Investigating the Cost Performance of UK Credit Unions Using Radial and Non-Radial Efficiency Measures.

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Abstract

This paper examines the relative efficiency of UK credit unions. Radial and nonradial measures of input cost efficiency plus associated scale efficiency measures are computed for a selection of input output specifications. Both measures highlighted that UK credit unions have considerable scope for efficiency gains. It was mooted that the documented high levels of inefficiency may be indicative of the fact that credit unions, based on clearly defined and non-overlapping common bonds, are not in competition with each other for market share. Credit unions were also highlighted as suffering from a considerable degree of scale inefficiency with the majority of scale inefficient credit unions subject to decreasing returns to scale. The latter aspect highlights that the UK Government's goal of larger credit unions must be accompanied by greater regulatory freedom if inefficiency is to be avoided. One of the advantages of computing nonradial measures is that an insight into potential over- or under-expenditure on specific inputs can be obtained through a comparison of the nonradial measure of efficiency with the associated radial measure. Two interesting findings emerged, the first that UK credit unions over-spend on dividend payments and the second that they under-spend on labour costs.

JEL classification G21

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Section 1: Introduction

Credit Unions are co-operative financial institutions that have successfully established themselves throughout the world. In excess of 95 million people in 90 nations now belong to a credit union and, in aggregate terms, the assets of credit unions world-wide are calculated at $418.5 billion (World Council of Credit Unions, 1997). As self-help, democratic institutions, credit unions have demonstrated the efficacy of co-operative principles to the management of their financial affairs for millions of people. The major strength of credit unions lies in the fact that their basic philosophy and objectives have such a universal appeal to a diverse range of people who see benefit in achieving greater self sufficiency in the running of their financial affairs.

Credit unions may be viewed as unique financial institutions in that they are consumer co-operatives and are limited to serving the market for consumer credit and saving. A credit union can be thought of as a 'purchasing' co-operative from the standpoint of its borrowing members, and a 'marketing' co-operative to its saving members (Taylor (1971))[1]. Since it deals exclusively with its members, a credit union can claim to be the purest form of all co-operatives (Croteau, 1963). It cannot do business with the general public due to charter limitations based on serving a membership that is characterised by a common bond. The definition is the subject of legal regulation and confers on credit unions a key-defining characteristic. In addition, the common bond restriction on membership is assumed to reduce the cost of gathering credit information and in consequence minimises the exposure of individual credit unions to bad debt losses.

The UK credit union movement has been described as a ‘nascent industry’ (Ferguson and McKillop (1997)). The authors use the term to contrast it with the more ‘mature industries’ of the US, Canada and Australia and to highlight that the UK movement is in its infancy and dwarfed by more established UK financial groupings. Although UK credit unions are relatively small (the largest credit union only equates with smaller sized building societies) this sector has recently been the focus of government attention for several important reasons: (i) with building societies and insurance companies opting for public status credit unions are seen as the last bastion of mutuality (ii) with other financial institutions perceived as neglecting inner city communities, credit unions are seen as a major weapon against financial exclusion (iii) their unprecendented growth in the 1980s and 1990s (iv) their lack of competition from other financial institutions and the consequent possibility of inefficient operations.

In a UK context credit unions were first established in Northern Ireland in 1960. Under the auspices of

[1] Aspects of this work were expanded and refined by Spencer (1996).

the trade organisation the Irish League of Credit Unions (ILCU) the movement in Northern Ireland has flourished. (In Northern Ireland approximately 12 percent of the adult population now belong to a credit union.) The ILCU was itself established in 1960 and it is a non-statutory, all-Ireland body organised voluntarily from within the credit union movement. The principal objectives of the ILCU are to promote, service and develop credit unions in Ireland. At the end of 1998 there were a total of 167 credit unions in Northern Ireland (of that number 107 were affiliated to the ILCU with the remainder affiliated to other trade bodies or operating as independent credit unions). In the rest of the UK the growth of the movement has not been as rapid as in Northern Ireland. (Less than 1 percent of the adult population in Great Britain belong to a credit union.) The first credit union in Great Britain was established in 1964 and although the Crowther (1971) report on consumer credit made an early and impassioned call for credit union development it was not until the passage of the 1979 Credit unions Act that the movement in Great Britain gained significant positive impetus. After the introduction of the 1979 Act there was a sharp increase in credit union formation in Great Britain so that by 1982 some 73 had registered. The period since the mid 1980's has witnessed unprecedented growth in the number of credit unions formed in Great Britain. Over the period 1987 to 1998 there has been a six-fold increase in registrations. There were 108 registered for business in 1987 with the number by 1998 rising to 660 with 50 new credit unions alone formed in 1998. Total assets now exceed £100 million (if credit unions in Northern Ireland are included total assets stand at approximately £400 million) and are growing at about £20 million a year. Membership is around 200,000 (450,000 if Northern Ireland credit unions are included) and it is concentrated in the North of England and Scotland, although there is increasing growth in the South and West of England and in Wales. Credit unions in Great Britain are affiliated to either the - SLCU (Scottish League of Credit Unions) which was established in 1993 and now has 37 affiliated credit unions; NATFED (National Federation of Credit Unions) which has 121 affiliated credit unions; or ABCUL (Association of British Credit Unions which is the biggest mainland British trade organisation by far with 429 affiliated credit unions.

With many building societies and insurance companies opting for public listings and consequently vacating the mutual sector, credit unions are increasingly being viewed as one of the last bastions of mutuality in the UK. Not surprisingly this has resulted in unprecedented levels of attention from Government. A recent example of just such attention is the establishment in 1998 of a Credit Union Taskforce, under the auspices of H M Treasury, to examine ways in which banks and building societies could help credit unions expand their business[2]. At the launch of this taskforce the Economic Secretary to H M Treasury commented

[2] Changes to the operational environment within which credit unions conduct their business as a consequence of the Treasury review are not likely to come into force until late in the year 2000 or early 2001. It should also be noted that prior to the 1998 Treasury initiative the previous major regulatory change for UK credit unions occurred in 1979

with the publication of the 1979 Credit Union Act.

> "Without fanfare, credit unions have been doing invaluable work encouraging people to save money by providing savings facilities, low cost credit, and financial education to the less well off, giving them the chance to build up a good credit record. There can be no doubt that credit unions are vital in poorer communities but, at the same time, can be a competitive provider of basic services for the better off. That is why the Government supports fully their ethos of self help and thrift and is determined to encourage the sector." P. Hewitt, Economic Secretary to the Treasury (1998).

While much effort is now being expended to promote and develop credit unions in the UK it should be stressed that this is against the backdrop of a very much under-researched organisational form at least in the UK. Where research has occurred it has tended to be policy orientated, see for example Berthoud and Hinton (1989); McArthur, McGregor and Stewart (1993); Crow, Howells and Pick (1993); Griffiths and Howells 1991, 1993); and Thomas and Balloch (1994). Other work having a less policy-orientated approach includes that by McKillop, Ferguson and Nesbitt (1995), which employed a paired difference approach to investigate for the existence of scale economies in UK credit unions. A further piece of work is that by Ferguson and McKillop (1997) which develops a typology for analysing credit unions. The authors divide the movement into three distinct types; that is mature, transition, and nascent. In other words credit unions will potentially move along a developmental growth path from nascent to transition to mature. Finally McKillop and Ferguson (1998) explore the member group orientation of UK credit unions. The methodology adopted in the study was to derive an index of member group imbalance and then to employ this index to determine whether member group imbalance has an adverse impact upon the generation of total benefits by individual credit unions. The analysis demonstrated that there is a strong pro-borrower bias in the operation of UK credit unions with this pro-borrower bias driven by the regulatory environment within which they operate. As discussed in the methodology section this bias suggests that the minimising of all costs, including dividends, would constitute an appropriate objective for credit unions.

The present paper endeavours to provide further insight into UK credit unions by exploring their relative efficiency. In the context of this analysis we propose to examine a number of aspects of efficiency employing a technique called Data Envelopment Analysis (DEA). As a technique DEA permits the construction of production and cost frontiers. These frontiers are known as best-practice frontiers and are constructed empirically from observed inputs and outputs. Once the frontier is constructed the efficiency of each credit union can then be measured relative to this frontier.

In this study a number of aspects of efficiency are explored. In the first instance we examine the input cost efficiency of UK credit unions. If a credit union is guilty of employing an inefficient level of expenditure then that credit union is considered to be cost inefficient and that credit union can achieve a minimisation of its costs by scaling all input expenditures down by the same proportion. Initially the input cost efficiency measure is obtained under the assumption that all credit unions are operating under constant returns to scale. If in contrast it is assumed that credit unions are able to operate under decreasing, constant or increasing returns to scale then it becomes possible to decompose the input cost efficiency measure into a scale efficiency component and a 'pure' input cost efficiency component. Furthermore it then also becomes possible to determine whether credit unions operate under increasing, decreasing or constant returns to scale.

The above efficiency measures are based on a radial input cost efficiency measure that requires an *equiproportionate* reduction in all input expenditures. These radial measures can, however, leave unwanted slack in the adjusted input expenditure vectors consequently in this analysis we also introduce nonradial measures that leave no slack. Under this scenario input cost minimisation is achieved by a *non-proportional* scaling down of each input expenditure. De Borger and Kerstens (1996) argue that although almost all empirical efficiency studies have been inspired by radial efficiency measures such measures are inadequate as they do not necessarily project inefficient observations onto the efficient subset. In this analysis we focus upon the nonradial efficiency measure proposed by Färe and Lovell (1978). Through the imposition of restrictions the Färe-Lovell measure can also be calculated for non-increasing returns to scale and variable returns to scale technologies and consequently inferences can be made regarding the nature of scale economies.

As highlighted, computation of nonradial efficiency permits insight into the additional input expenditure savings that can be achieved through the elimination of input expenditure slack. It should also be noted that a comparison of nonradial efficiency and radial efficiency opens up a further area for investigation in that it becomes possible to identify potential over- or under- expenditure on prespecified inputs. The computation of the two sets of measures also enables us to determine the extent to which the respective measures lead to differences in the relative efficiency rankings of credit unions.

The format of the paper is as follows. In the next section the reference technology is described, as are the radial and nonradial measures of input cost efficiency, plus the associated scale efficiency measures. This section also indicates how misallocation of input expenditures is measured. Section three details the database utilised in this study with particular attention given to the fact that the analysis is undertaken under three different input-output specifications. The fourth section provides information on the computed efficiency measures as well as endeavouring to explain the calculated inefficiencies using a variety of financial and institutional organisational form variables. A final section then presents some concluding comments.

Section 2: Methodology

The theoretic literature has consistently demonstrated that the co-operative nature of credit unions precludes a straightforward application of the neo-classical concept of profit maximisation and associated duality properties. The literature has recognised the possibility of variant objective functions - see Taylor (1971), Flannery (1974), Walker and Chandler (1977), Smith et al. (1981), Smith (1984) and Smith (1986). As Smith (1986) argues, in a co-operative such as a credit union the owners (members) supply the principal input (savings) and also comprise the demand for the principal output (loans). Since the entire membership can be divided into net borrowers and net savers, there is an inherent conflict. Borrowers naturally prefer an objective stated in terms of low interest rates to be charged on loans while savers prefer an objective of high dividend rates paid on savings. The idea is that this borrower-saver conflict and the resolution of the conflict could lead to a variety of credit union types, ranging from complete borrower or saver preference at the extremes to some sense of neutrality at the intermediate position. In the context of UK credit unions research has identified the sector as being characterised by a pro-borrower emphasis (see for example, McKillop and Ferguson (1998)). This finding is important in that it is consistent with cost minimisation and consequently credit unions endeavouring to minimise dividend payments to their members. Given this finding we have employed cost minimisation as an appropriate objective for UK credit unions.

In measuring the relative cost efficiency of a set of firms, the usual DEA procedure involves: (1) collecting data on input and output quantities, plus input prices, and then (2) using this data to construct nonparametric cost frontiers, and lastly (3) measuring cost efficiency relative to these frontiers. This procedure yields a multi-output, multi-input cost efficiency measure for each firm that permits assessment of its productive performance relative to best-practice in the given sample of firms. Moreover, when a firm is found to be cost inefficient, the decomposition of the cost efficiency measure into technical and allocative components enables us to assess whether the cost inefficiency is due to an excessive input usage and/or a wrong mix of inputs.

Unfortunately, in many situations, data availability does not permit implementation of the above procedure. Often the only available data relates to output quantities and input expenditures, with input prices and quantities being unavailable. This is precisely the case for the large majority of UK credit unions. For such situations, researchers must be content to construct cost frontiers from the output quantities and input expenditures data and measure cost efficiency relative to these frontiers. (For studies of financial institutions using this approach see Ferrier, Grosskopf, Hayes and Yaisawarng (1993) and Fried and Lovell (1994). For applications to public sector institutions see the Grosskopf and Yaisawarng (1990) and De Borger and Kerstens (1996) studies.)

As indicated by Färe and Grosskopf (1985), the latter approach can be used to yield an input-cost-based scale efficiency measure and to determine whether a firm's input cost scale inefficiency is due to increasing returns to scale or to decreasing returns to scale. Although the latter measurement of scale economies using input costs and output quantities may generate different results from that using input quantities and output quantities (unless, as Färe, Grosskopf and Lovell (1994) note, certain strong assumptions about input prices and allocative efficiencies across firms are empirically satisfied), it does provide useful insights into relative input cost scale efficiencies in a data-deficient situation. This approach is used in the current study due to data deficiencies.

While the construction of cost frontiers from input expenditures and output quantities is used to obtain credit-union-specific measures of both cost efficiency and scale efficiency, the lack of data on input prices and quantities prohibits the decomposition of any cost inefficiency into technical and allocative inefficiencies. However, as demonstrated below, it is still possible to gain certain insights into the misallocation of input expenditures yielded under the radial and nonradial cost efficiency scenarios. Also, 'overall' input cost inefficiency can be decomposed into input cost scale inefficiency and 'pure' input cost inefficiency.

2.1 Constructing the nonparametric cost frontier

Let us think of j = 1, …, J producers (credit unions) using input vector $x^j \in \mathbf{R}^N_+$, to produce output vector $y^j \in \mathbf{R}^M_+$, with the attendant input expenditures being given by the input costs vector $c^j \in \mathbf{R}^N_{++}$. We denote the $J \times M$ matrix of observed outputs as $\mathbf{M}$ and the $J \times N$ matrix of observed input costs as $\mathbf{C}$. A piecewise linear reference technology can then be constructed from these observations by taking convex combinations of the observed data points and their extensions as given by

$$C(y, c \mid V,S) = \{ (y,c) : y \leq zM, zC \leq c, z \in R^J_+, \sum_{j=1}^{J} z_j = 1 \} \tag{1}$$

where z is a vector of intensity variables from activity analysis. $C(y, c \mid V,S)$ represents the cost set with its (lower) boundary reflecting the minimum or best-practice costs for producing an observed output vector given input costs and the assumed technology. As described in (1), the technology satisfies strong disposability of outputs and input costs (denoted in (1) by S) and exhibits variable returns to scale (denoted in (1) by V).

2.2 Radial measurement of input cost efficiency

Given the representation of the technology in (1), the cost performance of an individual producer j can then be evaluated by comparing j's observed vector of input costs c^j, incurred in producing its observed output vector y^j, with those input costs on the boundary (or best-practice frontier) of the cost set C(y,c). To do this, we calculate the radial input cost efficiency measure

$$W_R(y^j, c^j \mid V,S) = \min \{ \lambda : \lambda c^j \in C(y, c \mid V,S) \} \qquad (2)$$

where $0 < W_R(y^j,c^j \mid V,S) \leq 1$. For producer j, (2) measures the cost efficiency of c^j in producing y^j relative to a (V,S) technology. It does so by calculating the ratio of the largest feasible radial contraction of c^j to c^j itself, with feasibility being defined relative to the cost set (1).

If we denote the solution to (2) as λ^*, then minimum (best-practice) cost $c^{j*} = \lambda^* c^j$. Hence the relative cost efficiency of producer j is measured by the ratio of best-practice input cost to j's observed input cost as given by $\lambda^* = c^{j*}/c^j$. When $\lambda^* = 1$, producer j is cost efficient with its (y^j,c^j) being located on the best-practice cost frontier. Alternatively, when $\lambda^* < 1$, producer j is cost inefficient in the sense that all its input expenditures can be (potentially) scaled down proportionately by the scale factor λ^*, while still producing (at least) its observed output vector y^j.

The radial input cost efficiency measure is empirically calculated for producer j, using the piecewise linear (V,S) technology (1), as the solution to the linear programming problem

$$\begin{aligned} W_R (y^j, c^j \mid VS) &= \min_{\lambda,z} \lambda \\ \text{subject to} \quad y^j &\leq z\mathbf{M} \\ z\mathbf{C} &\leq \lambda c^j \\ z &\in \mathbf{R}^J_+ \\ \sum_{j=1}^{J} z_j &= 1. \end{aligned} \qquad (3)$$

By solving (3) J times we obtain a measure of input cost efficiency for each producer in the sample of UK credit unions. This enables us to assess the relative cost performance of these credit unions.

Note that in solving (3), the objective is to minimize input expenditure, with this minimum given by $\sum^N_{n=1}\lambda^* c_{jn}$. As mentioned earlier, this differs from the conventional cost minimisation which solves for optimal input quantities x^*_n, given j's observed input prices p_{jn}, to yield the minimum cost of input usage as given $\sum^N_{n=1} p_{jn} x^*_n$. Clearly, if data availability permits, the latter conventional approach is preferable when assessing relative cost efficiency. However, in data-deficient situations where only input expenditures c^j are available, as opposed to both p^j and x^j being available, (3) provides useful insights into the cost performance of each firm as measured by its input expenditure relative to best-practice input expenditure.

2.3 Nonradial measurement of input cost efficiency

As noted in the introduction, additional insight into efficiency in input expenditures can be obtained by comparing radial and nonradial efficiency measures with respect to each input. In proceeding to explain this, note that the radial measure yielded by (3) calculates the largest feasible contraction of the observed input expenditures vector c^j to this vector itself, while still permitting the production of observed outputs y^j. This radial contraction, however, may leave slack in certain input expenditures. Consequently, there is a difficulty with radial measurement of input cost efficiency, as calculated by (3), in that a radially shrunken input expenditure vector need not necessarily belong to the efficient subset (which contains no such slack in input expenditures) of the cost set $C(y,c| V,S)$. This difficulty can be avoided by using a nonradial input cost efficiency measure, defined in the spirit of the Färe and Lovell (1978) nonradial technical efficiency measure, which projects an input expenditure vector onto the efficient subset of the cost set.

The Färe-Lovell-type nonradial input cost efficiency measure for producer j can be defined as

$$W_{NR}(y^j,c^j| V,S) = \min \{\sum_{n=1}^{N} \lambda_n/N : (\lambda_1 c^j_1, \ldots, \lambda_N c^j_N) \in C(y,c| V,S),\ \lambda_n \leq 1 \}. \quad (4)$$

As shown in (4), this nonradial measure permits each input expenditure to be scaled down by a different proportion (given by the scalars λ_n, where $0 < \lambda_n \leq 1$) and is calculated as the minimum arithmetic mean of these non-proportional reductions in all input expenditures. The Färe-Lovell-type of nonradial input cost efficiency measure is empirically computed for producer j as the solution to the linear programming problem.

$$W_{NR}(y^j,c^j|V,S) = \min_{\lambda,z} \sum_{n=1}^{N} \lambda_n/N$$

$$\text{subject to} \quad y_{jm} \le \sum_{j=1}^{J} z_j y_{jm}, \qquad m = 1,\ldots,M,$$

$$\sum_{j=1}^{J} z_j c_{jn} \le \lambda_n c_{jn}, \qquad n = 1,\ldots,N,$$

$$\sum_{j=1}^{J} z_j = 1,$$

$$\lambda_n \le 1, \qquad n = 1,\ldots,N,$$

$$z_j \ge 0, \qquad j = 1,\ldots,J, \qquad (5)$$

where $0 < W_{NR}(y^j,c^j|V,S) \le 1$. In (4) and (5), it is assumed that none of the input expenditures c_{jn} is zero, otherwise the Färe-Lovell-type measure must be modified as proposed in Färe, Grosskopf and Lovell (1994). Since all c_{jn} are positive in our credit union study, such modification is not necessary. As noted in Ferrier, Kerstens and Vanden Eeckaut (1994), radial and nonradial efficiency measures can be ranked, so that $W_{NR} \le W_R$ for the given (V,S) reference technology.

2.4 Measuring misallocation of input expenditures

Since, by construction, the Färe-Lovell-type nonradial measure of input cost efficiency (5) projects the observed input expenditure vector onto the efficiency subset of the cost set, it thereby eliminates slack in input expenditures. In contrast, since the radial efficiency measure (3) does not necessarily compare observed input expenditures to the efficient subset, there may be slack in certain input expenditures. Also note that, in permitting such slack, the radial measure *maintains* the original input expenditure mix of observed data (by scaling each of the $c_{j1},\ldots,c_{jN}$ down equally by the same scalar λ). In contrast, in eliminating such slack, the nonradial measure *changes* the input expenditure mix (by scaling each of the c_{jn} down by different scalars $\lambda_1,\ldots,\lambda_N$ to give $\lambda_1 c_{j1},\ldots,\lambda_N c_{jN}$). Consequently, since the latter changed input expenditure situation is the result of projection onto the efficient subset of the cost set, comparison of the solution value λ^*_n, for input n in (5), with λ^* from (3) yields insight into potential over- or under-expenditure on this input.

Thus, $\lambda^*_n < \lambda^*$ indicates over-expenditure on input n in the sense that projection onto the efficient subset of the cost set requires a reduction in the input expenditure level for input n relative to its radially efficient level in the original input expenditure mix situation. Contrariwise, $\lambda^*_n > \lambda^*$ indicates under-expenditure on input n, while $\lambda^*_n = \lambda^*$ indicates that the observed input expenditure proportion for input n is optimal. In gaining this insight into misallocation of input expenditures, however, we must remember that a cost inefficient credit union has too high a level of input expenditure on *all* its inputs (as shown by it having a radial efficiency measure of $\lambda^* < 1$). By comparing λ^* and λ^*_n we can learn whether a particular input expenditure level should decrease, increase, or remain unchanged, as measured relative to its radially efficient level, in projecting the observed input expenditure vector c^j onto the efficiency subset of the cost set $C(y,c \mid V,S)$.

2.5 'Overall', scale and 'pure' input cost measurement

Finally, note that the radial and nonradial efficiency measures, given by (3) and (5), respectively, allow for variable returns to scale. Credit unions may thus be either scale efficient (operating under constant returns to scale) or scale inefficient (operating under either increasing or decreasing returns to scale). As stated in Färe and Grosskopf (1985), scale efficiency for producer j is measured as the ratio of input cost efficiency under constant returns to scale (denoted by C) to that under variable returns to scale as given by

$$S_R(y^j,c^j) = W_R(y^j,c^j \mid C,S)/\ W_R(y^j,c^j \mid V,S) \qquad (6)$$

and

$$S_{NR}(y^j,c^j) = W_{NR}(y^j,c^j \mid C,S)/\ W_{NR}(y^j,c^j \mid V,S) \qquad (7)$$

for the radial (S_R) and nonradial (S_{NR}) cases, respectively. In (6) and (7) $0 < S_R \leq 1$ and $0 < S_{NR} \leq 1$, with $W_R(y^j,c^j \mid C,S)$ and $W_{NR}(y^j,c^j \mid C,S)$ being obtained by removing the summation constraint on the intensity variables (the z_j) in (3) and (5), respectively. When S_R (or S_{NR}) = 1, credit union j is scale efficient while S_R (or S_{NR}) < 1 indicates that j is scale inefficient.

To determine whether scale inefficiency $S_R < 1$ is due to operating under increasing returns (too low a scale of operation) or decreasing returns (too high a scale of operation), we compute W_R under nonincreasing returns to scale (with the latter denoted as N) by replacing $\sum^J_{j=1} z_j = 1$ in (3) by $\sum^J_{j=1} z_j \leq 1$. If $S_R(y^j,c^j) < 1$ and $W_R(y^j,c^j \mid N,S) = W_R(y^j,c^j \mid C,S)$, then scale inefficiency is due to increasing returns to scale, while if $S_R(y^j,c^j) < 1$ and $W_R(y^j,c^j \mid C,S) < W_R(y^j,c^j \mid N,S)$, then scale inefficiency is due to decreasing returns to scale. Analogous conditions hold for the nonradial scale inefficiency cases, obtained by computing $W_{NR}(y^j,c^j \mid N,S)$.

Equation (6) indicates that the 'overall' input cost efficiency measure $W_R(y^j,c^j \mid C,S)$ can be decomposed into scale efficiency $S_R(y^j,c^j)$ and 'pure' input cost efficiency $W_R(y^j,c^j \mid V,S)$. This enables us to identify the source of 'overall' input cost inefficiency of a credit union as being attributable to scale inefficiency (due to the observed scale of operation being either too low or too high), 'pure' input cost inefficiency (due to a failure to operate on the minimum (V,S) cost frontier for the observed scale of operation), or a combination of the two. As indicated in equation (7), an analogous decomposition holds for the nonradial case.

Section 3: Data Description

The database is constructed from financial information published by credit unions in their 1997 annual returns consequently the information refers to end-year 1996. (Although in the introductory comments aggregate statistics based upon 1998 data were quoted for UK credit unions detailed annual return information later than end-year 1996 is not as yet available.)[3]

1996 was a year of relative stability for the UK economy. The recession of 1992-1993 was a distant memory as were the inflationary pressures of the 1994-1995 period. Indeed 1996 was the start of a period of sustained growth for the UK economy which has been characterised by falling levels of unemployment, low inflation as well as partnership between the trade unions and government. These were the benign conditions faced by the UK credit union movement in 1996. The fact that similar conditions have held since might suggest that the results generated in our analysis may also hold equally well for the period since 1996.

Credit unions with an asset base less than £1m were excluded from the sample therefore the sample size was restricted to 104 credit unions. The removal of small credit unions from the database was undertaken as a precaution against the introduction of a bias into the analysis. Small credit unions are for the most part those that have recently been formed and the majority of these credit unions have not as yet achieved benchmark standards in their operation. For example, in their formative years many credit unions chose not to pay dividends to members preferring to reinvest any end-year surplus back into the credit union in order to achieve basic levels of service provision. In the early years credit unions also tend to rely heavily on grants and subsidies without which they would be unlikely to survive. Furthermore in certain regions of the UK a 'buddy system' is operated by the more mature credit unions whereby they provide manpower and capital equipment to newly established credit unions. Clearly the inclusion of recently formed credit unions would result in serious distortions being introduced into the data.

As currently constituted UK credit unions are highly restricted in the range of services they can provide to

[3] Data for UK credit unions is not as yet available in computerised format. Much of the information used in this study was obtained by photocopying the AR20 returns made by individual credit unions to the Registry of Friendly Societies with the researchers then creating their own database from this paper-based information source. It is expected that in the near future the regulatory authorities will computerise the returns made by credit unions allowing this research to be expanded into a panel framework.

their members. Indeed, it could be argued that UK credit unions are at present a highly uncomplicated savings and loans vehicle mirroring, for example, the US credit union movement of the 1960s. The input output mix employed in the analysis is accordingly straightforward and does not include service variables such as loan and deposit variety indices which can be found in recent studies of US credit unions, see Fried et al. (1993); Fried and Lovell (1994); Fried et al. (1999) and Karels and McClatchey (1999).

The specification of outputs is particularly straightforward. Employing the intermediation approach, each credit union is viewed as collecting shareholders' funds to be subsequently intermediated into various earning assets, namely loans to members, investments and deposits with other financial institutions. These three outputs encompass, on average, 97 percent of the earning assets of the top 104 credit unions.

On the input side the opportunity was taken to explore the impact upon input expenditure misallocation of an increasing disaggregation of the input mix. Initially a two input expenditure model was specified. The two broad input categories were (1) management expenses and (2) non-management expenses plus dividends paid. Management expenses in the Annual Accounts is defined to include: salaries, wages and National Insurance; repairs and renewals; printing stationery and advertising; loan and share insurance; general insurance; bank charges and audit fees; conference/convention expenses; regional committee/chapter expenses; and promotion and training expenses. Non-management expenses include interest payable on secured and unsecured loans; loans written off as bad debts; provision for doubtful debts; provision for taxation; depreciation of fixtures, fittings and equipment; and leaseholds.

Dividends paid to members are one of the major expenditures for most credit unions consequently the input expenditure mix was reformulated and a three input model was specified with dividends considered separately. Computation of the nonradial measure of technical efficiency allows for non-proportional reductions in each positive input hence the three input decomposition permits an examination of the degree of feasible input expenditure reduction vis à vis dividend expenses. Credit unions in that they are based on non-overlapping common bonds are to some extent protected from competitive pressures from other credit unions, which results in considerable variation in the dividend rates on offer between credit unions. They also face limited competition from other mainstream financial institutions which again permits dividend rate variability. For example, McArthur et al. (1993) argue that the lack of competition with other institutions occurs because these institutions tend to ignore the clientele served by credit unions. In the main credit union members are primarily from low-income communities and are viewed by certain retail financial institutions as offering limited prospects for the provision of profitable financial services.[4] The 1998 Treasury Review attests to this view in that it considers UK

[4] This is not the case in countries where the credit union movement is more developed. In the US, for example Srinivasan and King (1998) argue that credit unions have played an increasingly important role in consumer

credit unions as a major weapon against ‘financial exclusion’ particularly for certain inner city communities which they suggest are now largely ignored by UK banks and building societies.

Another major expenditure component for many credit unions is salaries, wages and National Insurance. The input mix was consequently reworked and broken into four input expenditure categories (dividends, non-management expenses, salaries, wages and National Insurance, and other management expenses). Interest in labour expenditure centres upon the fact that credit unions are mutual support and self-help organisations and have an enviable track record in mobilising voluntary member action in their communities. This suggests that the reported labour remuneration figure in the Annual Accounts is in fact not the true cost of labour. The problem is further compounded by the fact that as a credit union increases in size it becomes increasingly difficult to cover obligations with solely volunteer staff and there is an increasing need to hire professionally trained employees, which implies that the true cost of labour exceeds the actual cost of labour to a greater extent for smaller credit unions than for larger credit unions. Ferguson and McKillop (1997) provide support for this intuition in a study of scale economies in UK credit unions.

> "Salaries as a proportion of total expenses ……. declines almost in linear fashion, from 34% for those with assets over £1 million to marginally less than 3% for those with an asset level between £613 and £49,000. It is, perhaps, in this category of expenditure that the most visible demonstration of the subsidised nature of the operation of small credit unions emerges and, of course, by implication, the inherent difficulty in attempting to test for scale economies."

As this study only considers credit unions with assets exceeding £1 million it is hoped that the potential for the introduction of bias in this expenditure category is downplayed. Having said this, the nonradial analysis does provide information on the potential for scaling down salaries, wages and National Insurance expenditure across the respective credit unions. Therefore as part of this discussion the role of credit union size with respect to the documented inefficiencies will be examined. It should be noted, however, that we should not necessarily expect larger credit union to exhibit a more pronounced level of inefficiency with respect to this input expenditure. McKillop and Ferguson (1998) in an investigation of operational efficiency argue that although larger credit unions face a broader portfolio of input costs these are more than offset by the operational efficiency gains achieved through scale.

In Table 1 the opportunity is taken to present summary information on the three output and four input expenditure categories.

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banking over the last 35 years. While Emmons and Mueller (1998) argue that German co-operative banks undertook major structural reforms in the 1960s and 1970s in order to compete with other banking groups. It should also be noted that regulation prohibits UK credit unions from competing with other UK financial

Table 1: Summary Statistics

	Mean (£m)	Median (£m)	Minimum	Maximum	Standard Deviation	Skew	Kurtosis	Total (£m)
Total assets	2.964	1.578	1.01	31.026	3.91	4.58	27.10	308.241
Outputs								
Loans to members	2.222	1.203	0.467	25.875	3.17	4.89	31.23	231.057
Investments	0.287	0.127	0.004	4.625	0.57	5.30	34.74	29.806
Deposits in other institutions	0.456	0.310	0.0	2.511	0.52	2.23	5.35	47.378
Inputs								
Salaries etc	0.036	0.0198	0.0	0.448	0.05	4.94	33.84	3.772
Other management expenses	0.045	0.028	0.013	0.427	0.05	4.57	28.63	4.687
Dividends	0.103	0.0524	0.014	1.50	0.18	5.44	37.04	10.671
Non-management Expenses	0.033	0.018	0.005	0.421	0.05	5.44	35.08	3.396

institutions in the inputs funds market.

Section 4: Empirical Results

4.1 Radial Measures of Efficiency

In Table 2 information is presented on the geometric means, standard deviations, minimum values, skewness and kurtosis values for the radial based technical and scale efficiency measures. This information is detailed for each of the three input-output specifications.

Table 2
Radial Input Cost and Scale Efficiency Measures

Statistics	Model 1	Model 2	Model 3
Overall Input Cost Efficiency			
Geometric Mean	0.7730	0.7914	0.8774
Standard Deviation	0.1275	0.1663	0.1179
Minimum	0.4616	0.4623	0.5716
Maximum	1.0000	1.0000	1.0000
Skewness	0.3519	-0.4678	-1.5282
Kurtosis	2.2808	2.1314	4.7508
Pure Input Cost Efficiency			
Geometric Mean	0.8336	0.8536	0.9199
Standard Deviation	0.1346	0.1592	0.1020
Minimum	0.4763	0.4893	0.6693
Maximum	1.0000	1.0000	1.0000
Skewness	0.2641	-0.8341	-0.8646
Kurtosis	1.8199	2.1111	2.7248
Scale Efficiency			
Geometric Mean	0.9272	0.9010	0.9535
Standard Deviation	0.0910	0.1276	0.0650
Minimum	0.5849	0.6056	0.6860
Maximum	1.0000	1.0000	1.0000
Skewness	-0.5022	-0.8777	-1.7535
Kurtosis	2.0121	2.0997	5.9957

Model 1 Three output and two input specification
Model 2 Three output and three input specification
Model 3 Three output and four input specification

To obtain a feel for the empirical findings let us focus on model 1 - the three output two input specification. Clearly UK credit unions have considerable scope for efficiency gains. The average overall cost efficiency value of 0.7730 suggests that UK credit unions could produce the same level of outputs with a 22.7 percent reduction in input expenditure. This high level of inefficiency may be indicative of the fact that credit unions, based on clearly defined and non-overlapping common bonds, are not in competition with each other for market share nor for that matter are they in competion with mainstream financial organisations. To the extent that this protected environment insulates credit unions from the adverse consequences of allowing inefficiences to develop, this could explain the high level of inefficiency and have implications for policy. However, before coming to such a conclusion it is necessary to examine models 2 and 3, which involve greater input disaggregation, and note the inefficiency levels found in other UK financial instituitions facing higher levels of competition

Before doing this, we note the results of decomposing overall cost efficiency into its 'pure' input cost efficiency and scale efficiency components via equation (6). As Table 2 records for model 1, this decomposition indicates that there is considerable scope for efficiency gains in both components. Thus with mean 'pure' input cost efficiency of 0.8336, credit unions could potentially produce the same level of outputs with approximately a 16.6 percent equiproportionate reduction in all input expenditures. Also with mean scale efficiency of 0.9272, credit unions could potentially secure a further 7.3 percent saving in input usage (in addition to that achievable by eliminating 'pure' input cost efficiency) relative to output performance by suitably altering both their input expenditure and output bundles. The relative sizes of these two inefficiency components suggest that inefficiency in UK credit unions is much more a problem of excessive input usage at this observed scale of operation than of operating at the wrong size.

With regard to returns to scale, the study found that 29 credit unions were scale efficient, that is they are operating under constant returns to scale. Of the 75 classed as scale inefficient, 28 were operating under increasing returns to scale (indicating that cost savings would emerge through further output expansion) and 47 under decreasing returns to scale (indicating that these credit unions would benefit from a cost efficiency perspective by size reduction).

For those credit unions identified as being subject to increasing returns to scale the Treasury Review document (1998) makes interesting reading. As credit unions grow they find that the common bond qualifications act as a restriction on who they can attract as members, particularly where workplace and community based ones wish to merge. The 1998 Review argues for new flexibilities in combining certain common bond categories. The Review also seeks removal of the current maximum membership limit. Both amendments will foster credit union growth and should aid those credit unions identified as scale inefficient through being subject to increasing returns to scale.

These measures per se are unlikely to be of benefit to the sizeable number of credit unions subject to decreasing returns to scale. The problem for these credit unions (most of which are the larger asset size credit unions in the sample) is that they currently operate within narrowly defined boundaries as to the type and range of products they can offer to their members. Essentially UK credit unions provide simple savings and loan products which are subject to tight cash limits. In that larger credit unions have invested heavily in premises, staff and technology it can be of no surprise that they are classed as being subject to decreasing returns to scale. The Treasury Review document makes welcome reading for these credit unions in that it offers much greater freedoms in the provision of services both in terms of range and money value. If these credit unions are able to cross sell higher net worth services to their members then current levels of investment in premises, staff and technology may prove justified. Examples of new freedoms which may be on offer to credit unions as a consequence of the Treasury Review include: the opportunity to borrow money from external sources, other than authorised banks and other credit unions; the ability to offer interest bearing share accounts; the opportunity to provide additional basic services and charge fees; the abolition of the limit on the maximum amount that can be held in youth accounts; and allowing credit unions more flexibility to dispose of re-possessed collateral.

It should also be noted that this finding of decreasing returns to scale would be of little surprise to a section of the UK credit union movement. NATFED one of the three main trade associations, is oriented towards the disadvantaged, focusing on self-help, empowerment, and personal development. Credit unions, in their view, should be limited to a few hundred members, because much above this figure makes their single committee structure unworkable. NATFED while encouraging its members to become economically viable by developing to a size appropriate to the needs of the members and the local community nevertheless prefers credit unions not to exceed a few hundred members. Expansion, where it occurs, should be in the development of new credit unions. Given this ethos NATFED would be more than comfortable in dealing with credit unions subject to decreasing returns to scale. Their solution would be to split the credit union into two or indeed more parts, if necessary. ABCUL in Great Britain and its sister organisation in Ireland the ILCU, in contrast to NATFED have an instrumental philosophy. Asset growth is viewed as the best way to ensure the credit union philosophy is spread. Attention is focused upon individual credit unions achieving significant critical mass which is then expected to result in the generation of business efficiency and scale economies with the credit union eventually occupying a significant position in the savings and loans market. This philosophy is clearly not compatible with a strategy of downsizing in order to eliminate scale inefficiencies. (It should be noted that no evidence emerged to indicate that any one trade body was associated with a disproportionate number of scale inefficient credit unions.)

Table 2 also provides results for models 2 and 3, with the move from model 1 involving a progressive increase in the degree of input disaggregation[5]. As the greater input aggregation in model 1 may

[5] Nunamaker (1985) argues that if the sample size relative to the sum of the inputs and outputs is too small then there is a danger of some credit unions being found efficient as a consequence of a degrees of freedom problem. In our study this is not a problem. For example, between models 1 and 2 there is no increase in the number of credit unions on the efficient frontier. While there is a 7% increase in the number of credit unions on the frontier between models 2 and 3 an outlier check (as detailed by Anderson and Peterson (1993)) on the smallest and largest efficient credit

influence the relative efficiency measures of credit unions, by over-aggregating and thus mis-measuring inputs, the finer input decompositions in models 2 and 3 are used to obtain alternative sets of relative efficiency measures. These further sets of results not only provide a protective check against such mis-measurement influences they also enable a more insightful discussion of input expenditure misallocation. However, in moving from model 1 to models 2 and 3, it is important to stress that the emphasis of the empirical work reported in Table 2 relates to the relative efficiencies of credit unions within a given model, as opposed to comparing results across models.

There is an important reason for the just-mentioned emphasis. Thrall (1989) has shown, for nonparametric reference technologies, that the radial input efficiency measures cannot decrease when computed on additional input dimensions, and cannot increase if computed on less input dimensions. This means that as we move from model 1 through to model 3, cost efficient observations will remain efficient but cost-inefficient observations may become more efficient when measured in the context of a greater number of inputs. In the latter situation, as is the case in Table 2, we expect a monotonic rise in average cost efficiencies across models 1 through 3. In contrast to this predictable direction of change in the radial measure Kerstens and Vanden Eeckaut (1995, 1999) have shown that the Färe-Lovell nonradial efficiency measure may increase, remain constant or decrease in value as input dimensions are added. (Hence as is the case in Table 3, average cost efficiencies can manifest non-monotonicity across models 1 through 3.)

While the empirical emphasis in Table 2 is on relative efficiency measures within a given model, De Borger, Ferrier and Kerstens (1995) note that additional insight can be gained by examining which inefficient observations experienced an increase in efficiency across models. In particular, we can note how such increases impact on the pattern of increasing and decreasing returns found in smaller models. Thus in Table 2, we first note that the average overall cost efficiency rises as inputs are added, the greatest increase being found in the move from the three-input to four-input model. However, while the average overall efficiency measure ranges from 0.773 to 0.877 in Table 2 it is interesting to note that UK credit unions have quite similar average levels of efficiency to UK banks (with Drake (1997) finding an average overall efficiency of 0.882 using an intermediation approach, DEA model) and to UK building societies (with Drake and Weyman-Jones (1996) finding an overall efficiency of 0.876 using an intermediation approach DEA model). Hence despite their relative protection from competition and the potentially skewed incentives resulting from their co-operative structure, UK credit unions nevertheless appear to manifest very similar efficiency levels to other UK

unions highlighted by model 3 indicated that there was no reason to suspect that any of these observations were not efficient in the true sense.

financial institutions[6]

With regard to the pattern of returns to scale across the three radial models, it is interesting to record that (i) the pattern is essentially the same for models 1 and 2, and (ii) while there are 40 credit unions efficient in model 3 (compared to 29 and 30 in models 1 and 2 respectively), decreasing returns to scale (DRS) rather than increasing returns (IRS) still accounts for the greater part of the scale inefficiency (51 credit unions subject to DRS and 13 subject to IRS in model 3 compared to 47 DRS and 28 IRS in model 1). Moreover, this finding that the majority of the scale-inefficient credit unions exhibited decreasing returns to scale accords with the very similar results found for UK banks by Drake (1997) and for UK building societies by Drake and Weyman-Jones (1996). (The latter study also found that a stochastic frontier approach gave very similar efficiency rankings to their nonparametric DEA results).[7]

In Table 2 information is also reported on the second, third and fourth moments of the distributions of the respective efficiency measures. The standard deviations are very similar over the various efficiency measures. The kurtosis values for models 1 and 2 are less than two indicating that the distributions are platykurtic, that is they have less mass in the tails than a normal distribution. With respect to model 3 the kurtosis value for scale and overall input cost efficiency is greater than three, suggesting leptokurtic distributions and indicating that these two distributions have more mass in their tails than a normal distribution. The skewness values indicate that these distributions are negatively skewed.

[6] The Fried, Lovell and Vanden Eeckaut (1993) study likewise found that US credit unions had levels of overall efficiency very similar to that of US banking. However as the authors note, we must be cautious since the respective results relate to relative efficiency findings within distinct samples of one type of financial institution rather than to findings within a sample combining both types. Also comparison via a combined sample is difficult as most credit unions and banks are non-comparable as a result of the relative smallness of credit unions.

[7] This finding, however, may not hold elsewhere. For example Ferrier and Lovell (1990) got very different rankings for US banks. Drake and Weyman-Jones (1996) and indeed Berger and Humphrey (1991) note that the nonparametric approach provides an upper (or pessimistic) bound to measured inefficiency while the stochastic frontier approach provides a lower (or optimistic) bound to measured inefficiency but unfortunately the range between these bounds can be very large and the association between efficiency distributions may be small. Both studies also provide useful commentaries on the advantages and disadvantages of the two approaches.

4.2 Nonradial Measures of Efficiency

Table 3 presents the empirical results for the Färe-Lovell nonradial based input cost and scale efficiency measures. This information is again detailed for each of the three input-output specifications.

Table 3
Nonradial Input Cost and Scale Efficiency Measures

Statistics	Model 1	Model 2	Model 3
Overall Input Cost Efficiency			
Geometric Mean	0.7506	0.5971	0.6121
Standard Deviation	0.1376	0.2009	0.2561
Minimum	0.4076	0.1309	0.1375
Maximum	1.0000	1.0000	1.0000
Skewness	0.5747	0.5341	0.3418
Kurtosis	1.5302	2.4467	1.9217
Pure Input Cost Efficiency			
Geometric Mean	0.8244	0.7461	0.7588
Standard Deviation	0.1426	0.2009	0.2122
Minimum	0.4749	0.2445	0.2295
Maximum	1.0000	1.0000	1.0000
Skewness	0.0885	0.0334	-0.1946
Kurtosis	1.7985	1.8999	1.8511
Scale Efficiency			
Geometric Mean	0.9158	0.8018	0.8030
Standard Deviation	0.1023	0.2076	0.2138
Minimum	0.5741	0.2609	0.2730
Maximum	1.0000	1.0000	1.0000
Skewness	-0.9698	-0.7962	-0.9408
Kurtosis	2.9551	2.6088	2.6600

Model 1 Three output and two input specification
Model 2 Three output and three input specification
Model 3 Three output and four input specification

With regard to the comparison of our radial and nonradial measures of cost efficiency we note the result in Ferrier, Kerstens and Vanden Eeckaut (1994) that the Färe-Lovell nonradial technical efficiency input measure must be less than or equal to the corresponding Farrell radial efficiency measure for a given reference technology. Since the input cost efficiency measures have been similarly constructed in our data-deficient context, a comparison of the cost efficiency measures in Tables 2 and 3 indicates that this ordering holds.

Focusing on model 1, Tables 2 and 3 report very similar (average) cost and scale efficiency values for the radial and nonradial measures. This comparison suggests that slack in the form of excessive expenditure on management expenses and non management expenses, is not a significant problem. Summary statistics for the second, third and fourth moments also indicate that the various distributions are similar in form to those identified for the radial equivalents. Indeed, when Pearson product-moment correlation coefficients were calculated between the radial and nonradial measures high positive correlations were obtained. The calculated values were 0.9858 for overall input cost efficiency, 0.9839 for 'pure' input cost efficiency and 0.9412 for scale efficiency. [8]

The uniformity in findings between the radial and nonradial versions rapidly disappears on examination of models 2 and 3. For both models the nonradial values are much lower. For example, for model 3 the overall input cost efficiency value is 0.6121 which suggests that UK credit unions could produce the same level of outputs with a 38.8 percent reduction (non-proportional) in input expenditures. The comparable figure from Table 2 was 0.8774 providing scope for a 12.2 percent proportional reduction in input expenditures. This result indicates how the use of a nonradial measure, together with greater input disaggregation, can highlight the extent to which nonradial slack is a major component of overall inefficiency. As Fried, Lovell and Vanden Eeckaut (1993) warn, reporting only radial inefficiency can lead to both an understatement of overall inefficiency and a failure to recognise its non neutral character. The importance of the latter point is further reinforced in the discussion of input expenditure misallocation below.

Before proceeding to examine input misallocation note from Table 3 that (as found in Table 2 for the radial models) inefficiency in UK credit unions is more a problem of excessive input usage at their existing scale of operation than of operating at the wrong size. However, the low input cost and scale efficiency values for the nonradial models in Table 3 suggest that there are considerable inefficiencies in the UK credit union sector. As highlighted earlier these findings may reflect the fact that credit unions currently operate within narrowly defined boundaries as to the type and range of products they can offer to their members. Such limitations on their operations while appropriate in 1979 when the present regulatory regime was last over-hauled may not be appropriate to the UK credit union movement some 20 years later. Having said this, the high levels of inefficiencies identified in Table 3 may be indicative of other problems. For example, the problem may be due to the weak supervisory control applied to UK credit unions. Supervision of credit unions is the responsibility of the Registry of Friendly Societies. The Registrar has only limited statutory powers to intervene in the affairs of a credit union. Under sections 17 and 18 of the 1979 Credit Union Act the Registrar has the power to require financial or other information and may appoint an inspector to investigate credit unions' affairs. If a credit union gets into financial difficulties or no longer meets the conditions for registration, the Registrar under Sections 19 and 20 of the Act ultimately has the power to suspend its operations. However, the Registrar has no statutory powers of the kinds available to other financial

[8] Although not directly comparable our model 1 figure of 25 percent overall inefficiency, see Table 3, in the usage of the two inputs is not out of line with the results of the Fried, Lovell and Vanden Eeckaut (1993) study for US credit unions. The latter study found that the average (nonradial) overutilisation of its two inputs (labour

regulators to intervene in the affairs of a credit union for example, to require it to remedy defects in its management of the business, or to discipline its officers or employees, where things have gone wrong. This lack of supervisory power may well have been instrumental in allowing inefficiencies to develop within the sector. Perhaps, in recognition of this the 1998 Treasury Review has sought opinions on whether the supervision of credit unions should be transferred to the Financial Services Authority (FSA). The FSA is the regulatory authority for all other UK deposit taking institutions and has available to it an extensive range of supervisory and enforcement measures.

As in the radial analysis the opportunity was taken to classify credit unions as either scale efficient or scale inefficient. With variable returns to scale employed as the reference technology 26, 27 and 26 credit unions were identified as scale efficient for models 1, 2 and 3 respectively. Of those classed as scale inefficient, the larger share again suffered decreasing returns to scale. The actual number of credit unions which would benefit in terms of cost efficiency gains from size reduction was 59, 71 and 72 in models 1, 2 and 3 respectively.

4.3 Misallocation of Input Expenditures

As detailed in the methodology section an insight into potential over- or under- expenditure on specific inputs can be obtained through comparison of the nonradial measure of efficiency with the associated radial measure. More specifically, if the nonradial scaling coefficient specific to input n is less than the radial measure this implies an over-expenditure on the input. In contrast, if the nonradial scaling coefficient for the input in question is less than the radial measure the implication is that under expenditure has occurred while if the values are equal then the observed expenditure proportion for input n is optimal.

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and operating expenses) was approximately 26.5 percent.

Table 4
Input Expenditure Misallocation (optimal, over or under expenditure)

Model 1

Non-Management expenses plus Dividends			Management Expenses		
Optimal exp.	Over exp.	Under exp.	Optimal exp.	Over exp.	Under exp.
30%	59%	11%	30%	11%	59%

Model 2

Non-Management expenses			Dividends			Management Expenses		
Opt. Exp.	Over exp.	Under exp.	Opt. exp.	Over exp.	Under exp.	Opt. exp.	Over exp.	Under exp.
32%	53%	15%	33%	51%	16%	33%	22%	45%

Model 3

Non-Man. Expenses			Dividends			Man. Exp. (less salaries..)			Salaries, wages etc		
Opt. exp.	Over exp.	Und. exp.	Opt. Exp.	Over exp.	Und. Exp.	Opt. exp.	Over exp.	Und. exp.	Opt. Exp.	Over exp.	Und. exp.
43%	49%	8%	43%	38%	19%	43%	46%	11%	40%	23%	37%

Model 1 Three output and two input specification
Model 2 Three output and three input specification
Model 3 Three output and four input specification

The dichotomy in the results detailed for model 1 in Table 4, vis à vis under- and over- expenditure, is to be expected given that the overall radial and nonradial efficiency measures in Tables 2 and 3 are of similar magnitude and strongly positively correlated. The findings indicate that 30 percent of UK credit unions have optimal observed expenditure proportions. However also apparent is that a sizeable share are engaged in over-expenditure within the expenditure class non-management expenses plus dividends (59 percent) while a significant percentage, again 59 percent, are under-spending within the category management expenses. In broad policy terms this suggests that 70 percent of UK credit unions would generate efficiency gains through reworking their input mix. While the highlighted percentages suggest how this rework could be achieved it is perhaps only marginally helpful in that each of the expenditure categories contain a broad array of input components.

Additional insights into input expenditure misallocation are gained however as the input dimensions of the model are expanded incrementally from two to four. For example in moving from model 1 to model 2 and now treating dividends separately from non-management expenses, the greater input disaggregation indicates that a substantial percentage (51 percent) of credit unions exhibit over-expenditure on dividend payments. Further investigation reveals that it is the larger credit unions, which tend to pay marginally higher dividends than their smaller counterparts (see Ferguson and McKillop, 1997). In general terms it should be emphasised that credit unions, given their common bond restriction, do not compete with each other and hence offering attractive dividends to attract members may not be as critical for credit unions as other organisational forms. Indeed, given the McKillop and Ferguson (1998) finding that UK credit unions have a pro-borrower bias so that the minimisation of all costs including dividends is an appropriate objective we would expect to find some opportunity for dividend payment restriction - as the results for model 2 in Table 4 suggest. This conclusion still holds under greater input disaggregation in model 3, even though the percentage of credit unions over-spending on dividends is somewhat lower (at 38 percent). Thus while inefficient credit unions clearly have too high a level of expenditure on all inputs this aspect of the analysis suggests that they have a disproportionately high share of expenditure on dividends.

The results for models 1 and 2 in Table 4 also indicate considerable under-expenditure on management expenses. However by disaggregating labour costs (salaries, wages and national insurance) from this expenditure category, as is done in model 3, Table 4 indicates that this under-expenditure largely relates to labour costs (37 percent of credit unions under-spend on labour costs). In general terms this is not an unexpected result in that credit unions rely heavily on volunteer labour, particularly in their formative years. Consequently expenditure on labour only represents a small percentage of input costs, especially when viewed in comparison with the labour expenditure proportions of other financial organisations. The 1998 Treasury Review considered ways in which banks and building societies could help credit unions expand their business and develop from simple savings and loans vehicles. If such developments occur then volunteers can be expected to play a much-reduced role in the operation and organisation of credit unions with their positions taken by salaried professionals. From Table 4 it is clear that for a number of credit unions such expenditure may have the positive benefit of enhancing efficiency in that cost reducing benefits may be expected to emerge as volunteers are replaced by paid professionals..

For example, as nonprofit organisations, credit unions (worldwide) do not generally compensate their managers on the basis of profit or stock performance. Instead management compensation often reflects a credit union's size and product offerings. The introduction of greater numbers of salaried professional in UK credit unions may thus result in more products sold per unit of labour. More professional labour may also have advantages in other areas. Table 4 also indicates a consistent finding of over-expenditure on non-management expenses as can be seen in the results for models 2 and 3. One component of this category relates to provision for bad debts. Again the expectation is that salaried professionals would help in reducing the high levels of bad debt provisions and thus over-expenditure on non-management expenses. This latter part of the analysis thus suggests that inefficient credit unions have too high a level of expenditure on all inputs, but may have too low a share with regard to labour costs and too high a share with respect to non-management expenses.

4.4 Factors of Importance in the Explanation of Efficiency

As highlighted in De Borger and Kerstens (1996) the selection of a model to explain the calculated efficiency differences should take account of the characteristics of the distribution of the efficiency measures. In that all the measures are constrained to lie between 0 and 1 the use of a censored regression model (Tobit model) is appropriate. The standard Tobit model is defined in terms of a latent variable y_i^* where $y_i^* = b'x_i + \varepsilon_i$ where ε_i are assumed to be independent and identically distributed drawings from $N(0,s^2)$. However the latent variable y_i^* is not directly observable. Instead, the efficiency index is observed which is truncated at 1, thus partly masking the true value of y_i^*. For y_i^* less than 1 both y_i and x_i are observed; while for $y_i^{*\,3}$ 1 the x_i are observed and the y_i equal the limit value of 1.

Given this statistical model the next step is to specify variables which may prove important in explaining differences in the overall (cost) efficiency scores. In this specification exercise we will draw from the introductory comments which highlighted organisational and structural differences within the UK credit union movement. One of the key differences relates to the trade association to which credit unions are affiliated. Three main trade bodies dominate the UK credit union movement. All three trade bodies are represented in the sample. As earlier argued, some trade bodies take the view that credit unions should be limited to a few hundred members and expansion, where it occurs, should be in the development of new credit unions. Other trade bodies consider big to be better and argue that economies of scale and scope can be generated through expansion. Dummy variables are employed to ascertain whether the ethos of the trade bodies is reflected in their efficiency scores.

Credit unions may also be distinguished in terms of their common bond. Three different types of common bond are represented in our sample - employer-based, association-based and community-based. The common bond may prove to be an important explanatory variable as community based common bonds by definition are less tightly defined and may also encompass a much wider membership spread in terms of income levels than the other common bond categorisations. Such differences may result in community based credit unions being subject to, for example, higher levels of bad debt write-offs with this in turn reflected in their efficiency scores. Dummy variables are employed to control for common bond class.

Size as measured by asset volume may also prove important. Earlier it was suggested that as credit unions increase in size it becomes increasingly difficult to cover obligations with solely volunteer staff and there is an increasing need to hire professionally trained employees. The imposition of such additional costs might suggest that larger credit unions would exhibit a more pronounced level of inefficiency with respect to their smaller counterparts. Set against this, however, McKillop and Ferguson

(1998) in an investigation of operational efficiency argue that although larger credit unions face a broader portfolio of input costs these in actual fact may be more than offset by the operational efficiency gains achieved through scale economies. To determine which, if either, pertain asset volume is included as an explanatory variable.

UK credit unions at present are simple savings and loans vehicles. As highlighted in Table 1 loans to members make up in excess of 80 percent of the asset base of most credit unions. Clearly UK credit unions are in general not well diversified. The question then arises whether the degree of diversification is related in anyway to credit union efficiency. To address this issue loans as a proportion of total assets was employed as an explanatory variable in the Tobit regressions.

Finally a number of performance indicators were constructed to determine whether efficiency was correlated to these aspects of credit union behaviour. Surplus generated per £ of assets was employed to gauge whether a relationship existed between efficiency and financial performance. Liquid assets as a proportion of total assets and reserves as a percentage of assets were incorporated to determine whether efficiency and the financial soundness of credit unions were correlated. The liquidity and capital ratios were not expected to yield insights in that UK credit unions are obliged to adhere to specified ratios and the majority of credit unions operate at the minimum specified levels. Finally to gauge whether the bad debt levels of credit unions had a detrimental effect on efficiency bad debt write-offs as a percentage of total assets was also employed as a potential explanatory variable.

The Tobit regression estimates, obtained by maximum likelihood techniques, are presented in Table 5 with standard errors in parentheses. Given the potential for almost extensive reporting of regression estimates we focus on the radial measure and nonradial measures derived with respect to the variable returns to scale reference technology. It should be noted that some variation in the relative importance of explanatory variables did emerge on employing efficiency measures calculated with reference to different technologies (constant and non-increasing returns to scale), having said this the documented findings in Table 5 broadly hold true for the other technologies.

Table 5
Tobit Results for the Efficiency Measures

	Radial (3 output 2 input)	Radial (3 output 3 input)	Radial (3 output 4 input)	Nonradial (3 output 2 input)	Nonradial (3 output 3 input)	Nonradial (3 output 4 input)
Constant	1.220* (10.504)	1.0085* (4.823)	1.075* (6.553)	1.226* (11.166)	1.216* (9.009)	1.177* (13.506)
Asset Size	0.160 -07* (5.325)	0.257 –07* (5.773)	0.248 –07* (5.836)	0.143 –07* (5.026)	0.223 -07* (5.667)	0.804 -08* (3.561)
Loan Ratio	-0.458* (3.471)	-0.333* (1.964)	-0.445* (2.387)	-0.449* (3.602)	-0.453* (2.091)	-0.293* (2.964)
Liquidity Ratio	-0.145 (1.211)	-0.219* (2.124)	0.218 (1.292)	-0.134 (1.182)	-0.011 (0.130)	-0.114 (1.271)
ABCUL	-0.022 (0.408)	-0.007 (0.446)	0.034 (0.446)	-0.008 (0.161)	0.044 (0.222)	0.043 (1.068)
ILCU	-0.075 (1.593)	-0.077 (1.613)	-0.086 (1.277)	-0.064 (1.413)	-0.088* (2.008)	-0.059 (1.654)
Bad-debt Ratio	-9.661* (3.206)	-10.448* (3.298)	-18.655* (4.384)	-9.659* (3.392)	-9.099* (3.991)	-5.954* (2.635)
Log-Likelihood	78.303	52.934	42.434	84.200	82.333	108.244

* Statistically significant at the 5 percent level

A number of variables hypothesised as impacting on efficiency, did not play an explanatory role in any of the specifications. These variables were omitted from the estimation process. Variables, which fell into this category, included the dummy variable to represent common bond differences, the reserve to asset ratio and the financial performance variable (surplus per £ of assets). Additionally certain variables were only important in a subset of the specifications. These we continued to incorporate and they are the dummy variables capturing trade association and the liquidity ratio defined as liquid assets as a percentage of total assets.

Of the latter results perhaps the most surprising and indeed counter intuitive result was that credit unions affiliated to the ILCU appeared, in certain specifications, to be less efficient than credit unions affiliated to other trade bodies. One reason for this might be that the ILCU is much longer in existence than the other trade bodies and provides a much broader range of *compulsory* services to member credit unions. These *compulsory* services are invariably fee based and consequently will be reflected in higher input costs. Loan and share insurance is perhaps the most onerous of the various additional component costs. Although such services reduce the risks inherent in the operation of ILCU affiliated credit unions they also appear to impact adversely upon efficiency. Having made this point it should be emphasised that although the dummy variable representing ILCU membership is negative in all cases it is only statistically significant at the 5 percent level for the nonradial three output three input model.

The remaining explanatory variables, asset size, the loan to asset ratio and the bad debt write-off ratio display consistent findings across each of the specifications. The positive coefficient on asset size suggests that larger credit unions are more efficient than their smaller counterparts. It should be noted however that the coefficient value, detailed in Table 5, is extremely small and hence the size effect must be viewed as marginal[9]. Looking at the detailed results, we find a mix of cost efficient and cost inefficient credit unions in both the smaller and larger size classifications. With respect to the larger credit unions the picture reflects a mix of both cost efficient and scale efficient credit unions together with cost inefficient and scale inefficient credit unions. As noted in the non parametric analysis the dominant finding with respect to size is that of decreasing returns to scale among larger credit unions.

An inverse relationship is identified between efficiency and the loan ratio, that is the greater the proportion of credit union funds tied up in members' loans the lower the documented efficiency score. The implication is that the risks inherent in a lack of diversification are compounded in that a relatively lower level of efficiency accompanies them. It is difficult to identify why loan concentration and efficiency are linked in this manner. One explanation might be that credit unions, which behave in this manner, demonstrate a lack of financial sophistication which may also translate into other aspects of their operational and organisational structure resulting in missed opportunities for efficiency gains.

Not unexpectedly bad debt write-offs and efficiency demonstrate a clear and pronounced negative relationship irrespective of the input output structure or for that matter the radial/nonradial form of the model. A high write-off ratio is indicative of a poorly run organisation and again it can be argued that organisations which face problems in one aspect of their business are likely to see these problems spill-over to other areas

Section 5: Concluding Comments

Credit unions are member owned democratic institutions emphasising self-help and voluntarism and with social objectives concerning educational and developmental concerns, particularly for weaker, disadvantaged segments of society. With many building societies and insurance companies opting for public listings and consequently vacating the mutual sector, credit unions are increasingly being viewed as one of the last bastions of mutuality in the UK. As indicated this has resulted in unprecedented levels of attention from Government with the objective of the attention that of promoting credit unions through legislative reforms. At this juncture the degree of attention focused upon credit unions by governmental and quasi-governmental bodies has not been matched by research into credit unions. Our paper, in that it explores the efficiency of credit unions with assets in excess of £1million, endeavours to provide some answers into one aspect of credit union behaviour, that is credit union efficiency.

Radial and nonradial input cost efficiency measures are computed for a selection of input output specifications. Both measures highlighted that UK credit unions have considerable scope for efficiency gains. It was mooted that the documented high levels of inefficiency may be indicative of the fact that credit unions, based on clearly defined and non-overlapping common bonds, are not in competition with each other for market share nor for that matter are they in competion with mainstream financial organisations. Credit unions were also highlighted as suffering from a considerable degree of scale inefficiency with in excess of 50 percent of scale inefficient credit unions subject to decreasing returns to scale. This finding is problematic for a government which wishes to promote credit unions through encouraging existing unions to embrace a much wider membership base. The problem for these credit unions is that they currently operate within narrowly defined boundaries as to the type and range of products they can offer to their members. In that larger credit unions have invested heavily in premises, staff and technology it can be of no surprise that they are classed as being subject to decreasing returns to scale. It was argued that the 1998 Treasury Review document makes welcome reading for these credit unions in that it offers much greater freedoms in the provision of services both in terms of range and money value. If credit unions are able to cross sell higher net worth services to their members then current levels of investment in premises, staff and technology may prove justified.

One of the advantages of computing nonradial measures is that an insight into potential over- or under-expenditure on specific inputs can be obtained through a comparison of the nonradial measure of efficiency with the associated radial measure. One interesting finding to emerge was that credit unions over-spend on dividend payments. Given their common bond restriction, credit unions do not compete with each other and consequently offering attractive dividends to attract members may not be as critical for credit unions as other organisational forms. If this hypothesis holds and is taken in conjunction with the identified over-expenditure there may be scope for some UK credit unions to reduce dividend rates on offer to members.

From this part of the analysis it was also noted that 37 percent of credit unions under-spend on labour costs (salaries, wages and National Insurance). This was not an unexpected result in that credit unions rely heavily on volunteer labour, particularly in their formative years. It was, however, argued that if credit unions are to fulfil the aspirations of Government and develop from simple savings and loans

[9] Caudill et al. (1995) demonstrate the manner in which heteroscedasticity can impact upon such findings.

vehicles then volunteers could be expected to play a much-reduced role in the operation and organisation of the credit union with their position being taken by salaried professionals. For a number of credit unions it transpires that such expenditure may have the additional positive benefit of enhancing efficiency.

A truncated regression model was employed to explore the role of a selection of variables in the determination of credit union efficiency. From the perspective of the current drive by Government to enhance credit union growth and indeed their determination to provide credit unions with freedoms to offer a wider product range a key result is the inverse relationship identified between efficiency and the loan ratio. The implication being that risks inherent in a lack of diversification are compounded in that they are accompanied by relatively lower levels of efficiency. If as a consequence of the Government taskforce review a wider portfolio remit for UK credit unions results not only will this give rise to diversification advantages but also we have demonstrated that efficiency advantages may accrue. Such a policy implication must, however, be set against the non-parametric finding that credit unions suffer from a considerable degree of scale inefficiency in the form of decreasing returns to scale. This suggests that the attempt to secure benefits from diversification may be thwarted by operating size inefficiencies.

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