Productivity Change in Taiwan's Farmers' Credit Unions: A Nonparametric Risk-Adjusted Malmquist Approach

by

Po-Chi Chen,

Department of International Trade, Chung Hua University, Hsinchu, Taiwan.
Email: pochi@chu.edu.tw

Ming-Miin Yu,

Department of Transportation Technology, National Taiwan Ocean University, Keelung, Taiwan. Email: yumm@mail.ntou.edu.tw

Ching-Cheng Chang,

Institute of Economics, Academia Sinica, Taipei, Taiwan.
Email: emily@econ.sinica.edu.tw

Shih-Hsun Hsu

Department of Agricultural Economics, National Taiwan University, Taipei, Taiwan.
Email: m577@ntu.edu.tw

Contributed paper prepared for presentation at the International Association of Agricultural Economists Conference, Gold Coast, Australia, August 12-18,2006

Productivity Change in Taiwan's Farmers' Credit Unions: A Nonparametric Risk-Adjusted Malmquist Approach

Introduction

Farmers' credit unions (FCUs) have played an important role in financing Taiwan's rural development. Over the period from 1961 to 1994, total FCU loans grew dramatically, registering an average annual growth rate of 23%. The increase in FCU savings was also substantial with an average growth rate of 23.4%. In 1993, total FCU loans for agricultural usage accounted for more than 50% of Taiwan's total agricultural loans (Chang). However, the shares of the total deposits and loans of the FCUs in the entire financial market fell dramatically from 17.93% in 1993 to 9.29% in 2003. Such a reduction indicates that these FCUs are encountering severe problems in making profits. During 2001-2002, 34 of the 287 FCUs went bankrupt and were taken over by commercial banks. The average ratio of non-performing loans to loans outstanding for FCUs climbed substantially from 5.07% in 1995 to 17.57% in 2003, a ratio about 4 times that for Taiwan's domestic commercial banks. Therefore, in monitoring their efficiency performance, asset quality and risk factors need to be taken into account, otherwise, FCUs that scrimp on credit evaluations or generate excessively risky loans might be mistakenly regarded as being efficient or more productive.

The major purpose of this study is to investigate factors that might explain the profusion of banking crises among the FCUs in Taiwan. In particular, we will focus on the productivity growth of FCUs using the Malmquist total factor productivity (MTFP) index method. The MTFP method has become very popular in the banking literature where the impact of financial reform (or liberalization) on management efficiency and productivity growth has been explored (e.g., Grifell-Tatje and Lovell, Leightner and Lovell, Gilbert and Wilson, Devaney and Weber, Chen and Yeh, Mukherjee et al., Sathye, Isik and Hassan), because it rests exclusively on the quantity of information, requiring neither price information nor a behavioral assumption in its construction. Moreover, the MTFP index may easily accommodate multi-output cases when panel data are available. Finally, changes in the MTFP index can be further decomposed into the components of efficiency change and technical change and offer more insights into the sources of productivity growth (Färe et al.).

According to Fried et al., the performance of producers is influenced by three very different phenomena, namely, the efficiency with which a manager organizes production activities, the characteristics of the environment in which production activities are carried out, and the impact of good or bad luck (i.e. statistical noise). Therefore, in order to improve measures of managerial efficiency performance, Fried et al. proposed a three-stage approach to purge the impacts of exogenous environmental features and statistical noise. In this study, we adopt the spirit of the three-stage methodology of Fried et al. and extend the conventional Malmquist TFP index to an adjusted Malmquist-Luenberger TFP index that includes credit risk as an undesirable output. In the first stage, we treat non-performing loans as an undesirable output produced together with desirable outputs. Instead of using the hyperbolic output measures, we use the directional distance function developed in Chung et al. to calculate the output slack for each output where the firm's activities to reduce its bad outputs and increase its good outputs are credited asymmetrically. In the second stage, we use stochastic frontier analysis (SFA) to regress the estimated output slacks against the observed environmental variables and use the regression results to adjust the observed output values while purging the influences of the operating environment and statistical noise. In the third stage, we re-run the DEA model based on the directional distance function using the adjusted output and input data. The Malmquist-Luenberger TFP index are then obtained.

The remainder of this study is organized as follows. The next section describes the three-stage methodology of TFP measurement followed by a brief description of the data and empirical model. Section four presents the empirical results and the final section concludes.

Three-Stage DEA

The directional distance function approach is designed to avoid the computational problems involving the calculation of output efficiency as a solution to non-linear programming problems. In contrast to the Shephard output distance functions which seek to increase the goods and the bads simultaneously, the directional output distance function seeks to increase the goods and decrease the bads directionally as depicted by the following formulation:

(1) $$\vec{D}_O((u_g^k, u_b^k), x^k) = \sup\{\lambda : (u_g^k, u_b^k) + \lambda \cdot h \in P(x/C, S^g)\} \quad ,$$

where $h = (u_g^k, -u_b^k)$ is the vector of "directions" in which both desirable outputs (u_g^k) and undesirable outputs (u_b^k) are scaled, and the output reference set $P(x/C, S^g)$ satisfies the assumptions of constant returns to scale, a strong disposability of desirable outputs, and a weak disposability of undesirable outputs.

Stage 1: The Initial DEA Evaluation Accounting for Undesirable Output

Stage 1 in our approach is similar to the first stage conducted in Fried et al. That is, we use the original unadjusted input and output data to identify a DEA frontier. However, our procedure allows for the possibility of undesirable output, and hence the conventional DEA model adopted by Fried et al., which implicitly assumes that all outputs are "goods", has to be modified.

In order to incorporate the idea that a reduction in bads is costly, following Chung et al. we assume that undesirable outputs are weakly disposable and employ the directional output distance function instead of the traditional Shephard output distance function to represent technology. For each firm k' at time period t, the directional output distance function can be obtained by solving the following linear programming problem with a constant-returns-to-scale (CRS) technology:

$$(3) \qquad \vec{D}_o(x^{k'}, u_g^{k'}, u_b^{k'}; u_g^{k'}, -u_b^{k'}) = \max\ \theta$$

$$\text{s.t.} \quad \sum_{t=1}^{T}\sum_{k=1}^{K} z_k^t u_g^{k.t,m} \geq (1+\theta)u_g^{k',t,m}, \quad \forall m = 1,\cdots,M,$$

$$\sum_{t=1}^{T}\sum_{k=1}^{K} z_k^t u_b^{k.t,i} = (1-\theta)u_b^{k',t,i}, \forall i = 1,\cdots,I,$$

$$\sum_{t=1}^{T}\sum_{k=1}^{K} z_k^t x^{k.t,n} \leq x^{k',t,n}, \quad \forall n = 1,\cdots,N,$$

$$z_k^t \geq 0, \quad k = 1,\cdots,K, \quad t = 1,\cdots,T.,$$

where $\vec{D}_o$ denotes the directional output distance function which seeks to increase the good outputs while simultaneously decreasing the bad outputs. We assume that, at each time period, there are K producers that use N inputs (x) to produce M desirable outputs (u_g) and I bad (or undesirable) outputs (u_b). The vector, z_k^t, denotes the intensity level of producer k at time period t. The vector z_k^t enables us to shrink or expand the individual observed activities of producer k for the purpose of constructing convex combinations of the observed inputs and outputs. The value, θ, represents the coefficient of "direction" in which outputs are scaled.

In addition, it should be noted that in spite of there being T time periods and K producers in the data set, we put all the data together and treat them as if there were K* T producers to solve the linear programming problem stated above. Our reason for doing this is that we intend to attribute the productivity change to four effects, i.e.

the environmental effects, statistical noise, efficiency improvement and technical change. We do not consider the time change in this stage and let the effect of technical change remain in the output slacks.

Stage 2: Using SFA to Decompose Stage 1 Output Slacks

Using the SFA approach, we choose the *M+I* Stage 1 output slacks as dependent variables and regress them as specified in (4) against observable environmental variables, a time variable and a composite error term which captures and distinguishes the effects of managerial inefficiency and statistical noise:

(4) $$S_{mkt} = \beta_0^m + \beta_t^m TM + \beta^m EN + (v_{kt}^m + u_{kt}^m), \quad m = 1,\cdots,M,\ \ k = 1,\cdots,K,\ \ t = 1,\cdots T\ ,$$

where S_{mit} is the output slack-*m* of the *k-th* producer in the *t-th* time period; TM represents the time trend; EN is a vector of environmental variables; and β_0^m, β_t^m, and β^m are, respectively, unknown parameters for the intercept, technical change, and environmental variables. Moreover, the v_{kt}^m are random variables which are assumed to be $iid \sim N(0,\sigma_v^{m^2})$, and independent of the u_{kt}^m where the u_k^m are non-negative random variables accounting for managerial inefficiency and which are assumed to be *iid* and truncated at zero from $N(\mu^m,\sigma_u^{m^2})$. Under such assumptions, equation (4) may be estimated using maximum likelihood estimation techniques. Following the parameterization of Battese and Corra (1977), we replace $\sigma_v^{m^2}$ and $\sigma_u^{m^2}$ with $\sigma^{m^2} = \sigma_v^{m^2} + \sigma_u^{m^2}$ and $\gamma^m = \sigma_u^{m^2} \big/ (\sigma_v^{m^2} + \sigma_u^{m^2})$. [2] The impacts of the environment variables on Stage 1 slacks are captured by the deterministic feasible slack frontier, which is estimated from the regression results in (4) as follows:

(5) $$\hat{S}_{mkt} = \hat{\beta}_0^m + \hat{\beta}_t^m TM + \hat{\beta}^m EN,$$

where $\hat{\beta}_0^m + \hat{\beta}^m EN$ represents the external environment effect, and $\hat{\beta}_t^m TM$ the technical-change effect. In addition to purging the effects of the operating environment, the observed outputs should be further adjusted for the influence of statistical noise. Following Fried et al., the estimators for statistical noise are derived residually by means of

(6) $$\hat{E}(v_{kt}^{m} \mid v_{kt}^{m} + u_{kt}^{m}) = S_{mkt} - \hat{S}_{mkt} - \hat{E}(u_{kt}^{m} \mid v_{kt}^{m} + u_{kt}^{m})$$

where the $\hat{E}(u_{kt}^{m} \mid v_{kt}^{m} + u_{kt}^{m})$, are the conditional estimators for managerial inefficiency. Thus, the effects of environmental variables and statistical noise are used to adjust the original desirable outputs u_{mkt}^{g} and undesirable outputs u_{mkt}^{b} by means of

(7) $$u_{mkt}^{g,A} = u_{mkt}^{g} + [(\hat{\beta}_0^m + \hat{\beta}^m EN) - \min_{kt}(\hat{\beta}_0^m + \hat{\beta}^m EN)] + [\hat{v}_{kt}^{m} - \min_{kt}(\hat{v}_{kt}^{m})]$$, and

(8) $$u_{mkt}^{b,A} = u_{mkt}^{b} - [(\hat{\beta}_0^m + \hat{\beta}^m EN) - \min_{kt}(\hat{\beta}_0^m + \hat{\beta}^m EN)] - [\hat{v}_{kt}^{m} - \min_{kt}(\hat{v}_{kt}^{m})]$$

where $u_{mkt}^{g,A}$ and $u_{mkt}^{b,A}$ denote the adjusted desirable and undesirable output quantities, respectively. The second terms in equations (7) and (8) are used to adjust for the environmental effects, while the third terms take care of the statistical noise.

Stage 3: Adjusted Malmquist-Luenberger productivity index

The formula used to obtain this adjusted Malmquist-Luenberger productivity index is developed in Chung et al. which states that

(9) $$ML_t^{t+1} = \left\{ \frac{\left(1+\vec{D}_0^t(x^t, u_g^t, u_b^t; u_g^t, -u_b^t)\right)}{\left(1+\vec{D}_0^t(x^{t+1}, u_g^{t+1}, u_b^{t+1}; u_g^{t+1}, -u_b^{t+1}\right)} \frac{\left(1+\vec{D}_0^{t+1}(x^t, u_g^t, b^t; u_g^t, -u_b^t)\right)}{\left(1+\vec{D}_0^{t+1}(x^{t+1}, u_g^{t+1}, u_b^{t+1}; u_g^{t+1}, -u_b^{t+1}\right)} \right\}^{1/2} .$$

This index can be decomposed into two component measures, i.e., efficiency change and technical change, by computing the four directional distance functions:

$\vec{D}_0^t(x^{t,k'}, u_g^{t,k'}, u_b^{t,k'}; u_g^{t,k'}, -u_b^{t,k'})$, $\vec{D}_0^{t+1}(x^{t+1,k'}, u_g^{t+1,k'}, u_b^{t+1,k'}; u_g^{t+1,k'}, -u_b^{t+1,k'})$,

$\vec{D}_0^t(x^{t+1,k'}, u_g^{t+1,k'}, u_b^{t+1,k'}; u_g^{t+1,k'}, -u_b^{t+1,k'})$, and $\vec{D}_0^{t+1}(x^{t,k'}, u_g^{t,k'}, u_b^{t,k'}; u_g^{t,k'}, -u_b^{t,k'})$.

Data and Variable Specification

The sample used for this analysis consists of 264 FCUs out of a total of 287 FCUs in Taiwan for three consecutive years, 1998-2000. There are four inputs: loanable funds (*X1*), labor (*X2*), fixed assets (*X3*), and capital expense (*X4*), and three outputs which include two desirable outputs: total loans (*Y1*), and non-loan output (*Y2*), and one undesirable output: non-performing loans (*B*). These data are obtained from the *Farmers' Association Yearbook* published by the Taiwan Provincial Farmers' Association. Seven environmental variables, which cannot be controlled by the general managers of farmers' associations, are specified as follows:

1. **Education:** The proportion of employees with a college degree and above is employed to characterize the employees' quality.[3] Most of their employees are locally-based and have close relationships with the local faction leaders. For this reason, we treat this variable as part of the operating environment.
2. **Membership:** The members of FCUs consist of regular and associate members. Only full-time farmers are eligible to become regular members. The associated members are mostly rural residents (Wang and Chang). It can be found that FCUs with high ratios of regular members to total members are more likely to be located in communities with a concentration of agricultural activities and hence this variable can be used to reflect their economic and community environment.
3. **Number of branches:** In general, the larger the number of branches of FCUs implies the larger scale of these FCUs, because it is not easy for FCUs to increase or reduce the number of their branches within a short period (Fu and Lu). Hence, this variable is used as a proxy for the FCUs' scale of operations. However, the relationship between the FCUs' scale of operations and performance has not been determined.

4.Loan ratio: The loan ratio refers to loans extended to associate members as a proportion of total loans. According to statistics released by the Ministry of Finance, the loans that amounted to less than NT$1 million were mostly extended to farmers for agricultural purposes. On the other hand, the loans amounting to more than NT$20 million were often extended to non-farmers for non-agricultural purposes. The decisions are often beyond the general managers' control because many local politicians regard the FCUs as an important channel for funding their campaign activities. Therefore, we use this variable as a proxy to represent the political pressure faced by the FCUs.

5.Number of local commercial banks: This variable is used as a proxy to represent the degree of market competition faced by FCUs.

6.Land price: In general, the land prices in urban areas are higher than those in rural areas, and hence this variable can be used to reflect the location effect.

7.Time: A time trend variable is used as a proxy for technical change during the sample period.

Empirical Results

As shown in Table 1, an FCU with a higher ratio of educated employees is capable of producing more output with less non-performing loans. This result is consistent with our expectations. As for the membership and loan ratio, we found that both had a negative impact on the slacks of *Y1* and *Y2*, but a positive impact on the slack of *B*. This indicates that those FCUs located in agricultural communities and facing stronger political pressure are more likely to be associated with larger non-performing loans. The land price was also negatively related to the slacks of the good outputs, but positively related to the slack of the bad output. This indicates that FCUs located in areas with higher land values are more vulnerable to non-performing loans. The coefficients of the number of branches exhibit positive signs and implies that there are diseconomies of scale in Taiwan's FCUs. As for the number of banks, the coefficients estimated are all positive and significant, too. This suggests that the FCUs' performance has not been maintained in the face of increasing competition from commercial banks. The estimated coefficients of the time trend are found to be both positive and suggest that the overall inefficiency of FCUs has been worsening over time in terms of producing good outputs. Finally, the values for the parameter γ are all found to be close to 1. This means that the deviations in these three output slacks are due mostly to managerial inefficiency and environmental variables.

The geometric means of *ML* indexes are summarized in Table 2 according to regions and for two periods. The resulting values are all less than 1, implying that the productivity has deteriorated on average over the sample period. For comparison purposes, we also compute the *ML* based on the original panel data which did not account for the impacts of environmental variables and statistical noise. It is found that the adjusted *MLs* are smaller than the unadjusted versions. This suggests that after removing the environmental effects and statistical noise, the productivity performance of the FCUs turns out to be worse than if these factors had not been taken into consideration. The differences between the adjusted and unadjusted *ML* indexes are tested for statistical significance using an experimental test. The p values in Table 2 indicate that their differences are all significant except in the southern region during the 1999-2000 period.

Table 3 summarizes the results for the adjusted *ML* and its two components. All regions display negative productivity growth in both periods, although there is a slight recovery over the 1999-2000 period. Although there are improvements in managerial efficiency over time, they are not sufficient to compensate for the losses in technical change.

Table 4 compares the percentage of FCUs that experienced productivity gains with that of FCUs experiencing productivity losses by region. It is found that the number of FCUs with a value for *ML* of greater than 1 dropped dramatically across the four regions as well as over the two periods. Furthermore, Table 4 demonstrates that, before adjusting the data, the FCUs in the northern region had a smaller percentage that were characterized by negative productivity growth than those in the southern and eastern regions. However, after the data are adjusted, the superiority of the FCUs in the northern region disappears and this finding suggests that they have higher productivity growth mainly due to their favorable environment.

Conclusion

In this article we have proposed a three-stage DEA approach to improve the measurement of productivity growth when the assumption of free disposability of output no longer applies. The directional distance function has been used to construct an adjusted Malmquist-Luenberger productivity index to simultaneously account for the impacts of an undesirable output, environmental variables, and statistical noise. Our results have demonstrated that productivity measurement is sensitive to whether or not environmental variables and statistical noise are included. In addition, our adjusted ML productivity indexes have shown that on average the productivity of Taiwan's FCUs has deteriorated over time. Although improvements in efficiency have been observed, the major reason for the slow-down in productivity has been found to be the regression of technology. Therefore, investment in such technologies should be helpful for FCUs to modernize their operations as they face competitive challenges and at the same time improve their risk management.

References

Battese, G. E. and G. S. Corra. "Estimation of a Production Frontier Model: With Application to the Pastoral Zone of Eastern Australia." *Australian Journal of Agricultural Economics* 21(1977): 169-179.

Caves, D. W., L. R. Christensen, and W. E. Diewert. "The Economic Theory of Index Numbers and the Measurement of Input, Output, and Productivity." *Econometrica* 50 (1982): 1393-1414.

Chang, C.-C. "The Nonparametric Risk-Adjusted Efficiency Measurement: An Application to Taiwan's Major Rural Financial Intermediaries." *American Journal of Agricultural Economics* 81(1999): 902-913.

Chen, T.-Y., and T.-L. Yeh. "A Measurement of Bank Efficiency, Ownership and Productivity Changes in Taiwan." *The Service Industries Journal* 20-1(2000): 95-109.

Chen, Y.-C., T.-T. Fu and R.-J. Woo. "Cost Efficiencies of Mergence between Commercial Banks and Farmer Credit Unions in Taiwan." Paper presented at the Asian Conference on Efficiency and Productivity Growth, Taipei, Taiwan, 2000.

Chung, Y.-H., R. Färe, and S. Grosskopf. "A Directional Distance Function Approach." *Journal of Environmental Management* 51(1997): 229-240.

Devaney, M., and W. L. Weber. "Productivity Growth, Market Structure, and Technological Change: Evidence from the Rural Banking Sector." *Applied Financial Economics* 10(2000): 587-595.

Färe, R., S. Grosskopf, M. Norris, and Z. Zhang. "Productivity Growth, Technical Progress, and Efficiency Change in Industrialized Countries." *American Economic Review* 84(1994): 66-83.

Färe, R., S. Grosskopf, C. A. K. Lovell, and C. Pasurka. "Multilateral Productivity Comparisons when Some Outputs are Undesirable: A Nonparametric Approach." *Review of Economics and Statistics* 71(1989): 90-98.

Fried, H. O., C. A. K. Lovell, S. S. Schmidt, and S. Yaisawarng. "Accounting for Environmental Effects and Statistical Noise in Data Envelopment Analysis," *Journal of Productivity Analysis* 17(2002): 157-174.

Gilbert, R. A., and P. W. Wilson. "Effects of Deregulation on the Productivity of Korean Banks." *Journal of Economics and Business* 50(1998): 133-155.

Grifell-Tatje, E., and C. A. K. Lovell. "Deregulation and Productivity Decline: The Case of Spanish Savings Banks." *European Economic Review* 40 (1996): 1281-1303.

Grifell-Tatje, E., and C. A .K. Lovell. "The Sources of Productivity Change in Spanish Banking." *European Journal of Operational Research* 98 (1997): 364-380.

Isik, I., and M. K. Hassan. "Financial Disruption and Bank Productivity: The 1994 Experience of Turkish Banks." *Quarterly Review of Economics and Finance* 43(2003a): 291-320.

Isik, I., and M. K. Hassan. "Financial Deregulation and Total Factor Productivity Change: An Empirical Study of Turkish Commercial Banks." *Journal of Banking & Finance* 27 (2003b): 1455-1485.

Leightner, J. E., and C. A. K. Lovell. "The Impact of Financial Liberalization on the Performance of Thai Banks." *Journal of Economics and Business* 50(1998): 115-131.

Mukherjee, K., S. C. Ray, and S. M. Miller. "Productivity Growth in Large US Commercial Banks: The Initial Post-deregulation Experience." *Journal of Banking & Finance* 25(2001): 913-939.

Sathye, M. "Measuring Productivity Changes in Australian Banking: An Application of Malmquist Indices." *Managerial Finance* 289 (2002): 48-59.

Shephard, R.W. *Theory of Cost and Production*. Princeton: Princeton University Press, 1970.

Wang, H.-J., and C.-C. Chang. "The Cost Effects of Government-Subsidized Credits on Financial Intermediaries: Evidence from Farmers' Credit Unions in Taiwan." Working paper, Institute of Economics, Academia Sinica, 2003.

Table 1. Estimation Results of the Stochastic Frontier Functions

Explanatory Variables	Dependent Variables		
	Y1 slack	*Y2* slack	*B* slack
Constant	-60.0601	-200.0151*	-383.6129*
	(-0.50)	(-1.84)	(-310.15)
Education ratio	-380.9393*	-279.1761*	-275.6081*
	(-3.85)	(-3.52)	(-193.13)
Membership ratio	-1.3998	-0.5028	3.5009*
	(-1.22)	(-0.51)	(32.41)
No. of branches	86.6188*	77.8151*	11.0208*
	(13.33)	(11.31)	(12.20)
Loan ratio	-1.0649	-0.3562	2.9626*
	(-0.94)	(-0.35)	(18.44)
No. of banks	8.3819*	5.7381*	0.5027*
	(7.74)	(7.02)	(7.26)
Land price	-2.6038*	-1.2162	0.9833*
	(-2.7129)	(-1.37)	(9.03)
Time	85.3270*	82.7779*	5.9669
	(4.97)	(4.76)	(1.26)
σ^2	449784.00*	617537.39*	286535.45*
	(92716.85)	(517295.77)	(286532.60)
γ	0.8831*	0.9408*	0.9999*
	(49.03)	(85.05)	(9631.71)
Log-likelihood function	-5943.78	-6027.26	-5422.62
LR test of the one-sided error	115.50	147.17	565.46

* Significant at the 5% level or above.

Table 2. Comparison of Adjusted and Unadjusted Productivity Indexes

	1998-1999			1999-2000		
	Unadjusted	Adjusted	P-value	Unadjusted	Adjusted	P-value
North	0.9708	0.8310	0.0000004*	0.9826	0.9149	0.0003440*
Central	0.9403	0.8567	0.0368958*	0.9320	0.8950	0.0017867*
South	0.9052	0.8641	0.0024801*	0.9211	0.9217	0.8367437
East	0.9376	0.8390	0.0000018*	0.9684	0.8477	0.0000143*
Total	0.9331	0.8525	0.0000196*	0.9413	0.9032	0.0000028*

Note: Paired difference experiments are used to test for the same mean between two groups. The symbol * means significant at the 5% level or above.

Table 3. The Decomposition of the Adjusted *ML* Productivity Indexes by Region

	ML		*TECH*		*EFFCH*	
	1998-1999	1999-2000	1998-1999	1999-2000	1998-1999	1999-2000
Northern	0.831	0.915	0.834	0.898	0.996	1.019
Central	0.857	0.895	0.845	0.892	1.014	1.003
Southern	0.864	0.922	0.851	0.893	1.015	1.032
Eastern	0.839	0.848	0.801	0.877	1.048	0.967
Total	0.852	0.903	0.840	0.892	1.014	1.013

Table 4. Number of FCUs with Productivity Gain or Loss-
Comparison between Adjusted and Unadjusted *ML*

Region	Total Number of FCUs	Unadjusted *ML*			Adjusted *ML*		
		Increase (*ML>1*) %	No change (*ML=1*) %	Decrease (*ML<1*) %	Increase (*ML>1*) %	No change (*ML=1*) %	Decrease (*ML<1*) %
I. 1998-1999							
Northern	51	29.4	3.9	66.7	7.8	2.0	90.2
Central	92	21.7	0.0	78.3	2.2	0.0	97.8
Southern	94	13.8	0.0	86.2	5.3	0.0	94.7
Eastern	27	11.1	0.0	88.9	0.0	0.0	100.0
Total	264	19.3	0.8	79.9	4.2	0.4	95.5
II. 1999-2000							
Northern	51	39.2	2.0	58.8	9.8	0.0	90.2
Central	92	34.8	0.0	65.2	10.9	0.0	89.1
Southern	94	16.0	2.1	81.9	13.8	0.0	86.2
Eastern	27	22.2	0.0	77.8	3.7	0.0	96.3
Total	264	27.7	1.1	71.2	11.0	0.0	89.0