



Cost Inefficiency and the Holding of Non-traditional Assets by Solvent Stock Thrifts

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In contrast to greater restrictions on thrifts' non-traditional assets under FIRREA, Congress is considering new legislation forcing thrifts to convert to banks. Hence, the efficiency implications of product diversification for thrifts is an important issue. We examine the relation between thrifts' movement into non-traditional assets and the operating inefficiency of adequately capitalized stock thrifts in 1988 and 1994. We estimate inefficiency scores for individual thrifts for each year using a stochastic cost-frontier methodology. In a second step, we regress these scores against measures for movement into non-traditional assets. We find a significant fall in inefficiency with a rise in holdings of both traditional and non-traditional assets. Our results suggest that greater diversification privileges for thrifts should be beneficial to the health of the industry.

The thrift debacle of the late 1980s, which included the failure of over 1248 thrifts and an estimated \$450-billion taxpayer bailout,¹ has stimulated public policy debate on the costs and benefits of the movement of thrifts into non-traditional assets. Based on the assumption that thrifts misused their powers to enter non-traditional areas, the Financial Institutions Reform, Recovery, and Enforcement Act of 1989 (FIRREA) raised the qualified thrift lender (QTL) test to 70% holdings of thrift portfolio assets in home-mortgage

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¹ See Saunders (1997), p. 365. The Government Accounting Office in July 1996 estimated the total cost of the savings-and-loan crisis, including indirect interest costs, to be about \$480.9 billion, with total direct bailout costs to taxpayers of \$152.6 billion (*New York Times*, July 15, 1996, p. B-1).

related assets (later reduced to 65%).² Thrifts failing to meet this test are not allowed to borrow from the Federal Home Loan Bank (FHLB) unless they purchase a large amount of nonvoting capital stock, effectively increasing their cost of FHLB borrowing. Furthermore, if they do not meet the IRS's 60% QTL test, they will not be given preferential treatment for bad-debt reserves.³ A thrift must also pass the FHLB's QTL test to qualify as a unitary thrift holding company which allows non-thrift subsidiaries the freedom to engage in almost any type of non-bank activity.⁴ In contrast to FIRREA, currently proposed legislation eliminates the specialized charter of thrifts altogether, with a new type of bank holding company to replace the existing thrift holding company charter.⁵

While many financial economists question whether specialized mortgage lenders can survive in competition with more diversified financial institutions in today's complex market environment, others argue thrifts generally hold fractions of non-traditional assets below the maximum fraction allowed. Also, many thrifts choose not to be QTL lenders, forfeiting lower FHLB

² QTL assets include home mortgages, mortgage-backed securities, and other narrowly defined housing-related assets. For the FHLB's QTL test these assets are divided by portfolio assets, defined as total assets less the sum of fixed assets, goodwill, intangible assets, liquid assets and cash greater than 10% of total assets. Prior to FIRREA, the QTL minimum was 60% mortgage-related assets using a more comprehensive definition of thrift portfolio assets (see Cole and McKenzie 1994). Under FIRREA, more stringent product regulations were put in place. Junk bonds had to be disposed of by 1994, and commercial real estate loans were restricted to four times a thrift's capital. Direct real estate investments could only be made through a separately capitalized subsidiary, and real estate loans had to meet loan-to-value limits. State S&Ls were required to abide by the same restrictions as federal thrifts, including a maximum of 3% of assets in service companies (Cole and McKenzie 1994).

³ The IRS QTL test uses a more comprehensive definition of thrift assets. Thrifts failing this QTL test face recapture of bad-debt reserves by the IRS. This recapture has been the major impediment facing many thrifts contemplating converting to bank charters. Recent legislation requires a smaller recapture for all thrifts.

⁴ See Tannenbaum (1995). Under the National Housing Act of 1968, which gave FHLBB control over the chartering of holding companies, unitary thrift holding companies meeting a thriftiness test (holding the majority of assets in mortgages and selected securities) were allowed to engage in almost any activity without restriction. Otherwise, they could only engage in activities permissible by the FSLIC (see Brumbaugh 1988, pp. 18-20). Recent legislative proposals have been made to reduce this freedom by replacing unitary-thrift-holding-company charters with a new type of bank holding-company charter.

⁵ See Wilke (1995). With a declining Savings Association Insurance Fund (SAIF), recent legislation proposed to merge SAIF with the Bank Insurance Fund (BIF), to merge the Office of Thrift Supervision with the Office of the Comptroller of the Currency and to eventually require thrifts to convert to banks.

borrowing costs, IRS preferential treatment for bad debt reserves and freedom for non-bank subsidiaries. Although the efficiency effects of the movement of thrifts into non-traditional assets has significant implications for the industry's long-term viability, little research has studied this issue. In this paper we extend previous research by examining the relation between the controllable operating inefficiency of thrifts and their holdings of non-traditional assets. We use a two-step approach for adequately capitalized thrifts operating in 1988 and in 1994. In the first step, we estimate inefficiency scores for individual thrifts for each year, using a stochastic cost-frontier methodology. In a second step, we use these scores to examine the relation between firm inefficiency and movement into non-traditional assets. We find an insignificant difference in the operating inefficiency of thrifts with portfolio assets concentrated in home-mortgage activities and thrifts with more non-traditional assets. We also find a significant decline in operating inefficiency with increases in most individual traditional and non-traditional assets. The only exceptions were generally insignificant relations on inefficiency for service-corporation assets in 1988 and for land loans, real estate investment and service corporation assets in 1994.

A summary of previous studies follows. The section after presents the data and methodology, and the third the empirical results. The final section contains a summary and conclusion.

Previous Studies

Table 1 provides a brief summary of previous studies analyzing the effect of non-traditional assets on the performance of thrifts in the 1980s. These studies fall into two major categories. The first category examines the relation between the holding of non-traditional assets by thrifts and insolvency and/or resolution costs. These studies find less solvent thrifts to hold larger percentages of non-traditional assets (Barth, Bartholomew and Labich 1989; Barth, Bartholomew and Bradley 1990; Cole, McKenzie and White 1990; Pantalone and Platt 1990). They also find a higher probability of insolvency, higher resolution costs and lower profitability for thrifts holding larger percentages of non-traditional assets (Cole 1990(a), (b) 1993; Cole and Eisenbeis 1996; Benston, Carhill and Olovson 1994; McKenzie, Cole and Brown 1992). However, Benston and Koehn (1989) find holdings of non-traditional assets to be associated with greater risk and lower profitability only for undercapitalized thrifts. This suggests a moral-hazard problem for poorly capitalized thrifts.

The second category of studies examines the risk–return characteristics of the movement of thrifts into non-traditional assets. Brewer, Jackson and

Table 1 ■ Summary of previous studies examining the effect of thrifts' movement into non-traditional assets.

Issue Examined	Studies	General Findings
Relation between thrift failures and non-traditional assets in the 1980s	Barth, Bartholomew and Labich (1989) Barth, Bartholomew and Bradley (1990) Cole, McKenzie and White (1990) Pantalone and Platt (1990) Cole (1990a,b, 1993)	Insolvent thrifts held more non-traditional assets than solvent thrifts. Higher probability of insolvency associated with greater holdings of non-traditional assets.
Relation between volatility of thrift stock-market returns in the mid-1980s and non-traditional assets	Cole and Eisenheis (1996) Benston, Carhill and Olasov (1994) McKenzie, Cole and Brown (1992) Benston and Koehn (1989)	Higher resolution costs for thrifts with holdings of non-traditional assets. Thrifts holding more non-traditional assets were less profitable than other thrifts. Only less solvent thrifts with more non-traditional assets were more risky than other thrifts.
Relation between efficient risk-return frontier and asset portfolio holdings	Brewer, Jackson and Mondschean (1996) Cole and McKenzie (1994)	For traditional fixed-rate lenders movement to non-traditional assets resulted in higher return. For less traditional thrifts movement resulted in lower returns and/or higher risk. Most efficient portfolio consisted of traditional assets.

Mondschean (1996) examine stock market risk–return data for 100 large publicly traded thrifts between 1985 and 1989. They find traditional fixed-rate mortgage lenders moving into non-traditional assets to have higher returns and lower risk. In contrast, less traditional thrifts have lower returns and higher risk, as they invested more in non-traditional assets. Cole and McKenzie (1994) examine efficient risk–return frontiers based on imputed accounting-asset returns and volatility in returns for thrifts between 1984 and 1989. They find the most efficient thrift portfolios to hold predominantly traditional mortgage assets. Comparing these efficient portfolios to *ex post* thrift data, they find well-capitalized thrifts to hold primarily traditional housing assets, and to operate close to the efficient frontier. In contrast, less solvent thrifts had larger holdings of non-traditional assets that operated far from the efficient frontier. Cole and McKenzie suggest that these less solvent thrifts engaged in “go for broke” strategies.

Both categories of studies suggest moral-hazard problems associated with holdings of non-traditional assets by less solvent thrifts. The first category, however, does not address the question whether adequately capitalized thrifts benefit from holding non-traditional assets. The second category examines adequately capitalized thrifts. However, Brewer, Jackson and Mondschean (1996) examine only the 100 largest publicly traded thrifts. Cole and McKenzie (1994) examine well-capitalized and undercapitalized thrifts, but their study uses imputed net accounting returns that allocate costs equally across assets. Consequently, it does not consider cost economies of thrifts’ movement into non-traditional assets. Recent studies find inefficiency to be a significant determinant of bank and thrift failures (Kwan and Eisenbeis 1994; Cebenoyan, Cooperman and Register 1993a). Hence, an examination of the relation between controllable operating inefficiency and thrift holdings of non-traditional assets has important implications for the health of the deposit insurance system.

In this study we examine the relations between thrift concentration in home-mortgage assets or movement into non-traditional assets and controllable operating inefficiency. From the perspective of an efficient specialized lender, thrifts that “stick to their knitting” and continue to act as specialized home mortgage lenders may develop a niche and achieve efficiencies by such specialization. This premise is consistent with a finding by Eisenbeis and Kwast (1991) that the earnings performance of real-estate-specializing banks was on a par with that of other more diversified commercial banks in the 1980s. By extension, thrifts investing in non-traditional assets may take on inefficient risks through inexpertise in their credit assessment and underwriting of new assets, making them vulnerable to adverse selection

(Cole and Eisenbeis 1996). Similarly, entering non-traditional areas may be costly in the absence of cost economies.

Alternatively, movement into non-traditional assets may provide synergies or cost economies for different products and inputs (Wall and Eisenbeis 1987). For instance, taking on a large percentage of consumer loans may generate cheaper retail deposits for thrifts or cross-marketing opportunities. Similarly, from a portfolio-theory perspective, thrifts moving into non-traditional assets may receive diversification benefits, making them less dependent on a single industry sector, and perhaps reducing agency costs (Diamond 1984).

Whether movement into non-traditional assets provides synergies and/or diversification effects, however, may be contingent upon the specific type of investment that thrifts make. Non-traditional assets encompass a broad array of asset classes, including non-residential mortgages, multifamily mortgages, consumer loans, commercial non-mortgage loans, other securities, and direct equity investments in real estate or service-corporation assets. Some of these asset classes are less correlated with home-mortgage assets, such as consumer and commercial loans, while others are unlikely to provide diversification benefits, such as acquisition and development of land loans, non-residential mortgages and direct equity investments in real estate. Service corporations, particularly for state-chartered thrifts in liberally regulated states, such as Texas and California, were allowed to diversify more widely. They could invest in areas unrelated to banking, from food chains to equity ownership in corporations, as well as real-estate-related activities. Some service corporations, however, made direct equity real estate investments in real estate that provided less diversification. Therefore, it is important to consider not just the relation between operating inefficiencies as a group, but also to examine the relation between inefficiency and movement into specific types of non-traditional asset classes.

Data and Estimation Procedures for Inefficiency Scores

Data

The data for this study are taken from the annual balance sheet and income statement reports for all stock-chartered thrifts listed on the FHLB data tape in 1988 and 1994. We focus on stock-chartered thrifts because previous studies have shown them to hold more non-traditional assets and to have higher resolution costs than mutual thrifts (see Cordell, MacDonald and Wohar 1993). We wish to examine whether adequately capitalized (solvent)

thrifts will benefit from product deregulation. Therefore, we exclude thrifts currently categorized as severely undercapitalized (a leverage ratio of tangible equity capital to total assets $<3\%$).⁶ Our final sample includes all adequately capitalized stock thrifts with sufficient data and adequate outputs for our cost-function analysis. The translog cost function requires positive values for each output in the function, so thrifts with non-positive values for output classes could not be included. In 1988, the FHLB data tape had data for 1143 stock thrifts. Using five outputs for the cost function, 202 firms had to be eliminated for nonpositive outputs or other insufficient data. An additional 245 thrifts had a leverage ratio below 3%. Excluding these inadequately capitalized thrifts, the resulting sample in 1988 is 696 thrifts. In 1994, the FHLB data tape had data for 854 stock firms. Of these firms 100 were excluded for having non-positive outputs or insufficient data, and nine for having a leverage ratio below 3%, leaving a sample of 745 thrifts in 1994.⁷

Because FIRREA placed more stringent product restrictions on thrifts in 1989, we examine thrifts in 1988, which offers the most recent available data prior to the implementation of FIRREA. This year also represents the peak of the thrift crisis, when evidence of excessive risk taking in the 1980s became apparent. As thrifts were granted extended powers for commercial and consumer loans in 1980–1982, we avoid any bias associated with start-up or learning costs for new types of lending by using 1988 data. Given the post-FIRREA environment in which many of the 1988 thrifts merged with banks or other thrifts, we also analyze thrifts operating in 1994. Our 1994 sample represents currently operating thrifts that will be directly affected by proposed regulatory changes.

For our cost function we take the number of employees for each thrift in the sample from the *Rand and McNally Savings and Loan Directory*, 1989, 1995. We take state unemployment rates from *U.S. Bureau of the Census, Statistical Abstract of the U.S. (110 Edition)*, 1990, 1995.

⁶ Under the prompt-corrective-action section of the FDIC Improvement Act, banks and thrifts are categorized into five categories based on risk-adjusted assets and tier 1 capital. A bank or thrift is significantly undercapitalized if its leverage ratio (tangible equity to total assets) or ratio of core capital to risk-based assets is less than 3% or its total tier 1 and tier 2 capital is less than 6% of risk-based assets. Risk-based assets are not available for 1988, so we use the leverage-ratio minimum (Hempel, Simonson and Coleman 1994, p. 278).

⁷ We replicated the reported analysis using a translog cost function with only three outputs, allowing a somewhat larger sample of firms each year. The results are consistent with the results reported here, and are available from the authors.

Estimation Procedure for Inefficiency Scores

For our dependent variable in the cross-sectional regressions, we calculate individual indices of controllable operating inefficiency for each firm for each year.⁸ To do so we employ a stochastic cost frontier methodology (see Aigner, Lovell and Schmidt 1977, Meeusen and Van Den Broeck 1977) based on multiproduct translog cost functions. The methodology is described in detail in the studies cited above and in Jondrow *et al.* (1982), and the translog cost function for thrifts in LeCompte and Smith (1990) and Mester (1987). For the sake of brevity, we refer the interested reader to these studies and to the Appendix, which describes the methodology in more detail.⁹

The stochastic cost-frontier methodology incorporates a two-component error structure. One component represents random, uncontrollable factors, and the other represents individual-firm deviation from the efficient frontier caused by factors within a manager's control, such as technical and allocative efficiency. By estimating the ratio of the variability for these factors, an overall measure of controllable thrift inefficiency (*INEFF*) can be calculated. Intuitively, *INEFF* measures the percentage of unnecessary costs incurred by a thrift in producing its outputs, relative to an efficient frontier based on the best-practice thrifts in the sample.

We use a financial intermediation approach, following the arguments of Sealey and Lindley (1977) to specify thrift inputs and outputs in the cost function. This method assumes a thrift uses physical capital, deposits, other borrowings and labor as inputs to produce earning assets. Outputs are: (Q1) one- to four-home mortgages and mortgage-backed securities; (Q2) non-mortgage loans including commercial loans, consumer loans, and lease financing; (Q3) cash and other security investments including U.S. government and agency securities, municipals, and other securities; (Q4) construction and land loans, and real estate and service-corporation investment; and (Q5) multi-family and non-residential mortgage loans.

Our input measures are similar to those used by Cebenoyan *et al.* (1993a,b). We measure the price of physical capital (P1) by dividing total physical capital expenditures (*i.e.*, expense of office occupancy, furniture, equipment, etc.) by the book value of net total office premises and equipment (including

⁸ See Cebenoyan *et al.* (1993b) for a detailed description of this methodology, which this section heavily draws from.

⁹ Even there, we do not include the ten translog cost functions (total sample and each of the quartiles in each of the two years) used in the paper. These are available from the authors.

office buildings and land, leasehold improvements, furniture, fixtures, equipment and capitalized leases). The price of deposits (P2) is total interest expense divided by total deposits and other borrowings. For the price of labor (P3), we use total expenditures on employees divided by the number of full-time-equivalent employees at the end of the year. The appropriate linear homogeneity in input price restrictions on the translog function is imposed by normalizing total costs, the price of deposits and the price of physical capital by the price of labor.

Since Berger and Humphrey (1991) point out that valuable information may be lost when institutions of many sizes are combined, we test for pooling across size quartiles in each year. We perform a joint F -test for the null hypothesis that the cost relations are the same for firms in each of the size quartiles. For each year, the F -statistic was less than the critical value. Consequently, we performed our analysis for the pooled total samples for each year. To provide additional information within thrift size quartiles, we also replicated the analysis for each of the four size quartiles for each year.

Cross-Sectional Models

In our second stage, we perform cross-sectional regressions for respectively the entire sample and for each size quartile to examine the relation between thrift inefficiency and movement into non-traditional assets. This second-step regression to be estimated is

$$c_i = a + b_1 \text{NONTRAD} + b_2 \text{SIZE} + b_3 \text{UNEMP} \quad (1)$$

where

- c_i = Individual inefficiency scores of a thrift (dependent variables).
- NONTRAD* = Measure of movement into non-traditional assets.
- SIZE* = Log of asset size in thousands for a thrift.
- UNEMP* = State unemployment rate for a thrift.

We use two approaches to measure movement into non-traditional assets (*NONTRAD*). In the first we create a Herfindahl index of asset concentration. This index is calculated by taking the summed square of a thrift's fraction of investment in each possible asset portfolio class relative to the total of all portfolio assets in these classes. The ten respective classes which make up the *HERF* index include: (1) one- to four-family mortgages, (2) multi-family mortgages, (3) non-residential mortgages, (4) land loans; (5) mortgage securities, (6) commercial loans, (7) consumer loans, (8) cash and investment

securities, (9) real estate investment and (10) service-corporation assets. In the second approach, we estimate the cross-sectional regression in Equation (1) using the ten respective individual asset classes for *NONTRAD* to capture the effect of movement into each respective non-traditional asset class, holding other factors constant.

Given that the majority of the typical savings and loan's output is in one- to four-home mortgages and mortgage-backed securities, the Herfindahl index (*HERF*) indicates any movement away from home-mortgage assets into non-traditional assets.¹⁰ Thrifts with higher *HERF* values are specialized home-mortgage lenders, while thrifts with lower *HERF* values have a lower concentration in home mortgage assets, and hence more non-traditional assets.

SIZE (the log of asset size in thousands) is included in the model to control for effects of asset size on thrift inefficiency. Previous studies find asset size to have a significant negative effect on operating efficiency (see Berger and Humphrey 1991). The effect of movement into non-traditional assets may also be contingent upon size. Larger thrifts may have greater expertise and ability to move efficiently into non-traditional assets. Since there is a wide range of assets within size quartiles, we also include *SIZE* in the regression by size quartiles to control for size variations that may affect inefficiency within quartiles.

Previous studies find that thrifts in states suffering economic problems to have higher operating inefficiency (Cebenoyan, Cooperman and Register 1993a). To control for economic conditions that previous studies find to

¹⁰ This is confirmed by a positive (.60) correlation between *HERF* and the sum of one- to four-family mortgages and mortgage securities. All other individual asset correlations with *HERF* were negative. We also performed the same analysis including one- to four-family home mortgages and mortgage securities together as one separate asset class. The regression results are similar to those reported in this paper and are available from the authors.

affect the operating inefficiency of thrifts, we include *UNEMP*, the unemployment rate in the state in which a thrift operates.¹¹

Empirical Results: Descriptive Statistics

Table 2 shows the means, with standard errors below in parentheses, for the variables used in the cross-sectional regression models. Panel A shows the results for 1988. The mean inefficiency score of 0.14 for the sample is similar to that observed in other studies. This mean suggests that the average firm in the sample produces its outputs at a cost that is about 14% greater than necessary. Deviations from the best-practice thrifts on the frontier are similar for each of the respective quartiles.

The mean *HERF* value is about 0.37 for the entire sample, with a lower mean of 0.32 for the largest size quartile. The largest thrifts appear to spread their investments across a wider variety of assets than the smaller thrifts.

For individual holdings of assets, the largest asset class in 1988 is one- to four-family mortgages, with a sample mean of 0.53. The mean for the largest thrift quartile is smaller, but the largest thrifts have a larger mean for mortgage securities. When these means are combined, the mean for home-mortgage-related assets is 0.64 for the sample, with a similar mean for each size quartile. Thus, the average thrift in 1988 appears to hold home-mortgage-related assets above the QTL minimum. The means for respective individual non-traditional asset classes are relatively small and appear to be well below maximum constraints for individual assets classes.¹² Mean

¹¹ In an alternative regression we include *LIBSTATE* to test for a differential effect on state-chartered S&Ls operating in liberally regulated states. *LIBSTATE* slope and intercept dummies were consistently insignificant. Lagrange-multiplier tests also indicated that they should not be included in the model for any quartile (see Ramanathan 1992, p. 313). Tests for differences in the means for different asset classes between *LIBSTATE* and *NONLIBSTATE* thrifts were also insignificant.

¹² Regulatory restrictions on individual assets include limitation of consumer loans to 30% of total assets, commercial loans to 10%, commercial real estate loans and non-residential mortgage loans to 400% of capital, and service-corporation investment to 3% of assets (Cole and McKenzie 1994). State-chartered thrifts had more liberal regulations in the 1980s, particularly in more liberally regulated states [Texas, California, Ohio, Florida and Louisiana—see Benston (1985)]. In March 1985, FHLBB restricted all insured S&Ls to direct investments up to 10% of assets or twice capital (unless special supervisory permission was given). Since the denominator for each asset class is total liabilities rather than total assets as in Table 2, our mean fraction of each asset held is biased upward. Thus, the means are well below the maximum restrictions as a fraction of total assets.

Table 2 ■ Descriptive statistics for variables used in regression model by size quartiles for adequately capitalized stock chartered thrifts (means, with standard errors in parentheses).

Panel A: 1988					
Variable	Entire Sample	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Number	696	174	174	174	174
Inefficiency	0.14 (0.00)	0.13 (0.01)	0.13 (0.01)	0.12 (0.01)	0.11 (0.01)
<i>HERF</i>	.37 (.01)	.38 (.01)	.39 (.01)	.38 (.01)	.32 (.01)
1-4-family mortgages	.53 (.01)	.53 (.02)	.56 (.02)	.55 (.02)	.44 (.01)
Multi-family mortgages	.05 (.00)	.03 (.00)	.05 (.01)	.06 (.01)	.05 (.01)
Non-residential mortgages	.10 (.00)	.10 (.01)	.11 (.01)	.10 (.01)	.10 (.01)
Land loans	.02 (.00)	.03 (.00)	.02 (.00)	.03 (.00)	.02 (.00)
Mortgage securities	.11 (.01)	.06 (.01)	.08 (.01)	.11 (.01)	.18 (.01)
Commercial loans	.02 (.00)	.03 (.00)	.02 (.00)	.02 (.00)	.03 (.00)
Consumer loans	.06 (.00)	.07 (.01)	.06 (.01)	.06 (.00)	.06 (.00)
Cash and other securities	.15 (.00)	.20 (.01)	.14 (.01)	.14 (.01)	.14 (.01)
Real estate investment	.003 (.00)	.002 (.00)	.005 (.00)	.002 (.00)	.003 (.00)
Service-corporation investment	.01 (.00)	.01 (.00)	.01 (.00)	.01 (.00)	.02 (.00)
Assets (\$ million)	538.66 (53.09)	35.86 (1.04)	92.81 (1.77)	221.39 (4.38)	1,804.59 (181.13)
Unemployment rate (%)	5.49 (.06)	5.91 (.13)	5.54 (.12)	5.29 (.10)	5.24 (.01)

holdings of different non-traditional and traditional assets vary little across size quartiles in 1988.

Panel B shows the mean descriptive statistics for the 1994 sample. The mean inefficiency score for the entire sample in 1994 is 0.20, with a lower mean

Table 2 ■ continued

Panel B: 1994					
Variable	Entire Sample	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Number	745	186	186	186	187
Inefficiency	0.20 (0.01)	0.23 (0.02)	0.19 (0.01)	0.18 (0.01)	0.14 (0.01)
<i>HERF</i>	.40 (.01)	.42 (.01)	.39 (.01)	.39 (.01)	.39 (.01)
1-4-family mortgages	.56 (.01)	.61 (.02)	.57 (.01)	.55 (.02)	.50 (.02)
Multi-family mortgages	.05 (.00)	.03 (.00)	.05 (.01)	.06 (.01)	.06 (.01)
Non-residential mortgages	.08 (.00)	.07 (.00)	.09 (.01)	.07 (.00)	.06 (.00)
Land loans	.01 (.00)	.02 (.00)	.01 (.00)	.01 (.00)	.01 (.00)
Mortgage securities	.13 (.01)	.08 (.01)	.11 (.01)	.13 (.01)	.18 (.01)
Commercial loans	.02 (.00)	.02 (.00)	.02 (.00)	.01 (.00)	.01 (.00)
Consumer loans	.06 (.00)	.06 (.00)	.05 (.00)	.06 (.01)	.06 (.01)
Cash and other securities	.19 (.01)	.20 (.01)	.19 (.01)	.19 (.01)	.17 (.01)
Real estate investment	.0003 (.00)	.001 (.00)	.0003 (.00)	.0001 (.00)	.0004 (.00)
Service-corporation investment	.003 (.00)	.002 (.00)	.003 (.00)	.004 (.00)	.01 (.00)
Assets (\$ million)	794.93 (94.34)	46.62 (1.20)	116.80 (2.07)	278.58 (5.73)	2,727.33 (338.87)
Unemployment rate (%)	5.91 (.04)	5.71 (.08)	5.74 (.09)	5.94 (.09)	6.24 (.10)

Asset classes are divided by total liabilities. Inefficiency is a thrift's inefficiency score.

for the largest thrift quartile (0.14) and a higher mean for the smallest thrift quartile (0.23). The difference between the mean inefficiency scores for the largest and smallest thrift quartiles is significant. This suggests that very large thrifts had lower operating inefficiency on average than smaller thrifts in 1994. Adequately capitalized stock thrifts in 1994 are on average

significantly larger than thrifts in 1988, reflecting greater consolidation in the industry.

The mean *HERF* for the sample in 1994 is 0.40, which is significantly greater than the mean in 1988 of 0.35. This suggests a greater concentration of assets in home-mortgage lending for thrifts on average under FIRREA. Means on *HERF* are similar for each size quartile.

The largest thrift quartile in 1994 again has a smaller mean percentage of one- to four-family mortgages than the smallest thrifts, but a larger mean percentage of mortgage-backed securities. When the means on mortgage securities and one- to four-family mortgages are combined, the combined mean is 0.69 in 1994, with similar means across quartiles. As in 1988, the average adequately capitalized stock thrift in 1994 appears to be a home-mortgage specialist, and to hold a larger fraction of investment assets in home-mortgage related assets than the QTL minimum. The mean fraction held for each asset class of non-traditional assets is quite small, below the regulatory maximum for each class. The means for the entire sample for real estate investment and service-corporation assets are very small, and significantly lower than the means for these respective asset classes in 1988. This may reflect greater restrictions placed on these assets under FIRREA.

Table 3 provides the distribution of total non-traditional assets held as a fraction of total liabilities for each year for the entire sample and each size quartile. Total non-traditional assets equals total portfolio assets minus the sum of one- to four-home mortgages and mortgage securities. Approximately 30% of the sample thrifts in 1988 held the majority of their liabilities (>50%) in non-traditional assets, and 25% in 1994. Also, about 51% of sample thrifts in 1988 and 46% of sample thrifts in 1994 had 40% or more of their liabilities invested in non-traditional assets, with some variation across size quartiles.¹³ This suggests a wide range of holdings of non-traditional assets across adequately capitalized stock thrifts in both 1988 and

¹³ A recent Office of Thrift Supervision study found about 42% of thrifts met current QTL requirements as mortgage specialists in 1985, with a rise to 54% in 1989 (Baltimore *Sun*, March 1, 1996, p. 10C). We use a different denominator (total liabilities) than that used in the QTL test, so our percentages will be somewhat higher. Otherwise, the results are quite similar. A number of thrifts in our sample had extremely low holdings of home-mortgage assets. Some of these thrifts acted more like mortgage banks, with large mortgage-security holdings, while others acted more like security firms, with large other-security holdings. These thrifts were healthy and had operated for ten years or more. When they were excluded from the sample, we had similar results.

Table 3 ■ Distribution of thrifts by percentage holding of non-traditional assets relative to total liabilities for sample of adequately capitalized stock thrifts in 1988 and 1994.

% Nontraditional	Number (%) Thrifts	
	1988	1994
Panel A: Total Sample		
0-10	4 (0.57)	13 (1.75)
10-20	57 (8.19)	77 (10.33)
20-30	127 (18.25)	133 (17.85)
30-40	152 (21.84)	179 (24.03)
40-50	147 (21.12)	154 (20.67)
>50	209 (30.03)	189 (25.37)
Panel B: 1st Thrift Quartile (Smallest) on Size		
0-10	2 (1.15)	0 (0.00)
10-20	11 (6.32)	13 (6.98)
20-30	23 (13.22)	38 (20.43)
30-40	34 (19.54)	56 (30.11)
40-50	35 (20.11)	35 (18.82)
>50	69 (39.66)	44 (23.66)
Panel C: 2nd Thrift Quartile on Size		
0-10	1 (0.57)	5 (2.69)
10-20	18 (10.34)	14 (7.52)
20-30	31 (17.82)	26 (13.98)
30-40	44 (25.29)	43 (23.12)
40-50	32 (18.39)	46 (24.73)
>50	48 (27.59)	52 (27.96)
Panel D: 3rd Thrift Quartile on Size		
0-10	0 (0.00)	5 (2.69)
10-20	14 (8.06)	15 (8.04)
20-30	45 (25.86)	31 (16.69)
30-40	31 (17.82)	42 (22.58)
40-50	37 (21.26)	42 (22.58)
>50	47 (27.01)	51 (27.42)
Panel E: 4th Thrift Quartile (Largest) on Size		
0-10	1 (0.57)	3 (1.60)
10-20	14 (8.05)	35 (18.72)
20-30	28 (16.09)	38 (20.32)
30-40	43 (24.71)	38 (20.32)
40-50	43 (24.71)	31 (16.58)
>50	45 (25.86)	42 (22.46)

1994. Also, the percentage investment in non-traditional assets in 1994 under FIRREA is somewhat lower.

Cross-Sectional Results

Table 4 shows the cross-sectional results for the regressions on inefficiency using *HERF* as the independent variable for the samples of adequately capitalized stock thrifts. As implied by the Wald chi-square statistics, the regressions for the entire sample in both 1988 and 1994 were strongly significant. However, the coefficients on *HERF* were consistently insignificant for the entire sample and for each quartile for both 1988 and 1994. This suggests that adequately capitalized stock thrifts with assets concentrated in home lending were not more or less inefficient than thrifts moving away from home lending.

For control variables, for the entire sample in both 1988 and 1994, the coefficient on *UNEMP* is strongly significant and positive, with variations across quartiles. Consistent with previous studies, adequately capitalized thrifts operating in financially distressed states were generally more inefficient than other thrifts. The coefficient on *SIZE* is positive and significant only for quartile 2 in 1988. This suggests that larger thrifts within this quartile operated more inefficiently than other thrifts.¹⁴

Table 5 shows the cross-sectional results on inefficiency for the regressions using individual classes of assets. The Wald chi-square statistics indicate that the models are highly significant for the entire sample and for the quartile regressions. The first column of panel A shows the results for the entire sample in 1988. Generally, as each individual asset class rises, inefficiency falls. Only the coefficient on service corporation investment is insignificant.

The regression results for the individual quartiles in 1988 are shown in the subsequent columns.

Table 6 summarizes the overall results. The following asset classes are consistently significant and negative on inefficiency for the entire sample and most quartiles including: one- to four-family mortgages, non-residential mortgages, mortgage securities, consumer loans, commercial loans, cash and other securities, multi-family loans (except for quartile 1), service-

¹⁴ The correlation between *HERF* and *SIZE* for these regressions was small (.17 in 1988 and .09 in 1994), indicating no significant multicollinearity.

Table 4 ■ Cross-sectional regression results: dependent-variable inefficiency scores for sample of adequately capitalized stock thrifts in 1988 and 1994.

Independent Variable	Coefficients on Independent Variables				
	Total Sample	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Panel A: Regression Results for 1988					
Constant	0.15 (3.11)***	-0.07 (-0.44)	-0.97 (-2.40)**	-0.12 (-0.36)	0.13 (1.24)
<i>HERF</i>	-0.02 (-0.76)	-0.04 (-0.79)	-0.00 (-0.56)	-0.06 (-0.77)	0.05 (0.66)
<i>SIZE</i>	-0.00 (-1.36)	0.02 (1.38)	0.09 (2.49)***	0.02 (0.61)	-0.01 (-0.93)
<i>UNEMP</i>	0.01 (3.02)**	0.00 (0.09)	0.02 (4.23)***	0.01 (1.60)	0.01 (1.84)*
<i>N</i>	696	174	174	174	174
Wald χ^2	12.76***	2.28	20.69***	4.77	4.60
Panel B: Regression Results for 1994					
Constant	0.10 (1.64)*	-0.32 (-0.89)	0.12 (0.27)	-0.70 (-1.41)	0.03 (0.62)
<i>HERF</i>	0.04 (1.40)	0.11 (1.15)	-0.07 (-0.82)	-0.02 (-0.24)	0.04 (0.62)
<i>SIZE</i>	-0.01 (-1.09)	0.04 (1.28)	-0.01 (-0.16)	0.06 (1.57)	0.01 (0.72)
<i>UNEMP</i>	0.02 (4.61)***	0.01 (0.90)	0.03 (2.94)***	0.02 (1.96)**	0.00 (0.58)
<i>N</i>	745	186	186	186	187
Wald χ^2	28.85***	3.44	8.62**	7.43*	1.92

Regression results use White's (1980) consistent variance-covariance estimation procedure to adjust for heteroskedasticity. *HERF* is a Herfindahl product concentration index. *SIZE* is asset size in thousands. *UNEMP* is the state unemployment rate. The Wald chi-square provides a test of whether the independent variables are jointly different from zero (Greene 1993, p. 393).

***, **, *significance at respective .01, .05, .10 levels; coefficients are rounded to two decimal places.

Table 5 ■ Cross-sectional results by asset classes: Dependent-variable inefficiency scores.

Independent Variable	Coefficients on Independent Variables				
	Total Sample	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Constant	0.99 (6.59)***	0.29 (1.53)	0.25 (0.55)	0.35 (1.03)	1.04 (5.25)***
1-4-family mortgages	-0.69 (-5.76)***	-0.32 (-3.21)***	-0.80 (-4.58)***	-0.64 (-5.84)***	-0.75 (-4.91)***
Multi-family mortgages	-0.48 (-3.41)***	-0.07 (0.71)	-0.64 (-2.56)***	-0.69 (-4.13)***	-0.97 (-6.17)***
Non-residential mortgages	-0.78 (-6.60)***	-0.42 (-2.77)***	-0.78 (-4.54)***	-0.54 (-3.64)***	-0.86 (-5.09)***
Land loans	-0.51 (-3.06)***	-0.07 (-0.67)	-0.86 (-1.98)*	-0.76 (-5.21)***	-0.77 (-2.74)***
Mortgage securities	-0.71 (-5.61)***	-0.26 (-2.26)**	-0.73 (-3.80)***	-0.69 (-5.27)***	-0.89 (-5.41)***
Commercial loans	-0.63 (-4.56)***	-0.28 (-2.09)**	-0.66 (-2.95)***	-0.91 (-3.13)***	-0.72 (-2.97)***
Consumer loans	-0.67 (-3.83)***	-0.28 (-1.92)*	-1.20 (5.44)***	-0.45 (-2.27)**	-0.91 (-4.55)***
Cash and other securities	-0.68 (-5.78)***	-0.29 (-2.89)***	-0.90 (-5.57)***	-0.72 (-6.26)***	-0.92 (-5.83)***
Real estate investment	-0.43 (-1.94)**	-0.53 (-1.36)	-0.67 (-1.05)	2.09 (2.84)***	-1.45 (-2.58)***
Service corporation	-0.28 (-1.31)	-0.33 (-2.41)**	-1.09 (-1.97)**	-0.55 (-2.13)**	-0.10 (-0.27)
SIZE	-0.01 (-3.70)***	0.02 (1.06)	0.06 (2.14)**	0.03 (1.22)	-0.01 (-1.18)
UNEMP	-0.00 (-0.35)	-0.00 (-0.53)	0.01 (1.25)	0.01 (1.11)	0.01 (0.91)
Wald χ^2	88.72***	36.73***	81.89***	79.29***	50.73***
N	696	174	174	174	174

corporation assets (except for quartile 4) and land loans (except for quartile 1) in 1988. Within quartiles the coefficient on real estate is only significant and negative for quartile 4. In contrast to the regression for the entire sample, the coefficient is significant and positive for quartile 3, indicating that an

Table 5 ■ continued

Independent Variable	Coefficients on Independent Variables				
	Total Sample	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Constant	1.20 (6.75)***	0.93 (2.41)**	0.57 (1.33)	0.65 (1.11)	0.87 (4.53)***
1-4-family mortgages	-0.82 (-6.23)***	-0.88 (-4.69)***	-0.76 (-4.66)***	-0.95 (-3.26)***	-0.63 (-4.57)***
Multi-family mortgages	-0.50 (-3.67)***	-0.49 (-1.94)**	-0.93 (-3.63)***	-0.89 (-3.00)***	-0.64 (-3.90)***
Non-residential mortgages	-1.12 (-6.26)***	-1.61 (-4.36)***	-0.61 (-2.78)***	-0.98 (-2.28)**	-0.52 (-2.76)***
Land loans	0.08 (0.24)	-0.57 (-0.58)	-0.30 (-0.87)	0.02 (0.96)	-0.32 (-0.93)
Mortgage securities	-0.88 (-6.19)***	-1.06 (-4.51)***	-0.85 (-5.07)***	-0.93 (-2.97)***	-0.60 (-3.87)***
Commercial loans	-1.54 (-4.49)***	-1.12 (-1.76)*	-0.78 (-1.28)	-1.07 (-1.61)	-1.78 (-5.39)***
Consumer loans	-0.61 (-2.37)**	-0.99 (-3.15)***	-0.87 (-3.29)***	-1.01 (-2.76)***	-0.38 (-2.40)**
Cash and other securities	-0.86 (-6.91)***	-1.13 (-5.46)***	-0.67 (-3.88)***	-0.97 (-3.18)***	-0.62 (-4.44)***
Real estate investment	4.06 (0.47)	1.89 (0.19)	-0.96 (-0.10)	-1.89 (-0.16)	9.05 (2.47)**
Service corporation	-0.24 (-0.78)	-4.66 (-2.22)**	0.06 (0.96)	-1.00 (-0.57)	0.58 (0.65)
SIZE	-0.02 (-4.02)***	0.03 (0.94)	0.03 (0.72)	0.04 (0.96)	-0.01 (-1.24)
UNEMP	0.01 (2.93)***	0.01 (1.01)	0.02 (1.90)*	0.01 (1.42)	0.00 (0.72)
Wald χ^2	92.05***	43.87***	44.24***	19.53*	85.60***
N	745	186	186	186	187

The regression results use White's (1980) consistent variance-covariance procedure to adjust for heteroskedasticity. Each asset class is as a fraction of total liabilities. SIZE is asset size in thousands. UNEMP is the state unemployment rate. The Wald chi-square provides a test of whether the independent variables are jointly different from zero (Greene 1993, p. 393). ***, **, * mean significance at .01, .05, .10 levels.

Table 6 ■ Descriptive summary of the cross-sectional results on inefficiency.

I. Results on Inefficiency for Asset Concentration in Home Mortgage Assets (<i>HERF</i> index)			
<i>HERF</i> Insignificant Each Year and for Each Quartile			
II. Results on Inefficiency for Individual Asset Classes			
Assets significant and negative on inefficiency for entire sample and all quartiles both years:			
1-4 family mortgages			
Non-residential mortgages			
Mortgage securities			
Consumer loans			
Cash and other securities			
Multi-family loans (except for quartile 1 in 1988)			
Commercial loans (except for quartiles 2, 3 in 1994)			
Assets occasionally significant and positive on inefficiency:			
Real estate investment:	Quartile 3	1988	
	Quartile 4	1994	
Assets occasionally significant and negative on inefficiency:			
Service-corporation assets:	Quartiles 1, 2, 3	1988	
	Quartile 1	1994	
Real estate investment:	Entire sample and quartile 4 in 1988		
Land loans:	Entire sample and quartiles 2, 3, 4 in 1988		

increase in real estate assets within this quartile results in a rise in operating inefficiency.

For control variables, *SIZE* is significant and negative for the entire sample, indicating lower operating inefficiency as thrifts get larger. Within the quartiles, the coefficient on *SIZE*, however, is positive and significant for quartile 2. This indicates higher operating inefficiency for larger thrifts within this quartile.

The first column of panel B of Table 5 shows the results for the entire sample in 1994, which are similar to 1988. For the total sample in 1994, with the exception of land loans, real estate and service corporation investment, as each individual asset class rises, inefficiency falls. The coefficient on *SIZE* is again significant and negative. The coefficient on *UNEMP* is significant and positive.

Table 6 summarizes the results for the individual size quartiles in 1994. The results are similar with some variations. As in 1988, in 1994 a rise in one-

to four-family mortgages, non-residential mortgages, mortgage securities, consumer loans, cash and other securities, and commercial loans (except for quartiles 2 and 3) resulted in a fall in inefficiency. For quartile 4, the coefficient on real estate investment is positive and significant. For quartile 1, the coefficient on land loans is consistently insignificant.

In summary, the results for the individual asset class regressions generally suggest that a rise in the fraction held of most individual traditional and non-traditional assets reduces the operating inefficiency of adequately capitalized thrifts, with variations across different size quartiles.¹⁵

Summary and Conclusion

This study uses a stochastic cost-frontier methodology to examine the relation between the controllable operating cost inefficiency of thrifts and their investment in traditional versus non-traditional mortgage assets. This methodology allows us to calculate an index of operating inefficiency for samples of adequately capitalized stock thrifts in 1988 and 1994. Using this index in a second-stage, cross-sectional regression, we examine the relation between thrift investment in non-traditional assets and operating inefficiency. We find an insignificant difference in operating inefficiency between thrifts with a greater concentration of home-mortgage assets and thrifts holding more non-traditional assets. We also find rises in individual traditional and non-traditional assets to be significant in reducing a thrift's operating inefficiency. The only exceptions for the entire samples are insignificant relations for service-corporation assets in 1988 and 1994, and real estate investment and land loans in 1994.

Recent legislation proposes to eliminate the thrift charter and permit thrifts to diversify into non-traditional assets like commercial banks. Our results support this legislation by showing the difference in operating inefficiency to be insignificant between concentrated home-mortgage lenders and lenders moving into more non-traditional assets. The results also show that holding other factors constant, a rise in most individual non-traditional assets reduces thrift operating inefficiency. This suggests that greater diversification privileges for adequately capitalized stock thrifts should be beneficial to the overall health of the thrift industry.

¹⁵ We also performed our regressions including real estate owned (repossessed assets). The results were similar and are available from the authors. Since *REO* has a very high positive correlation with *UNEMP* and negative correlation with *HERF*, the model fit was better excluding this variable.

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Appendix

Procedure for Calculating Inefficiency Scores

For a more detailed explanation see Cebenoyan, Cooperman and Register (1993a), which this heavily draws from.

Aigner, Lovell and Schmidt (1977) and Meeusen and Van Den Broeck (1977) describe a cost function in simple terms as

$$TC = F(Q_j, P_j) + e_j, \quad (1)$$

where TC represents total costs; Q_j , outputs; P_j , input prices; and e_j , a disturbance term:

$$e_j = u_j + c_j, \quad j = 1, \dots, n \quad (2)$$

with u_j representing random, uncontrollable factors, independently and identically distributed as $N(0, S_u^2)$, and c_j , individual firm deviations due to factors within a manager's control, such as technical and allocative efficiency. These controllable deviations are derived from a $N(0, S_c^2)$ distribution truncated below zero.

Part of the frontier, excluding c_j , is stochastic, while c_j requires the cost of each firm to lie on or above its frontier. Jondrow *et al.* (1982) demonstrate that the ratio of the variability (standard deviation S) for c and u can be used to measure a firm's relative inefficiency, $INEF = S_c/S_u$, where a small value for $INEF$ implies that uncontrollable factors dominate controllable inefficiencies. A measure of controllable firm inefficiency for firm j is then formulated as

$$c_j = \frac{S \text{ INEF}}{1 + \text{INEF}^2} \left(\frac{O(e_j \text{ INEF}/S)}{F(e_j \text{ INEF}/S)} + \frac{e_j \text{ INEF}}{S} \right) \quad (3)$$

where $S = (S_u^2 + S_c^2)^{1/2}$, O is the standard normal density function, F is the cumulative normal density function, and all other terms are as defined above. To estimate (3), a standard translog cost function (see Mester 1987, LeCompte and Smith 1990) incorporating a two-component error structure is first estimated using a maximum-likelihood estimation. To estimate the translog function, the appropriate linear homogeneity in input price restrictions must be imposed. These restrictions were imposed by normalizing total costs and the other prices by the price of labor.