Research Journal of Business Management

ISSN 1819-1932

Academic Journals Inc.

www.academicjournals.com

Research Journal of Business Management 8 (3): 242-253, 2014
ISSN 1819-1932 / DOI: 10.3923/rjbm.2014.242.253

Analysis on Savings and Credit Cooperatives Efficiency in Thailand: A Data Envelopment Analysis (DEA) Approach

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ABSTRACT

The microfinance institutions in Thailand were considered to be significant as the alternative financing source such as Savings and Credit Cooperatives (SCCs). While these institutions have been intensified in term of cooperative quantity and impact on entire economy, many SCCs' operations have still now been suffered from losses with negative returns and liquidity problems. This research therefore aims to investigate the efficiency of 732 SCCs in Thailand by using the databases of Cooperative Auditing Department, Ministry of Agriculture and Cooperatives of Thailand and evaluate SCCs' technical efficiencies on production and intermediation model by Data Envelopment Analysis (DEA) method. The efficiency evaluation results classified according to the types of cooperatives indicated that state enterprise cooperative had maximum quantity of efficient cooperatives and average efficiency score. When conducting the co-analysis on efficient cooperatives or best practiced cooperatives of each type of cooperative, it was found that private cooperatives had maximum efficiency in term of cooperative quantity and efficiency score.

Key words: Savings and credit cooperatives, microfinance, data envelopment analysis, efficiency

INTRODUCTION

The first cooperative of Thailand was established in 1916 under the objective to be the source of funds for cooperative members, also to enhance the bargaining powers on production factor and output selling, as well as to be the news information exchanges for mutual benefits. Until present, the cooperative businesses have been highly developed and grown so that there have been 7,018 cooperatives throughout the country with 10,827,490 members or equivalent to 16.90% of the populations of the whole nation, 67,182.42 million USD of business volume or equivalent to 24.96% of GDP in 2011. Due to this reason, the cooperatives have played very crucial roles for national economic and social development making better qualities of people lives in the society (Cooperative Promotion Department, 2013). In Thailand, there have been seven types of the cooperatives including Savings and Credit Cooperatives, Credit Union Cooperatives, Fisheries Cooperatives, Agricultural Cooperatives, Service Cooperatives, Land Settlement Cooperatives and Consumer Cooperatives.

If considering on the business volumes of all types of cooperatives, it was found that the Savings and Credit Cooperatives were the cooperatives having maximum business volumes at 79% of total cooperative business volumes. The Savings and Credit Cooperatives were the cooperatives

for rentiers who required self-dependences by savings and helping each other to solve the living and financial status problems by lending when they were necessary and they could be established in the official places, state enterprises, academies, companies or in communities. Besides the establishments of the Savings and Credit Cooperative were possible for assisting the members to be self-dependent, they would also build good relationships to be occurred among the members who were employees and business owners in order to ease up the contradictions into better directions. The Savings and Credit Cooperatives were one of the Microfinance Institutions format in the category of retail microfinance institutions. In Thailand, the MFIs as one of the financial source options have been lately intensified and have become significance. Nowadays' problems confronted by some of SCCs were the sufferings from losses due to negative returns and illiquidity. It was therefore the requirement to create benchmark for MFIs' performance by investing the proofs of institutional causes of failure and poor performance (Nyamsogoro, 2010; Kipesha, 2012). Then, it was very essential for efficiency evaluation and development of SCCs. Few performances in resource utilization efficiency of both public and private SCCs in Thailand have been known. However, due to its specific characteristics of Savings and Credit Cooperatives that was different from traditional banking institutions in general, the common vehicle of traditional banking institutions could not be employed to measure the efficiencies of Savings and Credit Cooperatives. Therefore, the problem issue about the efficiency evaluations of the Savings and Credit Cooperatives and the measurement instrument became the crucial problem.

Data Envelopment Analysis (DEA) was one of the instruments being mentioned in several researches as being suitable for efficiency evaluations of microfinance institutions and non-profit organizations (Gutierrez-Nieto *et al*., 2007). This study therefore has applied this instrument in efficiency evaluations from the empirical performance proofs of SCCs in Thailand. Their performances will be measured in term of their relative efficiencies in order to determine the benchmark for efficient operations, performance improvement, growth policies and finally being the main element of economic growth sustainability in order to help those people who had limited financing as the efficient financial service providers and financial mediators accordingly.

LITERATURE REVIEW

Few studies have been conducted on the efficiencies of SCCs or microfinance institution and most of them were the studies of banking efficiencies applying the financial ratios as crucial variables in efficiency measurement (Gutierrez-Nieto *et al*., 2007; Haq *et al*., 2010). Therefore, if the efficiency study on the Savings and Credit Cooperatives was required, then the query was raised whether the same banking financial ratios should be applied for their efficiency evaluations or not. With regard to this query, Gutierrez-Nieto *et al*. (2007) said that the measurement of microfinance institution efficiency should not utilize the same variables in efficiency evaluations as the banks. It was like the study of Morduch (1999), Farrington (2000), Lafourcade *et al*. (2005), Gutierrez-Nieto *et al*. (2007), Xu and Wang (2009), Haq *et al*. (2010) and Hassan *et al*. (2012), etc., that evaluated microcredit performance without use of financial ratios. The study of Farrington (2000) applied the administrative expense ratio, number of loans per loan officer and loan officers to total staff, portfolio size, loan size, lending methodology, source of funds and salary structure to evaluate the efficiency of microfinance institutions. In addition, the study of Gutierrez-Nieto *et al*. (2007) utilized credit officers, operating expenses, interest and fee income, gross loan portfolio and number of loans outstanding in measuring the efficiencies of the microfinance institutions in Latin America.

The measurements of financial institution efficiencies were developed into two major approaches (Berger and Humphrey, 1997) including: (1) Parametric frontiers (Lang and Welzel, 1996; Berger *et al*., 1997; Hailu *et al*., 2007; Mersland and Strom, 2009; Hermes *et al*., 2011) and (2) Data Envelopment Analysis (DEA) (Fukuyama *et al*., 1999; Gutierrez-Nieto *et al*., 2007; Ni-Di and Ming-Xian, 2010; Haq *et al*., 2010; Ren *et al*., 2011). These two approaches utilized for evaluating the best practiced frontiers by measuring the efficiencies of specific decision-making unit that was related to the frontier (Hailu *et al*., 2007). However, one of the advantages of DEA (nonparametric) being superior than parametric method was this technique could be utilized in case of unjustified conventional cost and profit functions (Berger and Humphrey, 1997; Gutierrez-Nieto *et al*., 2007). In addition, the multiple comparisons between a set of homogeneous units was conducted by using DEA (Gutierrez-Nieto *et al*., 2007) as described on DEA theory introduction by Thanassoulis (2001), Charnes *et al*. (1994) and Cooper *et al*. (2000).

The popular DEA model applied for efficiency evaluation of the financial institutions that were either banks or microfinance institutions included intermediation model and production model (Athanassopoulos, 1997; Bassem, 2008; Haq *et al*., 2010; Hassan *et al*., 2012) and both models were different in definitions of production factor and output.

The intermediation model was the model that considered the financial institutions to be the financial intermediaries. The input variables utilized included operating expenses and acquired loans, etc. and the output variables required included interest and fee income, gross loan portfolio and placing loans, etc. (Berger and Humphrey, 1991).

The production model was the model that considered the financial institutions to be the production unit. The input variables utilized included manpower and assets, etc. and the output variables included deposits and loans, etc. (Vassiloglou and Giokas, 1990; Soteriou and Zenios, 1999).

Some studies used DEA to investigate the efficiencies of the savings and credit cooperative or microfinance.

According to the application of data development analysis (DEA) by Fukuyama *et al*. (1999), the credit cooperatives in Japan were evaluated by DEA on their entire efficiency and productivity growth during 1992-1996 and the finding of their paper indicated that the cooperatives having more efficiency and greater productivity growth during the evaluated period were foreign-owned cooperatives.

Gutierrez-Nieto *et al*. (2007) also applied Data Envelopment Analysis (DEA) for efficiency measurement from 30 Latin American MFIs using two inputs and three outputs that were covered according to intermediation and production model for efficiency measurement. The efficiency measurements were divided into 21 specifications and the finding showed maximum efficiencies in almost of all specifications in NGO financial institution (W-Popayan) and a non-bank financial institution (Findesa). Haq *et al*. (2010) also evaluated by using non-parametric data envelopment under production approach on the cost efficiencies of 39 microfinance institutions across Africa, Asia and the Latin America and their finding was that the most efficient institutions were non-governmental microfinance institutions, however under intermediation approach, it discovered that the outperformance in efficiency measure was bank-microfinance institutions. Based on DEA, Ni-Di and Ming-Xian (2010) analyzed the operational efficiencies of 14 rural credit cooperatives in HuNan and their study results showed that the location either in the city or rural areas of the five branches of efficient rural credit cooperatives did not affect the operating efficiencies.

RESEARCH METHODOLOGY

The relative efficiency measurement of peer making units (DMUs) in multiple input and multiple output determinations were conducted by DEA as an efficient instrument for performance evaluation. According to the DEA framework, performance was evaluated pertaining to an efficient frontier that was created by investigating the linear combinations of DMUs as well as determining the minimum requirement of input utilization for achievement of specified level of outputs (Hua *et al*., 2007). According to DEA development and application by Charnes *et al*. (1978), the objectives of profit maximization and cost minimization of non-profit organizations might be considered as the non-crucial factors. The function for small sample sizes without price information requirements was considered as the advantage of DEA. In addition, DEA was advised by Cooper *et al*. (2000) to be applied in generating the cooperation between the policymakers and practitioners on input and output selections in order to detect both inefficient input and output sources and amounts.

Model: Either production approach or intermediation approach were conformed in the data envelopment method. According to CCR model-based DEA method (Charnes *et al*., 1978; Banker *et al*., 1984), it agreed with input orientation and constant return to scale and the optional assumption of variable return to scale (BBC model) (Banker *et al*., 1984).

Avkiran (1999) and Coelli (1996) found that CCR model generated the same efficiency results for both cases. According to BCC model, the increases in inputs were considered while the increases in outputs were unexpected. Both input and output-oriented models were applied using the production and intermediation approach, thus our analysis was based on constant return to scale measure according to Charnes *et al*. (1978) that indicated the following formula for efficiency measurement:

$$\text{Max} \sum_{r=1}^{S} u_r y_r 0$$

Subject to:

$$\sum_{r=1}^{S} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \leq 0$$

$$\sum_{i=1}^{m} v_i x_{i0} = l; - u_v \leq -\varepsilon \qquad (1)$$

$$-v_i \leq -\varepsilon$$

where, y_{ri} and x_{ij} are positive known outputs and inputs of the jth decision making unit (DMU) u_r and v_i are the variable weights determined for solving the above equation problem:

$$\sum_{i=1}^{m} v_i x_{i0} = 1$$

assures its possibility for moving from ratio form to linear programming form and vice versa.

$u_r, v_i \geq \varepsilon > 0$, $\forall r, i$, are from the non-Archimedean conditions. According to Charnes and Cooper (1962), this assures the followings:

$$h_0^* \sum_{r=1}^{S} u_r^* y_r 0 \tag{2}$$

The Eq. 1 is interpreted as the MFIs objective for output maximization subjected to unit input under the condition that virtual output cannot go beyond virtual input for any DMU. On the other hand, the following model provided by Banker *et al.* (1984) will cope with the variable return to scale version of DEA:

$$\text{Max} \sum_{r=1}^{S} u_r y_r - u_0$$

Subject to:

$$\sum_{r=1}^{S} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \leq 0$$

$$\sum_{i=1}^{m} v_i x_{i0} = 1; -u_v \leq -\varepsilon \tag{3}$$

$$-v_i \leq -\varepsilon$$

u* implies the return to scale possibilities. An u*<0 indicates increasing return to scale and u*>0 indicates decreasing return to scale. The DEA score are ranged between 0 and 1 and DEA score = 1 refers to efficiency and if DEA score <1 refers to inefficiency.

Sample: The databases of Cooperative Auditing Department, Ministry of Agriculture and Cooperatives of Thailand were the sources of the data collection for input and output data of 732 Savings and Credit Cooperatives (SCCs) of Thailand in 2012 with sample groups of 17 State Enterprises' Employees SCCs, 75 Government SCCs, 195 Private Individual SCCs, 19 Institution of Education SCCs, 58 Public Health SCCs, 59 Hospital SCCs, 73 Teacher SCCs, 134 Soldier SCCs and 102 Police SCCs.

Input and output selection: The production model would imply the inclusion of the first input (Bassem, 2008; Xu and Wang, 2009; Hassan *et al.*, 2012) whereas the intermediation model would be compatible for the second input. According to Berger and Humphrey (1997), Gutierrez-Nieto *et al.* (2007), Hassan *et al.* (2012), Pastor (1999) and Worthington (1998), they advised the operating expenses or similar inputs. Therefore, total assets and operating expenses were selected as inputs in this study.

The production and intermediation models were also applied for output selections by the way that the interest and fee income and the gross loan portfolio were related to the intermediation orientation (Berger and Humphrey, 1997; Gutierrez-Nieto *et al.*, 2007; Pastor, 1999; Tortosa-Ausina, 2002; Worthington, 1998) while the deposits were related to the production orientation (Gutierrez-Nieto *et al.*, 2007). Table 1 exhibited the inputs and outputs included in the DEA model.

Table 1: Inputs and outputs inclusive in the DEA model together with their measurement units

Input	Output
Total assets ($ thousands)	Interest and fee income ($ thousands)
Operating expenses ($ thousands)	Gross loan portfolio ($ thousands)
	Deposits ($ thousands)

RESULTS AND DISCUSSION

Result of CCR model: According to the analysis result, CCR model or Constant Return to Scale (CRS) that were the consideration of the efficiencies existent in the assumption that the cooperatives had appropriate scales of productions (Coelli, 1996), the efficiency score from this model therefore would be used for measuring Overall Technical Efficiency with following analysis results as shown in Table 2.

The state enterprise cooperatives had up to 47.1% of maximum numbers of efficient cooperatives followed by the institution of education cooperatives with 21.1% of efficient cooperatives. On the other hand, teacher cooperatives had 5.5% of minimum numbers of efficient cooperatives. Besides that, if efficiencies were considered under the production model-based classification, the finding was that the state enterprise cooperatives had 5.9% of maximum numbers of efficient cooperatives. For intermediation model, institution of education cooperatives had 15.8% of maximum numbers of efficient cooperatives.

According to the calculation outcome of efficiency score, the finding was that state enterprise and public health cooperatives had maximum average efficiency scores equaling to 0.9004 and 0.7757, respectively. This meant that both types of cooperatives could utilize the inputs effectively equivalent to 90.04 and 77.57%, respectively and private cooperatives had minimum average efficiency score equivalent to 0.5520 or 55.20% of efficient input utilization capability only.

When considering on the efficiency in case of production model, it was found that state enterprise and public health cooperatives were still the cooperatives having the maximum average efficiency scores top at top two ranks. However, if it was the case of intermediation model, it appeared that the institution of education cooperatives had maximum efficiency scores with average efficiency score at 0.4739, or 47.39% of efficient input utilization capability, while the state enterprise cooperatives were at the second rank with average efficiency score at 0.4405 or 44.05% of efficient input utilization capability.

Result of BBC model: According to the analysis result by BBC model or Variable Return to Scale (VRS) model, it was the consideration on the efficiency value in case of the cooperatives having inappropriate level scales of productions, the efficiency value from this model was applied to measure pure technical efficiency (Coelli, 1996) and the following analysis results were shown in Table 3.

State enterprise cooperatives had 58.8% of maximum numbers of efficient cooperatives, followed by the institution of education cooperatives with 31.6% of numbers of efficient cooperatives. On the other hand, private cooperatives had only 11.8% of minimum numbers of efficient cooperatives. Besides that if considering the efficiency being classified according to production model and intermediation model, the finding were that state enterprise and institution of education cooperatives again had 17.6 and 15.8% of maximum numbers of efficient cooperatives, respectively in case of production model and 23.5 and 15.8% of efficient cooperatives in case of intermediation model.

Table 2: Analysis result on the efficiency in case of constant return to scale (CCR model)

		CRS			CRS_PM			CRS_IM		
SCCs	Total	Percentage	Mean	SD	Percentage	Mean	SD	Percentage	Mean	SD
Teacher	73	5.5	0.5994	0.2079	1.4	0.1344	0.1694	1.4	0.1248	0.1204
Police	102	7.8	0.6477	0.1784	1.0	0.1746	0.1487	2.0	0.3437	0.1880
Soldier	134	8.2	0.6211	0.1922	0.7	0.2390	0.2130	1.5	0.1831	0.1614
State enterprise	17	47.1	0.9004	0.1543	5.9	0.3617	0.2822	11.8	0.4405	0.2539
Government	75	12.0	0.6677	0.1938	1.3	0.0745	0.1282	2.7	0.3428	0.2404
Hospital	59	6.8	0.5889	0.2219	1.7	0.0915	0.1540	3.4	0.2192	0.2087
Institution of education	19	21.1	0.6089	0.2727	5.3	0.1390	0.2171	15.8	0.4739	0.3277
Public health	58	10.3	0.7757	0.1504	1.7	0.2318	0.1832	3.4	0.4333	0.2209
Private	195	8.2	0.5520	0.2284	0.5	0.1889	0.1871	1.0	0.0766	0.1523

Table 3: Efficient analysis results in case of variable return to scale (BBC model)

		VRS			VRS_PM			VRS_IM		
SCCs	Total	Percentage	Mean	SD	Percentage	Mean	SD	Percentage	Mean	SD
Teacher	73	26.0	0.7941	0.1896	6.8	0.2309	0.2935	11.0	0.5003	0.2697
Police	102	15.7	0.7339	0.1929	3.9	0.3165	0.2568	6.9	0.3883	0.2245
Soldier	134	22.4	0.6997	0.2150	4.5	0.3109	0.2435	8.2	0.3577	0.2821
State enterprise	17	58.8	0.9343	0.1436	17.6	0.4270	0.3308	23.5	0.5526	0.2852
Government	75	28.0	0.7586	0.1972	8.0	0.2952	0.3052	9.3	0.4310	0.2638
Hospital	59	28.8	0.6990	0.2392	5.1	0.1795	0.2381	10.2	0.3911	0.2800
Institution of education	19	31.6	0.6768	0.2559	15.8	0.2834	0.3512	15.8	0.5522	0.2959
Public health	58	22.4	0.8299	0.1464	5.2	0.3224	0.2387	10.3	0.5546	0.2470
Private	195	11.8	0.5929	0.2377	1.5	0.2500	0.2443	4.1	0.1592	0.2327

For calculation result of efficiency score, it was discovered that state enterprise and public health cooperatives had maximum average efficiency scores equivalent to 0.9343 and 0.8299 respectively, meaning that both types of cooperatives could efficiently utilize their inputs equivalent to 93.43 and 82.99%, respectively and private cooperatives had minimum efficiency score equivalent to 0.5929 or only 59.29% of efficient input utilization capability.

When considering the efficiency in case of production model, it was found that state enterprise cooperatives and public health cooperatives were still the cooperatives having maximum average efficiency scores at the first top two ranks with average efficiency score equivalent to 0.4270 and 0.3224 or 421.70 and 32.24% of efficient input utilization, respectively. However, in case of intermediation model, it appeared that public health cooperatives had higher average efficiency score than state enterprise cooperatives and both types of cooperatives had average efficiency score equivalent to 0.5546 and 0.5526 or 55.46 and 55.26% of efficient input utilization capability, respectively.

Result of scale efficiency: The analysis result of scale efficiency could help find whether the cooperatives had appropriate scales of productions or not. The finding of the analysis result was that state enterprise cooperatives had 47.1% of most appropriate scale of production cooperatives, followed by 21.1% of the institution of education cooperatives. The state enterprise cooperatives had 47.1% of maximum numbers of the appropriate scale of production cooperatives with average scale efficiency score at 0.9638, followed by 21.1% of institution of education cooperatives with average scale efficiency score at 0.8899 and 12.1% of public health cooperatives with average scale

Table 4: Analysis result on efficiency per scale (SE)

		SE			RTS		
SCCs	Total	Percentage	Mean	SD	IRS	CRS	DRS
Teacher	73	5.5	0.7656	0.2018	11.0	5.5	83.6
Police	102	7.8	0.8913	0.1155	13.7	7.8	78.4
Soldier	134	8.2	0.8991	0.1184	38.8	8.2	53.0
State enterprise	17	47.1	0.9638	0.0686	41.2	47.1	11.8
Government	75	12.0	0.8886	0.1386	30.7	12.0	57.3
Hospital	59	6.8	0.8504	0.1407	3.4	6.8	89.8
Institution of education	19	21.1	0.8899	0.1356	15.8	21.1	63.2
Public health	58	12.1	0.9390	0.1049	72.4	10.3	17.2
Private	195	9.2	0.9302	0.0962	23.1	8.2	68.7

efficiency score at 0.9390. The teacher cooperatives had only 5.5% of minimum numbers of appropriate scale of production cooperatives with average scale efficiency score at 0.7656. Besides that, it was found that the characteristics of almost types of the cooperatives were decreasing return to scale (DRS), except the characteristics of the estate enterprise and public health cooperatives as major numbers of cooperatives were increasing return to scale (IRS) and were two types of cooperatives having highest average scale efficiency score values in the top two ranks as shown in Table 4.

The above analysis results were the evaluations of efficiency scores by comparing intra-groups of each type of the cooperatives. In this part, the efficient cooperatives from the evaluations in each group were co-analyzed to consider in overall perspective on which types of cooperatives were most efficient. Total numbers of efficient cooperatives from all types of cooperatives included 71 cooperatives being classified into 4 teacher cooperatives, 8 police cooperatives, 11 soldier cooperatives, 8 public enterprise cooperatives, 9 government cooperatives, 5 hospital cooperatives, 4 educational institution cooperatives, 6 public health cooperatives and 16 private cooperatives. It was appeared that when considering the efficiency scores in case of CCR model, there were 17 efficient cooperatives including 15 private cooperatives and 2 government cooperatives having average efficiency scores at 0.6704, saying that 67.04% of efficient input utilization cooperatives. According to BBC model, there were 29 efficient cooperatives distributed in almost types of the cooperatives (except soldier cooperatives that had inefficient cooperatives). It was private cooperative again having 16 cooperatives of maximum numbers of efficient cooperatives with average efficiency score at 0.7931 or 79.31% of efficient resource utilization cooperatives. Finally, these 71 cooperatives having 18 cooperatives with proper production scales when considering from scale efficiency values including 15 private cooperatives, 2 government cooperatives and 1 teacher cooperative.

The cooperative efficiency analysis classified according the cooperative types would greatly include some numbers of efficient cooperatives in these types of cooperatives such as the cooperatives in the types of state enterprise, institution of education and government, etc. In these groups of cooperatives, the governmental sector should mainly promote to be self-dependent groups to support each other. The efficient or best practiced cooperatives should be the coaches to help shadowing the inefficient cooperatives for advice given for higher primary efficiency development. According to the cooperatives having few best practiced cooperatives, the governmental sector or Cooperatives Promotion Department should be involved in developing the cooperative efficiencies.

For teacher and soldier cooperatives either the analysis according to cooperative type classification or combination of all types of cooperatives, it was appeared that both cooperatives had

Table 5: Efficiency score evaluation results on the efficient cooperatives from all types of cooperatives

	Efficiency Score				Efficiency Score		
SCCs	CRS	VRS	SE	SCCs	CRS	VRS	SE
Teacher 1	0.7026	0.7033	0.9990	Government 6	1.0000	1.0000	1.0000
Teacher 2	0.4472	0.4472	1.0000	Government 7	0.5177	0.5220	0.9917
Teacher 3	0.7227	0.7635	0.9467	Government 8	0.4893	0.5024	0.9739
Teacher 4	0.7867	1.0000	0.7867	Government 9	1.0000	1.0000	1.0000
Police 1	0.5681	0.8526	0.6663	Hospital 1	0.8965	0.9165	0.9782
Police 2	0.7051	1.0000	0.7051	Hospital 2	0.8112	1.0000	0.8112
Police 3	0.4239	1.0000	0.4239	Hospital 3	0.7382	0.7441	0.9920
Police 4	0.9903	1.0000	0.9903	Hospital 4	0.7823	0.8934	0.8757
Police 5	0.6111	0.6339	0.9641	Hospital 5	0.8708	0.8713	0.9994
Police 6	0.4085	0.4202	0.9723	Institution of education 1	0.3419	0.7631	0.4480
Police 7	0.3051	0.6503	0.4691	Institution of education 2	0.7642	0.7644	0.9997
Police 8	0.8746	0.8746	1.0000	Institution of education 3	0.5253	0.8616	0.6097
Soldier 1	0.4717	0.4725	0.9983	Institution of education 4	0.5915	1.0000	0.5915
Soldier 2	0.5390	0.5995	0.8990	Public health 1	0.6176	1.0000	0.6176
Soldier 3	0.5254	0.5668	0.9271	Public health 2	0.4823	0.7360	0.6553
Soldier 4	0.4046	0.8685	0.4659	Public health 3	0.5101	0.5119	0.9966
Soldier 5	0.6437	0.6958	0.9252	Public health 4	0.4462	0.8595	0.5191
Soldier 6	0.4938	0.6819	0.7241	Public health 5	0.4451	0.4557	0.9767
Soldier 7	0.3592	0.4180	0.8593	Public health 6	0.4962	0.5965	0.8318
Soldier 8	0.8355	0.8366	0.9986	Private 1	0.9958	1.0000	0.9958
Soldier 9	0.6115	0.6144	0.9952	Private 2	1.0000	1.0000	1.0000
Soldier 10	0.4374	0.4808	0.9097	Private 3	1.0000	1.0000	1.0000
Soldier 11	0.3115	0.3122	0.9978	Private 4	1.0000	1.0000	1.0000
State enterprise 1	0.4112	1.0000	0.4112	Private 5	1.0000	1.0000	1.0000
State enterprise 2	0.4700	0.7552	0.6224	Private 6	1.0000	1.0000	1.0000
State enterprise 3	0.1682	1.0000	0.1682	Private 7	1.0000	1.0000	1.0000
State enterprise 4	0.6125	0.6317	0.9695	Private 8	1.0000	1.0000	1.0000
State enterprise 5	0.3792	0.3954	0.9590	Private 9	1.0000	1.0000	1.0000
State enterprise 6	0.3610	0.5027	0.7181	Private 10	1.0000	1.0000	1.0000
State enterprise 7	0.5969	0.6190	0.9643	Private 11	1.0000	1.0000	1.0000
State enterprise 8	0.4435	0.4720	0.9397	Private 12	1.0000	1.0000	1.0000
Government 1	0.4772	1.0000	0.4772	Private 13	1.0000	1.0000	1.0000
Government 2	0.8166	0.8460	0.9653	Private 14	1.0000	1.0000	1.0000
Government 3	0.3012	1.0000	0.3012	Private 15	1.0000	1.0000	1.0000
Government 4	0.8490	0.8753	0.9700	Private 16	1.0000	1.0000	1.0000
Government 5	0.2128	0.3232	0.6585	Mean	0.6704	0.7931	0.8537

least numbers of efficient cooperatives among other types of cooperatives. Both types of cooperatives therefore should be specially ranked in promoting for special efficiency development at top ranks.

When each type of best practiced cooperatives were taken into efficiency co-analysis, it was discovered that almost of the private cooperatives were efficient cooperatives, while other types of cooperatives which were relatively much associated with the civil service existences had very few efficient cooperatives. The future study therefore might further studying whether the cooperatives which were related to the civil service existences affected the cooperative efficiency or not and survey which factors that caused private cooperative to be efficient in order to be applied for other types of cooperatives continually. As shown in Table 5.

CONCLUSION

The analysis on efficiency of SCCs in Thailand was conducted in this research utilizing the DEA technique and the data from the databases of Cooperative Auditing Department, Ministry of Agriculture and Cooperatives of Thailand and conforming the production approach for efficiency measurement of SCCs plans. This study also described the overall technical efficiency and pure technical efficiency and discussed on the results of efficiency score on production model and intermediation model.

According to the analysis result with CCR model, it was discovered that state enterprise cooperatives had maximum numbers of efficient cooperatives up to 47.1% with average efficiency score at 0.9004 or saying that these cooperatives could reduce the input utilization to be remained only at 90.04% from the existing utilizations without effect on output quantities. On the other hand, teacher cooperatives had minimum numbers of efficient cooperatives at only 5.5% with average efficiency score at 0.5994 or saying that these cooperatives could reduce the input utilizations to be remained at only 59.94% from existing utilizations without effect on input quantities. In addition, when considering efficiency score classification according to production model, it was found that the state enterprise cooperatives had 5.9% of maximum numbers of efficient cooperatives, while according to intermediation model, institution of education cooperatives had 15.8% of maximum numbers of efficient cooperatives.

For BBC model, it was discovered that state enterprise cooperatives had maximum numbers of efficient cooperatives up to 58.8% with average score efficiency at 0.9343, or saying that the cooperatives could reduce the input utilizations to be remained at 93.43% only from the existing utilizations without effect on output quantities. On the other hand, private cooperatives had only 11.8% of minimum numbers of efficient cooperatives with average efficiency score at 0.5929, or saying that the cooperatives could reduce the input utilizations to be remained at 59.29% only from the existing utilizations without effect on output quantities. When classifying the efficiency scores according to production model and intermediation model, the finding was that state enterprise cooperatives again had 17.6 and 23.5% of maximum numbers of efficient cooperatives, respectively. Almost types of the cooperatives had return characteristics in term of Decreasing Return to Scale (DRS) and only state enterprise and public health cooperatives that most of these cooperative numbers had return in term of Increasing Return to Scale (IRS).

The suggestions from this study were that any types of cooperatives with many efficient cooperatives or called as best practices, it should be best practiced cooperatives that were the coaches to assist for development of ineffective cooperatives. Any types of cooperatives with few numbers of best practiced cooperatives, the government sector should be involved in providing special aids to develop the inefficient cooperatives. In addition, it has been possible for future studies whether the association of the cooperatives with civil service existence affected the cooperative efficiency or not. According to the analysis result in the combination of all types of efficient cooperatives, it was found that private cooperatives had numerous numbers of efficient cooperatives or best practiced cooperatives, the survey should be performed by employing any factors making the cooperatives effective to be determined as efficiency development method for other types of cooperatives continually.

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