Risk-shifting, Regulation and Government Assistance

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Abstract

This paper examines an episode when policy response to a financial crisis effectively incentivized financial institutions to reallocate their portfolios toward safe assets. Following a shift to a regime of enhanced regulation and scaled-down public assistance during the Savings and Loans (S&L) crisis in 1989, S&Ls with a high probability of failure increased their composition of safe assets relative to S&Ls with a low probability of failure. The shift to safe assets is also observed among stock S&Ls relative to mutual S&Ls, thereby showing evidence of risk-shifting from equity-holders to debt-holders of stock S&Ls prior to the regulatory reforms. These findings show that credible signals to shareholders around government assistance will be crucial for the policies aimed at reducing moral hazard (such as the Orderly Liquidation Authority under Title II of the Dodd-Frank Act) to succeed. This paper identifies the effect of the policy change by developing a new Bayesian estimation method for causal studies.

1 Introduction

When public funds are deployed to bail out distressed banks in periods of crises, policymakers have to contend with the moral hazard effects of their interventions not only on the institutions

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that directly benefit from the rescue, but on the wider banking system. Theoretical models have outlined the role of ex-ante probabilities of bailouts on bank risk-taking, thereby illustrating their role in decisions of ongoing concerns besides the failed banks that were assisted. However, the focus of empirical studies of government interventions has been the behavior of banks that were the direct recipients of these programs. This paper uses a natural experiment from the U.S. Savings and Loans crisis to examine the impact of changes in bailout policy on the broader set of institutions whose incentives shifted while not being direct recipients of bailouts themselves, namely, operational Savings and Loans institutions (S&Ls or thrifts[1]) at risk of failure. In examining the specific mechanisms that drive the responses to changes in bailout policy, this paper uncovers the prominent role of risk-shifting from equity-holders to debt-holders by comparing stock-owned and mutual thrifts.

A fallout of the Savings and Loans Crisis in the U.S. was the bankruptcy of the deposit insurer, the Federal Savings and Loans Insurance Corporation (FSLIC) in 1989 and the institution of the Resolution Trust Corporation (RTC) in its place. The FSLIC performed the dual role of deposit insurer and resolution agency in the thrift industry, in a manner analogous to the Federal Deposit Insurance Corporation (FDIC) in the banking industry. Whereas the FSLIC undertook one of three actions upon the failure of a Savings and Loans institution (S&L), namely, 1) the provision of financial assistance, 2) the facilitation of the acquisition of the failed S&L by a healthy institution and 3) the liquidation of the failed institution, the RTC discontinued the provision of assistance to failed S&Ls and all resolutions involved either one of the two latter actions. This shift in resolution from 1989 regime is evident in Figure 1. The overall shift toward increased regulation of banks and thrifts and stricter treatment of distressed thrifts was reinforced by the passage of the Financial Institutions Reform, Recovery, and Enforcement Act (FIRREA) in 1989. This new legislation introduced capital requirements and restrictions on the asset composition of S&L institutions and defined a period of increased regulatory oversight within the industry.

[1] S&L institutions are also referred to as thrifts

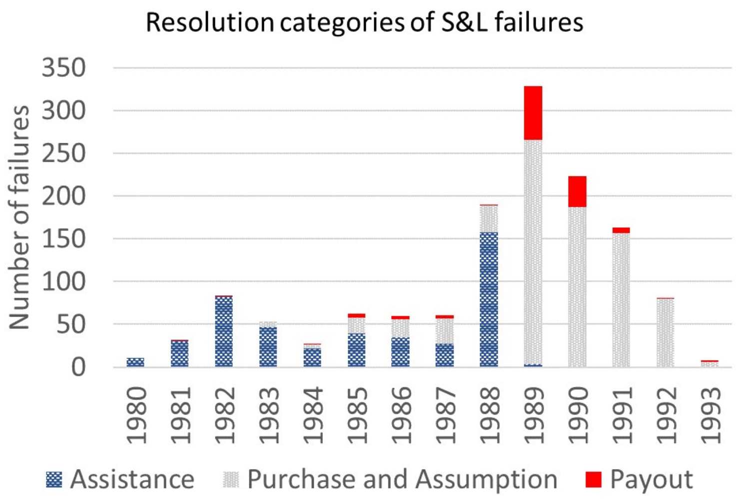


Figure 1: Distribution of failed thrifts across time and by resolution type

This paper examines the impact of the change in the thrift regulation and resolution regime on the composition of the balance sheets of operational thrifts. The empirical analysis in this paper consists of two main lines of enquiry. First, I examine the types of institutions that respond to this regime change. Previous theoretical literature suggests that thrift institutions facing elevated probabilities of failure or those flagged by regulators as troubled institutions are more likely to respond to the change in resolution regime (Acharya and Yorulmazer, 2007; Cordella and Yeyati, 2003). I empirically test this theoretical prediction by using a latent class model to identify institutions that responded to the regime change and subsequently evaluate the direction of the change in thrift balance sheets. Secondly, I investigate the differences between the responses of stock and mutual S&L to the enhanced regulatory and resolution regime. This analysis provides insights into the relevance of the organizational structure of S&L institutions as an operative mechanism in shifting the incentives of such institutions and in ensuring the effectiveness of the new regulatory regime.

This paper provides several new insights into the behavior of thrift institutions following the closure of the FSLIC and the creation of the RTC during the Savings & Loans crisis by studying the impact of the regulatory changes on a broad range of components of the balance sheet. Previous research on policy changes affecting deposit insurance and bank resolution has focused on the risk-taking behavior that primarily measured the composition of high-risk loans in the balance sheets of these institutions.

In order to address the two research questions, this paper develops a Bayesian method for causal inference by incorporating the difference-in-difference strategy into the potential outcome framework developed by Rubin (1978). The adoption of a potential outcomes approach that jointly models treatment assignment and outcomes enables the relaxation of the assumptions of exogeneity of the treatment to the outcome at baseline and of parallel slopes across the treated and control groups. A further salient feature of this model is its applicability in cases where the treatment status of individual units is unobserved such as in the current context where it is not possible to directly specify treated and control groups based on observables. This dimension of missing information is addressed with a latent class model, which assigns a probability of each unit belonging to the two groups and therefore determines the clusters of institutions that responded most strongly to the treatment. The combination of the two enhancements extends the applicability of a difference-in-difference strategy into applied studies that may not necessarily meet the assumptions in the standard model. The longitudinal model developed here can also be applied in the special case where only one period of outcome is recorded before and after treatment. Simulation exercises demonstrate that the MCMC algorithm developed in this paper accurately recovers the true values of all the estimated parameters. The discussion illustrates the scope for detailed inferences based on the entire posterior distributions of the Average Treatment Effect.

In addressing the first research question concerning the differential responses of thrifts based on risk of failure, I make use of the model with the latent treatment assignment mechanism since the riskiness of thrifts is not directly observed on the basis of a single variable. Instead, this approach involves using the financial statement variables that have been demonstrated to be important predictors of the CAMEL score in Collier et al. (2003) as covariates in the latent treatment assignment model. Previous theoretical studies (Cordella and Yeyati, 2003) predict two potential responses of thrift risk-taking to the elimination of government assistance to failed institutions. The dominance of moral hazard effects of government assistance would result in an increase in risk-taking in the regime in which such assistance was available and consequently, in a decline in risk-taking when such assistance was discontinued. Alternatively, franchise value of effects of such assistance would result in diminished risk-taking while the policy was in place and an uptake in risk-taking following its discontinuance. The main finding from this analysis is that thrifts at a high risk of failure prior to the policy change increased the composition of safe assets such as Securities and decreased the composition of high-risk loans such as Commercial and Industrial (C&I) loans and Construction, Land and Development (CLD) loans. A sub-category of institutions, characterized by a high stock of high-risk loans in their books prior to the policy change increased their intake of Multifamily Real Estate Loans, which is also a category of high-risk loans. The Average Treatment Effect (ATE) for Securities at 5.2% exceeded the ATE for all other types of assets. This reveals the importance of the moral hazard effect associated with government assistance to failed institutions.

The second estimation exercise, namely, the assessment of the differential responses of mutual and stock thrifts to the policy change, is motivated by theoretical literature on risk-shifting incentives of equity-holders in the presence of debt (Jensen and Meckling, 1976; John et al., 1991; Myers, 1977). Equity-holders of stock thrifts hold leveraged investments with a potential to shift risk to debt-holders whereas depositor-owners in mutual thrifts bear risks that cannot be shifted. The equity-holders' claim to the assets of a firm has previously been equated to that of a call option on the value of the assets, whose value increases with increased volatility in the value of the firm. Correspondingly, Merton (1977) showed that deposit insurance can be viewed is a put option on the value of a bank's assets where the strike price is the promised value of the debt on its maturity. The value of this put option can be maximized by increasing asset risk or minimizing the capital to assets ratio and effectively transfer wealth from the insuring agency to the equity-holders.

The empirical strategy in studying the differences in balance sheet compoisiton of the two types of thrifts involves considering the organizational form as exogenous to the response to the policy change as considered in Esty (1997). The Average Treatment Effect (ATE) for Securities, as with the analysis on high-risk institutions, registered a higher magnitude than for all the other components of the balance sheet. The increased accumulation of these safe and liquid assets by stock institutions relative to mutual institutions following the policy change provides evidence in favor of risk-shifting by equity-holders prior to the policy change. This conclusion is further supported by the decline in high-risk assets such as Multifamily Real Estate Loans among stock institutions relative to mutual institutions across the two years before and after the the announcement of the FSLIC's closure in 1989. An increase in the composition of Construction and Land Development (CLD) Loans and Investment in Real Estate by stock thrifts relative to mutual thrifts also provides evidence of substitution across sub-categories of such "high-risk"[2] assets. Overall, the results show that stock institutions considered in this analysis would have lent an additional \$2.14 billion and reduced their holdings of securities by \$4.5 billion in the absence of the regime change brought about the FSLIC's closure. These institutions also shift away from relatively volatile sources of funding such as Brokered Deposits and into stable funding sources such as Time Deposits. These findings provide new insights into the ways in which depository institutions adjust their portfolio in response to a change in the resolution and regulation regime.

Prior studies have focused on the differential responses of stock and mutual thrifts to various changes in regulation and have not specifically addressed the natural experiment arising from the change in resolution policy following the closure of the FSLIC. Esty (1997) find evidence for increased risk-taking among stock thrifts over the period 1982-1988, when the measures for deregulation introduced in the legislation from the early and mid-1980's was operative. Barth et al. (1995) found similar evidence of greater risk-taking among stock thrifts relative to mutual thrifts until 1989. Other empirical studies on the relationship between bank regulation and risk-taking examined the role of the ownership structure of thrift institutions. Knopf and Teall (1996) examined the impact of the Financial Institutions Reform, Recovery and Enforcement Act of 1989 (FIRREA) between thrift ownership structure and risk-taking. The author found evidence of augmented levels of risk-taking among insider-controlled thrifts relative to widely-owned institutions and that such risk-taking was restrained subsequent to the passage of FIRREA. Cebenoyan et al. (1999) examined risk-taking in stock thrift institutions over the period 1986-1995 and found support for the moral-hazard hypothesis as thrifts with low charter values in their sample undertook greater risk during 1986-1988, when regulations were more permissive than the subsequent period. Saunders et al. (1990) find evidence of increased risk-taking among stockholder controlled banks relative to manager-controlled banks during 1979-1982, which was a period of relative deregulation in the banking industry.

[2]The loan categories are included under the group of High Risk loans within the variable LNHRSKR in the FDIC's database of Thrift Financial Reports

The article is organized as follows: Section 2 provides a background to the role of the FSLIC, the legislation governing the S&L industry in the 1980's and the nature of the change in policy effected in 1989. Section 3 develops the empirical specification by building from the potential outcome framework and incorporating the difference-in-difference principle within it. This section also includes an efficient MCMC sampling algorithm to estimate the equations jointly. Section 4 details the various datasets used in this study, their source and a set of descriptive statistics. Section 5 provides the results of the model, Section 6 performs counterfactual analysis based on the treatment model and Section 7 provides concluding remarks.

2 Background

S&L institutions or thrifts were first established in the 19^{th} century to meet the social goal of homeownership at a time when banks did not finance residential mortgages (Robinson, 2013).[3] While these institutions were originally organized by groups of individuals who pooled their savings and lent money to members toward the purchase of homes, they evolved to operate like small banks with a concentration of assets in mortgage loans. Among the nearly 4,000 thrifts in operation in 1980, 80% of their total assets of $600 billion were held in mortgage loans (FDIC, 1997).

The thrift industry was subject to federal regulation that was distinct from that of commercial and mutual savings banks and legislation within the industry was guided by the overarching objective of fostering home ownership. The Federal Home Loan Bank Act of 1932 established the Federal Home Loan Bank System to provide liquidity and low-cost financing to thrifts. This system consisted of 12 regional Home Loan Banks and was supervised by the three-member Federal Home Loan Bank Board (FHLBB). The Home Owners' Loan Act of 1933 authorized the FHLBB to charter and regulate federal thrifts. The FSLIC was established under the National Housing Act of 1934 to provide federal deposit insurance for deposits in thrift institutions and serve as the resolution agency for failed thrifts. The FSLIC was instituted within the FHLBB, effectively placing the chartering and insurance functions for thrifts within the same

[3]The first S&L was established in Pennsylvania in 1831.

agency, unlike in the case of commercial and mutual savings banks whose insurer, the FDIC was independent of the chartering authorities.

The period from 1980-1982 was marked by the failure of 118 thrift institutions that cost the FSLIC $3.5 billion to resolve. The high interest rates of the early 1980's and the resulting interest rate risk arising from the mismatch in the maturity of assets and liabilities were recognized as the driving force behind the financial fragility of these institutions. The legislative response to the failures of thrifts was to deregulate the thrift industry and provide forbearance to weak thrifts. These approaches were codified within the Depository Institutions Deregulation and Monetary Control Act of 1980 (DIDMCA) and the Garn-St Germain Depository Institutions Act of 1982. The previous statutory net worth requirement of 5 percent of insured accounts was replaced by DIDMCA with a range of between 3 to 6 percent of insured accounts. Garn-St Germain further relaxed capital requirements by granting the authority to the FSLIC to determine a level of capital that would be deemed satisfactory. The DIDMCA phased out interest rate ceilings on time and savings deposits over a six year period Kaufman et al. (1981) and increased federal deposit insurance from $40,000 to $100,000 per account. DIDMCA expanded the authority of federally chartered thrifts to make acquisition, development, and construction (ADC) loans and Garn-St Germain eliminated the previous statutory limit on loan-to value ratios, effectively permitting thrifts to provide high-risk loans that financed the full appraised value of a project.

The deregulation and forbearance enshrined in the legislation of the early 1980's resulted in a period of rapid asset growth of 56% among thrift institutions over the period 1982-1985. During this period, the portfolio of thrift assets shifted from traditional mortgage loans into other riskier loan categories such as ADC loans. The FHLBB followed lax supervisory and examination practices during this period, including relocating its Ninth District from Little Rock, Arkansas to Dallas, Texas in 1983, which resulted in a decline in the number of examinations by a third. State-charted institutions were subject to particularly lenient supervisory standards in states such as California, Florida and Texas. The FHLBB was restricted by its policy of waiting until an institution was insolvent under the Regulatory Accounting Principles (RAP) standard, which was a more lax accounting standard than the GAAP and this delayed closure of failed thrifts. Furthermore, the agency lacked the resources to close the 71 institutions that were RAP-insolvent at the end of 1984 and the number of failed institutions steadily grew to 227 within two years. The FSLIC was declared insolvent by the U.S. General Accounting Office in 1986 (White, 1990). The Competitive Equality Banking Act of 1987 authorized the FSLIC to borrow up to $10.825 billion but these additional funds proved to be inadequate to resolve failed institutions. This reflected in insolvent thrifts remaining in operation for longer periods of time so that by 1988, thrifts that were resolved by the FSLIC had already been insolvent for an average of 42 months. The FSLIC was faced with 250 insolvent thrifts, with $80.8 billion in assets, under the RAP standard by the end of 1988.

On February 6, 1989, President George H. W. Bush announced proposals for legislation to effect reforms in the regulation of the thrift industry in response to the widespread failures among thrifts and the insolvency of the FSLIC (FDIC, 1998). The proposal recommended the abolition of the Federal Home Loan Bank Board (FHLBB) as the regulator of savings and loan institutions and its replacement with a single chairman under the Treasury Department. The insurer of thrift institutions, the Federal Savings and Loan Insurance Corporation (FSLIC), was to be dissolved and subsequently merged with the FDIC. The FDIC was to manage separate funds for thrifts and commercial banks. The proposal also called for the creation of the Resolution Trust Corporation (RTC) to close or sell the thrifts declared insolvent between January 1, 1989 and August 8, 1992 (the end date was later extended to September 30, 1993 and subsequently to June 30, 1995).[4]

These proposals resulted in the Financial Institutions Reform, Recovery, and Enforcement Act (FIRREA) of 1989, which was passed on August 9, 1989. The legislation authorized the creation of the Savings Association Insurance Fund (SAIF), which was placed under the FDIC's administration, to insure deposits in savings associations. FIRREA also established the Office of Thrift Supervision to replace the FHLBB in examining and supervising thrifts and their holding companies. This legislation also imposed stricter capital requirements that consisted of (i) A core capital ratio of 3%, (ii) tangible-capital-to-assets ratio of 1.5% and (iii) minimum risk-based capital requirements that are no less stringent than the standards applied to national banks

[4] BUSH SAVINGS PLAN CALLS FOR SHARING THE COST BROADLY; Big Sale Of Bonds, New York Times, 7 February, 1989

(Laderman, 1990; FDIC, 1997). Banks that could not meet capital adequacy requirements were mandated to obtain FDIC approval before accepting brokered deposits (FDIC, 1997). The provisions on the asset side of the balance sheet specified that secured nonresidential real property loans could be held by thrifts up to 400% of their capital. The statute also restricted S&L's from holding any junk bonds. The period since 1989 has been recognized as a period of increased stringency in thrift regulation. In particular, the FIRREA has been termed in FDIC (1997) as legislative "reregulation", which contrasted with the previous deregulatory legislation of the early and mid-1980's.

3 Model

This model offers two salient extensions to the potential outcome framework of Rubin (1978) applied in longitudinal settings (Chib and Hamilton, 2000, 2002; Chib and Jacobi, 2007). First, the standard joint model of treatment assignment and potential outcomes is extended into a difference-in-difference framework so that the treated and control groups are observed before and after the assignment of a treatment and not solely in the post-treatment period. Secondly, the treatment status of individual units in this model is unobserved and this dimension of missing information is addressed with a latent class model, which assigns a probability of each unit belonging to the two groups. The assignment of individual units into treatment categories occurs only once in the first period and is maintained for the rest of the sample period as considered in Chib and Jacobi (2007) but considers an alternative specification for the covariance matrix relative to the previous study. This section describes the ways in which enhancements developed in this model address estimation challenges for the problem on thrift risk-taking studied in this paper.

The difference-in-difference estimation method in econometric studies (Lester (1946), Campbell et al. (1963), Ashenfelter and Card (1984)) uses the assumption of a parallel trend for treated and control units to estimate the level of the counterfactual for the treated group in the absence of treatment. Whereas the assumption of parallel trends and the absence of a relationship between the outcome at baseline and assignment of treatment can be restrictive, this estimation framework permits the consideration of treated and control units that are not entirely exchangeable since their outcomes evolve at different levels. In the model developed in this paper, the empirical design of utilizing treatment and control samples evolving at distinct levels is retained while relaxing the assumptions of a parallel trend and independence of the baseline outcome and treatment assignment.

Consider n thrifts and T time periods each in the pre-treatment and post-treatment periods so that the full sample comprises of $2T$ time periods. In period 1, long-term financial characteristics FC_i of thrifts determine the probability with which they are safe and risky. Let R_i be the unobserved indicator that determines whether a thrift is risky or safe. In the following discussion, thrift i are considered to be risky when $R_i = 1$ and safe when $R_i = 0$. This notation serves to exemplify the structure of the model without loss of any generality. In practice, the classes are labeled as "safe" or "risky" depending on the sign of coefficients pertaining to covariates indicative of financial strength such as the 5-year capital ratio and the ratio of non-performing loans to assets. Let R_i^* be the latent continuous variable underlying the discrete indicator R_i so that,

$$R_i^* = FC_i'\alpha + \epsilon_{1i}, \;\; \epsilon_{1i} \sim \mathcal{N}(0,1), \tag{1}$$

$$R_i = \begin{cases} 0, R_i^* \leq 0 \\ 1, R_i^* > 0 \end{cases} .$$

The primary outcome of interest measures thrift risk-taking and is the change in high risk loans as a percent of total assets $\Delta RT_{it} = RT_{it}/A_{it} - RT_{it-1}/A_{it-1}$, which is modeled as a function of covariates X_{it} that consist of thrift (B_{it}), state (St_{it}) and county characteristics (C_{it}).

The full sample of outcomes and covariates is divided into pre-treatment ($\Delta RT_{0it}, X_{0it}$) and post-treatment ($\Delta RT_{1it}, X_{1it}$) observations for $t = 1, 2, ..., T$. The pre-treatment period starts at period 1 and contains observations until period T whereas the post-treatment period starts at period $T + 1$ and ends in period $2T$, thus resulting in T observations in both periods. Even though both time periods need not be equal in length in the general specification of this model, the special case of equal periods is considered in order to ensure symmetry in the informational content of the two periods. The three sets of (observed and latent) outcomes and covariates are combined into the vector y_{it} and the matrix $\mathbf{X}_{it}$ respectively.

$$y_{it} = \begin{pmatrix} R_i^* \\ \Delta RT_{0it} \\ \Delta RT_{1it} \end{pmatrix}, \ \mathbf{X}_{it} = \begin{pmatrix} FC_i \\ X_{0it} \\ X_{1it} \end{pmatrix}, \ i = 1, 2, .., n, \ \ t = 1, 2, .., T.$$

Since class assignment occurs only once in period 1, R_i^* and FC_i are replaced by vectors of zeros when $t > 1$.

The latent class model introduced by Heckman and Singer (1984) and applied across diverse areas such as Greene and Hensher (2003), Deb and Trivedi (2002) and Carson et al. (1994) attributes different distributions to the outcome depending on class membership. Accordingly, this structure entails a separate equation for each risk-group in the pre-treatment and post-treatment periods and the resulting equations are summarized below.

$$\text{Pre-treatment, safe thrifts:} \quad \Delta RT_{0it} = X'_{0it}\beta_2 + \epsilon_{2it} \tag{2}$$

$$\text{Post-treatment, safe thrifts:} \quad \Delta RT_{1it} = X'_{1it}\beta_3 + \epsilon_{3it} \tag{3}$$

$$\text{Pre-treatment, risky thrifts:} \quad \Delta RT_{0it} = X'_{0it}\beta_4 + \epsilon_{4it} \tag{4}$$

$$\text{Post-treatment, risky thrifts:} \quad \Delta RT_{1it} = X'_{1it}\beta_5 + \epsilon_{5it} \tag{5}$$

A multivariate normal distribution is specified for the errors from the three outcomes in y_{it}. The means of the observations under the two latent classes arising from Equations 1 - 5 are summarized below.

$$\mu_{s,it} = \begin{pmatrix} FC_i'\alpha \\ X'_{0it}\beta_2 \\ X'_{1it}\beta_3 \end{pmatrix}, \ \mu_{r,it} = \begin{pmatrix} FC_i'\alpha \\ X'_{0it}\beta_4 \\ X'_{1it}\beta_5 \end{pmatrix}.$$

The covariance matrix in this set-up is unique as the determination of class membership in period 1 implies that the relationship across the class-membership and outcome variables exists only in period 1. This eliminates any relationship between the errors pertaining to the outcomes from the post-treatment period and class-membership indicators and therefore precludes the scope for the undue inflation of treatment effects due to classes that are determined based on post-treatment differences. Notably, the incorporation of contemporaneous covariances between the class assignment model and the outcome in the pre-treatment period is one of the factors that distinguish this model from a standard difference-in-difference model, which assumes independence across these entities. Moreover, this model allows for covariances across the pre-treatment and post-treatment periods for the two groups. The covariances of errors across the risky and safe groups are provided below.

$$\Omega_s = \begin{pmatrix} 1 & \Omega_{12} & 0 \\ \Omega_{12} & \Omega_{22} & \Omega_{23} \\ 0 & \Omega_{23} & \Omega_{33} \end{pmatrix}, \quad \Omega_r = \begin{pmatrix} 1 & \Omega_{14} & 0 \\ \Omega_{14} & \Omega_{44} & \Omega_{45} \\ 0 & \Omega_{45} & \Omega_{55} \end{pmatrix}.$$

The covariance terms of errors from equations (1)-(5) can be combined to obtain the matrix Ω.

$$\Omega = \begin{pmatrix} 1 & \Omega_{12} & 0 & \Omega_{14} & 0 \\ \Omega_{12} & \Omega_{22} & \Omega_{23} & \centerdot & \centerdot \\ 0 & \Omega_{23} & \Omega_{33} & \centerdot & \centerdot \\ \Omega_{14} & \centerdot & \centerdot & \Omega_{44} & \Omega_{45} \\ 0 & \centerdot & \centerdot & \Omega_{45} & \Omega_{55} \end{pmatrix}.$$

The covariance terms across the latent classes are not identified and are replaced with "$\centerdot$" since a thrift belongs to only one of the two mutually exclusive categories within an MCMC iteration.

In decomposing the joint distribution of y_{it}, the standard approach in latent class models involves considering the marginal of the latent outcome R_i^* and the conditional of the observed outcomes $[\Delta RT_{0it}\ \Delta RT_{1it}]|R_i^*$. However, on account of the unique covariance structure of this model in which Ω_{12} and Ω_{14} apply only in period $t = 1$, the decomposition into the conditional, $R_i^*|[\Delta RT_{0it}\ \Delta RT_{1it}]$ and the marginal, $[\Delta RT_{0it}\ \Delta RT_{1it}]$ is more tractable.

Define $\mu_{R_{s,i}^*|RT}$, $\mu_{R_{r,i}^*|RT}$, $\Omega_{R_s^*|RT}$ and $\Omega_{R_r^*|RT}$ as the conditional mean and covariance of R_i^* conditional on the other two outcomes within y_{it} under the two latent classes. The outcomes and covariates pertaining exclusively to the continuous risk-taking outcome specified with a "$\centerdot$"

in the subscript in order to identify marginal distributions.

$$y_{it\cdot} = \begin{pmatrix} \Delta RT_{0it} \\ \Delta RT_{1it} \end{pmatrix}, \quad \mathbf{X}_{it\cdot} = \begin{pmatrix} X_{0it} \\ X_{1it} \end{pmatrix}.$$

The mean and variance components corresponding to $y_{it\cdot}$ under the two latent classes are,

$$\mu_{s,it\cdot} = \begin{pmatrix} X'_{0it}\beta_2 \\ X'_{1it}\beta_3 \end{pmatrix}, \quad \mu_{r,it\cdot} = \begin{pmatrix} X'_{0it}\beta_4 \\ X'_{1it}\beta_5 \end{pmatrix}.$$

and

$$\Omega_{s\cdot} = \begin{pmatrix} \Omega_{22} & \Omega_{23} \\ \Omega_{23} & \Omega_{33} \end{pmatrix}, \quad \Omega_{r\cdot} = \begin{pmatrix} \Omega_{44} & \Omega_{45} \\ \Omega_{45} & \Omega_{55} \end{pmatrix}.$$

The likelihood function is then obtained as follows,

$$\begin{aligned} f(y|\mu_s, \mu_r, \Omega_s, \Omega_r) = \prod_{i=1}^{n} \Bigg[\prod_{t=1}^{T} \Big\{ & P(R_i = 0|\mu_{R^*_{s,i}|RT}, \Omega_{R^*_s|RT}) f_{\mathcal{N}}(y_{it\cdot}|\mu_{s,it\cdot}, \Omega_{s\cdot}) + \\ & P(R_i = 1|\mu_{R^*_{r,i}|RT}, \Omega_{R^*_r|RT}) f_{\mathcal{N}}(y_{it\cdot}|\mu_{r,it\cdot}, \Omega_{r\cdot}) \Big\} \Bigg]. \end{aligned} \tag{6}$$

Independent multivariate normal priors are assigned to the coefficients α and $\boldsymbol{\beta} = \{\beta_2, \beta_3, \beta_4, \beta_5\}$. The covariance matrices Ω_s and Ω_r are assigned Inverse Wishart priors, which are independent of priors assigned to the coefficients.

$$f(\alpha, \boldsymbol{\beta}, \Omega_s, \Omega_s) = f(\alpha) f(\boldsymbol{\beta}) f(\Omega_s) f(\Omega_r),$$

where, $f(\alpha) = f_{\mathcal{N}}(\alpha|\alpha_0, A_0)$ and $f(\boldsymbol{\beta}) = f_{\mathcal{N}}(\boldsymbol{\beta}|\beta_0, B_0)$. The priors on the covariance matrices are parametrized as $f(\Omega_p) = f_{\mathcal{IW}}(\Omega_p|\nu, Q)$ for $p = s, r$.

On augmenting the likelihood in 6 with the latent continuous variable R^*_i, the augmented posterior for this model can be represented as follows,

$$f(\Theta|y) \propto \prod_{i=1}^{n} \prod_{t=1}^{T} \sum_{p=s,r} \Big\{ \mathbf{1}(S_i = p) f_{\mathcal{N}}(R^*_{p,i}|\mu_{R^*_{p,i}|RT}, \Omega_{R^*_p|RT}) f_{\mathcal{N}}(y_{it\cdot}|\mu_{p,it\cdot}, \Omega_{p\cdot}) \Big\} f(\alpha, \boldsymbol{\beta}, \Omega_s, \Omega_s),$$

where $S_i = s$ when $R_i = 0$ and $S_i = r$ when $R_i = 1$.

3.1 MCMC Algorithm

The steps in the estimation of the model are summarized as follows:

1. Sample $\theta = [\alpha, \boldsymbol{\beta}]$ from the distribution $\theta|\Omega, y, R^*$.

2. Sample Ω from $\Omega|\theta, y, R^*$ in one block by partitioning into sub-matrices.

3. Sample R_i^* from $R_i^*|\theta, R, \Omega$ for $i = 1, 2, ..., n$.

4. Sample R_i from $R_i|\theta, y, R^*, \Omega$ for $i = 1, 2, ..., n$.

The estimation algorithm follows other algorithms (Chib et al. (2009), Vossmeyer (2016)) involving joint modeling of outcomes without generating the counterfactual outcomes $y_{it}^* = [\Delta RT_{0it}^* \; \Delta RT_{1it}^*]'$ in the estimation of parameters. The counterfactual outcomes will be subsequently discussed in the computation of treatment effects. The steps of the estimation algorithm are discussed in detail below.

3.2 Sampling coefficients: θ

The coefficients $\theta = [\alpha, \boldsymbol{\beta}]$ are sampled in a single step by stacking the covariates and outcomes from Equations 1 - 5 in a seemingly unrelated regressions setup(Zellner, 1962). Let n_1 and n_2 denote the number of thrifts in the safe and risky classes respectively. $\mathbf{X}_{s,it}$ selects the rows for which $R_i = 0$ and $\mathbf{X}_{r,it}$ corresponds to rows that satisfy $R_i = 1$. The outcomes $y_{s,it\boldsymbol{.}}$ and $y_{r,it\boldsymbol{.}}$ are similarly categorized. Define $z_{it} = [R_i^* \; y_{s,it\boldsymbol{.}} \; y_{r,it\boldsymbol{.}}]'$, the vector of latent and observed outcomes. The matrices are constructed as follows,

$$\mathbf{X}_{s,it} = \begin{pmatrix} FC_i & \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & X_{0it} & \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & X_{1it} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \end{pmatrix}, z_{s,it} = \begin{pmatrix} R_i^* \\ \Delta RT_{0it} \\ \Delta RT_{1it} \\ \mathbf{0} \\ \mathbf{0} \end{pmatrix}, \quad i \in n_1.$$

$$\mathbf{X}_{r,it} = \begin{pmatrix} FC_i & \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \mathbf{0} & X_{0it} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \mathbf{0} & \mathbf{0} & X_{1it} \end{pmatrix}, z_{r,it} = \begin{pmatrix} R_i^* \\ \mathbf{0} \\ \mathbf{0} \\ \Delta RT_{0it} \\ \Delta RT_{1it} \end{pmatrix}, \quad i \in n_2.$$

When $t > 1$, FC_i and R_i^* are replaced by vectors of zeros. The parameters of the posterior distribution $\mathcal{N}(\hat{\theta}, \hat{T})$ are obtained as follows,

$$\begin{aligned} \hat{\theta} &= \hat{T} \left(T_0^{-1}\theta_0 + \sum_{i \in n_1} \sum_{t=1}^{T} \mathbf{X}'_{s,it} \Omega^{-1} z_{s,it} + \sum_{i \in n_2} \sum_{t=1}^{T} \mathbf{X}'_{r,it} \Omega^{-1} z_{r,it} \right), \\ \hat{T} &= \left(T_0^{-1} + \sum_{i \in n_1} \sum_{t=1}^{T} \mathbf{X}'_{s,it} \Omega^{-1} \mathbf{X}_{s,it} + \sum_{i \in n_2} \sum_{t=1}^{T} \mathbf{X}'_{r,it} \Omega^{-1} \mathbf{X}_{r,it} \right)^{-1}. \end{aligned}$$

θ_0 and T_0 contain the hyperparameters of the components of θ in the same order so that, $\theta_0 = [\alpha_0 \;\; \beta_0]$ and $T_0 = [A_0 \;\; B_0]$.

3.3 Sampling the covariance matrix: Ω

The covariance matrix can be sampled by sampling sub-matrices of Ω across several steps based on algorithms used in Chib et al. (2009), Vossmeyer (2016) and Li (2011). As highlighted previously, the covariance terms Ω_{12} and Ω_{14} only arise within the first period and other variance and covariance terms apply to mutually exclusive sub-groups that vary in size across MCMC iterations. The sampling algorithm addresses these features of the model by making appropriate enhancements to previous algorithms from the literature.

The subcomponents $\Omega_{tt.s} = \Omega_{tt} - \Omega_{ts}\Omega_{ss}^{-1}\Omega_{st}$ and $B_{st} = \Omega_{ss}^{-1}\Omega_{st}$ will be used in the partitioning of the matrix. The hyperparameter Q of the Inverse Wishart distribution is of dimension 3×3 as the sampling algorithm only requires considering submatrices of dimension 3 at a time.

The sampling of the components of Ω requires the introduction of the matrices $\mathrm{R}^p = Q + \sum_i \sum_t \eta^*_{p,it}\eta^{*\prime}_{p,it}$ and their associated conditional matrices $\mathrm{R}^p_{tt.l} = \mathrm{R}^p_{tt} - \mathrm{R}^p_{tl}(\mathrm{R}^p_{ll})^{-1}\mathrm{R}^p_{lt}$, where, $\eta^*_{p,it} = y_{p,it} - \mu_{p,it}$ for $p = s, r$.

The steps in the estimation of Ω are outlined below.

Class of safe thrifts:

1. $\Omega_{22.1} \sim \mathcal{IW}(\nu + n_1, \mathrm{R}^s_{22.1})$
2. $\Omega_{22} \sim \mathcal{IW}(\nu + nT_1, \mathrm{R}^s_{22})$, where $nT_1 = n_1 \cdot T$.
3. $B_{12} \sim \mathcal{N}((\mathrm{R}^s_{22})^{-1}\mathrm{R}^s_{21}, (\mathrm{R}^s_{22})^{-1}\Omega_{22.1})$ to obtain Ω_{12}
4. Define $\Omega_s = \begin{pmatrix} 1 & \Omega_{12} \\ \Omega_{12} & \Omega_{22} \end{pmatrix}$
5. $\Omega_{33.s} \sim \mathcal{IW}(\nu + nT_1, \mathrm{R}^s_{33.s})$
6. $B_{s3} \sim \mathcal{N}((\mathrm{R}^s_{22})^{-1}\mathrm{R}^s_{23}, (\mathrm{R}^s_{22})^{-1}\Omega_{33.s})$ to obtain Ω_{23} and Ω_{33}

Class of risky thrifts:

1. $\Omega_{44.1} \sim \mathcal{IW}(\nu + n_2, \mathrm{R}^r_{22.1})$
2. $\Omega_{44} \sim \mathcal{IW}(\nu + nT_2, \mathrm{R}^r_{22})$, where $nT_2 = n_2 \cdot T$.
3. $B_{14} \sim \mathcal{N}((\mathrm{R}^r_{22})^{-1}R_{21}, (\mathrm{R}^r_{22})^{-1}\Omega_{44.1})$ to obtain Ω_{14}
4. Define $\Omega_r = \begin{pmatrix} 1 & \Omega_{14} \\ \Omega_{14} & \Omega_{44} \end{pmatrix}$
5. $\Omega_{55.r} \sim \mathcal{IW}(\nu + nT_2, \mathrm{R}^r_{33.r})$
6. $B_{r5} \sim \mathcal{N}((\mathrm{R}^r_{22})^{-1}\mathrm{R}^r_{23}, (\mathrm{R}^r_{22})^{-1}\Omega_{55.r})$ to obtain Ω_{45} and Ω_{55}

3.4 Sampling latent variable R^*

The latent continuous outcomes are sampled from the conditional truncated normal distribution $\mathcal{TN}_{(-\infty,0)}(\mu_{R^*_{s,i}|RT}, \Omega_{R^*_s|RT})$ for $R_i = 0$ and $\mathcal{TN}_{(0,\infty)}(\mu_{R^*_{r,i}|RT}, \Omega_{R^*_r|RT})$ for $R_i = 1$. The parameters of the conditional posterior distribution are derived by conditioning on the continuous outcomes $y_{it\cdot}$ when $t = 1$.

3.5 Sampling Class Membership indicator R^*_i

The class membership indicators R_i for $i = 1, 2, ..., n$ are sampled from a Bernoulli distribution with probability of success (K_i) where,

$$K_i = \frac{\Phi(\mu_{R^*_{r,i}|RT}, \Omega_{R^*_r|RT})P_{2,i}}{(1-\Phi(\mu_{R^*_{s,i}|RT}, \Omega_{R^*_s|RT}))P_{1,i} + \Phi(\mu_{R^*_{r,i}|RT}, \Omega_{R^*_r|RT})P_{2,i}},$$

where,

$$P_{2,i} = f_{\mathcal{N}_2}\left(y_{it\cdot}|\mu_{r,it\cdot}, \Omega_{r\cdot}\right)$$

and

$$P_{1,i} = f_{\mathcal{N}_2}\left(y_{it\cdot}|\mu_{s,it\cdot}, \Omega_{s\cdot}\right).$$

3.6 Simulation Results

Table 1 provides results for a simulation exercise based on $n = 10000$ and $T = 4$ and shows that the estimation algorithm accurately recovers the true values of the parameters. Figure 8 shows the distribution of the control and treated groups across the pre-treatment and post-treatment periods. This figure illustrates that while the treated and control groups may be centered around distinct baseline means, it is the varying magnitude of change in the means across the two periods that is of inferential interest.

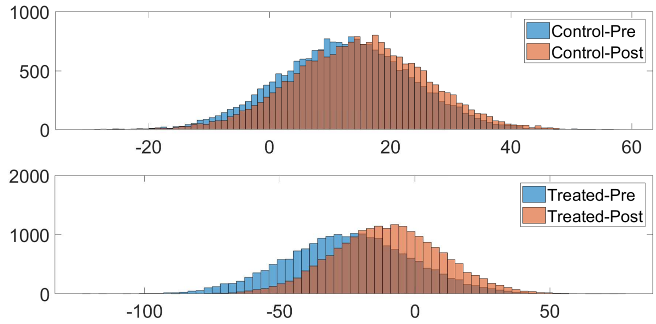


Figure 2: Distribution of treatment and control samples in the pre-treatment and post-treatment periods

Table 1: Simulation results based on 10000 post burn-in posterior draws

	Post. Mean	Post. Std	True Values
	Class Membership		
α_1	0.30	0.02	0.30
α_2	-0.51	0.02	-0.50
α_3	0.60	0.02	0.60
α_4	-0.89	0.02	-0.90
	Class 1: Pre-treatment		
$\beta_{2,1}$	2.00	0.00	2
$\beta_{2,2}$	5.00	0.00	5
$\beta_{2,3}$	2.99	0.02	3
$\beta_{2,4}$	1.02	0.03	1
	Class 1: Post-treatment		
$\beta_{3,1}$	2.00	0.00	2
$\beta_{3,2}$	5.00	0.00	5
$\beta_{3,3}$	3.99	0.02	4
$\beta_{3,4}$	2.02	0.03	2
	Class 2: Pre-treatment		
$\beta_{4,1}$	-10.00	0.00	-10
$\beta_{4,2}$	-6.00	0.00	-6
$\beta_{4,3}$	-2.99	0.02	-3
$\beta_{4,4}$	-4.02	0.03	-4
	Class 2: Post-treatment		
$\beta_{5,1}$	-9.99	0.00	-10
$\beta_{5,2}$	1.00	0.00	1
$\beta_{5,3}$	1.97	0.02	2
$\beta_{5,4}$	-3.97	0.03	-4
	Covariance matrix		
$\Omega_{1,2}$	-0.22	0.02	-0.20
$\Omega_{1,4}$	0.18	0.02	0.20
$\Omega_{2,2}$	0.79	0.01	0.80
$\Omega_{2,3}$	0.10	0.01	0.10
$\Omega_{3,3}$	0.77	0.01	0.75
$\Omega_{4,4}$	0.78	0.01	0.80
$\Omega_{4,5}$	0.09	0.01	0.10
$\Omega_{5,5}$	0.74	0.01	0.75

3.7 Treatment Effects

Treatment effects are computed by extending the method for this computation described in Chib and Hamilton (2002) in two main directions. First, the treatment effects are extended into the difference-in-difference framework so that differences are calculated both across the two latent classes and across the pre-treatment and post-treatment periods. Secondly, the treatment effects are computed so that the static nature of class membership indicators across time is addressed.

As a first step, average values of observed and counterfactual outcomes are computed for each thrift i in the sample.

$$y_{s,mi} = \begin{cases} \frac{1}{T}\sum_{t=1}^{T}\left(\Delta RT_{mit}\right) \ \text{when} R_i = 0, \\ \frac{1}{T}\sum_{t=1}^{T}\left(\Delta RT^{*}_{mit}\right) \ \text{when} R_i = 1, \end{cases} \qquad \text{for } m = 0, 1.$$

$$y_{r,mi} = \begin{cases} \frac{1}{T}\sum_{t=1}^{T}\left(\Delta RT^{*}_{mit}\right) \ \text{when} R_i = 0, \\ \frac{1}{T}\sum_{t=1}^{T}\left(\Delta RT_{mit}\right) \ \text{when} R_i = 1, \end{cases} \qquad \text{for } m = 0, 1.$$

The treatment effect for each observation is then computed as follows,

$$\delta_i = (y_{r,1i} - y_{r,0i}) - (y_{s,1i} - y_{s,0i}) \ \text{for } i = 1, 2, ..., n.$$

The thrift-level treatment effect is then utilized to compute the average mean treatment effect by averaging over the G MCMC iterations as follows,

$$\bar{\delta} = \frac{1}{Gn}\sum_{g=1}^{G}\sum_{i=1}^{n}\delta_i^{(g)}$$

Since the full distribution of δ is obtained from the MCMC runs, summary statistics in addition to the mean such as percentiles and measures of dispersion can also be directly obtained. The contribution of each individual observation towards the treatment effect as part of the safe (control) or risky (treated) groups is implicitly weighted by the probability of belonging to each of these groups since the class membership indicator R_i changes for each of the G MCMC iterations. The Average Treatment Effect in the following discussion refers to the average mean treatment effect $\bar{\delta}$.

4 Data

The model in Section 3 has been applied on quarterly Thrift Financial Reports obtained from the FDIC. The outcome of interest is the change in the composition of categories of assets and liabilities as a ratio of total assets on a year-on-year basis. The covariates are various ratios of financial condition computed using data from the Thrift Financial Reports from one year prior to the outcome. The summaries of the data utilized in the analysis are provided in the tables below.

The sample consists of 1022 thrifts that were retained from the universe of federally insured thrifts after applying the following exclusions:

1. Thrifts that change across mutual and stock categories during the period 1986Q1-1990Q4.
2. De novo thrifts.
3. Foreign charters.
4. Acquired and acquiring thrifts.
5. Thrifts that failed prior to 1989.

The covariates for the latent class model as measured of 1987Q1. The outcomes for the pre-treatment and post-treatment periods are measured over 1987Q1-1988Q4 and 1989Q1-1990Q4. The institutions for which any of the outcomes or covariates of interest are missing are further excluded to obtain 1015 institutions and 8120 thrift-quarters.

Table 2: *Descriptive statistics of covariates from the latent class treatment assignment model*

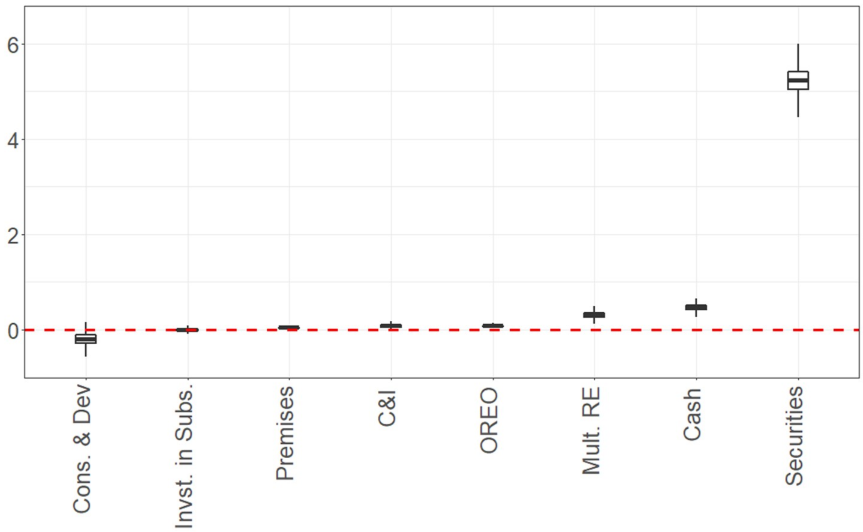
	Mean	Std. dev.	Min	Max
CI Ratio 5yr	0.01	0.02	0.00	0.26
CLD Ratio 5yr	0.05	0.10	0.00	1.28
Cons Ratio 5yr	0.05	0.05	0.00	0.49
RE Ratio 5yr	0.97	0.09	0.53	2.49
Loan Loss Res Ratio	0.00	0.01	-0.02	0.07
Int. Receivable	0.00	0.00	0.00	0.02
Size (‘000s USD)	98,107	158,114	1,110	2,339,848
Cap Ratio 5yr	0.07	0.03	-0.03	0.25
Sec Ratio 5yr	0.27	0.16	0.00	0.91
Undiv Profit 5yr	0.06	0.04	-0.12	0.25
Vol Liab 5yr	0.08	0.08	0.00	0.58
Cr Concen	0.12	0.13	0.00	1.05

Table 3: *Descriptive statistics of covariates from the treatment model*

	Pre-treatment				Post-treatment			
	Mean	Std. dev.	Min	Max	Mean	Std. dev.	Min	Max
CI Ratio	0.01	0.03	-0.55	0.77	0.01	0.02	0.00	0.37
Int. Receivable	0.00	0.00	0.00	0.03	0.01	0.00	0.00	0.02
Size(‘ooos USD)	97,710	157,879	1,061	2,405,318	112,258	195,041	1,129	2,870,261
Cap. Ratio	0.07	0.04	-0.05	0.56	0.07	0.03	-0.10	0.29
Earnings	0.01	0.01	-0.05	0.04	0.00	0.00	-0.06	0.05
Oper. Lev.	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.03
Age	65.03	29.26	0.00	153.00	67.03	29.26	2.00	155.00
State Econ. Dist. Indicator	0.10	0.29	0.00	1.00	0.10	0.29	0.00	1.00
Fed. Charter	0.42	0.49	0.00	1.00	0.43	0.50	0.00	1.00

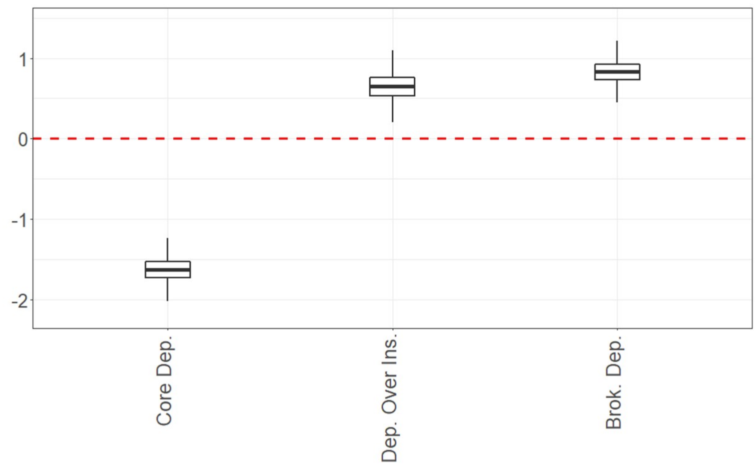
Table 4: *Descriptive statistics of outcomes from the treatment model*

	Pre-treatment				Post-treatment			
	Mean	Std. dev.	Min	Max	Mean	Std. dev.	Min	Max
% Δ C&I Ratio	0.05	1.05	-13.96	25.91	0.01	0.77	-12.71	12.78
% Δ Multifamily Loan Ratio	0.05	2.12	-20.73	35.29	-0.01	1.55	-30.05	17.47
% Δ Cons. & Land Dev. Ratio	-0.06	3.67	-83.33	56.81	-0.20	2.56	-38.90	23.01
% Δ Core Dep. Ratio	-0.56	4.54	-41.10	60.54	0.40	4.10	-67.05	32.34
% Δ Securities Ratio	-0.14	6.57	-75.15	70.68	-4.52	7.63	-64.28	36.10
% Δ Dep. Over Ins. Ratio	0.05	3.22	-62.18	27.74	0.03	2.54	-23.74	70.97
% Δ Cash Ratio	-0.21	1.67	-43.99	23.76	-0.01	0.98	-10.12	42.14
% Δ Premises Ratio	0.02	0.39	-4.53	5.22	0.02	0.34	-3.35	5.82
% Δ Bro. Dep. Ratio	0.08	1.46	-35.52	42.14	-0.05	1.67	-34.93	29.42
% Δ OREO Ratio	0.04	0.60	-4.93	7.18	0.02	0.64	-6.32	7.90
% Δ Invst. In RE Ratio	0.00	0.70	-29.35	11.78	-0.02	0.55	-12.31	12.31
% Δ Invst. In Subs. Ratio	0.00	0.60	-10.67	13.70	0.00	0.74	-22.28	22.68
% Δ Oth. Assets Ratio	-0.04	0.94	-23.67	25.07	-0.01	0.81	-27.84	14.95



	Cons. & Dev.	Invst. in Subs.	Premises	C&I	OREO	Mult. RE	Cash	Securities
Positive coefficients	CLD Ratio 5yr	Cons Ratio 5yr Size 5yr Vol Liab 5yr	Size 5yr Sec Ratio 5yr Undiv Profit 5yr		Size 5yr Sec Ratio 5yr Undiv Profit 5yr	CLD Ratio 5yr	CI Ratio 5yr CLD Ratio 5yr Cap Ratio 5yr	Size 5yr Undiv Profit 5yr
Negative coefficients	Size 5yr Sec Ratio 5yr		CI Ratio 5yr Cons Ratio 5yr Cap Ratio 5yr Vol Liab 5yr	CI Ratio 5yr Cons Ratio 5yr Size 5yr Credit Concen.	Loan Loss Res Ratio Int. Receivable Credit Concen.	Credit Concen.	Size 5yr Undiv Profit 5yr	Loan Loss Res Ratio Cap Ratio 5yr Sec Ratio 5yr Vol Liab 5yr

Figure 3: Box plot of the posterior distribution of Average Treatment Effects for categories of assets. The accompanying table lists the characteristics that were statistically important in determining the treated group for each of the outcomes along with the direction of the coefficient of these characteristics.



	Core Dep.	Dep. Over Ins.	Brok. Dep.
Positive coefficients	Size 5yr Undiv Profit 5yr	Cap Ratio 5yr Vol Liab 5yr	Sec Ratio 5yr
Negative coefficients	CLD Ratio 5yr Cap Ratio 5yr Vol Liab 5yr	Size 5yr Undiv Profit 5yr	Cap Ratio 5yr Vol Liab 5yr Credit Concen.

Figure 4: Box plot of the posterior distribution of Average Treatment Effects for categories of liabilities. The accompanying table lists the characteristics that were statistically important in determining the treated group for each of the outcomes along with the direction of the coefficient of these characteristics.

5 Results

The tables accompanying Figures 3 and 4 provide an overview of the classification achieved from the latent class model within the model structure developed in Section 3. These figures identify those covariates that were statistically important viz., covariates whose two-standard deviation credibility interval lies solely within the positive or negative region of the real line. The covariates used in the class membership model are five-year averages of the categories of financial characteristics used in developing the CAMEL score (Collier et al., 2003). The use of long-term averages results in classification based on intrinsic financial health rather than based on movements in the balance sheet at a point in time that might themselves have been influenced by the policy change. Therefore, these long-term averages serve as instruments while studying subsequent changes in the various components of the balance sheet. The results show that average size, profit over assets and ratio of volatile liabilities to total liabilities are statistically important determinants of latent classes of thrifts that respond heterogeneously to the change in resolution methods and deposit insurance provider.

Figure 3 represents the Average Treatment Effect for each of the asset classes. The ATE for Securities has the largest magnitude relative to the ATE for all the other components of the balance sheet. The table underlying this figure shows that the treated group in the model for Securities consists of large, profitable thrifts with low levels of loss reserves, capital and securities ratios as well as a low ratio of volatile liabilities. These results provide evidence in favor of the moral hazard effects of government guarantees. The policy changes that engendered a more conservative approach to the insurance and resolution of thrifts resulted in high-risk thrifts accumulating additional securities, which are considered to be an asset class that is both safe and liquid, relative to low-risk thrifts.

The other two categories of assets with a statistically important ATE are Cash and Multi-family real estate loans. The treated group in the model for Cash are small, weakly-profitable thrifts with high five-year average ratios of Commerical & Industrial Loans, Construction, Land and Development Loans and Capital to total assets. Since these institutions accumulated a stock of high-risk loans over time, they responded to the policy change by accumulating additional stock of cash relative to the thrifts with lower ratios of high-risk loans to total assets. The category of institutions that increase their share of Multifamily Real Estate Loans or the treated group consists of thrifts with a high ratio of Construction, Land and Development Loans to total assets and those with low levels of Credit Concentration. Therefore, this group of institutions consists of thrifts that had previously acquired elevated levels of a high-risk category of loans but did not carry loans that had large exposures to a single borrower in their balance sheets.

On the liabilities side of the balance sheet, the ATE for Brokered Deposits, Core Deposits and Deposits over the Insurance Limit are all statistically important. The table accompanying Figure 4 reveals that the treated group or the institutions that increased their composition of Brokered Deposits and decreased their composition of Core Deposits are highly leveraged thrifts with a low proportion of volatile liabilities. The treated group for Core Deposits additionally includes big banks with a high profit ratio. The treated group for Brokered Deposits is defined by banks with a high ratio of Securities to total assets as well as high levels of Credit Concentration. The treated group for Deposits over the Insurance Limit is composed of small banks with high capital ratios, low profit ratios and high levels of volatile liabilities, which is the complement of the treated group for Core Deposits. This analysis reveals that large, highly leveraged banks underwent a decline in the change of both Core Deposits and Deposits over Insurance Limit to total liabilities relative to small, well-capitalized banks following the FSLIC's closure. This decline in deposit growth in weakly capitalized institutions is consistent with expected shifts in deposits from the closure of the incumbent insuring agency. The movements of growth in Brokered Deposits in the opposite direction reflect the speculative nature of these deposits.

5.1 Risk-shifting among Stock Thrifts

In assessing the magnitude of risk-shifting among stock thrift institutions, I apply the model from Section 3 on outcomes defined in Section 4 by considering stock thrifts and mutual thrifts to be the treated and control groups respectively. I consider organizational structure to be exogenous to the outcome in line with Esty (1997). As a result, Equation 1 for treatment assignment mechanism is excluded from the model and the remaining four equations within

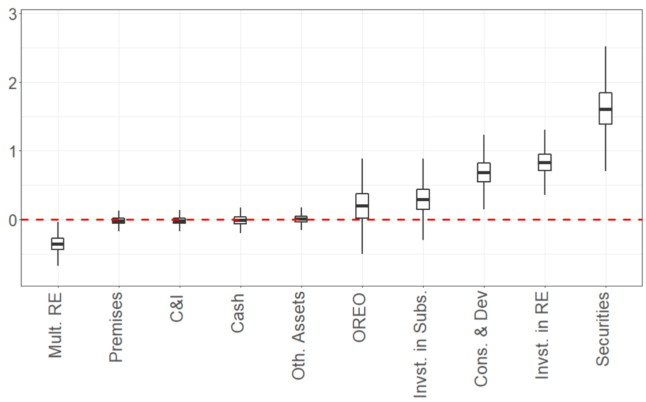


Figure 5: Box plot of the posterior distribution of Average Treatment Effects for categories of assets

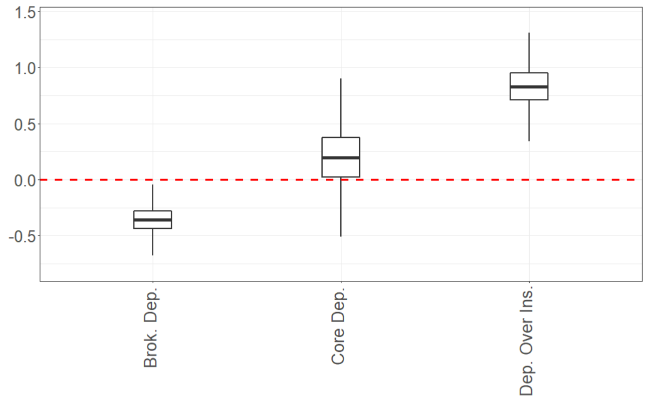


Figure 6: Box plot of the posterior distribution of Average Treatment Effects for categories of liabilities

Equations 2 - 5 that pertain to the outcome in the pre-treatment and post-treatment periods are estimated.

Figures 5 and 6 summarize the posterior distributions of the Average Treatment Effects for the various categories of assets and liabilities in the balance sheets of stock and mutual thrift institutions. The differences in the change in composition of Securities in the balance sheet of stock and mutual institutions is statistically important, as evidenced by the distribution of the treatment effect for this asset category. Securities held for investment are considered to be low-risk and liquid assets (Balla et al., 2015; Cole and White, 2012). The relative increase in the proportion of these assets among stock institutions is indicative of risk-shifting by equity-holders prior to the policy change.

Figure 5 also shows that on average, stock institutions assumed lower percentages of Multifamily Real Estate Loans relative to mutual institutions across the two years before and after the the announcement of the FSLIC's closure in 1989. However, The composition of Investments in Real Estate within the thrift's own balance sheet and Construction and Land

Development loans increased among stock institutions relative to their mutual counterparts following the policy announcement. This is consistent with the growing trend in real estate lending across the banking industry starting in the early 1990's (Bassett and Marsh, 2017). This finding also provides evidence in favor of substitution across categories of high-risk loans. The ATE for Commercial and Industrial Loans is statistically close to zero. The composition of Other Real Estate Owned or repossessed real estate shows a statistically unimportant relative increase among stock thrifts. This component of the balance sheet is subject to factors beyond the decisions made by thrift stockholders and managers as it depends on the performance of previously booked loans. The treatment effect pertaining to repossessed real estate highlights the elevated risk inherent among loans booked by stock thrifts relative to mutual institutions.

The remaining components within Figure 5 reveal that the ATE for Cash, Premises, Investment in Subsidiaries and the asset category labeled as Other Assets (financial assets, accrued interest and other repossessed assets) are not statistically important.

Figure 6 shows that the ATE for Core Deposits is not statistically important and that the change in the composition of these deposits among stock thrifts was not statistically different from that of mutual institutions. Conversely, the figure shows that stock institutions increased their reliance on Time Deposits over the standard insurance limit and decreased the composition of Brokered Deposits on their balance sheets. This shows a shift toward a financing structure based on more longer-term liabilities and the paring down of financing sources that are speculative in nature.

5.2 Posterior Estimates for High-risk Loans

This section details the results from the estimation of equations 2 - 5 when we jointly consider changes in the composition of C&I, CLD and Multifamily RE Loans by aggregating these categories into the variable "High Risk Loans". These three categories of loans are included within the definition of high-risk loans (LNHRSKR) generated within the FDIC's database of Thrift Financial Reports.

Tables 5 and 6 provide the posterior estimates for the coefficients and elements of the covariance matrices respectively. This estimation is based on the bank-level variables summarized in Table 5 as well as bank fixed effects and state and county-level control variables. These control variables cover a broad range of indicators that represent economic performance, the condition of the real-estate market as well as bank competition at the local level. The state-level controls consist of unemployment, mortgage delinquencies, building permits and house price index. The sector-wise composition of employment as well as the Herfindahl-Hirschman Index (HHI) are included as county-level controls.

Table 5: Posterior mean and standard deviation of parameters in the model with change in High-risk Loans Ratio as the outcome

	Mutual Pre-1989		Mutual Post-1989		Stock Pre-1989		Stock Post-1989	
	Post. Mean	Post. SD	Post. Mean	Post. SD	Post. Mean	Post. SD	Post. Mean	Post. SD
Constant	0.099	0.036	-0.098	0.027	-0.035	0.162	0.059	0.143
Cap. Ratio	-0.216	0.093	-0.143	0.051	0.141	0.110	0.187	0.083
Age	0.132	0.071	0.101	0.036	0.443	0.306	0.178	0.180
Oper. Lev.	0.120	0.048	0.112	0.034	-0.118	0.106	-0.005	0.103
log(Size)	0.022	0.072	0.006	0.047	-0.152	0.129	-0.148	0.091
CI Ratio	-0.100	0.066	-0.182	0.042	-0.001	0.076	0.006	0.064
Int. Receivable	-0.007	0.038	-0.005	0.027	-0.014	0.113	-0.120	0.098
Earnings	0.023	0.044	0.026	0.031	-0.097	0.135	0.057	0.100
Bank Fixed Effects, State-level and County-level controls								

Table 6: Posterior mean and standard deviation of elements of the covariance matrix

	Post. Mean	Post. SD
Ω_{11}	7.595	0.133
Ω_{12}	-1.085	0.070
Ω_{22}	3.932	0.070
Ω_{33}	7.595	0.133
Ω_{34}	-8.310	0.806
Ω_{44}	24.775	0.903

The posterior moments of the coefficients in Table 5 reveal a consistent pattern of differences in the responses of stock and mutual thrifts to the same change in bank-level ratios. The change in composition of high-risk loans in response to a unit change in the capital ratio provides evidence of altered incentives among equity-holders of stock thrifts across the pre-treatment and post-treatment periods. Previous theoretical literature finds that since the option value of deposit insurance decreases with the capital-asset ratio (Keeley and Furlong, 1990; Furlong and Keeley, 1989), banks that are well-capitalized have an incentive to assume lower levels of asset risk. This behavior is evident among mutual thrifts, which lower the composition of high-risk loans in their balance sheets, both before and after the announcement of the policy change.

Jeitschko and Jeung (2005) describe moral hazard incentives for shareholders to assume higher levels of risk across all levels of capital when assets are High Risk High Return or those with a Mean Preserving Spread. Prior to the policy change, stock thrifts registered a statistically weak positive coefficient for the capital ratio and a statistically important, positive relationship following the change. These changes in the composition of high-risk loans are consistent with the mechanism involving moral hazard. Subsequent to the announcement of the closure of the FSLIC, thrifts continued to assume higher levels of high-risk loans as the possibility of thrift insurance moving into the FDIC's authority was also concurrently proposed.

Bank age is positively related to the change in the composition of high-risk loans among stock and mutual thrifts in both periods. This relationship is not statistically important for mutual thrifts. Esty (1997) found a negative relationship between the age of thrift institutions and risk-taking as younger thrifts had the resources to expand their portfolio of high-risk loans in the form of larger cash balances in the period 1982-1988. Since the pre-treatment and post-treatment periods in this study consist of outcomes from 1987-1988 and 1989-1990 respectively, the findings in this paper suggest a shift in the behavior of thrifts in the late 1980's that was marked by an expansion of high-risk loans in the portfolio of older institutions.

Operating leverage is calculated as the ratio of fixed costs to assets following Saunders et al. (1990). Mandelker and Rhee (1984) found that operating leverage, in a manner analagous to financial leverage, magnifies the systemic risk in common stock as measured by the capital asset pricing model. This paper finds a positive relationship between risk-taking and operating leverage among mutual thrifts in both periods, which is consistent with an expected positive relationship between financial leverage and risk-taking (Keeley and Furlong, 1990; Furlong and Keeley, 1989). Stock thrifts do not show evidence of such augmented risk-taking behavior in either of the two periods as the coefficient for operating leverage is negative but not statistically important in both cases.

Keeley (1990) identified the inverse relationship between bank franchise value and risk-taking. Since bank size is a measure of franchise value, this finding is further supported in this paper in the form of a decline in the composition of high-risk loans for a unit change in the logarithm of bank size for stock thrift institutions in the post-treatment period. This effect is only statistically important in the post-treatment period, further highlighting the shift in incentives of stock to preserve franchise value upon the failure of deposit insurance. The relationship between the size of mutual thrifts and their changes in the composition of high-risk loans is not statistically important in either of the two periods.

Higher ratios of Commercial and Industrial (CI) loans correspond to lesser risk-taking among mutual institutions across the pre-treatment and post-treatment periods. The CI loans ratio measures the stock of a broad sub-category of high-risk loans on the institutions' balance sheets while the outcome measures the change in the composition, or the 'flow' of this variable. The posterior estimates of coefficients reveal that mutual institutions with already high levels of this loan category decreased their intake of such assets whereas stock institutions did not show any such evidence of de-risking before or after the policy change, as revealed by the weak, negative coefficients on this variable.

Interest Receivable Ratio provides a measure of the credit risk inherent in the lending institution and has been found to be predictive of bank failure as well as loss to the regulatory agency subsequent to failure by Balla et al. (2015) and Bennett and Unal (2014). This relationship is negative and statistically important for stock institutions in the post-treatment period, showing evidence of thrifts with a high exposure to credit risk being limited in their ability to expand their portfolio of high-risk loans. It is notable that this relationship is not statistically important for mutual institutions in either of the two periods and for stock thrifts in the pre-treatment period. The weak coefficients on interest receivable highlight the relatively unconstrained portfolio optimization undertaken by these institutions during these periods as well as the constraints to the risks deemed acceptable by stock thrifts following the closure of the FSLIC.

The earnings ratio is positively correlated with the capital ratio for both groups of institutions and its coefficient is not statistically for either group in either period. Notwithstanding its weak explanatory power, its inclusion is merited in the model by virtue of its importance in explaining changes in the composition of the other elements of the balance sheet. The results for all the categories of assets and liabilities evaluated in this study are provided in the Appendix.

6 Counterfactual Analysis

This section presents a counterfactual analysis to evaluate the composition of the balance sheet in the absence of the risk-shifting effects of the closure of the FSLIC on stock institutions reported in Section 5.1. This involves imputing the trajectory of the mutual thrifts onto the pre-treatment outcomes of the stock thrifts. The values of the counterfactual outcomes in the post-treatment period are directly obtained from the estimation algorithm. The counterfactual values are obtained by performing the following calculation,

$$\Delta RT_{1i} = \Delta RT_{0i} + \left(\Delta RT^{co}_{1i} - \Delta RT^{co}_{0i}\right), \quad i = 1, 2, ..., n. \tag{7}$$

When institution i is a stock institution, its counterfactual values are obtained from the estimation algorithm. For mutual institutions, the counterfactual value is replaced by the observed change in ΔRT across the post-treatment and pre-treatment periods. Since ΔRT represents the change in the composition of individual categories assets and liabilities in the balance sheet,viz.,

$$\Delta RT_{it} = \frac{RT_{it}}{A_{it}} - \frac{RT_{it-1}}{A_{it-1}}$$

the counterfactual balance of these categories is derived as,

$$RT^{co}_{it} = A_{it} * \left(\frac{RT_{it-1}}{A_{it-1}} + \left(\Delta RT^{co}_{1i} - \Delta RT^{co}_{0i}\right)\right)$$

When the quantity in the parentheses in the equation above is negative due to numerical issues, it is replaced with zero. Hence, the computation of the counterfactuals in this Section represents a conservative upper bound to average changes. The results from this counterfactual analysis reveal that stock and mutual thrifts would have engaged in additional lending if the FSLIC had not closed down and been subsequently replaced by the RTC. The institutions within the sample considered for analysis would have lent an additional \$11 million in Multifamily real estate loans and reduced their holdings of Securities by \$22 million on average. These institutions would have also decreased lending under the categories of Construction and Land Development loans and increased C&I loans by an average of \$1.68 million and a less significant \$742,000 respectively. These values represent an aggregate of \$2.14 billion in foregone lending in the high-risk categories and an excess of $4.5 billion in accumulated Securities across the 207 stock institutions in the sample following the closure of the FSLIC.

7 Conclusion

This paper provides several new insights into the impact of the change in the resolution and regulatory regime for thrift institutions in 1989 on the changes in the composition of their balance sheets. The research question is addressed by developing a Bayesian method for causal inference by extending the potential outcome framework developed by Rubin (1978) into a difference-in-difference approach. This method also offers a technique to address unobserved treatment assignments by using latent classes as a clustering tool to identify the units that respond most to the treatment.

The first estimation exercise in this paper uses the latent class model to identify the types of thrift institutions that respond to the change in resolution and deposit insurance regime. The results show that the institutions that respond most strongly to the change are those that can be classified as high-risk institutions based on the elements considered in supervisory measures such as the CAMEL score. However, this exercise provides nuanced insights into these changes and reveals that subgroups of institutions that are highly leveraged and hold a high percentage of high-risk loans on their books but that have also been previously profitable are the institutions that shift into safe assets such as Securities following the regime change. The shift toward safe assets by high-risk institutions following the change provide evidence in favor of risk-taking that occurred prior to 1989 due to the moral hazard effects of government assistance to failed thrifts that was available under the FSLIC and eliminated under the RTC. There is also evidence of a substitution among different categories of real-estate loans and investments. High-risk thrifts are seen to increase their share of Multifamily Real Estate Loans but decrease their share of CLD loans. This is consistent with portfolio decisions by thrift institutions that prioritized maintaining overall expected returns while adjusting portfolio risk.

This paper also builds on previous research on the effect of organizational structure on risk-taking incentives and studies the differential response of stock and mutual thrifts to the announcement of the closure of the FSLIC. As in the previous analysis, the ATE for Securities registered a higher magnitude than for all the other components of the balance sheet. The increased accumulation of these safe and liquid assets by stock institutions relative to mutual institutions following the regime change provides evidence in favor of risk-shifting by equity-holders prior to the policy change. The substitution across categories of real-estate loans and investments is also observed in this exercise. Stock institutions are found to reduce the composition of Multifamily RE Loans and increase the composition of CLD Loans as well as investment in Real Estate on their own account. Moreover, this analysis also reveals a decline in Core Deposits and Deposits Over Insurance Limit for thrifts that were already highly leveraged. These findings provide new insights into the numerous dimensions in which depository institutions respond to changes in resolution policy and regulation and that have not been previously documented.

Counterfactual exercises reveal that on balance, stock institutions in the sample analyzed in this paper had foregone an aggregate of $2.14 billion in additional lending in commercial real-estate loans and increased accumulation of Securities to the tune of $4.5 billion relative to mutual institutions following the closure of the FSLIC. This shift in the balance sheet is consistent with risk-shifting by stockholders in FSLIC-regime and de-risking in the RTC-regime relative to depositor-owned mutual institutions. These findings show that the realignment of shareholder incentives is an important channel through which policy changes concerning deposit insurance and resolution can affect financial institution behavior. In the light of the passage of the Orderly Liquidation Authority of the Dodd-Frank Act that signals the unavailability of public assistance to financial institutions in the event of failure, this paper demonstrates that the internalization of such signals by shareholders will be crucial for the policy to succeed in its intended aim of curbing moral hazard effects associated with the expectation of assistance.

8 Appendix

Table 7: Posterior mean and standard deviation of parameters in the model with change in C&I Loans Ratio as the outcome

	Mutual Pre-1989		Mutual Post-1989		Stock Pre-1989		Stock Post-1989	
	Post. Mean	Post. SD	Post. Mean	Post. SD	Post. Mean	Post. SD	Post. Mean	Post. SD
Constant	0.016	0.009	-0.012	0.006	0.007	0.042	-0.040	0.040
CI Ratio	-0.068	0.016	-0.137	0.009	-0.079	0.020	-0.117	0.019
Int. Receivable	-0.009	0.009	0.004	0.006	0.002	0.029	-0.048	0.028
log(Size)	-0.017	0.017	0.003	0.011	-0.027	0.034	0.004	0.026
Cap. Ratio	-0.003	0.022	0.005	0.012	0.037	0.029	0.025	0.024
Earnings	-0.008	0.010	-0.001	0.007	0.022	0.035	0.030	0.029
Oper. Lev.	0.012	0.012	0.005	0.008	-0.024	0.027	-0.021	0.030
Age	0.012	0.017	0.009	0.008	-0.096	0.086	-0.046	0.052
Bank Fixed Effects, State-level and County-level controls								

Table 8: Posterior mean and standard deviation of parameters in the model with change in Construction and Land Development Loans Ratio as the outcome

	Mutual Pre-1989		Mutual Post-1989		Stock Pre-1989		Stock Post-1989	
	Post. Mean	Post. SD	Post. Mean	Post. SD	Post. Mean	Post. SD	Post. Mean	Post. SD
Constant	0.125	0.032	-0.127	0.022	-0.201	0.142	0.232	0.122
CI Ratio	-0.022	0.058	-0.036	0.035	0.058	0.064	0.080	0.055
Int. Receivable	0.011	0.034	-0.031	0.023	0.070	0.096	-0.066	0.083
log(Size)	0.032	0.063	-0.004	0.039	-0.028	0.111	-0.063	0.079
Cap. Ratio	-0.084	0.081	-0.063	0.042	0.198	0.093	0.187	0.071
Earnings	0.024	0.039	0.035	0.025	-0.079	0.114	-0.012	0.085
Oper. Lev.	0.094	0.042	0.091	0.028	-0.103	0.091	-0.028	0.089
Age	0.080	0.061	0.080	0.030	0.400	0.267	0.107	0.160
Bank Fixed Effects, State-level and County-level controls								

Table 9: Posterior mean and standard deviation of parameters in the model with change in Multifamily RE Loans Ratio as the outcome

	Mutual Pre-1989		Mutual Post-1989		Stock Pre-1989		Stock Post-1989	
	Post. Mean	Post. SD	Post. Mean	Post. SD	Post. Mean	Post. SD	Post. Mean	Post. SD
Constant	-0.037	0.015	0.036	0.014	0.130	0.089	-0.150	0.080
CI Ratio	-0.002	0.028	-0.002	0.022	-0.005	0.042	0.004	0.036
Int. Receivable	-0.006	0.016	0.020	0.014	-0.078	0.061	-0.010	0.055
log(Size)	-0.003	0.031	0.000	0.025	-0.130	0.070	-0.091	0.052
Cap. Ratio	-0.131	0.039	-0.089	0.027	-0.093	0.059	-0.038	0.047
Earnings	0.013	0.018	-0.005	0.016	0.053	0.075	0.058	0.057
Oper. Lev.	0.014	0.020	0.019	0.017	0.014	0.058	0.052	0.058
Age	0.038	0.030	0.016	0.019	0.165	0.174	0.151	0.103
Bank Fixed Effects, State-level and County-level controls								

Table 10: Posterior mean and standard deviation of parameters in the model with change in Cash Ratio as the outcome

	Mutual Pre-1989		Mutual Post-1989		Stock Pre-1989		Stock Post-1989	
	Post. Mean	Post. SD	Post. Mean	Post. SD	Post. Mean	Post. SD	Post. Mean	Post. SD
Constant	-0.106	0.018	0.101	0.010	-0.085	0.055	0.111	0.046
CI Ratio	0.427	0.032	0.039	0.016	0.005	0.026	0.045	0.021
Int. Receivable	0.070	0.019	0.031	0.010	-0.015	0.038	-0.007	0.032
log(Size)	0.046	0.035	0.017	0.018	-0.006	0.044	-0.048	0.030
Cap. Ratio	-0.129	0.045	-0.040	0.019	-0.091	0.038	-0.021	0.027
Earnings	0.018	0.022	0.030	0.012	-0.086	0.047	-0.002	0.033
Oper. Lev.	0.027	0.023	0.000	0.013	0.030	0.036	-0.056	0.033
Age	0.166	0.034	0.014	0.014	0.127	0.108	0.132	0.060
Bank Fixed Effects, State-level and County-level controls								

Table 11: Posterior mean and standard deviation of parameters in the model with change in Securities Ratio as the outcome

	Mutual Pre-1989		Mutual Post-1989		Stock Pre-1989		Stock Post-1989	
	Post. Mean	Post. SD	Post. Mean	Post. SD	Post. Mean	Post. SD	Post. Mean	Post. SD
Constant	2.333	0.067	-2.349	0.091	1.447	0.223	-1.613	0.229
CI Ratio	0.504	0.119	0.126	0.142	0.180	0.105	0.041	0.107
Int. Receivable	0.049	0.070	0.010	0.093	-0.017	0.153	-0.139	0.161
log(Size)	0.597	0.131	0.445	0.160	0.271	0.174	0.287	0.151
Cap. Ratio	0.329	0.166	0.351	0.172	-0.093	0.150	-0.341	0.137
Earnings	-0.252	0.081	-0.246	0.106	0.311	0.185	-0.040	0.167
Oper. Lev.	-0.007	0.087	-0.018	0.115	-0.254	0.147	-0.029	0.169
Age	0.045	0.128	0.000	0.124	0.205	0.398	-0.137	0.290
Bank Fixed Effects, State-level and County-level controls								

Table 12: Posterior mean and standard deviation of parameters in the model with change in Premises as a Ratio of Assets as the outcome

	Mutual Pre-1989		Mutual Post-1989		Stock Pre-1989		Stock Post-1989	
	Post. Mean	Post. SD	Post. Mean	Post. SD	Post. Mean	Post. SD	Post. Mean	Post. SD
Constant	0.017	0.009	-0.012	0.006	0.007	0.042	-0.040	0.040
CI Ratio	-0.068	0.016	-0.137	0.010	-0.079	0.020	-0.116	0.019
Int. Receivable	-0.009	0.009	0.003	0.006	0.001	0.030	-0.049	0.028
log(Size)	-0.017	0.017	0.003	0.011	-0.027	0.034	0.003	0.027
Cap. Ratio	-0.004	0.022	0.005	0.012	0.037	0.029	0.025	0.024
Earnings	-0.008	0.010	-0.001	0.007	0.021	0.036	0.030	0.029
Oper. Lev.	0.012	0.011	0.005	0.008	-0.023	0.028	-0.020	0.030
Age	0.012	0.017	0.009	0.008	-0.095	0.084	-0.045	0.053
Bank Fixed Effects, State-level and County-level controls								

Table 13: Posterior mean and standard deviation of parameters in the model with change in Investment in Subsidiaries Ratio as the outcome

	Mutual Pre-1989		Mutual Post-1989		Stock Pre-1989		Stock Post-1989	
	Post. Mean	Post. SD	Post. Mean	Post. SD	Post. Mean	Post. SD	Post. Mean	Post. SD
Constant	0.099	0.036	-0.098	0.027	-0.038	0.166	0.062	0.141
CI Ratio	-0.099	0.066	-0.182	0.042	0.000	0.076	0.004	0.064
Int. Receivable	-0.007	0.039	-0.005	0.027	-0.014	0.113	-0.121	0.099
log(Size)	0.023	0.073	0.006	0.047	-0.152	0.130	-0.149	0.091
Cap. Ratio	-0.216	0.092	-0.143	0.051	0.142	0.110	0.188	0.081
Earnings	0.022	0.045	0.026	0.031	-0.097	0.136	0.057	0.100
Oper. Lev.	0.121	0.048	0.112	0.034	-0.119	0.106	-0.005	0.102
Age	0.131	0.071	0.101	0.036	0.441	0.306	0.176	0.181
Bank Fixed Effects, State-level and County-level controls								

Table 14: Posterior mean and standard deviation of parameters in the model with change in Other Real Estate Owned Ratio as the outcome

	Mutual Pre-1989		Mutual Post-1989		Stock Pre-1989		Stock Post-1989	
	Post. Mean	Post. SD	Post. Mean	Post. SD	Post. Mean	Post. SD	Post. Mean	Post. SD
Constant	-0.466	0.042	0.480	0.039	-0.615	0.179	0.522	0.183
CI Ratio	-0.023	0.074	-0.003	0.062	-0.043	0.084	0.181	0.086
Int. Receivable	0.021	0.043	0.000	0.041	-0.043	0.124	-0.262	0.133
log(Size)	0.471	0.083	0.449	0.069	0.239	0.142	0.201	0.122
Cap. Ratio	0.110	0.105	0.041	0.074	0.042	0.120	-0.074	0.111
Earnings	-0.102	0.049	-0.127	0.045	-0.402	0.149	0.059	0.133
Oper. Lev.	0.042	0.054	-0.055	0.050	0.018	0.118	0.077	0.137
Age	-0.061	0.080	-0.061	0.053	-0.373	0.325	-0.191	0.241
Bank Fixed Effects, State-level and County-level controls								

Table 15: Posterior mean and standard deviation of parameters in the model with change in Core Deposit Ratio as the outcome

	Mutual Pre-1989		Mutual Post-1989		Stock Pre-1989		Stock Post-1989	
	Post. Mean	Post. SD	Post. Mean	Post. SD	Post. Mean	Post. SD	Post. Mean	Post. SD
Constant	-0.466	0.041	0.480	0.040	-0.615	0.177	0.523	0.185
CI Ratio	-0.021	0.074	-0.003	0.062	-0.046	0.085	0.181	0.088
Int. Receivable	0.021	0.043	0.000	0.041	-0.039	0.124	-0.262	0.130
log(Size)	0.472	0.081	0.449	0.070	0.237	0.142	0.199	0.123
Cap. Ratio	0.110	0.105	0.041	0.074	0.043	0.119	-0.075	0.111
Earnings	-0.101	0.050	-0.127	0.045	-0.400	0.149	0.063	0.136
Oper. Lev.	0.042	0.054	-0.053	0.049	0.019	0.118	0.073	0.138
Age	-0.059	0.079	-0.062	0.054	-0.371	0.331	-0.190	0.238
Bank Fixed Effects, State-level and County-level controls								

Table 16: Posterior mean and standard deviation of parameters in the model with change in Brokered Deposit Ratio as the outcome

	Mutual Pre-1989		Mutual Post-1989		Stock Pre-1989		Stock Post-1989	
	Post. Mean	Post. SD	Post. Mean	Post. SD	Post. Mean	Post. SD	Post. Mean	Post. SD
Constant	-0.037	0.015	0.036	0.014	0.131	0.089	-0.151	0.078
CI Ratio	-0.002	0.028	-0.002	0.022	-0.005	0.042	0.005	0.036
Int. Receivable	-0.006	0.016	0.020	0.014	-0.078	0.062	-0.011	0.055
log(Size)	-0.003	0.031	0.000	0.025	-0.129	0.071	-0.091	0.052
Cap. Ratio	-0.131	0.039	-0.089	0.026	-0.093	0.060	-0.038	0.047
Earnings	0.013	0.019	-0.004	0.016	0.052	0.075	0.057	0.057
Oper. Lev.	0.014	0.020	0.018	0.017	0.013	0.058	0.051	0.058
Age	0.038	0.030	0.016	0.019	0.167	0.174	0.151	0.103
Bank Fixed Effects, State-level and County-level controls								

Table 17: Posterior mean and standard deviation of parameters in the model with change in Deposit Over Insurance Ratio as the outcome

	Mutual Pre-1989		Mutual Post-1989		Stock Pre-1989		Stock Post-1989	
	Post. Mean	Post. SD	Post. Mean	Post. SD	Post. Mean	Post. SD	Post. Mean	Post. SD
Constant	0.112	0.027	-0.109	0.024	-0.315	0.130	0.292	0.119
CI Ratio	-0.011	0.048	-0.052	0.038	0.025	0.060	-0.065	0.055
Int. Receivable	-0.027	0.029	0.011	0.025	-0.046	0.088	0.148	0.083
log(Size)	-0.087	0.054	-0.064	0.041	0.104	0.102	0.010	0.078
Cap. Ratio	-0.088	0.068	-0.056	0.045	0.043	0.085	-0.018	0.070
Earnings	0.001	0.033	0.037	0.027	0.101	0.107	-0.038	0.084
Oper. Lev.	0.022	0.036	0.067	0.030	-0.066	0.085	-0.017	0.089
Age	0.014	0.052	0.077	0.032	0.435	0.244	0.215	0.154
Bank Fixed Effects, State-level and County-level controls								

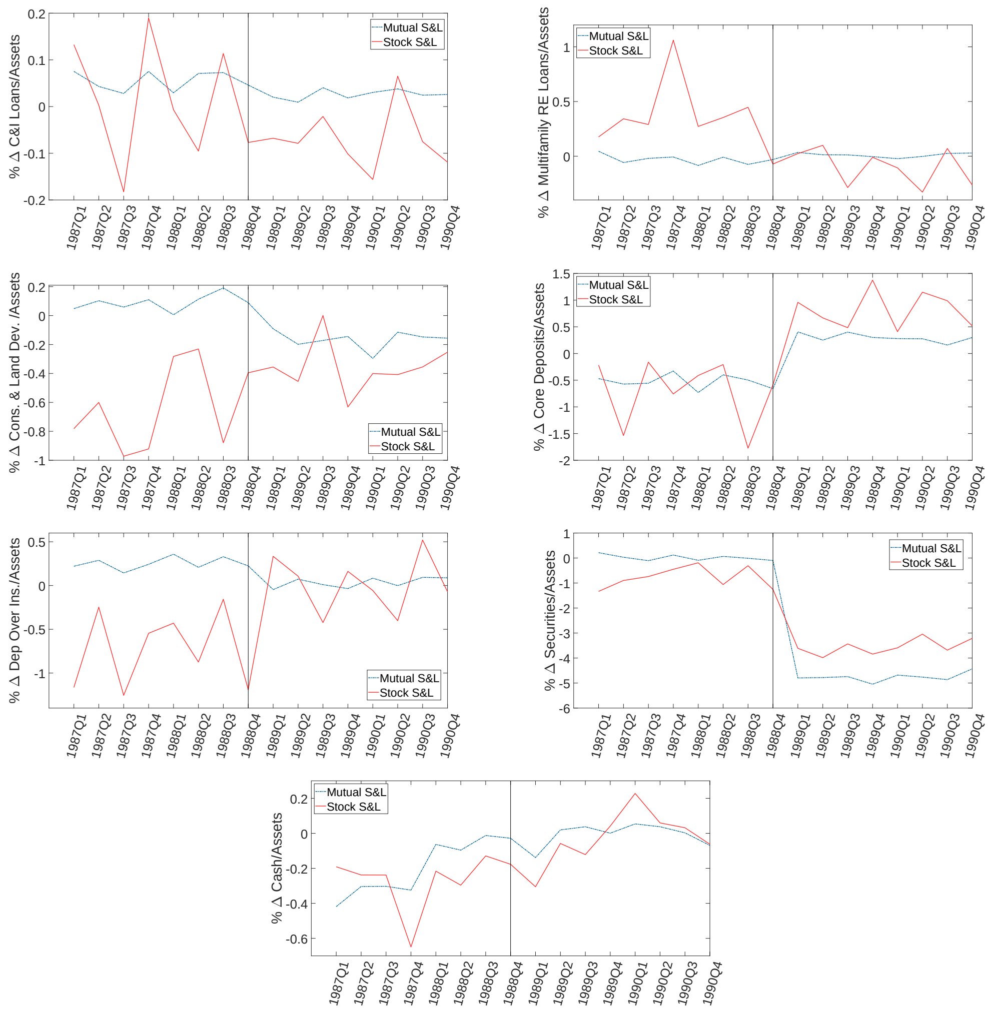


Figure 7: Distribution of changes in the composition of balance sheet components among stock and mutual thrifts

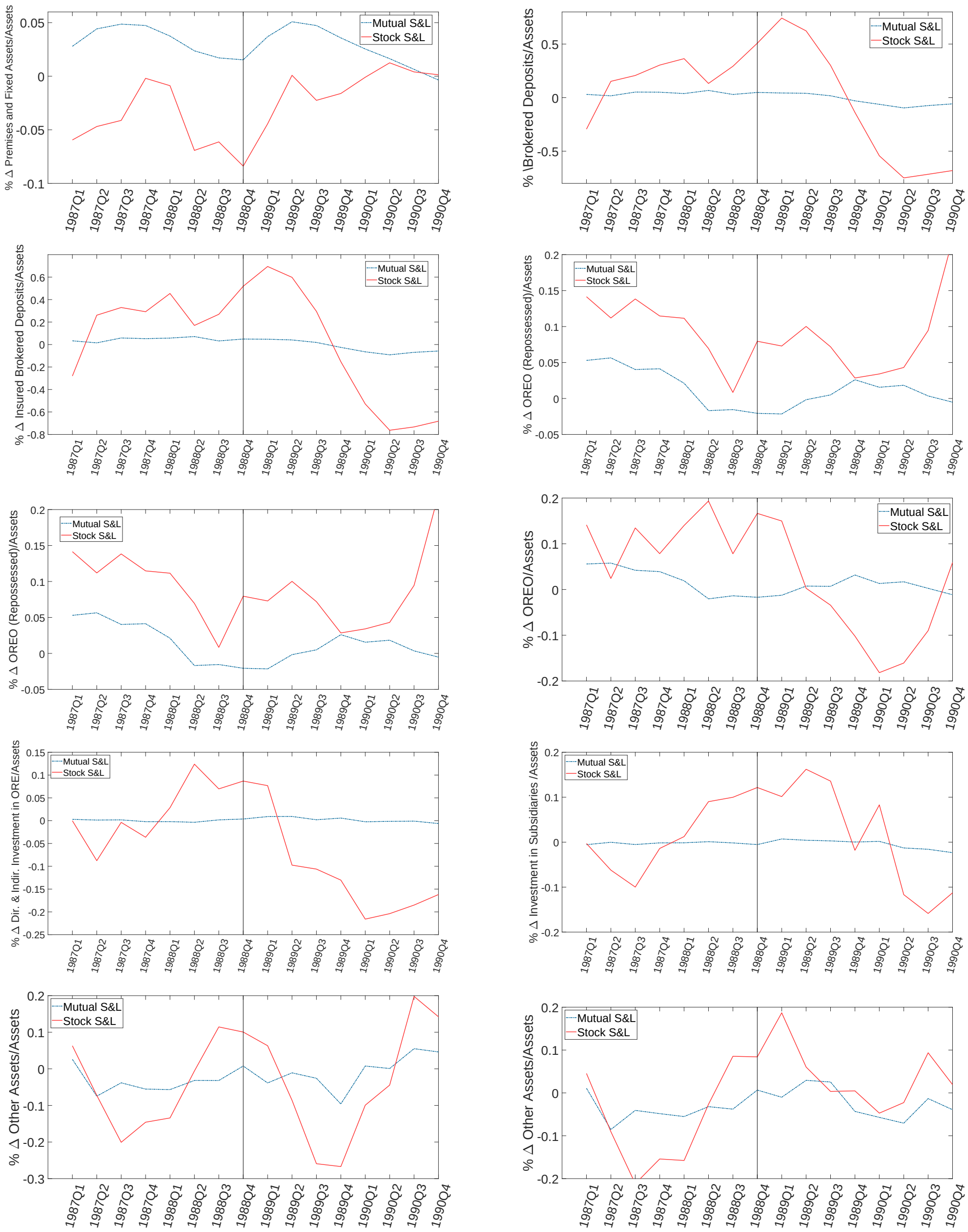


Figure 8: Distribution of changes in the composition of balance sheet components among stock and mutual thrifts

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