Research in Reform Efficiency of Rural Credit Cooperatives Based on the Dual-goal

Shuming Ren, Hong Diao, Hongjing Wang, Min Gao
Department of Economics
Dalian University of Technology
Dalian, P. R. China
smren@dlut.edu.cn

Abstract—This paper constructs efficiency of evaluation index system to estimate the technique efficiency, pure technical efficiency and allocative efficiency in samples of rural credit cooperatives (RCCs). It is based on dual goals that develop for itself and service on the “Three Rural Issues” in reform of RCCs by using the CRS and VRS models in the data envelopment analysis (DEA) methodology. By a comparison between the efficiency values, slack variables on outputs and inputs before and after the reform, this article reveals that reform does not make a difference on the improvement of efficiency on RCCs unless to reduce net value of fixed assets and strengthen the efforts in supporting agriculture. The innovations and characteristics are as follows, the first is that the agricultural loans, as an output factor to represent the influence of agriculture supporting, is added to evaluation index system in efficiency, which reflect favorable the implement of dual-target in the reform of RCCs. The second is to make a province as a group to estimate efficiency so as to indicate the overall achievements by reform around the whole province and the effect of increasing the efficiency of RCCs by establishing the provincial cooperatives as a significant measure in the reform. The third is that by comparison between slack variables on outputs and inputs, theoretical references have been provided for the further reform in RCCs quantificationally.

Keywords-RCCs; Reform; The efficiency evaluation; DEA; supporting role of agriculture

In fact, the central government accelerated the pace of the third reform hoping to to improve RCCs’ efficiency and strengthen the force of service on the “Three Rural Issues”.

Thus, whether the reform has achieved as expected since 2003? Does it fulfill its promise? Views differ because of different methods of assessing effects in reform measures on RCCs.

Some scholars put qualitative analysis on the effect of reform, and representatives are as follows. Baojin Chu, Enjiang Cheng and Yuebo Bian (2004) dissect the main content of RCCs reform in Jiangsu Province, and claim that reform can not be regarded as a realistic choice proceed from the reality, but some problems which still exist on the project design and implement of reform need to be solved. Shusong Ba, Wenjie Lin and Ping Yuan (2007) analyze the abuse of cooperatives system which is widely used on reform of RCCs, and deem that it has accelerated the pace of outflow of rural funds, broken down the incentive mechanism, and intervened in independent management of RCCs. Xiang An (2007) analyzes the cost, the performance and the success by stages since reform, and thinks the insiders control has not been solved, and the government’ paying does not worth the perfect system.

However, such subjective analysis which is hard to avoid mix of individual preference cannot reflect the effect of reform objectively and accurately. Hence, some other scholars collect data by field survey to analyze the reform performance on RCCs quantificationally. Ping Xie, Zhong Xu and Minggao Shen (2006) argue that reform does not bring about the capacity increasing on RCCs by questionnaire survey on RCCs among counties. Lei Song and Jiachuan Wang (2007) put survey on RCCs governed by Shandong Province through questionnaire combining with informal discussions, deem that lots of content is becoming a mere formality in property right reform, so construction inside should be strengthened.

The main problem in questionnaire method is uncontrollable factors existing during the implementation process, such as whether participants fill in the form seriously and personally or not; whether they are familiar with the survey problems; whether the orders of difficulty can reflect the research content. In order to overcome these drawbacks, some scholars evaluate the performance of reform by comparing the variation of efficiency before and after reform in RCCs. Baojin Chu, Lan Zhang and Juan Wang (2007) conduct overall merit

Supported by Research Fund for the Doctoral Program in Liaoning Province and the Fundamental Research Funds for the Central Universities

978-1-4244-6581-1/11/$26.00 ©2011 IEEE
on the operation during the reform period on RCCs using the data envelopment analysis (DEA) method in Northern Suzhou; and conclude that the RCCs’ efficiency has been increased after the reform[9]. Daoqi Qin and Xingfa Li (2009) assess and analyze the reform performance on China’s RCCs empirically using DEA multistage method, and think that its capacity has been strengthened under reform[10]. Efficiency measures overall resource allocation to economic entity[6], and by comparing the variation of efficiency before and after reform, the achievements of reform have been reflected, which means it can reflect current situation objectively and generally by using reliable data.

This article estimates efficiency of RCCs in DEA method to evaluate the performance of reform and put forward further suggestion based on reckoning by comparing the variation of efficiency in RCCs before and after the reform.

Differing from the lately research, this article considers the dual-target of reform in RCCs’ self-construction and service on the “Three Rural Issues”, which characterized by the achieving sustainable development in finance of RCCs; the second is to boost the pace of service on the “Three Rural Issues”; in turn, a RCC is not of efficient which is of finance persistent without achieving the goal of service on “Three Rural Issues”; in turn, a RCC is not of efficient also when it is not of finance persistent but has done the service target well; only if self-construction and service on the “Three Rural Issues” have been taken into account, the RCCs is of high efficiency. Based on the fundamental of efficiency evaluation system, this paper regards the bank as a producer service on deposit accounts and slack variables corresponding to input-output factors to get the original values.

II. EFFICIENCY EVALUATION MODEL AND INDEX SELECTION OF RCCS UNDER THE DUAL-GOAL

A. DEA model

This paper estimates the technique efficiency of RCCs using DEA method, and assumes there are n DMUs, each DMU has m kinds of inputs and s kinds of outputs, for the j-th DMU these are represented by the vectors $x_j$ and $y_j$ respectively, $x_j = (x_{1j}, x_{2j}, \ldots, x_{mj})^T, y_j = (y_{1j}, y_{2j}, \ldots, y_{sj})^T, j = 1, 2, \ldots, n$. When set the input and output of $DMU_0$ for $(x_0, y_0)$, formula (1) assesses the relative effectiveness of $DMU_0$ in CCR model under the constant returns to scale.

In the model of CRS, $v = (v_1, v_2, \ldots, v_m )^T$ and $u = (u_1, u_2, \ldots, u_o )^T$ are the m kinds of inputs and s kinds of outputs weight coefficient respectively. The technique efficiency (TE) is the value using the CRS model under the assumed condition that constant returns to scale, which means enterprises can acquire the maximum output capacity under the constant input. However in practical application, not every bank can operate under the optimal scale. For solving the condition of variable returns to scale, Banker, Charnes and Cooper (1984) dualize the CRS model and add convexity hypothesis then expand it to VRS model (2)[9]. In VRS model, $\lambda$ is an N*1 vector of constants, $\lambda = [\lambda_1, \lambda_2, \ldots, \lambda_N]^T$. The calculated $\delta$ is the pure technique efficiency (PTE) of $DMU_o$. PTE measures the distance between enterprise observed and production frontier when returns to scale is inconstant, using $TE = PTE * SE$ to figure out the scale efficiency (SE), which means expansion of output and scale in production result in the unit cost of production declining[10].

\[
\begin{align*}
\max & \quad \frac{u^T y}{v^T x} \\
\text{s.t.} & \quad \frac{u^T y_j}{v^T x_j} \leq 1 \\
& \quad u \geq 0, v \geq 0
\end{align*}
\]

\[
\begin{align*}
\min & \quad \delta \\
\text{s.t.} & \quad \sum_{j=1}^{n} x_j \lambda_j + s^- = 0 x_j \\
& \quad \sum_{j=1}^{n} y_j \lambda_j - s^+ = y_0 \\
& \quad \sum_{j=1}^{n} \lambda_j = 1 \\
& \quad \lambda_j \geq 0, j = 1, 2, \ldots, n, \theta \in E^n
\end{align*}
\]

B. building up the input-output index system

The key point to DEA method is to select the input-output index correctly. The choosing methods about output-input index of bank include production, intermediary and assets methods on recently research, differing form the different understandings on bank’s functionary: production method regards the bank as a producer service on deposit accounts and loans, that is to say the output of bank is the amount of deposit accounts but not the number of deposit and loans money. The bank’ input is mainly asset and labor which data is unavailable about the economic entity of whole industry; the bank is also deemed as financial tertium quid, and the output is defined as the assets in statement of assets and liabilities, including the amount of money in loans and security. The deposit, as debt, is not reckoned in the output[11].

Combining this dual-goal, the market positioning and reform in the article, the input-output index system has been built up in this article. Previous reform stresses that reform of
RCCs should take the service on the “Three Rural Issues” as the main aim, hence RCCs should be the financial intermediaries servicing on the “Three Rural Issues”. Accordingly, this paper selects input-output factors referring to intermediary. The daily input of RCCs includes real capital, human capital and cost on business, and this paper uses net value of fixed assets (x1), number of staff (x2) and cost on business (x3) as elements of input; the cash inflow can show the goal of achieving the self-construction, thus the business income (y1) is the output element measuring self-construction; the effect of servicing on the “Three Rural Issues” is measured by the agriculture loan (y2).

III. THE EFFICIENCY CHANGE OF RCCS BEFORE AND AFTER THE REFORM

A. sample selection

This paper investigates RCC as a DMU up to 18 units of Shandong and Henan Province in an inspected period from 1999 to 2007. The related data comes from the Shandong Finance Statistics (SFS), Henan Finance Statistics (HFS), Shandong Statistical Yearbook (SSY), and Henan Statistical Yearbook (HSY). Choosing these samples because that:

Firstly, the two provinces can reflect that whether the serving agriculture has achieved or not. Henan and Shandong are the entire agricultural big province, the ratio of agricultural population is huge, by 2007, the total population in Shandong Province is 93,450,000, and the agricultural population is 59,090,000, accounting for 63.23% of total population. The total population in Henan Province is 103,630,000, and the agricultural population is 81,220,000, accounting for 78.38% of total population. The reform of RCCs will make a great difference on development of rural economy in these provinces.

Secondly, the two provinces are of typical. The leaders of the first and second selected units for experiments in RCCs’ reform are Shandong and Henan respectively. The local government pays a great attention on the reform, putting the reform measures’ into practice.

Thirdly, the sample credit cooperatives have been in reform since 2003 and 2004, before the reform, the cooperatives in two provinces are similar in the level of scale and profitability and very alike in the measures and stages of reform, samples of data from 1999 to 2007 of the two provinces are full of comparability and sense of reality. Moreover, this reform act unit as province. The provincial data can reflect the total achievement of reform, and also show the effect of building the provincial cooperative indirectly.

Finally, most data of RCCs is private. The selected data has the integrity when considering the availability. The first to pilot reform is Jiangsu Province, but its data is not complete, so the data in Shandong and Henan Province are as samples.

B. result analyze

This paper uses DEAP Version 2.1 software to calculate, get every DMU’ TE, PTE and SE, and protracts Fig. 1.

From Fig. 1 and 2, the value of technical efficiency goes steadily upward in samples of RCCs. The curve is consisted of annually value of technical efficiency in two provinces on the Fig. 1 and 2. We know well that the slope of every two attachment change is not obviously around the reform. Comparing with the reform preceding, no change in the absolute value of slope of curve is noted after the reform, which means the ascensional range of efficiency value is not improved after the reform. Only in 2003 when Shandong Province started to come into effect in reform, the efficiency increased substantially and temporarily. Because of attention from all around in the start of reform, the input cut short by a large margin and appraisal of the fixed assets and the circulating funds, the temporary increase arise. From the resolve angle in TE, the PTE and SE change are not stable, and the amplitude of variation about the slope of related curve does not act regularly, as Fig. 1 and 2 shown. In the equation TE = PTE * SE, they are combined to affect the variation of TE, and reform does not make the PTE and SE remain stable upward. In other words, without reform, the RCC can achieve the efficiency level like 2007 when it operates in increment speed and style as the reform proceeding. It is clear that reform has not accelerated the pace of efficiency promoting.

One of the most significant measures in reform is to build up the provincial cooperative, which can manage, guide, coordinate and service on the RCCs and enhance the power of sustainable development and service on the “Three Rural Issues”. For that reason, this article chooses the provincial data as samples to inspect whether building up the provincial cooperative can promote the efficiency on RCCs indirectly. However, from the reckoning on the Fig. 1 and 2, reform does not make a great difference on promoting the overall efficiency of RCCs, which reflects that provincial cooperatives’ found has not achieved the expect goal indirectly, but this does not rule
out that reform measure promotes the efficiency of some RCCs.

<table>
<thead>
<tr>
<th>DMU</th>
<th><strong>s₁</strong></th>
<th><strong>s₂</strong></th>
<th><strong>s₃</strong></th>
<th><strong>s₄</strong></th>
<th><strong>s₅</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>DMU₁</td>
<td>144143</td>
<td>0</td>
<td>67610</td>
<td>0</td>
<td>1790299</td>
</tr>
<tr>
<td>DMU₂</td>
<td>223291</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1006980</td>
</tr>
<tr>
<td>DMU₃</td>
<td>236222</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1267967</td>
</tr>
<tr>
<td>DMU₄</td>
<td>234168</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>922397</td>
</tr>
<tr>
<td>DMU₅</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>DMU₆</td>
<td>234232</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>405635</td>
</tr>
<tr>
<td>DMU₇</td>
<td>129602</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1548840</td>
</tr>
<tr>
<td>DMU₈</td>
<td>86783</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>174345</td>
</tr>
<tr>
<td>DMU₉</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>DMU₁₀</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>DMU₁₁</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4314</td>
</tr>
<tr>
<td>DMU₁₂</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>452444</td>
</tr>
<tr>
<td>DMU₁₃</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1150863</td>
</tr>
<tr>
<td>DMU₁₄</td>
<td>13618</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>448512</td>
</tr>
<tr>
<td>DMU₁₅</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>DMU₁₆</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>112447</td>
</tr>
<tr>
<td>DMU₁₇</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>DMU₁₈</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

If the inefficient DMU is changed into relatively efficient, the input index should be reduced accordingly, the computational formula is \( \bar{x} = \delta x - s \), \( \bar{x} \) is the theoretical value achieved by an input factor of a DMU, while \( \delta \) is the value of PTE related to DMU. \( x \) is the actual value of input factor for this DMU, and \( s \) is the calculated slack variable; All output index should be increased accordingly, and the formula is \( \bar{y} = y + s \). \( \bar{y} \) is the theoretical value achieved by an output factor of a DMU, \( y \) is the actual value of output factor for this DMU, \( s \) is the calculated slack variable. The slack variable is number of input factor increased or output factor decreased when the weak DEA efficient points on the efficiency leading edge reach to efficient one. According to previous formulas we can calculate the ratio of input-output element when compared with the samples of PTE is 1.0 in DMU, and the theoretical original value of every input-output factor when the PTE of other DMUs reach to efficiency. The Tab. I is the slack variable of input-output factors calculated by VRS model under the variable returns to scale.

According to the results, the slack variable of net value of fixed assets is quite large in every DMU relating to input factor; the slack variable of agriculture loans representing service on agriculture is huge within the output factor. That is to say, under the variable returns to scale, the net value of fixed assets should be cut short while every input factor is reduced in same proportion in inefficient DMU; the output of agriculture loans which represent service on agriculture should be promoted in all output factors.

IV. CONCLUSIONS

This paper investigates the operational aspects of RCCs in Shandong and Henan Province from 1999 to 2007, based on the dual target: self-construction and service on the “Three Rural Issues” with provincial data as a unit. Comparing the TE, PTE and SE around the reform in these provinces, it shows that establishment of provincial cooperative does not make a great difference on promoting the overall efficiency in RCCs, and reform does not play an important role in improving the efficiency for RCCs. Through the calculation to value of efficiency in every DMU and slack variable relating to every input-output factor, this paper reveals that every input-output factor should be reached to theoretical original value, net value of fixed assets should be cut short, and the power of service on agriculture should be enhanced if RCCs can achieve its dual-target better. It also provides the theoretical reference for deepen the reform of RCCs quantitatively.

REFERENCES
