EFFECT OF DEREGULATION AND OFF-BALANCE SHEET ACTIVITIES ON THE X-EFFICIENCY OF U.S. CREDIT UNIONS

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ABSTRACT

The 1998 Credit Union Membership Access Act resulted in the active dissolution of the common bond requirement. Now credit unions are able to include more geographic area into their member base. However, over the years the total number of credit unions have been reduced, but the average size of total assets escalated severely along with the increase in total number of members. Amid the economic recession in 2002 and the financial crisis during 2008-2009, credit unions had to struggle in minimizing costs of operation to stay competitive with the commercial finance institutions.

In this study, X-efficiency scores (with and without off-balance sheet items) of each of the credit unions from 1994 through 2012 were calculated by dividing data into four periods of importance to analysis each period individually. A Tobit regression was run to understand the variations in performances by each group of credit unions.

ACKNOWLEDGEMENTS

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CHAPTER 1. INTRODUCTION

1.1. What is a credit union?

Credit unions (CU) are cooperative financial institutions. Their members provide inputs in the form of savings and use the outputs in the form of loans. Providers of inputs (savers) in a credit union are also the users of outputs (borrowers). By law, credit unions are cooperative enterprises controlled by their members-under the principle of "one-person one-vote." Credit union membership is open to all within an accepted common bond restriction or community designation. Members enjoy economic benefit on the basis of their usage. Members can attain economic benefits including a higher interest rate on deposits and lower rates on loans. These benefits are part of a process of the credit union to channel excess proceeds to members. When a member wants to optimize gains as a borrower and a lender simultaneously, credit unions must reduce loan charges while increasing share account rates, implying that the costs of operating should be kept to a minimum. Credit unions that do not minimize operating costs will have problems competing with other financial institutions.

Relationship-directed finance is the principal notion of the credit union. Interaction between credit union members in sharing responsibilities by democratic control and voluntary services provide the opportunity to improve in informational efficiencies that help credit unions grow and possibly reduce loan losses. The competitive advantage of information gathering also helps credit unions reduce information costs and also helps credit unions manage operating costs. The advantage of commercial banks can be the ability to obtain economy of scale due to their asset size, but comparatively smaller credit unions can also increase their asset base through their ability to attract small deposit holders. However, when banks increase their earnings by increasing non-interest income, smaller credit unions can appeal more to small depositors.

Credit unions have an income tax exemption based upon cooperative ownership of the entity. Credit unions are able to pass tax benefits to members in terms of lower loan rates, higher deposit rates, or by providing a variety of financial products and services. Non-metro communities, where community banks may not be present, are markets in which credit unions may provide access to financial services.

1.2. US credit unions from 1994 to 2012

Credit unions have been serving members in the U.S. for more than 100 years. During this period, the credit union movement became popular gradually as state and federal laws were enacted to charter credit unions. In 1970, the National Credit Union Administration (NCUA) became an independent federal agency. Throughout the 1970s and 1980s deregulation allowed credit unions to increase their member base and services; in the 1990s U.S. credit unions continued to expand as a group. Deregulation during this period, a milestone in the history of U.S. credit unions, helped credit unions to expand geographically across the country as members with more than one common bond (or community) were able to join. At the start of 21st century, credit unions had to counter two economic shocks – recession in 2002 and financial crisis in 2008-2009.

In 1994, there were 12,201 credit unions, which decreased to 6,960 in 2012 – a reduction of nearly 43%. In spite of deregulation to make credit unions more competitive with commercial banks, this sharp decline in total number invites a critical study of this industry. The total number is not the only variable explaining the overall condition of U.S. credit unions. In 1994 credit unions had a total assets of over $295 billion dollars, which increased to $1.03 trillion dollars by 2012 – an increase of 251% since 1994. Credit unions increased membership from 1994 to 2012 approximately 44 percent.

1.3. Credit unions regulations

Traditionally, commercial banks and credit unions have co-existed in a competitive relationship. Banks continue to argue against the tax-subsidy of credit unions, while credit unions wish to remove regulatory burdens. Changes in the market environment also obligate credit unions to offer innovative ranges of products and appeal to new members by expanding to additional geographical areas (based on mergers and charter changes).

Legislation passed in 1976, 1978 and 1980 enabled credit unions to offer parallel services that commercial banks deliver (Black and Dugger, 1981). Legislation afforded credit unions authority to provide competitive industry services, but also shifted credit unions further from the principles they were established on. The 1998 Credit Union Membership Access Act resulted in the practical dissolution of the single common bond requirement, allowing federally chartered unions to add select employee groups to their fields of membership. This allowed credit unions to expand the geographic of the member base. However, the total number of credit unions has declined while average size of total asset escalated significantly over the past two decades. This may help explain how changes in regulations have not enabled all credit unions to stay competitive. Therefore, there is an opportunity to study the financial performance of credit unions during this period (1994-2012) in order to identify activities that may help explain the ability of credit unions to exploit the benefit of deregulation.

1.4. Credit union management

The orientation of management structure affects the variations in performance among credit unions. Unpredictability in the upper level of management affects the performance of the firm across all levels. Decisions made regarding staffing, product mix, or even on the philosophy of credit unions, have a direct influence on performance. Since end users of services are also the owners of the organization, credit union managers have less motivation to take risks. When

managers are not part of the ownership base, questions of agency theory may arise. With a non-profit maximizing objective, credit union management choices can influence the cost structure, and the members can experience less empowerment concerning the growth of institutions. As a result, management may attain more authority and a principal-agent struggle arise (O'Brien, 1993).

If the manager of a credit union has weak motivation to perform in a stakeholders' best interest a principal-agent conflict is likely to happen. Managers may choose cost-preference activities that benefit themselves in the form of higher employee compensation and operation costs at the expense of members. Evidence confirms that benefits are transferred to management from members as more member groups are added to credit unions (Leggett and Strand, 2002). To avoid these potential conflicts while turning competitive risks into opportunities requires a well-managed credit union. But whether most credit unions are well-managed remains a fundamental question.

1.5. Efficiency measure of credit unions

The ownership structure and membership restrictions of credit unions have traditionally limited the ability of cost reduction. Mergers and technological innovation are providing opportunities for growth as well as risking the survival of credit unions. But to take advantage of opportunities and to ensure survival, credit unions have to be operated efficiently, managed well, and provide better member services.

The operational structure of credit unions may be compatible with realizing achievements in cost efficiency. If paper-based operations and labor-intensive processes can be replaced by using information technology, operational costs will be reduced. When members of credit unions get services through the Internet, they no longer have to be present physically. This also helps generate extra sources of fee earnings for credit unions from added services and products. Cost efficiency provides a measure of any credit union's cost of producing an output bundle relative to a best-

practicing credit union's cost of producing similar bundle. The environment credit unions operate in accounts for most efficiency differences. In this study, the feature of cost efficiency of particular note is X-efficiency, which is directly attributed to managerial ability to control costs (Berger, Hunter, and Timme, 1993).

1.6. Off-balance sheet activities

When some credit unions are under pressure to create new products and services, they may add more off-balance sheet activities into their portfolio, with the total amount increasing in recent years. Off-balance sheet (OBS) items are not revealed in traditional portfolio activity. Fees received from the operation of off-balance sheet products are not identified in the balance sheet. According to the Federal Deposit Insurance Corporation (FDIC), off-balance sheet activities incorporate ranges of items including loan commitments, certain letters of credit, and revolving underwriting facilities. Credit union commitments include lines of credit, credit cards, and home equity lines. These are products external to the consolidated financial statement that comprise features of credit and interest rate risk. Commitments are arrangements to offer credit to any member until the expiration date as long as there is no alteration of any condition recognized in the contract. Sometimes a fee payment is required to use this service. Researchers argue whether off-balance sheet items are risky or not. Some view off-balance sheet items as risky and difficult to measure market risk (Angbazo, 1997), while some claim that including off-balance sheet items in a portfolio reduces risk (Boot and Thakor, 1991; Hassan, 2005). Off-balance sheet activities are additional sources of bank output and sources of additional non-interest income (Pasiouras, 2008), and better risk management (Jagtiani, Nathan and Sick; 1995). Since bank inefficiency is related to product mix, omission of off-balance sheet items from bank output may produce an understate efficiency score (Clark and Siems, 2002).

1.7. Influence of macroeconomic variables

Similar to other financial intermediaries, credit unions adjust their portfolio to respond to changing economic conditions. Expansionary and contractionary monetary policies determine the availability of credit and the rate of interest on loans and deposits, which in turn affect GDP components such as the consumption of durable goods, non-durable goods, capital goods, housing investment, retail sales, and trade. On one hand, the income level of the community, customers' ability to save, the local unemployment rate, and business opportunities all shape the product mix and operation structure of any credit union. On the other hand, the services and products offered by credit unions help generate income, create opportunities for employment, and provide members with access to credit, which helps the local economy function better. From 1994 to 2012, the U.S. credit unions have operated through two economic downturns – a recession in 2002 and a financial crisis during 2008-2009. These complications caused by macroeconomic changes make the performance of credit unions interesting to observe.

CHAPTER 2. LITERATURE REVIEW

2.1. Credit union industry

Smith, Cargill and Meyer (1981) stated that the traditional cooperative theory was not directly applicable to model credit union performance. The first reason for this is that members are both the owners of the organization and the consumers of its output. Traditional cooperatives have only one role in the market: to provide benefits to users. The second reason is that credit unions provide services to two groups with contradictory demands for benefits. For example, one group, savers, wants higher interest rates in order to obtain increased revenue. The other group, borrowers, wants lower interest rates in order to decrease expenses. Creating financial benefits for the users with opposing objectives in the financial marketplace leads to tension within the firm.

A number of authors have studied the role of the common bond in promoting the financial performance of credit unions. Black and Dugger (1981) observed that the common bond restriction reduced the cost of collecting credit information compared with other financial institutions. This restriction may also reduce bad debt losses. A number of members, by virtue of their close relationship to a common bond group, share common goals and purposes as well as a common bond relationship with the credit union. DeYoung, Hunter and Udell (2004) noticed that "relationship finance" helps improve informational efficiencies, which ensure the efficient flow of credit and enhanced growth. Another aspect in which credit unions are unique is the income tax exemption. This exemption reduces non-interest expenses and enables credit unions to maintain a lower loan interest rate and higher deposit rate, all else being equal (Frame, Karels, and McClatchey; 2003). Tokle and Tokle (2000) identified the credit union corporate tax exemption as a cost advantage relative to other types of financial institutions. This cost advantage enables credit unions to lower interest rates on various financial products and services available to its

members, by creating competition with credit unions. A study on the economic benefits of the credit union tax exemption by Feinberg and Meade (2014) found that credit union members benefitted most from lower interest rates on car loans, with $29.1 billion in savings from 2005-2013 during the nine year period of the study.

2.2. Managing credit unions

Smith (1984) described the idiosyncratic nature of credit union objectives. Smith emphasized the monetary gain to credit union members as a key objective of credit union management over cost minimization. This research also described the selection of types of loan and savings accounts offered and decisions on the prices and/or quantities of those accounts as crucial functions of credit union management. In fact, the conflict of interest between members, some who join as savers and others who join as borrowers, shapes the strategic objectives of a credit union management system (Smith, 1986; Overstreet and Rubin, 1990). An interest margin squeeze is generated by the twofold objectives of members with large deposits and members with large loans (Bauer, 2008). Goddard, McKillop and Wilson (2008) explained that credit union performance primarily depends on the ability of managers to make decisions at the level of staffing, governance, and product portfolio. Goddard, McKillop and Wilson added that when credit union members participate in management activity voluntarily, their ability and expertise reflects the overall performance. Berger and Humphrey (1992) found that managerial ability accounts for 20 percent or more of cost variations in commercial banking industry.

2.3. X-efficiency

Performance can be measured either by either a cost minimization or a profit maximization approach. The profit maximization approach of efficiency measurement is unsuitable for credit unions, since making a profit is not the primary objective (Goddard, McKillop and Wilson; 2008).

The type of efficiency on which this study focuses is the X-efficiency because it measures managers' ability to make decisions regarding the appropriate input mix to reduce firm level costs. Due to an absence of competitive forces, an unidentified type of efficiency – X-(in)efficiency exists (Leibenstein, 1966). Leibenstein (1973) argues that motivational deficiencies in resource holders increase X-inefficiency. In an effort to explain X-efficiency at firm-level production, Leibenstein (1975) further asserted that manager's ability to make decisions based on the quantity of input makes the difference between maximal utilization and actual utilization, which is a measure of the degree of X-inefficiency. Leibenstein (1975) added that if managers are not competent enough to enter the industry, if a regulatory system provides some sort of protection, or if the users of the services are not aware of the nature of the product, firm-level X-efficiency is affected. When it comes to understanding the performances of the commercial banking sector, X-efficiency is more significant than scale economies (Berger and Humphrey, 1991). Berger (1993) defined X-efficiency as the ratio of minimum cost that could be exhausted to the actual cost of producing a similar output bundle.

Sibbald, Ferguson and McKillop (2002) identified leadership as the key determinant for the growth of the credit union industry. The role of managers' ability in determining credit union performance was further emphasized when McKillop, Glass and Ferguson (2002), who investigated credit unions in the United Kingdom, found that credit unions were inefficient due to lack of competition not only with other financial institutions but also within the industry. If there is a lack of competition between credit unions, that could then justify Leibenstein's argument that difference between maximal utilization and actual utilization in firm-level production amid imperfect competition may cause X-(in)efficiency in the credit union industry.

Lang and Welzel (1998) explained that larger banks are able to dominate market power by mergers and acquisition, while other banks concentrate on minimizing cost. However, credit unions do not operate with the same objectives as commercial financial institutions. Bauer, Miles and Nishikawa (2009) described that commercial banks may merge to gain on the market value, but the aim of credit unions is to improve the deposit amount and lending rates offered to members if they decide to improve performance by merger. Goddard, McKillop and Wilson (2002) described that the ability to increase business is an advantage for larger credit unions, but smaller credit unions strive to survive in business by attracting new members. Smaller credit unions' growth is more manageable than the larger credit unions. In order to improve in X-efficiency, credit unions have to reduce cost instead of only opting for merger (Garden and Ralston, 1999). According to Garden and Ralston, it is inappropriate to only consider mergers as a tool to improve X-efficiency.

The structure of a credit union provides more opportunity to reduce operational costs than other types of financial institutions. Upon observing Irish credit unions, Glass, McKillop and Rasaratnam (2010) found that 68 percent of Irish credit unions did not face extra opportunity costs of conforming with bad debt guidelines due to information advantages the common bond provides the credit union industry. Glass and McKillop (2006) described that if credit unions were operated in equivalent environments, only minimal differences would have been observed in their managerial performance, which is the ability to reduce cost of operation by selecting an appropriate input mix.

2.4. Deregulation

Financial deregulation has augmented competition among depository institutions (Bundt and Keating, 1988). Black and Dugger (1981) described the effects of gradual deregulation on

credit unions. Black and Dugger explained that as a result of legislation passed in 1976, 1978 and 1980, credit unions were authorized to offer services in the form of longer loan maturities, lines of credit, higher loan ceilings, 30 year mortgage loans, and 15 year home improvement loans. These pieces of legislation provided credit unions with improved competitive power but weakened the traditional image of credit unions serving very specific groups of members with modest means. Due to deregulation, adding diversified groups of people under the common bond membership was possible (Glass and McKillop, 2006). Deregulation positioned that credit union membership is no longer focused upon individuals of "limited financial means". The 1998 Credit Union Membership Access Act permitted credit unions to add select employee groups to their fields of membership. Under this Act, a company may offer credit union membership as a benefit to employees and their families, can add all of its employees to the member base of the credit union, and, without additional fees or operating charges, allow employees to enjoy the benefits of being a credit union member. The extension of common bond requirements has provided credit unions with access to additional geographic areas which enable them to compete more effectively other financial institutions.

Diverse regulatory obligations create dissimilar modes of operation for credit unions. State chartered credit unions enjoy more liberal regulatory restrictions than federal chartered credit unions, which enable larger, state chartered credit unions to exploit growth opportunities more than federal chartered credit unions (Goddard, McKillop and Wilson; 2002). In essence state chartered credit unions enjoy a lower regulatory burden than federal chartered credit unions. This allows more space for state chartered credit unions to affect credit union policy. Tokle and Tokle (2000) observed that occupational and associational federal credit unions can add only new common bond groups under 3,000, while community federal credit unions can operate only in a

well-defined local area. Apart from the charter types, types of common bond also affect the operating environment in the credit union industry. Differences in type of common bond are connected to expense preference behavior, as Frame, Karels, and McClatchey (2003) clarified. These researchers concluded that residential, common bond credit unions appear to engage in expense preference behavior. Credit unions were also found to switch to another type of common bond to exploit membership opportunities. Goddard, McKillop and Wilson (2008) noticed a number of conversions from occupational common bonds to community common bonds.

2.5. Off-balance sheet activities

In an effort to discuss risk reduction through off-balance sheet operations, Boot and Thakor (1991) said that banks experience lower asset risk if they have a loan commitment service. However Berger and Humphrey (1991) emphasized cost minimization more than mixing services with various products as part of off-balance sheet activities. Hassan, Karels and Peterson (1994) found empirical evidence of the existence of 'market discipline' of off-balance sheet activities and termed off-balance sheet items as 'risk-reducing'. Jagtiani, Nathan and Sick (1995) found little or no impact of using off-balance sheet operations on cost, but it was possible to move to an optimal output level by using off-balance sheet items. Angbazo (1997) credited off-balance sheet operations with helping achieve higher profitability along with higher risk. Inclusion of off-balance sheet items in the overall firm level cost function was proposed by Clark and Siems (2002), who found cost X-efficiency scores rising with inclusion of off-balance sheet items. In their study of European banks, Casu and Girardone (2006) found that most of the impact on technological change was caused by off-balance sheet items.

2.6. Influence of macroeconomic variables

Several studies were conducted to address the influence of macroeconomic variables on the behavior of financial institutions. Saunders and Schumacher (2000) found a positive effect of macroeconomic policies regarding reduced interest rate volatilities on the reduction of bank margins. Morgan, Rime and Strahan (2003) discovered that the merger of banks with other states' banks caused fluctuations of employment growth contracts. Calza, Gartner and Sousa (2003) observed loan behaviors and stated that these are related to real GDP and long-term interest rates.

Macroeconomic environment also influences the performance credit union industry. Credit unions are about 75% as sensitive to macroeconomic shocks as banks (Smith and Woodbury, 2010). Underserved communities with lower level of income benefit from the services of credit unions (Isbister, 1994). On the other hand, the sizes of income at the county level modulate the bank-credit union competition (Emmons and Schmid, 2004). The fluctuations in business cycle also affect the performance of credit unions. The cyclical unemployment trends help explains the movements of lending growth in credit unions (Smith and Woodbury, 2010).

In this study we want to observe the differences in X-efficiency of credit unions that deregulation in 1998 has brought. We also want to observe the effect of off-balance sheet activities on the managerial ability to reduce the costs of operation before and after the deregulation periods and before and after the economic down turns.

CHAPTER 3. METHODOLOGY

3.1. Theoretical framework

3.1.1. Approaches to X-efficiency calculation

Several studies were published regarding the measurement of firm efficiency. The approaches are generally either profit maximization or cost minimization. While measurements of technical efficiency and scale efficiency can be done by either of the approaches, the measurement of X-efficiency has always been a cost minimization approach. Researchers argue over whether the choice of method should be either the data envelopment analysis (DEA) or the stochastic frontier analysis (SFA) approach. Both methods have their advantages and disadvantages. While the former requires no assumption of a production function, the later requires a specification and provides error terms. Majumdar (1995), Garden and Ralston (1999), Sathye (2001), Neal (2004), and Hassan (2005), used DEA in calculating X-efficiency scores for their studies. While Gardner and Grace (1993), DeYoung (1997), Clark and Siems (2002), Kwan (2006), Lieu, Yeh and Chiu (2006), and Fu and Heffernan (2007) used SFA in calculating X-efficiency scores for their research. This study used the DEA method for calculation of X-efficiency scores of U.S. credit unions.

3.1.2. Production possibility sets

The Production Possibility Set (PPS) contains all feasible correspondences of input and output vectors. The relative performance of any decision making unit (DMU) can be estimated once their position in a PPS is identified. Thanassoulis, Portela and Despic (2008) described the theory of PPS as follows.

Let the PPS be *T*, such that

$$T = \{(x,y) \in \mathbb{R}_{+}^{m+s} \mid x \text{ can produce } y \}.$$

The PPS *T* contains all the feasible correspondences of input levels $x \in \mathbb{R}_+^m$ capable of producing output levels $y \in \mathbb{R}_+^s$. In defining *T* non-negativity of data $\mathbb{R}_+^m$, $\mathbb{R}_+^s$, $\mathbb{R}_+^{m+s}$ is presumed. An input set L(y) is the subset of all input vectors $x \in \mathbb{R}_+^m$ yielding at least y, and a production set P(x) is the subset of all output vectors $y \in \mathbb{R}_+^s$ that are obtained from x. An input set is defined as

$$L(y) = \{x \mid (x, y) \in T\} \text{ or } L(y) = \{x \mid y \in P(x)\}$$

A production technology defined by L(y) has some relevant subsets that are useful for efficiency measurement. Two subsets of interest are: the isoquant and the efficient subset. The input isoquant of L(y) is defined as

$$I(y) = \{ x \mid x \in L(y), \lambda x \notin L(y), \lambda < 1\}$$

The efficient subset of L(y) is defined as

$$E(y) = \{ x \mid x \in L(y), \ x' \leq x \text{ and } x' \neq x \ \rightarrow \ x' \notin L(y) \}$$

These definitions imply that $E(y) \subseteq L(y)$

Figure 3.1 illustrates the input correspondence for the case of constant returns to scale (CRS) technology. The input set L(y) is the space to the right and above the piecewise linear boundary (A'ABCDD'). I(y) is the boundary A'ABCDD' and the efficient subset E(y) is the part of the isoquant ABC (without the vertical and horizontal extensions).

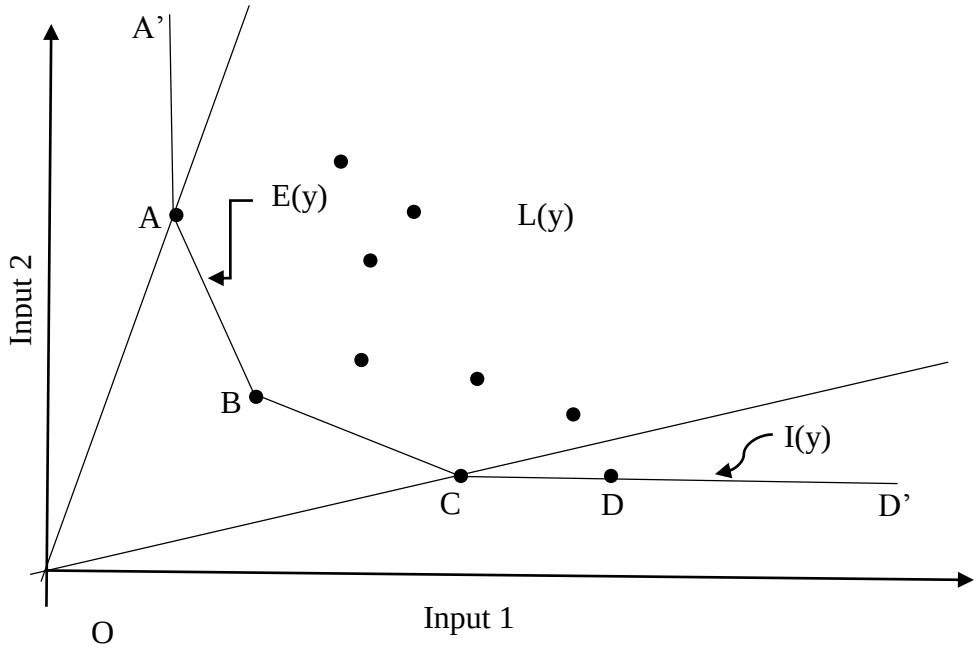

Figure 3.1: Input space representation

3.1.3. Theory of cost minimization

Nicholson and Snyder (2008) explained the theory of cost minimization as the economic cost of any input is the payment required to keep that input in its present employment. If there are only two inputs: homogeneous labor (*l*) and homogeneous capital (*k*), and perfectly competitive market rental rates *w* and *v* respectively, then

$$\text{total costs} = C = wl + vk.$$

Mathematically,

$$\frac{w}{v} = \frac{\delta f/\delta l}{\delta f/\delta k} = \text{Marginal rate of technical substitution, } RTS \text{ (}l\text{ for }k\text{)}$$

which leads to the optimization principle of cost minimization, which is: in order to minimize the cost of any given level of input (q_o), the firm should produce at that point on the q_o isoquant for which the *RTS* (of *l* for *k*) is equal to the ratio of the inputs' rental prices (*w/v*).

Graphically, given the output isoquant q_0, the cost minimizing input combination is l^*, k^*. The condition for this minimization is that the rate at which k and l can be traded technically which should be equal to the rate at which these inputs can be traded in the market.

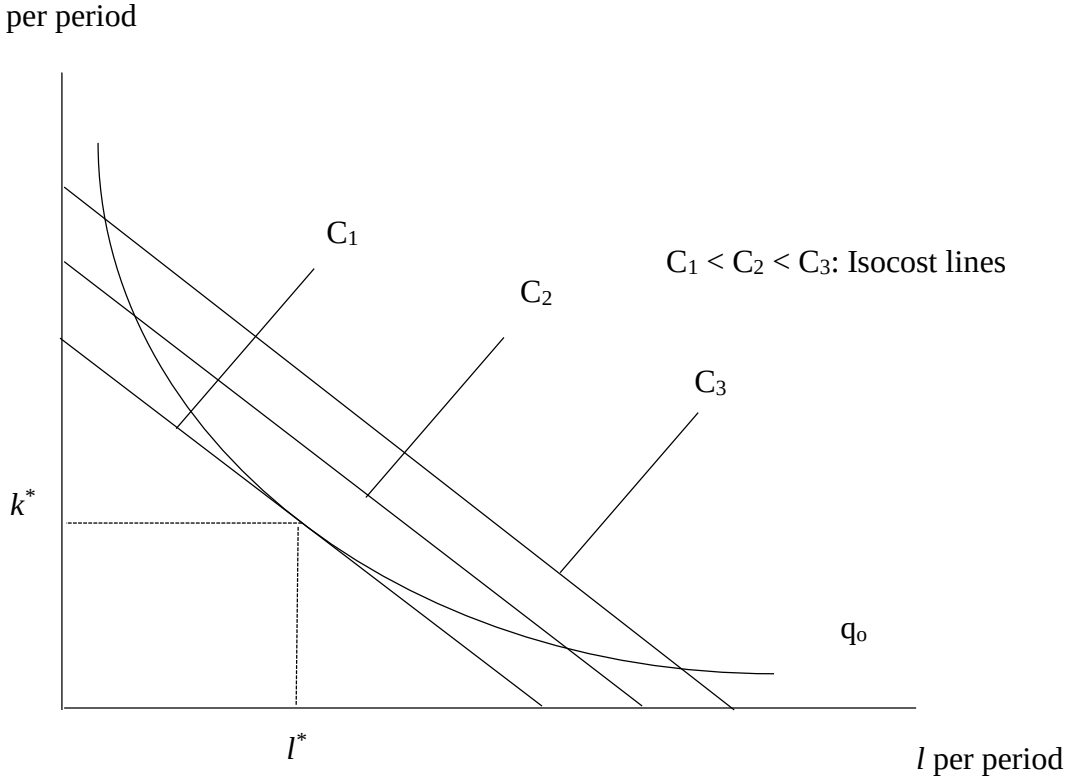

Figure 3.2: Minimization of costs

3.1.4. Cost function

Fried, Lovell and Schmidt (2008) provided the following explanation of cost function:

Suppose that producers face input prices $w = (w_1,\ldots w_N) \in R^N_{++}$ and seek to minimize cost. Then, a minimum cost function, or a cost frontier, is defined as

$$c(y,w) = \min_x\{w^T x : D_1(y,x) \geq 1\}$$

If the input sets L(y) are closed and convex, and if inputs are freely disposable, the cost frontier is dual to the input distance function in the sense of the prior equation of c(y,w) and

$$D_1(y,x) = \min_w\{w^T x : c(y,w) \geq 1\}$$

A measure of X-efficiency XE is provided by the ratio of minimum cost to actual cost:

$$XE(x,y,w) = c(y,w)/w^{T}x$$

3.2. Empirical framework

3.2.1. Evolution of data envelopment analysis (DEA)

Farrell (1957) proposed the measurement of technical efficiency as the equiproportional reduction of all inputs holding output at current levels. Farrell provided the formulation to handle a single output in the case of constant returns to scale (CRS). Farrell and Fieldhouse (1962) later amended the method by allowing a linear program in the case of increasing returns to scale. Proportional reduction in observed inputs holds the output mix constant. Cost minimization, however, requires not only production on the isoquant but also the appropriate mix of inputs that depends on the associated input prices. Hence, if technically efficient firms are not using the allocatively efficient input mix, these firms could still lower costs by adjusting input levels accordingly. Afriat (1972) proposed a formulation for technical efficiency measurement that was consistent with data envelopment analysis (DEA). Fare, Grosskopf and Lovell (1994) provided the theoretical details of efficiency measurement. In their seminal work, Charnes, Cooper and Rhodes (1978) used the linear programming method (CCR model) to estimate the empirical production technology frontier of an observed decision making unit (DMU) assuming constant returns to scale. Their work is marked as the introduction of data envelopment analysis (DEA). Later, Banker, Charnes and Cooper (1984) extended the CCR model (to BCC model) to allow variable returns to scale (VRS).

3.2.2. Input-oriented measures of technical and X-efficiency

Coelli et al. (2005) provided the fundamental account of input-oriented measures of production technology. In Figure 3.2, the unit isoquant line SS’ represents fully efficient firms,

which helps measure the technical efficiency. When any given firm uses P quantities of inputs to produce a unit of output, the distance QP represents the technical inefficiency – an amount by which input quantities can be reduced without compromising output. The ratio QP/OP represents the percentage by which input quantities have to be reduced to achieve technically efficient production. The technical efficiency (TE) of a firm is measured by the ratio

$$TE = OQ/OP$$

which is equal to one minus QP/OP. For a fully technically efficient firm this value is 1. The point Q is technically efficient.

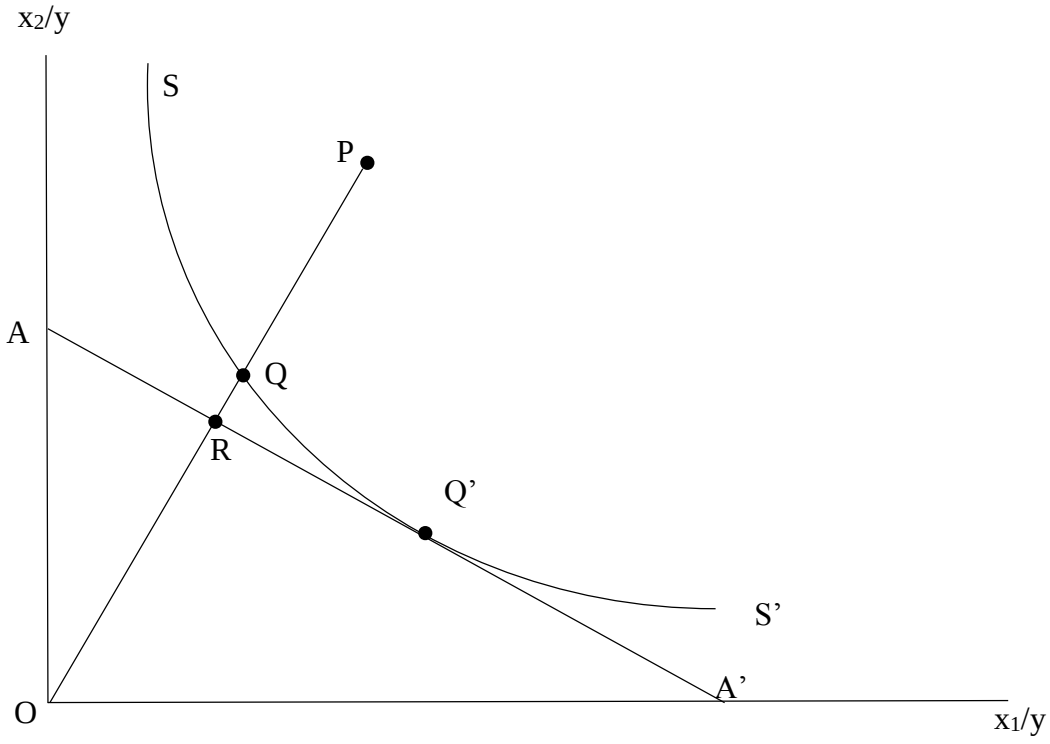

Figure 3.3: Input-oriented measure of technical and X-efficiency

The input-oriented measure of technical efficiency of a firm can be expressed in terms of input-distance function $d_i(x,y)$ as:

$$TE = 1/\ d_i(x,y)$$

Any given firm will be on the technical frontier if $TE = 1$ and $d_i(x,y)$ is also equal to 1.

Measurement of the X-efficiency (*XE*) requires information on input price. Where:

w represents the vector of input prices,

x represents the observed vector of inputs used associated with point P

$\hat{x}$ represent the input vector associated with the technically efficient point Q

and x* represent the input vector associated with the cost-minimizing input vector at Q'.

Then X-efficiency of the firm is defined as the ratio of input costs associated with input vectors, x and x*, associated with points, P and Q'. Thus

$$XE = \frac{w'x^*}{w'x} = \frac{OR}{OP}$$

If the input price ratio, represented by the slope of the isocost line, AA', in Figure 3.2, is also known, then allocative efficiency (*AE*) and technical efficiency measures can be calculated using the isocost line. These are given by:

$$AE = \frac{w'x^*}{w'\hat{x}} = \frac{OR}{OQ}$$

$$TE = \frac{w'\hat{x}}{w'x} = \frac{OQ}{OP}$$

The distance RQ represents the reduction in production costs that would be attained if production were to occur at the allocatively (and technically) efficient point Q', instead of at the technically efficient, but allocatively inefficient, point Q.

Once *TE* and *AE* are known, the total overall X-efficiency (*XE*) can be expressed as a product of technical and allocative efficiency measures:

$$TE \times AE = (OQ/OP) \times (OR/OQ) = (OR/OP) = XE$$

3.2.3. Return to scale assumption

The construction of a PPS requires an assumption on the nature of returns to scale. The term "returns to scale" describes the technology under which a DMU operates. Returns to scale relate to how average product would be affected by scale size if production is efficient. If operation is not efficient, changes in average product as scale size changes can be due both to changes in efficiency or changes in scale size and it would not be possible to differentiate between the two. Thanassoulis, Portela and Despic (2008) explained the difference between constant return to scale (CRS) and variable return to scale (VRS) for a single input-output case, which is illustrated in figure 3.3. The ray from the origin separates the PPS to the right side of it under the CRS assumption. PPS is convex under the VRS assumption and is bound by the right side of VRS frontier in figure 3.3. DMU C is inefficient both under CRS and VRS. Input oriented technical efficiency under VRS assumption is calculated as $E_{VRS} = OA' / OA$, while the measure of technical efficiency is calculated in relation to the CRS frontier as $E_{CRS} = OA'' / OA$. The difference arises because under VRS, DMU C can be compared to virtual DMU C'', which represents a convex combination of two observed DMUs so that it offers the same scale size as C on the output. The major difference between CRS and VRS is that the latter does not permit extrapolation of scale size from observed DMUs or their convex combination.

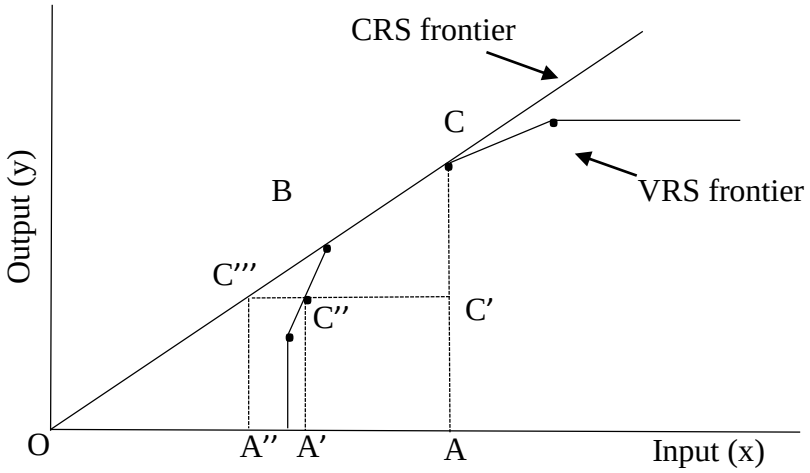

Figure 3.4: Returns to scale assumption in DEA

3.2.4. Efficiency calculation by linear programming formulation

Let input prices faced by credit unions are represented as $w = (w_1, w_2, \ldots . w_n) \in R^+$,

output prices faced by credit unions are represented as $p = (p_1, p_2, \ldots . p_m) \in R^+$,

number of credit unions are represented as k,

number of inputs represented as n,

number of outputs are represented as m,

credit union of interest is represented as I,

the intensity variable is represented as z.

Then n*k will be the input matrix (X) and m*k will be the output matrix (Y).

3.2.5. Technical efficiency under CRS

Let, technical efficiency under CRS be *TEC*.

$$\text{Min } TEC_i$$

s. t.

$$\sum_{k=1}^{K} x_{nk} z_k \leq TEC_i x_{ni} \quad ;$$

$$\sum_{k=1}^{K} y_{mk} z_k - y_{mi} \geq 0 \; ;$$

$$z_k \geq 0$$

The firm is technically efficient if $TEC_i = 1$. Conversely if $TEC_i < 1$, the firm is technically inefficient.

3.2.6. Technical efficiency under VRS

Let, technical efficiency under VRS be *TEV*.

$$\text{Min } TEV_i$$

s. t.

$$\sum_{k=1}^{K} x_{nk} z_k \leq TEV_i x_{ni} \quad ;$$

$$\sum_{k=1}^{K} y_{mk} z_k - y_{mi} \geq 0 \; ;$$

$$\sum_{k=1}^{K} z_k = 1 \; ;$$

$$z_k \geq 0$$

The firm is technically efficient if $TEV_i = 1$. Conversely if $TEV_i < 1$, the firm is technically inefficient.

Scale efficiency is estimated by dividing TEC_i by TEV_i for each credit union.

3.2.7. X-efficiency (*XE*)

X-efficiency is calculated by dividing the minimum cost under VRS by the actual cost.

$$XE_i = C_i(w, y, S_v) / w_i x_i$$

The minimum cost under the VRS technology is solved by the following LP formulation:

$$C_i(w, y, S_v) = \text{Min } w_i x_i$$

s. t.

$$\sum_{k=1}^{K} x_{nk} z_k \leq x_{ni} \quad ;$$

$$\sum_{k=1}^{K} y_{mk} z_k - y_{mi} \geq 0 \; ;$$

$$\sum_{k=1}^{K} z_k = 1 \; ;$$

$$z_k \geq 0$$

Allocative efficiency can be estimated by dividing X-efficiency scores by technical efficiency scores under the VRS.

$$AE_i = C_i(w, y, S_v)/ w_i\ TEV_i\ x_i = XE_i / TEV_i$$

3.2.8. Test for efficiency comparison

Banker, Zheng and Natarajan (2010) suggest three nonparametric tests for efficiency comparison including a median test, the Mann-Whitney test, and the Kolmogorov-Smirnov test. These tests are based on order statistics. The Mann-Whitney test, which is also known as the Wilcoxon–Mann–Whitney (WMW) test, is used to test the differences in X-efficiency scores calculated without off-balance sheet activities and with off-balance sheet activities.

The WMW test is run on two independent samples from two populations. It is a statistical test of the difference between the two medians (η1 and η2) under the null hypothesis that they have no difference. The WMW test requires combining two samples into one column, followed by ranking from smallest to largest. Then total rank scores (U) are summed up for the original samples.

An expected score is calculated to test for significance:

$$E(U) = n_u\,(N + 1)/2$$

where $E(U)$ is the expectation of U, n_u is the sample size of the sample being tested, and N is the total sample size $N = n_1 + n_2$. The difference between the observed and expected rank sums is estimated through the use of a normal distribution; the area under the curve of a z-distribution:

$$z = \frac{U - E(U)}{\sqrt{n_1 n_2 (N+1)/2}}$$

3.3. Explaining differences in efficiency scores

Tobin (1958) introduced the Tobit model specification for analytical purposes pertaining to the estimation of relationships for limited dependent variables. DEA X-efficiency scores estimated in the first stage are the dependent variables for the Tobit regression. The differences in X-efficiency scores are explained in the second stage by some variables not directly included in DEA models. In a standard Tobit model the dependent variable is either zero or some positive number (Maddala, 1983).

3.3.1. Tobit model

$$y_i^* = x_i\beta + \epsilon_i \quad \text{where } \epsilon_i \sim N(0, \sigma^2).$$

y^* is a latent variable that is observed for values greater than τ and censored otherwise.

The observed y,

$$y_i = y^* \qquad \text{if } y^* > \tau ;$$

$$y_i = \tau_y \qquad \text{if } y^* <= \tau$$

In a typical tobit model, $\tau = 0$. Thus,

$$y_i = y^* \qquad \text{if } y^* > 0 ;$$

$$y_i = 0 \qquad \text{if } y^* <= 0 ;$$

where x_i is a vector of explanatory variables, β is a vector of unknown parameters, y_i^* is a latent variable and y_i is the efficiency score.

3.4. Data and variables

The NCUA 5300 Call Report from 1994 to 2012 was used as a data source for U.S. credit unions. Statistics regarding the unemployment rate, house price index and per capita income were collected respectively from data from the U.S. Bureau of Labor Statistics, the Federal Housing Finance Agency, and the U.S. Bureau of Economic Analysis data. To understand the consequences

of deregulation in 1998, and the two economic downturns in 2002 and 2008-2009, data were divided into four panel datasets for each of the periods – 1994 to 1998, 1999 to 2001, 2002 to 2007, and 2008 to 2012. Since large versus small banks (applied to credit unions in this study) are likely to produce dissimilar services for different customers, differences in terms of asset size may produce a misspecification problem (Jagtiani and Khanthavit, 1996). So, in analyzing scale and scope economies at large banks, Jagtiani and Khanthavit divided the sample size into four quartiles according to asset size. This current research divided credit unions into four quartiles according to asset size for each year.

Input and output variables for building efficiency models differ among various approaches. The most commonly employed approaches are production, intermediation, and profit (Pasiouras, 2008). Under the production approach, financial institutions are defined as the providers of services to the account holders, whereas under the intermediation approach, the role of financial institutions is perceived as intermediating funds between savers and investors. Since it is challenging to accumulate data on service flow, the book value of the firms (bank) assets is presumed to be equivalent to service flow data under intermediation approach. Berger and Humphrey (1997) reasoned that the production approach is appropriate for analyzing the efficiency of bank branches; however, for the analysis of entire banking institutions, the intermediation approach is more suitable. This study adopted the intermediation approach for analyzing performance(s) of credit unions as financial intermediaries. As previously indicated, the absence of the profit-maximization motive of credit unions makes the profit approach questionable.

The identification of input and output variables remains another subject undeveloped and open to debate. Table 3.1 lists some of these variables used in existing literature. According to Berger and Humphrey (1997), loan and other major assets should be counted as outputs, but debate

persists over inclusion of deposits as an input or output variable. This study included fixed assets, total deposits, and employee compensation as input variables; on the other hand, this study also included total loans, total investments and off-balance sheet items as output variables. Interest payments to member deposits by credit unions, and the usability of deposited fund as primary investable basis for credit unions validate this inclusion. Cost of input was calculated by the asset price (as a ratio of fixed asset to total asset), deposit price (as a ratio of total of interest expense plus other expense to total deposit), and the price of labor (as a ratio of personnel expense to total asset).

To understand the variation in performance across the credit union industry, X-efficiency scores were regressed on the total assets and the number of credit union members as size factors (Jackson and Fethi, 2000; Loikkanen and Susiluoto, 2002; McDonald, 2009; Ismail, Rahim and Majid; 2011); the ratio of net income to total assets as a profitability measure (Jackson and Fethi, 2000; Chang and Chiu, 2006; Pasiouras, 2008; Altunbas and Marques, 2008; Altunbas, Gambacorta and Ibanez, 2010; Ismail, Rahim and Majid; 2011); the ratio of delinquent loan to total loans as the delinquency ratio (Fried, Lovell and Eeckaut; 1993; Bauer, Miles and Nishikawa; 2009); the ratio of total loans to total assets as a measure of intermediation activity (Chang and Chiu, 2006; Pasiouras, 2008; Altunbas and Marques, 2008; Altunbas, Gambacorta and Ibanez, 2010); the ratio of equity to total assets as a measure of capital adequacy (Pasiouras, 2008 and Altunbas, Gambacorta and Ibanez, 2010, Ismail, Rahim and Majid; 2011); the ratio of total customer loans to total deposits as a measure of deposit activity (Altunbas and Marques, 2008); the number of branches (Pasiouras, 2008) and charter type as a dummy variable to differentiate among institutional categories (Jackson and Fethi, 2000; Chang and Chiu, 2006 ; Altunbas, Gambacorta and Ibanez, 2010); and macroeconomic variables such as house price index

representing housing market (Drake, Hall and Simper, 2006; Koetter and Poghosyan, 2010), the unemployment rate (Loh and Tan, 2002), and per capita income (Attanasio, Goldberg and Kyriazidou; 2008).

Table 3.1: Input and output variables under the intermediation approach

Studies/Reference	*Input variables*	*Output variables*
Rangan et al (1988)	Employee compensation, capital, purchased funds	Loans, deposits
Aly et al (1990)	Employee compensation, capital, loanable funds	Loans, demand deposit
Burger and Humphrey (1991)	Labor compensation, purchased funds, capital	Deposits, loans
Yue (1992)	Interest expenses, Non-interest expenses, deposits	Interest income, non-interest income, total loans
Casu and Molyneux (2003)	Total expenses (interest, non-interest, personnel), total deposits	Total loans, other earning assets, off-balance sheet items
Staub, Souza, and Tabak (2010)	Operational expenses net of personnel expenses, personnel expenses, interest expenses	Total loans net of provision loan, investments, deposits
Ismail, Rahim and Majid (2011)	Fixed assets, total deposits, personnel expenses	Total loans, other earning assets, off-balance sheet items
Doumpos and Zopounidis (2013)	Deposits and short-term funding, fixed assets, loan loss provisions	Loans, other earning assets

3.5. Summary statistics

The averages of input and output variables (in million dollars) are presented in the Table 3.2 and Table 3.3 by asset quartiles and by study periods.

Table 3.2: Input and output variables (average) of non-metro credit unions (in million dollars)

Quartile	Period	Observations	Total assets, $	Fixed assets, $	Deposits, $	Compensation, $	Loans, $	Investments, $	OBS, $
1st	1994-1998	10,435	0.707	0.003	0.595	0.013	0.453	0.222	0.008
	1999-2001	5,802	0.926	0.004	0.763	0.018	0.568	0.315	0.007
	2002-2007	9,288	1.503	0.008	1.241	0.030	0.861	0.546	0.038
	2008-2012	6,635	2.147	0.014	1.776	0.046	1.090	0.637	0.115
2nd	1994-1998	10,430	3.173	0.025	2.732	0.059	2.078	0.979	0.076
	1999-2001	5,799	4.424	0.043	3.759	0.086	2.793	1.401	0.197
	2002-2007	9,288	7.213	0.098	6.116	0.140	4.091	2.635	0.510
	2008-2012	6,630	10.589	0.173	9.016	0.205	5.291	3.637	1.029
3rd	1994-1998	10,430	10.026	0.152	8.750	0.175	6.365	3.229	0.817
	1999-2001	5,799	14.298	0.251	12.347	0.259	9.075	4.360	1.485
	2002-2007	9,288	23.373	0.492	20.125	0.435	13.867	7.727	3.045
	2008-2012	6,635	35.934	0.882	31.278	0.652	19.528	11.127	5.423
4th	1994-1998	10,430	103.712	1.901	90.865	1.523	65.221	33.799	18.914
	1999-2001	5,799	152.637	2.880	132.409	2.336	100.453	43.101	28.489
	2002-2007	9,282	284.886	5.737	241.968	4.312	189.674	74.886	70.347
	2008-2012	6,630	468.656	10.603	397.232	7.011	299.889	114.215	142.000

Table 3.3: Input and output variables (average) of metro credit unions (in million dollars)

Quartile	Period	Observations	Total assets, $	Fixed assets, $	Deposits, $	Compensation, $	Loans, $	Investments, $	OBS, $
1st	1994-1998	2,975	0.977	0.005	0.828	0.018	0.643	0.298	0.005
	1999-2001	1,698	1.339	0.007	1.113	0.026	0.850	0.426	0.011
	2002-2007	2,778	2.296	0.014	1.917	0.045	1.323	0.828	0.082
	2008-2012	1,950	3.319	0.024	2.770	0.068	1.680	1.062	0.236
2nd	1994-1998	2,970	4.166	0.041	3.597	0.074	2.712	1.295	0.149
	1999-2001	1,695	5.736	0.071	4.886	0.107	3.720	1.708	0.324
	2002-2007	2,772	9.260	0.148	7.892	0.172	5.462	3.165	0.811
	2008-2012	1,945	13.948	0.299	12.028	0.254	7.219	4.450	1.661
3rd	1994-1998	2,970	12.693	0.220	11.101	0.214	8.048	4.086	1.108
	1999-2001	1,695	17.789	0.361	15.415	0.317	11.381	5.252	2.053
	2002-2007	2,772	29.551	0.767	25.569	0.539	17.712	9.412	4.059
	2008-2012	1,950	45.041	1.248	39.256	0.809	24.822	13.824	7.004
4th	1994-1998	2,970	105.304	2.264	93.385	1.629	69.083	31.065	17.872
	1999-2001	1,695	155.031	3.493	136.172	2.508	107.788	37.580	26.731
	2002-2007	2,772	281.289	6.647	244.515	4.566	190.919	70.256	71.466
	2008-2012	1,945	492.470	12.797	428.568	7.455	304.682	120.753	152.452

CHAPTER 4. RESULTS AND INTERPRETATION

4.1. First Stage: data envelopment analysis (DEA)

This study attempted to observe the performances of non-metro and metro credit unions separately because the nature of relationships with borrowers in locally owned smaller banks requires local bankers to possess more expertise in the needs and circumstances of local producers than employees of large regional banks (Neff and Ellinger, 1996). It is also possible that in a less competitive rural market one dominant lending institution may affect relationship-based and small business lending (Cyree and Spurlin, 2012).

Table 4.1 exhibits various measures of efficiencies to understand the different aspects of production techniques. Technical efficiency (TE) scores under VRS were calculated to compare performance under concurrent technologies, scale efficiency (SE) scores were calculated to compare performance at the optimal size of firm level operation, allocative efficiency (AE) scores were calculated to compare the ability to mix inputs that produce at minimum cost, and X-efficiency (XE) scores under VRS were calculated to compare managements' ability to operate with minimum operation cost.

Non-metro credit unions in the first quartile performed relatively lower than results reported in other studies. Glass and McKillop (2006) estimated cost efficiency as 91% (approximately) for larger credit unions during 1994 to 2001. Doumpos and Zopounidis (2013) found that cooperatives were 75.5% technically efficient and 91.4% scale efficient during 2005 to 2010 when viewing European cooperatives. This current study found that the first quartile of non-metro credit unions improved efficiency immediately after the enactment of Credit Union Membership Access Act (1998). The most improvement was observed in scale efficiency, which increased by 7.4% (See Table 4.1). The improvement in average X-efficiency score rose by 4.5%.

Table 4.1: Efficiency scores of non-metro credit unions

Quartile	Period	Technical efficiency	X-efficiency	Scale efficiency	Allocative efficiency	Technical efficiency with OBS	X-efficiency with OBS	Scale efficiency with OBS	Allocative efficiency with OBS
1st	1994-1998	0.635	0.515	0.506	0.811	0.637	0.516	0.509	0.811
	1999-2001	0.660	0.560	0.580	0.847	0.663	0.563	0.585	0.847
	2002-2007	0.697	0.610	0.615	0.875	0.704	0.616	0.621	0.875
	2008-2012	0.625	0.515	0.578	0.824	0.639	0.533	0.607	0.833
2nd	1994-1998	0.724	0.592	0.900	0.826	0.736	0.604	0.906	0.828
	1999-2001	0.702	0.548	0.893	0.790	0.714	0.560	0.899	0.792
	2002-2007	0.701	0.611	0.870	0.877	0.716	0.624	0.879	0.877
	2008-2012	0.722	0.652	0.918	0.906	0.749	0.680	0.923	0.911
3rd	1994-1998	0.787	0.739	0.935	0.940	0.795	0.749	0.938	0.943
	1999-2001	0.742	0.694	0.922	0.938	0.750	0.701	0.924	0.938
	2002-2007	0.747	0.686	0.918	0.919	0.764	0.706	0.923	0.926
	2008-2012	0.761	0.712	0.944	0.938	0.770	0.720	0.943	0.938
4th	1994-1998	0.710	0.673	0.898	0.951	0.734	0.697	0.909	0.952
	1999-2001	0.654	0.581	0.891	0.891	0.689	0.616	0.903	0.898
	2002-2007	0.637	0.563	0.896	0.887	0.669	0.599	0.907	0.899
	2008-2012	0.709	0.671	0.877	0.950	0.718	0.679	0.877	0.950

The ability to add member groups might have helped credit unions increase fee income from additional services offered to members. The increase in average X-efficiency score also indicates the progress in managerial ability to reduce the cost ratio relative to total output produced. Credit unions x-efficiency increased after the recession in 2002. A 5% increase in XE in comparison with previous time periods revealed that managers' ability to operate at minimum cost helped non-metro credit unions to withstand the economic downturn. However, after the financial crisis in 2008-2009, non-metro credit unions suffered in all measurements of performance. Average XE scores faced a sharp decline of 9.5% compared to the previous time period. The contribution of off-balance sheet items to XE scores from 1994 to 2001 did not lead to a statistically different score (See Table 4.2). During the economic crisis, OBS items helped improve the XE scores. Non-metro credit union XE scores increased more after the crisis of 2008-09 than during 2002-07. This may suggest that, even though during the period of largest decline in managerial performance, this quartile of non-metro credit unions successfully improved performance through the use of OBS activities.

The second quartile of non-metro credit unions showed greater improvement in TE, SE and AE scores than the first quartile throughout the study periods. The most noticeable improvement was observed in the average scale efficiency scores compared to any other efficiency measures. If we compare score averages of first and second quartiles of non-metro credit unions by periods, the averages in second quartile was at least 25% more than that of first quartile periods (See Table 4.1). Average scale efficiency scores in third and fourth quartiles were maintained around the score averages of second quartile. This may help infer that asset size supports developing the capability to perform at optimal size; in our observation of all non-metro credit unions, credit unions needed to be at least at second quartile to see improvement in scale efficiency

and they maintained it for other upper quartiles. Unlike the first quartile, this quartile of non-metro credit unions did not appear to benefit from deregulation, at least from the effects of the Credit Union Membership Access Act. On the contrary, these credit unions struggled to maintain performance during 1999-2001. However after the recession in 2002, this quartile exhibited improvement in AE and XE scores by 8.7% and 6.3% respectively. The ability to choose an optimal array of inputs helped this set of credit unions reduce operational costs, which was reflected in maintaining better managerial performance. After the financial crisis in 2008-09, this quartile of credit unions continued gaining in efficiency scores. The contribution of OBS items significantly improved performance throughout continuing periods ($p < .0001$). Similar to the first quartile, this quartile of non-metro credit unions also achieved better XE scores during 2008-12 through OBS activities.

Credit unions composing the third quartile exhibited better overall performance than the smaller quartiles in all efficiency measures. During the 1998-2001 time period, this asset group of credit unions also failed to capture the benefits of deregulation. Similar to the previous quartiles, this group of non-metro credit unions also struggled to maintain performances and scored lower than in the previous period. Unlike the first and second quartiles, the economic recession of 2002 reduced the overall efficiency performance during 2002-2007 for this quartile of credit unions. The effect of economic downturn may bring different consequences to credit unions of different asset size. The ability to act within a changed economic environment may also vary according to asset size. After the financial crisis in 2008-2009, this quartile showed improvement in efficiency scores. For this quartile, the contribution of OBS items in improving efficiency scores was significant ($p<.0001$) throughout the study periods.

Non-metro credit unions in the fourth quartile group were less efficient than those in the third quartile. This financial performance of credit unions in this quartile also did not benefit after the enactment of Credit Union Membership Access Act 1998. The decline in performance continued after the recession in 2002 as well. With the end of the financial crisis in 2008-2009, non-metro credit unions in this quartile improved their overall performance. The greatest improvement was seen in the XE score, an increase of 10.8% over the earlier period. The contribution of OBS activities towards the improvement in performance was significant ($p<.0001$) throughout the study period (See Table 4.2).

Table 4.2: Test of differences in X-efficiency scores without OBS activities and with OBS activities (non-metro credit unions)

Time Period	Quartile-1			Quartile-2		
	Z-value	p-value	Difference	Z-value	p-value	Difference
1994-1998	0.350	0.727	No	5.845	<.0001	Yes
1999-2001	0.920	0.357	No	4.100	<.0001	Yes
2002-2007	2.425	0.015	Yes	6.921	<.0001	Yes
2008-2012	6.160	<.0001	Yes	13.689	<.0001	Yes
	Quartile-3			Quartile-4		
	Z-value	p-value	Difference	Z-value	p-value	Difference
1994-1998	9.017	<.0001	Yes	16.850	<.0001	Yes
1999-2001	4.047	<.0001	Yes	17.364	<.0001	Yes
2002-2007	11.920	<.0001	Yes	19.630	<.0001	Yes
2008-2012	3.910	<.0001	Yes	3.909	<.0001	Yes

Credit unions composing the third quartile exhibited better overall performance than the smaller quartiles in all efficiency measures. During the 1998-2001 time period, this asset group of credit unions also failed to capture the benefits of deregulation. Similar to the previous quartiles, this group of non-metro credit unions also struggled to maintain performances and scored lower than in the previous period. Unlike the first and second quartiles, the economic recession of 2002 reduced the overall efficiency performance during 2002-2007 for this quartile of credit unions. The effect of economic downturn may bring different consequences to credit unions of different

asset size. The ability to act within a changed economic environment may also vary according to asset size. After the financial crisis in 2008-2009, this quartile showed improvement in efficiency scores. For this quartile, the contribution of OBS items in improving efficiency scores was significant ($p<.0001$) throughout the study periods.

Metro credit union average TE and SE scores (See Table 4.3) were greater than average European cooperative bank TE and SE scores, which were 75.5% and 91.4% respectively (Doumpos and Zopounidis, 2013). However, the XE score average, which is an indicator of managers' ability to operate at minimum cost, was lower than the cost efficiency score of credit unions (91%) calculated by Glass and McKillop (2006). One possible explanation for this finding may be that Glass and McKillop (2006) observed only larger credit unions. According to Glass and McKillop, smaller credit unions might have relied upon unpaid volunteers and availed themselves of subsidized rates on premises and equipment that would have provided them with an unequal comparison in reducing cost of operation to a minimum. In this study of all sizes of credit unions, the assumption of cost advantages for small scale credit unions by Glass and McKillop was not established.

Metro credit unions in the first quartile group exhibited greater efficiency scores when compared with the first quartile of non-metro credit unions. In comparison with non-metro credit unions' average TE, XE, SE and AE scores during 1994-1998, metro credit unions scored higher by 15.7, 19.3, 33.5 and 8.8 percent respectively (See Table 4.3). The most difference was observed in the average SE score. The persistence of the result suggests metro credit unions may have the ability to operate at optimal size better than non-metro credit unions. After deregulation in 1998, performance in all measures was reduced, and the largest reduction was observed in

Table 4.3: Efficiency scores of metro credit unions

Quartile	Period	Technical efficiency	X-efficiency	Scale efficiency	Allocative efficiency	Technical efficiency with OBS	X-efficiency with OBS	Scale efficiency with OBS	Allocative efficiency with OBS
1st	1994-1998	0.792	0.708	0.841	0.899	0.795	0.711	0.845	0.900
	1999-2001	0.768	0.678	0.546	0.890	0.776	0.686	0.565	0.891
	2002-2007	0.819	0.757	0.889	0.925	0.831	0.769	0.891	0.927
	2008-2012	0.762	0.646	0.855	0.852	0.779	0.666	0.874	0.858
2nd	1994-1998	0.834	0.800	0.952	0.961	0.844	0.811	0.954	0.962
	1999-2001	0.812	0.782	0.949	0.965	0.825	0.796	0.949	0.967
	2002-2007	0.818	0.782	0.940	0.958	0.839	0.803	0.945	0.958
	2008-2012	0.788	0.738	0.942	0.938	0.806	0.756	0.946	0.940
3rd	1994-1998	0.856	0.824	0.951	0.965	0.867	0.836	0.955	0.966
	1999-2001	0.861	0.833	0.956	0.969	0.866	0.837	0.956	0.967
	2002-2007	0.864	0.837	0.953	0.969	0.879	0.851	0.958	0.969
	2008-2012	0.840	0.800	0.942	0.954	0.846	0.806	0.941	0.954
4th	1994-1998	0.872	0.852	0.966	0.978	0.885	0.865	0.969	0.978
	1999-2001	0.860	0.846	0.959	0.984	0.867	0.851	0.960	0.983
	2002-2007	0.839	0.814	0.952	0.971	0.849	0.824	0.955	0.971
	2008-2012	0.797	0.770	0.937	0.967	0.807	0.780	0.935	0.967

average SE score compared to the earlier period the average SE score in this circumstance was 29.5% lower. Metro credit unions were able to improve performance after the recession in 2002. The XE score average increased by 7.9% compared to the earlier period while the SE score average recovered. During the recovery period after the financial crisis in 2008-2009, along with reductions in other measures, XE and AE scores were reduced by 11.1% and 7.3% respectively. The ability to operate with an appropriate input mix aiming at cost reduction may have lowered the XE score. OBS items did not significantly affect efficiency scores in the time periods before 2002 (See Table 4.4). However, credit unions were able to improve average XE scores significantly (p<.0001) after the economic recession through OBS activities. The second quartile of metro credit unions was more efficient in all measures than the smaller quartile. After the enactment of the Credit Union Membership Access Act 1998, average efficiency scores decreased, but credit unions in this quartile were able to maintain the efficiency scores after recession in 2002. Similar to the previous quartile, credit unions in this quartile also could not maintain the cost ratio of earlier period; the XE score average decreased by 4.4% compared to the previous time period. For this asset group, OBS items significantly (?) increased XE scores throughout the study period.

Table 4.4: Test of differences in X-efficiency scores without OBS activities and with OBS activities (metro credit unions)

Time Period	Quartile-1			Quartile-2		
	Z-value	p-value	Difference	Z-value	p-value	Difference
1994-1998	1.104	0.269	No	5.129	<.0001	Yes
1999-2001	1.735	0.083	No	4.598	<.0001	Yes
2002-2007	3.856	0.0001	Yes	7.570	<.0001	Yes
2008-2012	4.350	<.0001	Yes	4.993	<.0001	Yes
	Quartile-3			Quartile-4		
	Z-value	p-value	Difference	Z-value	p-value	Difference
1994-1998	6.535	<.0001	Yes	8.216	<.0001	Yes
1999-2001	1.454	0.146	No	2.812	0.005	Yes
2002-2007	6.471	<.0001	Yes	4.953	<.0001	Yes
2008-2012	1.917	0.055	No	2.939	0.003	Yes

The third quartile group of metro credit unions displayed improved performance compared to the first and second quartiles of metro credit unions and the X-efficiency score average is highest for this quartile among the all four quartiles during the economic recovery period (2008-2012). The average efficiency score improved in all measures during the period of 1998-2001 relative to first and second quartiles. Limited improvement in efficiency scores was observed after the recession in 2002. Like all other quartiles of metro credit unions the X-efficiency scores average also got decreased for this quartile of group after the financial crisis of 2008-09. The XE score average declined more than any other efficiency measures. Credit union manager's ability to make decisions regarding proper input mix to ensure firm operations at a minimum cost diminished. However, this quartile of credit unions showed better efficiency scores in all measures after the economic downturns in comparison with all other quartiles regardless of location. The impact of OBS items to improve the XE efficiency scores average was not significant after deregulation in 1998 or after the financial crisis of 2008-2009. Even so, credit unions experienced positive development in efficiency scores throughout the periods before deregulation and after the economic recession in 2002 by utilizing OBS activities.

The efficiency score averages were highest across all credit union quartile groups in the time periods before the economic recession of 2002 for the fourth quartile of metro credit unions. Efficiency scores decreased after deregulation in 1998. In fact, this quartile experienced a continuing decline in efficiency score averages for subsequent periods as well. Despite being the largest asset size group, these credit unions did not improve performance under the structural changes imposed by deregulation and the economic downturn. Managerial ability to operate at minimum cost weakened more during the recovery periods after each of the economic down turns than their ability was at the beginning of the study period, after the membership act and before the

financial crisis. The contribution of OBS items towards better managerial performance was significant ($p<.0001$) throughout the study periods.

4.2. Explaining the differences in efficiency scores

To better understand the effect of environmental variables on the differences of managerial performances in metro and non-metro credit unions throughout the study periods the Tobit regression results and analyses were prepared. Irrespective of the locations of credit unions and their quartiles, profitability of credit unions was found negatively related with the managerial performances. Which helps infer that credit unions shouldn't target to improve both the X-efficiency and profitability together; a drive towards the profit making strategies may increase the cost ratio. Capital adequacy, which is a measure of total equity to total asset, had a positive effect on the X-efficiency scores. More equity investment in credit unions helps the managers better to manage the operations. Deposit activity, a ratio of total loans to total deposits, was positively related with X-efficiency scores. So, if more loans are offered, it helps credit unions keeping the cost ratio low. A more in-depth discussion on the effects of each of the environment variables is presented below.

Total assets: With an increase in the amount of total assets, X-efficiency scores improved for the first and third quartiles for non-metro credit unions (See Tables 4.5 to 4.12). The second and fourth quartiles groups of non-metro credit unions showed slight negative performance measures with the increase in asset size during the recovery period after the financial crisis in 2008-2009. Metro credit unions exhibited improvement in XE scores with the increase in total assets. However for the second quartile group of metro credit unions, improvement was not significant during the period 1999-2001or for the third quartile of metro credit unions during the recovery period of 2008-2012. In general, asset size has a significant ($p<.0001$) impact on the XE

score for all credit unions. In some cases negative, or no impact was observed during economic recovery periods.

Number of members: The first quartile of non-metro credit unions showed significant ($p<.0001$) improvement in XE scores with the increase in the number of members during the period before deregulation occurred and the time period after the economic recession in 2002 (See Tables 4.5 to 4.12). But for all other quartiles throughout the study period, the impact of the number of members on XE scores was negative ($p<.0013$). For the first quartile of metro credit unions, the impact of number of members on the XE score was positive ($p<.0001$) before the economic recessions. But for all other quartile groups of metro credit unions, the impact was negative ($p<.0013$) throughout the study period. The number of members may have had some positive impact on XE scores in the past for lower asset size groups, but in general the impact of the number of members on credit unions' managerial performance is negative ($p<.06$). There might be a trade-off between the number of members and the X-efficiency of credit unions in higher asset bands.

Profitability: The ratio of operating income to total asset was the measure for profitability. For the first and second quartile of non-metro credit unions, the impact of credit unions' profitability on XE scores was significantly negative during the periods 1994-98 and 2002-07 (Table 4.5 to 4.12); the impact was insignificant during the periods 1999-01 and 2008-12 ($p>.14$). For the third quartile of non-metro credit unions, the impact was significantly negative from 1994 to 2007 ($p<.0001$) and became insignificant in 2008-12 ($p=0.44$). For the fourth quartile of non-metro credit unions, the impact of profitability on the XE score was significantly negative throughout the study period ($p<.03$). For the first and third quartile of metro credit unions, the impact of credit unions' profitability on the XE score was significantly negative during the periods 1994-98 and 2002-07 ($p<.0017$); the impact was insignificant during the periods 1999-01 and

Table 4.5: Tobit regression for XE scores of 1st quartile of non-metro credit unions

	Estimates for 1st quartile (without OBS)				Estimates for 1st quartile (with OBS)			
Parameter	1994-1998	1999-2001	2002-2007	2008-2012	1994-1998	1999-2001	2002-2007	2008-2012
Intercept	-1.792* (<.0001)	-1.422* (<.0001)	-1.082* (<.0001)	-0.956* (<.0001)	-1.803* (<.0001)	-1.449* (<.0001)	-1.105* (<.0001)	-0.976* (<.0001)
Total assets	0.165* (<.0001)	0.144* (<.0001)	0.100* (<.0001)	0.091* (<.0001)	0.165* (<.0001)	0.145* (<.0001)	0.099* (<.001)	0.091* (<.0001)
Total membership	0.011* (<.0001)	-0.001 (0.803)	0.018* (<.0001)	-0.008* (0.040)	0.011* (<.0001)	0.001 (0.810)	0.023* (<.0001)	-0.004 (0.300)
Profitability	-0.451* (<.0001)	0.089 (0.140)	-0.695* (<.0001)	-0.002 (0.981)	-0.442* (<.0001)	0.109** (0.076)	-0.679* (<.0001)	0.145** (0.087)
Delinquency	0.068* (<.0001)	0.073* (<.0001)	0.169* (<.0001)	0.050* (0.020)	0.067* (<.0001)	0.069* (0.0003)	0.160* (<.0001)	0.031 (0.157)
Intermediation activity	0.046* (<.0001)	-0.616* (<.0001)	-0.060* (0.002)	0.142* (<.0001)	0.047* (<.0001)	-0.609* (<.0001)	-0.060* (0.003)	0.179* (<.0001)
Capital adequacy	0.615* (<.0001)	0.212* (<.0001)	0.624* (<.0001)	0.709* (<.0001)	0.618* (<.0001)	0.213* (<.0001)	0.630* (<.0001)	0.743* (<.0001)
Deposit activity	0.008* (<.0001)	0.403* (<.0001)	0.129* (<.0001)	0.028* (0.044)	0.008* (0.002)	0.402* (<.0001)	0.133* (<.0001)	0.021 (0.144)
HPI	-0.001* (<.0001)	-0.0001 (0.160)	-0.0004* (<.0001)	-0.00003 (0.203)	-0.001* (<.0001)	-0.0001 (0.143)	-0.0004* (<.0001)	0.000 (0.165)
Income per capita	0.0003 (0.697)	0.004* (<.0001)	0.004* (<.0001)	0.002* (0.006)	0.0004* (0.002)	0.004* (<.0001)	0.004* (<.0001)	0.002* (0.013)
Unemployment rate	0.192* (0.001)	0.108 (0.292)	0.956* (<.0001)	-0.401* (<.0001)	0.181* (0.002)	0.126 (0.226)	0.897* (<.0001)	-0.385* (<.0001)
Federal charter	-0.005** (0.076)	0.002 (0.600)	-0.006* (0.034)	-0.012* (0.001)	-0.005* (0.002)	-0.0001 (0.977)	-0.009* (0.0006)	-0.012* (0.002)
Number of branches			-0.005* (0.022)	0.004 (0.489)			-0.004** (0.066)	0.003 (0.566)

* is significant at 5% level ** is significant at 10% level

Table 4.6: Tobit regression for XE scores of 2nd quartile of non-metro credit unions

	Estimates for 2nd quartile (without OBS)				Estimates for 2nd quartile (with OBS)			
Parameter	1994-1998	1999-2001	2002-2007	2008-2012	1994-1998	1999-2001	2002-2007	2008-2012
Intercept	-1.271* (<.0001)	-4.428* (<.0001)	-3.169* (<.0001)	1.02* (<.0001)	-1.402* (<.0001)	-4.526* (<.0001)	-3.316* (<.0001)	0.677* (<.0001)
Total assets	0.132* (<.0001)	0.315* (<.0001)	0.250* (<.0001)	-0.011* (0.020)	0.138* (<.0001)	0.320* (<.0001)	0.256* (<.0001)	0.007 (0.163)
Total membership	-0.012* (<.0001)	-0.024* (<.0001)	-0.047* (<.0001)	-0.060* (<.0001)	-0.008* (0.008)	-0.026* (<.0001)	-0.044* (<.0001)	-0.06* (<.0001)
Profitability	-0.913* (<.0001)	0.129 (0.186)	-0.507* (<.0001)	0.150 (0.203)	-0.681* (<.0001)	0.439* (<.0001)	-0.430* (<.0001)	0.466* (0.0002)
Delinquency	0.435* (<.0001)	0.277* (<.0001)	0.300* (<.0001)	0.199* (0.001)	0.355* (<.0001)	0.207* (<.0001)	0.221* (<.0001)	0.026 (0.6667)
Intermediation activity	-0.362* (<.0001)	0.011 (0.781)	-0.275* (<.0001)	-0.254* (0.0002)	-0.360* (<.0001)	0.029 (0.514)	-0.271* (<.0001)	-0.236* (0.0011)
Capital adequacy	0.456* (<.0001)	0.548* (<.0001)	0.420* (<.0001)	0.452* (<.0001)	0.411* (<.0001)	0.536* (<.0001)	0.405* (<.0001)	0.443* (<.0001)
Deposit activity	0.259* (<.0001)	0.121* (0.0003)	0.278* (<.0001)	0.318* (<.0001)	0.251* (<.0001)	0.100* (0.005)	0.278* (<.0001)	0.293* (<.0001)
HPI	-0.0006* (<.0001)	0.000 (0.663)	-0.0002* (<.0001)	0.0002* (<.0001)	-0.001* (<.0001)	0.0002* (0.014)	-0.0002* (<.0001)	0.000* (<.0001)
Income per capita	0.002* (0.0023)	0.006* (<.0001)	0.005* (<.0001)	0.002* (0.024)	0.003* (<.0001)	0.00711* (<.0001)	0.007 (0.2403)	0.007* (<.0001)
Unemployment rate	0.259* (<.0001)	0.170** (0.057)	0.522* (<.0001)	0.580* (<.0001)	0.158* (0.016)	0.097 (0.312)	0.514* (<.0001)	0.492* (<.0001)
Federal charter	-0.0004 (0.881)	0.006* (0.020)	0.004** (0.077)	-0.010* (0.0003)	-0.002 (0.418)	0.005** (0.081)	0.003* (<.0001)	-0.012* (<.0001)
Number of branches			0.015* (<.0001)	0.003 (0.213)			0.015* (<.0001)	0.003 (0.285)

* is significant at 5% level ** is significant at 10% level

Table 4.7: Tobit regression for XE scores of 3rd quartile of non-metro credit unions

	Estimates for 3rd quartile (without OBS)				Estimates for 3rd quartile (with OBS)			
Parameter	1994-1998	1999-2001	2002-2007	2008-2012	1994-1998	1999-2001	2002-2007	2008-2012
Intercept	0.064**	-0.430*	-0.410*	0.629*	0.086*	-0.42*	-0.561*	0.729*
	(0.071)	(<.0001)	(<.0001)	(<.0001)	(0.016)	(<.0001)	(<.0001)	(<.0001)
Total assets	0.036*	0.066*	0.065*	0.020*	0.033*	0.066*	0.071*	0.015*
	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(0.0003)
Total membership	-0.009*	-0.012*	-0.020*	-0.057*	-0.007*	-0.015*	-0.020*	-0.06*
	(<.0001)	(0.0002)	(<.0001)	(<.0001)	(0.0003)	(<.0001)	(<.0001)	(<.0001)
Profitability	-0.460*	-0.491*	-0.474*	0.080	-0.441*	-0.309*	-0.427*	0.197**
	(<.0001)	(<.0001)	(<.0001)	(0.437)	(<.0001)	(0.007)	(<.0001)	(0.071)
Delinquency	0.227*	0.353*	0.401*	0.282*	0.184*	0.273*	0.223*	0.225*
	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(0.0002)	(0.0012)	(0.0013)
Intermediation activity	-0.281*	-0.425*	-0.820*	-0.538*	-0.307*	-0.424*	-0.776*	-0.586*
	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)
Capital adequacy	0.547*	0.456*	0.263*	0.279*	0.513*	0.457*	0.179*	0.216*
	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)
Deposit activity	0.403*	0.471*	0.754*	0.644*	0.431*	0.470*	0.729*	0.672*
	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)
HPI	-0.0001*	-0.0004*	-0.000	0.0001*	-0.0002*	-0.0003*	-0.0001*	0.0001*
	(<.0001)	(<.0001)	(0.814)	(<.0001)	(<.0001)	(<.0001)	(0.005)	(<.0001)
Income per capita	0.001*	0.004*	0.006*	0.001	0.002*	0.004*	0.009*	0.002*
	(0.021)	(<.0001)	(<.0001)	(0.256)	(<.0001)	(<.0001)	(<.0001)	(0.010)
Unemployment rate	0.083*	-0.346*	-0.199*	0.37774*	0.055	-0.432*	-0.042	0.449*
	(0.023)	(<.0001)	(0.009)	(<.0001)	(0.14)	(<.0001)	(0.557)	(<.0001)
Federal charter	0.001	-0.001	-0.003	-0.005*	0.001	-0.0002	-0.004**	-0.007*
	(0.459)	(0.558)	(0.186)	(0.025)	(0.311)	(0.934)	(0.056)	(0.004)
Number of branches			-0.005*	0.001			-0.006*	0.0006
			(<.0001)	(0.534)			(<.0001)	(0.623)

* is significant at 5% level ** is significant at 10% level

Table 4.8: Tobit regression for XE scores of 4th quartile of non-metro credit unions

	Estimates for 4th quartile (without OBS)				Estimates for 4th quartile (with OBS)			
Parameter	1994-1998	1999-2001	2002-2007	2008-2012	1994-1998	1999-2001	2002-2007	2008-2012
Intercept	0.399* (<.0001)	-0.476* (<.0001)	-0.408* (<.0001)	1.492* (<.0001)	0.355* (<.0001)	-0.380* (<.0001)	-0.28321* (<.0001)	1.435* (<.0001)
Total assets	0.023* (<.0001)	0.072* (<.0001)	0.070* (<.0001)	-0.010* (0.010)	0.021* (<.0001)	0.064* (<.0001)	0.05871* (<.0001)	-0.007** (0.068)
Total membership	-0.011* (<.0001)	-0.015* (0.0001)	-0.012* (0.001)	-0.059* (<.0001)	-0.006* (0.0258)	-0.014* (0.001)	-0.00527 (0.1697)	-0.061* (<.0001)
Profitability	-1.249* (<.0001)	-0.977* (<.0001)	-1.356* (<.0001)	-0.267* (0.024)	-1.177* (<.0001)	-0.437* (0.007)	-1.10223* (<.0001)	-0.176 (0.153)
Delinquency	0.768* (<.0001)	0.582* (<.0001)	0.119 (0.327)	-0.041 (0.675)	0.6071* (<.0001)	0.140 (0.361)	-0.168 (0.197)	-0.071 (0.489)
Intermediation activity	-0.675* (<.0001)	-0.957* (<.0001)	-1.057* (<.0001)	-1.038* (<.0001)	-0.682* (<.0001)	-0.887* (<.0001)	-1.085* (<.0001)	-1.065* (<.0001)
Capital adequacy	0.413* (<.0001)	0.291* (<.0001)	-0.103* (0.010)	0.172* (0.0006)	0.337* (<.0001)	0.244* (<.0001)	-0.295* (<.0001)	0.083 (0.1151)
Deposit activity	0.555* (<.0001)	0.620* (<.0001)	0.617* (<.0001)	0.783* (<.0001)	0.592* (<.0001)	0.612* (<.0001)	0.655* (<.0001)	0.8257* (<.0001)
HPI	-0.0004* (<.0001)	-0.0003* (<.0001)	-0.0002* (<.0001)	0.0002* (<.0001)	-0.001* (<.0001)	-0.0004* (<.0001)	-0.0003* (<.0001)	0.0002* (<.0001)
Income per capita	0.002* (<.0001)	0.005* (<.0001)	0.003* (0.0001)	-0.003* (<.0001)	0.005* (<.0001)	0.008* (<.0001)	0.006* (<.0001)	-0.002* (0.0152)
Unemployment rate	-0.122* (0.009)	-0.514* (<.0001)	0.715* (<.0001)	0.470* (<.0001)	-0.185* (0.0001)	-0.963* (<.0001)	0.562* (<.0001)	0.527* (<.0001)
Federal charter	0.003* (0.050)	0.002 (0.451)	0.001 (0.514)	0.002 (0.424)	0.005* (0.013)	0.003 (0.313)	0.001 (0.569)	0.003 (0.2896)
Number of branches			0.0004** (0.086)	0.004* (<.0001)			-0.001* (0.002)	0.004* (<.0001)

* is significant at 5% level ** is significant at 10% level

Table 4.9: Tobit regression for XE scores of 1st quartile of metro credit unions

	Estimates for 1st quartile (without OBS)				Estimates for 1st quartile (with OBS)			
Parameter	1994-1998	1999-2001	2002-2007	2008-2012	1994-1998	1999-2001	2002-2007	2008-2012
Intercept	0.370* (<.0001)	-0.400* (<.0001)	0.028 (0.672)	-0.657* (<.0001)	0.346* (<.0001)	-0.490* (<.0001)	-0.056 (0.406)	-0.708* (<.0001)
Total assets	0.049* (<.0001)	0.056* (<.0001)	0.048* (<.0001)	0.058* (<.0001)	0.051* (<.0001)	0.063* (<.0001)	0.053* (<.0001)	0.066* (<.0001)
Total membership	0.008* (0.019)	0.012* (0.033)	-0.007 (0.210)	-0.014* (0.045)	0.009* (0.011)	0.012* (0.033)	-0.005 (0.333)	-0.017* (0.024)
Profitability	-0.743* (<.0001)	-0.154 (0.360)	-0.419* (0.002)	0.010 (0.92)	-0.702* (<.0001)	0.025 (0.889)	-0.234** (0.083)	0.089 (0.371)
Delinquency	0.186* (<.0001)	0.073 (0.123)	0.052 (0.154)	0.088 (0.134)	0.183* (<.0001)	0.062 (0.221)	0.059 (0.117)	0.096 (0.120)
Intermediation activity	-0.373* (<.0001)	-0.068* (0.022)	-0.575* (<.0001)	0.074 (0.553)	-0.349* (<.0001)	-0.06941* (0.029)	-0.604* (<.0001)	0.120 (0.150)
Capital adequacy	0.507* (<.0001)	0.726* (<.0001)	0.210* (0.001)	0.953* (<.0001)	0.522* (<.0001)	0.700* (<.0001)	0.176* (0.008)	0.985* (<.0001)
Deposit activity	0.414* (<.0001)	0.140* (<.0001)	0.481* (<.0001)	0.048 (0.631)	0.397* (<.0001)	0.143* (<.0001)	0.511* (<.0001)	0.018 (0.7829)
HPI	-0.003* (<.0001)	-0.0003** (0.060)	-0.001* (<.0001)	-0.000 (0.110)	-0.003* (<.0001)	-0.0002 (0.216)	-0.001* (<.0001)	-0.0001 (0.158)
Income per capita	-0.005* (0.0004)	0.004** (0.091)	0.007* (0.001)	0.016* (<.0001)	-0.006* (0.0002)	0.004 (0.151)	0.008* (0.0003)	0.014* (<.0001)
Unemployment rate	-0.053 (0.374)	0.0473 (0.736)	0.968* (<.0001)	-0.056 (0.6272)	-0.095 (0.128)	-0.066 (0.657)	0.661* (<.0001)	-0.038 (0.749)
Federal charter	-0.004 (0.192)	-0.001 (0.770)	0.0003 (0.955)	-0.036* (<.0001)	-0.006** (0.082)	-0.004 (0.415)	-0.012* (0.009)	-0.048* (<.0001)
Number of branches			-0.048* (<.0001)	0.008 (0.3598)			-0.041* (<.0001)	0.009 (0.366)

* is significant at 5% level ** is significant at 10% level

Table 4.10: Tobit regression for XE scores of 2nd quartile of metro credit unions

	Estimates for 2nd quartile (without OBS)				Estimates for 2nd quartile (with OBS)			
Parameter	1994-1998	1999-2001	2002-2007	2008-2012	1994-1998	1999-2001	2002-2007	2008-2012
Intercept	0.365* (<.0001)	0.481* (<.0001)	-0.591* (<.0001)	-0.129 (0.323)	0.344* (<.0001)	0.443* (0.001)	-0.353* (0.001)	-0.008 (0.955)
Total assets	0.039* (<.0001)	0.002 (0.746)	0.068* (<.0001)	0.061* (<.0001)	0.039* (<.0001)	0.006 (0.433)	0.053* (<.0001)	0.050* (<.0001)
Total membership	-0.024* (<.0001)	-0.03268* (<.0001)	-0.036* (<.0001)	-0.051* (<.0001)	-0.022* (<.0001)	-0.031* (0.001)	-0.028* (<.0001)	-0.040* (<.0001)
Profitability	-0.853* (<.0001)	-0.207 (0.227)	-0.670* (<.0001)	-0.318* (0.0047)	-0.598* (<.0001)	-0.006 (0.974)	-0.548* (0.001)	-0.293* (0.014)
Delinquency	0.422* (<.0001)	0.300* (0.002)	0.339* (0.0005)	-0.120 (0.349)	0.253* (0.0002)	0.102 (0.327)	0.126 (0.226)	-0.189 (0.161)
Intermediation activity	-0.553* (<.0001)	-0.007 (0.952)	0.040 (0.693)	-0.234 (0.107)	-0.569* (<.0001)	-0.031 (0.791)	-0.0714 (0.507)	-0.263** (0.085)
Capital adequacy	0.375* (<.0001)	0.769* (<.0001)	0.698* (<.0001)	0.688* (<.0001)	0.337* (<.0001)	0.702* (0.001)	0.551* (<.0001)	0.650* (<.0001)
Deposit activity	0.654* (<.0001)	0.232* (0.011)	0.138 (0.102)	0.209* (0.019)	0.657* (<.0001)	0.237* (0.014)	0.209* (0.019)	0.310* (0.016)
HPI	-0.002* (<.0001)	0.00004 (0.748)	-0.0004* (<.0001)	0.000 (0.819)	-0.002* (<.0001)	0.0001 (0.689)	-0.0004* (<.0001)	0.000 (0.186)
Income per capita	0.003* (0.007)	0.010* (<.0001)	0.017* (<.0001)	0.005* (0.012)	0.004* (0.001)	0.010* (0.001)	0.018* (<.0001)	0.005* (0.012)
Unemployment rate	-0.016 (0.810)	-0.065 (0.586)	0.741* (<.0001)	0.122 (0.140)	-0.069 (0.321)	-0.007 (0.954)	0.656* (<.0001)	0.074 (0.396)
Federal charter	0.0004 (0.891)	0.002 (0.656)	0.003 (0.437)	-0.002 (0.712)	-0.004 (0.128)	-0.001 (0.805)	-0.002 (0.547)	-0.004 (0.443)
Number of branches			-0.013* (0.0004)	0.002 (0.687)			-0.007** (0.081)	-0.001 (0.849)

* is significant at 5% level ** is significant at 10% level

Table 4.11: Tobit regression for XE scores of 3rd quartile of metro credit unions

	Estimates for 3rd quartile (without OBS)				Estimates for 3rd quartile (with OBS)			
Parameter	1994-1998	1999-2001	2002-2007	2008-2012	1994-1998	1999-2001	2002-2007	2008-2012
Intercept	0.089 (0.139)	-0.408* (0.0001)	-0.537* (0.0001)	0.993* (<.0001)	0.075 (0.241)	-0.525* (0.0001)	-0.484* (<.0001)	1.013* (<.0001)
Total assets	0.042* (<.0001)	0.072* (0.0001)	0.074* (0.0001)	0.0004 (0.951)	0.042* (<.0001)	0.077* (0.0001)	0.071* (<.0001)	-0.001 (0.852)
Total membership	-0.019* (<.0001)	-0.036* (0.0001)	-0.028* (0.0001)	-0.047* (<.0001)	-0.016* (<.0001)	-0.036* (0.0001)	-0.032* (<.0001)	-0.049* (<.0001)
Profitability	-0.558* (0.0001)	0.107 (0.511)	-0.869* (0.0001)	-0.036 (0.859)	-0.457* (0.003)	0.181 (0.289)	-0.583* (0.0004)	0.035 (0.869)
Delinquency	0.168** (0.063)	0.302* (0.021)	0.383* (0.0001)	0.057 (0.667)	0.068 (0.483)	0.342* (0.013)	0.289* (0.006)	0.002 (0.990)
Intermediation activity	-0.101 (0.227)	-0.012 (0.911)	-0.392* (0.0001)	-0.550* (<.0001)	-0.140 (0.116)	0.003 (0.981)	-0.500* (<.0001)	-0.622* (<.0001)
Capital adequacy	0.743* (<.0001)	0.729* (0.0001)	0.392* (0.0001)	0.542* (<.0001)	0.686* (<.0001)	0.738* (0.0001)	0.296* (<.0001)	0.441* (<.0001)
Deposit activity	0.272* (0.0001)	0.243* (0.001)	0.482* (0.0001)	0.617* (<.0001)	0.304* (<.0001)	0.230* (0.020)	0.573* (<.0001)	0.673* (<.0001)
HPI	-0.0005* (0.004)	0.0001 (0.201)	-0.0005* (0.0001)	-0.000 (0.333)	-0.001* (<.0001)	0.0001 (0.168)	-0.0005* (<.0001)	-0.0002)
Income per capita	0.003* (0.015)	0.002 (0.111)	0.0134* (0.0001)	0.004* (0.013)	0.005* (<.0001)	0.003* (0.029)	0.016* (<.0001)	0.006* (0.0002)
Unemployment rate	0.033 (0.463)	0.009 (0.909)	0.284* (0.001)	-0.149* (0.011)	-0.042 (0.367)	0.016 (0.851)	0.181* (0.034)	-0.178* (0.005)
Federal charter	-0.001 (0.769)	-0.004 (0.120)	0.003 (0.284)	0.002 (0.665)	0.001 (0.670)	-0.003 (0.246)	0.004 (0.138)	0.004 (0.286)
Number of branches			-0.008* (0.0001)	-0.005* (0.004)			-0.007* (<.0001)	-0.005* (0.004)

* is significant at 5% level ** is significant at 10% level

Table 4.12: Tobit regression for XE scores of 4th quartile of metro credit unions

	Estimates for 4th quartile (without OBS)				Estimates for 4th quartile (with OBS)			
Parameter	1994-1998	1999-2001	2002-2007	2008-2012	1994-1998	1999-2001	2002-2007	2008-2012
Intercept	0.479* (<.0001)	0.527* (<.0001)	0.502* (<.0001)	0.481* (<.0001)	0.461* (<.0001)	0.527* (<.0001)	0.466* (<.0001)	0.335* (0.0002)
Total assets	0.025* (<.0001)	0.019* (0.0003)	0.013* (0.0108)	0.049* (<.0001)	0.024* (<.0001)	0.019* (0.0004)	0.014* (0.011)	0.057* (<.0001)
Total membership	-0.013* (<.0001)	-0.018* (0.0012)	-0.011** (0.053)	-0.071* (<.0001)	-0.009* (0.007)	-0.019* (0.0007)	-0.012* (0.047)	-0.075* (<.0001)
Profitability	-1.050* (<.0001)	-0.933* (<.0001)	-1.200* (<.0001)	-0.483** (0.052)	-1.086* (<.0001)	-0.739* (0.0001)	-1.141* (<.0001)	-0.409 (0.122)
Delinquency	0.612* (<.0001)	0.986* (<.0001)	0.053 (0.733)	-0.064 (0.733)	0.404* (0.001)	0.940* (<.0001)	-0.092 (0.578)	-0.091 (0.648)
Intermediation activity	-0.768* (<.0001)	-0.928* (<.0001)	-1.019* (<.0001)	-0.932* (<.0001)	-0.768* (<.0001)	-0.950* (<.0001)	-1.080* (<.0001)	-0.917* (<.0001)
Capital adequacy	0.305* (<.0001)	0.185* (0.003)	0.170* (0.002)	0.122 (0.182)	0.236* (<.0001)	0.172* (0.009)	0.049 (0.409)	0.064 (0.5125)
Deposit activity	0.817* (<.0001)	0.835* (<.0001)	0.810* (<.0001)	0.883* (<.0001)	0.837* (<.0001)	0.858* (<.0001)	0.864* (<.0001)	0.870* (<.0001)
HPI	-0.001* (<.0001)	0.0002* (0.047)	-0.0002* (<.0001)	0.000** (0.0561)	-0.001* (<.0001)	0.0001** (0.070)	-0.0003* (<.0001)	0.000* (0.001)
Income per capita	0.002* (0.0085)	0.006* (<.0001)	0.012* (<.0001)	-0.001 (0.532)	0.004* (<.0001)	0.006* (<.0001)	0.0153* (<.0001)	0.001 (0.573)
Unemployment rate	-0.155* (<.0001)	-0.113* (0.048)	0.391* (<.0001)	0.129* (0.035)	-0.189* (<.0001)	-0.157* (0.007)	0.382* (<.0001)	0.090 (0.170)
Federal charter	0.002 (0.374)	-0.003 (0.268)	0.004 (0.110)	-0.002 (0.576)	0.003** (0.063)	-0.002 (0.415)	0.007* (0.012)	-0.002 (0.719)
Number of branches			0.001* (<.0001)	0.003* (<.0001)			0.001* (<.0001)	0.003* (<.0001)

2008-12 (p>0.35). For the second quartile impact was insignificant in 1999-01 (p=.23) and significantly negative for other periods (p<.0048). Impact on XE scores was negative for the fourth quartile of metro credit unions throughout the study period (p<.052). With the increase in profitability, the XE scores generally decreased for credit unions and the impact was insignificant for the lower quartiles of credit unions during the recovery period. Cyree and Spurlin (2012) also observed a trade-off between the efficiency and profitability of rural community banks. Turati (2001) observed a tendency among inefficient banks to convert their higher costs to higher prices of services they offer to consumers in order to continue with positive profitability. For credit unions aiming more profit, might have to do it at the expense of higher cost ratio.

Delinquency ratio: Bauer, Miles and Nishikawa (2009) termed the delinquency ratio as measure of "asset quality." For the first, second, and third quartiles of non-metro credit unions, the effect of the delinquency ratio on the XE score was positively significant (p<.021) (See Tables 4.5 to 4.12). After a continuous increase over the periods (1994-2007) the effect started decreasing during the recovery period from 2008-2012. For the fourth quartile group, the magnitude of the coefficient diminished over the periods (1994-2012) and was not significant for the periods after the recession in 2002 (p>0.32). For the first quartile of metro credit unions, the delinquency ratio had a significant positive (p<.0001) impact on XE scores during 1994-1998 time frame, The remaining time periods were not significant. For the second and third quartiles, the effect was significantly (p<.064) positive during 1994-2007 and was not significant during recovery period of 2008-2012. For the fourth quartile of metro credit unions, the effect was significant (p<.0001) before the economic recessions and was not significant during subsequent economic recessions and recovery periods. The effect of delinquent loans on the XE score was positive for the lower quartiles of non-metro credit unions and started decreasing during the recovery period. For the

upper quartile of non-metro credit unions and all metro credit unions, the influence of delinquent loan on the XE score was not significant during the economic recovery process.

Intermediation activity: For the first quartile category of non-metro credit unions, the effect of intermediation activity (the ratio of total loans to total assets) on the XE scores was mixed – significantly ($p<.002$) positive during the periods 1994-1998 and 2008-2012, and negative ($p<.002$) during 1999-2007 (See Tables 4.5 to 4.12). The opportunity of adding more members after the 1998 membership act, the impulse to cope up with the economic recession in 2002 might have led the non-metro credit unions to restructure the loan portfolio, which might have increased the costs of services for this lower asset band group. For the all other quartiles of non-metro credit unions, the effect of total loans on XE scores was negative ($p<.0003$) throughout the remaining study periods. The first quartile group of metro credit unions, the impact of total loans on the XE scores was negative ($p<.023$) during 1994-2007, and was not significant during the economic recovery period from 2008-2009. For the second quartile category, the effect was also negative ($p<.0001$) during 1994-1998 while not significant for any other study periods. For the third quartile, the effect was not significant before recession in 2002, and became negative ($p<.0002$) during the economic recovery process. For the fourth quartile of metro credit unions, the impact was negative ($p<.0001$) throughout all study periods. The lower quartiles of non-metro credit unions started increasing XE scores during the economic recovery period by providing more loans. This observation contrasts with the remaining non-metro credit unions, for which effect of loans was significantly negative ($p<.0003$). For the lower quartiles of metro credit unions, the amount of loans had no significant impact on XE scores during the economic recovery process. During the same time periods, however, the amount of loans had a significant negative ($p<.0002$) impact on XE scores for the upper quartiles of metro credit unions.

Capital adequacy: An increased amount of member equity helped non-metro and metro credit unions improve XE scores significantly ($p<.0034$) for all quartiles throughout the study period, except for the fourth quartile of non-metro credit unions during 2002-2007, in which the impact was significantly ($p<.001$) negative (See Tables 4.5 to 4.12). The lower quartiles of credit unions managed to perform better in XE measures during the economic recovery process through increased members' equity, but credit unions in the upper quartiles performed lower during economic recovery in comparison with periods before the economic recessions.

Deposit activity: An increase in the ratio of total loans to total deposits helped non-metro credit unions to improve XE scores throughout the study period (See Tables 4.5 to 4.12). The contribution of deposit activities was lower for the lower quartiles of non-metro credit unions during economic recovery periods in comparison with periods before the economic recessions. However, the upper quartiles of non-metro credit unions managed to gain more in XE scores during economic recovery periods in comparison with periods before economic recessions through an increase in deposit activity. Increasing deposit activity helped metro credit unions to improve XE scores throughout the entire study period, with the exception of the first quartile group during 2008-2012, and the second quartile during 2002-2007. The upper quartiles of credit unions experienced more gain in XE scores with the increase in loans to deposits ratio than lower quartile credit unions during economic recovery time periods.

House price index: For the first quartile of non-metro credit unions, the impact of house price on XE scores was significantly negative ($p<.0001$) during 1994-1998 and 2002-2007, and was not significant during 1999-2001 and 2008-2012 (See Tables 4.5 to 4.12). For the second quartile, the impact was significantly negative ($p<.0001$) during 1994-1998 and 2002-2007, the results were not significant during 1999-2001, significantly positive ($p<.0001$) during 1994-2001,

insignificant from 2002-2007, and significantly positive (p<.0001) from 2008-2012. For the fourth quartile, the impact was negative (p<.0001) during 1999-2007, and positive in 2008-2012 (p<.0001). For the first quartile of metro credit unions, the effect of house price on XE scores was significantly negative (p<.06) during 1994-2007 while not being significant from 2008-2012. For the second and third quartiles, the impact was significantly negative (p<.0043) in 1994-1998 and 2002-2007, no significant results were present during 1999-2001 or 2008-2012. For the fourth quartile, the impact was significantly negative (p<.0001) during 1994-1998 and 2002-2007. Significantly positive impacts were observed (p<.06) during the periods 1999-2001 and 2008-2012. However the effect of an increase in house price was negative or not significant for non-metro credit unions before the financial crisis in 2008-2009, the upper quartiles of non-metro credit unions benefited from the increase in house price during the economic recovery period during the period 2008-2012. The first three quartiles of metro credit unions experienced no significant impact of house price increase on XE scores, but the fourth quartile of metro credit unions have gained in XE score with the increase in housing expense during 2008-2012.

Per capita income: For the first quartile of non-metro credit unions, the impact of income on XE was significantly positive (p<.0062) during 1999-2012; for the second quartile significantly positive (p<.025) during 1994-2012; for the third quartile significantly positive (p<.021) during 1994-2007, and insignificant during 2008-2012; and for the fourth quartile significantly positive (p<.0002) during 1994-2007, and significantly negative (p<.0001) during 2008-2012. For the first quartile of metro credit unions, the impact of income on XE was significantly positive (p<.092) during 1999-2012, and negatively significant (p<.0005) during 1994-1998; for the second quartile significantly positive (p<.012) during 1994-2012; for the third quartile significantly positive

(p<.015) during 1994-1998 and 2002-2012, and insignificant during 1999-2001; and for the fourth quartile significantly positive (p<.0086) during 1994-2007, and insignificant during 2008-2012.

Unemployment rate: The effect of an increase in the unemployment rate on XE scores was negative (p<.012) for the first quartile of non-metro credit unions and the third quartile of metro credit unions during the economic recovery in 2008-12 (See Tables 4.5 to 4.12). For the same period, the effect was positive (p<.0001) for the upper quartiles of non-metro credit unions, no significant results were present for the first and second quartiles of metro credit unions, while positive relationships were evident for the fourth quartile group of metro credit unions.

Credit union charter type: The first quartile of federally chartered non-metro credit unions performed lower (p<.076) than state chartered credit unions in 1994-1998 and 2002-2007 (See Tables 4.5 to 4.12). The second quartile of federally chartered non-metro credit unions performed higher (p=0.02) than state chartered credit unions in 1999-2001, but performed lower (p=.0003) during 2008-2012. The third quartile of federally chartered non-metro credit unions also performed lower than state chartered credit unions in 2008-2012. The fourth quartile of federally chartered non-metro credit unions performed higher (p=0.0496) than state chartered credit unions in 1994-1998. The first quartile of federally chartered metro credit unions performed (p<.0001) lower than state chartered credit unions during 2008-2012. For the second, third, and fourth quartiles of metro credit unions performance was not dependent on charter type. During the economic recovery period, charter type significantly explained differences (p<.025) in performance for the first three quartiles of non-metro credit unions and the first quartile of metro credit unions, and the performance of state chartered credit unions was always higher than that of federally chartered credit unions.

Number of branches: The percentages of the non-metro credit unions with more than one branches ranged between 1.4% - 9.15%, 7.3% - 15.5%, 22.1% - 52.4% and 69.7% - 90% throughout the study periods for the 1st, 2nd, 3rd and 4th quartiles respectively. For the first three quartiles of non-metro credit unions numbers of branches were only significant during 2002-2007, having a positive impact on XE scores for the second quartile and having a negative impact on XE scores for the first and third quartiles (See Tables 4.5 to 4.12). Branch numbers had a positively significant ($p<.087$) impact on XE scores for the fourth quartile of credit unions during 2002-2012. The percentages of the metro credit unions with more than one branches ranged between 2% - 9.2%, 13% - 33.5%, 44.6% - 71.5% and 86.6% - 96.1% throughout the study periods for the 1st, 2nd, 3rd and 4th quartiles respectively. For the first and second quartiles of metro credit unions the number of branches had a significantly ($p<.0005$) negative impact on XE scores during 2002-2007. For the third quartile the impact was significantly ($p<.0036$) negative during the periods from 2002-2012. For the fourth quartile the impact was significantly ($p<.0001$) positive during the extended time period from 2002-2012. In general, only the upper quartiles of non-metro and metro credit unions had significant ($p<.0001$) improvement in XE scores associated with an increased number of branches during the economic recovery from 2008-2012.

CHAPTER 5. CONCLUSIONS

After deregulation (1998), X-efficiency scores of the 1st quartile of non-metro credit unions increased compared to earlier time periods. The lower two quartiles (1st and 2nd) also increased growth in efficiency scores after the recession in 2002. However upper quartile groups (2nd, 3rd and 4th) of non-metro credit unions did not benefit from deregulation. Credit unions in upper two quartiles (3rd and 4th) experienced decrease in managerial performance measures of cost controlling after the recession in 2002. All quartiles of metro credit unions failed to gain from deregulation, though the third quartile achieved a slight improvement in efficiency scores. The lower quartiles of metro credit unions managed to improve performance after the recession in 2002. In general, the opportunity to add one or more fields of membership was beneficial to the lower quartile groups of non-metro credit unions and to some upper quartile metro credit unions. All other credit unions could not take advantage of the opportunity of deregulation with respect to X-efficiency scores. They could not control the costs of operation after the opportunity of adding more members was open to them.

By utilizing off-balance sheet activities, the lowest quartile of non-metro credit unions did not gain significant benefits before and after the deregulation. However, before and after the deregulation, all other non-metro credit unions increased efficiency scores throughout the study periods; they also managed to improve performances by increasing off-balance sheet items during the economic downturns. The lowest quartile of metro credit unions didn't show significant improvement by added off-balance sheet activities before and after the derregulation; however, they improved performance during the economic downturn through off-balance sheet items was evident. For the upper quartiles of metro credit unions the contribution of off-balance sheet items was mixed among different asset size categories. In general, off-balance sheet activities improved

efficiency scores for all types of credit unions. All credit unions learned to survive financial upheavals by increasing off-balance-sheet activities.

An increase in total assets improves the managerial performance of all quartiles of credit unions. However, during the recovery period, the upper quartile groups of credit unions faced decrease in the measurement of managerial performance in cost controlling. An increase in the total number of members had a significant negative ($p<.053$) impact on overall X-efficiency scores. Delinquency ratio always had a positive impact (when statistically significant) on the X-efficiency scores of credit unions; so, delayed earnings from repayment by the borrowers didn't increase the cost of collection for credit unions, or for the credit unions with higher delinquency ratio, the cost management was better by them. Nevertheless, the lower quartiles of non-metro credit unions have gained in efficiency scores during economic recovery period after the financial crisis. Greater member equity helped all metro and non-metro credit unions increase efficiency scores except for the 4th quartile of metro credit unions; they are unaffected by the increase in member equity. The upper quartiles of credit unions gain more in efficiency scores with increases in deposits than do lower quartiles. The upper quartiles of non-metro and metro credit unions gain in efficiency scores with increases in housing price. Per capita income has a significant ($p<.092$) positive impact on all credit unions' performance. An increase in the unemployment rate appears to reduce efficiency scores for the lower quartiles of non-metro credit unions more than any other type of credit union. Charter type appears to have a significant ($p<.083$) impact on the performances of the first three quartiles of non-metro credit unions and the first quartile of metro credit unions. During the economic recovery period, credit unions with lower asset size performed better if operating under a state charter.

This study was limited by the fact that DEA efficiency score is a relative efficiency index (Xue and Harker, 1999). It is possible for future researchers to improve on the efficiency measurement technique by using more recently developed measurement methods e.g. bootstrapping or double bootstrapping method. Further researches on the performances of non-metro credit unions are possible. It would be an interesting notion to observe on the ability of lower asset band non-metro credit unions in managing the opportunity offered by more members.

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