COMMUNITY BANK STRESS TESTING: WHY BANKS STRESS TEST AND THE IMPACT OF STRESS TESTING ON BANK CAPITAL AND PROFITABILITY

Kristin Carvalho

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COMMUNITY BANK STRESS TESTING:
WHY BANKS STRESS TEST AND THE IMPACT OF STRESS TESTING ON BANK CAPITAL AND PROFITABILITY

BY

KRISTIN CARVALHO

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KRISTIN CARVALHO

APPROVED:

Dissertation Committee:

Major Professor  Georges Tsafack

  Devandra Kale

  Jing Jian Xiao

  Brenton DeBoef

DEAN OF THE GRADUATE SCHOOL

UNIVERSITY OF RHODE ISLAND

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ABSTRACT

Stress testing uses objective data to support various risk assessments of conditions within a bank’s loan portfolio. Risk assessments include an analysis of both credit losses and capital adequacy, in addition to other related risk assessments. The purpose of this mixed method research study is to develop an understanding of stress testing of commercial real estate loan assets of community banks and of bank balance sheets. This understanding includes the impact of stress testing on both community bank financial performance and capital ratios, which is the quantitative component of this study with related hypotheses using multiple quantitative methods. The qualitative component of this study includes interviews of bank executives with questions about reasons for voluntary stress testing and the allocation of bank resources to stress testing when it is not required by regulatory statutes. Quantitative analyses findings concluded that banks that conduct voluntary stress testing do not have stronger financial performance and capital ratios and the null hypotheses were accepted. Qualitative analyses findings concluded that stress testing is a best practice and can be used for many purposes. Also, banks interviewed agree that stress testing is encouraged by the regulators despite not being required.
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CHAPTER 1

INTRODUCTION

Bank stress testing uses objective data to support risk assessments of conditions within a bank’s loan portfolio and/or of a bank’s entire balance sheet. Risk assessments include (but may not be limited to) the identification and analysis of credit losses and capital adequacy. The purpose of this research paper mixed methods case study is to develop an understanding of stress testing of commercial loan assets of community banks, and to determine if stress testing can assist community banks with managing their loan assets and balance sheet. The mixed methods are needed to fully understand the impact of stress testing on the bank and the reasons that the bank would conduct stress testing. This understanding would additionally include the relationship between stress testing and financial performance, as well as the relationship between stress testing and capital levels through survey data collected.

Interviews conducted provided detailed reasons why stress testing is utilized, how it is conducted, as well as the purpose stress testing is being conducted. This study is important given information about stress testing for community banks, which is defined as banks with less than ten billion in assets, is a gap in the literature. There is little empirical data available for smaller community banks, studies lack uniformity in comparing stress testing amongst banks, and the analysis and approach are undocumented. Stress test banks are challenging to identify, and transparency on stress testing activities is lacking. This study is in the context of banks/financial institutions with commercial loan assets on their balance sheets.
Stress testing has become an established practice of financial institutions around the world since the last financial crisis and are deemed important tools to manage various relevant strategic risks (Baudino, et al., 2018). Stress testing has become tremendously useful for banks to use a tool to analyze down cycle stress on bank assets as part of their risk management initiatives and stress testing has become more broadly embraced over time (Schuermann, et al., 2016).

According to the federal bank regulators, stress testing is the process of looking forward utilizing a quantitative evaluation of different adverse scenarios that could impact a banking institution’s financial condition and capital adequacy (FDIC et al., 2015). Exposure to commercial real estate (CRE) loans increased sharply at community banks between 1990 and 2006, which prompted supervisors to issue guidance that defined CRE concentration thresholds and encourage banks to stress test loan portfolios (FDIC et al., 2015). Even as late as 2017, CRE lending comprised 48.6% of total loans (FDIC et al., 2015). The financial crisis and subsequent recession revealed the substantial risk to community banks resulting from high commercial real estate concentrations (Fang and Yeager, 2020). Some models put forth proforma thought (through underlying assumptions) on modifying the bank’s business model prior to possible or potential bank failure (Gogas, et al., 2018). Stress testing serves as a dominating global supervisory tool to monitor banks particularly and the banking systems generally (Schuermann, et al., 2016).

Stress scenarios are defined as economic stress variables under the most severe, moderate, and best-case conditions (FDIC, et al., 2015). In the case of commercial loan assets, the stress variables would be rising interest rates (up 100, 200, 300 basis points),
decreasing net operating income, and declining commercial real estate property values (both down 10, 20, 30%) (FDIC, 2020). Stress testing has always been a part of a financial institutions management tool to assist with balance sheet financial risk and has effectively supported this capital management effort over time (Langley, 2012).

This is a mixed methods research study, and the study design would fit (and be complimentary) with this community bank stress testing research topic. Each approach would provide different information that would be unique contributions to the literature. The data collected is from banks voluntary participation on an individual basis, which in the past has been unpublished and unavailable. Available stress testing information was related to banks over ten billion in asset sizes since stress testing is required within this group.

**Importance of business problem/research questions**

Stress testing has become tremendously useful for banks to use a tool to analyze down cycle stress on bank assets as part of their risk management initiatives and stress testing has become more broadly embraced over time (Schuermann, et al., 2016). The level of stress testing interest has increased over the period of time that this study has been conducted. Given the current economic and banking industry environment, considering two bank failures at the conclusion of this study, stress testing has gained heightened interest and attention. This level of interest by many parties (investors, bank regulators, the public) includes banks’ stress testing activities (process, underlying assumptions, current considerations, geography, etc.) and the role of stress testing in heightened regulatory scrutiny as well as in bank failures as an early warning indicator.
Proponents of stress testing put forth viable frameworks to establish the stress testing tool that would support risk management efforts, which in some cases utilizes past proven correlations between the health of United States banks and varied macroeconomic financial conditions (Huang, et al., 2009). More specifically, stress testing commercial loan assets is well known to assist with determining the stability of banks’ commercial lending credit systems (and stressed for greater adverse scenarios) (Lu & Yang, 2012). Since the dawn of modern risk management in the 1990s, stress testing has been a tool used to address the basic question of how exposures or positions behave under adverse conditions (Jacobs, 2020).

The literature supports the conclusion that banks with greater capital levels are more likely to withstand more severe economic downturns (Balla et al., 2019; Huang et al., 2009; Montagnoli, et al., 2020). Also, the research supports that capital ratios behave in a particular manner in certain economic scenarios and higher ratios depict financial stability (Montagnoli, et al., 2020). There are researchers that contend that the evidence supports comparing stress testing outcomes to macro-economic conditions results in effective forecasts of anticipated future losses (Dissem & Lobez, 2018). Along this same line, banks that have completed stress testing have higher capital ratios over time through economic volatility (Cornett, et al., 2018). Most recently released stress test results, completed by the Federal Reserve, contends that large banks currently have strong capital ratios and can continue to lend to households and businesses currently and if there were a severe downturn in the economy (Board of Governors of the Federal Reserve System, 2021).
Thus, from the framework of commercial real estate loan assets that are reflected on the banks’ balance sheet, this study will examine the impact of different scenarios on the banks through utilization of stress testing. More specifically, the impact of different scenarios on the banks’ capital ratios and financial performance. This includes, but may not be limited to, the detailed reasons why banks complete stress testing on their commercial real estate portfolios and why they do not.

There are multiple questions being put forth in this study, which relate to both the qualitative and quantitative components. One approach is not comprehensive, and each approach provided valuable data to the study individually and collectively. The qualitative research questions are why banks conduct voluntary stress test and for what purpose are they conducting stress testing. The quantitative research questions are does stress testing assist banks with managing real estate assets of the portfolio, what is the impact of stress testing on capital and financial performance, and what drives the decision to stress test.

**Key constructs**

Relevant study constructs range from simplistic (i.e., stress testing yes or no, bank size, problem asset levels, and loan portfolio complexities/components) to more complex and multi-dimensional (management best practices/human behavior in strategic planning and resource allocation matters). Bank size is defined as assets on the bank’s balance sheet, and types of loans included are identified by coding (FDIC, 2020). Investment real estate are business loans secured by property that houses tenants and not the borrower’s business (FDIC, 2020). Construction loans and other real estate loans are
also captured within this study, as well as the banks’ loan loss reserve (savings account for loan losses), delinquency and nonperforming loans. Financial performance is defined as stronger earning from the bank income statement and higher capital levels from the bank balance sheet. Risk weighted assets determination is a definition as set forth by the federal government high and risk-based capital and bank information would be obtained through available regulatory sources (FDIC, 2020).
CHAPTER 2

REVIEW OF LITERATURE

General Procedure of Stress Testing

The Board of Governors of the Federal Reserve System is the governing body of the Federal Reserve System which is the central bank of the United States. This Board is tasked with supervision of both domestic and international banks. The Board establishes stress testing scenarios annually for the largest banks, which for 2022 was thirty-four. In addition to the Board’s identification of large banks subject to stress testing at the over ten billion size thresholds, the Board establishes stress testing scenarios under which the banks are tested. There are baseline and severely adverse scenarios established, and economic scenarios include economic activity in this country, inflation, and interest rates. Baseline is essentially status quo. Severe adverse scenarios are a recession, compounded by stress in commercial real estate and corporate debt markets. Noteworthy is that the Board adjusted some of the underlying stress testing assumptions to account for fluctuations in economic data associated with the global pandemic.

The 2022 stress test shows that large banks have sufficient capital to absorb more than $600 billion in losses and continue lending to households and businesses under stressful conditions (Federal Reserve, 2022). The strong bank capital positions currently are attributed to bank buildups in capital since the last economic downturn in 2009. Bank earnings are related to the capital positions given the financial connection between the income statement and the balance sheet. 2022 results also indicate that banks would have substantial losses in the severely adverse scenarios but would maintain capital ratios that exceed regulatory requirements as established.
Capital Levels/Financial Stability

The literature supports the conclusion that banks with greater capital levels are more likely to withstand more severe economic downturns (Balla et al., 2019; Huang et al., 2009; Montagnoli, et al., 2020). Also, the research supports that capital ratios behave in a particular manner in certain economic scenarios and higher ratios depict financial stability (Montagnoli, et al., 2020). There are researchers that contend that the evidence supports comparing stress testing outcomes to macro-economic conditions results in effective forecasts of anticipated future losses (Dissem & Lobez, 2018). Along this same line, banks that have completed stress testing have higher capital ratios over time through economic volatility (Cornett, et al., 2018).

Stress testing is not new and is a well healed tool of bank management in analyzing capital adequacy including incorporating into proforma planning and budgeting (Schuermann, et al., 2016). There were three primary stress tests that the Federal Reserve conducted during 2009-2012, which focus on capital ratios based upon risk weighted assets (Acharya et al., 2012). Stress test results beginning in 2017 reflect lower insolvency risk than past results for community banks which is attributed to banks having less construction and investment real estate loans in their commercial lending portfolios (Fang & Yeager, 2020). Some feel that stress testing could reduce adverse financial results and capital ratio calculations by decreasing the ratio of risk-weighted assets to total assets which is utilized for bank capital calculations (Garcia & Steele, 2020). Bank investors have the perception that stress tested banks have lower risk and funding costs than non-stress tested banks (Garcia & Steele, 2020). During the last economic downturn bank failures were attributed to investment portfolio holdings as opposed to real estate lending activities. This fallout
had an adverse impact on the U.S. commercial banking industry in 2008, which continued into much of 2009 (Rice & Rose, 2016). This study’s hypotheses are related to these indicators namely bank capital and profitability as reflected within the quantitative approach.

**Regulatory Issues**

Faith and confidence in the global banking system have been a regulatory priority and in a complicated environment, financial and banking regulation should be considered systemic risk identification, with the primary priority of systemic risk with concern over financial health of different broader issues and how they interact (Levy-Carciente, et al., 2015). Stress testing is a tool put forth to support this priority. Much regulatory support for stress testing has been well documented over the years (Adler, 2010; Clayton, 2013). Stress testing details are interesting and impactful (Newett & Gilliam, 2011). Some argue that regulatory structures (monitoring and minimum ratio requirements) are not adequate to forecast adverse impact on bank balance sheets (Montagnoli, et al., 2020). Others feel as though despite increases in risky lending (namely commercial real estate loans as defined above) according to the regulators banks with higher capital level and with stress testing in place more often over time there were less bank failures (Balla, et al., 2019). Bank lending activity does not decline based upon a modified business approach to extend less risk weighted assets, and an increase in regulatory oversight for stress tested banks does not influence banks capital planning and level requirements (Garcia & Steele, 2020).

Some researchers that are of the opinion that the federal bank regulators were not tough enough in overseeing bank activities in the last economic downturn and some feel in completing postmortems of some failed banks (in 2008) that bank regulators could have
done more to insure safe and sound operations (Adler, 2010). All banks, regardless of size, are expected to assess of adverse issues and their possible impact on the banks (Fang & Yeager, 2020). One study showed that utilizing available data and a clear methodology, regulators could assess the basic condition and resilience of specific banks, and generally the banking system to larger macroeconomic adverse scenarios (Kapinos et al., 2015). Proactive early fleshing out of any potentially marginal banks is a priority to both bank regulators and bank management (Gogas, et al., 2018).

Widely regarded as a watershed moment in the governance of a financial crisis, in 2009 the United States federal government started to consider proforma capital adequacy by stress testing the solvency of this country’s largest banks to restore faith and confidence in this country’s banking system after the last economic downturn (Langley, 2012). Exposure to commercial real estate (CRE) loans increased sharply at community banks between 1990 and 2006, which prompted supervisors to issue guidance that defined CRE concentration thresholds and encourage banks to stress test loan portfolios (FDIC, et al., 2015). Even as late as 2017, CRE lending comprised 48.6% of total loans (FDIC, 2020). The financial crisis and subsequent recession revealed the substantial risk to community banks resulting from high commercial real estate concentrations (Fang & Yeager, 2020).

Some models put forth proforma thought (through underlying assumptions) on modifying the bank’s business model prior to possible or potential bank failure (Gogas, et al., 2018). Stress testing serves as a dominating global supervisory tool to monitor banks particularly and the banking systems generally (Schuermann, et al., 2016). Implications of the Dodd-Frank Act continue to be felt here in the United States. In addition to being extensive (845 pages, 225 new rules across 11 agencies approved by Congress in 2010)
this Act includes: systemic risk, too big to fail, expanded Federal Reserve regulatory oversight, limit discretionary regulatory enforcement, Volker Rule limits (trading parameters), derivative use rules, and consumer lending regulations and enforcement (CFPB – federal Bureau of Consumer Financial Protection establishment) (Acharya et al., 2012). This study’s interviews of bank executives include questions pertaining to the banks’ regulators position about their stress testing activities.

There is some stress testing (also used for forecasting) that provides for a linear decision boundary, which specifically included an analysis of 1,443 banks (using publicly available information and particular variables) during 2007-2013, and exhibits 99.22% forecasting accuracy (Gogas et al., 2018). Quantile regressions could assist with homogenizing the relationship between bank regulation and supervision and bank risk across banks throughout the industry. This study utilized data from 200 OECD (The Organization for Economic Co-operation and Development – specifically noted and detailed) banks around the globe (Klomp & de Haan, 2011). In 2012 the so-called London Whale was studied which essentially analyzed the relationship and correlations between variables associated with many banks’ investment portfolios in the stress testing context. This was scenario-based stress testing and findings supported dependency between various variables in bank asset trading portfolios (Packman, et al., 2019). Some literature supports the position that the full balance sheet should be stress tested to comprehensively assess the risk profile of the bank (Drehmann, et al., 2009).

**Stress Testing Support**

Stress test use could serve two primary objectives: 1.) to recognize and assist banks with a capital shortfall, and 2.) to maintain faith and confidence of the primary
banking system with the regulators mandating corrective action requirements including timely capital raises to improve bank capital levels to requirement through different capital sources including government funds (Herring, 2019). The primary purpose of stress testing is to test banks’ capacity to both economic and financial shocks through both monitoring their existing capital levels and to require increases in capital (to increase bank stability) where appropriate (Herring & Schuermann, 2019). In addition, the literature supports the value of stress testing, both at the bank company level for the full balance sheet assets (Ong & Pazarbasioglu, 2014; Pagratis et al., 2017) and for commercial real estate loan assets specifically (Lu & Yang, 2012; Wang et al., 2019). Stress testing has become an established practice of financial institutions around the world since the last financial crisis and are deemed important tools to manage various relevant strategic risks (Baudino, et al. 2018).

Stress testing has become tremendously useful for banks to use a tool to analyze down cycle stress on bank assets as part of their risk management initiatives and stress testing has become more broadly embraced over time (Schuermann, et al., 2016). Outcomes of stress testing results in Europe also support the contention that there is more capital in banks that complete stress testing, and these banks are more financially resilient during economic downturns (Alves, et al., 2015) which is consistent with findings here in the United States. United States bank stress tests’ primary objective is to strengthen the stability of the banking industry, and stress tests results are typically stronger for banks that are safer than for those that are not (Acharya, et al., 2018). Stress tests effectively reduce bank risk without the major costs that critics argue could occur (Garcia, et al., 2020).
Proponents of stress testing put forth viable frameworks to establish the stress testing tool that would support risk management efforts, which in some cases utilizes past proven correlations between the health of United States banks and varied macroeconomic financial conditions (Huang, et al., 2009). More specifically, stress testing commercial loan assets is well known to assist with determining the stability of banks’ commercial lending credit systems (and stressed for greater adverse scenarios) (Lu & Yang, 2012). Other studies have shown that testing asset quality of commercial loan portfolios using stress testing results in identifying credit deterioration tools that demonstrate connections between asset quality and macroeconomic conditions (Bangia et al., 2002).

Stress testing, modeling/data collection and analysis, has pushed management to consider best practices in managing company risk (Schuermann, et al., 2016) which is an industry best practice. There is data and literature review of top-down stress testing with basic methodology and assumptions, utilizing available public information of large bank holding companies that provide meaningful findings in macro-economic conditions (Kapinos et al., 2016). Stress testing and related lending activity supports forward planning and assists banks with strategic management throughout the organization (Garcia & Steele, 2020). There is some support that stress testing provides a decision-making tool for the bank to take necessary actions to avoid future failures. One study collected data on 144 variables of 1,443 United States banks and after modeling the data utilizing linear decision boundaries determined that solvent and failed banks can be determined with 98.25% accuracy (Gogas, et al., 2018). Overall, the interviewed banks in this study support stress testing and most banks within the sample stress test either their commercial real estate portfolio and/or their full balance sheet.
Stress Testing Limitations

Shortfalls and shortcomings of stress testing are inherent and if properly understood and managed could be addressed (Kupiec, 2019; Clayton, 2013). In many cases the analysis and ultimate results of stress tests remain undocumented (Kupiec, 2019). In some cases, there was contention that researchers did not have proper asset value discount information to properly reflect anticipated future credit losses (Abbink, 2011). Furthermore, the research suggests that the regulatory guidelines and pronouncements have many shortcomings of their own. Methods and modeling include underlying credit loss assumptions, not actual losses sustained during periods of economic downturns (Bookstaber et al., 2014). There are also researchers that are of the opinion that basic stress testing lacks consistency amongst regulatory guidance and review (between regulators) including (but not limited to) monitoring and/or global factors. Given that asset losses are projected under a common set of macroeconomic scenarios subjected to all institutions undergoing the stress tests, they potentially penalize correlated exposures on assets losing most value under such scenario (Acharya, et al., 2012). Interested parties should look closely as to stress testing methodologies as well as models and details within those models selected (Clayton, 2013). It would be very difficult to evaluate whether the stress tests were successful or not in their main goals until a period of actual adverse conditions or another financial crisis occurs (Acharya, et al., 2018).

Some contend that stress testing in not useful given it is dependent upon historical information and information does not forecast future credit risk if the historical period reviewed is positive (Langley, 2012). Had instead the models been fitted more appropriately to historic periods of stress, capital requirements would have been much
higher, and the financial world would be in far better shape today (Langley, 2012). Conversely, historical information and associated risk may not be representative of future results if history does not repeat itself. Some models are solely based upon historical financial information and micro/macro-economic conditions (Curti, et al., 2019). Some banks studied do not stress test.

The lack of uniformity amongst banks (their own uniqueness particularly related to smaller community banks) is a limitation of stress testing/modeling given the lack of ability of both the underlying assumptions and data that populates various models/approaches (Klomp & de Haan, 2011). Precision with stress testing inputs is very difficult to accomplish (Acharya, et al., 2018). The size of the portfolio could impact the outcome of the stress test particularly in large groups of assets (Packham & Woebbedking, 2018). Little empirical data is available for smaller community banks (Fang & Yeager, 2020). Some contend that large bank stress testing results shift their business strategy and as a result provides increased business lending opportunities for regional banks (Garcia & Steele, 2020). The lack of uniformity is demonstrated within the banks interviewed as each stress tested but using different methods and do so for different purposes.

**Related Theoretical Foundations**

Two theories related to stress testing studied within the literature included network theory and rough set theory. Network theory is the study of complex systems interact with one another. The interbank payment system can be seen as an example of a complex network, and thus considered as a network, from which one can derive information on the system’s stability, efficiency, and resilience features (Levy-Carciente, et. al., 2015). Therefore, complex network theory has been widely applied to the study of financial
systemic risk, which has proven the feasibility of the network analysis method for analyzing interconnected economic complex systems (Lou, 2022).

Compared with traditional economic methods, network analysis features the characteristics of simple presentation, intuitive visualization, and interpretation of complex relationships in measuring systemic risks, so it has become a hot topic in measuring financial systemic risks (Lou, 2022). There were models used to determine bank failures within the framework of network theory, which included testing how one certain assets type of a bank influences another. Stress testing is an example of this testing for both banks that stress test their commercial real estate assets and banks that stress test their full balance sheet. This model has been shown to provide critical information that can determine which banks are vulnerable to failure and offer policy suggestions, such as requiring mandatory reduction in exposure to a shocked asset or closely monitoring the exposed bank to prevent failure (Levy-Carciente, et. al., 2015).

Rough set theory was also detailed within the literature studies about bank stress testing. Rough set theory is based upon the assumption that any object has associated information, and that objects characterized by the same information are indistinguishable (Chen & Cheng, 2013). Rough set theory is very useful in decision support systems for dealing with vague and uncertain information in classification problems, and has been widely used in diverse, including finance, manufacturing, medicine, and image processing (Chen & Cheng, 2013). The rough set method using only the information provided by the data itself without any prior knowledge (Hu, 2012).

Rough set is a powerful data analysis tools which can express and deal with incomplete information, retain key information on the minimum expression data
simplification and seek knowledge, to identify and evaluate data dependence between relationships to explain the concept of a simple model and get easy proven rules knowledge from empirical data (Hu, 2012). This study’s approach in collecting data about banks that there was initially no knowledge of, analyzing this collected data without complete knowledge and information about the banks being studied, and considering both the strength and relationships between the established variables were all consistent within the rough set theory framework.

The well-established economic downturn is without question, although the timing/breadth/depth is unknown currently (Bartik, et al., 2020). Research also reflects that during the 2007-2009 financial crisis banks were reckless with lending activities, which reduced their capital levels and increased regulatory oversight in some circumstances (Chen, et al., 2012). Stress testing reduces moral hazard by decreasing the ratio of risk-weighted assets to total assets (Garcia & Steele, 2019).

A commonly utilized stress testing macro-economic model is top down, which assesses a community bank’s ability to withstand periods of sustained severe credit losses. One study grouped banks by geography between 2008 and 2012 (Fang & Yeager, 2020). Another contended that the simpler the better with the stress testing model (top-down approach recommended) and related underlying assumptions. In some cases, this approach clearly depicts declining capital while utilizing reasonable asset growth assumptions and can be utilized around the globe (Kapinos & Mitnik, 2014).

Two hypotheses were developed from the research questions being asked and are as follows:
Hypothesis 1: There is a positive relationship between stress testing and bank financial performance.

Hypothesis 2: There is a positive relationship between stress testing and bank capital levels (see below Conceptual Model/Quant.).

Banks with greater capital levels are more likely to withstand more severe economic downturns (Balla et al., 2019; Huang et al., 2009; Montagnoli, et al., 2020). Noteworthy is that stress testing could impact loan availability by reducing credit supply, particularly related to higher risk loans, by banks extending less loans based upon stress test higher risk identified characteristics (Acharya, et al., 2018). Access to credit is discussed frequently in the review of stress testing findings. One study constructed a hypothetic bank, with parameters as compiled from available information, to create a comprehensive framework to measure both credit and interest rate risk using stress testing models. This same study’s findings support the relationship between the two, namely one cannot be tested and analyzed without the other, including understanding this relationship between the two risks (Drehmann, et al., 2009). Within the related literature, benchmarking was introduced by the Federal Reserve Board. The Board is a proponent of forecasting loss projections and clearly documenting industry compliance of these proforma losses and several approaches to assess capital adequacy utilizing stress test modeling (Curti, et al., 2018). A relevant tool, utilizing a network theory approach, was put forth considering certain macroeconomic scenarios that supports the strength of the banking system (Levy-Carciente, et al., 2015).
Study Factors

There are dependent, independent, and dependent variables identified within this study. The dependent variables (or outcome variables) are the capital proxy and the profitability proxy. The capital proxy is calculated as bank capital as a percentage of total assets. Similarly, the profitability proxy is calculated as bank net income as a percentage of total assets. The independent variables are stress testing and not stress testing (banks that self-identify as conducting voluntary stress testing and banks that do not). The dummy variable is equal to one if the bank voluntarily does stress testing and equal to zero if the bank does not conduct stress testing. Similarly for non-stress test banks the dummy variable is equal to zero if the bank does not conduct voluntary stress testing. There are two different types of bank stress testing identified within this study. One type of stress testing is stress testing of just the commercial real estate assets and the second is stress testing the full balance sheet of the bank.

In addition, key explanatory variables were included within this study to continue to assist with the development of the understanding of stress testing in community banks of less than ten billion dollars. These key variables (control purposes) were bank size or total assets, loan portfolio levels for varying asset classes, commercial real estate levels specific to investment real estate/loan type, construction loan levels, and other loan types which could include residential real estate loans. Bank capital was defined as capital available on the bank balance sheet and bank earnings as profits after expenses.

Furthermore, available regulatory (and credit) guidelines were reviewed and incorporated within this study as they are frameworks for the banks’ management of the commercial investment real estate portfolio. There were 2 treatment groups given the 2
hypotheses being tested. The groups are equivalent to each other and both groups conduct stress testing. Stress testing was considered the same amongst the participants and utilized to study the effects of stress testing (consistent with both hypothesis) as well as the causality.

Financial Performance

The outcomes in this study are financial performance and capital levels. Financial performance is a subjective measure on how well the bank uses their assets to generate business revenues to support bank expenses. The basic understanding of financial performance is generally measuring bank success. In loan assets context, financial performance is defined as higher capital and bank information would be obtained through available regulatory sources. Financial performance is obtained through the review of bank financial statements, which reflect earnings numbers.

Some research notes that if stress test banks are managing financial statements to improve their chances of passing the stress test, we expect capital ratios and performance to increase as they enter the stress test group (Cornett, et al., 2017). One study found that the overall financial performance of Bank is improving in terms of liquidity ratios, assets quality ratios or credit performance, profitability ratios (NPM, ROA, ROE) (Adam, M.H.M., 2014). This study suggests a set of recommendations regarding the development and enhancing of some banking operations which will boost the bank's profitability and improve the financial performance for the bank (Adam, M.H.M., 2014).
Capital Levels

Bank capital is essentially a savings account for the bank to hold in case they have to liquidate assets. Capital is the difference between the bank’s assets and the bank’s liabilities which represents the value (net worth) of the bank. The bank capital calculation is basically the banks’ capital levels as a percentage of assets. There were three primary stress tests that the Federal Reserve conducted during 2009-2012, which focus on capital ratios based upon risk weighted assets (Acharya et al., 2012). Stress test results beginning in 2017 reflect lower insolvency risk than past results for community banks which is attributed to banks having less construction and investment real estate loans in their commercial lending portfolios (Fang & Yeager, 2020).
Figure 1: Conceptual model

Conceptual quantitative model for stress testing relationship to both capital and financial performance

**Conceptual Model/Quant.:**

![Conceptual Model/Quant. Diagram](image-url)
CHAPTER 3

METHODOLOGY

The explanatory sequential data (two-phase design) method design was an appropriate mixed method for this community bank stress testing research study (see APPENDIX B). One of the most important areas in applied social research these days is called mixed methods (Kanika, et al., 2015). This mixed method design fit (and was complimentary) with this community bank stress testing research topic. Phases noted within this study were conducted simultaneously despite being noted as phases one and two. The first phase was the collection of the quantitative bank data, or the information that would be necessary to identify banks by size and to determine if they do commercial real estate and/or full balance sheet stress testing or not. This was closed-ended survey and review /analysis of archival data.

The second phase was the collection of open-ended qualitative data to determine and analyze the “why” stress testing is completed using the explanatory case study. Simultaneously collecting quantitative information and qualitative data assisted with clarifying bank stress testing financial results and the existence of stress testing (i.e., “why” the banks direct resources to stress testing). Neither the quantitative nor qualitative approach separately would be adequate to fully understand the relevant research questions. The proponents of mixed methods research argue that the combination of qualitative and quantitative methods provides for a better understanding of the research problem than any one approach alone (Kanika, et al., 2015).

Mixed methods bank stress testing research did start with quantitative data collection. The population was 5,276 banks nationwide with 83,000 branches in 10,193
cities. Two hundred banks would be randomly selected, data collected and analyzed. A minimum sample of 100 will be maintained to validate statistical significance. A power model confirmed this number of banks is enough banks to analyze and potentially generalize results back to the full population. Quantitative was phase one of this research projects and the timeframe was not as fast and efficient as originally anticipated given delays with the URI IRB approval as well as delays with identifying banks that stress test through email addresses which typically are confidential. Once the banks were identified, the information was easily collected from archival publicly available federal regulatory online information. The Qualtrics survey developed and designed was simplistic and identified those banks that conduct stress testing of the commercial real estate portfolio and/or the full balance sheet or not (yes or no). The statistical margin of error was established too. Qualitative was phase two of the research project and results were utilized to further explain the quantitative information. Banks interviewed were also included within the quantitative component of this study with their financial information being included.

**Phase 1: Quantitative Study**

**Research Design**

This research design included an analysis of publicly available bank website and FDIC information and other relevant archival data available through regulatory sources. Archival financial information provided relevant bank information as reported for multiple periods. Each tool supplemented one another. The banks analyzed were included based upon the self-disclosure of voluntarily conducting stress testing randomly selected to participate in the study. A Qualtrics survey was designed and utilized in addition to email
communication to bank management to collect data for the quantitative component of this study. Information received was analyzed and the variables’ relationships studied (study variables are also defined below). The information collected was also statistically analyzed and determinations as to the relationship(s) between variables reviewed as they existed. The strengths of these relationships were also studied and analyzed.

**Sampling Method**

The theoretical population for this study was all banks in the United States, regardless of bank charter or ownership. Bank charters include national banks, state member banks, insured state nonmember banks and federal savings associations. There are 5,276 banks nationwide with 83,000 branches in 10,183 cities.

**Sample**

The sampling frame is how you gain access to this study sample, which is essentially the inventory of the population. The on-line available federal bank regulator financial information through the Federal Deposit Insurance Fund (the federal government) website provided archival information to gain access to the study sample. The on-line available general and/or specific bank information provided study sample information. Access was readily available with internet service, as well as a computer to access the website (and related relevant sections) directly. The sample of this study was a portion of targeted identified banks based on size from the theoretical population. The survey selection criteria captured banks across the charter, size, stress testing completion (yes or no), geographies, and financial condition. Access to this financial information was readily available.
Sampling is a technique (procedure or device) employed by a researcher to systematically select representative items or individuals (a subset) from a pre-defined population to serve as subjects (data source) for observation or experimentation as per objectives of his or her study (Sharma, 2017). The sample of this study was a portion of randomly selected banks from the theoretical population. This random selection captured banks across the charter, size, stress testing completion (yes or no), geographies, and financial condition.

This study’s sample selected was as many banks as possible that self-identify stress testing from the population. This sample size is a representative sample and the validity of testing the adequacy of the sample size was confirmed using a power analysis. Power is how likely there is an actual effect versus a chance, and the likelihood that the test is correctly proving your hypothesis.

**Type of (Non) Probability Sampling**

Probability sampling is any sampling scheme in which the probability of choosing each individual is the same (Sharma, 2017). This study includes a targeted sampling process of the 5,276 banks based upon the banks’ asset size. Data collection was readily available through regulatory and company publicly available on-line sources, and the data was analyzed using statistical tests and modeling. The statistical margin of error for this study was defined and calculated. The concept of targeted selection would assist with generalizability to the population. The study was not replicated, and as detailed additional studies could be a future opportunity to continue to advance the topics within this study.
There were 2 groups in this study. Banks were assigned to the stress testing condition and banks were assigned to the control condition (no stress testing). One controlled group—maintained rigor and control of the variables and the impact of one on the other. Each bank selected was assigned to a treatment group. There were 2 treatment groups given the 2 hypotheses being tested. The groups are equivalent to each other.

In this study the bank stress test was the dichotomous predictor in testing both hypotheses. Dichotomous variables may be used for predictions and means that there are only two possible values (yes or no). Some contend that stress testing can forecast future bank failures through early identification of potential asset losses surfaced by bank management and/or bank regulators (Gogas et al., 2018). The outcomes in this study were financial performance and capital levels. Some research notes that if stress test banks are managing financial statements to improve their chances of passing the stress test, we expect capital ratios and performance to increase as they enter the stress test group (Cornett, et al., 2017).

Data Collection

Stress testing is an analysis completed to understand how a bank will be impacted under adverse scenarios (bad conditions). Stress testing uses objective data to support risk assessments (current and future) of conditions within a bank’s loan portfolio. For example, in some cases banks will stress their loan portfolio’s adverse scenarios in terms of certain underwriting criteria. Specifically, there could be financial modeling in place to capture different scenarios as defined by the bank. These model parameters could generally be debt service coverage (a borrower’s ability to repay to the debt), loan to value (the loan amount
compared with the value of the collateral), declining net operating income, and increases in interest rates.

Stress testing has always been a part of a financial institutions management tool to assist with balance sheet financial risk and has effectively supported this capital management effort over time (Langley, 2012). Some contend that stress testing can forecast future bank failures through early identification of potential asset losses surfaced by bank management and/or bank regulator (Gogas, et al., 2018). The conducted survey asked if the bank conducts stress testing or not. The degree to which stress testing varies would be important and financial performance could be expanded and defined as incremental (ranges and movement within established ranges).

The data collection process started with accessing the FDIC website, which is: FDIC: Federal Deposit Insurance Corporation. Within this website, there was a search for the Bank Call Report Information – UBPR FDIC. The UBPR is an analytical tool to review bank financial data. This bank data was downloaded to excel all banks nationwide by charter on November 21, 2021. The data captured was as of September 30, 2021, which at the time was the most recent available.
**Figure 2:** Banks by charter including the following:

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition:</th>
<th>Number:</th>
</tr>
</thead>
<tbody>
<tr>
<td>101</td>
<td>Insured savings - Assets &gt; $ billion</td>
<td>141</td>
</tr>
<tr>
<td>101M</td>
<td>Mutual banks - Assets &gt; $ 1 billion</td>
<td>53</td>
</tr>
<tr>
<td>101S</td>
<td>Stock owned banks - Assets &gt; $ 1 billion</td>
<td>72</td>
</tr>
<tr>
<td>102</td>
<td>Insured savings - $ 300 million to 1 billion</td>
<td>176</td>
</tr>
<tr>
<td>102M</td>
<td>Mutual banks - $ 300 million to 1 billion</td>
<td>93</td>
</tr>
<tr>
<td>Commercial LG – 3</td>
<td>Banks between $ 3 billion and 10</td>
<td>182</td>
</tr>
<tr>
<td>Commercial Med – 4</td>
<td>Banks between $ 1 billion and 3</td>
<td>505</td>
</tr>
<tr>
<td>Commercial SM – 5</td>
<td>Banks between $ 300 million to 1</td>
<td>1,311</td>
</tr>
<tr>
<td>Total:</td>
<td></td>
<td>2,616</td>
</tr>
</tbody>
</table>

*Source: FDIC Call Data*

Within the 101S category, sixteen banks were removed given their size. In addition to the larger bank exclusion, smaller banks and non-insured trust companies were excluded. Information collected was from the FDIC archival data (which is the Bank quantitative financial information that is filed quarterly within 30 days of the quarter end). See APPENDIX F for a sample of the excel data collection spreadsheet established, utilized, and shared for this study. Banks are on a calendar year basis. Details of this information included the following: ID RSSD number, FDIC Certificate number, Class of Bank, Name of Bank, City of Bank, State of Bank, Number of Offices, Average Assets, and Net Income. The bank holding company and website were added (if holding company is applicable) in an attempt to identify banks that were voluntarily conducting stress testing. 10K’s of multiple companies, and websites, were reviewed to attempt to identify banks that voluntarily conduct stress testing. Programming to identify banks less than $ 10 billion that voluntary stress test was considered but deemed ineffective given the identification would have been through public records and public records were not available given many of the...
banks within the population were not public banks and did not publicly disclose stress testing status.

Survey and interviews were identified as most effective way to identify stress test banks and interviews were added as the second component of this mixed methods study.

**Survey Steps**

Representative random sample number of 180 to 200 banks nationwide was deemed optimal based upon the spreadsheet population as noted above. The purpose of the survey was to identify banks that do stress testing and that do not do stress testing. This self-identification was fleshed out within the primary purpose of the survey. Qualtrics was engaged, after URI IRB approval was obtained, to conduct this survey which was anticipated to take approximately 30 days start to finish. The URI invoice approval process was also completed for the survey cost which was established at $6,000. The Qualtrics software was used to set up the survey to provide to them to assist with the data collection. The survey initially included just the URI consent (as approved by the URI IRB) and the yes or no question of: do you conduct stress testing of commercial real estate portfolio? Closed end question. After many emails and many calls with Qualtrics, they requested multiple prequalification questions be added to the survey.

The original spreadsheet of bank’s nationwide (as noted above) could not be utilized. Qualtrics originally had said it could be utilized. This misinformation delayed the survey process and timing. Simultaneously, URI student assistance with data collection was sought. Three students were considered for paid assistance with collecting data from the bank FDIC Call reports (as detailed and noted within the interview component of this process) for multiple periods and for the variables (and potential other issues) as detailed
within this study. In light of the added pre-qualifier questions to the survey, the URI approved IRB had to be amended and approval for the amendment was sought – revision paperwork submitted October 30, 2022. After the amendment was approved, the survey was adjusted in accordance with the approval. This approval included the addition of the following prequalifying questions: industry, title of participant (in accordance with IRB application and RP), size of the bank, consent, and ST yes or no question. The Qualtrics software was updated to facilitate these additional questions within the survey and the link was updated accordingly.

A soft launch was initiated by Qualtrics, and data received reflected issues with moving the study forward. A soft launch was a practice of dissemination of the survey to a small group of banks to ensure the survey was technically working properly prior to widespread distribution. Multiple calls with Qualtrics and major professor took place (another call after the data from the soft launch was received). Ongoing calls with major professor also have been taking place throughout this process. Qualtrics requested prequalifier questions for the survey, which included industry identifier, additional titles, and what size your bank is.

The IRB application was revised and an amendment to the approval requested. In addition to the Qualtrics prequalifier questions, the following questions were added (in addition to the question do you perform stress testing of the commercial real estate portfolio): Does your bank perform stress testing of the full balance sheet? Is stress testing of the commercial real estate portfolio recommended or suggested by your bank regulator(s)? Is stress testing of the full balance sheet recommended or suggested by your bank regulator(s)? A second soft launch of the Qualtrics revised survey took place. URI
undergraduate students were engaged to assist with obtaining archival data from the FDIC Call report of those banks that participated in the Qualtrics survey once the data for the survey was compiled. These students were trained by the researcher and major professor and had a basic knowledge of finance. Instruction for them written, which were detailed and included: excel spreadsheet completed for interviews as a sample, link to FDIC Call data, specific detail where each included item (crafted in accordance with the RP’s variables).

The Qualtrics second soft launch did not provide data that could be useful in the study (banks were above the under $10 billion maximum requirement and duplicate banks could not be removed based upon Qualtrics identification of participants). After much discussion, the engagement was fundamentally revised and to proceed Qualtrics needs email addresses. Qualtrics also would no longer guaranty the 180 banks within the sample.

Multiple courses of action were pursued to obtain email addresses, which included: school recommendations of potential companies to purchase the database from, multiple online options to request a quote from, and potential researcher (with student assistance) collection of addresses through available means (bank website, etc.). Capital IQ through URI deemed most effective email source for the survey. Established sorting parameters within the Capital IQ search engine included: people, industry, size (less than $10 billion), United States geography, and bank position as defined.

Proposals for data collection (emails to provide to Qualtrics for completion of the survey) from 2 marketing companies were received. Front media and Blue Mail Media. Neither deemed an adequate sample, nor proposed to work from the FDIC call data dated September 30, 2021. Trade associations were contacted and given data confidentiality and
privacy policies; email addresses of bank colleagues nationwide were not available. These trade associations included: Massachusetts Banker’s Association, American Bankers Association, and Independent Community Bankers Association.

In addition to Capital IQ, the Bloomberg data base through URI was pursued as an email source. By utilizing the Capital IQ search engine, the list of banks, mailing addresses and contacts (people) was generated 6064 banks nationwide. Parameters defined were banks less than $10 billion in assets, which captured the banks by charter as the study starting point detail. This search also included bank executives as available. The Capital IQ search engine list of these banks nationwide was the basis for additional searches to generate email addresses. Both Google and Yahoo search engines were utilized to generate most common business email naming conventions.

Noteworthy is that a business consultant recommended by the Massachusetts Bankers Association suggested the naming convention search engines given the proprietary issue with business email addresses. The American Bankers Association declined to participate in the study given confidentiality issues associated with the research in their opinion. 20,579 and 9,092 in two separate lists, for a total of 29,671 for banks under $10 billion nationwide. There are multiple contacts within the same bank, which were intentionally maintained to maximize responses. The goal was a minimum of 200 participants, some banks that stress test and some banks that do not.

Lists were provided to Qualtrics, along with a cover email that provided general information as to the purpose of the survey as well as the opportunity for participants to request the findings if there was interest. Soft launch with 12,000 emails was conducted and started January 11, 2023. Some emails may not be valid given the programming
associated with the various email conventions. The soft launch failed with only 1 response. Survey questions were reduced from 10 questions to 3 to assist with enlisting responses. Survey questions asked if the participant was one of a series of titles, and two yes or no questions pertaining to stress testing. These questions were do you stress test your commercial real estate portfolio and do you stress test your full balance sheet. A cover email was included (also reduced from the cover email that was included within the last soft launch) to explain the survey purpose as well as to offer disclosure of the results if interested parties participated. The time to complete the survey was also mentioned within the cover email, which was 5 minutes.

The additional shortened information was provided to Qualtrics for facilitation of survey. The survey was launched January 18, 2023. The first 2 days provided twenty-two responses. Responses increased; however, many banks confirmed the legitimacy of the data collection through contact with the researcher via email and via LinkedIn. Also, some potential participants were reluctant to click on the provided link (based upon concerns with compromising the bank’s systems. The cover email to participants was revised to include the survey both within the email and the link. Additional researcher detail, to assist with legitimacy confirmation, was provided. Given the slow response, other avenues were pursued, which included the possibility of distributing the survey via LinkedIn. Another suggestion was advertising within trade publications which was also pursued.

On January 25, 2023, the first import from the current Qualtrics survey was imported into excel. Duplicate banks were eliminated. Non-banks were eliminated (credit unions/trust and investment companies). Data was organized. Partial responses were contacted with a personal email asking that they respond in the email since the link did not
fully record their responses. Respondents that answered no to question 1 (title/role within the bank) were removed given the assumption that they were not qualified to answer the stress testing questions. These individuals were also contacted via email to enlist their assistance with survey completion and to request they send along the survey to individuals that have the titles mentioned in the first question. Participants that responded via email (given bank security concerns with utilizing the Qualtrics link) were added to this spreadsheet.

Interview participants were added to this spreadsheet so as to include these 5 additional banks within the survey. Ongoing throughout the survey process was the maintenance of the database (that included email addresses and bank names sorted through Capital IQ). Non-banks that responded were removed, and some individuals were no longer with their banks (also removed). Banks that did not want to participate were removed once notice from them was received. Shared google file was created, and the 3 URI undergraduate students were engaged to assist with the collection of FDIC call information. The initial data set of respondents was uploaded, as well as the data collection instructions. The spreadsheet from interviews utilized to collect call data was expanded with another tab to include the Qualtrics survey respondents. This spreadsheet was also uploaded to the shared google file.

Data collection continued with the researcher reaching out directly to individuals that were connected to her through LinkedIn to enlist participation. Multiple LinkedIn potential sources to assist with utilizing LinkedIn as a survey distribution means were contacted (within URI and outside of URI). Other means of survey distribution were considered. These were advertisements within industry publications through national
industry associations. Specifically, these were the American Bankers Association and the Independent Community Bankers Association. These advertisements were not pursued based upon cost.

The same was considered with the Massachusetts Banker’s Association, however, given this population is limited to the State of Massachusetts, this association was not pursued. Original bank list from Capital IQ, as well as the email lists (there are 2) were provided to Sundin marketing for consideration of a LinkedIn add to the list. The detail (and possibility to move forward) was subject to their review and analysis. Two subsequent reminders to updated email base from Qualtrics took place both on February 14 and February 21, 2023, to enlist additional participation (in addition to the LinkedIn communications). September 2022 financial information for the interview banks was added to the shared google file, and as noted these same five banks were included within the survey as to capture the related financial information (and statistical analysis) within this study’s date analysis.

Sundin was engaged to facilitate the survey distribution through LinkedIn advertising opportunities. Sundin worked with Qualtrics with both establishing the reach of the LinkedIn advertisement, the audience was established (through the LinkedIn pivot table). Through the use of Qualtrics’ “Sent, Soft Bounces and Opened” lists were utilized to create a LinkedIn pivot table. The industries included were financial services, credit intermediation, banking, and savings institutions. Within these industries, 15% had between 11 and 50 employees, 41% had between 51 and 200 employees, and 21% had between 201 and 500 employees. There were negative growth companies as well as growth up to 10%. The functions that the audience works within are as follows: finance, business
development, operations, human resources, sales, information technology, legal, and marketing. In terms of seniority, 62% of potential participants are anticipated to be Vice President level, and 78% with 12 years or more of experience. Skills span banking, finance, loans, management, credit, commercial banking, financial services, portfolio management, financial analysis, and analytical skills. Job titles span Chief Officer, Finance Specialist, Head of Finance, Senior Vice President, Vice President, Chief Financial Officer, President, Business Strategy Specialist, Chief Executive Officer, and Executive Vice President.

From the Qualtrics sorting and responses, Sundin identified 3,600 potential people that could participate in the study. The Qualtrics Survey was shared with Sundin (through collaboration) and Sundin designed the link to be provided to LinkedIn for the advertisement. Qualtrics hid qualifying questions (to be used in the LinkedIn advertisement) which were questions 1 through 5 and had been removed as to not discourage online participation with completing the survey that was too long with too many questions (per Qualtrics’ opinion). These LinkedIn qualifying questions included: name, email address, bank name, location of bank and size of the bank. Sundin designed a LinkedIn landing page to include in the advertisement and the advertisement utilizes both texts and LinkedIn messenger. A soft LinkedIn launch took place prior to the full advertisement/landing page launch and a targeting initial group of the Qualtrics “Soft Bounce” list. This was Phase 1 of the LinkedIn campaign.

This campaign commenced February 15, 2023, and was estimated to be completed in 2 weeks. This LinkedIn campaign ran concurrently with the Qualtrics 2 reminders for the survey. Phase 1 did not result in any responses. Phase 2 commenced despite the lack of response with full distribution. Prior to launching the LinkedIn advertisement, a landing
page was added which explained the purpose of the study and identified the researchers as well as URI. The researcher’s LinkedIn page was shared with Sundin to facilitate the launch. Titles and job functions within the Qualtrics survey responses on and about February 10, 2023, were revisited and any additional expanded positions from respondents that would have knowledge of stress testing at the respective bank was added to the data.

The respondents that answered no to the title qualifying question that did not complete the survey continue to be excluded from the survey data. The added back respondent’s titles were compliance and executive level titles and those titled within the banks to have knowledge related to the company’s stress testing activities. This represents an expanded title group. The final Qualtrics survey distribution took place on January 22, 2023. The reminder went out to 18,346 email addresses. The same process was followed in that partially completed surveys were eliminated from the sample. There were responses that the individuals were not any of the title’s notes, whereby the participant did not complete the remaining questions within the survey. Some surveys were completed via email, and participants/responses were added to the sample given data needed was complete. Completed surveys with a no answer to the title question were researched and if the individual that completed the survey was differently qualified to complete the survey their responses were included within the sample.

The LinkedIn advertisement was ongoing, and responses were slow and minimal. Additional researchers’ collection of the FDIC Call archival data was taking place simultaneously to expanding the sample data collection. A shared google file was populated with multiple files, including instructions, sample detail from Qualtrics, and interview and survey archival data collection spreadsheets. Also included was the original
mailing database generated through Capital IQ. Although ongoing, the LinkedIn advertising campaign was yielding no results (no click on the link despite wide distribution. According to the engaged marketing professional, of the sixty-nine million LinkedIn users, only 16% log in every day. After further discussion and review, the campaign was suspended on March 1st, 2023, given the lack of any responses. There were seven clicks on the LinkedIn advertisement on March 1 and 2nd. However, potential participants did not complete the survey and their banks/information was not included within the data set since their information could not be properly identified. This information included, but was not limited to, title, bank name, bank size, as well as the stress test status.

In collecting FDIC Call archival data, the interim period September 30, 2022 (and like period 2021) was deemed unnecessary and eliminated. At the time the collection of archival data commenced. September information had been the most current information and December 2022 fiscal year information was not yet available. The town or city and state where the bank is located was added given some name similarities with participating banks. The bank name was also confirmed during this process to ensure that the FDIC Call data was available. Respondents’ names were utilized to confirm the bank name (through both LinkedIn and web searches). With this review, multiple credit unions were removed from the sample. The archival data collected includes 5 fiscal year end periods. 2018 and 2019 are pre-pandemic periods and 2020, 2021 and 2022 are post pandemic periods. Some could argue that some of these 3 years are during the pandemic, which is understandable.

The Bank FDIC Call archival data spreadsheet was adjusted and updated to maintain the same order of participating banks. Same order as the survey data list of participants as detailed. Bank’s exceeding the study (and stress testing size parameter) of
$ 10 billion and above were removed from the data set of participating banks even though they responded to the survey. The most recent period was collected first. Throughout the data collection process, bank names were confirmed and verified. Individual bank research was conducted throughout the archival collection process. For example, the bank FDIC Call data for one bank for 2018 and 2019 was not available. It appears that the bank was a different organization prior to 2020 and research includes the bank being established in 1957 but as a different bank which evolved through acquisition and growth. Presumably the prior period information was recorded in a different name and as a result was not included within the data collection spreadsheet for these periods. The same was the case for three other banks within this study and data for the 2018 and 2019 periods was not available. The data collection spreadsheet was continuously expanded to add the respective banks and their five fiscal year FDIC archival call data. Once the data collection was completed, the periods were reviewed for completeness. Some periods were missed, and then completed if available at this review. The participants’ data tracking spreadsheet was also cross checked to ensure accuracy and completeness.

The data was then merged from the FDIC Call data collection spreadsheet to the data tracking spreadsheet. Unnecessary data (for the purposes of facilitating the linear regression analyses) for this merger of information was removed. The participants’ response date, individual participants’ name, the title question (yes or no), FDIC Call Collected (yes or no), Researcher, and bank location were all removed, and the tracking spreadsheet was renamed to STATA Regression Data CSV formatting March 26, 2023. Five items for each bank were added to not the five fiscal periods of archival data captured within the study. The total number of banks in the study is 105 and the list of participants
and their responses has been compiled and retain utilizing Excel. The study’s main independent variable is stress testing, and the STATA data tracking spreadsheet identifies if the bank stress tests or not through participants’ voluntary responses. The study variables from the approved research proposal were added. For the stress testing (independent variable), a one was added for yes and a 0 for no for both the banks that stress test (or do not) the commercial real estate portfolio and for the banks that stress test (or do not) the full balance sheet. FDIC Call data collected was recast within the CSV framework and format for regression analysis use. The dependent variables were added to the CSV file, which was the banks’ capital proxy and profitability proxy. Each are as calculated as a percentage of total assets as defined within the study variables. Each period that was available was added, which included 2018, 2019, 2020, 2021 and 2022.

Data Analysis

The raw data collected would is included herein and has been analyzed in a meaningful manner. The use of multiple excel spreadsheet assisting with remaining organized. Related archival data is quantitative and basic financial information. Simple, factual, direct, objective observations of the available quantitative information was maintained throughout this study. The data and observations were non-behavioral as well. STATA statistical software was utilized for related linear and logistic regression analyses. Logistic regression allows prediction of group membership when predictors are continuous, discrete, or a combination of the two (Tabachnick & Fidell, 2007). Logistic regression emphasizes a probability outcome, is more flexible, and predictor variables are not normally distributed. As a result, outcomes were more complex to interpret.
Statistical forecasting was utilized which provided an anticipated future relationship between the variables identified, which is commonly utilized in banking. A binary logistic regression was utilized to understand how the changes in the independent variables are associated with the probability (also called log odds or logit function) of the dependent variables occurring. The binary variable is the yes or no answer to the question of conducting stress testing or not. Stress testing happens or it does not. There are 2 independent variables (response variables) which are conducting stress testing for the commercial real estate portfolio and conducting stress testing for the full balance sheet. The underlying assumptions associated with this approach is the binary dependent variables and the independence of the predictor variables.

The following variables (which have been further defined within this study) were used as detailed:

**Variables List:** Definition of variable codes used in the analysis.

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Variable definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dstcre</td>
<td>Stress-Test CRE: take value 1 for a bank that stress-tests its CRE portfolio and 0 otherwise</td>
</tr>
<tr>
<td>Dst</td>
<td>Stress-Test: take value 1 for a bank that stress-tests its entire balance and 0 otherwise</td>
</tr>
<tr>
<td>Rev</td>
<td>Revenue ($B): total income before expenses on the bank’s income statement</td>
</tr>
<tr>
<td>Netin</td>
<td>Net Income ($B): income after expenses on the bank’s income statement</td>
</tr>
<tr>
<td>Tassets</td>
<td>Total Assets ($B): total assets of the bank from the bank’s balance sheet</td>
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<td>Tcapital</td>
<td>Total Capital ($B): total capital of the bank from the bank’s balance sheet</td>
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<td>crettassets</td>
<td>CRE Total Assets ($B): commercial real estate loans outstanding from the bank’s reported data</td>
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<td>comlnassets</td>
<td>Commercial Loan Assets ($B): commercial loan assets outstanding from the bank’s reported data</td>
</tr>
<tr>
<td>constlnassets</td>
<td>Construction Loan Assets ($B): construction loan assets outstanding from the bank’s reported data</td>
</tr>
<tr>
<td>otherrelnassets</td>
<td>Other RE Loan Assets ($B): other real estate assets include any additional real estate secured loans which are residential</td>
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</table>
### Modeling

We will use both linear regression and logistic regression. The goal of the linear regression is to test whether stress-test has an impact on the profitability and capital, while logistic regression allows us to investigate the reason of performing stress-tests.

The below diagram was considered with this statistical modeling process. For linear regression, the outcome (dependent) variable is the capital for some regression and profitability for others. When explaining the decision of performing stress-test, the dependent variable is categorical (binary), leading to the use of logistic regression.
Figure 3: Tree diagram for statistical method choice.

Table 1 provides the descriptive statistics’ calculations for each of the variables within the study noted. The mean is defined as the data’s center point or most typical value. The standard deviation is average amount of variability in this data set and shows how far the data set varies from the mean. The lower the value the closer to the mean the number rests. The standard deviation reflects the spread of the distribution of the data within this study.
Table 1: Descriptive Statistics:

Mean, Standard deviation, minimum and maximum values for different variables.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. dev.</th>
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<th>Max</th>
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Within the 105 participating banks in this study, 82.86 percent of the banks surveyed conducted stress testing for the commercial real estate portfolio and 80 percent of them conducted stress testing for the full balance sheet. The minimum is 0 and the maximum is 1 as stress-test variables take only these two values. The average assets value is $1.3 billion ranging from $3.4 million to $12.14 billion. It is worth noticing that this max exceeds $10 billion which was the maximum to include a bank in the sample. However, this happened because of the increase in value from 2018 to 2022 for some banks. The same analyses can be applied for each variable within this study.
**Figure 4:** Evolution of the means of different variables from 2018 to 2022.

The evolution of average values of data utilized in this quantitative analysis, for each of the periods noted, is reflected in the Figure 4 above. The total assets of the bank would be related to the risk weighted assets; larger banks could have riskier assets in their portfolios. Bank growth is depicted within total assets, as banks have grown over time. Other real estate assets include residential loans, which could be similar to commercial real estate loans. Different banks likely have different strategic asset mix goals which could influence the levels of portfolio balances, by products and loan categories. For example, residential lending in the communities that the bank is located and/or affordable housing including first time homebuyer programs. Earnings and capital appear consistent over the timeline.
**Figure 5: CRE Stress-Test vs Non CRE Stress-Test**

Comparing the average of different variables for CRE stress-test vs non-stress-test banks.

![CRE Stress-Test vs Non CRE Stress-Test Diagram](image-url)
As depicted above, the banks that stress test the commercial real estate portfolio are larger and have more risk weighted assets. This is also the case for the full balance sheet although (as we will show later) not statistically significant. These larger banks may have the resources to conduct stress testing, as well as colleagues with the higher level of qualifications and/or competencies. The risk weighted asset calculation includes bank loan assets that are higher risk, which are commercial real estate loans (office buildings, strip malls, etc.) and/or construction loans (subdivision, rehabilitation projects, condominium construction, etc.). It appears that the commercial real estate stress testing is more likely with banks that have the higher risk asset holdings profile(s).
Pairwise Correlation Review

A pairwise correlation method is a statistical test that is used to assess whether variables are related or not. The STATA pairwise correlation model below produces p-values to test for significance of correlations. The p-value is the probability of not rejecting the null hypothesis. The smaller the p-value the greater the probability of rejecting the null hypothesis. Therefore, if the results are statistically significant the null hypothesis would be false, and we can conclude to a significant correlation between the pair of variables concerned. We have three levels of significance: 1% indicated by (***) 5% indicated by (**) and 10% indicated by (*).
Table 2: Correlation with tests

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*** p<0.01, ** p<0.05, * p<0.1
As noted below, the pairwise correlation, most of the paired variables are significantly correlated. The variables within STATA include the independent and dependent variables, as well as the explanatory variables utilized for control purposes. The p<.01 (***), reflect stronger correlations, while p<.05 (**), reflect moderate correlation and p<.10 (*), reflect weak but significant correlation. For insignificant correlation p>.10, there is no star.

We can notice that the full balance sheet stress-test variable (dst) is not correlated to any variable except other real estate assets (otherrelnassets) with which there a weak correlation. More noticeable is the lack of correlation with both profitability and capital. This is already an indication that stress-test of the full balance sheet may not have a significant impact on both profitability and capital. Moreover, variables such as assets size, capital level and others do not explain the decision to stress-test the full balance sheet. In contrary, the commercial real estate portfolio stress-test variable (dstcre) is correlated with bank variables such as total asset, total capital and others.

There were however high correlations between many variables which could result in multicollinearity if they are not carefully used simultaneously in regressions. Multicollinearity refers to situation where two or more variables can be highly linearly related in the same regression (Gujarati & Porter, 2010). Revenue is highly correlated to net income, total assets, total capital, level of commercial real estate assets, level of construction loans and amount of risk weighted assets. Net income, which could be attributed to higher revenue, is highly correlated to total assets, total capital, level of commercial real estate assets and risk weighted assets. These correlations continue for total
assets and total capital. Risk weighted assets are highly correlated with most of the explanatory variables.

The CRE guidance also identifies institutions that are potentially exposed to significant CRE concentration risk as those that have experienced rapid growth in CRE lending, have notable exposures to a specific type of CRE, or are approaching or exceed the following supervisory criteria: Total loans reported on the Report of Condition for construction, land development, and other land represent 100 percent or more of the institution’s total capital; or Total CRE loans as defined in the CRE guidance represent 300 percent or more of the institution’s total capital, and the outstanding balance of the institution’s CRE loan portfolio has increased by 50 percent or more during the prior 36 months (FDIC, April 2022). These criteria are not limits and are viewed neither negatively nor as a safe haven. A bank can have significant diversification within its CRE portfolio or have a concentration within a specific CRE category (FDIC, April 2022). Construction is a risky business, and any bank extending credit to finance construction encounters both credit and operational risk (Hamm, H. et al., 2015). Now a third risk has recently been added to the risk management portfolio. Banks now must maintain capital at 150% of their construction loan exposure (Hamm, H. et al., 2015). The CRE mentioned refers to the banks’ commercial real estate assets on the banks’ balance sheet.

One FDIC report provided a detailed study about bank failures in banks with high construction loan assets. Construction loans (ADC) are considered the riskiest type of commercial real estate (CRE) lending (FDIC, October 2012). Risk weighted assets is the risk associated with the banks’ assets and loan portfolio. So, as a result, the pairwise
communication table reflecting that banks with higher construction loan assets tend to have higher risk weighted assets (0.805*** correlation).

**Testing effect of Stress-Test on Capital and Profitability using Linear Regression**

Linear regression is the most common form of regression analysis and is used for both predicting and forecasting. When running a regression, we make two assumptions, 1) there is a linear relationship between variables (i.e., X and Y) and 2). The relationships between variables can be seen using regression analysis by estimating how much Y changes when X changes one unit. The most historically used linear regression analysis is the method of least squares. The term “regression” and the methods for investigating the relationships between two variables may date back to about one hundred years ago (Yan & Su, 2009).

The simple linear regression model is stated in the following form $Y = \beta_0 + \beta_1 X_1 + \cdots + \beta_n X_n$. In this model, y is the dependent variable (or the outcome or response variable). There are two outcomes in this study, which are defined as the capital proxy and the earnings proxy. The x is the independent variable (or the predictor or explanatory variable). In this study there are two predictors which are two different bank stress test scenarios. One stress test is stress testing just the commercial real estate assets of the bank (one portion of the banks’ assets) and the second predictor is stress testing the full assets of the bank (all of the banks’ assets). The $\epsilon$ noted is the random error. The explanatory variable explains causal changes in the response variables (Yan & Su, 2009).

Using variables and data available, basic linear regressions were completed with STATA software.
For the bank performance, the statistical model is the following:

$$BkPrm = \beta_0 + \beta_1 StrTst + \beta_2 Cntrl_2 + \beta_3 Cntrl_3 + \ldots + \epsilon \ldots$$  \hspace{1cm} (1)

where?

- $BkPrm$ is the bank financial performance.
- $StrTst$ is the dummy variable for stress test.
- $Cntrl_2, Cntrl_3 \ldots$ are control variables such as size, loans portfolio levels…

For the capital level, the model is the following:

$$BkCL = \gamma_0 + \gamma_1 StrTst + \gamma_2 Cntrl_2 + \gamma_3 Cntrl_3 + \ldots + u \ldots$$  \hspace{1cm} (2)

where?

- $BkCL$ is bank capital level.
- $StrTst$ is the dummy variable for stress test.
- $Cntrl_2, Cntrl_3 \ldots$ are control variables such as size, loans portfolio levels…

This study’s hypotheses are:

- Null hypothesis: (Ho,1): $\beta_1 = 0$ (meaning that there is no relationship between stress test and bank performance).
- The alternative hypothesis to the null hypothesis in this case is: (Ha,1): $\beta_1 > 0$ (meaning that there is a positive relationship between stress test and bank performance).
- The Null hypothesis 2: (Ho,2): $\gamma_1 = 0$ (meaning that there is no relationship between stress test and capital).
- The alternative hypothesis to this second null hypothesis in this case is: (Ha, 2): $\gamma_1 > 0$ (meaning that there is a positive relationship between stress test and capital levels).

The simple linear regression analysis for both capital and profitability (the outcome variables) are as detailed in Tables 3 and 4. Table 3 shows results for the linear regressions of capital and Table 4 presents results for the linear regressions for profitability.
Explanatory (independent) variables are listed in the first column. And each column starting from second represents one regression model. Model M1 is a simple linear regression with only one independent variable, the full balance sheet stress-test (dst). In model M2 a couple of control variables are added. Model M3 is a simple linear regression with only one independent variable, the commercial real estate stress-test (dstcre). In model M4 a couple of control variables are added. Standard errors are in the brackets and the p-values ranges are indicated by the number of stars. There are three level of significance. Strong level, labelled by (*** for a p-value of less than 1%, moderate, labelled by (**) for a p-value between 1% and 5% and weak, labelled by (*) for a p-value between 5% and 10%. There is no significance when p-value is larger than 10%.

Table 3: Linear regression of capital on stress-test
(full balance sheet, then commercial real estate portfolio) without and with some control variables.

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Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1
As we can see in Table 3, the coefficients of stress-test variables are not significant. Meaning that stress-test either on the full balance sheet or the commercial real estate portfolio does not affect the capital level. This may be unexpected but will make sense as stress-test might have different goals for different banks. Either voluntary or recommended by the regulator, the stress-test exercise is often used as a tool to convince bank examiners that the bank is being managed in a safe and sound manner.

Those results are just confirmation from the pairwise correlation tests performed above. Using the regression allow us to add control variables (models M2 and M4) to check for consistency. We can see that results remain qualitatively the same when those variables are added.

**Table 4: Linear regression of profitability on stress-test**

(full balance sheet, then commercial real estate portfolio) without and with some control variables.

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Observations 515 515 515 515
R-squared 0.0016 0.0073 0.0 0.0056

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1
For profitability, regressions’ results in table 4 are qualitatively very similar to results for capital level in table 3. Stress-test does not impact the profitability. Again, this is unexpected, but not surprising as profitability is not the goal of stress-test either for the full balance sheet or the commercial real estate portfolio. It may mostly be for compliance purpose.

The numbers included reflect the same outcome with the insignificance of relation between the variables with the same data set but analysis of profitability. Therefore, the banks’ stress testing activities have no impact of the banks’ earnings, and the null hypothesis cannot be rejected. Noteworthy is that stress testing activities could impact other areas of the bank besides capital and earnings. Stress testing of the commercial real estate assets is a credit risk management activity which assists with managing the commercial real estate assets within the bank’s commercial real estate portfolio. These assets could be managed broadly or specifically. The level of these assets would be the broad management of the portfolio. For example, banks could utilize stress test results for both short- and long-term strategic planning of what type of assets should be focused on for business development activities while considered credit risk management factors (i.e., less commercial real estate loans and more commercial and industrial non-real estate secured loans). Specifically at the loan level, these assets could be managed individually and if any one particular loan fails the bank’s stress test this loan could be exited, restructured and/or sold to another financial institution given the asset does not meet the bank’s credit risk management profile and expectations.

In summary, the positive impact of stress-test (in either scenario) on capital or profitability hypothesis has been disproven. This is quite interesting on both sides. While
some may argue that stress-test will improve bank profitability and capital level as a good risk management practice, other could argue that it is a costly exercise with no effect on the bottom line. There are also many contentions that stress testing should be required for all banks’ particularly given regulators are supportive of stress testing activities. Others point to the recent failure of Silicon Valley Bank who reportedly did stress testing to no avail.

**Explaining the Stress-Test using Logistic Regressions.**

Logistic regression allows one to predict the probability of a discrete outcome from a set of variables that may be continuous, discrete, dichotomous, or a mix (Tabachnick & Fidell, 2007). This is the regression approach utilized when the dependent variable is dichotomous, which are both stress-test of full balance sheet and of commercial real estate. These two variables take values 0 or 1 only. The logit model is often used for classification and predictive purposes and estimates the probability of an event occurring. Namely what is the probability of the bank stress tests (level of portfolio). The logit regression analysis answers that question posed of what drives the decision to stress test.

The equation for the logistic regression is $\Pr(Y = 1) = \text{logit} (\beta_0 + \beta_1 X_1 + \cdots + \beta_n X_n)$ and the dependent variable $Y$ has two possible outcomes. $X_1, \ldots, X_n$ independent variables. There are no assumptions about the predictor variables, and logistic regression estimates the probability of a particular outcome for each case. The model is non-linear, and relevant for one or multiple independent variables. The model is commonly referred to as the log odds and the related formula is $\log \left( \frac{p_i}{1-p_i} \right) = \beta_0 + \beta_1 X_1 + \cdots + \beta_n X_n$, where

\[ \logit(x) = \frac{1}{1+\exp(-x)} \]
\( p_i = \Pr(Y = 1) \) is the probability of the outcome being 1. In our case, it is the probability of a bank performing stress-test. The negative or positive coefficient denotes the direction of the relationship between the variable and that probability.

Table 5 details the results of the logit regression model for stress-test of bank full balance sheet portfolio and Table 6 details the results of the logit regression model for commercial real estate portfolio.\(^2\)

**Table 5: Logit regression of bank full balance sheet portfolio stress-test**

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Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

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\(^2\) Model are run with Stata software.
Results in Table 5 show that the decision to stress-test the full balance sheet is independent to any of the size and risk variables such as total assets, total capital, risk weighted assets and others.

Stress testing of the full balance sheet is a financial modeling exercise for the bank, versus the credit risk management analysis for stress testing the commercial real estate portfolio. Again, differing opinions on why it is important to stress test the full balance sheet. The primary reason to do so is to determine how the bank will be impacted overall in different periods of economic situations. The full balance sheet stress testing is more comprehensive and broader than the stress testing of one component of assets. The underlying assumptions are broader, and forecasts differ. For example, stress testing of commercial estate assets would consider rising interest rates, declining loan to value ratios, and declining cash flows. Stress testing of the full balance sheet would also be forward thinking in terms of analysis, but would include macroeconomic factors like unemployment ratios, gross domestic product numbers, interest rates, exchange rates, real estate prices and stock prices. If a bank has a smaller portfolio of commercial real estate assets, the possibility of the bank stress testing the full balance for financial planning and forecasting purposes is strong. Bank management would likely decide about stress testing activities based upon factors both specific to the bank and general to the environment and the industry. Environmental conditions certainly could be based upon the current climate overall, and the industry conditions could consider the federal reserve actions related to interest rates and related regulatory priorities and/or current examination focus. The size and complexity of the bank could also be a factor.
Table 6: Logit regression of bank CRE portfolio stress-test.

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Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 6 shows interesting results. Risk and size play a big role in the decision of stress-test the commercial real estate portfolio. We can see that coefficients of risk weighted assets, total assets, total capital commercial real estate total assets construction loan assets and other real estate loan assets are all significant. This means that the risk and the size factors increase the likelihood of the bank to perform commercial real estate stress portfolio. This contrasts with the decision to perform the full balance sheet as we shown in table 5.
Many factors could influence if a bank stress tests the commercial real estate portfolio. There is specific federal regulatory guidance the details the reasons stress testing of the commercial real estate portfolio is important to the bank, particularly those banks that have high levels of commercial real estate assets (compared with the bank’s capital levels) and banks that are strategically focused on growth within the commercial real estate portfolio. According to *History of the Eighties – Lessons for the Future*, the high number of bank and savings institution failures during the 1980s and 1990s can be attributed to primarily to overinvestment in CRE loans (FDIC, 2022). Also, conversely if banks do not provide commercial real estate lending products the conducting of stress testing is unlikely given the lack of information available to populate any stress test models.

We also consider the variable combining both stress-test. The output variable is 1 when the bank performs both CRE portfolio and the full balance sheet stress-tests.
Table 7: Logit regression of bank stress-testing both CRE portfolio and the full balance sheet

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Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 7 results for bank performing both CRE and full balance sheet stress-tests are qualitatively like table 6 results for bank performing CRE stress-test. It appears that bank stress testing activities are driven by the stress-test of the CRE portfolio. For example, if banks stress tests the commercial real estate portfolio it is more likely than not that they
are stress testing the balance sheet as well. The size of the banks’ commercial real estate portfolio could also be a factor with the banks’ stress testing activities.

Banks that are committing to stress testing as a priority have allocated company resources to do so and as a result could implement and continue robust stress testing activities. Specifically, stress testing could be conducted internally, externally, or a combination of the two. Bank colleagues would be qualified to understand and administer stress testing which has a level of atypical complexity. Their qualifications would have to be robust enough the facilitate third party consultant involvement with the process. This includes, but may not be limited to, establishing underlying initial assumptions, forecasting (both short and long term) model parameters, analyzing results, tweaking all for relevance purposes, and providing feedback to parties involved with stress testing. If the bank conducts stress testing, these stress tests are presented internally to management and/or management committees and to the Board of Directors and/or Audit Committee. This information is also provided to bank auditors and regulators, and bank colleagues would have to have an understanding on how to present stress testing to these stakeholders. Stress testing overall is also a fluid activity, meaning all within it should be closely reviewed and modified to adjust to changing bank and other conditions.

Power Analysis

The final size of the study is 105 banks while data financial characteristics were collected over five years, which leads to 525 observations. The sample covers a wide range of small bank type across the country. Given the nature of study and the number of variables, the sample size should be adequate. It is however important to analyze the power of some key tests.
The power analysis depends on the test performed. We have different tests for mean, correlation, regression with multiple variables etc. Here we analyze the power of the tests for the regressions which yield significant results, namely the logistics regressions for commercial real estate stress-tests (Table 6 and 7). Each model includes 3 covariates and with r-squared ranging between 0.01 to 0.88. With an alpha of 5%, the power of the tests ranges from 12% to 75%. However, when we consider the number of observations (525), the power of the tests goes from 46% to 100% for r-squared of 0.01 to 0.88. With these results, we can conclude that the sample size as well as the total number of observations are large enough for relevant tests.
Other relevant design information

The strength of the survey was the ease of use and of collecting the closed end responses, which were clear and concise. The simplistic layout supported unlimited treatment and replication opportunities, as well as related statistical testing. The disadvantages were the lack of room for expressed opinions by the participants, and/or the ability to determine if the participants truly understood the question. The strength of the archival data attainment (and validity) and analysis is the depth, breadth, level, and ease of accessibility. The primary challenge was enlisting participation from the original population. Ethical issues were established at the beginning of this phase one planning process. Misuse and misrepresentation of statistical information was an important requirement to maintain the integrity of this study and findings/conclusions. The power and internal validity of this research was maximized by maintaining the targeted identification of banks in the sample. Publicly available information from federal regulatory websites was collected. Replication of the study should be achievable for an unlimited number of times for future studies.

Manipulation of the predictor could impact external validity, which is the extent to which the results can be generalized to the 5,276 banks in the population nationwide. This goal was to determine if stress testing operationally causes a change in bank financial performance and capital levels. Construct validity insured with the direct quantitative measurement of the two predictors. The generalization between stress testing and financial performance/bank capital levels operationally are the degree to which the constructs are true.
Phase 2: Qualitative Study

Research Design

The purpose of this collective case study utilizing the explanatory case study design was to explain the findings of the quantitative portion of this study. This design focused on details of stress testing and the impact on banks, with an ultimate objective of providing a basic understanding of commercial real estate community bank stress testing. This understanding could also provide the base line of future research and/or expanded stress test use. The complexity of bank stress testing was simplified with this research design clarity. The design resulted in updating available relevant research and literature, expanded the knowledge base of the practical applications of the Presidents utilizing stress testing in their organizations through open ended discussions, and enlisted additional peer review/feedback beyond that of the open-ended survey (and survey participants).

Each bank was analyzed separately, and then themes amongst them developed. This collection of bank information was cross studied, and commonalities identified and analyzed. The design selected was exploratory (also known as pilot case study). The research general question was followed by additional developed research questions (while being mindful of not subscribing to foregone conclusions) accordingly. This design-maintained flexibility and provided additional conclusions ultimately. Other research designs would have been less applicable to this study.

Once the quantitative research proceeded, the completion of an open-ended interview with questions enlisting feedback from these banks that were interviewed. The financial information for these 5 interviewed banks was added to the data collection.
spreadsheet and included within the quantitative component of this study as well. Given the bank executives have basic professional core responsibilities for stress testing activities, they were the most effective group to collect meaningful data from. The timeframe for commencement (based upon access/gatekeeper issues) for this portion of the research was longer as anticipated given challenges with scheduling. Results could influence additional qualitative research, which would likely be more in depth.

**Researcher credentials**

The researcher is a peer of the participants and is skilled and knowledgeable as a peer. She was a community bank President and Chief Executive Officer for 10 years, has in excess of 30 years of industry experience, and is currently a bank executive at a Massachusetts bank. She previously managed a bank auditing company that provides stress testing services to client banks throughout the Northeast and New York. She also is educated with directly related advanced business degrees and professional training. Given the peer status, study validity and reliability improved as did analysis transparency and bias management (of researcher and participants). Data collection and analysis understanding, and thoroughness was also improved given the qualifications (considering the complexities too) of the researcher.

**Location, site or setting.**

Considering the current COVID-19 pandemic, and limitations regarding face-to-face meetings, the setting to collect data was both by phone interviews and by email communication whereby participants could be located wherever they chose. Given operating restrictions, some participants were at the bank site while others may have been
working remotely (alternative business location or home-based office). Most bank and remote locations are comfortable offices that are equipped with current technology.

The interviews were beneficial given the ease of use (content and timing), high participation rates. One hundred percent of the 5 participants were engaged, and 9 potential participants were originally identified. This represents 55% of the interviewees that participated versus the total identified potential participants. Since 5 was the established goal for the number of banks interviewed, the remaining 4 were not pursued. The respondents’ banks captured a particular geography, and participants were accessible. This was a cost-effective approach in collecting data and was more personal to conduct. The primary limitation of this setting was that the direct observations of the participants were not available, including (but not limited to) their reactions to the questions being put forth and any related discussion, and the lack of non-verbal clues (i.e., lack of body language observations and eye contact). The complexity of the open-ended questions was also a limitation.

Population

Data sources included information collected from the bank executives within the sample. The goal of participant recruiting was to include peer executives that are currently managing varied (size and complexity/span different bank charters) organizations, as well as those that complete stress testing and those that do not. The population was geographically limited to the Northeast. The expectation was that the executive had the primary role in leading the organization. Accessibility to this population was important, including willingness and wherewithal to participate in this study, and there were no gatekeeper issues in making contact to enlist participation.
The bank executive were long-standing (defined as minimum position tenure of ten years) Presidents and their demographics varied (age, race, ethnicity, gender, etc.). Given the fundamental requirements of this position, executives were college educated white collar professionals that are responsible community members as well. These responsibilities span to community service (volunteer work and/or financial advocacy and education work). There was homogeneity within the population since participants would currently be in a similar executive position/role within their financial institution, and as a result information collected was from the same executive perspective and could possibly be generalized to the larger population. Since these executives are researcher peers, the relationship between the two parties was likely not impacted by power dynamics, and those participants identified are professionally known to the researcher.

The University of Rhode Island IRB approval included the established interview protocol. From the established call report spreadsheet dated November 21, 2021 (FDIC CALL data as of September 30, 2021), 5 banks were specifically chosen to participate in a survey by the researcher. These banks were identified across multiple charters as noted above within this initial September 30, 2021, collection and obtainment of archival data. These banks were directly targeted by the researcher, which included contacts that were known (to increase the likelihood of participation). These banks were all located within the Northeast United States.

Interviewed banks and the title of participants included the following:

Bank # 1 - 102S/Comm. SM – 5 FDIC call report category – $ 750 million plus
President and Chief Executive Officer – 35 minutes approximately

Bank # 2 – 101 – FDIC call report category - $ 2 billion plus
President – 50 minutes approximately
Bank # 3 - 102 – FDIC call report category - $ 720 million plus

President and Chief Executive Officer – 25 minutes approximately
Bank # 4 – 102M – FDIC call report category - $ 480 million plus

President and Chief Executive Officer – 30 minutes approximately
Bank # 5 – 101 M – FDIC call report category - $ 4.0 billion plus

President and Senior Loan Officer – 65 minutes approximately
All interviews were conducted within the month of October 2022. Interviews were taken by phone, with detailed notes taken. These notes were reviewed multiple times right after the interviews took place and were typed to be accessible for revisit throughout this study analyses over time.

Each potential participant was contacted utilizing LinkedIn as a vehicle to enlist interest and participation. A total of 9 banks were originally identified as potential participants. All 9 responded and expressed interest in participating. The first 5 to schedule an interview were interviewed. The remaining 4 were not pursued since the number of participants’ goal was reached. A code book had been previously constructed and is attached here as APPENDIX E. Detailed notes were taken during the interviews, which have been retained. FDIC Call financial data was collected for each bank that participated for 5 fiscal year ends which were 2018, 2019, 2020, 2021 and 2022.

An excel spreadsheet was established to house said archival data, which included the following information (based upon the general objective and specific variables of the study): Income Statement – Revenue and Net Income, Balance Sheet – Total Assets, Total Capital, Commercial real estate total assets, Commercial Loan Assets, Construction Loan Assets, Assets, Other real estate loan assets, Risk Weighted Assets. Problem Loan Levels
– Charge-offs and Recoveries, Past Due & Nonaccrual Loans, and annual Provision. Also, 2018 and 2019 – pre-pandemic periods were utilized, 2020 and 2021 – post-pandemic periods were utilized, and current 2022 fiscal year end were all utilized in collecting archival data.

Included within this collected data were commercial loan assets which were commercial loans that are not secured by real estate, construction loan assets which were both 1 to 4 family residential and other construction loans, and other assets which included residential mortgages and consumer home equity loans. Once publicly available, the interview participants’ banks current FDIC Call data was added to the created spreadsheet (available after the banks filed the information, which was early March 2023). The study code book was added to the excel spreadsheet and the 5 bank interviews were coded accordingly. Excel was utilized for coding of the interviews.

Limitations of the population selection could include executives that are not representative of the greater population in terms of their effectiveness within their organizations. In addition to limited population size, given the researcher is part of the population, researcher selection bias/relationships (and perspective) could impact this case study. Both the geography and the homogeneity of the population could be limitations. Namely the population could have similarities given they are selected from the same geography and have the similar business components and/or strategic objectives.

Sample

This sample was high-quality, well-established community banks and choosing each of theirs’ selection represented nonprobability purposive convenience sampling. There was a clear set of selection criteria that would assist with sample determination. High
quality was defined as bank Presidents that have been in their position for more than ten years, the bank has no bank regulatory actions pending (adverse findings from the federal government), and the bank profitability has been consistent over the last three full years.

Every national bank, state member bank, insured state nonmember bank, and savings association (institution) is required to file Consolidated Reports of Condition and Income (a Call Report) as of the close of business on the last day of each calendar quarter, i.e., the report date (Federal Deposit Insurance Corporation, 2020, page 1). Participant selection within the identified population was principally based upon researcher knowledge and relationships, while utilizing available supplemental financial (and other relevant study) information. The sample was complete well before the data was collected, which was the case with this sample size of five.

Relevance spanned from the organization definitions (bank charters) to the executive role and responsibilities as the primary company decision maker. Bank charters included stock banks, mutual banks, savings banks, and commercial banks. The detailed procedures in the selection of the financial institutions, and of individuals managing these financial institutions, were from the researcher circle of acquaintances. The organizational culture starts with the leader of the company, and this leader is the primary influencer of the organizational culture. Incorporating lower-level colleagues within the financial institution would not result in an effective sample, and the viewpoints from the top would be critical. This sample was large enough given additional interviews of financial institution Presidents would not deem different results than the sample at hand given the quality of the participants (they are trained/versed/time/willingness and cognitive capacity
to participant at a high level). Success with this case study is dependent upon the researcher’s abilities (Yin, 2014).

**Data Collection Schedule**

This research study advanced through the process as required within the University of Rhode Island dissertation framework. Namely, a dissertation committee was formulated by the Spring 2022 (will hear the comprehensive topic examination), and by August 2022 (which was deemed required) Internal Review Board approval commenced. Ultimate oral defense is scheduled for June 3, 2023.

The quantitative portion of this mixed method research commenced as soon as was practical with the research utilizing archival data and simplistic yes or no survey regarding conducting (or not conducting) stress testing. This survey was completed within 6 months, and professional engagements to assist transpired as anticipated (i.e., agency). The qualitative interviews were conducted (after URI IRB approval was obtained) and the two collection vehicles proceeded simultaneously. Data analysis was ongoing and in accordance with deadlines as required and established.

**Data Collection Process**

Phone interviews (with open ended questions) was the primary data collection method for the qualitative component of this mixed methods study, given the personal approach to collecting information is common and resulted in effective conversation. Interview questions (as detailed within) assisted with providing answers to the research questions. This semi-structured method was selected to collect in depth information and
provide the opportunity to conduct and collect impactful comprehensive stress testing information.

The research process has been explained and documented at length in as much detail as possible by the researcher. This included (but may not be limited to): explaining the researcher’s background and knowledge of the role of commercial real estate loan stress testing (as the researcher’s qualifications’ justification), documenting the data collection methods of the survey of Bank Presidents, insuring the context that the survey is conducted in is clearly explained (namely in person/at the bank/effectively working with the gatekeeper to cooperate), documenting the methods of analysis and verification that procedural guidelines are in place/followed/consistent/valid, and disclosing proper references/literature review of relevant stress testing information/materials. Group data interpretations have not been included (i.e., information in groups), particularly considering the 5 interviews being conducted, and would logically explain methods/approaches utilized to maintain strength with the utilized methodology.

**Standardized/Structured Interview Protocol**

An interview protocol is more than a list of interview questions; it also extends to the procedural level of interviewing and includes a script of what you will say before the interview, script for what you will say at the conclusion of the interview, prompts for the interviewer to collect informed consent and prompts to remind the interviewer the information that she or he is interested in collecting (Jacob & Furgerson, 2012). Interview protocols become not only a set of questions, but also a procedural guide for directing a new qualitative researcher through the interview process (Jacob & Furgerson, 2012). A protocol is a list of topics instead of a list of questions (Belk, et al., 2013). The
interview script is attached as APPENDIX C and the interview questions are attached as APPENDIX D.

**Para data**

Para data is the process used in collecting the data. The researcher utilized available federal bank financial information and personal contacts to confirm financial performance and to identify the availability of participants. The administrative data about the survey was collected by phone interviews of bank Presidents that manage profitable banks (with a review of federal bank financial reports for the past 3 years), during the ordinary business day (9:00 a.m. to 5:00 p.m.) for 30 minutes.

**Response Recording**

The researcher took notes while listening intently. Notes are both general and detailed as appropriate. Checklist and logs were informal tools as well. Given confidentiality concerns recording was not an option and would have dissuaded participation. The researcher was versed with both the requirements of the position, the bank operations, and the topic being studied and as a result note taking was more succinct and accurate. Also, additional follow-up discussion could have taken place if information needed to be expanded and/or clarified as appropriate and relevant.

**Pilot Test**

The researcher identified two close friends that meet the participant profile. These two parties were asked the same questions, under the same conditions to assess generally how the interviews would go and/or to provide areas of improvement/refinement. The pilot studies yielded honest feedback, confirmed the time was adequate, provided additional data to collect/study, and ultimately yielded support for the survey results. This feedback
included enlisting feedback about the questions themselves as well as the flow of the questions.

**Proposed Data Analysis**

Thematic analysis was utilized to explore the stress testing process phenomena, which is a financial study with a behavioral component dimension. Thematic analysis assisted with the predetermined categories utilized with available archival data as well as which assisted with generalizability of this study. To the extent that relevant variables are well-defined or readily observable, empirical studies in finance typically employ classical investigative techniques and positivistic methodologies to measure and analyze financial phenomena (Silverman, 2011). Many unanswered questions in modern finance, however, rely critically on insight into the behavior or intentions of various agents, for which there may be no easily discernible proxy that lends itself to traditional quantitative analysis (Silverman, 2011).

Once data was collected manually, the data analysis and interpretation were completed. Theory was developed from the literature and from the data collected and reviewed. Often, pre-existing theoretical perspectives can provide a lens through which your focal phenomenon can be viewed, and a set of enabling concepts that may help you answer your research questions (Belk et al., 2013). Thematic data analysis, although complex, would provide a framework that can help facilitate analysis of the data through coding reliability approaches, code book approaches and reflexivity approaches throughout (Yin, 2014). Interviews were coded by both the researcher and a second coder with an 82% accuracy.
Methodological Integrity

In explaining and documenting the research process in detail, the credibility and the phenomenon was truly tested. Triangulation – multiple data methods, collection of data over a longer period, member checking back to confirm – continued discussion, clearly describing methods as noted, incorporating real world events in detail, and reflection (looking back at the process on an ongoing basis) assisted. Findings may or may not ultimately be properly generalized to a larger group, consistent results amongst the 5 being studied were identified, findings could contribute to future research – beyond the 5 banks being studied, and findings might be generalized to a larger bank population particularly since some results were consistent amongst the participants. Explanations remain in clear industry and situational context, with added detail to descriptions and the elimination of jargon and acronyms, and sampling adjustments/expansions as data collection proceeded to adjust to truth in categories (as relevant, evolving and/or necessary).

The feedback from the anticipated bank Presidents’ interview results/consistency and transferability (accuracy, comprehensiveness, flexibility, sensitivity, social context, etc.) to the group would further support reliability. The researcher was flexible and exhibited an ability to adjust to an ever-changing context to which the research occurred, as well as the context in which they were generated – design trustworthy and linked to the research questions. Intent listening with the collection of data was utilized to establish consistency value, saturation – used insights, and fluid openness to findings/topics adjustment and interceding all were important. Corroboration and claims being well founded were also be detailed within this study to support credibility. Much literature was collected, which has been incorporated within this study. Peer debriefings (discussing
results with others), clarification of researcher biases of researcher (open and honest reflection on me as the researcher), audit trail in research and documentation, and consistent assistance from the study’s major professor all assisted with the viability and validity of this study.

Also, appropriateness (of both data collection and evaluation) was an important criterion to consider for a community bank stress testing qualitative research study. The questions within the survey are applicable, there was room for the participants to provide feedback at length, the interviews were conducted in context, and an unlimited amount of time was dedicated to the collected data in the field by the researcher. Typed transcriptions are lengthy and detailed (with no jargon, acronyms and all related banking/stress testing terminology defined in clear detail), and a detailed sampling strategy is included herein (how the President was chosen to be a participant – including cross charter identification, complexity, size of the financial institution).

Related Theoretical Foundations

The theory foundation, namely that community bank stress testing as a best management/leadership practice, was based on the available and documented topic literature and past studies. There is textual evidence included. These 5 cases did not conflict, however the reasons and purposes of completing stress testing varied amongst the group. All interviews consistently maintained the best practices phenomenon. Consistency, relevance, and self-reflection was part of this process, which was anticipated to support the best possible result – namely that stress testing is a best practice for community banks provided leadership sufficiently supports/commits to this credit resources through resources’ allocation.
A leader’s most important role in any organization is making good judgments – well-informed, wise decisions that produce the desired outcomes (Tichy & Bennis, 2007). Also, stress testing requires bank resources to initiate, construct, conduct, analyze and to manage on an ongoing basis. *Here’s the leadership challenge:* judgement is not simply a matter of choosing *right* versus *wrong* alternatives (Wheeler & Goldsmith, 2010). The tough decisions are those in which you must weigh one right alternative versus another right alternative or one good option against the best (Wheeler & Goldsmith, 2010). Some researchers contend that judgment doesn’t occur in a single moment but grows out of a process (Tichy & Beenis, 2007).

**Resources Utilized**

Qualtrics was engaged to conduct the quantitative survey using funds allocated by the URI DBA program. In addition to utilizing related topic research (literature), other resources required were archival data principally available from the federal government websites of public information. The URI library was an integral resource to conduct the literature review. The qualitative component of this study required bank executives willing to participate in the study. Software utilized was NVivo, -Qualtrics, and STATA (as detailed within this study and in addition to the basic software required – i.e., Microsoft Excel and Word). These software applications were provided by the URI DBA program and were utilized during the program course work as well.
CHAPTER 4

FINDINGS

Based upon the quantitative analysis of the structured data, the null hypotheses cannot be disproven for the relation between stress-tests and the capital or the profitability, which is the opposite of what the study was expecting. There is not a positive relationship between stress testing and bank financial performance, and that there is not a positive relationship between stress testing and bank capital levels. Model results in no significant relation between the independent and dependent variables. Correlation does not necessarily indicate causation, which cannot be presumed. Any minor relationships between the variables were not significant. Also, the logit model answered the quantitative research question of what drives the decision to stress test. This decision can be seen with level and components of the commercial real estate portfolio, the total assets and the banks’ risk weighted asset levels.

As expected, there is a strong correlation between size variables and risk. The pairwise correlations reflect the fact that the banks’ level of construction assets is related to the risk weighted assets and the risk associated with the banks’ lending activities. While running regressions (both linear and logistic), it is important to be mindful that multicollinearity may be an issue, some independent variables could be expected to have correlations to some degree. For example, higher capital levels could be as a result of higher earnings since the banks’ balance sheet and income statements are related. Higher risk assets could result in higher yields or conversely higher risk lending activities could result in additional credit risk management practices including but not limited to stress testing at the individual loan level and at the portfolio level as deemed necessary.

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In addition to the specific results, and interpretations noted above, other results of this research proposal analyses could vary in many ways. Variances in capital ratios (considering differing compliance – voluntary and required), charter and ownership of the bank (i.e., mutuals are not profit driven/are community driven and stock banks are profit/return to shareholder driven), fluctuations in profitability from other factors beyond commercial real estate stress testing matters (i.e., accounting compliance CECL/ALLL matter), and potentially stress tests and analysis of capital and financial performance for different periods of time.

Based upon the qualitative analysis of the unstructured data, stress testing information and details can be learned which was an additional objective of this study. Of the banks interviewed, all of them conducted some form of stress testing and each thought stress testing was important. Stress testing was used for different purposes – i.e., strategic planning, credit risk, loan loss reserve planning, and most contended that stress testing was embraced internally. Each thought the regulators preferred the bank stress test, even though it was not required and was considered a best practice. Noteworthy is that some of the stress testing approaches transactional (at each individual loan level) versus portfolio level (a group of loan assets with similar characteristics). The models used, approaches, purposes, and underlying assumptions varied amongst the group. The processes amongst banks also varied with some stress testing being done internally and others being done externally by third party engaged consultants.

The qualitative component of this study provided additional explanation of the quantitative findings. The interviews all resulted in bank executives explaining that they used stress testing for different reasons (as detailed) and that the bank regulators advised
them to continue to use and expand the use of stress testing within the organization. The banks’ financial performance and capital conditions were irrelevant in these banks’ stress testing activities meaning that the 5 banks interviewed that explained the importance of stress testing did not demonstrate that their respective banks had higher profits and/or capital. These qualitative findings again supported the results of the quantitative component of this study, that there is no relation between stress test with neither bank performance, nor bank capital. None of the open-ended questions asked of the participants resulted in earnings and/or capital improvements being the reason for stress testing either the commercial real estate loan assets or the full balance sheet of the bank. These observations further validate and confirm the multiple quantitative model results.

**Potential study limitations**

Researcher exclusions of population base could result in banks nationwide that are not participating in the study and whose data could advance this research topic. The researcher’s direct selection of interview participants, based upon knowledge of the market and individual contacts, could limit open ended feedback within the qualitative portion of this study. Interviewed banks were limited to the Northeast, not nationwide, and geographic limitations could impact the data collected.

The survey data collection process could be a limitation given multiple individuals collected archival data from FDIC Call information and inconsistencies between researchers could be possible. Qualtrics emails may not have reached potential participants given bank emails’ security systems and bank training advising against clicking on links within emails. There was no participation from bankers through the LinkedIn advertisement limitations.
Linear predictor function to forecast possible outcomes could be an issue if this assumption is not accurate. Regression is not perfectly precise and the margin for error is included the constant and cause and effect remaining unchanged may not necessarily be the case.

Limitations of this information could include archival data from one source without another source validation and reporting from the bank to the FDIC could be incorrect or inaccurate based upon mistakes at the bank level and/or with the FDIC software for submission. Proper coding of certain asset categories could impact these reports, namely if loans on the bank core system are not properly reflected as investment real estate, they will not be captured properly within that category. Also, bank strategic decisions are not accounted for within the data. For example, if the bank is proactively positioning for voluntary CECL adoption, the net income could be impacted by greater loan loss reserve allocations and lower earnings. There could be other data challenges as noted above as well. The assumption that all stress testing between banks is the same may or may not be the case. There are many available stress test models, including underlying assumptions and bank-built models, which vary vastly in many respects (from stress testing methodology to parameters given stress testing would be voluntary and adherence to regulatory requirements not specifically necessary). Overall results could vary, profitability fluctuations from many factors could take place, and capital ratios could be impacted by management capital planning decisions.
CHAPTER 5

CONCLUSION

This study’s topic was chosen in August of 2020, in the height of the global pandemic with much uncertainty about economic and industry conditions. Besides the lack of forecasting ability for the timing and resolution of the pandemic, the potential credit deterioration from interrupted business operations was unknown and very concerning to many. The researcher chose the stress test topic at the beginning of the study from a different vantage point than from when the study concluded. Namely from an audit credit risk management perspective of a regional credit risk management executive level to a bank executive leadership position. Credit stress testing, as well as financial statement stress testing, has been a bank practice for many banks over many years.

This study evolved to be even more timely over the 3-year research period. In additional to pandemic related concerns, including the uncertainty of federal action for both interest rates and regulatory supervision changes, the fundamental safety and soundness of the banking industry continues to be of question. Over the past 12 months the federal reserve has increased interest rates more (in terms of rate increases and number of increases) in the past 12 months than they have in many years if ever. The fundamental goal of these rate increases was to slow down the economy.

Specifically, there were 2 recent bank failure on each coast. Silicon Valley Bank in California and Signature Bank in New York were each ceased respectively by related state and federal bank regulators. There had not been a bank failure for many years. Based upon regulatory supervision requirement during the Trump administration, neither bank was subject to mandatory federal government stress tests. That’s not to say the banks did not
stress test, and there is a question as to if they did (or did not) stress test (either the commercial real estate loan portfolio and/or the full balance sheet) would they have both failed. The future of a third bank, First Republic, is in question as based upon current financial indicators failure is expected. Both bank failures are attributed to management risk mismanagement and inadequate regulatory supervision. There is much finger pointing as to responsibility and increased regulations going forward are already being discussed.

This study has implications, which have evolved and are both theoretical and practical. Theoretical implications could include new additions to these covered theories. For example, network theory was studied within some of the references. Network theory is that the banking system is complex and multifaceted, which is applicable to current conditions of the banking industry. The federal action with interest rates and continued anticipated increased regulatory scrutiny will have much effect on many areas going forward. Also, unprecedented is the federal government agreeing to pay deposits back their uninsured deposit amounts. This additional coverage could be seen as a government bailout given the depositors are not entitled to these funds about the FDIC Deposit Insurance Fund $250,000 coverage. The cost of the additional payments will be borne by other banks, that already pay deposit insurance premiums to the FDIC fund.

Rough set theory decisions support systems for dealing with vague and uncertain information in classification problems with incomplete information. Data collection in this environment will continue to be a challenge, as well as analysis of this information, in this time of uncertainty. Leadership theory was applied given stress testing is not required for the banks analyzed in this study. The thought process that stress testing is a best practice and given executives would have to reallocate resources from other areas of the bank could
form a basis for new theories. With the Silicon Valley Bank failure there has been much discussion of the responsibility of executive management with the demise of the bank. The bank failed fast, and the bank President and Chief Executive Officer was not only compensated heavily but served on the California Federal Reserve Board. The reasons for the Silicon Valley Bank failure were liquidity, meaning the question related to this study is if the bank stressed tested their full balance sheet and this stress test was extensively reviewed by the Federal Reserve (as the bank’s primary regulator) could the failure been avoided. The executive compensation structure has resumed as top of mind as well.

Based upon the data collected, the analysis of the data and the findings, there is much room for future topic and related topic research. The study accomplished the increased understanding of stress testing and answer the fundamental questions of reasons for stress testing. The quantitative data collected could be further analyzed. Namely, the problem loan information collected could be analyzed and hypotheses related non-performing assets, delinquency levels and/or the allowance for loan losses developed. For example, banks that stress test their commercial real estate portfolios have lower levels of delinquencies and non-performing assets. Also, additional capital and profitability studies could be pursed. For example, segmentation by bank size and different asset classes within the banks’ balance sheets analyzed (i.e., residential lenders are less likely to stress test the commercial real estate portfolio and some commercial real estate lenders will not stress test at all).

The qualitative component of this study could be expanded as well. Interviews of the 5 bank executives could be revisited with additional questions added and responses to the questions already asked could be expanded. These 5 executives voluntary agreed to
participate in the study and freely shared information about their banks related to their stress testing activities. Other related questions could include leadership and colleague skill requirements to conduct, analyze and monitor the bank’s stress testing activities could be included as well. Originally, 9 banks agreed to participate in the interviews and the remaining 4 willing participants could be contacted with the same (or the new/additional) interview questions asked. The identification of banks could be expanded geographically beyond the northeast.

Further research could include the same topic reviews by the bank regulators at both the state and federal levels. Industry trade associations have expressed interest in sharing results both at the regional and federal levels. These include the Massachusetts Banker’s Association and the American Bankers Association, and the researcher has been invited to craft white papers about this study for future membership distribution. The banks that completed the survey and the banks that participated within the interviews have requested the study be shared with them and once the study is shared additional dialogue between the researcher and these participants could be possible.

In closing, this study was worthwhile and impactful and can be seen as an initial step for integrating both quantitative and qualitative research at an important (and uncertain) time in the banking industry. The knowledge about stress testing has been expanded through information collected from the 105 banks participating in this study. The contacts made at these banks, as well as through the professional associations, are meaningful and leverageable in the future at a national level. The expanded knowledge of the basic topic of stress testing has been expanded with this study. The understanding that the process, use, and regulatory requirements (amongst other factors) of stress testing
varies across institutions nationally. The disproving of the original quantitative hypotheses was also interesting, as was the relationships between the variables contained within this study. The evidence supports the importance of stress testing for many purposes and many reasons.
APPENDICES

APPENDIX A – MIXED METHODS STUDY

Source: Nurse Amygdala – WorldPress.com
Sequential designs

Explanatory sequential mixed methods

Quantitative data collection and analysis → Follow-up with → Qualitative data collection and analysis → Interpretation

Exploratory sequential mixed methods

Qualitative data collection and analysis → Builds to → Quantitative data collection and analysis → Interpretation

APPENDIX C – INTERVIEW SCRIPT

This is a study about stress testing of community bank commercial real estate assets to shift to proforma capital planning and risk management strategies. The researcher is a colleague peer of the participants, which would enlist respect and comfort with sharing information.

There is this form that was previously provided to you and is informed consent, and are there any questions and/or has it been executed? (Collected, and researcher contact information is provided) Participants would be encouraged to answer as completely as possible without breaching any bank confidentiality. There is room for complete answers, after the study is explained in detail. No jargon and/or acronyms would be utilized, and all related stress testing terminology explained in detail. This phone interview estimated to take more than 30 minutes, and the researcher will be taking notes as well.

Consistency, relevance, and self-reflection was also part of this process, which supports the best possible result – namely that stress testing is a best practice for community banks provided leadership sufficiently supports/commits to this credit resources through resources’ allocation.
APPENDIX D – INTERVIEW QUESTIONS

The interview questions were established as the following:

1. Interview Question
   Tell me more about your professional experience here at the bank?

   Validating Question
   Could you explain how your career evolved here to result in your current position?

2. Interview Question
   Could you please share your understanding of what stress testing is?

   Validating Question
   How, and too what degree, do you think stress testing would be more widely used amongst banks if its better understood?

3. Interview Question
   What do you think about banks that do stress testing?

   Validating Question
   Could you explain your stress testing here at the bank?

4. Interview Question
   Could you explain your thoughts about using stress testing for managing credit risk?

   Validating Question
   Do you think stress testing would be a good use of bank resources?

5. Interview Question
   Explain how stress testing would be a strategic tool for the bank?
Validating Question

Could you explain how stress testing results can be used to project your risk in certain bank areas?

6. Interview Question

Do you think bank regulators prefer that you do stress testing?

Validating Question

Are stress tests requested as part of your federal bank regulatory examination?

7. Interview Question

Could you share your thoughts on how pre-pandemic stress test results will be different from the post-pandemic stress test results once the pandemic has ended?

Validating Question

How do you think the pandemic will impact the bank’s stress testing activities?
APPENDIX E - CODES

This code book was constructed prior to data being collected and evolved throughout the study. The following codes were utilized in the coding of the data for the qualitative component of this study:

*Community bank stress testing coding key (anticipated from the data):*

<table>
<thead>
<tr>
<th>Code</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>Stress Testing Completed</td>
</tr>
<tr>
<td>101</td>
<td>Transaction stress testing</td>
</tr>
<tr>
<td>102</td>
<td>Portfolio level stress testing</td>
</tr>
<tr>
<td>103</td>
<td>Enterprise stress testing</td>
</tr>
<tr>
<td>104</td>
<td>Scenario analysis stress testing</td>
</tr>
<tr>
<td>105</td>
<td>Loan Migration analysis</td>
</tr>
<tr>
<td>106</td>
<td>Reverse stress testing</td>
</tr>
<tr>
<td>200</td>
<td>Commercial Loan Asset Stress Testing Model</td>
</tr>
<tr>
<td>201</td>
<td>Top-Down Model</td>
</tr>
<tr>
<td>202</td>
<td>Loan Level/Bottom-Up Model</td>
</tr>
<tr>
<td>203</td>
<td>Construction on Speculation Model</td>
</tr>
<tr>
<td>300</td>
<td>Stress Testing Best Practice</td>
</tr>
<tr>
<td>301</td>
<td>Supported by regulators.</td>
</tr>
<tr>
<td>302</td>
<td>Embraced internally.</td>
</tr>
<tr>
<td>303</td>
<td>Availability of resources internally</td>
</tr>
<tr>
<td>304</td>
<td>External tools to complete.</td>
</tr>
<tr>
<td>305</td>
<td>Bank colleagues are motivated by management best practices culture/environment.</td>
</tr>
<tr>
<td>400</td>
<td>Stress Testing Risk Management Tool</td>
</tr>
<tr>
<td>401</td>
<td>Forecast risk of loss at the portfolio level</td>
</tr>
<tr>
<td>402</td>
<td>Forecast actual loss at the loan level</td>
</tr>
<tr>
<td>403</td>
<td>Tool to manage the bank’s loan loss allowance.</td>
</tr>
<tr>
<td>404</td>
<td>Other</td>
</tr>
<tr>
<td>500</td>
<td>No Stress Testing</td>
</tr>
<tr>
<td>501</td>
<td>Lack of understanding</td>
</tr>
<tr>
<td>502</td>
<td>Too sophisticated to complete.</td>
</tr>
<tr>
<td>503</td>
<td>Not required by regulators.</td>
</tr>
<tr>
<td>504</td>
<td>Not necessarily given loss history.</td>
</tr>
<tr>
<td>505</td>
<td>Lack of internal and external resources</td>
</tr>
<tr>
<td>600</td>
<td>Other not mentioned above.</td>
</tr>
<tr>
<td>601</td>
<td>Clear but not relevant</td>
</tr>
<tr>
<td>602</td>
<td>Unclear</td>
</tr>
</tbody>
</table>
# APPENDIX F – DATA COLLECTED SPREADSHEET

## FDIC CALL

### Data

K.T. Carvalho

FDIC Cert. #:

<table>
<thead>
<tr>
<th></th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
</tr>
</thead>
</table>

## Income Statement

Revenue

Net Income

## Balance Sheet

Total Assets

Total Capital

CRE Total Assets

Commercial Loan Assets

Construction Loan Assets

Other RE Loan Assets

Risk Weighted Assets

## Problem Loan Levels

Charge-offs and Recoveries

Past Due & Nonaccrual Loans

Provision

Pre-Pandemic: 2019

2018

Post Pandemic: 2021

2020

Current:

Notes:
Commercial loan assets are commercial loans that are not secured by real estate.
Construction loan assets include both 1 to 4 family residential and other construction loans.
Other loan assets include residential mortgages and consumer home equity loans.

Website source: View or download data for individual institutions - FFIEC Central Data Repository’s Public Data Distribution


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Federal Deposit Insurance Corporation Supervisory Insights (April 2022). Managing Commercial Real Estate Concentrations. FDIC: Supervisory Insights - Managing Commercial Real Estate Concentrations


