MEASURING PERFORMANCE OF THAI CREDIT UNION COOPERATIVES USING SLACKS-BASED MEASURE OF EFFICIENCY

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Abstract - The first cooperative of Thailand was established in 1916 under the main objective to be the source of funds for the cooperative members. In August 2005, credit union cooperatives were separated from savings and credit cooperatives and classified as a new type of cooperative in Thailand. Since then, business transaction of credit union cooperatives grew significantly, and its volume of business transaction was ranking third after the saving cooperative and agricultural cooperative. The aim of this research is to find an appropriate benchmark model by proposing non-parametric efficient frontier approach called Data Envelopment Analysis (DEA) as an alternative method to evaluate the performance of credit union cooperatives in Thailand. Additionally, the sources of inefficiency in the Credit union cooperatives and potential improvements will be investigated. The financial data of 50 large credit union cooperatives during 2013 to2017 were collected from the databases of Cooperative Auditing Department, Ministry of Agriculture and Cooperatives of Thailand. The slacks-based measure model comprise of 2 inputs and 3 outputs, according to production approach, were used to estimate technical efficiency. The primary results show that performance of the credit union cooperatives constantly declined from80.94percent in 2013 to 63.83 percent in 2017,on average.The major output slacks that should be concerned is shortage of deposit, which was increasing over the period of study. This may cause by a panic of the Klongchan credit union cooperative collapse. Then, depositors moved their funds to commercial banks, which were guaranteed by Deposit Protection Agency. The results are comparable to literature, which shows a deterioration of the credit union cooperative efficiency over the last decade. This may raise attention from both policy makers, and regulators to look after the credit union system seriously.

Keyword - Credit Union Cooperative, Data Envelopment Analysis, Performance Measurement, Slacks

I. INTRODUCTION

The first cooperative of Thailand was established in 1916 under the main objective to be the source of funds for the cooperative members. The Wat Chan Cooperative Unlimited Liability, was the first cooperative established by the government in a small village of Phitsanulok province, with a main purpose, to help severely indebted farmers. This, later on, resulted in the expansion of a large number of small village credit cooperatives in all parts of the country.During the settlement era, there were six types of cooperatives in Thailand: agricultural cooperatives, fisheries cooperatives, land settlement cooperatives, consumer cooperatives, service cooperatives and savings and credit cooperatives (which includes credit union cooperatives). Nearly a half century after the first Thai cooperative was founded, the first credit union cooperative in Thailand was organised on July 25, 1965 by 13 pioneers with initial saving 360 baht; its name was "Soon KlangThewa Credit Union". In 1968 the Catholic Council for Thailand Development, a credit union organising and extension supporter, established the Committee of Credit Union in Thailand to respond to all credit union promotion.

In August 2005, credit union cooperatives were separated from savings and credit cooperatives and classified as a new type of cooperative in Thailand. Since then, business transaction of credit union cooperatives grew significantly from 10,175.08 million THB (Thai Baht) in 2006 to 33,190.58 million THB in 2015, and an annual growth rate exceeded 20 percent [1]. Its volume of business transaction was ranking third after the saving cooperative and agricultural cooperative. At the end of 2017, there are 568 credit union cooperatives in Thailand. However, Aswaruangpipop and Suwannamek[1] showed that efficiency of credit union cooperatives was gradually decreasing from 2010 to 2014, and high interest expense was needed to be seriously reduced. In fact, the problems of the Klongchan credit union cooperative during 2013-2015 severely shacked confidence of Thai cooperative system. Questions that “Is the rapid growth of credit union cooperatives turns down?”, and “Does the performance of credit union cooperatives are deteriorating?” were flashed to public interests. Thus, this study is aimed to analyse the efficiency of credit union cooperatives in Thailand during 2013-2017 by employing an alternative model of data envelopment analysis (DEA) method so called slacks-based measure of efficiency.

II. LITERATURE REVIEW

In the 1990s, the research focus to X-efficiency, which estimates deviations in performance from that of best practice firms on the efficient frontier, holding constant a number of exogenous market factors such

as the prices faced in local markets [2-5]. Traditionally, estimated efficiency indicators are based on the alternative use of production, cost, or profit frontiers. Berger and Mester[3] assert that these different concepts of efficiency used in financial intermediaries' literature are one of the sources of variation in measured efficiency. The frontier can be defined in each case, for a set of observations, assuming that it is not possible to find any other observation above the frontier (in the case of the production and profit frontiers) or below it (in the case of cost frontier). Which concept should be used depends on the question being considered. For example, Berger, Hunter, and Timme[6] mentioned that, on average, banks' cost in their U.S. based study were about 20% above the efficient frontier. This means that a bank, on average, has costs around 20% more than a 'best-practice' bank producing the same outputs. Most of the sources of the inefficiencies are caused by inappropriate operations, such as excessive use of labour in branch offices, and financial inefficiency, such as excessive interest paid for funds. Pastor, Perez, and Quesda[7] give the definition of the production frontier as "the maximum attainable level of output, given a level of input, or the minimum level of inputs required to produce a given output." Alternatively, the cost (profit) frontier is associated with the minimum (maximum) level of costs (profits) that can be obtained given a set of output quantities and input prices. The use of cost frontiers makes possible the study of the bank efficiency in both its technical and allocative components. In the case of cost frontier, the knowledge of input prices is necessary, whereas in the case of the profit frontier, both input and output prices are needed. DEA, a non-parametric frontier method, evaluates actual observed performance based on multiple inputs and multiple outputs simultaneously and identifies efficient versus inefficient decision units. It is also a benchmarking technique that determines potential improvements for the inefficient units' inputs and outputs. The technique measures how well a decision unit performs with respect to its best reference set of decision units on a Pareto-efficient frontier line. The frontier designates the performance of efficient units and measures the efficiency of other decision units by deviations from it. The extent of the deviation represents the degree of inefficiency and the potential improvements for the inputs and outputs. Thus there exists a fundamental difference between statistical approaches via regression analysis and DEA. The former reflects average or central tendency behaviour of decision units while the latter deals with best performance and evaluates all performances by deviations from the efficient frontier line. Few studies have been conducted on the efficiencies of credit union cooperative or microfinance institution and most of them were the studies of banking efficiencies applying the financial ratios as crucial variables in efficiency measurement [8, 9]. With regard to this query, Gutierrez-Nieto, Serrano-Cinca, and Marr[8] said that the measurement of microfinance institution efficiency should not utilise the same variables in efficiency evaluations as the banks. The studies such as Haq,Skully, and Pathan[9] and Othman, Mansor, and Kari [10] evaluated microcredit performance without use of financial ratios. Othman, Mansor, and Kari [10] applied the turnover, profit, members, assets and share equity to evaluate the efficiency of cooperatives in Malaysia. In addition, the study of Gutierrez-Nieto, Serrano-Cinca, and Marr[8]employed 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.

Some studies used DEA to investigate the efficiencies of the savings and credit cooperative or microfinance. According to Fukuyama,Guerra, and Weber[11], the credit cooperatives in Japan were evaluated by DEA on their entire efficiency and productivity growth during 1992-1996. The finding of their paper indicated that the foreign-owned cooperatives had more efficiency scores and greater productivity growth during the evaluated period.Gutierrez-Nieto, Serrano-Cinca, and Marr[8]applied DEA to measure efficiency of 30 Latin American MFIs using two inputs and three outputs that were covered according to intermediation and production models. 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,Skully, and Pathan[9]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. The main 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. Syamni and Abd. Majid [12]studied relative efficiency of saving and credit cooperative units in North Aceh, Indonesia.Data Envelopment Analysis was selected using the intermediation approach. The results showed that the overall saving and credit cooperative units in North Aceh, Indonesia have not operated fully efficient.

III. METHODOLOGY AND DATA

To answer the research questions, this study applied non-parametric efficient frontier approach to analyse the data. 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 the first 50

largest credit union cooperatives of Thailand during 2013 to 2017. The sample were categorised into 7 groupsaccording to geographical area of the sample, namely, North, Northeast, East, Central, West, South, and Bangkok area.

The methodology started with a non-parametric frontier approach to measure technical efficiencies. Then, mean efficiency scores were analysed to test the proposed hypothesis. Data Envelopment Analysis, introduced by Charnes, Cooper, and Rhodes [13], is a linear programming technique where the set of best-practice or frontier observations are those for which no other decision making unit (DMU) or linear combination of units has as much or more of every output or as little or less of every input. This is known as the Pareto-Koopmans efficiency. The DEA frontier is formed as the piecewise linear combinations that connect the set of these best-practice observations, yielding a convex production possibilities set. Therefore, DEA does not require the explicit specification of the form of the underlying production relationship. However, a key drawback of DEA is that it assumes no random error. That is, DEA assumes there is no measurement error in constructing the frontier, and no luck that temporarily gives a decision making unit better measured performance over other units. Any of these potential errors that appear in a unit's data may be reflected as a change in its measured efficiency. DEA may be cast in either an output-maximising (e.g. profit maximisation) or an input-minimising (e.g. cost minimisation) role.

There are two widely used DEA models. The first, developed by Charnes, Cooper, and Rhodes [13]assumes constant returns to scale (CRS). The second, developed by Banker, Charnes, and Cooper [14] assumes variable returns to scale (VRS). These models are respectively known as the CCR and BCC models. Therefore, the CCR model was used to construct a set of best-practice or frontier observations to evaluate technical efficiency (TE).Then, the BCC model was selected as its ability to estimate pure technical efficiency (PTE), and scale efficiency (SE) in an imperfect competition.The traditional DEA models mentioned earlier measure only technical efficiency in a scalar measure (θ*). Since θ* accounts for the proportionate change (radial) in input/output values, but neglects the existence of non-radial inefficiencies, a DMU may have the full efficiency score of 1 following the BCC model, although it has input excesses or output shortage. Also, the common models required all inputs and outputs to be non-negative, hence they may not suitable for measuring operators that generate negative outputs, such as loss from operations. To overcome this issue, Tone [15] proposes a slacks-based measure (SBM), which identifies non-radial inefficiency in the scalar measure known as ρ shown in (1).

$$\min \rho_{in} = 1 - \frac{1}{N}\sum_{i=1}^{N} \mathbf{s}_i^- / \mathbf{x}_i^o$$

$$\begin{aligned} \text{subject to } & \mathbf{x}^o = \mathbf{X}\boldsymbol{\lambda} + \mathbf{s}^-, \\ & \mathbf{y}^o = \mathbf{Y}\boldsymbol{\lambda} - \mathbf{s}^+, \\ & \sum_{j=1}^{I} \boldsymbol{\lambda}_j = 1, \\ & \boldsymbol{\lambda} \geq 0, \\ & \mathbf{s}^- \geq 0, \\ & \mathbf{s}^+ \geq 0 \end{aligned} \qquad (1)$$

wherexis a DMU's N x 1 vector of inputs, y is a DMU's M x 1 vector of outputs, $\mathbf{s}^-$ and $\mathbf{s}^+$ are vectors of input and output slacks, respectively, and Xλ and Yλrepresent benchmark input consumption and output production. Inputs and outputs for the unit evaluated are indicated by the superscript 'o' and the linear program is solved once for each unit in the sample. The term $\sum_{j=1}^{I} \boldsymbol{\lambda}_j = 1$ is the constraint to invoke variable returns to scale. A DMU is evaluated as efficient if the optimal value for the objective function equals one ($\rho^* = 1$). That is, the efficient DMU will have zero input slacks.Besides the ability to identify slacks, another advantage of the SBM model is that it does not have to be oriented (input orientation and output orientation). Therefore, it can combine two orientations together to deal with the reduction in inputs and the expansion in outputs at the same time; such a measure of SBM is called non-oriented. Also, this model does not suffer from the infeasibility of linear programming solutions from negative inputs or outputs. Therefore, the non-oriented slacks-based measure (SBM) was selected to this study. In the design of an efficiency model, the choice of variables needs to be justified.Modelling the production function of financial institutions, which have multiple services and products, raises a long-standing debate on the definition of the inputs and outputs of banks. There are two main schools of thought on bank behaviour, which have been widely used in the banking literature. The first is the intermediation approach, which views a bank as a mediator of funds between depositors and investors [16]. Following this concept, deposits, labour and physical capital are regarded as inputs being converted into loans. The second is the production approach, which emphasises the role of banks as providers of services for account holders. With this view, banks are regarded as using inputs such as labour and capital to generate deposits and loans.

While the production approach is probably better able to evaluate the efficiency of bank branches, the intermediation approach may be better for the evaluation of large banks in their entirety [17]. Since the main objectives of the credit union cooperatives

are to promote savings, and provide a source of funds for their members, the combination of two inputs and three outputs based on production model were selected as follows: (I1)Total Expenses, (I2)External Debt, (O1) Deposits, (O2) Loans, and (O3) Net Income.

IV. RESULTS AND DISCUSSIONS

Originally, the technical efficiency estimated from the SBMshows that, on average, technical efficiency of the credit union cooperatives was decreasing during the five-year window, from 80.94percent in 2013 to 63.83 percent in 2017. This suggests that the failure of Klongchan credit union cooperative which started in 2013 may increasingly impactperformance of the credit union cooperatives overtime. On average, the cooperatives should improve their operation by nearly 40% to become an efficient unit, which required serious efforts. Also, the figures in Table 1 shows the minimum efficiency scores those nearly zero, that raise another concern for policy maker and regulator. It may imply that, even though they are all large cooperatives in the sample, one may operate in different way, which should be monitored carefully.

Efficiency Scores	2013	2014	2015	2016	2017
Average	0.8094	0.7877	0.7560	0.7276	0.6383
Max	1.0000	1.0000	1.0000	1.0000	1.0000
Min	0.0180	0.1099	0.0008	0.0072	0.0214
S.D.	0.2188	0.2292	0.2729	0.2809	0.2994

Table I Average technical efficiency of credit union cooperatives

The Average inputs and output slacks shown in Table II also suggests sources of inefficiency in the Credit union cooperatives operations. The major output slacks that should be concerned is a lack of deposit, which was increasing over the period of study. This may cause by a panic of the Klongchan credit union cooperative collapse. Then, depositors moved their funds to commercial banks, which were guaranteed by Deposit Protection Agency.

Slacks	2013	2014	2015	2016	2017
Total Expense	881	3,986	18,528	5,930	2,350
Debt	16,317	11,265	2,932	11,055	4,483
Capital	16,300	21,930	24,485	26,941	10,300
Deposit	67,014	76,657	87,015	135,812	162,475
Loans	28,157	39,877	41,190	28,816	39,428
Profit	442	362	13,037	3,240	5,893

Table IIAverage input and output slacksduring 2013-2017

Unit: Thousand Baht

Figures in Table IIIshow average efficiency scores by regions. The cooperatives in all regions experienced deterioration in efficiency over the period of study. The cooperatives in urban areas, such as Bangkok metropolitan, and eastern provinces of Thailand, where economic activities were high, were operated in a higher level of efficiency than that of in other parts of the country. In the northeast region, the efficiency of credit union cooperatives, on average, dropped dramatically by 15% for two consecutive years. In addition, during the five years of the study, the average efficiency of the cooperatives in all regions, except Bangkok area, continually declined from 12- 25%. This may due to differences in information flow, and knowledge of the cooperative members in the countryside.

Regions	2013	2014	2015	2016	2017
North	0.8272	0.6605	0.5296	0.5635	0.4862
Northeast	0.8133	0.6851	0.6025	0.5700	0.5284
East	0.8412	0.8340	0.8453	0.8559	0.7372
Central	0.7247	0.8556	0.6886	0.6854	0.6017
West	0.8103	0.8064	0.8125	0.7386	0.6347
South	0.8359	0.7487	0.8393	0.7350	0.6621
Bangkok	0.8279	0.8304	0.9389	0.9310	0.8371
Overall	0.8094	0.7877	0.7560	0.7276	0.6383

Table IIIAverage efficiency of credit union cooperatives by regions

Although the efficiency scores in this study is lower than that in aforementioned study, due to an ability to capture non-radial slacks, the results of this study are comparable to literature [1], which shows deterioration of the credit union cooperative efficiency over the last decade. This may raise attention from both policy makers and regulators to look after the credit union system seriously.

V. CONCLUSIONS

The analysis on efficiency of credit union cooperatives in Thailand was conducted in this research utilising the DEA technique, called SBM. The results may come to a conclusion that a high growth rate, which exceeded 20 percent, of credit union cooperatives in during the last decade, was not generated by their efficiency themselves. But the whole system was dominated by few large cooperatives, which expanded abnormally. The evidence in this study may send a signal to the regulator to monitor the cooperative system closely, not only using the common financial ratios, but also performance evaluating, regularly.

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