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Economies of Scale in Credit Unions: Further Evidence

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STUDIES ON ECONOMIES OF scale in most financial institutions have consistently found small, but significant economies when employing the Benston-Bell-Murphy cost specification [1, 2, 3, 4, 7, 9]. Yet, when utilizing the same approach, significant non-increasing returns have been discovered for credit unions [5, 6]. Flannery [5] contends that this was because most credit unions receive subsidies in the form of donated office space and equipment from sponsoring organizations and volunteer labor from their members. These subsidized inputs do not enter into their observed costs, and if the degree of subsidization declines with credit union size, then economies might well exist when subsidies are taken into account. However, Koot [6] claims to have found diseconomies of scale, even after correcting for subsidies, thus refuting Flannery's contention.

The purpose of this paper is to correct the analysis of Professors Koot and Flannery and shed some light on the apparent anomalous cost conditions between credit unions and other financial institutions.[1] Specifically, we are able to demonstrate that Koot and Flannery misspecified their empirical cost equations, which when corrected, reverses their results regarding economies of scale. Second, we demonstrate that Koot incorporated labor subsidies incorrectly. Moreover, when subsidies are correctly included, they consistently increase the estimated scale economies, as Flannery predicted.

I. Specification Errors in Koot and Flannery

1. *Omission of Factor Prices*

The Bell-Murphy model derives a Cobb-Douglas cost function under the assumptions of constrained cost minimization given a Cobb-Douglas production

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[1] Arguing that credit unions are inherently "different" (because of "common bonds," lack of profit maximization, etc.) is not sufficient to explain this anomaly. First, every financial institution (commercial banks, finance companies, savings and loans) for which economies of scale have been found face different regulators and regulations. Second, the products are similar. Credit unions primarily offer passbook and time deposit savings accounts (called share accounts) and short-term consumer loans (loans similar to finance companies and commercial bank consumer lending). Finally, to argue that the ownership rights (credit unions are cooperatives) cause the difference is insufficient given the assumptions of the Bell-Murphy approach, namely constrained cost minimization. It is of course possible that these assumptions may be inappropriate for credit unions, but Flannery presents (and Koot accepts) justifications for this set of assumptions.

function, exogenous output, and competitive factor markets. The cost function is given as

$$\log C = a + b \log Q + \sum_i c_i \log W_i + \sum_i d_i \log H_i \tag{1.1}$$

where

C is the total cost
Q is a measure of output
W_i is a vector of factor prices
H_i is a vector of homogeneity (structural and/or organizational) factors.

In order to properly estimate the cost-output relationship it is necessary to include other variables which affect costs in the empirical specification. If any relevant variables (from the set of W_i and H_i) are excluded from the equation, then biased and inconsistent results may be obtained.

Particularly important for the current discussion is the fact that both Koot and Flannery fail to: (1) include any measure of factor prices, and/or (2) make any explicit assumption about the cross-sectional constancy of factor prices when attempting to estimate the cost-output relationship. All of the other previously cited studies which utilized the Cobb-Douglas approach included a measure of the wage rate for each firm and explicitly assumed that the price of capital was constant across firms. Because labor market areas exhibit important cross-sectional variations in wages, credit unions facing higher market-determined wages will have higher costs, *ceteris paribus*. Since labor is such an important factor of production in financial services, it is imperative that the effects of wages be considered in estimating scale economies. Thus, in our empirical analysis, we include a wage variable, and assume that the price of capital is constant cross-sectionally.

2. *Misspecification of Subsidies*

Firms which receive subsidies should find that their true "economic" costs (C^*) are higher than their reported or observed costs (C_0) by the value of the subsidy (S). Further, if subsidies do affect the estimated economies of scale, they do so as part of the dependent variable, and not as part of the set of independent variables. Thus, two potential specification errors can occur. The first is the omission of the value of subsidies from the dependent variable, whereas the second is caused by incorrectly including the subsidy variable on the right-hand-side of the cost equation.

The bias caused by the omission of subsidies from the dependent variable can be shown by evaluating the vector of expected values of the estimated coefficients ($\hat{\beta}$) when subsidies are excluded. Letting β represent the true coefficient parameter vector, then

$$E(\hat{\beta}) = \beta - (X'X)^{-1}X'E[\log(C_0 + S) - \log C_0], \tag{1.2}$$

where the set of independent variables (X) has been transformed to logarithms to conduct the Cobb-Douglas estimation. $\hat{\beta}$ will be unbiased only if S is uncorre-

lated with the independent variables. Even in this case, the standard errors of the estimators are biased upward, so that confidence intervals for β are unduly large.

Koot included the logarithm of the volunteer hours supplied to the credit union (*VOL*, which is strictly a quantity variable) on the right-hand-side of his estimated equation as an independent variable.[2] He found the coefficient of *VOL* to be insignificant, and thus concluded that labor subsidies do not affect costs. Unfortunately, Koot's multiplicative (log-log) specification of the effect of *VOL* on total costs is valid econometrically only if:

A. wages are constant across credit unions (so that volunteer hours are proportional to the value of the labor subsidy);
B. *VOL* is exogenous (uncorrelated with the error term of the estimated equation);
C. *VOL* is proportional to costs.[3]

The last two conditions are logically inconsistent and there are no strong theoretical reasons which suggest that the amount of volunteer labor is proportional to observed costs. Furthermore, there was no such relationship in the sample considered. Consequently, it appears that Koot was unable to determine the impact of labor subsidies on the estimated scale parameter even though he attempted to account for the effects of volunteer labor on observed cost.

II. Empirical Evidence

Koot utilized a special survey conducted by the Credit Union National Association (CUNA) in 1976, which collected data for the 1972–1975 operations of credit unions. Data from this same survey along with balance sheet, operating expense and statistical data supplied by CUNA was combined with Financial and Statistical Data for 1975 available from the National Credit Union Administration (NCUA) to form the data base for the current study. A complete description of the data and sampling procedure is given in the Appendix.

In order to determine the nature and severity of Koot's and Flannery's specification errors, four different equations were estimated via OLS. Except for

[2] Koot correctly adjusts for subsidized capital by including the value of capital subsidy in the measure of cost. He did not attempt to do this for labor. In fact, comparing Koot's equations without the capital subsidy to the equations with the capital subsidy included in cost reveals that in all four cases he considered, the point estimates of the scale parameter fell—thus, indicating an increase in the estimated economies of scale, as predicted by Flannery.

[3] Assuming, for analytical convenience, that the value of the capital subsidy is zero, then this can be shown as follows:
$C^* = C_0 + S = C_0 + (WAGE)(VOL)$. Taking total derivatives, setting $d(C^*) = 0$, $d(C_0) = -(WAGE)(d(VOL)) - (VOL)(d(WAGE))$. Assuming that *WAGE* is constant, this gives $d(C_0)/d(VOL) = -(WAGE)$. Koot's log-log formulation implies that $d(\log C_0)/d(\log VOL) = [d(C_0)/d(VOL)]\cdot[VOL/C_0] = k$, a constant. Substituting $-(WAGE) = [d(C_0)/d(VOL)]$ yields $[VOL/C_0] = -[k/WAGE]$. This implies that *VOL* and C_0 must be in the same proportion for all firms. Note that the above result is sufficient, but not necessary, for the value of the subsidy to be proportional to observed costs. If subsidies are proportional to observed costs, it can be shown that only the intercept term will be biased if subsidies are excluded from the analysis. This proof is available from the authors.

minor definitional differences, the first equation (2.1) is identical to Koot's basic model. To measure the bias caused by the omission of the wage variable, a second equation (2.2) is specified which includes the wage in the independent variable set. A third specification (2.3) is the same as the first, except that the total value of both labor and capital subsidies is included as part of the dependent variable. Comparisons between the first and third equations give an indication of the biases caused by failure to include the value of subsidies in the definition of total cost. The fourth equation (2.4), which includes wages among the independent variables and the value of subsidies as part of the dependent variable, is the only equation which simultaneously utilizes the correct measure of cost and the correct specification of the Cobb-Douglas equation.

The four equations are:

$$\log TOE = a + b \log Q_{\text{out}} + c \log AVS + d \log AVL + e \log L/A + f \log CUR + v_1 \tag{2.1}$$

$$\log TOE = a + b \log Q_{\text{out}} + c \log AVS + d \log AVL + e \log L/A + f \log CUR + g \log WAGE + v_2 \tag{2.2}$$

$$\log (TOE + SUB) = a + b \log Q_{\text{out}} + c \log AVS + d \log AVL + e \log L/A + f \log CUR + v_3 \tag{2.3}$$

$$\log (TOE + SUB) = a + b \log Q_{\text{out}} + c \log AVS + d \log AVL + e \log L/A + f \log CUR + g \log WAGE + v_4 \tag{2.4}$$

where[4]

TOE = operating expenses
SUB = the total value of both capital and labor subsidies
Q_{out} = a measure of output; three different measures were employed: number of loans granted in 1975 (NLG), number of loans outstanding at the end of 1975 (NLA), and number of share accounts at the end of 1975 (NSA).[5]
AVS = average size of share accounts
AVL = average size of loans outstanding at year end

[4] *TOE* is defined as total cost exclusive of borrower and saver life insurance, interest on borrowed money, league dues, annual meeting expenses, and advertising expenses. This differs from Koot's definition in the treatment of advertising expenses, which most other cost studies exclude because of the possible effects on demand caused by advertising expenses (see e.g., [5]). *SUB* is defined as the value of the capital subsidy plus the number of volunteer hours multiplied by the wage rate, which differs from Koot as explained in the text. *WAGE* is computed by dividing total labor costs by the number of credit union paid employees to obtain an average annual salary which is then adjusted to an hourly basis. *L/A* was chosen instead of Koot's loan-to-share ratio, since *L/A* should better represent portfolio composition. In any case, the correlation coefficient between the two is .958. *CUR* is equal to one minus *DEL*, the proxy utilized by Koot for delinquencies. Some credit unions had no delinquent loans, which would make it impossible to compute log *DEL*. In most of our results, *CUR* behaves analogously to Koot's *DEL*, except that the sign is opposite. For a more complete description of the sample, see the Appendix.

[5] Koot also utilized a fourth measure of output: *NLA* + *NSA*. This aggregation procedure assumes that the costs associated with processing share accounts and loan accounts are identical. We omit this measure of output as specious.

L/A = loan-to-asset ratio
CUR = ratio of the number of loans not delinquent more than two months to the total number of loans outstanding at year end
$WAGE$ = average hourly wage paid employees of the credit union
v_1, v_2, v_3, v_4 = stochastic error terms.

Empirical results are presented in Tables I and II. The results from equation (2.1) are comparable to those obtained by Koot for the NLA and NSA equations. The NLG results are different, most likely due to differences in the data (see the Appendix). All estimates of the economies of scale parameter (see Table I) for equation (2.1) are significantly greater than one, except for the NLG measure, which is not significantly different from one. The control variables in the NLA and NSA specifications are also similar in sign and significance to those reported by Koot.

The two forms of specification error discussed in Section I have striking effects on the scale parameter—especially that caused by the omission of the wage variable. Comparing the scale parameter estimates between equations (2.1) and (2.2), and between (2.3) and (2.4) give an indication of this bias. In every case,

Table I

Estimates of Economies of Scale[a]

	Output Measure		
Equation	NLG	NLA	NSA
without subsidy			
without wage			
(2.1)	.974	1.041	1.040
s.e.	(.020)	(.014)	(.014)
5%ci	[.935–1.013]	[1.014–1.068]	[1.014–1.068]
without subsidy			
with wage			
(2.2)	.920	1.001	.998
s.e.	(.021)	(.015)	(.015)
5%ci	[.879–.961]	[.972–1.030]	[.969–1.027]
with subsidy			
without wage			
(2.3)	.943	1.006	1.007
s.e.	(.019)	(.014)	(.015)
5%ci	[.906–.980]	[.979–1.033]	[.978–1.036]
with subsidy			
with wage			
(2.4)	.889	.965	.962
s.e.	(.021)	(.015)	(.016)
5%ci	[.858–.930]	[.936–.994]	[.931–.993]

[a] Estimates less than one indicate economies of scale; estimates equal to one indicate constant returns to scale; estimates greater than one indicate diseconomies of scale. "s.e." refers to the standard error of the estimate; "5%ci" indicates the bounds on the two-tailed 5% confidence interval.

Table II

Empirical Cost Functions for Credit Unions

Equation Output Measure	Intercept	Q_{out}	*AVS*	*AVL*	*L/A*	*CUR*	*WAGE*	$\bar{R}^2$	d.w.[a]	*F*
Equation (2.1)										
NLG	−.6133*	.9738*	−.1957*	.8976*	−.3722*	.7142*		.9026	2.01	688.
	(.1963)	(.0195)	(.0755)	(.0867)	(.1117)	(.2585)				
NLA	−.4345*	1.0411*	−.4013*	.9773*	−.5224*	.2181		.9560	2.03	1612.
	(.1318)	(.0135)	(.0516)	(.0584)	(.0754)	(.1734)				
NSA	−.3755*	1.0411*	.5759*	−.0044	.4972*	.1933		.9517	1.98	1462.
	(.1380)	(.0141)	(.0496)	(.0603)	(.0761)	(.1817)				
Equation (2.2)										
NLG	−.2465	.9201*	−.2149*	.7961*	−.4527*	−.6614*	.2816*	.9101	2.05	627.
	(.1995)	(.0210)	(.0726)	(.0852)	(.1083)	(.2485)	(.0501)			
NLA	−.1804	1.0008*	−.4081*	.9023*	−.5750*	.2191	.2007*	.9598	2.07	1476.
	(.1330)	(.0145)	(.0493)	(.0572)	(.0727)	(.1658)	(.0337)			
NSA	−.1052	.9981*	.5280*	−.0442	.3983*	.1955	.2155*	.9561	2.01	1346.
	(.1388)	(.0152)	(.0480)	(.0579)	(.0743)	(.1733)	(.0351)			
Equation (2.3)										
NLG	−.4531*	.9428*	−.1680*	.8611*	−.3772*	−.6655*		.8999	1.99	668.
	(.1935)	(.0192)	(.0744)	(.0854)	(.1102)	(.2549)				
NLA	−.2792*	1.0064*	−.3644*	.9370*	−.5200*	.2370		.9506	2.09	1429.
	(.1358)	(.0139)	(.0531)	(.0601)	(.0777)	(.1787)				
NSA	−.2221	1.0065*	.5802*	−.0120	.4656*	.2131		.9465	2.07	1314.
	(.1413)	(.0145)	(.0508)	(.0617)	(.0779)	(.1859)				
Equation (2.4)										
NLG	−.0822	.8886*	−.1875*	.7585*	−.4585*	−.6121*	.2846*	.9081	2.02	612.
	(.1962)	(.0207)	(.0714)	(.0838)	(.1065)	(.2445)	(.0493)			
NLA	−.0150	.9646*	−.3714*	.8591*	−.5746*	.2381*	.2086*	.9549	2.11	1311.
	(.1369)	(.0150)	(.0508)	(.0589)	(.0748)	(.1707)	(.0347)			
NSA	.0573	.9621*	.5306*	−.0531	.3634*	.2153	.2227*	.9515	2.04	1213.
	(.1419)	(.0155)	(.0590)	(.0592)	(.0760)	(.1771)	(.0359)			

[a] The d.w. is constructed after ordering the observations by the measure of output variable for each equation. Numbers in parentheses below the coefficients are estimated standard errors. An "*" indicates significantly different from zero at the 5 percent level of confidence. All equations were estimated with 372 observations.

including wages causes the scale parameter to decrease significantly.[6]

Comparisons of the estimates of the scale parameters between equations (2.1) and (2.3), and between (2.2) and (2.4) give an indication of the biases caused by failing to include the value of subsidies in the definition of total costs. Defining the total cost variable inclusive of subsidies also causes the estimated scale

[6] A five percent confidence interval about the "correct" estimated parameter was established. If the point estimate obtained from the "incorrect" equation did not lie in this confidence interval, we concluded that the estimates were significantly different. For example, equation (2.2) for output measure *NLG* includes *WAGE*. The point estimate for the scale parameter was .920, with a standard error of 0.021. The five percent confidence interval is .879 to .861. The estimated scale parameter from equation (2.1), output measure *NLG*, is .974, and hence is significantly different. In all cases considered, the wage variable was significant.

parameter to decrease significantly, except in the NLG version where the point estimates are smaller, though not significantly so.

Finally, when wages and subsidies are included correctly, as in equation (2.4), significant economies of scale are found to exist, irrespective of the measure of output. Thus, we conclude that credit unions, like other financial institutions, reap small but statistically significant economies of scale.

III. Summary

We have demonstrated that previous researchers who investigated the question of scale economies for credit unions improperly specified their Cobb-Douglas cost functions. Specification errors existed in both the definition of the dependent variable, and in the set of independent variables. Correction of these errors revealed that they caused statistically significant biased estimates of the economies of scale parameter: credit unions experience significant economies of scale, irrespective of the output measure chosen.

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Appendix

The Credit Union National Association (CUNA) conducted a survey in 1976 which dealt with several aspects of credit union operations during the years 1972–1975. 541 credit unions responded to the questionnaire. However, many of the responses were incomplete. The hours of volunteer work and the value of the capital subsidy were obtained from this source. CUNA also collects annual data

for their "Yearbook" series, which was the source for the number of full-time and part-time employees used in the calculation of the wage rate.

The other variables utilized in this study are available from both CUNA and the National Credit Union Administration (NCUA), the Federal regulatory agency. Since NCUA's Financial and Statistical Data is much more comprehensive and undergoes several editing checks for consistency and data processing errors, it was the source for the other variables in the current study.

One advantage of the NCUA data is the ability to exclude advertising expenses from operating costs, which Koot was unable to do. As pointed out in Footnote 4, other cost studies (e.g., [1, 2]) exclude advertising expenses because they may affect demand, which would violate the assumption of exogenous output. One disadvantage of the NCUA data is that it is only available for those credit unions which participate in the Federal share insurance program. NCUA data exist for 422 of the 541 credit unions which responded to the CUNA questionnaire. 50 credit unions had inconsistent or incomplete data (such as recording wage and salary expenses but not reporting any paid employees). Dropping these from the study resulted in the final sample size of 372.

The present empirical base differs from Koot's data because of our use of NCUA data, and because different criteria may have been applied by Koot in reducing his sample size to 380. We do not know how extensive the data differences are, but they are most apparent in the NLG regressions. Differences in output measures between the CUNA and NCUA data used in this study are the greatest, in both percentage terms and absolute values, for NLG. However, these differences in the data should not be a substantive concern, because our results indicate clearly the theoretical and empirical bias associated with the exclusion of the wage and subsidy variables.

There is a very close correspondence in the distribution of credit unions by asset size between Koot's and this study, as shown in Table A-1. A Chi-Squared goodness of fit test performed on the two samples fails to reject the hypothesis that they have the same underlying distribution. The computed Chi-Squared is 1.02, while the critical value of Chi-Squared at the 0.05 level of significance and five degrees of freedom is 11.070.

Interestingly, Koot states that, "... the simple random sampling procedure

Table A-1:

Asset Size Distribution in Koot's Study and in the Present Study

Asset Size (in dollars)	Koot's Frequency[a]	Percentage of Koot's Sample[a]	Present Frequency	Percentage of Present Sample
less than 100,000	12	3.16%	9	2.42%
100,001–500,000	47	12.37	46	12.37
500,001–1,000,000	37	9.74	39	10.48
1,000,001–2,000,000	112	29.47	110	29.57
2,000,001–5,000,000	79	20.79	78	20.97
5,000,001 and over	93	24.47	90	24.19
	380	100.00%	372	100.00%

[a] Source: Koot [6, p. 1091].

employed provided data across all classes in the asset size distribution of credit unions. . ." (6, p. 1091). While this is true, it should be pointed out that both his study and the present one fail a goodness of fit test when compared with the population of all credit unions for 1975. In both cases, credit unions with more than $1 million in assets are overrepresented in the samples.