that are used in the analysis are reported in Table 2.

The Federal Reserve Board (FRB) does not disclosure many of the details of its own Dodd-Frank stress test model methodology. However, the FRB does disclose that its stress test model uses an "industry average" approach calibrated using pooled institution data. The FRB's models are not bank specific:

"The estimated model parameters are the same for all BHCs and reflect industrywide, portfolio- specific, and instrument-specific response to variation in the macroeconomic and financial market variables. This industrywide approach reflects both the challenge in estimating separate, statistically robust models for each of the 33 BHCs and the desire of the Federal Reserve not to assume that historical BHC-specific results will prevail in the future." (Board of Governors of the Federal Reserve, 2016, p. 3.)

Following Federal Reserve Board practice, I use a representative bank model as the proxy for each of the alternative regulatory stress test modeling approaches. I construct representative bank data as the quarterly asset-weighted averages (for each variable) calculated using all insured depository institutions reporting in a quarter. The details of the calculation are described in section A1 in the Appendix. Summary statistics for the representative bank data appear in Table 2.

I estimate individual stress test models and compute stress scenario forecasts for all traditional commercial banks with total assets in excess of \$100 billion as of June 2008, provided the banks remained independent through June 2011. Table 3 lists all 19 insured US depository institutions that reported assets in excess of \$100 billion as of June 2008. Four of these institutions—Countrywide, Wachovia, Washington Mutual and National City Bank— are not analyzed as standalone institutions because all were merged into an acquiring institution between

<sup>&</sup>lt;sup>8</sup> <u>http://www.aei.org/publication/national-housing-market-index-release-for-q2-2017/</u>

<sup>&</sup>lt;sup>9</sup> All Tables appear at the end of the paper.

September 2008 and June 2011.<sup>10</sup> I also exclude FIA Card Services from the analysis because it is not a traditional bank. It is a specialized credit card bank and would require a different modelling algorithm because the FIA eschews some of the bank-specific characteristics common to the remaining banks.<sup>11</sup>

## Other Data Issues

When estimating individual bank stress test models from historical data, it is important to account for mergers since most of the largest U.S. banks acquired the assets of several other banks through mergers. For example, between March 1993 and June 2008, JP Morgan Chase Bank<sup>12</sup> acquired or otherwise absorbed the assets of 225 depository institutions. Over the same period, Bank of America<sup>13</sup> acquired or otherwise absorbed 305 depository institutions. While mergers do not impact the construction of the representative bank data, they must be taken into account when constructing the data used to estimate individual bank stress test models.

When a bank acquires or merges with another institution, the event can cause jumps and discontinuities in the bank's reported income statement and balance sheet values. To control for merger events, I merger adjust each individual bank's data by combining the bank's reported data with the data reported by merged and acquired banks for all quarters prior to the merger. The merger-adjusted bank data simulates data that would have been reported by the bank if it had absorbed each acquired institution beginning in March 1993 (or the date the acquired institution was first chartered) assuming it was merged using the pooling method for merger accounting.<sup>14</sup> Each of the large banks data is merger-adjusted to include all banks acquired by the institution between March 1993 and June 2008.

<sup>&</sup>lt;sup>10</sup> These banks are included in the analysis as part the acquiring bank after they are merged into one of the 14 banks examined in the stress test analysis.

<sup>&</sup>lt;sup>11</sup> FIA Card Services has characteristics that differ markedly from the other banks in the analysis. Because it is a credit card bank it does not make any loans in some of the loan categories included in the first stage of the CLASS model. As a consequence, the first step CLASS model design matrix is singular. FIA must be modeled with a different algorithm than is used to fit the other banks' CLASS models. I omitted FIA Card Services to maintain the consistency of the estimation process across all estimated stress test models.

<sup>&</sup>lt;sup>12</sup> Bank Cert 628.

<sup>&</sup>lt;sup>13</sup> Bank Cert 3510.

<sup>&</sup>lt;sup>14</sup> Under pooling-of-interests accounting treatment, the target bank's assets, liabilities, and owner's equities are combined with those of the acquiring bank at book value. Under purchase accounting treatment, the assets of the target bank are marked to market before they are combined with the acquiring bank's assets. Any difference between the purchase price and the implied mark-to-market value of target bank's equity is recorded as goodwill in the acquiring bank's balance sheet. My method for merger adjusting the data implicitly assumes that all mergers used pooling-of-interests accounting.

# 3. Alternative Stress Test Modeling Approaches

The analysis uses three alternative approaches for modeling the ratio of bank income before taxes and extraordinary items to bank assets (INBFTXEX). The analysis focuses on INBFTXEX because it is the most important factor driving changes in bank capital adequacy over a three-year stress scenario and should be highly correlated with changes in macroeconomic and financial market conditions.<sup>15</sup> I model the ratio of income before tax and extraordinary items to assets because income and asset series share a common unit root.

The subsequent sections discuss the three alternative methodologies used to model INBFTXEX with variables that measure macroeconomic activity, financial market conditions, and bank-specific on- and off-balance sheet characteristics.

## 3.1 A CLASS-Style Stress Test Model

The New York Federal Reserve Bank CLASS model is a representative bank stress test model estimated using historical bank data collected in regulatory reports. A Federal Reserve Bank of New York Staff Report (Hirtle, et. al., 2015) includes a detailed discussion of the data and estimation methodology used in the CLASS model. Bhanot, Hirtle, Kovner, and Vickery (2014) report that CLASS model estimates were used in the earliest Federal Reserve SCAP stress test exercise.

The CLASS model forecasts a bank's income-to-asset ratio where the income measure excludes loan and lease loss provision expenses. Provision expenses are estimated separately in ratio form using an *ad hoc* regulatory rule and subsequently subtracted from the aforementioned income-to-asset ratio forecast.

The CLASS model disaggregates a bank's pre-provision income-to-asset ratio into six components that are modeled independently: net interest income, trading income, non-interest non-trading income, compensation expense, expenses related to premises and fixed assets, and other non-interest expense. Each individual component is modeled including explanatory

<sup>&</sup>lt;sup>15</sup> Extraordinary gains and losses, by their very nature, should not be predictable using macroeconomic factors. Retained earnings are income before tax, less tax (or plus tax refunds) and capital distributions. Capital adequacy calculations require, in addition to an estimate of bank income, estimates of retained earnings and, in the case of risk-based capital requirements, bank risk-weighted assets. The projection of bank income is the only component of the stress test capital adequacy calculation that is directly linked to the macroeconomic stress scenario.

variables that measure time-varying bank characteristics as well as macroeconomic and financial market variables.

All CLASS-style models are estimated using backward stepwise regression. The algorithm starts with all potential explanatory variables in the model and, at each step, identifies the variable whose estimated coefficient has the highest probability of being consistent with the null hypothesis that the coefficient has a 0 value.<sup>16</sup> The variable is eliminated, the model is re-estimated, and the variable with highest p-value is again identified and eliminated. The constant term is retained in the regression regardless of its statistical significance. The algorithm continues until the process maximizes the regression's adjusted R-square statistic. The New York Federal Reserve staff study also suggests that economic priors are used to guide the variable selection (Hirtle, et. al., p. 20) but the study does not provide any specific examples in which prior theoretical considerations overrode the stepwise regression procedures. CLASS model estimates do not utilize any information criteria like the AIC, BIC or Mallows Cp statistics.

To circumvent unit root issues, the CLASS models estimate bank income components in ratio form, normalizing quarterly bank income and expense items by bank assets or other balance sheet values (e.g. total loans) that share a common time trend. To convert ratio forecasts back into income component projections, the CLASS model applies historical average balance sheet growth rates to forecast the asset levels used to construct income forecasts in the stress scenario.

The within-sample fits of the individual models that comprise the Federal Reserve CLASS model are all exceptional. Many individual CLASS regression models have adjusted R<sup>2</sup> statistics close to 90 percent.

When it comes to loan and lease loss provision expenses, the CLASS model deviates from the stepwise regression methodology. CLASS loan and lease loss provision estimates are not calibrated to reproduce actual reported historical loan and lease loss provisions but instead are generated by a regulatory algorithm summarized in section A2 in the Appendix.

In the analysis that follows, I construct a 5-equation version of a CLASS-style model. I decompose INBFTXEX into 5 components: net interest income to assets (NIM); non-interest

<sup>&</sup>lt;sup>16</sup> That is, it identifies the coefficient estimate with the largest t-test p-value.

income to assets (NONII); non-interest expense to assets (NONIX); securities gains (losses) to assets (IGLSEC); and, loan and lease loss provisions to assets (ELNATR).

$$INBFTXEX = NIM + NONII + IGLSEC - NONIX - ELNATR$$
(1)

Each equation is modeled independently of the other equations using a stepwise regression algorithm that maximizes the regression  $R^2$ .<sup>17</sup> Unlike the New York Federal Reserve CLASS model, my CLASS-style model includes a regression model for the ratio of loan and lease loss provisions to assets using the actual historical loan and lease loss provision data as the dependent variable. I do not use the *ad hoc* CLASS model provisioning methodology because my goal is to estimate models that reproduce, as closely as possible, the actual loan and lease loss provision data reported by banks.

## 3.2 A Bayesian Model Average Stress Test Model

When there are numerous potential explanatory variables and significant uncertainty regarding which subset of variables are most likely to have the greatest predictive power, it is well-known that techniques like stepwise regression can over-fit the data and produce spurious model specifications.<sup>18</sup> Bayesian model averaging is a conceptually attractive alternative to CLASS-style data-driven specification searches and the Bayesian approach may have superior forecast accuracy in at least some empirical applications.<sup>19</sup> Given an appropriate prior distribution over the set of possible linear model specifications, Bayes rule and Markov chain Monte Carlo techniques can be used to process the data and produce, among other information, (i) an estimate of the posterior probability that each variable appears in the stress test model and, (ii) the expected value of a coefficient's posterior probability density given the observed data and the universe of possible stress test model specifications considered. These posterior estimates can be used to construct stress test model specifications considered. These posterior estimates can be used to construct stress test model specifications.

<sup>&</sup>lt;sup>17</sup> The explanatory variable with the largest p-value is dropped, and the regression is re-estimated. The process continues until the regression  $R^2$  reaches a maximum. This is algorithm is equivalent to dropping variables sequentially as long as the largest coefficient p-value exceeds 0.32.

<sup>&</sup>lt;sup>18</sup> For example, Freedman (1983) shows that, even in an extreme case when there are a large number of explanatory variables that are completely independent of the dependent variable, stepwise regression will sequentially eliminate variables and find spurious specifications with statistically significant coefficient estimates and misleadingly high  $R^2$  values.

<sup>&</sup>lt;sup>19</sup> See for example Min and Zellner (1993), Raftery, Madigan and Hoeting (1997), or Faust, Gilchrist, Wright and Zakrajšek (2013).

The logic behind forecasts using Bayesian model averaging in the linear model setting follows. Assume that the quantity of interest is the expected value of a random variable  $\tilde{y}$  given an observation on a set of explanatory variables X,  $E(\tilde{y}|X)$ , but that little is known about the relationship other than  $\tilde{y}$  and X are linearly related. Assume that X includes K explanatory variables in addition to a constant.

The most general linear model is,

$$\tilde{y} = X\beta + \tilde{\varepsilon},\tag{2}$$

where  $\tilde{y}$  is an  $(N \times 1)$  vector of observations on the dependent variable, X is a  $N \times (K + 1)$  vector of observations on the explanatory variables,  $\beta$  is an  $(K + 1 \times 1)$  vector of coefficients and  $\tilde{\varepsilon}$  is an  $(N \times 1)$  vector of homoscedastic independent normal random variables, with elements  $\tilde{\varepsilon}_i \sim N(0, \sigma^2)$ , where N(a, b) represents a normal density with mean 'a' and variance 'b'.<sup>20</sup> When K is large relative to N, to avoid overfitting the data it may be advantageous to model  $\tilde{y}$  using only a subset of the variables in X. However, a researcher may lack prior information regarding which variables in X are the most appropriate to exclude from the equation.

If a constant is included in all admissible specifications, there are  $2^{K}$  possible unique regression models that can be estimated using subsets of *K* explanatory variables. In the case of the CLASS-style models considered in this paper, including a lagged exogenous variable, there are 26 possible explanatory variables (excluding the constant) that can be included in each model. Thus, each of the five component CLASS-style models has more than 67 million possible linear model specifications that can be estimated using the available data.

Let D represent the data on y and X. Let  $M_{\gamma}$  be an  $(K + 1) \times (K + 1)$  diagonal matrix with elements  $\{1, \iota_2(\gamma), \iota_3(\gamma), \iota_4(\gamma), \dots, \iota_{R+1}(\gamma), \}$ . Each element  $\iota_j(\gamma)$  is an indicator variable that takes on a value of 0 or 1,  $\iota_j(\gamma) \in [0,1] \forall \gamma, j$ . Let  $X_{\gamma}$  be the matrix comprised of the nonzero columns of  $XM_{\gamma}$ , and  $\beta_{\gamma}$  represent the non-zero coefficients in  $M_{\gamma}\beta$ . Model  $M_{\gamma}$  can be written,  $\tilde{\gamma} = XM_{\gamma}M_{\gamma}\beta + \tilde{\varepsilon}_i = X_{\gamma}\beta_{\gamma} + \tilde{\varepsilon}$ .

<sup>&</sup>lt;sup>20</sup> In the multivariate setting in equation (5) below, 'a' is the mean vector and 'b' is the variance-covariance matrix.

Let M be the complete set of unique model parameter permutations  $\{M_{\gamma}\}$  that include a constant. If  $p(\tilde{z})$  represents a generic probability density of random variable  $\tilde{z}$ , and  $p(z_i)$  the probability that  $\tilde{z} = z_i$ , it follows that  $p(M_{\gamma})$  is the probability that model  $M_{\gamma}$  is the true model. Model uncertainty is explicitly recognized by imposing a prior density on the space of possible models M. The expression for expected value of  $\tilde{y}$  given the data, *D*, is given by,

$$E(\tilde{y}|D) = \sum_{\forall M_i \in M} E(\tilde{y}|M_i, D) p(M_i|D),$$
(3)

where  $E(\tilde{y}|M_i, D)$  is the expected value of the posterior density for  $\tilde{y}$  conditional on model specification  $M_i$ , prior assumptions regarding probability densities for the parameters in model  $M_i$  and the observed data D.  $p(M_i|D)$  is the posterior probability that model  $M_i$  is the true model. Bayes rule implies,

$$p(\mathbf{M}_{i}|D) = \frac{p(D|\mathbf{M}_{i}) p(\mathbf{M}_{i})}{\sum_{i=1}^{2^{K}} p(D|\mathbf{M}_{j}) p(\mathbf{M}_{j})}.$$
(4)

Equation (3) is the formula for constructing a Bayesian model average forecast. In the Bayesian framework, the optimal linear model forecast of the expected value of  $\tilde{y}$  given the data D is the weighted average of all possible forecasted values of the expected value of  $\tilde{y}$  conditional on D, where the average is taken across all possible linear model specifications that can be constructed from the set of K explanatory variables. The weight attached to each forecast is the model's estimated posterior probability.

To estimate (3) one must specify prior probabilities for each of the  $2^{K}$  models including prior probability densities for the parameters in each model. I adopt priors density assumptions that have been used in the literature.<sup>21</sup> For the standard deviation of the model error term  $\sigma$ , I adopt the uniform improper prior,  $p(\sigma) \propto \frac{1}{\sigma}$ . For the prior density of  $\beta_{\gamma}$ , I adopt Zellner's gprior, with g = N, the number of observations in the estimation sample,

$$f(\beta_{\gamma}|g) \sim N\left(0, \sigma^{2}\left(\frac{1}{N}X_{\gamma}'X_{\gamma}\right)^{-1}\right).$$
(5)

<sup>&</sup>lt;sup>21</sup> See for example, Raftery, Madigan and Hoeting (1997), Fernández, Ley and Steel (2001), or Ley and Steel (2009).

Under this prior,  $E(\tilde{y}|M_{\gamma}, D) = {N \choose N+1} X_{\gamma} \hat{\beta}_{\gamma}$ , where  $\hat{\beta}_{\gamma}$  is the ordinary least squares estimate of  $\beta_{\gamma}$ ,  $\hat{\beta} = (X_{\gamma}^T X_{\gamma})^{-1} X_{\gamma}^T y$ . The choice of g = N reflects low prior confidence in the assumption that the linear model coefficients are centered on 0 and allows the model's posterior estimates to be data-driven and not severely constrained by the 0 mean prior assumption.<sup>22</sup>

For the prior density over the set of possible model specifications, I follow Fernández, Ley and Steel (2001) and Ley and Steel (2009) and assume a binomial distribution over the parameter space. I assume each variable has a fixed probability of appearing in the model irrespective of other variables in the model. A linear model that includes h + 1 explanatory variables (including the constant) has a prior probability of  $\theta^h (1 - \theta)^{K-h}$ . I set  $\theta = \frac{6}{26}$ , so that the expected number of explanatory variables in an equation is 7 (6 plus a constant).<sup>23</sup> These priors are consistent with the finding of Kupiec (2018), that simple parsimonious stress test models are more likely to produce more accurate out-of-sample forecasts.

The Bayes factor is defined as the ratio of the marginal likelihoods of two alternative models. Assume that the rank of  $M_i = k_i$ , and the rank of  $M_j = k_j$ . Let  $l_y(M_i|D)$  be the likelihood that model  $M_i$  is true after incorporating the information in the data D, and  $l_y(M_j|D)$  be the likelihood that model  $M_j$  is true after observing D. Under the prior density assumptions, Ley and Steel (2009) derive the Bayes factor,

$$\frac{l_{y}(M_{i})}{l_{y}(M_{j})} = (N+1)^{\frac{k_{j}-k_{i}}{2}} \left(\frac{1+\frac{1}{N}-R_{i}^{2}}{1+\frac{1}{N}-R_{j}^{2}}\right)^{-\frac{N-1}{2}},$$
(6)

where  $R_{\gamma}^2 = 1 - \left[\frac{y^T (I_{(N \times N)} - X_{\gamma} (X_{\gamma}^T X_{\gamma})^{-1} X_{\gamma}^T) y}{(y - \bar{y}_{(N \times 1)})^T (y - \bar{y}_{(N \times 1)})}\right]$ ,  $\bar{y} = \frac{1}{N} \sum_{i=1}^N y_i$ ,  $X_{\gamma}$  is the data design matrix with dimension  $\left(N \times rank(M_{\gamma})\right)$  and the notation for  $\bar{y}$  is augmented to reflect that it is a vector of length N. The marginal likelihood for model  $M_i$  is given by,

 $<sup>^{22}</sup> g = N$  is the default setting in Feldkircher and Zeugner (2015) Bayesian model averaging open source R-code (Package 'BMS') which was the software I used to estimate the Bayesian models in this paper. The simulation results reported in Fernández, Ley and Steel (2001) suggest that when  $N < R^2$ , it may be preferable to place even less emphasis of the prior density assumption and set  $g = K^2$ . I have not assessed the sensitivity of the Bayesian estimates reported in this paper to a change in the value of g.

<sup>&</sup>lt;sup>23</sup> Under the binomial prior, the expected number of explanatory variables in an equation (not counting the constant) is  $\theta \times K$ .

$$l_{y}(\mathbf{M}_{i}) = \frac{(N+1)^{-\frac{rank(\mathbf{M}_{i})-1}{2}} \left(1 + \frac{1}{N} - R_{i}^{2}\right)^{-\frac{N-1}{2}}}{\sum_{j=1}^{2^{K}} \left((N+1)^{-\frac{rank(\mathbf{M}_{j})-1}{2}} \left(1 + \frac{1}{N} - R_{j}^{2}\right)^{-\frac{N-1}{2}}\right)},$$
(7)

The product of the marginal likelihood and the model prior probability produce the posterior probability. For model  $M_i$ , this posterior probability is,  $l_y(M_i) \times \theta^{rank(M_i)}(1-\theta)^{K-rank(M_i)}$ .

Given a new observation on the K dimensional vector X,  $X^i$ , the Bayesian model average forecast value of y,  $\hat{y}^i$  is given by,

$$\hat{y}^{i} = \sum_{j=1}^{2^{K}} \left( \frac{N}{N+1} \right) X_{j}^{i} \hat{\beta}_{j} \times l_{y} \left( \mathsf{M}_{j} \right) \times \theta^{rank(\mathsf{M}_{j})} (1-\theta)^{K-rank(\mathsf{M}_{j})}.$$

$$\tag{8}$$

Expressions (7) and (8) are cumbersome to enumerate as they require estimates for  $2^{K}$  regression models<sup>24</sup> and the summation of  $2^{K}$  product terms that use output from the regressions.

The posterior model likelihoods and Bayesian model average coefficient estimates can be recovered from the sampling output of a Markov Chain Monte Carlo algorithm (MCMC). I use the birth-death MCMC algorithm in the open source R-code "Package 'BMS'" written and maintained by Feldkircher and Zeugner.<sup>25</sup> Birth-death algorithms [Stephens (2000) and Cappé, Robert and Rydén (2003)] randomly sample the parameter space to ensure that an MCMC sampler has good coverage over the entire range of permissible parameter values. I estimate the parameters of each Bayesian stress test model using 500,000 MCMC sample observations after 1000 initial burn-in observations are discarded.

## 3.3 A Parsimonious Lasso Stress Test Model

Kupiec (2018) analyzed the predictive accuracy of a CLASS-style representative bank stress test model and found that this complex disaggregated modelling approach includes spurious explanatory variables that diminish the model's out-of-sample forecasting performance. He shows that the forecasting accuracy of the CLASS representative bank stress test model can be substantially improved using a parsimonious modelling approach that uses (i) a single equation; (ii) only macroeconomic and financial market variables as explanatory variables; and,

<sup>&</sup>lt;sup>24</sup> They require 67,108,864 regressions.

<sup>&</sup>lt;sup>25</sup> The Package "BMS" version I use is date 11/24/2015.

(iii) Tibshirani's (1996) Lasso algorithm and the Akaike (1973) information criterion (AIC) to calibrate the model.<sup>26</sup>

The Lasso is designed to reduce the risk of overfitting the data and including spurious explanatory variables. It has the potential to reduce ordinary least squares forecast errors but produces biased estimates of the model coefficients.<sup>27</sup> Lasso minimizes the model's mean square error while simultaneously imposing a penalty on the sum of the absolute values of the model's coefficient estimates. Let  $y_t$  represent a dependent variable observation,  $x_{it}$  represents an observation on the  $i^{th}$  explanatory variable,  $\delta_i$  represents the coefficient on the  $i^{th}$  explanatory variable and  $\delta$  be the vector of coefficients,  $\delta_i$ . Zou, Hastie and Tibshirani (2007) show that the Lasso coefficient estimates satisfy,

$$\hat{\delta} = \arg\min_{\delta} \left[ \left( \sum_{t=1}^{T} \left( y_t - \sum_{i=1}^{p} x_{it} \delta_i \right) \right) + \gamma \sum_{i=1}^{p} |\delta_i| \right]$$
(9)

The Lasso imposes a soft-threshold condition on the coefficient estimates. Coefficient estimates are set to zero unless the estimate's absolute value exceeds a threshold set by the penalty rate. If the penalty rate is set to zero, Lasso produces ordinary least squares estimates. If the penalty rate is set sufficiently high, Lasso will set all coefficient estimates to zero.

I estimate a Lasso model that includes only macroeconomic and financial market factors as explanatory variables.<sup>28</sup> Bank-specific characteristics are excluded as explanatory because the regulatory standard is to freeze the values of these variables throughout the stress test period when in reality these variables are endogenous. Kupiec (2018) shows omitting these variables improves forecast accuracy. I estimate the Lasso models using the Wu and Lange (2008) coordinate decent algorithm over the global grid of relevant Lasso penalty rates and calculate the AIC estimate following Zou, Hastie and Tibshirani (2007). The preferred model is the Lasso penalty rate and Lasso coefficient estimates that minimize the AIC.

<sup>&</sup>lt;sup>26</sup> The finding that simpler models often produce more accurate forecasts is consistent with a large literature in forecasting and statistics. See for example, Flynn, Hurvich, and Simonoff (2017), Forster (2000, 2001), Forester and Sober (1994), or Green and Armstrong (2015).

<sup>&</sup>lt;sup>27</sup> As a consequence, the statistical significance of individual Lasso coefficient estimates is not an important modelling consideration.

<sup>&</sup>lt;sup>28</sup> There is no intercept term in a Lasso model because means are removed from all variables.

# 4. Stress Test Model Estimates

Each alternative stress test model was estimated using quarterly data from June 1993 through June 2008.<sup>29</sup> In the case of individual bank models, the data was merger-adjusted through June 2008. These individual stress test model estimates are used to construct out-of-sample forecasts of bank performance under the specified stress scenario conditions.

Tables A1-A5 report the CLASS-style model estimates for the five component ratios that comprise INBFTXEX—NIM, NONII, NONIX, ELNATR and IGLSEC. Each table includes, in the first column, CLASS-style model estimates for the representative bank data followed by the CLASS-style model estimates for each individual bank. Each of the CLASS-style representative bank models has an excellent within-sample fit. The model with the poorest fit, noninterest expense to assets (NONIX), has an adjusted R-squared in excess of 75 percent. The model estimates for loan and lease loss provision expense, a critical component determining losses in a stress scenario, has an adjusted R-squared of nearly 94 percent.

With few exceptions, the bank-specific CLASS-style models exhibit lower adjusted R<sup>2</sup> statistics comparted to their representative bank counterparts. The coefficients in these model also tend to emphasize a different set bank characteristics relative to the representative bank model. For example, among the bespoke NIM models, JPMorgan Chase, Bank of America, BB&T and State Street each include only one of the non-zero bank-specific factors that are included in the representative bank model, and for two of these banks, Bank of America and State Street, the single common bank-specific factor has a different coefficient sign than appears in the representative bank model. Such differences are to be expected if the individual banks are heterogeneous in their exposures and business operations.

Table A6 reports the estimates from the Bayesian average stress test model. The correlation between the posterior model likelihoods and MCMC sampling frequencies for the best 500 models sampled by the MCMC algorithm are all greater than 98 percent indicating that the post burn-in sample size of 500,000 is adequate for replicating the posterior density.

<sup>&</sup>lt;sup>29</sup> As discussed in the subsequent section, the construction of stress test forecasts may require estimates of additional stress test models to be used to adjust forecasts for mergers consummated within the stress test period. While these additional models are estimated and their estimates are used to construct stress test forecasts, I do not report the estimates for these additional models in this paper.

Estimates for the representative bank model are reported in the first column of Table A6 while subsequent columns report estimates for each individual bank.

The estimates in Table 6 show a high degree of heterogeneity across the representative bank and individual bank models. A comparison of the explanatory variables' posterior inclusion probabilities and the expected value of their coefficient estimates suggests that there is unlikely to be a "one-size fits all" stress test model for these banks. The representative bank posterior model probability density has an expected number of explanatory variables equal to 5.97 whereas, excepting Citibank, the individual bank models are all expected to include a smaller number of the explanatory variables. The posterior probability that each explanatory variable appears in a model, and the expected value of the posterior coefficient probability density also differs substantially among individual banks and the representative bank model. For example, estimates suggest that there is nearly a 100 percent posterior probability that the notional value of the derivative-to-assets ratio should be included in the representative bank's model and yet the posterior probability of inclusion is less than 50 percent for each of the individual banks excepting Regions bank. Conversely, the representative bank has less than 5 a percent posterior probability that the Wilshire daily return standard deviation should be included in its stress test model whereas the posterior distribution suggests that there is nearly a 99.5 percent probability this variable should be included for BB&T.

The Lasso stress test model estimates are reported in Table A7. A comparison of the columns in Table A7 will again show large differences among individual bank models as well as between estimates for the individual bank models and the representative bank model. For example, SunTrust and RBS have only three explanatory variables in their preferred Lasso models (and a different set of three variables at that) while at the other extreme, HSBC, Bank of America and the representative bank include all of the explanatory variables in their preferred Lasso stress test model specifications.

## 5. Stress Test Forecast Construction

Forecasts from the alternative stress test models are constructed for the first 12-quarters of the 2008 financial crisis (September 2008-June 2011). The stress test forecasts are true out-of-sample forecasts based on the actual quarterly values of the financial market and macroeconomic factors over the 12-quarter stress period. In the initial forecast quarter (September 2008), lagged

dependent variables are set equal to June 2008 values. In subsequent quarters, lagged dependent variables are set equal to lagged forecast values.

Bank-specific explanatory variables are endogenous, but regulatory stress tests typically do not model or forecast these variables. The approach taken by the Federal Reserve is to hold these variables fixed at their June 2008 values throughout the stress scenario and my forecasts are calculated using this Fed convention.

Many of the large banks I examine acquired banks during the first 12 quarters of the financial crisis. Mergers complicate the process of evaluating the accuracy of 12-quarter forecasts. When the acquired bank is merged, the acquiring institution's Call report data are augmented to reflect the deposits, loans, securities and other characteristics of the newly-merged institution. A 12-quarter forecast made using initial conditions set equal to the bank's June 2008 call report data cannot be expected to accurately forecast the bank's INBFTXEX at a subsequent quarter should the bank acquire assets and liabilities from a merging institution.

Representative bank stress test model coefficient estimates are not impacted by mergers. The assets of a merged bank remain in the banking system and are merely transferred an acquiring institution and the transfer does not impact the representative bank's data. However, mergers do impact forecasts from the representative bank model by altering a bank's initial conditions for the stress test forecast. When a merger occurs within the stress scenario, forecasts must be assembled from forecasts for each merged-bank combination that is consummated within the stress period.

Figure 1 illustrates how the representative bank model stress test forecast for bank A is adjusted to account for acquisitions the bank makes within the stress test period. In the example in Figure 1, Bank A acquires Bank E in 2008 Q3, Bank F in 2008 Q4, Bank G in 2009 Q1 and Bank H in 2009 Q2. The first stress test quarter forecast, 2008 Q3, uses representative bank model coefficient estimates using data through June 2008 as well as June 2008 data to construct forecast initial conditions. When there are mergers in the stress test interval, it is necessary to construct 2008 Q2 initial conditions for each of the merger-augmented banks.<sup>30</sup> The 2008 Q2 initial conditions for these combined banks along with the coefficient estimates of the

<sup>&</sup>lt;sup>30</sup>In the case of Figure 3, this requires calculating initial conditions for four merger-augmented banks: banks A and E; banks A, E and F; banks A, E, F and G; banks A, E, F, G, and H.

representative bank model are used to construct 12-quarter stress test forecasts for each mergeraugmented bank.

А ———						<b>→</b>							
Е			Ť	Ť	Î								
F													
G													
н													
	2008 Q2	2008 Q3	2008 Q4	2009 Q1	2009 Q2								
	Initial												
	Conditions	Summation o	of banks' 2008 Q2	Call report dat	a needed to c	onstruct merger-							
quarter	mnemonic		adjusted in	nitial forecast c	onditions								
2008 Q3	8Q3	Bank A + Bank E											
2008 Q4	8Q4		Bank A	A + Bank E + B	Bank F								
2009 Q1	9Q1		Bank A + Bank E + Bank F + Bank G										
2009 Q2	9Q2		Bank A + Bank H	E + Bank F + B	ank G + Bank	сH							
	Co	onstruction of a	Merger-Adjusted	Stress Test Fo	recast								
Forecast Initial			Fore	cast Quarter									
Conditions	20	08 Q3	2008 Q4	200	9 Q1	2009 Q2							
2008 Q3	F(200	8Q3,8Q3)	F(2008Q4,8Q3)	F(2009	Q1,8Q3)	F(2009Q2,8Q3)							
2008 Q4	F(200	8Q3,8Q4)	F(2008Q4,8Q4)	F(2009	Q1,8Q4)	F(2009Q2,8Q4)							
2009 Q1	F(200	8Q3,9Q1)	F(2008Q4,9Q1)	F(2009	Q1,9Q1)	F(2009Q2,9Q1)							
2009 Q2	F(200	8Q3,9Q2)	F(2008Q4,9Q2)	F(2009	Q1,9Q2)	F(2009Q2,9Q2)							
Merger-Adjusted	F(200	8Q3,8Q3)	F(2008Q4,8Q4)	F(2009	Q1,9Q1)	F(2009Q2,9Q2)							

Figure 1: Merger-adjusting Stress Test Initial Conditions

Stress Test Forecast

Notes: The notation F(t,IC) represents a dynamic stress test forecast for quarter t based on the initial forcast conditions IC.

The merger-adjusted stress test forecast is constructed using selected quarters from each of the forecasts of the merger-combined banks. In the example in Figure 1, the merger-adjusted stress test forecast uses the 2008 Q3 forecast for union of bank A and E, [F2008Q3,8Q3)]; the 2008 Q4 forecast for the union of banks A, E and F, [F(2008Q4,8Q4}]; the 2009 Q1 forecast for the union of banks A, E, F and G, [F(2009Q1,9Q1)]; and the 2009 Q2 forecast for the union of banks A, E, F, G and H, [F(2009Q2,9Q2)]. If there are no additional mergers in the forecast period, the remaining forecasts are the subsequent quarterly forecasts for the union of banks A, E, F, G and H, [F(2009Q3,9Q2), F(2009Q4,9Q2),...]. Depending on a bank's merger history during the stress period, the merger adjustment process could require the construction of as many

as 12 separate merger-augmented bank forecasts to be used as inputs into the construction of the merger-adjusted forecast.

When stress test forecasts are made using a bank-specific stress test model, the mergeradjustment process is more complex because the bank-specific stress test model coefficient estimates must also be merger-adjusted. Referencing Figure 1, this requires the construction of merger-adjusted data for each of the four merger-augmented banks for the period 1993 Q2 through 2008 Q2 and estimating separate stress test models for each bank-combination. Stress test model coefficient estimates for the merger-augmented banks along with appropriate initial conditions (calculated as in Figure 1) are used to generate 12-quarter stress test forecasts for each merger-augmented bank. The merger-adjusted stress test forecast is assembled from the forecasts of these merger-augmented banks using the same process outlined in Figure 1. Again, depending on the merger history in the stress test period, merger adjusting a bank's stress test forecast could require estimating up to twelve merger-augmented stress test models, twelve sets of merger-augmented initial conditions, and extracting appropriate quarterly forecasts from as many as a dozen 12-quarter stress scenario forecasts.

A bank's equity-to-asset ratio calculated from Call reports data will include the impact of mergers, taxes, dividend payments, share repurchases, asset sales and new capital injections. To evaluate the accuracy of alternative stress test models it is necessary to purge the impact of these factors from a bank's reported equity-to asset ratio. Bank's reported equity-to-asset ratios can be corrected for the aforementioned factors by using the bank's INBFTXEX to dynamically adjust the bank's June 2008 reported equity-to-asset ratio. Assuming that, during the stress scenario, the bank forgoes making any capital distributions (dividends or share buybacks), does not raise any new external capital, undertake any assets sales, pay taxes or receives tax refunds, and reinvests any profits and absorbs any losses by scaling up or down its existing equity, investments and operations, it can be shown<sup>31</sup> that the bank's equity-to-asset ratio evolves as,

$$\frac{equity_t}{assets_t} = \left(\frac{equity_{t-1}}{assets_{t-1}} + INBFTXEX_t\right) / (1 + INBFTXEX_t)$$
(10)

Using a bank's reported June 2008 equity-to-asset ratio and a bank's actual and forecasted quarterly values of INBFTXEX over the stress scenario, equation (10) can be used to project the

<sup>&</sup>lt;sup>31</sup> See Appendix 1.

evolution of the bank's equity-to-asset ratio over the course of the stress test scenario under passive operating assumptions. Since this approach begins with a bank's capital position as of June 2008 and then adjusts the capital ratio dynamically using only additions and subtractions generated by the bank's quarterly INBFTXEX, these estimates are free from any distortion introduced by capital injections from mergers of government assistance programs like TARP.<sup>32</sup> Equation (10) assumes that any mergers that take place during the stress period do not augment or diminish the bank's equity-to-asset ratio except through their impact on INBFTXEX.

The top panel of Table 4 reports banks' reported equity-to-asset ratios calculated using Call report data. The bottom panel of Table 4 reports banks' baseline equity-to-asset ratios calculated using equation (10), June 2008 Call report bank equity and total asset values, and banks' subsequent values of INBFTXEX calculated from Call report data.

The passive operating assumptions embodied in equation (10) produce baseline capital ratio estimates that differ from those calculated directly from Call report data. Focusing on the baseline estimates, the equity-to-asset ratios of Bank of New York and HSBC both fall below the 6 percent minimum during the stress period. To maintain the required 6 percent baseline ratio throughout the stress period under the passive operating assumptions, Bank of New York would need an additional \$91,000,000 in equity capital as of June 2008<sup>33</sup>; HSBC would need an additional \$60,000,000<sup>34</sup>. In reality, when actual mergers, dividends, share buybacks, assets sales, capital injections and taxes are appropriately taken into account as they are in the Call report data, Bank of New York and State Street were the only two banks to break the 6 percent threshold over the stress test period.

## 6. Stress Test Results

The results of the stress test exercise are reported in Tables 5 through 10. The top panel of each table reports merger-adjusted quarterly forecasts of INBFTXEX for each bank. The bottom panel reports quarterly estimates of each banks' equity-to-asset ratio estimated using

<sup>&</sup>lt;sup>32</sup> TARP capital injections were made at the holding company level, not at the bank level. However, the bank holding company could, if needed or deemed desirable, pass some (or all) of the new TARP capital down to the bank.

<sup>&</sup>lt;sup>33</sup> Equivalently, it would need to start the stress test with an equity-to-asset ratio of 7.24 percent.

<sup>&</sup>lt;sup>34</sup> The additional capital would raise the bank's initial equity-to-asset ratio to 7.03 percent.

equation (10), June 2008 initial equity-to-asset values, and stress test merger-adjusted forecasts of each banks' INBFTXEX.

Table 5 reports stress test results for the CLASS-style representative bank stress test model. This model produces, by far, the most pessimistic stress test forecasts. Six banks are projected to fail the stress test: JPMorgan Chase, Bank of American, Citibank, Bank of New York, State Street, and HSBC. In total, this model predicts that these banks will need more than \$924 billion in new equity capital as of June 2008 to pass the stress test under the passive operating loss assumptions.

Table 6 includes the results for the bank-specific CLASS-style models. When banks use their own historical data to parameterize a CLASS-style model, only two banks fail the stress test: JPMorgan Chase and Bank of New York. Moreover, when individual bank data are used to calibrate the model, the capital shortfalls of these banks seems far less severe than the shortfall estimate from the representative bank model. Model estimates suggest that these two banks would need a combined \$28.78 billion in new equity capital as of June 2008 to pass the stress test.

The results of the representative bank Bayesian stress test model appear in Table 7. Forecasts from this model predict the failure of four banks: JPMorgan Chase, Bank of America, Citibank and HSBC. The estimates suggest that, in aggregate, these four banks will need nearly \$482 billion in new equity capital to survive the stress test. In contrast, when the Bayesian modelling approach is applied to individual bank data, the results in Table 8 suggest that all of the banks will pass the stress test with comfortable margins of excess equity capital.

The stress test results for the representative bank Lasso model are reported in Table 9. The stress test estimates from this model suggest that all fourteen banks pass the stress test. The smallest projected stress scenario equity-asset ratio among the fourteen banks considered is a ratio of 7.40 percent, the 2009 Q2 forecast for Citibank. In contrast to these highly optimistic forecasts, the bank-specific Lasso stress test model forecasts suggest that two banks will fail the stress test: Bank of New York and HSBC. The bank-specific Lasso model approach is the only stress test approach among the methodologies considered that correctly identifies the two banks whose baseline estimates fail the stress test. However, the approach overestimates the capital these two banks need to pass the stress test. The bank-specific Lasso model estimates suggest that these two banks need, in total, a little over \$3 billion in additional equity to pass the test

while the baseline estimates (Table 4) suggest that only \$151 million of additional equity is required.

# 7. Summary and Conclusions

This paper investigates the accuracy of three alternative stress test model methodologies when they are used to predict the quarterly equity-asset ratios of fourteen of the largest US banks over a three-year period that includes the worst financial crisis and economic recession in modern US history. It compares the accuracy of complex CLASS-style stress test models to two alternative parsimonious stress test methodologies: a Bayesian model average approach and a stress test model calibrated using the least absolute shrinkage and selection (Lasso) algorithm.

For all three methodological approaches considered, individual bank forecasts constructed from models calibrated using representative bank data are substantially less accurate compared to models calibrated using a bank's own historical data. The results question the propriety of the regulatory practice of evaluating banks' own stress test projections using forecasts from a regulatory model calibrated using representative bank data. For a number of the individual banks and stress scenario analyzed in this paper, two of the three approaches (CLASS and Bayesian model averaging) vastly overstate bank losses when forecasts were constructed using representative bank model estimates. In the third methodology considered, the representative bank Lasso model failed to detect the failure of two banks that were accurately identified when the Lasso model was calibrated using each bank's own historical data.

For the specific banks and the period analyzed, the bank-specific Lasso models provide the most accurate assessment of bank capital adequacy. Unfortunately, the superior accuracy of the bank-specific Lasso approach cannot be identified *ex ante*— one must wait and compare forecasts with baseline bank performance. Moreover, the analysis in this paper is a one-off case study. From this exercise alone, it is impossible to know whether bank-specific Lasso models will maintain their accuracy advantage in future stress situations.

These stress test exercises require significant resources and complex econometric computations and yet they do not provide any new information that reliably identifies *ex ante* which of the fourteen participating banks are undercapitalized against the impending stress or how much additional capital banks might need to ensure their continued solvency. From the

perspective of forecast accuracy, the social value-added of mandating stress test exercises is unclear, even if stress tests are implemented on the eve of a financial crisis and the hypothetical stress scenario accurately anticipates the actual economic and financial market conditions that prevail over the stress scenario interval. The results provide new insight into the degree policy uncertainty that is inherent in using dynamic stress tests to set minimum bank capital requirements.

# Appendix

## A1. Representative Bank Data

The representative bank's performance and time-varying characteristics are measured by asset-weighted banking system average values. Let  $w_{it}^{j}$  represent the value of bank income or operating characteristic j for bank i at quarter t. Let  $a_{it}$  represent the total assets of bank i at quarter t and  $A_t$  represent the total value of all insured depository institutions' assets at quarter t,  $A_t = \sum_{\forall i} a_{it}$ . Then, for every t, and bank characteristic j, the average system-wide variable-j-to-asset ratio is defined as,

$$\sum_{\forall i} \left( \frac{w_{it}^j}{a_{it}} \right) \frac{a_{it}}{A_t} = A_t^{-1} \sum_{\forall i} w_{it}^j$$
(A1)

## A2. CLASS Model Algorithm for Loan and Lease Loss Provisions

The New York Federal Reserve Bank's CLASS model provisions for loan and lease losses are driven by econometric models that estimate the write-off rates on 15 separate categories of loan and leases.<sup>35</sup> Using the stress scenario assumptions for macroeconomic variables and the 15 individual loss rate model coefficient estimates, the CLASS model forecasts quarterly loan and lease write-off amounts for each of the 15 loan and lease categories, and then aggregates them by quarter.

<sup>&</sup>lt;sup>35</sup> Models that estimate loan and lease writes include First lien and junior lien residential mortgages, home equity lines of credit (HELOC), construction loans, multifamily and non-farm non-residential commercial mortgages, credit cards, other consumer loans, commercial and industrial (C&I) loans, leases, loans to foreign governments, loans to depository institutions, agriculture loans, other real estate loans, and all other loans. <sup>35</sup> Quarterly loan and lease write-off amounts are scaled by loan and lease initial balances.

Let  $LWO_t$  represent the aggregate CLASS model loan and lease write-off estimate for quarter t in the stress scenario. Let  $SLWO_t$  represent the CLASS model estimate of the aggregate loan and lease loss write-offs over the next four stress scenario quarters,

$$SLWO_t = LWO_t + LWO_{t+1} + LWO_{t+2} + LWO_{t+3}$$
(A2)

Let  $ALLL_t$  represent the balance sheet value of the bank's allowance for loan and lease losses at stress test quarter t. If  $PrLLL_t$  represents the estimated value of the bank's aggregate loan and lease loss provision for quarter t. The estimate for  $PrLLL_t$  is given by,

$$PrLLL_{t} = \begin{cases} SLWO_{t} - ALLL_{t}, \text{ if } ALLL_{t} < SLWO_{t} \\ LWO_{t}, \text{ if } SLWO_{t} < ALLL_{t} \leq 2 \times SLWO_{t} \\ 2 \times SLWO_{t} - ALLL_{t}, \text{ if } ALLL_{t} > 2 \times SLOW_{t} \end{cases}$$
(A3)

## A2. Constructing bank equity-capital ratios using income-to-asset forecasts

In the paper, I make use of the following dynamic equality to forecast bank equity-asset ratios using initial conditions and forecasts of a bank's earnings before tax and extraordinary items (INBFTXEX),

$$\frac{equity_t}{assets_t} = \left(\frac{equity_{t-1}}{assets_{t-1}} + INBFTXEX_t\right) / (1 + INBFTXEX_t)$$
(A4)

The identify follows from two dynamic identities that will hold if the bank follows a passive operating strategy,<sup>36</sup>

$$equity_{t} = equity_{t-1} + assets_{t-1} \times INBFTXEX_{t}$$
$$assets_{t} = assets_{t-1} + assets_{t-1} \times INBFTXEX_{t}$$

The bank's ratio of equity to assets has the following dynamics,

$$\frac{equity_t}{assets_t} = \frac{equity_{t-1} + assets_{t-1} \times INBFTXEX_t}{assets_{t-1} + assets_{t-1} \times INBFTXEX_t}.$$
  
Multiplying by  $\left(\frac{\frac{1}{assets_{t-1}}}{\frac{1}{assets_{t-1}}}\right)$  yields equation (A4).

<sup>&</sup>lt;sup>36</sup> The assumptions are: (i) the bank forgoes making any capital distributions (dividends or share buybacks); (ii) the bank does not raise any new external capital or undertake any assets sales and retire debt of equity; and, (iii) the bank reinvests any profits and absorbs any losses by scaling up or down its existing equity, investments and operations.

# References

Akaike, H., 1973. "Information theory and an extension of the maximum likelihood principle." In, 2<sup>nd</sup> International Symposium on Information Theory, eds. B.N. Petrov and F. Csaki, Budapest: Akademiai Kiado, pp. 716-723.

Bhanot, M., B. Hirtle, A. Kovner, and J. Vickery, 2014. "The CLASS Model: A Top-Down Assessment of the U.S. Banking System," *Liberty Street Economics*, Federal Reserve Bank of New York, June.

Board of Governors of the Federal Reserve, 2012. "Comprehensive Capital Analysis and Review 2012: Methodology and Results for Stress Scenario Projections," Washington D.C., available at <u>https://www.federalreserve.gov/newsevents/press/bcreg/bcreg20120313a1.pdf</u>

Board of Governors of the Federal Reserve, 2016. "Dodd-Frank Act Stress Test 2016: Supervisory Stress Test Methodology and Results", Washington D.C., available at www.federalreserve.gov/bankinforeg/stress-tests/2016-Supervisory-Stress-Test-Framework-and-Model-Methodology.htm

Cappé, O., C. P. Robert, and T. Rydén, 2003. "Reversible jump, birth-and-death and more general continuous time Markov chain Monte Carlo samplers," Journal of the Royal Statistical Society Series B Statistical Methodology, Vol. 65, pp. 679–700.

Faust, Jon, Simon Gilchrist, Johnathan Wright and Egon Zakrajšek, 2013. "Credit spreads as predictors of real-time economic activity: a Bayesian model-averaging approach," Review of Economics and Statistics, Vol. 95, No. 5, pp. 1501-1519.

Federal Deposit Insurance Corporation, *Statistics on Depository Institutions*. Available at <u>https://www5.fdic.gov/sdi/main.asp?formname=compare</u>

Federal Reserve Bank of St. Louis. FRED economic data. https://fred.stlouisfed.org/

Feldkircher, Martin and Stefan Zeugner, 2015. "Package'BMS". http://bms.zeugner.eu/

Fernández, Carmen, Eduardo Ley, and Mark F.J. Steel, 2001. "Benchmark priors for Bayesian model averaging," Journal of Econometrics, Vol 100, pp. 381-427.

Flynn, Cheryl, Clifford Hurvich, and Jeffery Simonoff, 2017. "On the Sensitivity of the Lasso to the Number of Predictor Variables," *Statistical Science*, Vol. 32, No. 1, pp. 88-105.

Forster, Malcolm, 2000. "Key Concepts in Model Selection: Performance and Generalizability," *Journal of Mathematical Psychology*, Vol. 44, pp. 205-231.

Forster, Malcolm, 2001. "The new science of simplicity," in Simplicity, Inference and Modeling, Arnold Zellner, Hugo Keuzenkamp and Michael McAleer, editors. Cambridge: Cambridge University Press, pp. 83-117.

Forester, Malcolm and Elliott Sober, 1994. "How to Tell When Simpler, More Unified, or Less Ad Hoc Theories Will Provide More Accurate Predictions," *The British Journal for the Philosophy of Science*, Vol. 45, No. 1, pp. 1-35.

Freedman, David, 1983. "A Note on Screening Regression Equations," The American Statistician, Vol. 37, No. 2, pp. 152-155.

Green, K and J. S. Armstrong, 2015. "Simple versus complex forecasting: The evidence," *Journal of Business Research*, Vol. 68, No. 8, pp. 1678-1685.

Haste, Trevor, Robert Tibshirani, and Jerome Friedman, 2009. <u>The Elements of Statistical</u> <u>Learning: Data Mining, Inference and Prediction, Second Edition</u>. New York: Springer-Verlag.

Hirtle, B. A. Kovner, J. Vickery, and M. Bhanot, 2015. "Assessing Financial Stability: The Capital and Loss Assessment under Stress Scenarios (CLASS) Model," Federal Reserve Bank of New York Staff Report, No. 663 (July).

Hoeting, Jennifer, David Madigan, Adrian E. Raftery and Chris Volinsky, 1999. "Bayesian Model Averaging: A Tutorial," Statistical Science, Vol.14, No. 4, pp. 382-401.

Kupiec, Paul, 2018. "On the accuracy of alternative approaches for calibrating bank stress test models," Journal of Financial Stability, Vol. 38, pp. 132-146.

Ley, Eduardo, and Mark F.J. Steel, 2009. "On the effect of prior assumptions in Bayesian model averaging with applications to growth regression," Journal of Applied Econometrics, Vol. 24, pp. 651-674.

Liang, Feng, German Molina, Merlise A Clyde, and Jim Berger, 2008. "Mixtures of g priors for Bayesian Variable Selection," Journal of the American Statistical Association, Vol. 103, No. 481, pp. 410-423.

Min, C. and Zellner, A, 1993. "Bayesian and non-Bayesian methods for combining models and forecasts with applications to forecasting international growth rates," Journal of Econometrics, Vol. 56, No. 1-2, pp. 89–118.

Raftery, Adrian, David Madigan and Jennifer Hoeting, 1997. "Bayesian Model Averaging for Linear Regression Models," Journal of the American Statistical Association, Vol. 92, No. 437, pp. 179-191.

Robertson, J., E. Tallman and C. Whiteman, 2005. "Forecasting Using Relative Entropy, Journal of Money Credit and Banking, Vol. 37, No. 3, pp. 383-4001.

Sala-i-Martin, Xavier, Gernot Doppelhofer and Ronald Miller, 2004. "Determinants of Long-Term Growth: A Bayesian Averaging of Classical Estimates (BACE)," The American Economic Review, Vol. 94, No. 4, pp. 813-835.

Stephens, Matthew, 2000. "Bayesian analysis of mixture models with an unknown number of components—an alternative to reversible jump methods," The Annals of Statistics, Vol. 28, No. 1, pp.40-74.

Tarullo, Daniel, 2016. "Next Steps in the Evolution of Stress Testing," Remarks at the Yale University School of Management Leaders Forum (September 26), https://www.federalreserve.gov/newsevents/speech/tarullo20160926a.htm Tibshirani, R., 1996. "Regression shrinkage and selection via the Lasso," *Journal of the Royal Statistical Society B*, Vol. 58, pp. 267-288.

Wu, T. and K. Lange, 2008. "Coordinate Descent Algorithms for Lasso Penalized Regression," *The Annals of Applied Statistics*, Vol. 2, No. 1, pp.224-244.

Zou, Hui, Trevor Hastie and Robert Tibshirani, 2007. "On the "Degrees of Freedom" of the Lasso," *The Annals of Statistics*, Vol. 35, No. 5, pp. 2173-2192.

Macroeconomic and Financial Conditions Variables	Minimum	Maximum	Average	Median	Standard
	Willingun	Waximum	Avelage	Wieulali	deviation
Nominal Quarterly GDP growth rate, SAAR	-7.70	10.20	4.67	4.90	2.89
civilian unemployment rate, unadjusted +	3.80	10.00	5.82	5.50	1.64
10-year Treasury yield*	2.71	7.84	5.00	4.88	1.22
3-month Treasury yield*	0.04	6.23	3.29	3.60	2.01
Moody's AAA yield*	4.57	8.55	6.39	6.39	1.01
Moody's Baa yield*	5.04	9.19	7.19	7.27	1.01
Federal funds rate*	0.09	6.52	3.45	4.06	2.09
Wilshire quarterly market index return	-22.92	21.51	2.44	3.29	8.69
Wilshire daily return standard deviation	-0.87	4.22	1.02	0.86	0.63
Kansas City Fed Financial Stability Index (FSI) quarterly average	-0.94	5.56	0.11	-0.29	1.13
VIX daily average	11.03	58.60	20.57	19.92	8.02
VIX quarterly percent change	-82.41	127.50	3.58	-0.49	30.70
Change in Real House Price Index	-6.25	4.68	0.32	0.85	2.08

## Table 1: Stress Test Macroeconomic and Financial Market Explanatory Variables

Notes: Quarterly data for the period March 1993 through June 2011. All data except the change in the real house price index are from the Federal Reserve Bank of St. Louis economic research department public database https://fred.stlouisfed.org/. The change in the real house price index is the American Enterprise Institute International Center on Housing Risk calculated quarterly as FHFA's all-transaction house price index divided by BEA's price index for personal consumption expenditures. + Indicates unemployment rate on the first day following quarter-end. \* Indicates interest yield on the first day of each quarter.

		R	epresentative	Bank Sam	ple Statisti	cs
	Variable definitions	Minimum	Mariana	A	Madian	Standard
Variables		Minimum	Maximum	Average	Median	deviation
	(FDIC SDI variable names)		(Va	ilues x 100	)	
Income before tax and extraordinary items to total assets	$(nim_t+nonii_t+iglsec_t-elnatr_t-nonix_t)/asset_t$	-0.297	0.520	0.372	0.431	0.161
Net Interest Income to total assets	$nim_t/asset_t$	0.566	0.925	0.804	0.811	0.072
Noninterest income to total assets	nonii <sub>t</sub> /asset <sub>t</sub>	0.231	0.600	0.496	0.504	0.067
Noninterest expense to total assets	nonix <sub>t</sub> /asset <sub>t</sub>	0.631	0.937	0.794	0.806	0.063
Provisions for loan and lease losses to total assets	$elnatr_t/assets_t$	0.053	0.502	0.143	0.097	0.110
Securities gains and losses to total assets	glsec <sub>t</sub> /asset <sub>t</sub>	-0.053	0.054	0.010	0.010	0.019
Total securities to total assets	sc <sub>t</sub> /asset <sub>t</sub>	14.625	23.616	18.975	18.964	2.129
Trading account assets to total assets	trade <sub>t</sub> /asset <sub>t</sub>	2.095	7.554	4.732	4.705	0.999
Other real estate owned to total assets	ore <sub>t</sub> /asset <sub>t</sub>	0.047	0.944	0.179	0.097	0.181
Income earned, not collected on loans to total assets	oaienc <sub>t</sub> /asset <sub>t</sub>	0.361	0.662	0.457	0.445	0.064
Total unused commitments to total assets	$uc_t/asset_t$	30.611	69.053	55.253	60.417	11.488
Notional value of derivative positions to total assets	$obsdir_t/asset_t$	213.936	1829.845	792.183	632.296	460.756
Total loans and leases to total assets	$lnlsgr_t/asset_t$	54.045	63.289	60.003	60.593	1.943
Construction and development loans to total assets	lnrecons <sub>t</sub> /asset <sub>t</sub>	1.660	4.891	2.873	2.877	1.037
Commercial real estate loans to total assets	lnrenres <sub>t</sub> /asset <sub>t</sub>	6.344	8.331	7.190	7.305	0.534
1 to 4 family residential loans to total assets	lnrers <sub>t</sub> /asset <sub>t</sub>	18.299	23.857	20.821	20.567	1.318
Commercial and industrial loans to total assets	$lnci_t/asset_t$	8.745	14.856	11.748	11.636	1.799
Consumer loans to total assets	lncon <sub>t</sub> /asset <sub>t</sub>	7.705	10.874	9.159	9.054	0.894

#### Table 2: Stress Test Bank Balance Sheet and Income Statement Explanatory Variables

Notes: The data are calculated from Statistics on Depository Institutions (SDI) quarterly data as reported on the Federal Deposit Insurance Corporation's public website for the period March 1993 through June 2011. The exact variable definitions are reported in the SDI's "Read me" file. Variables with a "t" subscript represent the aggregate value for all reporting institutions in quarter "t" for the SDI variable of the same name. Income and expense variables are quarterly values calculated from the year-to-date data reported in SDI.

	cert	Name of insured depository	Holding company	depository assets
1	628	JPMorgan Chase Bank, National Association	JPMORGAN CHASE & CO.	1,378,468,000
2	3510	Bank of America, National Association	BANK OF AMERICA CORPORATION	1,327,429,079
3	7213	Citibank, National Association	CITIGROUP INC.	1,228,445,000
4	33869	Wachovia Bank, National Association	WACHOVIA CORPORATION	670,639,000
5	3511	Wells Fargo Bank, National Association	WELLS FARGO & COMPANY	503,327,000
6	32633	Washington Mutual Bank	WASHINGTON MUTUAL, INC	307,021,614
7	6548	U.S. Bank National Association	U.S. BANCORP	242,307,928
8	57890	HSBC Bank USA, National Association	HSBC HOLDINGS PLC	177,466,246
9	867	SunTrust Bank	SUNTRUST BANKS, INC.	171,500,853
10	33318	FIA Card Services, National Association	BANK OF AMERICA CORPORATION	165,349,652
11	6557	National City Bank	NATIONAL CITY CORPORATION	151,164,598
12	12368	Regions Bank	REGIONS FINANCIAL CORPORATION	139,353,930
13	14	State Street Bank and Trust Company	STATE STREET CORPORATION	138,858,742
14	9846	Branch Banking and Trust Company	BB&T CORPORATION	132,884,104
15	57957	RBS Citizens, National Association	THE ROYAL BANK OF SCOTLAND GROUP PLC	132,050,955
16	639	The Bank of New York	THE BANK OF NEW YORK MELLON CORPORATION	130,062,000
17	6384	PNC Bank, National Association	THE PNC FINANCIAL SERVICES GROUP, INC.	128,348,405
18	33143	Countrywide Bank, FSB	COUNTRYWIDE FINANCIAL CORPORATION	116,384,145
19	4297	Capital One, National Association	CAPITAL ONE FINANCIAL CORPORATION	108,520,315

# Table 3: Depository Institutions with more than \$100 billion as of June 2008

Reported Bank Equity-to-Asset Ratios														
	JPMorgan	Bank of					Regions			Capital One	Bank of	State Street		
Quarter	Chase	America	Citibank	Wells Fargo	US Bank	Sun Trust	Bank	BB&T Bank	PNC Bank	Bank	New York	Bank	HSBC bank	RBS
2008 Q2	7.90%	8.19%	7.77%	8.73%	8.89%	11.26%	14.84%	10.31%	9.41%	19.15%	6.54%	9.09%	7.00%	13.65%
2008 Q3	7.12%	8.37%	7.49%	8.60%	8.91%	11.56%	14.75%	10.29%	8.92%	19.05%	5.68%	4.17%	6.76%	13.47%
2008 Q4	7.37%	9.03%	6.61%	7.73%	8.09%	10.54%	9.99%	9.20%	7.28%	17.40%	5.83%	7.79%	6.97%	12.18%
2009 Q1	7.81%	9.47%	9.65%	8.20%	9.06%	10.85%	10.67%	11.89%	9.95%	17.73%	7.58%	9.95%	8.05%	12.10%
2009 Q2	7.95%	10.38%	9.49%	9.22%	9.35%	10.90%	10.61%	11.95%	10.85%	18.12%	7.84%	8.05%	9.54%	13.57%
2009 Q3	7.72%	11.18%	9.75%	9.33%	9.81%	11.11%	12.31%	12.02%	11.37%	18.64%	8.02%	8.41%	9.40%	13.98%
2009 Q4	7.85%	11.38%	10.17%	9.30%	9.49%	11.01%	11.72%	12.25%	12.23%	18.42%	8.36%	9.54%	9.48%	14.20%
2010 Q1	7.62%	11.24%	10.34%	11.89%	9.71%	11.31%	12.07%	12.61%	12.94%	19.24%	8.96%	10.39%	8.89%	14.56%
2010 Q2	8.34%	11.18%	10.60%	11.66%	10.05%	12.19%	12.35%	13.47%	13.63%	19.53%	8.55%	10.39%	9.32%	14.85%
2010 Q3	8.05%	11.44%	10.50%	11.58%	10.15%	12.07%	12.36%	13.31%	14.08%	19.39%	8.28%	10.59%	9.46%	14.69%
2010 Q4	7.55%	12.13%	11.13%	11.21%	10.20%	12.06%	12.15%	13.38%	13.15%	19.09%	8.73%	10.74%	9.72%	15.69%
2011 Q1	7.21%	12.00%	11.38%	11.45%	10.44%	12.02%	12.19%	13.53%	13.80%	19.05%	8.24%	10.53%	9.52%	15.01%
2011 Q2	7.04%	12.10%	10.57%	11.33%	10.81%	12.19%	12.51%	13.58%	13.80%	19.60%	7.23%	9.92%	9.49%	16.41%
			Base	line Bank Equi	ity-to-Asset	Ratio Estimate	s under Pas	sive Operating	Assumption	5				
2008 Q2	7.90%	8.19%	7.77%	8.73%	8.89%	11.26%	14.84%	10.31%	9.41%	19.15%	6.54%	9.09%	7.00%	13.65%
2008 Q3	7.98%	8.46%	7.74%	9.13%	9.26%	11.49%	14.91%	10.67%	9.64%	19.21%	7.00%	9.34%	6.94%	13.70%
2008 Q4	8.17%	8.41%	6.69%	8.85%	9.48%	11.20%	10.65%	10.86%	9.65%	18.37%	7.03%	9.60%	6.09%	12.88%
2009 Q1	8.37%	8.57%	6.81%	9.16%	9.77%	10.74%	10.94%	11.15%	9.67%	18.47%	7.38%	9.98%	6.04%	12.78%
2009 Q2	8.48%	8.74%	6.37%	9.75%	9.99%	10.57%	10.84%	11.23%	9.78%	18.54%	7.55%	10.42%	5.96%	12.60%
2009 Q3	8.68%	8.79%	6.22%	10.25%	10.27%	10.18%	10.42%	11.32%	9.98%	18.63%	5.29%	10.68%	6.11%	12.41%
2009 Q4	8.81%	8.86%	6.06%	10.81%	10.52%	9.92%	9.90%	11.39%	10.54%	18.51%	5.59%	11.31%	6.08%	12.24%
2010 Q1	9.01%	8.96%	6.29%	11.08%	10.78%	9.71%	9.68%	11.52%	10.83%	18.80%	5.95%	11.72%	6.50%	12.17%
2010 Q2	9.34%	9.06%	6.59%	11.40%	11.09%	9.65%	9.60%	11.63%	11.17%	19.16%	6.30%	12.10%	6.73%	12.16%
2010 Q3	9.52%	9.36%	6.77%	11.78%	11.44%	9.71%	9.42%	11.75%	11.48%	19.36%	6.57%	12.50%	7.07%	12.16%
2010 Q4	9.70%	9.61%	6.88%	12.17%	11.81%	9.80%	9.55%	11.86%	11.73%	19.48%	6.87%	12.68%	7.29%	12.15%
2011 Q1	9.89%	9.83%	7.02%	12.54%	12.21%	9.85%	9.62%	12.01%	12.06%	19.78%	7.10%	12.99%	7.58%	12.23%
2011 Q2	10.11%	9.97%	7.03%	12.91%	12.67%	9.97%	9.70%	12.20%	12.44%	20.10%	7.33%	13.31%	7.74%	12.37%
projected stress test outcome														
under passive operating	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	fail	pass	fail	pass
assumptions														
Additional equity required to p	ass stress tes	t (in \$thous)									91,000		60,000	
Estimated 2008 Q2 equ	iity-to-asset r	atio required	to pass stres	s test							7.24%		7.03%	
total estimated capital shortfall	(in \$thous)	151,000												

Table 4: Actual Reported and Projected Bank Equity-to-Asset Ratios under Passive Operating Assumptions

Notes: The top panel reports actual bank equity-to-asset ratios calculated from Call report data. The bottom panel reports baseline equity-to-asset ratios calculated using equation (10), June 2008 Call report equity-to-asset ratios as initial conditions, and banks' reported INBFTXEX calculated from Call report data. The final three rows indicate whether the bank's baseline equity-to-asset ratio remained above 6 percent for the 12 stress test quarters, and the additional equity capital required, if any, to keep the bank above the 6 percent minimum threshold.

quarterly INBFTXEX	JPMorgan	Bank of								Capital One	Bank of New	State Street		
rano	Chase	America	Citibank	Wells Fargo	US Bank	Sun Trust	Regions Bank	BB&T Bank	PNC Bank	Bank	York	Bank	HSBC bank	RBS
2008 Q2	0.19%	0.25%	-0.14%	0.43%	0.57%	0.45%	0.22%	0.40%	0.48%	0.14%	0.09%	0.58%	-0.14%	0.24%
2008 Q3	-3.91%	-2.14%	-1.93%	0.31%	0.67%	1.04%	1.49%	0.56%	0.45%	0.67%	-0.74%	-0.21%	-1.34%	0.03%
2008 Q4	-4.15%	-2.04%	-1.85%	0.14%	0.43%	0.71%	0.98%	0.35%	0.16%	0.45%	-1.27%	-0.57%	-1.45%	-0.08%
2009 Q1	-4.39%	-2.20%	-2.10%	0.07%	0.33%	0.67%	1.02%	0.24%	0.09%	0.40%	-1.33%	-0.63%	-1.60%	-0.16%
2009 Q2	-4.21%	-1.95%	-1.88%	0.25%	0.52%	0.82%	1.15%	0.26%	0.25%	0.56%	-1.18%	-0.45%	-1.42%	0.01%
2009 Q3	-4.10%	-1.74%	-1.78%	0.37%	0.64%	0.95%	1.28%	0.27%	0.39%	0.59%	-1.06%	-0.33%	-1.31%	0.13%
2009 Q4	-4.04%	-1.65%	-1.72%	0.21%	0.87%	1.00%	1.33%	0.31%	0.63%	0.65%	-1.00%	-0.27%	-1.25%	0.19%
2010 Q1	-4.02%	-1.63%	-1.69%	0.09%	0.90%	1.03%	1.36%	0.38%	0.66%	0.68%	-0.97%	-0.24%	-1.22%	0.22%
2010 Q2	-4.02%	-1.62%	-1.69%	0.10%	0.90%	1.03%	1.37%	0.47%	0.66%	0.68%	-0.97%	-0.24%	-1.22%	0.22%
2010 Q3	-3.95%	-1.56%	-1.63%	0.17%	0.96%	1.10%	1.43%	0.50%	0.73%	0.75%	-0.91%	-0.17%	-1.15%	0.28%
2010 Q4	-3.92%	-1.52%	-1.59%	0.20%	1.00%	1.13%	1.46%	0.45%	0.76%	0.78%	-0.87%	-0.14%	-1.12%	0.32%
2011 Q1	-3.90%	-1.50%	-1.57%	0.22%	1.07%	1.15%	1.49%	0.50%	0.78%	0.80%	-0.85%	-0.12%	-1.10%	0.34%
2011 Q2	-3.87%	-1.48%	-1.55%	0.25%	1.09%	1.17%	1.51%	0.52%	0.80%	0.82%	-0.83%	-0.10%	-1.08%	0.36%
projected quarterly														
equity/asset ratio														
2008 Q2	7.90%	8.19%	7.77%	8.73%	8.89%	11.26%	14.84%	10.31%	9.41%	19.15%	6.54%	9.09%	7.00%	13.65%
2008 Q3	4.15%	6.18%	5.95%	9.02%	9.49%	12.17%	16.09%	10.81%	9.81%	19.69%	5.85%	8.90%	5.74%	13.67%
2008 Q4	0.00%	4.22%	4.18%	9.14%	9.88%	12.79%	16.91%	11.12%	9.96%	20.06%	4.63%	8.38%	4.35%	13.60%
2009 Q1	-4.59%	2.07%	2.13%	9.21%	10.18%	13.36%	17.75%	11.33%	10.04%	20.37%	3.35%	7.80%	2.80%	13.46%
2009 Q2	-9.18%	0.12%	0.25%	9.43%	10.64%	14.07%	18.68%	11.56%	10.27%	20.82%	2.19%	7.39%	1.40%	13.47%
2009 Q3	-13.86%	-1.66%	-1.56%	9.77%	11.21%	14.87%	19.71%	11.80%	10.62%	21.28%	1.14%	7.08%	0.10%	13.59%
2009 Q4	-18.66%	-3.36%	-3.34%	9.96%	11.98%	15.72%	20.76%	12.08%	11.18%	21.79%	0.14%	6.83%	-1.16%	13.75%
2010 Q1	-23.62%	-5.07%	-5.12%	10.04%	12.76%	16.58%	21.83%	12.41%	11.76%	22.32%	-0.84%	6.61%	-2.41%	13.94%
2010 Q2	-28.79%	-6.80%	-6.93%	10.13%	13.54%	17.43%	22.88%	12.82%	12.34%	22.85%	-1.83%	6.39%	-3.67%	14.13%
2010 Q3	-34.09%	-8.50%	-8.70%	10.28%	14.36%	18.32%	23.97%	13.25%	12.97%	23.42%	-2.77%	6.23%	-4.88%	14.38%
2010 Q4	-39.56%	-10.18%	-10.45%	10.46%	15.21%	19.24%	25.07%	13.64%	13.63%	24.01%	-3.67%	6.10%	-6.07%	14.65%
2011 Q1	-45.22%	-11.86%	-12.22%	10.66%	16.11%	20.16%	26.16%	14.07%	14.30%	24.62%	-4.56%	5.99%	-7.25%	14.94%
2011 Q2	-51.07%	-13.54%	-13.98%	10.88%	17.01%	21.08%	27.26%	14.51%	14.98%	25.23%	-5.44%	5.90%	-8.41%	15.25%
stress test outcome	fail	fail	fail	pass	pass	pass	pass	pass	pass	pass	fail	fail	fail	pass
Additional equity required to pass stress test (\$thous)	480,150,000	209,700,000	198,900,000								13,190,000	125,000	21,940,000	
Estimated 2008 Q2 equity- to-asset ratio required to	42.69%	23.99%	23.94%								16.68%	9.18%	19.36%	
pass test	outfall (Ctherry)	024.00	5.000											
esumated total capital sh	ortiaii (Sthous)	924,00	JS,000											

Table 5: Representative Bank CLASS-Style Stress Test Model Forecast of Bank Stress Scenario Performance and Capitalization Under Passive Operating Assumptions

quarterly INBFTXEX ratio	JPMorgan	Bank of					Regions			Capital One	Bank of	State Street		
	Chase	America	Citibank	Wells Fargo	US Bank	Sun Trust	Bank	BB&T Bank	PNC Bank	Bank	New York	Bank	HSBC bank	RBS
2008 Q2	0.19%	0.25%	-0.14%	0.43%	0.57%	0.45%	0.22%	0.40%	0.48%	0.14%	0.09%	0.58%	-0.14%	0.24%
2008 Q3	-0.43%	0.05%	-0.17%	0.48%	0.85%	0.49%	-0.06%	0.56%	0.42%	0.53%	-0.63%	0.61%	0.25%	0.70%
2008 Q4	-0.57%	-0.53%	-0.13%	-0.07%	1.19%	0.44%	0.51%	0.35%	0.09%	0.79%	-1.75%	-0.25%	0.13%	1.28%
2009 Q1	-0.56%	-0.10%	0.28%	0.19%	0.37%	0.39%	0.29%	0.24%	-0.02%	-0.28%	-1.26%	-0.45%	0.23%	1.05%
2009 Q2	-0.46%	0.15%	0.57%	0.54%	0.39%	0.34%	0.30%	0.26%	0.07%	-0.34%	-1.21%	-0.33%	0.29%	0.90%
2009 Q3	-0.29%	0.09%	0.90%	0.77%	0.44%	0.36%	0.25%	0.27%	0.29%	-0.19%	-1.12%	-0.43%	0.48%	0.83%
2009 Q4	-0.25%	0.39%	0.76%	0.57%	0.32%	0.35%	0.20%	0.31%	-0.67%	-0.14%	-0.89%	-0.43%	0.44%	0.62%
2010 Q1	-0.20%	0.42%	0.89%	-0.19%	0.26%	0.36%	0.18%	0.38%	-0.71%	-0.03%	-0.92%	-0.46%	0.53%	0.73%
2010 Q2	-0.19%	0.34%	0.61%	-0.04%	0.44%	0.38%	0.17%	0.47%	-0.56%	0.19%	-0.86%	-0.35%	0.55%	0.67%
2010 Q3	-0.07%	0.54%	0.82%	0.14%	0.43%	0.35%	0.26%	0.50%	-0.55%	-0.24%	-0.84%	-0.23%	0.71%	0.41%
2010 Q4	-0.13%	0.50%	0.72%	0.17%	0.45%	0.36%	0.14%	0.45%	-0.51%	-0.50%	-0.68%	0.04%	0.62%	0.33%
2011 Q1	-0.05%	0.57%	0.88%	0.13%	0.47%	0.37%	0.22%	0.50%	-0.48%	-0.23%	-0.62%	-0.06%	0.65%	0.46%
2011 Q2	-0.11%	0.57%	0.90%	0.11%	0.44%	0.39%	0.04%	0.52%	-0.51%	-0.09%	-0.84%	-0.01%	0.81%	0.32%
projected quarterly														
equity/asset ratio														
2008 Q2	7.90%	8.19%	7.77%	8.73%	8.89%	11.26%	14.84%	10.31%	9.41%	19.15%	6.54%	9.09%	7.00%	13.65%
2008 Q3	7.50%	8.24%	7.62%	9.16%	9.66%	11.69%	14.79%	10.81%	9.79%	19.58%	5.95%	9.64%	7.23%	14.24%
2008 Q4	6.97%	7.76%	7.50%	9.10%	10.72%	12.07%	15.22%	11.12%	9.87%	20.21%	4.28%	9.41%	7.36%	15.32%
2009 Q1	6.44%	7.66%	7.75%	9.27%	11.06%	12.41%	15.47%	11.33%	9.86%	19.98%	3.05%	8.99%	7.57%	16.20%
2009 Q2	6.01%	7.80%	8.27%	9.76%	11.40%	12.71%	15.72%	11.56%	9.92%	19.71%	1.87%	8.69%	7.84%	16.95%
2009 Q3	5.74%	7.88%	9.09%	10.45%	11.79%	13.03%	15.93%	11.80%	10.17%	19.56%	0.75%	8.29%	8.28%	17.63%
2009 Q4	5.51%	8.23%	9.78%	10.95%	12.08%	13.33%	16.10%	12.08%	9.56%	19.45%	-0.14%	7.89%	8.68%	18.15%
2010 Q1	5.32%	8.62%	10.58%	10.78%	12.31%	13.64%	16.24%	12.41%	8.91%	19.43%	-1.07%	7.46%	9.17%	18.73%
2010 Q2	5.14%	8.93%	11.12%	10.75%	12.69%	13.96%	16.39%	12.82%	8.40%	19.58%	-1.95%	7.14%	9.66%	19.28%
2010 Q3	5.08%	9.42%	11.84%	10.87%	13.07%	14.26%	16.60%	13.25%	7.89%	19.39%	-2.81%	6.92%	10.30%	19.60%
2010 Q4	4.96%	9.86%	12.48%	11.02%	13.46%	14.57%	16.71%	13.64%	7.42%	18.98%	-3.52%	6.96%	10.85%	19.87%
2011 Q1	4.91%	10.38%	13.24%	11.14%	13.86%	14.88%	16.90%	14.07%	6.97%	18.80%	-4.17%	6.91%	11.43%	20.24%
2011 Q2	4.81%	10.89%	14.01%	11.24%	14.24%	15.21%	16.93%	14.51%	6.49%	18.72%	-5.05%	6.90%	12.14%	20.49%
stress test outcome	fail	pass	pass	pass	pass	pass	pass	pass	pass	pass	fail	pass	pass	pass
Additional equity required to pass stress test (\$thous)	16,000,000										12,780,000			
Estimated 2008 Q2 equity-to- asset ratio required to pass test	9.06%										16.37%			
estimated total capital shortfa	ull (Sthous)	28.78	0.000											

Table 6: Bank-Specific CLASS-Style Stress Test Model Forecasts of Bank Stress Scenario Performance and Capitalization Under Passive Operating Assumptions

quarterly	JPMorgan	Bank of								Capital One	Bank of New	State Street		
INBETXEX ratio	Chase	America	Citibank	Wells Fargo	US Bank	Sun Trust	Regions Bank	BB&T Bank	PNC Bank	Bank	York	Bank	HSBC bank	RBS
2008 Q2	0.19%	0.25%	-0.14%	0.43%	0.57%	0.45%	0.22%	0.40%	0.48%	0.14%	0.09%	0.58%	-0.14%	0.58%
2008 Q3	-2.62%	-1.28%	-0.65%	0.23%	0.50%	0.65%	0.65%	0.90%	0.34%	-0.09%	-0.15%	0.05%	-0.97%	0.08%
2008 Q4	-2.85%	-1.40%	-0.93%	-0.06%	0.19%	0.35%	0.35%	0.59%	0.59%	-0.38%	-0.44%	-0.23%	-1.24%	-0.21%
2009 Q1	-2.76%	-1.31%	-0.84%	0.03%	0.28%	0.44%	0.54%	0.68%	0.68%	-0.29%	-0.35%	-0.14%	-1.15%	-0.12%
2009 Q2	-2.59%	-1.02%	-0.67%	0.20%	0.46%	0.61%	0.71%	0.85%	0.85%	-0.11%	-0.17%	0.04%	-0.98%	0.06%
2009 Q3	-2.45%	-0.83%	-0.53%	0.35%	0.60%	0.76%	0.85%	1.06%	0.46%	0.09%	-0.03%	0.18%	-0.83%	0.20%
2009 Q4	-2.41%	-0.76%	-0.49%	0.35%	0.39%	0.80%	0.89%	1.10%	0.64%	0.13%	0.01%	0.22%	-0.79%	0.24%
2010 Q1	-2.37%	-0.73%	-0.46%	0.30%	0.42%	0.83%	0.92%	1.13%	0.67%	0.16%	0.04%	0.25%	-0.76%	0.27%
2010 Q2	-2.38%	-0.74%	-0.46%	0.31%	0.41%	0.82%	0.92%	1.13%	0.66%	0.15%	0.03%	0.25%	-0.77%	0.27%
2010 Q3	-2.37%	-0.73%	-0.45%	0.32%	0.42%	0.84%	0.93%	0.42%	0.67%	0.16%	0.05%	0.26%	-0.76%	0.28%
2010 Q4	-2.36%	-0.72%	-0.44%	0.33%	0.44%	0.85%	0.94%	1.15%	0.68%	0.17%	0.06%	0.27%	-0.74%	0.29%
2011 Q1	-2.32%	-0.68%	-0.40%	0.36%	0.81%	0.88%	0.98%	1.18%	0.72%	0.21%	0.09%	0.30%	-0.71%	0.32%
2011 Q2	-2.32%	-0.68%	-0.40%	0.37%	0.81%	0.88%	0.98%	1.18%	0.72%	0.21%	0.09%	0.30%	-0.71%	0.32%
projected quarterly														
equity/asset ratio														
2008 Q2	7.90%	8.19%	7.77%	8.73%	8.89%	11.26%	14.84%	10.36%	9.41%	19.15%	11.38%	9.09%	7.00%	13.65%
2008 Q3	5.42%	7.00%	7.16%	8.94%	9.35%	11.83%	15.39%	11.16%	9.72%	19.08%	11.25%	9.14%	6.09%	13.72%
2008 Q4	2.64%	5.68%	6.29%	8.89%	9.52%	12.14%	15.69%	11.68%	10.25%	18.78%	10.85%	8.93%	4.91%	13.54%
2009 Q1	-0.12%	4.43%	5.49%	8.91%	9.78%	12.52%	16.14%	12.28%	10.85%	18.54%	10.54%	8.80%	3.81%	13.44%
2009 Q2	-2.78%	3.44%	4.85%	9.10%	10.19%	13.06%	16.73%	13.02%	11.60%	18.45%	10.39%	8.84%	2.86%	13.49%
2009 Q3	-5.36%	2.63%	4.35%	9.41%	10.73%	13.71%	17.43%	13.93%	12.01%	18.52%	10.36%	9.00%	2.04%	13.66%
2009 Q4	-7.96%	1.88%	3.88%	9.73%	11.07%	14.40%	18.16%	14.87%	12.57%	18.63%	10.37%	9.20%	1.26%	13.87%
2010 Q1	-10.59%	1.15%	3.44%	10.00%	11.44%	15.10%	18.91%	15.82%	13.15%	18.75%	10.40%	9.43%	0.50%	14.11%
2010 Q2	-13.28%	0.42%	3.00%	10.28%	11.81%	15.79%	19.65%	16.76%	13.72%	18.88%	10.43%	9.65%	-0.27%	14.34%
2010 Q3	-16.03%	-0.31%	2.56%	10.56%	12.18%	16.49%	20.39%	17.11%	14.29%	19.01%	10.47%	9.88%	-1.03%	14.57%
2010 Q4	-18.83%	-1.04%	2.13%	10.86%	12.56%	17.19%	21.13%	18.05%	14.87%	19.15%	10.52%	10.12%	-1.79%	14.82%
2011 Q1	-21.66%	-1.73%	1.73%	11.18%	13.27%	17.92%	21.90%	19.01%	15.48%	19.32%	10.60%	10.39%	-2.52%	15.09%
2011 Q2	-24.55%	-2.43%	1.33%	11.51%	13.96%	18.63%	22.65%	19.96%	16.08%	19.49%	10.69%	10.66%	-3.25%	15.37%
stress test outcome	fail	fail	fail	pass	pass	pass	pass	pass	pass	pass	pass	pass	fail	pass
Additional equity														
required to pass stress	312,000,000	101,000,000	54,000,000										14,800,000	
test (in \$thous)														
Estimated 2008 Q2														
equity-to-asset ratio	30.51%	15.80%	12.16%										15.34%	
required to pass test			101.0											
estimated total capital	shortfall (\$the	ous)	481,8	00,000										

Table 7: Representative Bank Bayesian Model Average Stress Test Model Forecast of Bank Stress Scenario Performance and Capitalization Under Passive Operating Assumptions

quarterly	JPMorgan	Bank of								Capital One	Bank of New	State Street		
	Chase	America	Citibank	Wells Fargo	US Bank	Sun Trust	Regions Bank	BB&T Bank	PNC Bank	Bank	York	Bank	HSBC bank	RBS
2008 Q2	0.19%	0.25%	-0.14%	0.43%	0.57%	0.45%	0.22%	0.40%	0.48%	0.14%	0.09%	0.58%	-0.14%	0.58%
2008 Q3	-0.02%	0.20%	-0.06%	0.53%	0.69%	0.33%	0.33%	0.47%	0.31%	0.37%	-0.03%	0.48%	-0.01%	0.18%
2008 Q4	-0.05%	0.14%	-0.08%	0.53%	0.54%	0.32%	0.32%	0.38%	0.32%	0.50%	-0.20%	0.48%	-0.18%	-0.02%
2009 Q1	-0.07%	0.17%	0.00%	0.53%	0.54%	0.33%	0.27%	0.25%	0.33%	0.26%	-0.31%	0.47%	-0.12%	0.03%
2009 Q2	-0.05%	0.10%	0.13%	0.53%	0.61%	0.34%	0.30%	0.35%	0.34%	0.23%	-0.33%	0.46%	0.01%	0.16%
2009 Q3	-0.01%	0.21%	0.30%	0.55%	0.62%	0.34%	0.33%	0.39%	0.37%	0.30%	-0.31%	0.42%	0.14%	0.27%
2009 Q4	0.01%	0.24%	0.24%	0.52%	0.59%	0.34%	0.33%	0.45%	-0.16%	0.29%	-0.32%	0.42%	0.15%	0.30%
2010 Q1	0.02%	0.28%	0.29%	0.37%	0.57%	0.34%	0.33%	0.47%	-0.15%	0.30%	-0.27%	0.41%	0.16%	0.33%
2010 Q2	0.04%	0.28%	0.27%	0.45%	0.56%	0.34%	0.34%	0.56%	-0.09%	0.39%	-0.22%	0.40%	0.17%	0.31%
2010 Q3	0.04%	0.29%	0.32%	0.39%	0.65%	0.34%	0.36%	0.52%	-0.10%	0.30%	-0.23%	0.42%	0.22%	0.33%
2010 Q4	0.02%	0.28%	0.28%	0.27%	0.64%	0.34%	0.35%	0.48%	-0.11%	0.20%	-0.28%	0.44%	0.24%	0.32%
2011 Q1	0.03%	0.33%	0.41%	0.38%	0.60%	0.34%	0.36%	0.53%	-0.06%	0.23%	-0.14%	0.41%	0.26%	0.35%
2011 Q2	0.05%	0.35%	0.39%	0.47%	0.60%	0.34%	0.36%	0.53%	-0.06%	0.34%	-0.18%	0.41%	0.27%	0.37%
projected quarterly														
equity/asset ratio														
2008 Q2	7.90%	8.19%	7.77%	8.73%	8.89%	11.26%	14.84%	10.36%	9.41%	19.15%	11.38%	9.09%	7.00%	13.65%
2008 Q3	7.88%	8.37%	7.72%	9.22%	9.51%	11.54%	15.12%	10.77%	9.69%	19.45%	11.35%	9.52%	6.99%	13.80%
2008 Q4	7.83%	8.51%	7.65%	9.70%	10.00%	11.82%	15.39%	11.11%	9.98%	19.85%	11.17%	9.95%	6.83%	13.79%
2009 Q1	7.76%	8.66%	7.65%	10.17%	10.49%	12.11%	15.62%	11.33%	10.28%	20.06%	10.90%	10.37%	6.71%	13.81%
2009 Q2	7.71%	8.75%	7.77%	10.65%	11.03%	12.41%	15.87%	11.64%	10.58%	20.25%	10.60%	10.78%	6.72%	13.94%
2009 Q3	7.71%	8.94%	8.05%	11.14%	11.58%	12.70%	16.15%	11.98%	10.91%	20.48%	10.32%	11.15%	6.85%	14.17%
2009 Q4	7.71%	9.15%	8.27%	11.60%	12.10%	13.00%	16.42%	12.38%	10.77%	20.71%	10.03%	11.53%	6.98%	14.43%
2010 Q1	7.73%	9.41%	8.53%	11.92%	12.60%	13.29%	16.70%	12.79%	10.64%	20.95%	9.79%	11.88%	7.13%	14.71%
2010 Q2	7.77%	9.66%	8.78%	12.32%	13.09%	13.58%	16.98%	13.28%	10.56%	21.25%	9.59%	12.24%	7.29%	14.97%
2010 Q3	7.80%	9.92%	9.07%	12.65%	13.65%	13.87%	17.28%	13.73%	10.47%	21.49%	9.38%	12.60%	7.49%	15.25%
2010 Q4	7.82%	10.17%	9.32%	12.89%	14.20%	14.16%	17.56%	14.14%	10.37%	21.64%	9.13%	12.98%	7.71%	15.52%
2011 Q1	7.85%	10.47%	9.69%	13.22%	14.72%	14.45%	17.86%	14.59%	10.31%	21.83%	9.00%	13.33%	7.95%	15.82%
2011 Q2	7.90%	10.79%	10.04%	13.63%	15.23%	14.74%	18.16%	15.04%	10.26%	22.09%	8.83%	13.69%	8.20%	16.13%
stress test outcome	nass	nass	nass	nass	nass	nass	nass	nass	nass	nass	nass	nass	nass	nass

Table 8: Bank-Specific Bayesian Model Average Stress Test Model Forecast of Bank Stress Scenario Performance and Capitalization Under Passive Operating Assumptions

Notes: The top panel reports stress test model forecasts of INBFTXEX. The bottom panel reports estimates of the stress test equity-to-asset ratio calculated using equation (10), June 2008 Call report equity-to-asset ratios as initial conditions and the merger-adjusted stress test forecast of INBFTXEX. The final row indicates whether the forecast of the bank's equity-to-asset ratio remains above 6 percent for the 12 stress test quarters.

quarterly	JPMorgan	Bank of								Capital One	Bank of New	State Street		
INBF I AEA rauo	Chase	America	Citibank	Wells Fargo	US Bank	Sun Trust	Regions Bank	BB&T Bank	PNC Bank	Bank	York	Bank	HSBC bank	RBS
2008 Q2	0.19%	0.25%	-0.14%	0.43%	0.57%	0.45%	0.22%	0.40%	0.48%	0.14%	0.09%	0.58%	-0.14%	0.24%
2008 Q3	-0.07%	-0.04%	-0.14%	-0.03%	-0.02%	-0.03%	-0.05%	-0.03%	-0.03%	-0.05%	-0.05%	-0.02%	-0.07%	-0.04%
2008 Q4	-0.16%	-0.16%	-0.07%	-0.16%	-0.16%	-0.16%	-0.16%	-0.16%	-0.16%	-0.16%	-0.16%	-0.16%	-0.16%	-0.16%
2009 Q1	-0.14%	-0.14%	-0.16%	-0.14%	-0.14%	-0.14%	-0.14%	-0.14%	-0.14%	-0.14%	-0.14%	-0.14%	-0.14%	-0.14%
2009 Q2	-0.03%	-0.03%	-0.14%	-0.03%	-0.03%	-0.03%	-0.03%	-0.03%	-0.03%	-0.03%	-0.03%	-0.03%	-0.03%	-0.03%
2009 Q3	0.11%	0.11%	-0.03%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%
2009 Q4	0.16%	0.16%	0.11%	0.16%	0.16%	0.16%	0.16%	0.16%	0.16%	0.16%	0.16%	0.16%	0.16%	0.16%
2010 Q1	0.19%	0.19%	0.16%	0.19%	0.19%	0.19%	0.19%	0.19%	0.19%	0.19%	0.19%	0.19%	0.19%	0.19%
2010 Q2	0.22%	0.22%	0.19%	0.22%	0.22%	0.22%	0.22%	0.22%	0.22%	0.22%	0.22%	0.22%	0.22%	0.22%
2010 Q3	0.29%	0.29%	0.22%	0.29%	0.29%	0.29%	0.29%	0.29%	0.29%	0.29%	0.29%	0.29%	0.29%	0.29%
2010 Q4	0.25%	0.25%	0.29%	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%
2011 Q1	0.31%	0.31%	0.25%	0.31%	0.31%	0.31%	0.31%	0.31%	0.31%	0.31%	0.31%	0.31%	0.31%	0.31%
2011 Q2	0.35%	0.35%	0.31%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%
projected quarterly														
equity/asset ratio														
2008 Q2	7.90%	8.19%	7.77%	8.73%	8.89%	11.26%	14.84%	10.31%	9.41%	19.15%	6.54%	9.09%	7.00%	13.65%
2008 Q3	7.83%	8.16%	7.71%	8.70%	8.87%	11.23%	14.80%	10.29%	9.39%	19.11%	6.49%	9.07%	6.93%	13.61%
2008 Q4	7.69%	8.01%	7.56%	8.56%	8.73%	11.09%	14.67%	10.14%	9.24%	18.98%	6.34%	8.93%	6.78%	13.47%
2009 Q1	7.55%	7.88%	7.43%	8.43%	8.60%	10.96%	14.54%	10.02%	9.11%	18.87%	6.21%	8.80%	6.65%	13.35%
2009 Q2	7.53%	7.85%	7.40%	8.40%	8.57%	10.94%	14.52%	9.99%	9.09%	18.84%	6.18%	8.77%	6.62%	13.32%
2009 Q3	7.63%	7.96%	7.51%	8.51%	8.68%	11.04%	14.62%	10.09%	9.19%	18.94%	6.29%	8.87%	6.73%	13.42%
2009 Q4	7.78%	8.10%	7.65%	8.65%	8.82%	11.18%	14.75%	10.24%	9.34%	19.07%	6.44%	9.02%	6.88%	13.56%
2010 Q1	7.95%	8.28%	7.83%	8.83%	8.99%	11.35%	14.91%	10.41%	9.51%	19.22%	6.62%	9.19%	7.06%	13.72%
2010 Q2	8.16%	8.48%	8.03%	9.03%	9.20%	11.54%	15.10%	10.60%	9.71%	19.40%	6.82%	9.39%	7.26%	13.91%
2010 Q3	8.43%	8.75%	8.30%	9.29%	9.46%	11.80%	15.35%	10.86%	9.97%	19.63%	7.09%	9.66%	7.53%	14.16%
2010 Q4	8.66%	8.98%	8.53%	9.52%	9.69%	12.02%	15.56%	11.09%	10.20%	19.84%	7.33%	9.89%	7.77%	14.38%
2011 Q1	8.94%	9.26%	8.82%	9.80%	9.97%	12.30%	15.83%	11.37%	10.48%	20.09%	7.62%	10.17%	8.05%	14.65%
2011 Q2	9.26%	9.58%	9.13%	10.12%	10.28%	12.60%	16.12%	11.67%	10.79%	20.36%	7.94%	10.48%	8.37%	14.94%
stress test outcome	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass

Table 9: Representative Bank Lasso Stress Test Model Forecast of Bank Stress Scenario Performance and Capitalization Under Passive Operating Assumptions

Notes: The top panel reports stress test model forecasts of INBFTXEX. The bottom panel reports estimates of the stress test equity-to-asset ratio calculated using equation (10), June 2008 Call report equity-to-asset ratios as initial conditions and the merger-adjusted stress test forecast of INBFTXEX. The final row indicates whether the forecast of the bank's equity-to-asset ratio remains above 6 percent for the 12 stress test quarters.

quarterly	JPMorgan	Bank of								Capital One	Bank of New	State Street		
INBETXEX ratio	Chase	America	Citibank	Wells Fargo	US Bank	Sun Trust	Regions Bank	BB&T Bank	PNC Bank	Bank	York	Bank	HSBC bank	RBS
2008 Q2	0.19%	0.25%	-0.14%	0.43%	0.57%	0.45%	0.22%	0.40%	0.48%	0.14%	0.09%	0.58%	-0.14%	0.24%
2008 Q3	0.05%	-0.06%	-0.13%	0.50%	0.66%	0.44%	0.29%	0.48%	0.32%	0.51%	-0.08%	0.39%	-0.47%	0.43%
2008 Q4	0.18%	-0.12%	-0.21%	0.53%	0.61%	0.44%	0.41%	0.44%	0.48%	0.74%	-0.17%	-0.09%	-0.44%	0.65%
2009 Q1	0.14%	0.01%	-0.08%	0.50%	0.50%	0.42%	0.34%	0.35%	0.39%	0.40%	-0.29%	0.02%	-0.36%	0.52%
2009 Q2	0.17%	0.09%	0.09%	0.49%	0.54%	0.42%	0.40%	0.38%	0.40%	0.33%	-0.32%	0.13%	-0.06%	0.42%
2009 Q3	0.23%	0.19%	0.29%	0.52%	0.56%	0.42%	0.46%	0.35%	0.48%	0.47%	-0.29%	-0.03%	0.12%	0.37%
2009 Q4	0.21%	0.25%	0.27%	0.45%	0.50%	0.42%	0.44%	0.39%	-0.01%	0.44%	-0.31%	0.02%	0.17%	0.35%
2010 Q1	0.24%	0.27%	0.32%	0.40%	0.49%	0.42%	0.44%	0.38%	0.09%	0.45%	-0.24%	-0.06%	0.21%	0.32%
2010 Q2	0.25%	0.18%	0.31%	0.45%	0.53%	0.42%	0.48%	0.47%	0.29%	0.59%	-0.20%	-0.06%	0.09%	0.39%
2010 Q3	0.23%	0.41%	0.49%	0.38%	0.60%	0.41%	0.49%	0.47%	0.13%	0.46%	-0.25%	0.08%	0.35%	0.39%
2010 Q4	0.16%	0.36%	0.44%	0.23%	0.57%	0.41%	0.42%	0.45%	-0.11%	0.28%	-0.33%	0.36%	0.27%	0.37%
2011 Q1	0.22%	0.41%	0.54%	0.36%	0.54%	0.42%	0.45%	0.48%	0.10%	0.33%	-0.12%	0.19%	0.34%	0.37%
2011 Q2	0.23%	0.45%	0.61%	0.45%	0.60%	0.42%	0.46%	0.48%	0.23%	0.49%	-0.19%	0.11%	0.35%	0.37%
projected quarterly														
equity/asset ratio														
2008 Q2	7.90%	8.19%	7.77%	8.73%	8.89%	11.26%	14.84%	10.31%	9.41%	19.15%	6.54%	9.09%	7.00%	13.65%
2008 Q3	7.94%	8.13%	7.65%	9.19%	9.48%	11.64%	15.08%	10.75%	9.70%	19.56%	6.47%	9.44%	6.56%	14.02%
2008 Q4	8.11%	8.02%	7.46%	9.66%	10.03%	12.03%	15.43%	11.14%	10.13%	20.15%	6.30%	9.36%	6.14%	14.57%
2009 Q1	8.24%	8.03%	7.38%	10.11%	10.47%	12.39%	15.72%	11.45%	10.48%	20.47%	6.03%	9.38%	5.80%	15.01%
2009 Q2	8.40%	8.12%	7.46%	10.55%	10.95%	12.76%	16.05%	11.79%	10.83%	20.74%	5.73%	9.49%	5.75%	15.37%
2009 Q3	8.61%	8.30%	7.73%	11.01%	11.45%	13.13%	16.43%	12.09%	11.26%	21.10%	5.45%	9.47%	5.86%	15.69%
2009 Q4	8.80%	8.52%	7.97%	11.41%	11.89%	13.49%	16.80%	12.43%	11.25%	21.45%	5.16%	9.48%	6.02%	15.98%
2010 Q1	9.02%	8.77%	8.27%	11.76%	12.33%	13.86%	17.16%	12.77%	11.33%	21.80%	4.93%	9.43%	6.22%	16.25%
2010 Q2	9.24%	8.94%	8.55%	12.16%	12.79%	14.22%	17.56%	13.17%	11.59%	22.26%	4.75%	9.38%	6.31%	16.58%
2010 Q3	9.45%	9.31%	8.99%	12.49%	13.31%	14.57%	17.95%	13.58%	11.70%	22.61%	4.50%	9.45%	6.63%	16.91%
2010 Q4	9.59%	9.63%	9.39%	12.68%	13.80%	14.92%	18.30%	13.97%	11.60%	22.83%	4.19%	9.78%	6.89%	17.21%
2011 Q1	9.79%	10.00%	9.88%	13.00%	14.27%	15.27%	18.67%	14.38%	11.68%	23.08%	4.08%	9.94%	7.21%	17.52%
2011 Q2	10.00%	10.41%	10.43%	13.38%	14.78%	15.63%	19.04%	14.78%	11.88%	23.45%	3.90%	10.04%	7.53%	17.82%
stress test outcome	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	fail	pass	fail	pass
Additional equity														
required to pass test											2,650,000		435,000	
(\$thous) Estimated 2008 O2														
equity-to-asset ratio											8 58%		7 24%	
required to pass test											0.3070		1.27/0	
estimated total capital	shortfall (\$tho	us)	3.085.000											

Table 10: Bank-Specific Lasso Stress Test Model Forecast of Bank Stress Scenario Performance and Capitalization Under Passive Operating Assumptions

## Appendix Tables

Explanatory Variable	Representative Bank	JPMorgan Chase	Bank of America	Citibank	Wells Fargo	US Bank	Sun Trust	Regions Bank	BB&T Bank	PNC Bank	Capital One Bank	Bank of New York	State Street Bank	HSBC bank	RBS
Lagged dependent variable		-0.304		0.249	-0.195			-0.181	-0.159	-0.206			0.695	-0.480	-0.350
		-(2.41)		(2.35)	-(1.57)			-(1.60)	-(1.28)	-(1.79)			(7.31)	-(3.67)	-(2.57)
Trading account assets to total assets		0.023		-0.017									0.003		-0.560
		(3.24)		-(2.58)									(1.07)		-(1.19)
Total securities to total assets		-0.008		-0.026					-0.024		-0.067			0.025	
		-(1.34)		-(3.92)					-(1.66)		-(2.56)			(3.50)	
Other real estate owned to total assets	0.109				0.198		0.563	0.539		0.586		0.148			0.140
	(2.87)				(1.44)		(2.51)	(2.39)		(4.33)		(1.34)			(1.10)
Uncollected earned income on loans to total assets	0.118	0.461	-0.306			3.621		0.638		0.896	1.361	0.772			1.851
	(1.43)	(2.53)	-(1.54)			(2.77)		(3.28)		(3.09)	(1.28)	(2.45)			(2.08)
Total unused commitments to total assets			-0.004	0.001			-0.008		0.022	0.004		-0.008	-0.004	-0.008	
			-(1.70)	(1.45)			-(1.31)		(1.68)	(1.17)		-(2.03)	-(3.65)	-(1.62)	
Notional value of derivatives to total assets		0.000		-4.8E-05	4.3E-04			-0.009			0.044			1.5E-04	
		-(2.67)		-(1.00)	(1.70)			-(3.53)			(2.39)			(2.49)	
Total loans and leases to total assets		0.011	0.017	-0.025	-0.020	0.122				0.007	-0.157			-0.065	-0.028
		(1.95)	(3.17)	-(3.70)	-(4.67)	(3.19)				(1.63)	-(3.33)			-(3.13)	-(2.83)
Construction and development loans to total assets		0.285		-0.076	-0.109	-0.291			-0.085	-0.100	-0.802	-0.352	-1.283	-0.135	
		(3.52)		-(2.68)	-(3.98)	-(2.31)			-(3.48)	-(4.22)	-(3.65)	-(1.05)	-(2.08)	-(1.97)	
Commercial real estate loans to total assets			-0.061		0.050	-0.212	-0.182		-0.149			0.085		0.236	0.103
			-(1.90)		(2.89)	-(2.04)	-(2.57)		-(4.66)			(1.72)		(4.87)	(1.24)
1 to 4 family residential loans to total assets			-0.032						-0.068		0.067	-0.057	-0.757	0.024	
			-(4.57)						-(3.51)		(1.46)	-(2.60)	-(1.87)	(1.16)	
Commercial and industrial loans to total assets	0.024			0.021		-0.105	0.018	-0.064		-0.033	0.245	0.012	-0.011	0.051	
	(3.85)			(2.19)		-(1.84)	(2.20)	-(1.81)		-(2.38)	(2.34)	(1.51)	-(2.27)	(2.09)	
Consumer loans to total assets	0.029			0.017	0.014	-0.203	0.062		0.086		0.144	0.180		0.116	
	(3.93)			(2.30)	(1.18)	-(3.00)	(3.48)		(2.15)		(2.96)	(2.90)		(4.80)	

#### Table A1: CLASS-Style Model Estimates for Net Interest Income to Assets (NIM)

Explanatory Variable	Representative Bank	JPMorgan Chase	Bank of America	Citibank	Wells Fargo	US Bank	Sun Trust	Regions Bank	BB&T Bank	PNC Bank	Capital One Bank	Bank of New York	State Street Bank	HSBC bank	RBS
Nominal Quarterly GDP growth rate, SAAR	3.2E-05		8.8E-05	3.8E-05								7.5E-05			
	(1.63)		(1.37)	(1.11)								(1.26)			
civilian unemployment rate	1.9E-04	0.001		0.001	-0.001	-0.001	0.001					-0.001			
	(1.29)	(2.92)		(3.70)	-(2.25)	-(1.14)	(1.77)					-(3.17)			
10-year Treasury yield	5.0E-04		-0.002	2.6E-04	0.001		4.2E-04	0.003		0.002	0.003	0.002		-0.003	0.006
	(-2.63)		-(2.75)	(1.74)	(3.13)		(1.41)	(3.91)		(2.83)	(3.50)	(2.81)		-(3.40)	(3.57)
3-month Treasury yield	3.8E-04			1.7E-04	-2.0E-04				2.9E-04	0.002	-0.005				-0.003
	(1.92)			(1.28)	-(1.62)				(2.20)	(2.98)	-(2.06)				-(1.76)
Moody's AAA yield	-4.0E-04	0.001	0.002		-0.002	0.001		-0.003	-0.001	-0.002		-0.003		0.004	-0.005
	(-1.88)	(3.37)	(2.76)		-(4.13)	(2.02)		-(3.63)	-(1.88)	-(2.20)		-(3.07)		(3.19)	-(3.26)
Moody's Baa yield		0.001			-0.001	-0.002		-0.001	-0.001				1.5E-04	-0.001	
		(3.40)			-(2.76)	-(2.85)		-(2.35)	-(2.39)				(1.78)	-(3.08)	
Federal funds rate	-4.4E-04					-0.001	2.4E-04			-0.002	0.004		7.2E-05	-4.5E-04	0.002
	(-2.59)					-(2.87)	(1.25)			-(3.23)	(1.65)		(2.56)	-(2.84)	(1.67)
Wilshire quarterly market index return	7.4E-06	0.000			2.1E-05			7.5E-05							0.000
	(1.65)	(3.16)			(2.05)			(3.97)							(1.84)
Wilshire daily return standard deviation					3.3E-04				0.001		0.002		-3.8E-04	0.001	
					(1.38)				(1.85)		(1.86)		-(2.94)	(1.32)	
Kansas City Fed Financial Stability Index			-0.001	-0.001				0.002		0.001			-3.3E-04	0.001	0.004
			-(2.97)	-(2.14)				(3.10)		(1.33)			-(2.00)	(1.33)	(4.20)
VIX daily average	2.5E-05			3.7E-05				0.000	-1.2E-04	6.0E-05		8.0E-05	4.6E-05	-1.4E-04	
	(2.25)			(1.77)				(2.15)	-(2.76)	(1.53)		(1.88)	(2.94)	-(2.65)	
VIX quarterly percent change		0.000	-4.9E-06	-8.9E-06				0.000					-2.3E-06		1.4E-05
		(2.25)	-(1.31)	-(4.78)				(2.66)					-(1.99)		(1.56)
Change in Real House Price Index				-1.8E-04						-1.5E-04	0.001		-1.4E-04	0.001	0.001
				-(2.71)						-(1.67)	(1.72)		-(4.95)	(4.55)	(2.08)
Constant	0.001	-0.016	0.006	0.013	0.037	-0.004	0.008	0.023	0.056	0.008	0.060	0.014	0.001	0.016	0.019
	(0.87)	-(3.49)	(2.48)	(2.48)	(6.89)	-(0.18)	(1.10)	(3.76)	(4.87)	(2.13)	(2.84)	(3.64)	(0.76)	(3.04)	(1.86)
Adjusted R <sup>2</sup>	0.890	0.782	0.710	0.877	0.624	0 392	0.600	0.665	0 596	0.778	0.302	0 792	0.892	0 704	0 314

#### Table A1 Continued: CLASS-Style Model Estimates for Net Interest Income to Assets (NIM)

All models are estimated using quarterly data from June 1993 through June 2008 (61 observations), using backward stepwise regression where variables are eliminated to generate the maximum adjusted  $R^2$  value. T-statitics appear in parenthesis below coefficient estimates. The representive bank is the asset-weighted average of all insured depository institutions in a quarter. Individual bank estimates use merger-adjusted quarterly data including mergers completed through June 2008. All bank-specific variables are lagged one quarter.

P. 1	Representative	JPMorgan	Bank of	-1100 otj1	e niouer Esun			Regions			Capital One	Bank of	State Street		
Explanatory variable	Bank	Chase	America	Citibank	Wells Fargo	US Bank	Sun Trust	Bank	BB&T Bank	PNC Bank	Bank	New York	Bank	HSBC bank	RBS
Lagged dependent variable		-0.173		-0.190	-0.138		-0.199	-0.191		-0.175		-0.392		0.270	-0.344
		-(1.57)		-(1.53)	-(1.11)		-(1.53)	-(1.56)		-(1.43)		-(3.62)		(1.99)	-(2.61)
Trading account assets to total assets		0.025			0.080		-0.009	0.079		-0.068		-0.024	0.016	-0.007	
		(2.69)			(2.07)		-(1.54)	(1.22)		-(2.84)		-(2.91)	(1.41)	-(1.33)	
Total securities to total assets		-0.013			-0.010		-0.010	-0.012	-0.014		-0.022	-0.036	0.007	0.008	
		-(1.40)			-(1.70)		-(2.50)	-(1.58)	-(3.01)		-(1.71)	-(3.06)	(3.69)	(1.73)	
Other real estate owned to total assets										-0.239		0.319	5.087		0.062
										-(1.23)		(1.40)	(3.63)		(1.41)
Uncollected earned income on loans to total assets	-0.196	0.504			-1.005	1.365		-0.164			0.848	-1.813			1.066
	(-1.91)	(2.24)			-(3.83)	(2.09)		-(1.03)			(1.44)	-(2.60)			(3.08)
Total unused commitments to total assets	0.004	0.009	-0.003	0.006	-0.007				0.016		0.014	0.029		-0.006	
	(3.74)	(1.93)	-(1.26)	(4.27)	-(1.41)				(4.80)		(2.17)	(4.57)		-(1.57)	
Notional value of derivatives to total assets	-2.8E-04			-3.8E-04				-7.7E-03	1.4E-03		1.6E-02	1.6E-03		1.4E-04	
	(-3.88)			-(6.23)				-(2.57)	(1.20)		(1.69)	(4.17)		(3.00)	
Total loans and leases to total assets			0.025		-0.011	0.041			0.018		-0.090				
			(4.81)		-(1.79)	(2.08)			(2.75)		-(2.86)				
Construction and development loans to total assets	0.071	0.573			0.050				-0.051		-0.372	-3.038	-4.541		
	(3.76)	(3.45)			(2.08)				-(4.61)		-(3.58)	-(4.16)	-(1.57)		
Commercial real estate loans to total assets		-0.101	-0.050		0.076	-0.144		0.049	-0.050	-0.132		0.603			
		-(1.28)	-(2.36)		(3.06)	-(3.62)		(2.64)	-(3.78)	-(2.94)		(5.96)			
1 to 4 family residential loans to total assets			-0.027	0.032			-0.007	-0.030	-0.029		0.048			-0.006	-0.013
			-(4.54)	(3.68)			-(1.98)	-(2.91)	-(3.64)		(1.49)			-(1.14)	-(2.61)
Commercial and industrial loans to total assets	0.022					-0.041		-0.072		0.041	0.160	-0.105	0.023	0.028	
	(3.95)					-(1.53)		-(2.43)		(2.69)	(2.38)	-(6.69)	(2.07)	(2.74)	
Consumer loans to total assets		0.027	-0.037	-0.023		-0.077			-0.050		0.089			0.012	
		(1.55)	-(3.70)	-(2.35)		-(2.62)			-(3.36)		(2.56)			(1.64)	

#### Table A2: CLASS-Style Model Estimates for Non Interest Income to Assets (NONII)

E 1 / X 11	Representative	JPMorgan	Bank of		•			Regions		,	Capital One	Bank of	State Street		
Explanatory variable	Bank	Chase	America	Citibank	Wells Fargo	US Bank	Sun Trust	Bank	BB&T Bank	PNC Bank	Bank	New York	Bank	HSBC bank	RBS
Nominal Quarterly GDP growth rate, SAAR			8.3E-05	1.4E-04	-1.5E-04	-1.0E-04			-4.5E-05		-1.2E-04		-1.4E-04		
			(1.91)	(2.31)	-(2.52)	-(1.32)			-(2.37)		-(1.19)		-(2.14)		
civilian unemployment rate	-3.2E-04			1.2E-03	-2.0E-03	-6.5E-04		-3.1E-04		-6.9E-04	-1.2E-03	-2.0E-03	-1.9E-03		
	(-1.91)			(2.52)	-(4.17)	-(1.63)		-(1.36)		-(1.62)	-(1.75)	-(2.01)	-(4.27)		
10-year Treasury yield	-1.5E-04		-5.5E-04	-8.1E-04			3.6E-04	8.7E-04			1.4E-03		5.0E-04	-1.5E-03	2.9E-03
	(-1.56)		-(2.52)	-(2.44)			(2.38)	(1.60)			(3.67)		(1.63)	-(2.59)	(3.95)
3-month Treasury yield	5.8E-04	2.2E-03	1.3E-03	3.6E-03		-7.4E-04	-9.2E-04		4.2E-04		-7.8E-04	-3.5E-03	-7.6E-04	2.7E-03	-1.6E-03
	(2.11)	(2.94)	(2.36)	(4.38)		-(3.30)	-(2.68)		(2.02)		-(2.65)	-(2.39)	-(3.15)	(4.97)	-(2.27)
Moody's AAA yield					-0.001	0.001		-0.001		-0.001				0.001	-0.003
					-(3.08)	(1.40)		-(1.22)		-(2.22)				(1.64)	-(3.93)
Moody's Baa yield		7.6E-04	-7.4E-04	-4.3E-04		-9.4E-04				-6.9E-04	5.4E-04	7.0E-04		-3.1E-04	
		(2.59)	-(3.25)	-(1.38)		-(3.21)				-(2.37)	(1.45)	(1.11)		-(1.49)	
Federal funds rate	-6.9E-04	-2.2E-03	-1.3E-03	-2.7E-03			7.1E-04		-3.2E-04	-5.8E-04		2.9E-03		-2.5E-03	1.5E-03
	(-2.75)	-(2.99)	-(2.39)	-(3.48)			(2.32)		-(1.56)	-(3.49)		(2.01)		-(5.12)	(2.29)
Wilshire quarterly market index return	1.1E-05	2.7E-05			2.9E-05			4.5E-05					1.0E-04		1.8E-05
	(2.20)	(1.96)			(1.85)			(3.48)					(4.79)		(1.11)
Wilshire daily return standard deviation	-2.5E-04		-5.7E-04					-4.3E-04	-3.6E-04	1.1E-03	6.3E-04	-1.1E-03		6.6E-04	
	(-2.26)		-(2.29)					-(1.53)	-(3.29)	(2.97)	(1.34)	-(1.35)		(2.58)	
Kansas City Fed Financial Stability Index		-0.001						0.001				-0.002		-0.001	0.001
		-(1.79)						(1.79)				-(2.12)		-(1.89)	(3.43)
VIX daily average					-1.1E-04			4.2E-05		-1.3E-04		1.9E-04	5.1E-05		
					-(3.86)			(1.51)		-(3.33)		(1.65)	(1.31)		
VIX quarterly percent change			-3.1E-06	-5.3E-06	5.5E-06	6.7E-06		9.8E-06	2.0E-06				7.3E-06		6.0E-06
			-(1.07)	-(1.26)	(1.34)	(1.54)		(3.24)	(1.59)				(1.37)		(1.42)
Change in Real House Price Index				2.8E-04	-3.9E-04			1.7E-04			3.3E-04	-5.8E-04	-1.8E-04	1.8E-04	2.4E-04
-				(2.29)	-(4.00)			(2.10)			(1.60)	-(2.76)	-(2.22)	(1.84)	(2.55)
Constant	0.004	-0.011	0.011	0.006	0.033	0.010	0.007	0.020	0.013	0.027	0.026	0.015	0.017	0.001	0.005
2	(2.38)	-(2.57)	(3.95)	(0.99)	(5.14)	(1.38)	(4.34)	(3.00)	(3.56)	(5.11)	(2.32)	(1.69)	(5.06)	(0.21)	(1.76)
Adjusted R <sup>2</sup>	0.827	0 593	0.615	0 778	0.788	0.550	0.211	0.609	0.933	0.688	0.675	0.717	0.621	0.632	0 417

#### Table A2 Continued: CLASS-Style Model Estimates for Non Interest Income to Assets (NONII)

All models are estimated using quarterly data from June 1993 through June 2008 (61 observations), using backward stepwise regression where variables are eliminated to generate the maximum adjusted R<sup>2</sup> value. T-Statitics appear in parenthesis under coefficient estimates. The representive bank is the asset-weighted average of all insured depository institutions in a quarter. Individual bank estimates use merger-adjusted quarterly data including mergers completed through June 2008. All bank-specific variables are lagged one quarter.

The 1 start 11	Representative	JPMorgan	Bank of				P	Regions			Capital One	Bank of	State Street	:	
Explanatory variable	Bank	Chase	America	Citibank	Wells Fargo	US Bank	Sun Trust	Bank	BB&T Bank	PNC Bank	Bank	New York	Bank	HSBC bank	RBS
Lagged dependent variable	-0.364	-0.426		-0.179	-0.321			-0.343	0.231	-0.246	-0.181		-0.172	-0.505	-0.251
	(-2.72)	-(3.70)		-(1.45)	-(2.90)			-(2.92)	(1.95)	-(1.88)	-(1.34)		-(1.08)	-(4.47)	-(1.85)
Trading account assets to total assets		0.031		-0.013		-0.265	-0.028							-0.011	
		(2.46)		-(2.43)		-(1.04)	-(1.44)							-(1.74)	
Total securities to total assets	0.027			-0.021	-0.008		-0.035		-0.024	0.017		-0.011		0.013	
	(2.58)			-(3.06)	-(1.15)		-(2.26)		-(2.61)	(1.87)		-(2.41)		(2.43)	
Other real estate owned to total assets	0.322		-0.203	-0.309	0.342		0.280		0.322			0.189			0.280
	(3.56)		-(1.74)	-(1.71)	(1.75)		(2.06)		(1.86)			(2.31)			(2.52)
Uncollected earned income on loans to total assets	0.328	1.313	-0.359	-0.233		3.263				0.947					
	(1.89)	(3.96)	-(1.73)	-(2.19)		(3.17)				(3.03)					
Total unused commitments to total assets	0.003		-0.004	0.002	-0.014		-0.010		0.022		0.018		-0.004	-0.012	
	(1.54)		-(2.02)	(2.38)	-(2.90)		-(1.57)		(2.35)		(3.50)		-(1.46)	-(3.31)	
Notional value of derivatives to total assets	2.0E-04	-1.1E-04	-9.2E-05	-9.8E-05				-1.1E-02	4.0E-03		2.1E-02	1.2E-04		1.3E-04	1.3E-02
	(1.36)	-(3.19)	-(1.45)	-(1.92)				-(2.17)	(1.66)		(1.70)	(1.05)		(2.44)	(1.91)
Total loans and leases to total assets	0.037	0.023	0.061		-0.012	0.127	-0.027				-0.041		-0.013	-0.023	
	(3.49)	(2.26)	(3.08)		-(2.25)	(3.50)	-(1.63)				-(3.88)		-(1.48)	-(3.84)	
Construction and development loans to total assets	-0.066	0.914		0.374	-0.080	-0.257	0.038	0.025	-0.076		-0.357			0.171	
	(-1.32)	(4.77)		(1.95)	-(2.95)	-(2.76)	(1.24)	(1.20)	-(3.46)		-(3.05)			(3.07)	
Commercial real estate loans to total assets	-0.071	-0.355		0.158	0.145	-0.266			-0.059	-0.124		0.090		0.177	
	(-1.07)	-(3.31)		(3.39)	(4.19)	-(2.93)			-(2.42)	-(2.95)		(3.14)		(5.03)	
1 to 4 family residential loans to total assets	-0.017		-0.057					-0.057	-0.050	0.012		-0.022	-2.845		-0.028
	(-1.14)		-(2.89)					-(3.04)	-(3.41)	(1.36)		-(2.12)	-(1.35)		-(2.21)
Commercial and industrial loans to total assets		-0.051	-0.057		-0.028	-0.120	0.020	-0.181			0.186	-0.019		0.047	-0.023
		-(2.49)	-(2.03)		-(1.95)	-(2.38)	(1.76)	-(4.12)			(4.22)	-(5.10)		(4.07)	-(1.07)
Consumer loans to total assets			-0.057			-0.223	0.053	0.052		0.027	0.022			0.048	-0.056
			-(2.16)			-(3.46)	(2.49)	(1.62)		(4.11)	(1.25)			(4.24)	-(2.66)

#### Table A3: CLASS-Style Model Estimates for Non Interest Expense to Assets (NONIX)

Explanatory Variable	Representative	JPMorgan	Bank of					Regions	``````````````````````````````````````	, 	Capital One	Bank of	State Street		
	Bank	Chase	America	Citibank	Wells Fargo	US Bank	Sun Trust	Bank	BB&T Bank	PNC Bank	Bank	New York	Bank	HSBC bank	RBS
Nominal Quarterly GDP growth rate, SAAR					-1.5E-04			-9.7E-05			-3.0E-04			-5.8E-05	
					-(2.60)			-(1.25)			-(2.44)			-(1.16)	
civilian unemployment rate				-0.002	-0.002				0.001	-0.001		-3.1E-04	0.001		-0.002
				-(4.02)	-(4.69)				(2.71)	-(2.74)		-(1.47)	(1.54)		-(1.52)
10-year Treasury yield	0.001		-0.001	0.001	0.003			0.003			0.002		0.003	-0.002	0.003
	(1.67)		-(2.09)	(2.62)	(4.47)			(3.00)			(3.01)		(4.28)	-(2.91)	(1.78)
3-month Treasury yield	0.001	0.003			-3.0E-04	-0.001		-0.002		0.001	-0.002		-0.001		-0.001
	(1.63)	(3.70)			-(1.73)	-(3.72)		-(1.68)		(1.97)	-(1.51)		-(1.58)		-(1.35)
Moody's AAA yield	-0.001		0.001	-0.002	-0.004	0.001		-0.003				-0.001	-0.003	0.002	-0.003
	(-1.71)		(1.37)	-(3.56)	-(5.08)	(2.25)		-(3.13)				-(3.54)	-(5.31)	(2.20)	-(1.43)
Moody's Baa yield		0.001			-3.9E-04	-0.002		-0.001		0.000		0.000	0.001	-4.8E-04	0.001
		(3.72)			-(1.44)	-(2.64)		-(2.06)		-(1.13)		-(2.16)	(3.46)	-(2.11)	(1.33)
Federal funds rate	-0.001	-0.003		-4.1E-04				0.001	0.001	-0.002	0.002		0.001		
	(-1.94)	-(3.35)		-(2.35)				(1.60)	(4.34)	-(2.57)	(1.30)		(2.14)		
Wilshire quarterly market index return	1.7E-05	3.8E-05			5.6E-05			8.8E-05						-3.2E-05	7.0E-05
	(2.65)	(2.14)			(3.56)			(4.08)						-(2.02)	(2.06)
Wilshire daily return standard deviation			-0.001				-5.0E-04		-0.001	4.9E-04	0.001		-0.001		0.001
·			-(2.09)				-(1.37)		-(4.95)	(1.54)	(1.09)		-(1.74)		(1.24)
Kansas City Fed Financial Stability Index	4.1E-04				0.001			0.002				-4.3E-04			0.002
	(1.56)				(2.02)			(4.11)				-(2.10)			(1.82)
VIX daily average	2.3E-05			5.7E-05	× /			. ,	8.1E-05			. ,	1.5E-04		. ,
	(1.16)			(2.15)					(2.96)				(2.75)		
VIX quarterly percent change	· · · ·			-7.4E-06	7.6E-06			2.1E-05	. ,				-7.7E-06	-5.9E-06	1.1E-05
1 91 0				-(2.73)	(1.81)			(3.75)					-(2.07)	-(1.51)	(1.38)
Change in Real House Price Index				()	-2.6E-04			2.6E-04		1.5E-04			-2.2E-04	4.4E-04	5.5E-04
5					-(2.27)			(2.11)		(1.34)			-(2.45)	(4.37)	(2.25)
Constant	-0.009	-0.012	0.002	0.028	0.050	-0.008	0.026	0.051	0.025	0.016	0.010	0.020	0.009	0.006	0.029
	(-1.35)	-(1.86)	(0.50)	(7.26)	(7.30)	-(0.62)	(2.02)	(5.10)	(2.99)	(3.16)	(1.77)	(7.76)	(1.88)	(1.21)	(2.27)
Adjusted R <sup>2</sup>	0.765	0 434	0.768	0.787	0.615	0.369	0.457	0.641	0.580	0.381	0.309	0.804	0.582	0.674	0.351

#### Table A3 Continued: CLASS-Style Model Estimates for Non Interest Expense to Assets (NONIX)

All models are estimated using quarterly data from June 1993 through June 2008 (61 observations), using backward stepwise regression where variables are eliminated to generate the maximum adjusted  $\mathbb{R}^2$  value. T-statistics are in parenthesis below coefficient estimates. The representive bank is the asset-weighted average of all insured depository institutions in a quarter. Individual bank estimates use merger-adjusted quarterly data including mergers completed through June 2008. All bank-specific variables are lagged one quarter.

	Representative	JPMorgan	Bank of					Regions			Capital One	Bank of	State Street		
Explanatory variable	Bank	Chase	America	Citibank	Wells Fargo	US Bank	Sun Trust	Bank	BB&T Bank	PNC Bank	Bank	New York	Bank	HSBC bank	RBS
Lagged dependent variable	0.255	-0.127	-0.413	0.354	-0.399	-0.203		-0.355		-0.190				-0.298	-0.169
	(2.13)	-(1.23)	-(3.17)	(3.15)	-(2.94)	-(1.46)		-(2.95)		-(1.61)				-(2.33)	-(1.40)
Trading account assets to total assets				0.006	0.066		-0.009						0.000		
				(1.71)	(3.21)		-(1.95)						(1.09)		
Total securities to total assets	-0.017	-0.014			-0.007		-0.006	-0.014	-0.007		-0.018			-0.004	
	(-4.95)	-(4.26)			-(2.21)		-(1.37)	-(3.63)	-(2.62)		-(3.22)			-(1.73)	
Other real estate owned to total assets				0.038	0.380	-0.314			0.084			0.147	0.243	-0.192	0.091
				(1.24)	(4.62)	-(1.07)			(1.44)			(2.12)	(4.50)	-(2.64)	(4.91)
Uncollected earned income on loans to total assets		0.458	0.298	-0.103	-0.384	1.699				0.375	-0.772		0.002		
		(4.70)	(3.96)	-(1.20)	-(2.98)	(2.33)				(2.99)	-(2.79)		(1.07)		
Total unused commitments to total assets	-0.004		-0.002		-0.004	0.016		0.005		0.007			0.000		
	(-3.84)		-(2.39)		-(1.50)	(2.71)		(1.59)		(3.20)			-(1.68)		
Notional value of derivatives to total assets	2.0E-04	-2.1E-05		-6.4E-05	2.7E-04			3.8E-03	2.3E-03	-6.5E-04				-3.1E-05	4.3E-03
	(4.55)	-(2.36)		-(1.70)	(1.77)			(2.63)	(3.19)	-(1.65)				-(1.07)	(4.50)
Total loans and leases to total assets	0.015	0.012	0.008		0.005		0.038					0.014	0.001		-0.009
	(3.03)	(3.91)	(3.50)		(1.10)		(2.67)					(3.15)	(3.47)		-(2.43)
Construction and development loans to total assets	-0.049	0.167					-0.034							0.094	
	(-3.65)	(3.75)					-(2.55)							(1.63)	
Commercial real estate loans to total assets		-0.086	-0.043	-0.087	-0.047	-0.098	-0.045		-0.006		-0.031				
		-(3.29)	-(2.67)	-(3.13)	-(3.26)	-(2.35)	-(1.95)		-(1.74)		-(2.44)				
1 to 4 family residential loans to total assets	-0.016		-0.017		-0.011	0.036	-0.042	-0.028	-0.009		-0.007		-0.094		0.009
	(-2.20)		-(5.54)		-(2.52)	(1.62)	-(2.54)	-(3.64)	-(2.13)		-(2.37)		-(1.63)		(2.15)
Commercial and industrial loans to total assets		-0.017		0.019	0.031		-0.040	-0.056			-0.030	-0.023			0.010
		-(2.66)		(2.04)	(3.09)		-(2.67)	-(3.54)			-(1.44)	-(3.96)			(1.63)
Consumer loans to total assets	-0.031	-0.024			0.010	-0.056	-0.029	0.045	0.044	-0.025				0.011	
	(-3.49)	-(3.28)			(1.22)	-(1.44)	-(2.41)	(5.44)	(4.47)	-(3.23)				(2.34)	

#### Table A4: CLASS-Style Model Estimates for Loan and Lease Loss Provision Expense to Assets (ELNATR)

Employetary Variable	Representative	JPMorgan	Bank of	-				Regions	-		Capital One	Bank of	State Street		
Explanatory variable	Bank	Chase	America	Citibank	Wells Fargo	US Bank	Sun Trust	Bank	BB&T Bank	PNC Bank	Bank	New York	Bank	HSBC bank	RBS
Nominal Quarterly GDP growth rate, SAAR		5.4E-05	5.6E-05	-8.2E-05	-7.6E-05				-3.2E-05	4.8E-05	-1.1E-04			-3.7E-05	-6.4E-05
		(2.23)	(2.37)	-(1.98)	-(3.02)				-(2.34)	(1.49)	-(2.24)			-(1.29)	-(3.47)
civilian unemployment rate	5.2E-04	8.3E-04	7.2E-04	1.2E-03	-3.0E-04		5.5E-04			1.0E-03	7.5E-04	7.8E-04		4.3E-04	-3.6E-04
	(6.47)	(4.55)	(3.14)	(5.58)	-(1.35)		(2.94)			(5.31)	(2.61)	(2.81)		(2.37)	-(1.99)
10-year Treasury yield	2.4E-04			1.3E-03	9.3E-04	-3.7E-03	2.1E-04			5.0E-04		-1.2E-03		1.2E-03	
	(1.78)			(3.32)	(2.92)	-(2.78)	(1.94)			(3.25)		-(2.69)		(3.22)	
3-month Treasury yield		2.4E-04	-8.8E-05		-2.9E-04		-8.5E-04	-6.1E-04			-2.2E-03	1.6E-03		-6.3E-04	-9.1E-04
		(3.21)	-(1.04)		-(3.63)		-(3.44)	-(2.36)			-(4.27)	(2.91)		-(1.73)	-(4.21)
Moody's AAA yield	-2.4E-04	1.9E-04		-1.6E-03	-9.3E-04	5.2E-03			-1.9E-04		5.2E-04	1.1E-03		-1.0E-03	3.2E-04
	(-1.51)	(1.93)		-(3.88)	-(2.41)	(3.39)			-(2.46)		(2.80)	(2.71)		-(2.32)	(3.40)
Moody's Baa yield	-1.5E-04		-4.7E-04	3.7E-04	2.6E-04					3.1E-04				3.1E-04	
	(-1.89)		-(4.39)	(1.91)	(1.93)					(2.64)				(2.23)	
Federal funds rate						-6.5E-04	7.7E-04	5.9E-04	-7.4E-05		1.9E-03	-1.1E-03	5.8E-06	5.2E-04	5.2E-04
						-(2.35)	(3.60)	(2.38)	-(2.28)		(3.65)	-(2.34)	(1.75)	(1.57)	(2.39)
Wilshire quarterly market index return		1.2E-05				-3.5E-05	-1.2E-05	1.3E-05		2.1E-05		3.0E-05	-8.4E-07		
		(2.36)				-(1.58)	-(2.71)	(1.97)		(2.90)		(2.46)	-(1.26)		
Wilshire daily return standard deviation	8.5E-05			7.2E-04	4.1E-04		-1.8E-04				5.1E-04				
	(1.18)			(3.47)	(2.77)		-(1.65)				(2.23)				
Kansas City Fed Financial Stability Index	4.6E-04	1.1E-03	9.3E-04		5.2E-04	-1.6E-03		6.2E-04	2.4E-04	5.6E-04			-2.9E-05	9.2E-04	2.8E-04
	(3.64)	(7.23)	(6.65)		(2.10)	-(2.73)		(3.54)	(2.92)	(3.34)			-(2.45)	(3.97)	(2.23)
VIX daily average					-2.2E-05	-8.2E-05		-3.7E-05	-2.0E-05			1.5E-04	3.5E-06		
					-(1.10)	-(1.30)		-(2.03)	-(2.09)			(4.83)	(2.44)		
VIX quarterly percent change	7.4E-07							2.5E-06	1.2E-06				-3.1E-07		
	(1.14)							(1.41)	(1.52)				-(1.88)		
Change in Real House Price Index					-9.6E-05		-1.6E-04	1.3E-04		1.1E-04					4.6E-05
					-(1.74)		-(5.34)	(2.82)		(1.76)					(1.14)
Constant	0.002	-6.3E-03	2.4E-03	-4.6E-03	4.8E-03	-1.5E-02	-3.3E-03	1.2E-02	3.0E-03	-1.1E-02	9.3E-03	-1.2E-02	-1.2E-04	-2.9E-03	4.0E-03
	(0.77)	-(4.02)	(1.45)	-(2.12)	(1.61)	-(2.34)	-(1.00)	(3.36)	(2.54)	-(4.58)	(2.99)	-(4.62)	-(2.27)	-(1.48)	(1.70)
Adjusted R <sup>2</sup>	0.939	0.804	0.797	0.722	0.882	0.445	0.832	0.676	0.640	0.537	0.752	0.545	0.780	0.807	0.838

Table A4 Continued: CL	ASS-Style Model Estimates for	Loan and Lease Loss	Provision Expens	e to Assets (	ELNATR)

All models are estimated using quarterly data from June 1993 through June 2008 (61 observations), using backward stepwise regression where variables are eliminated to generate the maximum adjusted R<sup>2</sup> value. T-statistics appear in parenthesis below coefficient estimates. The representive bank is the asset-weighted average of all insured depository institutions in a quarter. Individual bank estimates use merger-adjusted quarterly data including mergers completed through June 2008. All bank-specific variables are lagged one quarter.

	Representative	JPMorgan	Bank of				(	Regions		.,	Capital One	Bank of	State Street	:	
Explanatory variable	Bank	Chase	America	Citibank	Wells Fargo	US Bank	Sun Trust	Bank	BB&T Bank	PNC Bank	Bank	New York	Bank	HSBC bank	RBS
Lagged dependent variable	-0.260				-0.320	-0.367	-0.368			-0.188	-0.483	-0.223			
	-(2.64)				-(3.00)	-(2.40)	-(3.27)			-(1.71)	-(3.87)	-(1.70)			
Trading account assets to total assets	-0.004	-0.007		-0.031			0.028						0.008	-0.159	-0.159
	-(4.17)	-(1.70)		-(3.10)			(1.69)						(3.24)	-(2.28)	(-2.28)
Total securities to total assets					-0.009			0.009		-0.004			0.006		
					-(2.87)			(2.22)		-(2.82)			(3.18)		
Other real estate owned to total assets		0.048	0.082		0.077	0.216		-0.101	0.110	0.077	0.109	-0.566		-0.033	-0.033
		(1.20)	(2.22)		(1.38)	(2.81)		-(1.19)	(2.30)	(4.12)	(3.61)	-(1.91)		-(2.07)	(-2.07)
Uncollected earned income on loans to total assets		0.122		0.366	-0.445		0.090					0.012	-0.045	0.563	0.563
		(2.00)		(4.92)	-(2.55)		(2.84)					(1.25)	-(1.36)	(3.08)	(3.08)
Total unused commitments to total assets			-0.001	-0.002						0.002	0.002			-0.007	-0.007
			-(4.12)	-(1.78)						(2.18)	(2.18)			-(2.53)	(-2.53)
Notional value of derivatives to total assets		-4.5E-05	1.1E-05			3.6E-03				-1.2E-03	6.4E-05			2.3E-03	2.3E-03
		-(2.46)	(1.04)			(6.48)				-(1.18)	(1.64)			(2.07)	(2.07)
Total loans and leases to total assets				-0.003		-0.036		-0.019		-0.013	-0.001		0.019		
				-(1.82)		-(3.50)		-(2.81)		-(4.22)	-(1.39)		(5.53)		
Construction and development loans to total assets		-0.067	-0.044	-0.011		-0.020		0.017		-0.023		0.764	0.040		
		-(3.53)	-(1.09)	-(1.62)		-(1.49)		(1.93)		-(2.21)		(1.79)	(2.31)		
Commercial real estate loans to total assets			-0.032	-0.013	0.012		-0.011	0.017		0.013	0.015	0.097			
			-(4.46)	-(2.41)	(1.22)		-(3.16)	(1.34)		(1.68)	(1.41)	(2.19)			
1 to 4 family residential loans to total assets	-0.011	0.003			-0.019	0.039		0.019		0.013	-0.012		-0.010	-0.005	-0.005
	-(4.76)	(2.18)			-(3.75)	(2.88)		(2.01)		(4.02)	-(2.52)		-(4.35)	-(3.57)	(-3.57)
Commercial and industrial loans to total assets		-0.004	0.006			0.056		0.036	0.007			-0.005			
		-(2.14)	(2.23)			(4.59)		(2.60)	(1.51)			-(2.16)			
Consumer loans to total assets	-0.007	-0.009	0.005			0.043				0.014			-0.013	-0.008	-0.008
	-(1.99)	-(2.70)	(3.00)			(3.07)				(3.79)			-(3.68)	-(2.52)	(-2.52)

#### Table A5: CLASS-Style Model Estimates for Securities Gains (Losses) to Assets (IGLSEC)

Evaluatory Variable	Representative	JPMorgan	Bank of		-,			Regions		,	Capital One	Bank of	State Street		
Explanatory variable	Bank	Chase	America	Citibank	Wells Fargo	US Bank	Sun Trust	Bank	BB&T Bank	PNC Bank	Bank	New York	Bank	HSBC bank	RBS
Nominal Quarterly GDP growth rate, SAAR	2.3E-05	-2.0E-05				-4.0E-05	1.8E-05	3.3E-05			2.6E-05			3.8E-05	3.8E-05
	(1.84)	-(1.64)				-(1.82)	(1.67)	(1.57)			(1.75)			(1.96)	(1.96)
civilian unemployment rate	5.5E-04				7.0E-04	6.4E-04	9.5E-05	2.4E-04			1.5E-04	1.6E-04	3.6E-04		
	(6.21)				(6.37)	(4.33)	(1.48)	(2.55)			(1.36)	(2.24)	(3.33)		
10-year Treasury yield	-2.4E-04	-1.3E-04	-1.1E-04	-1.5E-04	-5.9E-04				-9.3E-05	-2.6E-04	-4.7E-04	-3.6E-04	1.6E-04		
	-(5.18)	-(2.54)	-(2.44)	-(2.06)	-(7.45)				-(1.30)	-(5.62)	-(2.82)	-(2.83)	(2.25)		
3-month Treasury yield		-1.3E-04	1.0E-04	-2.4E-04		2.8E-04	-4.1E-04			-1.9E-04	5.3E-04	1.1E-04		-9.6E-05	-9.6E-05
		-(4.02)	(4.54)	-(1.36)		(3.10)	-(3.29)			-(1.33)	(2.51)	(3.15)		-(2.62)	(-2.62)
Moody's AAA yield						0.000	0.000	0.000			0.000	0.000		0.000	-2.6E-04
						-(1.80)	-(2.53)	-(1.94)			(2.44)	(1.98)		-(3.00)	(-3.00)
Moody's Baa yield		-1.6E-04			2.1E-04	-3.3E-04				-8.1E-05					
		-(2.68)			(2.18)	-(3.58)				-(1.86)					
Federal funds rate	2.0E-04			1.9E-04	4.3E-04		3.0E-04		-7.5E-05	2.6E-04	-4.0E-04		1.8E-04		
	(5.32)			(1.18)	(5.35)		(2.63)		-(1.70)	(1.97)	-(2.23)		(2.62)		
Wilshire quarterly market index return	8.7E-06		-3.6E-06			-5.1E-06						-9.7E-06	-9.1E-06	-1.2E-05	-1.2E-05
	(3.10)		-(1.15)			-(1.09)						-(3.21)	-(1.58)	-(1.87)	(-1.87)
Wilshire daily return standard deviation		1.4E-04	-9.2E-05	-2.0E-04	2.9E-04		3.0E-04	4.9E-04		-1.8E-04				2.7E-04	2.7E-04
		(2.16)	-(1.30)	-(2.03)	(2.16)		(4.43)	(3.55)		-(2.78)				(2.38)	(2.38)
Kansas City Fed Financial Stability Index	-2.0E-04		-2.6E-04		-7.5E-04		-1.7E-04	-4.7E-04	-1.2E-04		-5.5E-04	-2.1E-04		1.2E-04	1.2E-04
	-(2.23)		-(3.72)		-(4.63)		-(2.57)	-(3.17)	-(0.94)		-(4.81)	-(3.35)		(1.25)	(1.25)
VIX daily average	4.5E-05		1.8E-05	2.5E-05	4.1E-05			4.8E-05	1.6E-05	1.8E-05	2.3E-05	1.8E-05			
	(5.76)		(2.38)	(2.25)	(2.72)			(3.03)	(1.26)	(2.30)	(2.16)	(2.77)			
VIX quarterly percent change			-1.8E-06		-3.4E-06		-1.5E-06	-3.1E-06	2.1E-06		-1.3E-06	-2.1E-06	-6.3E-06	-2.3E-06	-2.3E-06
			-(2.29)		-(3.03)		-(2.14)	-(2.41)	(1.51)		-(1.44)	-(2.70)	-(4.16)	-(1.64)	(-1.64)
Change in Real House Price Index	-3.1E-05			6.2E-05	-7.1E-05	-1.1E-04				-4.0E-05					
	-(1.63)			(2.52)	-(1.78)	-(2.76)				-(1.96)					
Constant	-4.1E-04	4.7E-03	-4.4E-04	3.1E-03	8.2E-04	1.2E-03	1.0E-03	-1.9E-03	-6.7E-04	4.7E-03	-2.5E-03	-1.0E-03	-1.2E-02	3.7E-03	0.004
	-(0.58)	(4.35)	-(0.60)	(2.50)	(0.57)	(0.41)	(1.27)	-(0.47)	-(1.42)	(4.02)	-(2.29)	-(2.40)	-(5.35)	(2.91)	(2.91)
Adjusted R <sup>2</sup>	0.742	0.577	0.479	0.565	0.679	0.714	0.602	0.502	0.216	0.765	0.586	0.425	0.539	0.695	0.695

#### Table A5 Continued: CLASS-Style Model Estimates for Securities Gains (Losses) to Assets (IGLSEC)

All models are estimated using quarterly data from June 1993 through June 2008 (61 observations), using backward stepwise regression where variables are eliminated to generate the maximum adjusted R<sup>2</sup> value. T-statistics appear in parenthesis below coefficient estimates. The representive bank is the asset-weighted average of all insured depository institutions in a quarter. Individual bank estimates use merger-adjusted quarterly data including mergers completed through June 2008. All bank-specific variables are lagged one quarter.

			18	ible A6: Bay	yesian Model A	average Est	imates for IN	BFIXEX							
Posterior Distribution Coefficient Expected Value	Representative	JPMorgan	Bank of					Regions			Capital One	Bank of	State Street		
(coefficient expected value and std dev x100)	Bank	Chase	America	Citibank	Wells Fargo	US Bank	Sun Trust	Bank	BB&T Bank	PNC Bank	Bank	New York	Bank	HSBC bank	RBS
Lagged dependent variable	-2.521	21.283	-0.044	1.105	0.104	0.942	0.282	8.611	-0.653	-0.099	-0.412	-0.360	-0.131	1.175	-0.065
Posterior Inclusion probability	13.11%	57.20%	4.70%	7.65%	4.10%	6.26%	4.74%	29.81%	6.03%	3.99%	4.80%	5.05%	3.78%	7.30%	4.67%
Posterior coefficient standard deviation	7.928	21.295	3.713	5.455	2.875	5.819	3.331	15.181	3.924	3.245	3.650	3.630	2.675	5.993	3.633
Trading account assets to total assets	0.064	-0.030	-0.014	-0.927	0.094	-0.182	0.112	-0.969	-0.987	-0.578	-3.414	-0.134	0.007	0.002	-0.015
Posterior Inclusion probability	6.52%	7.13%	5.73%	40.24%	5.24%	5.52%	11.12%	10.19%	10.02%	12.95%	9.83%	9.31%	4.16%	5.92%	5.87%
Posterior coefficient standard deviation	0.518	0.271	0.347	1.291	1.168	4.402	0.438	4.007	3.705	2.188	13.839	0.583	0.294	0.301	0.358
Total securities to total assets	-0.874	-0.061	-0.581	-0.539	-9.292	-0.997	-0.975	0.071	-0.432	2.260	0.201	-0.529	-1.766	-1.347	-0.573
Posterior Inclusion probability	7.68%	9.37%	9.38%	7.33%	18.61%	7.69%	19.65%	14.35%	6.24%	30.82%	5.90%	20.38%	4.92%	88.63%	9.15%
Posterior coefficient standard deviation	0.420	0.462	0.269	0.435	0.386	0.375	0.677	0.368	0.350	0.738	0.269	0.872	0.043	0.704	0.264
Other real estate owned to total assets	-0.874	-0.061	-0.581	-0.539	-9.292	-0.997	-0.975	0.071	-0.432	2.260	0.201	-0.529	-1.766	-1.347	-0.573
Posterior Inclusion probability	8.14%	7.06%	6.72%	7.37%	32.02%	6.21%	10.70%	4.73%	5.54%	8.39%	5.73%	5.58%	4.90%	12.06%	6.73%
Posterior coefficient standard deviation	5.223	4.095	3.821	4.398	15.248	7.713	5.304	3.312	5.144	10.917	2.150	6.585	34.461	5.965	3.794
Uncollected earned income on loans to total assets	-14.943	-1.217	-0.511	31.341	-0.999	-11.420	21.375	7.430	-0.032	-25.763	-1.478	-4.698	0.870	0.281	-0.437
Posterior Inclusion probability	39.07%	6.65%	4.74%	55.83%	5.45%	13.89%	42.91%	22.62%	4.14%	36.22%	4.59%	7.30%	8.78%	5.57%	4.24%
Posterior coefficient standard deviation	21.150	8.458	5.293	32.059	7.818	34.383	29.007	16.307	3.789	39.064	17.133	25.465	3.662	2.864	4.922
Total unused commitments to total assets	1.002	1.050	0.626	0.054	-0.010	0.380	-0.010	0.038	1.260	0.008	0.021	0.181	0.035	0.018	0.616
Posterior Inclusion probability	99.11%	68.37%	83.33%	19.99%	6.65%	45.68%	8.08%	9.23%	78.74%	5.67%	6.49%	19.52%	9.55%	11.20%	82.11%
Posterior coefficient standard deviation	0.187	0.844	0.331	0.131	0.131	0.476	0.162	0.222	0.754	0.083	0.116	0.444	0.147	0.263	0.337
Notional value of derivatives to total assets	-0.054	-0.003	0.000	-0.009	0.001	0.025	-0.007	-0.385	0.001	-0.022	0.087	0.011	0.001	-0.001	0.000
Posterior Inclusion probability	99.95%	47.05%	8.02%	44.36%	6.11%	7.99%	12.32%	70.56%	4.64%	21.74%	6.32%	20.90%	6.09%	11.60%	8.37%
Posterior coefficient standard deviation	0.015	0.003	0.002	0.012	0.009	0.143	0.061	0.310	0.052	0.050	0.475	0.042	0.006	0.004	0.002
Total loans and leases to total assets	-0.174	0.041	-0.020	0.183	-0.035	0.093	-0.636	0.165	-0.085	0.273	-0.022	0.028	0.110	0.039	-0.020
Posterior Inclusion probability	11.49%	8.41%	6.16%	12.76%	7.37%	11.51%	24.03%	19.36%	8.04%	25.99%	6.21%	9.41%	8.89%	6.63%	6.25%
Posterior coefficient standard deviation	0.639	0.274	0.200	0.607	0.230	0.539	1.587	0.468	0.406	0.535	0.276	0.280	0.493	0.327	0.193
Construction and development loans to total assets	5.559	2.194	-0.289	-0.017	0.238	1.016	-2.970	0.204	0.076	-0.601	-1.334	-58.972	1.721	-1.045	-0.292
Posterior Inclusion probability	61.18%	13.15%	6.26%	5.99%	8.86%	15.82%	60.43%	14.54%	8.87%	16.36%	13.64%	37.02%	4.24%	10.43%	6.04%
Posterior coefficient standard deviation	5.161	7.377	1.908	4.774	1.024	2.918	2.909	0.699	0.476	1.634	4.660	92.086	57.943	4.186	1.910
Commercial real estate loans to total assets	0.434	0.075	-0.283	-1.453	0.083	0.311	-4.126	-0.019	-0.145	0.030	-3.978	5.572	-0.472	11.134	-0.292
Posterior Inclusion probability	9.93%	6.66%	9.10%	15.40%	6.38%	9.63%	65.73%	6.66%	9.60%	5.28%	40.66%	44.50%	6.31%	87.64%	9.66%
Posterior coefficient standard deviation	2.466	1.463	1.282	4.586	0.551	1.444	3.785	0.558	0.654	1.468	5.371	8.284	4.618	5.662	1.305
1 to 4 family residential loans to total assets	0.018	0.385	-0.047	-0.070	0.001	0.120	-0.335	0.048	-0.022	0.088	0.055	-0.158	-8.748	-0.049	-0.046
Posterior Inclusion probability	5.00%	22.17%	7.02%	6.75%	5.67%	8.83%	37.23%	6.78%	5.85%	12.43%	8.11%	7.80%	8.16%	7.63%	6.80%
Posterior coefficient standard deviation	0.391	0.853	0.271	0.433	0.112	0.712	1.657	0.315	0.318	0.428	0.545	1.091	49,939	0.341	0.268
Commercial and industrial loans to total assets	-0.047	0.014	0.035	0.083	-0.049	-0.094	0.560	-0.120	-0.256	0.173	0.072	-0.006	-0.066	0.678	0.033
Posterior Inclusion probability	6.48%	8.25%	7.47%	6.15%	7.42%	9.47%	21.43%	9.68%	7.17%	11.48%	5.77%	11.32%	6.59%	26.61%	7.11%
Posterior coefficient standard deviation	0.523	0.555	0.330	0.746	0.384	0.703	1.602	1.011	1.292	0.932	1.218	0.564	0.608	1.309	0.326
Consumer loans to total assets	-1.226	0.084	-0.025	0.123	-0.301	-0.738	0.103	-0.017	-0.435	0.102	-0.024	0.499	-0.538	0.109	-0.025
Posterior Inclusion probability	30.95%	6.84%	5.90%	10.42%	13.80%	17.37%	15.21%	9.97%	14.81%	10.83%	6.48%	7.56%	4.94%	10.61%	6.36%
Posterior coefficient standard deviation	2.110	0.726	0.431	0.738	0.901	1.950	1.278	0.648	1.262	0.413	0.522	5.007	11.797	0.563	0.442

#### Table A6: Bayesian Model Average Estimates for INBFTXEX

			I abic A	to Continuet	i. Dayesian w	ouel Averag	ge Estimates	IOI INDE LA	EA						
Posterior Distribution Coefficient Expected Value	Representative	JPMorgan	Bank of					Regions			Capital One	Bank of	State Street		
(coefficient expected value and std dev x100)	Bank	Chase	America	Citibank	Wells Fargo	US Bank	Sun Trust	Bank	BB&T Bank	PNC Bank	Bank	New York	Bank	HSBC bank	RBS
Nominal Quarterly GDP growth rate, SAAR	0.002	0.002	0.002	0.018	0.001	0.000	0.000	0.002	0.000	0.002	0.000	0.022	-0.004	0.001	0.002
Posterior Inclusion probability	25.64%	17.66%	14.99%	60.80%	10.42%	4.44%	4.58%	20.44%	4.26%	14.43%	4.19%	60.84%	26.35%	7.47%	14.38%
Posterior coefficient standard deviation	0.004	0.005	0.005	0.017	0.003	0.002	0.001	0.005	0.001	0.006	0.003	0.021	0.008	0.003	0.005
civilian unemployment rate	-0.006	-0.013	-0.002	0.005	-0.005	-0.027	0.003	0.000	-0.002	0.000	0.002	-0.157	-0.004	0.000	-0.002
Posterior Inclusion probability	18.79%	22.72%	8.13%	8.34%	12.35%	34.95%	14.02%	4.92%	7.41%	6.69%	6.22%	79.07%	9.37%	7.26%	8.18%
Posterior coefficient standard deviation	0.015	0.027	0.011	0.034	0.018	0.043	0.019	0.005	0.009	0.013	0.015	0.100	0.017	0.012	0.011
10-year Treasury yield	0.000	-0.001	0.001	-0.018	-0.002	-0.005	0.003	0.001	0.000	0.001	0.001	0.002	0.000	-0.002	0.001
Posterior Inclusion probability	5.16%	7.60%	6.49%	17.83%	9.27%	16.52%	11.37%	7.25%	5.07%	5.38%	5.49%	6.73%	5.05%	8.09%	5.97%
Posterior coefficient standard deviation	0.006	0.011	0.011	0.087	0.012	0.019	0.011	0.011	0.012	0.012	0.013	0.018	0.007	0.026	0.011
3-month Treasury yield	0.001	0.002	0.032	0.063	0.000	-0.002	0.005	0.000	0.000	0.004	-0.002	0.000	0.000	0.010	0.032
Posterior Inclusion probability	8.88%	8.73%	20.29%	28.68%	5.97%	10.59%	17.94%	4.99%	5.00%	9.46%	7.03%	7.83%	4.96%	17.34%	19.94%
Posterior coefficient standard deviation	0.005	0.015	0.081	0.134	0.006	0.011	0.017	0.007	0.005	0.034	0.013	0.018	0.006	0.042	0.081
Moody's AAA yield	-0.001	-0.007	-0.001	0.076	-0.001	-0.012	0.002	-0.009	-0.002	-0.001	0.002	0.007	0.001	0.003	-0.001
Posterior Inclusion probability	5.01%	14.34%	6.22%	54.34%	6.90%	21.46%	10.46%	19.29%	6.57%	5.98%	6.08%	10.64%	5.77%	6.73%	6.30%
Posterior coefficient standard deviation	0.007	0.022	0.011	0.100	0.010	0.030	0.013	0.023	0.016	0.014	0.014	0.029	0.011	0.027	0.011
Moody's Baa yield	0.000	0.000	-0.007	-0.134	-0.027	-0.057	-0.003	-0.018	-0.001	-0.032	0.000	0.002	0.000	-0.076	-0.007
Posterior Inclusion probability	4.91%	5.78%	14.68%	88.31%	49.38%	78.31%	11.24%	43.77%	5.90%	46.04%	4.85%	5.42%	4.39%	80.90%	14.43%
Posterior coefficient standard deviation	0.005	0.007	0.022	0.061	0.030	0.036	0.010	0.024	0.011	0.040	0.012	0.014	0.006	0.045	0.023
Federal funds rate	0.000	-0.001	-0.029	-0.052	0.000	-0.002	-0.001	0.000	0.000	-0.007	-0.001	0.001	-0.001	-0.005	-0.029
Posterior Inclusion probability	7.78%	8.02%	19.11%	24.01%	6.00%	10.62%	13.71%	5.39%	5.48%	11.51%	6.53%	7.23%	4.87%	13.01%	18.74%
Posterior coefficient standard deviation	0.004	0.014	0.075	0.118	0.005	0.011	0.017	0.007	0.004	0.034	0.012	0.016	0.007	0.041	0.075
Wilshire quarterly market index return	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	-0.001	0.001	0.000	0.000
Posterior Inclusion probability	4.06%	4.61%	5.02%	4.85%	4.38%	34.99%	4.44%	12.22%	9.33%	4.06%	4.13%	12.61%	14.39%	6.74%	4.60%
Posterior coefficient standard deviation	0.000	0.000	0.001	0.001	0.000	0.002	0.000	0.001	0.001	0.000	0.001	0.002	0.002	0.001	0.000
Wilshire daily return standard deviation	0.000	-0.001	-0.006	-0.003	-0.001	-0.001	0.000	0.000	0.159	0.004	0.003	-0.005	0.002	0.000	-0.006
Posterior Inclusion probability	4.24%	5.43%	10.34%	6.28%	4.61%	5.23%	4.70%	5.22%	99.48%	8.51%	6.57%	6.75%	6.30%	6.32%	9.74%
Posterior coefficient standard deviation	0.005	0.010	0.023	0.017	0.008	0.011	0.006	0.008	0.037	0.021	0.024	0.029	0.014	0.014	0.023
Kansas City Fed Financial Stability Index	-0.088	-0.015	-0.054	-0.020	-0.001	0.003	-0.002	-0.019	-0.122	-0.008	-0.001	0.000	0.005	-0.058	-0.053
Posterior Inclusion probability	99.13%	24.21%	60.19%	16.17%	6.01%	8.92%	7.40%	25.62%	96.61%	13.39%	7.12%	5.22%	12.25%	54.98%	59.47%
Posterior coefficient standard deviation	0.020	0.032	0.050	0.059	0.010	0.018	0.011	0.038	0.035	0.028	0.026	0.017	0.018	0.066	0.050
VIX daily average	0.000	0.000	-0.001	-0.002	0.000	0.000	0.000	0.002	0.000	0.000	0.003	-0.001	0.000	0.000	-0.001
Posterior Inclusion probability	4.55%	7.41%	13.19%	17.70%	5.58%	6.65%	5.54%	21.47%	6.36%	6.29%	24.01%	8.75%	7.21%	11.18%	13.25%
Posterior coefficient standard deviation	0.001	0.001	0.003	0.004	0.001	0.001	0.001	0.004	0.001	0.002	0.005	0.003	0.001	0.003	0.003
VIX quarterly percent change	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Posterior Inclusion probability	4.94%	3.80%	18.70%	6.68%	3.82%	5.14%	4.91%	4.31%	11.19%	6.66%	4.26%	4.86%	5.15%	8.56%	18.05%
Posterior coefficient standard deviation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Change in Real House Price Index	0.000	0.004	0.005	0.004	0.001	0.002	0.000	0.000	0.000	-0.002	0.030	0.000	-0.001	0.000	0.006
Posterior Inclusion probability	5.49%	24.33%	18.73%	15.91%	11.02%	10.08%	5.62%	7.51%	5.86%	9.83%	57.26%	4.61%	10.55%	5.37%	20.21%
Posterior coefficient standard deviation	0.002	0.008	0.012	0.011	0.005	0.006	0.002	0.003	0.002	0.008	0.029	0.004	0.005	0.004	0.013
Constant	0.307	-0.086	0.270	0.730	0.857	1.119	1.252	0.485	0.250	0.688	0.641	1.078	0.417	0.047	0.276
Posterior Inclusion probability	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Posterior expected number of regressors	5.972	4.229	3.806	5.901	2.634	4.138	4.452	4.109	4.382	3.504	5.262	4.262	1.979	5.258	3.766
Correlation between model marginal liklihood and MCMC model frequency for best 500 models	0.999	0.997	0.998	0.984	0.984	0.984	0.984	0.996	1.000	0.998	0.998	0.997	1.000	0.997	0.999

#### Table A6 Continued: Bayesian Model Average Estimates for INBFTXEX

#### Table A7: Lasso Estimates of INBFTXEX

Explanatory Variable Coefficient (x1000)	Representative Bank	JPMorgan Chase	Bank of America	Citibank	Wells Fargo	US Bank	Sun Trust	Regions Bank	BB&T Bank	PNC Bank	Capital One Bank	Bank of New York	State Street Bank	HSBC bank	RBS
Lagged dependent variable	0.060	0.142	0.063	0.158	0	0.063	0.135	0.149	0	0	0	0	-0.053	0.255	0
Nominal Quarterly GDP growth rate, SAAR	0.235	0.089	0.283	0.520	0.096	0	0	0.092	0	0.290	0	0.689	-0.357	0.343	0
civilian unemployment rate	-0.377	0	-0.515	-0.263	-0.161	-0.366	0	0	-0.204	-0.149	0	-1.172	-0.600	-0.423	-0.205
10-year Treasury yield	-1.640	0	-1.482	-3.944	-0.150	-0.344	0	0	0	0	0	0	0	-3.679	0
3-month Treasury yield	2.115	0	3.016	4.111	0	0	0	0.095	0	1.616	0	0	0	4.042	0
Moody's AAA yield	1.384	0	1.186	3.888	0	0	0.211	0	-0.323	0.157	0	0.662	0.370	3.402	0
Moody's Baa yield	-0.145	0.216	-0.212	-1.100	-0.315	-0.544	0	-0.106	-0.273	-0.259	0	0	-0.095	-0.073	-0.342
Federal funds rate	-1.918	0.178	-2.872	-3.399	0	0	0	0	0	-1.751	0	0	-0.643	-3.630	0
Wilshire quarterly market index return	-0.102	0.091	-0.286	0	-0.045	0.204	0	0.109	0	0.042	0	-0.117	0.383	0.019	0
Wilshire daily return standard deviation	-0.112	0	-0.322	-0.076	0	0	0	0	0.649	0.259	0	0	0	-0.163	0
Kansas City Fed Financial Stability Index	-0.851	0	-0.650	-0.828	0	0	0	-0.283	-0.440	-0.377	0	0	0	-1.899	0
VIX daily average	0.383	0	0.410	0	0	0.083	0	0.411	-0.172	0.322	0.341	0	0	0.949	0.439
VIX quarterly percent change	-0.107	0.045	-0.408	-0.096	0	0	0	0	-0.073	0.080	0	0	0.111	-0.431	0
Change in Real House Price Index	0.077	0	0.052	0.182	0.114	0	0.024	0.122	-0.159	0	0.716	0	-0.333	-0.222	0
Lasso penalty (x1000)	0	0.069	0	0.009	0.036	0.080	0.119	0.023	0.036	0.019	0.319	0.195	0.021	0	0.121
AIC	1.467	1.310	1.467	1.412	1.368	1.352	1.359	1.329	1.351	1.399	1.262	1.274	1.397	1.467	1.232

All models are estimated using quarterly data from June 1993 through June 2008 (61 observations) using the Wu and Lange (2008) coordinate decent algorithm and a global grid search to find the Lasso penalty that minimizes the AIC.