1

Measurement of Economies of Scale in Victorian Credit Unions

by
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Abstract:

This study on economies of scale in credit unions differs from the only previous Australian study in three important ways: (a) the cost function is derived from the translog production function; (b) estimates of economies of scale are made for four cross-sectional periods, not one; and (c) the total sample of credit unions is divided into subsamples by asset size and bond of association type. Significant diseconomies of scale are found for some subsamples of small credit unions but for most subsamples the null hypothesis of constant returns to scale is not rejected.

Keywords:

CREDIT UNIONS; ECONOMIES OF SCALE; TRANSLOG.

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1. Introduction

Since the seminal works of Benston (1965) and Bell and Murphy (1968), there have been numerous studies of economies of scale[1] in financial intermediaries. Moreover, interest in this area shows no sign of abating with much of the recent literature expanding evidence on the issue of X-efficiency.[2] In the United States, evidence of economies of scale has consistently been found only for banks with assets of less than US$100 million. The evidence for larger banks, including the multibillion dollar "superbanks" is not conclusive.[3] In Australia, there have been several empirical studies of economies of scale in building societies (Bartlett and Crapp (1977), Elstone (1980), Crapp (1982) and Esho and Sharpe (1993)) but there is only one published study of economies of scale in credit unions (Crapp 1983).

The major purpose of this research is to answer a question of "fact": to what extent are there economies of scale in Victorian credit unions?[4] The answer to this question has important implications for the desirability of growth, for credit union supervisors, managers and members. Moreover, Crapp's study can now be considered limited in its methodology and sample period studied. Therefore, this study provides recent and more reliable empirical evidence on economies of scale in credit unions and complements recent studies measuring economies of scale in Australian building societies by Esho and Sharpe (1993) and Australian banks by Walker (1994).

The paper is organised as follows. In Section 2 some characteristics of credit unions are discussed briefly. Section 3 reviews the existing empirical evidence. Section 4 provides empirical evidence on economies of scale[5] in Victorian credit unions from estimated cost functions for the total sample and for subsamples by asset size and bond of association type, while Section 5 discusses some policy implications. Section 6 provides a summary and conclusions.

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1. Economies of scale exist when a given proportionate increase in inputs results in a larger than proportionate increase in outputs. Economies of scope exist when two or more products can be produced together at a lower average cost than if they had been produced separately.
2. For example, the April 1993 issue of the *Journal of Banking and Finance* was devoted entirely to the topic of economies of scale and scope in financial intermediaries including the X-efficiency issue. X-inefficiencies occur when cost dispersions arise between firms of similar size as not all firms are on the efficient frontier. See Berger, Hunter and Timme (1993) for a review of the recent studies and Humphrey (1987) for an explanation of the X-efficiency issue.
3. Shaffer (1992, p. 1), Mester (1992), Berger et al. (1993) and McAllister and McManus (1993).
4. By restricting the sample to Victorian credit unions, the study controls for differences in economic conditions and prudential regulations between Australian states.
5. See Section 4.5 for an explanation as to why no attempt is made to estimate economies of scope.

2. Characteristics of Credit Unions

Credit unions differ from other intermediaries in that they are non-profit organisations whose members share a common bond of association. For example, in community credit unions, all members share the common bond of living in the same geographical area. Similarly, in industrial credit unions, all members share a common bond[6] involving the workplace and in parish credit unions the members share a religious affiliation. Credit unions are a relatively pure form of a coöperative since the members both supply the capital and consume the output. Being a coöperative, a credit union cannot usually be said to have the goal of maximising shareholders' wealth but rather its goal is to maximise the benefits provided to its members.

Therefore, it is at least questionable whether credit unions should be assumed to be profit maximisers, and accordingly it is sometimes claimed that the standard theory of the firm cannot be applied to credit union behaviour.[7] But standard techniques to measure economies of scale can be applied to credit unions if their goal is to maximise member benefits through cost minimisation.[8] Although managers may be able to capture agency benefits, the goal of cost minimisation is a standard assumption in the literature.

It has also been acknowledged in the literature that the common bond reduces operating costs by reducing the cost of gathering information on credit quality, hence reducing bad debt losses.[9] There has also been discussion of whether credit unions can be classified as "saver-dominated" or "borrower-dominated" and, if so, what effects there may be on the distribution of benefits.[10] Other researchers have considered the impact of parent company business on occupational credit union behaviour.[11] Therefore, while it is accepted that there may be links between the bond type and operating costs, there is no reason to assume that the impact is constant across all bond types. The implications of this effect on the measurement of economies of scale have not been investigated empirically.

Unlike other firms whose industrial classification depends on what they produce, financial intermediaries are usually classified in terms of their functions.[12] Measuring economies of scale in financial intermediaries is difficult

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6. In this paper, the term "bond type" refers to the classification of credit unions according to the bond of association of members, namely, Community, Industrial and Parish.
7. See Smith, Cargill and Meyer (1981) and Smith (1986) for a discussion of the objective function of credit unions and their decision-making processes.
8. For further discussion of this issue, see Koot (1978).
9. See Black and Dugger (1981).
10. See, for example, Patin and McNiel (1991*a*).
11. See Kohers and Mullis (1986).
12. For a detailed discussion of the functions of intermediaries, see Merton (1992).

because there is no consensus on how an intermediary's output should be defined and measured. Similarly, there is disagreement on the related issue of how the cost of intermediation should be defined. Two schools of thought, known as the "production approach" and the "intermediation approach", have developed. As the measurement of economies of scale requires estimation of the cost function (through duality from the underlying production function) it is useful to outline these two approaches.[13] Under the production approach,[14] financial intermediaries are viewed as producers of services associated with individual loan and deposit accounts. These services are produced using capital and labour, while output is proxied by the number of accounts serviced. Thus, deposit accounts are seen as an output and interest paid is excluded from total costs.

Under the intermediation approach,[15] financial intermediaries are viewed as producers of services that are related directly to their rôle as intermediaries in financial markets. That is, they are viewed as collecting deposits and purchasing funds to be transformed into loans and other earning assets. Therefore, the provision of deposit services is a payment in kind for use of the funds which are used to make loans. Deposits are inputs along with capital and labour, while output is measured by dollar volumes of earning assets. Thus, under this approach, deposits are an input and interest paid is included in total costs.[16] When a stock variable such as the dollar value of assets is used to measure output, the stock measure used is assumed to be proportional to the underlying output flow.

3. Prior Empirical Evidence

3.1 International Evidence

A large number of empirical studies of economies of scale in financial intermediaries is summarised in the comprehensive review articles of Benston, Hanweck and Humphrey (1982), Mester (1987*a*), Clark (1988), Humphrey (1990) and Berger, Hunter and Timme (1993). Although conceptually the intermediation and production approaches are very different, Clark (1988) and Humphrey (1985) both find that the empirical results do not appear to be sensitive to the approach used.

Existing studies can be classified by: (*a*) the form of the cost function (that is, by whether the cost function is linear in logs, as in the case of the Cobb-Douglas, or quadratic in logs, as in the case of the translog); and, by (*b*) the output definition (that is, by whether output is defined in single-product or multi-product

13. A more detailed outline of the alternative approaches can be found in Humphrey (1985).
14. For a comprehensive study of this approach, see Pesek (1970) and Towey (1974).
15. The intermediation approach was developed by Klein (1971) and Sealey and Lindley (1977).
16. For a detailed examination of the implications flowing from the alternate output definitions, see Shaffer (1993*a*).

terms). The empirical results appear to be sensitive to the functional form used, with early single-product studies using the Cobb-Douglas production function finding strong evidence of scale economies. But the more recent multiproduct cost studies such as Benston et al. (1983), Berger et al. (1987), Gilligan and Smirlock (1984), Gilligan et al. (1984), Le Compte and Smith (1985), Lawrence and Shay (1986) and Mester (1987*b*) have consistently found no evidence of economies of scale beyond *low* output levels. Mester (1987*a*, p.24) concludes that "except for the credit union study[17] the overall findings of the multiproduct cost studies of depository financial institutions suggest that the previous single-product studies overstated the degree of economies of scale that exist".[18] The early single-product studies of credit unions such as Taylor (1972) and Wolken and Navratil (1980) found evidence of economies of scale. Flannery (1974) found no evidence of economies of scale in the credit unions he studied but nevertheless suggested that economies of scale did exist, arguing that the value of the sponsor company subsidy declines with size and the scale effects were not large enough to offset the subsidisation available to large credit unions. Murray and White (1983) found economies of scale existed for most credit unions in their sample and similar results have been reported by Kim (1986), Kohers and Mullis (1988)[19] and Dermine and Röller (1992).

3.2 Australian Evidence

To our knowledge, the Australian literature on economies of scale in financial intermediaries consists of eleven studies, six of which relate to banks, four to permanent building societies and one to credit unions. Apart from Esho and Sharpe (1993) and Walker (1994) all use the production approach and the single-product functional form. For a table summarising the main features of most of these studies, see Esho and Sharpe (1993, pp.3–4). Evidence on scale economies in banks is provided by Walker (1994), while Esho and Sharpe (1993) present evidence on building societies. Thus, evidence on credit unions complements these two recent Australian studies.

Crapp (1983) found diseconomies of scale in New South Wales credit unions. From today's perspective Crapp's study is limited because:

(i) it uses 1979–1980 data;

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17. The study referred to is Murray and White (1983).
18. More recently, a strand of research has concentrated on "superbanks". See, for example, Shaffer (1992) and Mester (1992).
19. Kohers and Mullis (1988) differs from the other studies in that they use a financial statement data approach to measure operational efficiency and economies of scale were investigated using a paired-difference test.

(ii) the cost function is derived from a Cobb-Douglas production function which cannot detect a U-shaped average cost curve if one exists because it assumes that the economy of scale measure is constant across all output levels; and,

(iii) the structure of the industry has changed since 1980. Credit unions like other financial intermediaries have had to adjust to operating in the new environment created by the deregulation of the Australian financial sector. In addition, credit unions were significantly affected by a decision of the Trade Practices Commission in 1981. This decision allowed credit unions to offer credit cards.[20] Since 1981 the industry has undergone both considerable rationalisation and change in asset structure. For example, the number of credit unions in Victoria fell from 164 in 1983 to 90 in 1993. Over the same period, housing finance to individuals has increased from 4.5% of total assets for all credit unions in June 1981 to 24.7% in June 1993.[21]

4. Research Design Issues

The research design used in this study is explained using a modified version of Humphrey's (1990) listing of the research design issues in measuring economies of scale. These are: intermediation approach versus production approach, form of the total cost function, time period used, single versus multiple output, and efficiency differences. A further issue of bond type has been included in this paper.

4.1 Intermediation Approach versus Production Approach

This study adopts the intermediation approach. Mester (1987*a*, p.19) states that the choice of approach depends on "the philosophy of the investigator and the data being used". This paper adopts the argument of Sealey and Lindley (1977) that production in the economic sense means creating a product which the market values more highly than the inputs. In the case of financial intermediaries, only those services which are associated with the acquisition of earning assets are products which are valued in the market more highly than the inputs. The services received by depositors can be seen as part payment for an input (deposits). Payments for capital and labour are the implicit costs and interest is the explicit cost. This study differs from Crapp (1983) who used the production approach.

But as discussed by Mester (1993, fn.9), the conclusions regarding cost structures of financial intermediaries have generally not been sensitive to the method of measuring output.

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20. For a full discussion of the significance of this decision, see Crapp and Skully (1985, Ch.13).
21. Source: Reserve Bank of Australia, 1994, *Bulletin*, December Table S37.

4.2 Form of the Total Cost Function

This study uses the translog cost function[22] which overcomes some of the restrictive properties of the Cobb-Douglas,[23] namely single product output and a log-linear cost curve. The translog can detect a U-shaped average cost curve if one exists in the data. While it is argued in the literature[24] that estimating the translog using data from a sample over large output ranges may result in a distorted view of the cost function all ranges used in this study are within the acceptable range.[25] The model has two outputs (loans and investments) and, following the approach of Gilligan and Smirlock (1984), assumes constant input prices.[26] It is also necessary to control for variation in loan size between credit unions as costs depend on the number of loans as well as the dollar amount. To control for variation in loan size between credit unions an "average loan" variable[27] is included as in the specification used by Gilligan, Smirlock and Marshall (1984).[28]

The equation for the model is:

$$\ln C = a_o + a_1 \ln L + a_2 \ln I + \tfrac{1}{2} a_{11} (\ln L)^2 + \tfrac{1}{2} a_{22} (\ln I)^2 + a_{12} \ln L \ln I + b_1 \ln Z + \tfrac{1}{2} b_{11} (\ln Z)^2 + b_{12} \ln Z \ln L \qquad (1)$$

where: C = total cost;
L = loans;
I = investments; and,
Z = average loan.

Economies of scale are measured by the sum of the derivatives of Equation 1 with respect to each output. A sum equal to one indicates constant returns to scale, while a sum greater (less) than one indicates decreasing (increasing) returns to scale. The economy of scale measure, ES, is the sum of the derivatives of $\ln C$ with respect to $\ln L$ and $\ln I$ and Z is average loan, considered to be a constant.

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22. The translog was developed as a means of approximating the CES production function by Kmenta (1967). The translog was further developed by Christensen et al. (1973) and Brown et al. (1979).
23. Varian (1984) contains a detailed description of both the Cobb-Douglas and translog production functions.
24. See McAllister & McManus (1993) for a full discussion of this issue.
25. See Mester (1993).
26. The complete translog requires inclusion of the cost of capital and the wage rate, assuming capital and labour are the inputs. For further discussion see Gilligan and Smirlock (1984, fn.4).
27. "Average loan" is defined as the total dollar amount of loans outstanding divided by the number of loans.
28. Shaffer (1992) argues that the average variable is sufficient for small, relatively homogeneous organisations.

That is,

$$ES = a_1 + a_{11} \ln L + a_{12} \ln I + b_{12} \ln Z + a_2 + a_{22} \ln I + a_{12} \ln L \qquad (2)$$

The choice of a single measure to summarise the results is difficult because the economy of scale measure itself varies with output. The approach adopted here is to calculate the economy of scale measure for the "average" credit union for each cross-sectional period. The entire sample for each period is then divided into subsamples by bond type and asset size. The cost function is then estimated for each subsample. The economy of scale measure calculated for each subsample is for the average of that subsample. All economy of scale measures are tested for a statistically significant difference from unity. The test of statistical significance requires an estimate of the variance of *ES*, which, in turn, requires the variance/covariance matrix of the estimated coefficients. The variance of *ES* is given by $V'XV$ where V is a column vector with elements 1, $\ln L$, $\ln I$, $\ln Z$, 1, $\ln I$, $\ln L$ and X is the variance/covariance matrix of the estimated coefficients a_1, a_{11}, a_{12}, b_{12}, a_2, a_{22} and a_{12}. The *t*-statistic is given by

$$\frac{ES - 1}{\sqrt{\text{Var}(ES)}}$$

4.3 Time Period Used

Humphrey (1990) notes that differences in empirical results of cross-sectional studies could be due to the time period chosen. In particular, total costs may vary over the interest rate cycle and thus alter the slope of the estimated cost curve. This suggests that it is desirable to measure economies of scale at more than one point in time.

Using more than one point in time is also desirable because technological change may cause the average cost curve to shift between periods. However, at each point in time, technology is assumed to be constant across all credit unions.

In this study, four cross-sectional regressions are estimated using data as at 31 March in 1983, 1986, 1990 and 1993.

4.4 Commingling Scale with Scope: Single versus Multiple Output

The estimates of economies of scale that result from single-product studies may be unreliable where in fact there is more than one output. By using two outputs, the effects of scale and scope economies can be separated.

4.5 Efficiency Differences: Average Intermediaries versus those on the Frontier

Although the problem of controlling for and estimating the dispersion of costs between intermediaries of the same size (the "X-efficiency issue") has been prominent in some recent literature, in fact most studies of scale economies do not use a frontier estimation method.[29] Berger et al. (1993) survey the work of Berger

and Humphrey (1991), Bauer et al. (1993), McAllister and McManus (1993) and Mester (1993), all of which have compared estimates for scale efficiencies on and off the efficient frontier and have found only small differences. Berger et al. (1993 p.224) conclude that "this potential problem does not appear to be of practical significance". Accordingly, in this study, no attempt is made to test whether credit unions are operating on the efficient frontier.

Berger et al. (1993) also conclude that economies of scope should only be estimated on the efficient frontier, because otherwise the results are likely to be confounded with X-inefficiencies. Further problems arise in estimating economies of scope when a translog functional form is used and with a sample that has no data on firms that specialise.[30] Accordingly, given the homogeneity in product mix of Victorian credit unions and the use of a translog functional form, no attempt is made in this study to estimate economies of scope as the results could not be interpreted with confidence.

4.6 Controlling for the Effect of Bond Type on Credit Union Performance

The strength of the bond in a credit union is likely to affect its operating costs.[31] Kohers and Mullis (1986) found that parent company business may also affect the behaviour of industrial credit unions. Therefore, in this study it is hypothesised that credit unions with different bond types face different cost structures. To control for the effect of bond type, the credit unions are divided into the VicFIC classifications of (*a*) community, and (*b*) industrial. Parish credit unions are excluded from the study because of the small sample sizes. Consequently, they are also excluded from the total sample so that the total sample is a combination of the subgroups that could be analysed separately.

5. Data

5.1 Sample

The initial samples included all community and industrial credit unions in Victoria as at 31 March in the following years: 1983, 1986, 1990, and 1993. By using only Victorian credit unions economic conditions and regulations are constant across the sample. More than one date was chosen in order to limit the possibility of incorrect inferences being drawn from period-specific results. Further, it allows an examination of the effect, if any, of deregulation of the financial system on the existence of economies of scale in credit unions. This is achieved by comparing

29. For an explanation of the methods of frontier estimation and a discussion of their limitations, see Berger et al. (1993).
30. For a fuller discussion of these issues, see Berger et al. (1993, p.225).
31. Taylor (1971) and Fry, Harper and Stansell (1982) argue that transaction and monitoring costs are reduced by knowledge of such factors as future income and credit worthiness of members, and of company retrenchment plans.

results before and after the significant regulatory changes of the 1980s.

The 1983 data are the first available under the current reporting system and the 1993 data are the first available from a corresponding period after the introduction of the new prudential guidelines. The intermediate dates of 1986 and 1990 are chosen as representative years in a decade of change for the credit union industry and for the financial sector as a whole. The end of the financial year was not chosen in order to avoid transitory "balance date" transactions. Some credit unions were excluded from the sample because of:

(i) incomplete data;

(ii) clearly erroneous data which failed balance sheet identity tests;

(iii) classification as parish.

5.2 Summary Descriptive Statistics

To introduce the results that are given in detail in the next section, and to provide further information on the general characteristics of the data, Table 1 sets out summary descriptive statistics.

For each year, the total sample (after exclusions) was sorted by output size and divided into three subsamples representing small, medium and large credit unions. Summary details are provided in Table 2.

6. Results

6.1 Results of the Estimation using the Total Sample

Details of the estimates of the model using the total sample are shown in Table 3. The economy of scale measure in the final column is calculated for the "average" credit union in each period.

For the estimation run on the total sample the economy of scale measure is greater than unity in all years and statistically significant in all years apart from 1993. The level of diseconomies is approximately 5%.

6.2 Results of the Estimation using the Subsamples by Bond Type

6.2.1 Community Credit Unions As shown in Table 4, the null hypothesis of constant returns to scale cannot be rejected in 1983, 1986 and 1993. In 1990 there are significant diseconomies of scale estimated. The level of diseconomies is approximately 7%. The 1990 results may be biased by the one-off levy imposed that year to cover expenses associated with the insolvency of an industry member.

6.2.2 Industrial Credit Unions As shown in Table 5, the null hypothesis of constant returns to scale can be rejected 1986 and 1990. Significant diseconomies of scale in the order of 6% are measured in these years. The null hypothesis of constant returns to scale cannot be rejected in 1983 and 1993. While the economy of scale measures are greater than unity, implying diseconomies of scale, they are not statistically significant. In 1986 and 1990 there are significant diseconomies of

Table 1

Summary Characteristics for the Total Sample of Credit Unions in Each Year

	Before Exclusions	After Exclusions	Earning Assets ($'000) Min	Max	Average Output	Average Loan
Panel A: 1983						
Community	66	56	21	32 237	3 829	2 957
Industrial	79	71	5	78 172	6 532	2 972
Parish	19	0	–	–	–	–
Total	164	127	5	78 172	5 340	2 965
Panel B: 1986						
Community	40	40	76	46 077	9 101	5 959
Industrial	70	68	25	107 570	12 909	4 382
Parish	15	0	–	–	–	–
Total	125	108	25	107 570	11 499	4 966
Panel C: 1990						
Community	37	36	119	70 507	14 345	9 390
Industrial	65	64	16	163 878	21 639	6 107
Parish	13	0	–	–	–	–
Total	115	100	16	163 878	19 156	7 289
Panel D: 1993						
Community	27	25	101	53 256	14 070	8 234
Industrial	53	51	34	189 069	31 418	26 872
Parish	10	0	–	–	–	–
Total	90	76	34	189 069	25 711	20 741

scale.

When comparing the two subsamples by bond type it appears that there is slightly more evidence for concluding diseconomies of scale exist for industrial credit unions than for community credit unions. The bond type may have a slight impact on the cost structure of credit unions.

6.3 Results of the Estimation using Subsamples by Asset Size

6.3.1 Small Credit Unions As shown in Table 6, there are significant diseconomies of scale for small credit unions in 1986 and 1993. While the economy of scale measure in 1983 and 1990 is not statistically significant at the 1% level, it is greater than one with a probability value of 0.384 and 0.108 respectively.

Table 2

Summary of Subsamples by Output Size[1]

	Sample Size	Minimum ($'000)	Maximum ($'000)	Average ($'000)	Standard Deviation ($'000)
Panel A: 1983					
Small	42	5	451	198	122
Medium	42	469	3 247	1 617	811
Large	43	3 285	78 172	13 998	15 620
Panel B: 1986					
Small	36	25	1 164	5 155	371
Medium	36	1 218	8 648	4 037	2 065
Large	36	8 900	107 570	29 943	24 454
Panel C: 1990					
Small	33	15	2 084	843	661
Medium	33	2 144	11 880	6 572	2 720
Large	34	12 596	163 878	49 143	43 148
Panel D: 1993					
Small	25	34	4 707	1 592	1 509
Medium	25	4 836	15 333	8 980	3 066
Large	26	16 408	189 069	64 990	55 944

Note: 1. For each period, the total sample was divided by output size into three subsamples, each comprising an approximately equal number of credit unions.

6.3.2 Medium Credit Unions Table 7 provides summary results for the medium sized credit union subsample. In 1983, 1986 and 1993 the economy of scale measure is less than unity but not statistically significant whilst in 1990 it is greater than unity but not statistically significant. For all subsamples the hypothesis of constant returns to scale cannot be rejected.

6.3.3 Large Credit Unions Table 8 summarises the large subsample. In 1983, 1990 and 1993 the economy of scale measure is less than one but not statistically significant and in 1986[32] it is greater than one but not statistically significant. For all subsamples the hypothesis of constant returns to scale cannot be rejected. In principle, the issue of multi-branching may be a confounding factor. But very few

32. This apparent inconsistency may be explained by the levy imposed on credit unions in 1990 to cover the costs of an insolvency in the industry.

Table 3

Estimated Coefficients for the Cost Function—Total Sample[1]

Year	a_0	a_1	a_2	a_{11}	a_{22}	a_{12}	b_1	b_{11}	b_{12}	Adjusted R^2	Economy of Scale[2]
1983	–1.266811	0.106479	0.708572	0.074188	0.099259	–0.126272	0.506521	–0.385732	0.166095	0.967905	1.055065
$n = 127$[3]	(–0.494)	(0.319)	(3.094)	(1.340)	(3.332)	(–3.353)	(1.194)	(–4.163)	(2.931)		(2.020)
	[0.622]	[0.750]	[0.002]	[0.183]	[0.001]	[0.001]	[0.235]	[0.000]	[0.004]		[0.045]
1986	–2.715393	0.199457	0.616484	0.098250	0.091996	–0.112631	0.781141	–0.266289	0.085897	0.975559	1.052575
$n = 108$	(–0.735)	(0.622)	(2.891)	(3.118)	(4.056)	(–6.277)	(0.822)	(–1.479)	(0.295)		(2.231)
	[0.464]	[0.535]	[0.005]	[0.002]	[0.000]	[0.000]	[0.413]	[0.142]	[0.198]		[0.028]
1990	9.709837	–0.613220	0.987782	0.102461	0.042218	–0.093478	–1.256458	–0.122531	0.142157	0.983039	1.045785
$n = 100$	(2.911)	(–1.372)	(3.116)	(2.998)	(0.965)	(–4.153)	(–1.639)	(–0.841)	(2.334)		(2.147)
	[0.005]	[0.173]	[0.002]	[0.004]	[0.337]	[0.000]	[0.105]	[0.402]	[0.022]		[0.034]
1993	–0.898336	2.166141	–0.570122	–0.058984	0.096715	–0.042658	–1.139269	0.067008	0.023351	0.981235	1.003661
$n = 76$	(–0.230)	(5.353)	(–1.533)	(–0.589)	(1.170)	(–0.514)	(–1.753)	(1.305)	(0.427)		(0.149)
	[0.818]	[0.000]	[0.130]	[0.558]	[0.246]	[0.609]	[0.084]	[0.196]	[0.670]		[0.881]

Notes: 1. Estimated coefficients for Equation 1: $\ln C = a_0 + a_1 \ln L + a_2 \ln I + \tfrac{1}{2} a_{11} [\ln L]^2 + \tfrac{1}{2} a_{22} [\ln I]^2 + a_{12} \ln L \ln I + b_1 \ln Z + \tfrac{1}{2} b_{11} [\ln Z]^2 + b_{12} \ln Z \ln L$. For estimated coefficients, each cell provides: estimate, (*t*-statistic), [*p*-value].

2. Economy of scale measure relates to the average credit union and is defined in Equation 2. Figures provided are: economy of scale measure, (*t*-statistic for $ES = 1$) and [*p*-value].

3. *n* is the sample size for each period.

Table 4

Estimated Coefficients for the Cost Function—Community Credit Unions[1]

Year	a_0	a_1	a_2	a_{11}	a_{22}	a_{12}	b_1	b_{11}	b_{12}	Adjusted R^2	Economy of Scale[2]
1983	–7.804576	0.404991	1.232691	0.299110	0.240721	–0.292867	0.841529	–0.137553	–0.000072	0.96284	1.080957
$n = 56$[3]	(–1.735)	(0.852)	(2.877)	(2.407)	(3.052)	(–3.071)	(1.082)	(–0.820)	(–0.008)		(1.816)
	[0.089]	[0.398]	[0.006]	[0.020]	[0.003]	[0.003]	[0.284]	[0.416]	[0.993]		[0.075]
1986	–9.398440	0.265384	1.191229	0.169775	0.021990	–0.104134	1.415858	–0.113176	–0.042253	0.94723	0.998235
$n = 40$	(–1.248)	(0.348)	(1.828)	(2.127)	(0.477)	(–2.108)	(0.903)	(–0.350)	(–0.316)		(–0.029)
	[0.221]	[0.730]	[0.077]	[0.041]	[0.636]	[0.043]	[0.373]	[0.728]	[0.754]		[0.976]
1990	10.643595	0.654068	–0.351047	–0.123104	–0.037716	0.063931	–1.540955	–0.112907	0.150714	0.99204	1.074436
$n = 36$	(2.578)	(1.100)	(–0.620)	(–1.538)	(–0.532)	(1.102)	(–2.116)	(–0.842)	(2.196)		(2.932)
	[0.015]	[0.281]	[0.540]	[0.135]	[0.598]	[0.280]	[0.043]	[0.407]	[0.036]		[0.006]
1993	–2.598713	–0.026775	0.665076	–0.124292	–0.147126	0.106336	1.249977	–0.419181	0.138240	0.98692	0.996361
$n = 25$	(–0.234)	(–0.026)	(0.814)	(–0.739)	(–0.788)	(0.701)	(0.578)	(–1.268)	(0.850)		(–0.083)
	[0.818]	[0.979]	[0.427]	[0.470]	[0.442]	[0.493]	[0.571]	[0.222]	[0.408]		[0.935]

Notes: 1. Estimation of total cost function for community credit unions using the model: $\ln C = a_0 + a_1 \ln L + a_2 \ln I + \frac{1}{2} a_{11} [\ln L]^2 + \frac{1}{2} a_{22} [\ln I]^2 + a_{12} \ln L \ln I + b_1 \ln Z + \frac{1}{2} b_{11} [\ln Z]^2 + b_{12} \ln Z \ln L$. For estimated coefficients, each cell provides: estimate, (*t*-statistic), [*p*-value].

2. Economy of scale measure relates to the average community credit union and is defined in Equation 2. Figures provided are: economy of scale measure, (*t*-statistic for $ES = 1$) and [*p*-value].

3. *n* is the sample size for each period.

Table 5

Estimated Coefficients for the Cost Function—Industrial Credit Unions[1]

Year	a_0	a_1	a_2	a_{11}	a_{22}	a_{12}	b_1	b_{11}	b_{12}	Adjusted R^2	Economy of Scale[2]
1983	3.207590	–0.278818	0.644692	0.036888	0.086793	–0.111370	0.012362	–0.461157	0.255644	0.97644	1.017923
$n = 71$[3]	(0.869)	(–0.613)	(2.278)	(0.557)	(2.668)	(–2.641)	(0.022)	(–3.660)	(3.128)		(0.048)
	[0.388]	[0.541]	[0.026]	[0.579]	[0.009]	[0.010]	[0.982]	[0.000]	[0.002]		[0.632]
1986	15.957817	0.888413	0.334984	0.065349	0.123230	–0.115065	–4.546403	0.429944	0.056485	0.99073	1.065252
$n = 68$	(2.460)	(2.071)	(1.824)	(2.398)	(4.504)	(–6.380)	(–2.176)	(1.203)	(0.732)		(3.347)
	[0.016]	[0.042]	[0.073]	[0.019]	[0.000]	[0.000]	[0.033]	[0.233]	[0.466]		[0.001]
1990	24.820037	0.290173	0.938934	0.090639	0.029788	–0.076793	–6.186499	0.631232	0.030116	0.98260	1.064670
$n = 64$	(3.229)	(0.415)	(2.299)	(1.847)	(0.542)	(–2.748)	(–2.585)	(1.524)	(0.286)		(2.132)
	[0.002]	[0.679]	[0.025]	[0.070]	[0.589]	[0.008]	[0.012]	[0.133]	[0.775]		[0.037]
1993	–1.052485	2.061302	–0.545796	–0.018364	0.153444	–0.096722	–1.052312	0.017856	0.051563	0.98334	1.001137
$n = 51$	(–0.242)	(4.183)	(–1.170)	(–0.120)	(1.139)	(–0.695)	(–1.368)	(0.309)	(0.845)		(0.036)
	[0.810]	[0.000]	[0.248]	[0.904]	[0.261]	[0.490]	[0.178]	[0.759]	[0.402]		[0.971]

Notes: 1. Estimation of total cost function for industrial credit unions using the model: $\ln C = a_0 + a_1 \ln L + a_2 \ln I + \tfrac{1}{2} a_{11} [\ln L]^2 + \tfrac{1}{2} a_{22} [\ln I]^2 + a_{12} \ln L \ln I + b_1 \ln Z + \tfrac{1}{2} b_{11} [\ln Z]^2 + b_{12} \ln Z \ln L$. For estimated coefficients, each cell provides: estimate, (*t*-statistic), [*p*-value].

2. Economy of scale measure relates to the average industrial credit union and is defined in Equation 2. Figures provided are: economy of scale measure, (*t*-statistic for $ES = 1$) and [*p*-value].

3. *n* is the sample size for each period.

credit unions operate from more than one branch and these credit unions are concentrated in the large subsample. Therefore, there may be some distortion of results in the case of large credit unions.

Another possible explanation for the significant diseconomies of scale measured for the total sample and for the subsample of small credit unions is the existence of agency costs. As discussed by Mester (1991) the separation between ownership and management is sometimes thought to be greater in mutual organisations than in corporations as the ability to sell gives shareholders influence over managers. In credit unions, members cannot sell and hence managers may be better able to pursue their own goals without fear of takeover. Mester (1991) found evidence of agency costs in mutual S&L's operating in California in 1982. Agency costs were estimated by comparing the efficiency of stock-owned S&L's with mutual S&L's. Such a procedure is impossible in this study as at present there are no stock-owned credit unions in Victoria. Moreover, the problem may not be significant as Mester (1993) found the agency problems which appeared prior to deregulation did not appear post-deregulation and concluded that deregulation of interest rates had lessened agency problems at S&L's.

6.4 Summary of Results

Table 9 provides an easy comparison of the results for the different subsamples.

Whilst significant diseconomies of scale are measured in three periods for the total sample, the subsample results indicate that credit unions display constant returns to scale except for small industrial credit unions. These results may be explained by the special circumstances applying to such credit unions in the form of host company subsidies in areas such as provision of office space and arrangements for payroll deductions.

7. Policy Implications

7.1 Implications for Supervisors

The number of credit unions in Victoria has declined over the decade from 164 in 1983 to 90 in 1993. Although the supervisory authorities may not have explicitly sought this result, it is widely believed that this trend has been favourably regarded by the supervisors. Supervisors contributed to the trend by endorsing mergers when credit unions appeared to be failing. There may be many reasons for encouraging such mergers but our evidence suggests that supervisors would be unwise to cite economies of scale as one of them. Indeed, this implication is particularly pertinent because in the case of small industrial credit unions, there is evidence that these credit unions face diseconomies of scale. It may even be worthwhile for supervisors to consider whether there is a need for differential policy between credit unions.

Table 6

Estimated Coefficients for the Cost Function—Small Credit Unions[1]

Year	a_0	a_1	a_2	a_{11}	a_{22}	a_{12}	b_1	b_{11}	b_{12}	Adjusted R^2	Economy of Scale[2]
1983	0.751881	–0.39133	0.72858	0.111613	0.109431	–0.13598	0.829594	–0.48519	0.188518	0.791373	1.117375
$n = 42$[3]	(0.0657)	(–0.2383)	(1.0047)	(0.5955)	(2.0836)	(–1.7063)	(0.4961)	(–2.8976)	(1.3544)		(0.8779)
	[0.948]	[0.813]	[0.322]	[0.556]	[0.045]	[0.097]	[0.623]	[0.007]	[0.185]		[0.384]
1986	7.48008	–1.44882	0.197925	–0.03271	0.128805	–0.10932	1.319254	–0.99548	0.501818	0.963438	1.130953
$n = 36$	(0.7505)	(–2.0502)	(0.2489)	(–0.3918)	(3.0183)	(–3.3226)	(0.5632)	(–2.0192)	(2.7397)		(2.3422)
	[0.459]	[0.050]	[0.805]	[0.698]	[0.005]	[0.003]	[0.578]	[0.053]	[0.011]		[0.024]
1990	43.743	–3.36764	0.445844	–0.06284	0.028791	–0.03451	–4.86492	–0.48838	0.666569	0.93942	1.111702
$n = 33$	(1.8005)	(–2.3085)	(0.3885)	(–0.3325)	(0.2385)	(–1.0148)	(–0.7075)	(–0.4254)	(2.5697)		(1.6499)
	[0.084]	[0.030]	[0.701]	[0.742]	[0.813]	[0.320]	[0.486]	[0.674]	[0.017]		[0.108]
1993	–38.7252	3.632825	–2.89833	–0.25891	0.167494	0.07864	9.048756	–1.08807	–0.02406	0.96648	1.169832
$n = 25$	(–1.8144)	(3.1503)	(–3.3429)	(–1.1985)	(1.3639)	(0.5918)	(1.5501)	(–1.4151)	(–0.0986)		(2.1781)
	[0.088]	[0.006]	[0.004]	[0.248]	[0.191]	[0.562]	[0.141]	[0.176]	[0.923]		[0.039]

Notes: 1. Estimation coefficients for Equation 1: $\ln C = a_0 + a_1 \ln L + a_2 \ln I + \frac{1}{2} a_{11} [\ln L]^2 + \frac{1}{2} a_{22} [\ln I]^2 + a_{12} \ln L \ln I + b_1 \ln Z + \frac{1}{2} b_{11} [\ln Z]^2 + b_{12} \ln Z \ln L$. For estimated coefficients, each cell provides: estimate, (*t*-statistic), [*p*-value].

2. Economy of scale measure relates to the average credit union and is defined in Equation 2. Figures provided are: economy of scale measure, (*t*-statistic for $ES = 1$) and [*p*-value].

3. *n* is the sample size for each period.

Table 7

Estimated Coefficients for the Cost Function—Medium Credit Unions[1]

Year	a_0	a_1	a_2	a_{11}	a_{22}	a_{12}	b_1	b_{11}	b_{12}	Adjusted R^2	Economy of Scale[2]
1983	4.50921	1.747598	1.073606	–0.02408	0.028912	–0.0982	–4.37086	0.393009	0.085868	0.801319	0.944868
$n = 42$[3]	(0.1173)	(0.4242)	(0.6570)	(–0.0570)	(0.3108)	(–0.5590)	(–0.7532)	(0.7842)	(0.2097)		(–0.6374)
	[0.907]	[0.674]	[0.516]	[0.955]	[0.758]	[0.580]	[0.457]	[0.439]	[0.835]		[0.527]
1986	–3.7921	–6.01118	10.48816	0.670343	–0.80051	–0.00397	–3.11096	0.984424	–0.35518	0.723865	0.84475
$n = 36$	(–0.0891)	(–1.1949)	(4.0382)	(1.3632)	(–3.0913)	(–0.0157)	(–0.4926)	(2.0666)	(–0.9554)		(–1.2140)
	[0.930]	[0.242]	[0.000]	[0.184]	[0.005]	[0.988]	[0.626]	[0.048]	[0.348]		[0.232]
1990	23.86991	–1.07708	–0.7529	0.224736	0.06545	0.000575	–0.95006	0.384747	–0.16835	0.860418	1.066407
$n = 33$	(0.7487)	(–0.2154)	(–0.4815)	(0.5617)	(0.5505)	(0.0043)	(–0.2101)	(1.0279)	(–0.6843)		(0.6563)
	[0.461]	[0.831]	[0.634]	[0.579]	[0.587]	[0.997]	[0.835]	[0.314]	[0.500]		[0.516]
1993	60.11315	–5.2665	–2.01294	0.53022	0.174599	–0.02528	0.783059	0.232314	–0.20547	0.787676	0.917447
$n = 25$	(0.7129)	(–0.6187)	(–0.4741)	(1.1741)	(0.9672)	(–0.0854)	(0.2813)	(2.0889)	(–0.9460)		(–0.4685)
	[0.486]	[0.545]	[0.642]	[0.258]	[0.348]	[0.933]	[0.782]	[0.053]	[0.358]		[0.643]

Notes: 1. Estimation coefficients for Equation 1: $\ln C = a_0 + a_1 \ln L + a_2 \ln I + \tfrac{1}{2} a_{11} [\ln L]^2 + \tfrac{1}{2} a_{22} [\ln I]^2 + a_{12} \ln L \ln I + b_1 \ln Z + \tfrac{1}{2} b_{11} [\ln Z]^2 + b_{12} \ln Z \ln L$. For estimated coefficients, each cell provides: estimate, (t-statistic), [p-value].

2. Economy of scale measure relates to the average credit union and is defined in Equation 2. Figures provided are: economy of scale measure, (t-statistic for $ES = 1$) and [p-value].

3. n is the sample size for each period.

Table 8

Estimated Coefficients for the Cost Function—Large Credit Unions[1]

Year	a_0	a_1	a_2	a_{11}	a_{22}	a_{12}	b_1	b_{11}	b_{12}	Adjusted R^2	Economy of Scale[2]
1983	44.03153	–6.50542	2.464536	0.458689	–0.04218	–0.11308	–0.3994	–0.37237	0.201017	–0.874848	0.866081
$n = 43$[3]	(1.7363)	(–2.3812)	(1.4657)	(1.9965)	(–0.3127)	(–1.0028)	(–0.1115)	(–1.3292)	(0.9792)		(–1.8010)
	[0.092]	[0.023]	[0.152]	[0.054]	[0.756]	[0.323]	[0.912]	[0.193]	[0.334]		[0.078]
1986	–51.4448	2.862372	1.032897	0.005418	0.067256	–0.1084	6.053841	–0.57904	–0.06029	0.938519	1.026469
$n = 36$	(–1.4039)	(0.6286)	(0.3137)	(0.0164)	(0.3512)	(–1.4265)	(1.2887)	(–2.9157)	(–0.2989)		(0.4239)
	[0.172]	[0.535]	[0.756]	[0.987]	[0.728]	[0.165]	[0.208]	[0.007]	[0.767]		[0.674]
1990	–30.7143	1.651762	0.833801	0.027351	–0.08922	0.032787	3.918126	–0.06655	–0.19187	0.943295	0.910573
$n = 34$	(–1.1861)	(0.4074)	(0.3413)	(0.0628)	(–0.4029)	(0.1179)	(1.5193)	(–0.5348)	(–1.4883)		(–1.6695)
	[0.247]	[0.687]	[0.736]	[0.950]	[0.690]	[0.907]	[0.141]	[0.597]	[0.149]		[0.104]
1993	–20.432	–0.69862	4.186266	0.497949	0.207917	–0.42156	0.112118	0.060088	–0.04504	0.93411	0.968001
$n = 26$	(–0.6054)	(–0.2217)	(1.9867)	(1.2719)	(0.5656)	(–0.9908)	(0.0455)	(1.0017)	(–0.3400)		(–0.5206)
	[0.553]	[0.827]	[0.063]	[0.220]	[0.579]	[0.336]	[0.964]	[0.330]	[0.738]		[0.607]

Notes: 1. Estimation coefficients for Equation 1: $\ln C = a_0 + a_1 \ln L + a_2 \ln I + \frac{1}{2} a_{11} [\ln L]^2 + \frac{1}{2} a_{22} [\ln I]^2 + a_{12} \ln L \ln I + b_1 \ln Z + \frac{1}{2} b_{11} [\ln Z]^2 + b_{12} \ln Z \ln L$. For estimated coefficients, each cell provides: estimate, (t-statistic), [p-value].

2. Economy of scale measure relates to the average credit union and is defined in Equation 2. Figures provided are: economy of scale measure, (t-statistic for $ES = 1$) and [p-value].

3. n is the sample size for each period.

Table 9

Summary of Economy of Scale Estimates

Year	Total	Community	Industry	Small	Medium	Large
1983	1.055065*	1.080957	1.017923	1.117375	0.944868	0.866081
1986	1.052575*	0.998235	1.065252*	1.130953*	0.844750	1.026469
1990	1.045785*	1.074435*	1.064670*	1.111702	1.066407	0.910573
1993	1.003661	0.996361	1.001137	1.169832*	0.917447	0.968001

Note: * = significant at the 0.01 level.

7.2 Implications for Managers

The results of this study suggest that managers should not look to growth to reduce average costs. Small industrial credit unions face increased costs with growth, and, moreover, once diseconomies are exhausted, the average cost curve exhibits constant rather than increasing returns to scale. The results do not support the belief that growth will reduce average costs for any category of credit union.

7.3 Implications for Existing Members

The existence of diseconomies of scale implies a conflict between existing members and new members. Where there is evidence of diseconomies of scale, growth is expected to increase per unit production costs, thus disadvantaging existing members. This is likely to apply to members of small industrial credit unions. For members of other credit unions, where the evidence is consistent with constant returns to scale, growth does not bring clear benefits to existing members.

8. Summary and Conclusion

This study differs substantially from the previous Australian study (Crapp 1983) in methodology, sample and time period yet it provides further evidence on Crapp's finding of diseconomies of scale. Crapp found significant diseconomies of scale but was only able to speculate they were due to the organisational subsidies to small credit unions as no subsamples were estimated. The results of this study provide evidence that small industrial credit unions face significant diseconomies of scale while other categories of credit unions face constant returns to scale.

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References

Bartlett, W.H. and H.R. Crapp, 1977, Performance appraisal of permanent building societies in N.S.W., *Management Forum*, 3, 3, September, 183–194.

Bauer, P.W., A.N. Berger, and D.B. Humphrey, 1993, Efficiency and productivity growth in U.S. banking, in: H.O. Fried, C.A.K. Lovell, and S.S. Schmidt, eds., *The Measurement of Productive Efficiency* (London, Oxford University Press) pp.386–413.

Bell, F.W. and N.B. Murphy, 1968, Costs in commercial banking: a quantitative analysis of bank behaviour and its relation to bank regulation, Research Report No.41, Federal Reserve Bank of Boston.

Benston, G.J., 1965, Branch banking and economies of scale, *Journal of Finance*, 20, 2, May, 312–331.

Benston, G.J., 1972, Economies of scale in financial institutions, *Journal of Money, Credit and Banking*, 4, 2, May, 314–341.

Benston, G.J., A.N., Berger, G.A. Hanweck, and D.B. Humphrey, 1983, Economies of scale and scope in banking, Proceedings of a Conference on Bank Structure and Competition, Federal Reserve Bank of Chicago, Chicago, Illinois, 2–4 May.

Benston, G.J., G.A. Hanweck, and D.B. Humphrey, 1982, Scale economies in banking, *Journal of Money, Credit and Banking*, 14, 4, November, 435–456.

Berger, A.N., G.A. Hanweck, and D.B. Humphrey, 1987, Competitive viability in banking: scale, scope and product mix economies, *Journal of Monetary Economics*, 20, 3, December, 501–520.

Berger, A.N. and D.B. Humphrey, 1991, The dominance of inefficiencies over scale and product mix economies in banking, *Journal of Monetary Economics*, 28, 1, August, 117–148.

Berger, A.N., W.C. Hunter, and S.G. Timme, 1993, The efficiency of financial institutions: a review and preview of research past, present and future, *Journal of Banking and Finance*, 17, 2–3, April, 221–249.

Black, H.A. and R.H. Dugger, 1981, Credit union structure, growth and regulatory problems, *Journal of Finance*, 36, 2, May, 529–538.

Brown, R.S., D.W. Caves, and L.R. Christensen, 1979, Modelling the structure of cost and production for multiproduct firms, *Southern Economics Journal*, 46, 2, July, 256–273.

Christensen, L.R., D.W. Jorgensen, and L.J. Lau, 1973, Transcendental logarithmic production frontiers, *The Review of Economics and Statistics*, 55, 1, February, 28–45.

Clark, J.A., 1988, Economies of scale and scope at depository financial institutions: a review of the literature, *Federal Reserve Bank of Kansas City Economic Review*, 73, 8, September/October, 16–33.

Crapp, H.R., 1982, Scale economies in the N.S.W. permanent building society industry, *Australian Journal of Management*, 7, 1, June, 33–48.

Crapp, H.R., 1983, Scale economies in the N.S.W. credit union industry, *Australian Journal of Management*, 8, 1, June, 35–48.

Crapp, H.R. and M.T. Skully, 1985, *Credit Unions for Australians* (Sydney, Allen and Unwin).

Davis, K., 1992, Prudential regulation and Australian coöperative financial institutions, Working Paper, Department of Accounting and Finance, University of Melbourne, December.

Dermine, J. and L.H. Röller, 1992, Economies of scale and scope in French mutual funds, *Journal of Financial Intermediation*, 2, 1, March, 83–92.

Elstone, R.G., 1980, Returns to scale in the building society industry, *Accounting and Finance*, 20, 2, November, 53–70.

Esho, N. and I.G. Sharpe, 1993, Long-run estimates of technological change and scale and scope economies in a dynamic framework: Australian permanent building societies, 1973–1990, Working Paper, Department of Banking and Finance, University of New South Wales.

Flannery, M.J., 1974, An economic evaluation of credit unions in the United States, Report No.54, Federal Reserve Bank of Boston, Boston.

Fry, C.L., C.P. Harper, and S.R. Stansell, 1982, An analysis of credit union costs: a new approach to analyzing costs of financial institutions, *Journal of Bank Research*, 12, 4, Winter, 239–249.

Gilligan, T.W. and M. Smirlock, 1984, An empirical study of joint production and scale economies in commercial banking, *Journal of Banking and Finance*, 8, 1, March, 67–77.

Gilligan, T.W., M. Smirlock, and W. Marshall, 1984, Scale and scope economies in the multi-product banking firm, *Journal of Monetary Economics*, 13, 3, May, 393–405.

Humphrey, D.B., 1985, Costs and scale economies in bank intermediation, in: R.C. Aspinwall, and R.A. Eisenbeis, eds., *Handbook for Banking Strategy* (New York, NY, John Wiley & Sons) pp.745–783.

Humphrey, D.B., 1987, Cost dispersion and the measurement of economies in banking, *Federal Bank of Richmond Economic Review*, 73, 3, May/June, 24–38.

Humphrey, D.B., 1990, Why do estimates of bank scale economies differ? *Federal Reserve Bank of Chicago Economic Review*, 76, 5, September/October, 38–50.

Kim, H.Y., 1986, Economies of scale and economies of scope in multiproduct financial institutions: further evidence from credit unions: a note, *Journal of Money, Credit and Banking*, 18, 2, May, 220–226.

Klein, M.A., 1971, A theory of the banking firm, *Journal of Money, Credit and Banking*, 3, 2, May, 205–217.

Kmenta, J., 1967, On estimation of the CES production function, *International Economic Review*, 8, 2, June, 180–189.

Kohers, T. and D. Mullis, 1986, The effects of parent company business on occupational credit union behaviour, *Applied Economics*, 18, 12, December, 1311–1321.

Kohers, T. and D. Mullis, 1988, An update on economies of scale in credit unions, *Applied Economics*, 20, 12, December, 1653–1659.

Koot, R., 1978, On economies of scale in credit unions, *Journal of Finance*, 33, 4, September, 1087–1094.

Lawrence, C. and R. Shay, 1986, Technology and financial intermediation in a multiproduct banking firm: an econometric study of U.S. banks, 1979–1982, in C. Lawrence and R. Shay, eds.,*Technological Innovation, Regulation and the Monetary Economy* (Cambridge, Ballinger).

Le Compte, R.L.B. and S.D. Smith, 1985, An empirical analysis of scale and scope economies in the savings and loan industry, Texas Christian University and University of Florida Working

Paper, Fort Worth, Texas.

McAllister, P.H. and D. McManus, 1993, Resolving the scale efficiency puzzle in banking, *Journal of Banking and Finance*, 17, 2–3, April, 389–405.

Merton, R.C., 1992, Intermediation: a functional perspective, Working Paper 93–020, Harvard Graduate School of Business, Boston.

Mester, L.J., 1987*a*, Efficient production of financial services: scale and scope, *Federal Reserve Bank of Philadelphia Business Review*, January/February, 15–25.

Mester, L.J., 1987*b*, A multiproduct cost study of savings and loans, *Journal of Finance*, 42, 2, June, 423–445.

Mester, L.J., 1991, Agency costs among savings and loans, *Journal of Financial Intermediation*, 1, 3, June, 257–278.

Mester, L.J., 1992, Traditional and nontraditional banking: an information-theoretic approach, *Journal of Banking and Finance*, 16, 3, June, 545–566.

Mester, L.J., 1993, Efficiency in the savings and loan industry, *Journal of Banking and Finance*, 17, 2–3, April, 267–286.

Murray, J.D. and R.W. White, 1980, Economies of scale and deposit taking institutions in Canada, *Journal of Money, Credit and Banking*, 12, 1, February, 58–70.

Murray, J.D. and R.W White, 1983, Economies of scale and economies of scope in multi-product financial institutions: a study of British Columbia credit unions, *Journal of Finance*, 38, 3, June, 887–902.

Nelson, R., 1985, Branching, scale economies and banking costs, *Journal of Banking and Finance*, 9, 2, June, 177–191.

Patin, R.P. and D.W. McNiel, 1991*a*, Member group orientation of credit unions and total member benefits, *Review of Social Economy*, 49, 1, Spring, 37–61.

Patin, R.P. and D.W. McNiel, 1991*b*, Benefit imbalances among credit union member groups: evidence of borrower-dominated, saver-dominated and neutral behaviour, *Applied Economics*, 23, 4B, April, 769–779.

Pesek, B.P., 1970, Bank's supply function and the equilibrium quantity of money, *The Canadian Journal of Economics*, 3, 3, August, 357–385.

Sealey, C.W., and J.T. Lindley, 1977, Inputs, outputs, and the theory of production and cost at depository financial institutions, *Journal of Finance*, 32, 4, September, 1251–1266.

Shaffer, S., 1992, A revenue restricted cost study of 100 large banks, Working Paper, Federal Reserve Bank of Philadelphia, July.

Shaffer, S., 1993*a*, A test of competition in Canadian banking, *Journal of Money, Credit and Banking*, 25, 1, February, 49–61.

Shaffer, S., 1993*b*, Can megamergers improve bank efficiency? *Journal of Banking and Finance*, 17, 2–3, April, 423–436.

Smith, D.J., 1986, A test for variant objective functions in credit unions, *Applied Economics*, 39, 4, September, 959–970.

Smith, D.J., T.T. Cargill, and R.A. Meyer, 1981, An economic theory of a credit union, *Journal of Finance*, 36, 2, May, 519–528.

Taylor, R.A., 1971, The credit union as a coöperative institution, *Review of Social Economy*, 29, 2, September, 207–217.

Taylor, R.A., 1972, Economies of scale in large credit unions, *Applied Economics*, 4, 1, March, 33–40.

Towey, R.E., 1974, Money creation and the theory of the banking firm, *Journal of Finance*, 29, 1, March, 57–72.

Varian, H.R., 1984, *Microeconomic Analysis* (New York, Norton) 2nd edition.

Walker, G., 1994, Economies of scale and scope in Australian banking, Paper presented at the 7th Annual Australasian Finance and Banking Conference, University of New South Wales, Sydney, 8–9 December.

Wolken, J.D. and F.J. Navratil, 1980, Economies of scale in credit unions: further evidence, *Journal of Finance*, 35, 3, June, 769–777.