Technical Efficiency of Rural Micro and Community Enterprises in the Upper North of Thailand†

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Abstract

After economic crisis in 1997, the Thai government reconsidered the rural sector as a sector to absorb urban unemployed laborers on their returning home. Several policies and measure were realized for economic recovery based on the grass-root economy concept. To restore employment, production of micro, small and medium enterprises (MISMEs) as well as rural community ones was targeted. However, as an economic sub-sector, rural micro and community enterprises were found to still have quite low potential for a self-reliant and sustainable development. Therefore, the issue of productivity and production efficiency of rural micro and community enterprises should be discerned to identify their potentials. To investigate efficiency of the rural micro and community enterprises, the nonparametric data envelopment analysis (DEA) is used to evaluate their technical efficiency in this paper. In addition, this technique is applied to survey data collected from 61 rural micro and community enterprises including 15 cottage food, 17 wickerwork product and 29 woven

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fabric enterprises in the Upper North of Thailand from two points in time, 2002 and 2004. The empirical results showed that the overall technical inefficiency could be reduced by 56, 63 and 66 per cent for cottage food, wickerwork products and woven fabric by operating at optimal scales and by reducing pure technical inefficiency by 36, 56 and 52 per cent through the use of the best practices. In addition, individual products items analysis indicated that most of products were produced in the region of increasing returns to scale. They were 57 per cent for cottage food products, 66 per cent for wickerwork products and 54 per cent for woven fabric. Therefore, these product items could increase their technical efficiency by continuing to increase their size. The results of tobit model using to identify the sources of technical inefficiencies of rural micro and community enterprises indicated that the number of operating years of the enterprises and dummy variable for cottage food products were correlated significantly and positively with the technical efficiency of rural micro and community enterprises.

Keywords: grass-roots economy, rural micro and community enterprises, data envelopment analysis.

1. Introduction

During the 1980’s – 1990’s, Thailand has achieved and impressive economic growth with an average annual growth rate of 7.8 per cent of its Gross Domestic Production (GDP) per year. The remarkable economic growth was a result of the increasing contribution of the non-agricultural sector, with the agricultural sector declining significantly in terms of its share in GDP (from 30 per cent in 1967 to 10 per cent in 2003, Office of Agricultural Economics, 2005). As a consequence of non-agricultural employment, the off-farm income contributed

60 per cent to the farm household income, of which simply processed farm produces and cottage activities share a substantial part (Wiboonpongse and Sriboonchitta, 2005). Even though handicrafts and cottage foods were parts of life for their cash income and rural employment creation, this economic sub-sector was not considered for its important role. After 1997, when Thailand was hit by the financial crisis, the number of unemployed labour force has risen from 0.50 million to 1.42 million people in 2000 (Office of National Economic and Social Development Board, 2003) as a result of the labour layoff in manufacturing and service sector. The government policy then was readdressed to the rural sector to absorb urban unemployed laborers on their returning home. Several policies and measures were realized for economic recovery based on the grass-root economy concept. To restore employment, production of small and medium enterprises was aimed, as well as rural community enterprises (Wiboonpongse and Sriboonchitta, 2005).

The rural micro and community enterprises have played a key role in driving community economy in terms of labour force absorption, and utilization of local resources and farm produces. Expansion of the community enterprises due to government promotion policy led the grass-root economy to an increased competition among enterprises within the economy and with the private sector. So far, rural micro and community enterprises were found to still have quite low potential for self-reliant and sustainable development (Wiboonpongse, Sriboonchitta and Theerakul, 2005; Panthasein et al, 2002). Among others, productivity and efficiency are underlying economic factors for sustainability (Conway, 1988) Therefore, the issue of efficiency of the production of the rural micro and community enterprises should be considered to identify the economic potential of these enterprises.

The recent reviews (Thammaratana, 2004; Sriboonchitta et al. 2003) showed that most studies on rural community enterprises in Thailand focus on technology and quality (and food safety) improvement and to lesser extent on social aspect of community groups. The business operation and performance using financial ratio and SWOT analysis were used only intensively by Sriboonchitta et al. (2003) and Wiboonpongse, Sriboonchitta and Theerakul (2005). Previous studies on efficiency of rural community enterprises were very limited. Therefore, this paper seems to be one among the pioneers that consider efficiency measure in this grass-root economy of Thailand.

The objective of this paper is to construct non-parametric production frontiers of the rural micro and community enterprises, comprising cottage food, wickerwork product and woven fabric using data envelopment analysis (DEA) and then use them to produce a range of technical efficiency measures using the tobit model. Such a study has the ability to highlight substantial potentials of individual rural micro and community enterprises and the community economy sector.

This paper is set out as followed: Section 2 offers a brief overview of the rural micro and community enterprises in the North of Thailand. Section 3 provides theoretical framework. Section 4 presents data on rural community enterprises, model specifications and findings. The last section presents summary and conclusions of the study.

2. A Brief overview of the rural micro and community enterprises in northern Thailand

During the late 1980's, the National Social Economic Development Plan had been extended towards diversification of economic activities including non-agricultural activities such as handicrafts and agricultural related business. Despite the fact that three leading departments from Ministry of Industry, Ministry of Agriculture and Agricultural Cooperatives and Ministry of Interior Affairs had involved in setting up women's groups and farmers' housewives groups, the community group businesses were not yet strongly emphasized during the late 1980's (Panthasein and Zuzuki, 2003; NESDB, 2005). However, the number of rural enterprises (groups and non-groups) increased gradually but at accelerating rate after Thailand economic crisis (1997). To overcome economic downturn, the Thai government implemented three major schemes to boost up grass-roots economy. These include One Tambon One Product (OTOP) scheme. The objective of the OTOP program is to expand production utilizing local wisdom and resources to serve domestic, and subsequently, overseas markets. In 2001, when the program was launched, 7,000 local products and 3,000 attraction tourist spots were selected and posted on the website for publicity. Presently the number amounted to 49,046 items produced by community and micro enterprises. The value of the products rose from 215 million baht (1 US dollar = 40 baht) to more than 50 billion baht in 2005 (PRD, 2005). Due to the above-mentioned policy, at least 70,000 community group enterprises are expected to involve in the OTOP promotion scheme. An countless number of individual micro enterprises exist and participate in grass-roots economy.

The products of community enterprises (group/non-group) are of two broad categories, food and handicraft. Products vary from region to region basically depending on local raw material availability wisdom and skill. As for northern part of Thailand, especially the Upper North, teak wood, mulberry, bamboo, water hyacyne, wild calaburd (rukam) and cotton are common raw materials for handicrafts and woven fabric. While soy bean, rice, fish, chili, potato, local fruits (especially logan) and other farm produces are more common among group and micro-enterprises, pork is processed mostly by larger individual enterprises as cottage food. Wood products, ceramic/pottery and mulberry paper are famous handicraft of individual enterprises (usually small- and medium-sized) while cotton fabric, wickerwork, cottage food products are mostly made by micro and group enterprises. Accordingly, the size of community enterprise varies by product as well as business organizational types.

To be a registered group (of various names) at least seven individuals are needed to form a group with formal organization structure. The registered group entitles to receiving technical and financial supports (e.g. interest free loan) from government agencies. The most common size of a community group in the Upper North is 26-50 members (accounts for 23 per cent of total samples observed by Wiboonpongse, Sriboonchitta and Theerakul, 2005).

3. Theoretical framework

Data Envelopment Analysis (DEA) deals with the evaluation of the performance of decision making units (DMU) performing a transformation process of several inputs to several outputs. It relies on a technique based on Linear Programming (LP). This provides a measure of efficiency of each DMU thus allowing one to separate efficient DMU from non-efficient DMU and to indicate for each non-efficient DMU its efficient peers (Bouyssou, 1999). The DEA model is used to simultaneously construct the production frontier and obtain the technical efficiency measures. The advantage of DEA is that it easily compares the utilization of very different inputs in the production process and its scores are easily analyzed using standard econometric techniques. DEA has been widely used in measuring performance of firms and also farms. The model presented in this study is for the case of variable returns to scale as developed by Banker, Charnes and Cooper (1984) to eliminate shortcomings of constant returns to scale property. There are a number of factors hypothesized to affect the suitable level of production of decision-making unit such as imperfect competition in the market and financial constraint.

Given N DMU producing M products using K inputs. For the *i*-th firm, input and output vectors are represented by x_i and y_i, respectively. All data are written in terms of K*N as input matrix (x) and M*N as output matrix (y). The DEA model, using the duality in linear programming, for calculation of the technical efficiency is:

$$\begin{aligned} & min_{\theta,\lambda}\ \theta, \\ & subject\ to \qquad -y_i + Y\lambda \geq 0, \\ & \qquad\qquad\qquad \theta x_i - X\lambda \geq 0, \\ & \qquad\qquad\qquad \lambda \geq 0, \end{aligned}$$

Where θ is a scalar and λ is N*1 vector of constants. The value of θ obtained is the efficiency score for the *i*-th firm, It will satisfy: $\theta \leq 1$, with a value of 1 indicating a point on the frontier and hence a perfectly-technically efficient-firm, according to the Farrell (1957) definition. The linear programming must be solved N times to obtain a value of θ for each firm.

The estimation is obtained from the difference between TE values under the constant returns to scale (CRS) assumption where all decision making units operate at their suitable level. Under imperfect competition situation certain DMUs may not be able to operate at the suitable level; and, hence, the variable returns to scale (VRS) assumption will be more realistic and flexible to allow the envelopment of more observed data the case of CRS assumption. Consequently,

$$\text{VRS TE } \left(\theta^{VRS}\right) \geq \text{ CRS TE } \left(\theta^{CRS}\right)$$

and scale efficiency (SE) of DMU$_i$ becomes:

$$SE_i = \frac{\theta_i^{CRS}}{\theta_i^{VRS}}$$

If SE = 1, the industry is operating with CRS. If SE < 1, the industry is operating with increasing or decreasing returns to scale which can be judged (or determined) by analysis under the non-increasing returns to scale assumption.

The analysis of factors determining technical inefficiency proceeds by subtracting the (expected value of) TE values from 1 along the tobit model specification due to limited dependent variables or censored observations from zero (Judge et. al., 1988. p.796).

$$\begin{aligned} y_i \quad &= x_i'\beta + e_i \quad if \quad x_i'\beta + e_i > 0 \\ &= 0 \text{ otherwise} \end{aligned}$$

Where x_i' is 1*k vector of explanatory variables. Analysis is performed by least squares method when observed $y_t > 0$ or

$$E\left[y_i \middle| y_i > 0\right] = x_i'\beta + E\left(e_i \middle| y_i > 0\right)$$

If expected value of $e_i = 0$, least squares regression procedure will provide unbiased estimate. However, if e_i s are independent and characterized as normally distributed random variables, then

$$E\left[e_i \middle| y_i > 0\right] = E\left[e_i \middle| e_i > x_i'\beta\right] > 0$$

Since expected value of e_i is non-negative, the p.d.f values will be asymmetric, and the p.d.f value of truncated normal random variables can be obtained as:

$$f\left(e_i \middle| e_i \geqslant x_i'\beta\right) = \frac{f\left(e_i\right)}{\int_{x_i'\beta}^{\infty} f\,(t)df} \; for\ e_i > x_i'\beta$$

4. Empirical Analysis

4.1 Data on Rural Community Enterprises

The data used in this study came from a survey of rural micro and community enterprises, conducted in the Upper North of Thailand in two periods of time 2002 and 2004. Observations were collected from 61 rural micro and community enterprises comprising 15 cottage food enterprises, 17 wickerwork product enterprises and 29 woven fabric enterprises. From these 61 rural micro and community enterprises, they produced 723 product items of which 53 were cottage food products, 300 wickerwork products and 370 woven fabric products. These data were used in analyzing technical efficiency separately based on the type of products. Sixty one individual technical efficiency scores were obtained from the DEA analysis.

Only survey data in 2004 were applied for cottage food enterprises due to incomplete data in 2002. As for wickerwork products and woven fabric, data in 2002 and 2004 were used. Then the data of both product enterprises were deflated by using general consumer price index in 2002 as based year. The results from the DEA analysis, TE of individual product, were weighted by share of each product selling and integrated to be TEs of individual enterprises which were used in tobit analysis.

A summary of the data for the different variables, in the DEA analysis and tobit model in three types of enterprises were presented in Table 1. The summary statistics were presented for separate enterprises, including 15 cottage food enterprises, 17 wickerwork product enterprises and 29 woven fabric enterprises. The average output price and average input value were different in all types of enterprises. The woven fabric enterprise has the highest mean output price and mean input value, namely, the mean output price, raw material value, labour used value and depreciation of fixed capital were 794, 635, 423 and 12 baht, respectively. Average age and formal education level of the heads of enterprises were very close in three types of products with the range of age between 46-50 years and the maximum of 67 years was in the woven fabric enterprise. This indicated that the woven fabric was delicate product and needed more skilled labour than other kinds of product. The average formal education level of the heads of enterprises was junior high school which ranged from 7 to 9 years of schooling. For the number of operating years of enterprises, the woven fabric enterprises had the highest number of years in operation with the average of 12 years. This is simply because woven fabrication was the way of life in the Upper North of Thailand. Number of members of three kinds of products enterprises ranged from 56 to 66 persons with the highest number of 560 persons in the wickerwork product enterprise. However, the cottage food enterprises had the highest maximum number of shareholders (335 persons) while that of the wickerwork product enterprises was only 49 persons. The wickerwork product and woven fabric need more sophistication than cottage food product so more skilled workers were required in both enterprises. The average skilled labours in the woven fabric and wickerwork product enterprises were about 12 and 10 persons, respectively while only three persons were found in the cottage food enterprises.

Table 1: Summary statistics of key variables for rural micro and community enterprises in the Upper North of Thailand

Variable	Sample mean			Sample Standard Deviation			Minimum			Maximum		
	1	2	3	1	2	3	1	2	3	1	2	3
Value per unit of output (baht)	51.8	315.2	793.6	50.4	923.2	1,253.9	4.0	1.8	3	170	6,692	3,780
Value of raw material per output unit (baht)	24.9	134.1	634.8	34.9	442.3	1,214.1	0.05	0.02	0.9	144	3,030	9,936
Value of labour used per output unit (baht)	7.8	88.7	423.4	10.4	169.2	532.0	0.4	1.8	1	58	1,147	3,061
Value of Depreciation of fixed capital per output unit (baht)	3.1	2.6	11.6	6.4	9.1	16.0	0.01	0.005	0.01	31	68	98.8
Age (years)	50.2	45.8	48.5	4.2	5.2	8.9	45	38	32	48	55	67
Education (years)	7.4	7.3	9.1	2.2	3.1	3.9	6	4	4	12	12	16
Operation year (years)	5.4	8.2	12.2	3.0	7.0	7.7	1	1	1	10	24	34
Member of enterprise (persons)	66.1	62.6	56.5	77.5	129.6	47.5	14	3	0	335	560	175
Shareholders (persons)	51	10.1	33.6	88.5	15.7	51.0	0	0	0	335	49	175
Skilled labour (persons)	3.4	10.4	11.6	4.9	14.0	15.6	0	0	0	16	49	59

Note: 1 represents cottage food enterprises
2 represents wickerwork product enterprises
3 represents woven fabric enterprises

- The number of observations for variables included in DEA analysis is number of product items of which 53, 300 and 370 product items from cottage food enterprises, wickerwork product enterprises and woven fabric enterprises, respectively.
- The number of observations for variables included in tobit model is number of enterprises where 15 were cottage food enterprises, 17 were wickerwork product enterprises and 29 were woven fabric enterprises.

4.2 Model specifications

The estimation procedures, in this study, to meet the purpose of this study comprised two steps. The first step in estimating the productive efficiency of the unit was to specify the inputs and the outputs of the enterprises. The output variable could be proxied by price per unit of enterprise's products. The inputs used in micro and community enterprises production were also measured in terms of value per output unit due to the incomplete data on physical units given from the survey. These inputs took account of value of raw material, labour use and depreciation of fixed capital per output unit which were measured in baht. Fixed capital was defined as the value of fixed factors used in the production process. We could use depreciation on equipment capitalized. This variable was normally taken into account of the cost of capital as previous studies on efficiency of some organizations such as universities (e.g. Casu and Thanassoulis, 2006).

This analysis could be helpful in targeting extension to deal with technical inefficiencies in production. The linear tobit regression in equation (1) is used to identify possible factors associated with inefficiency in the second step. Tobit analysis was employed because the dependent variable was a censored variable having an upper limit of 1.00 and low limit of zero. Efficiency measures were regressed on the age of the head of community enterprise, the formal education level of the head of community enterprise, the operating years, the number of members in the enterprise, two dummy variables representing existence of organization plan and production plan. Moreover, other two dummy variables were used for kinds of product, representing cottage food enterprises and wickerwork product enterprises. The parameters, β_9 and β_{10} provide an idea of how much the type of products/enterprises affects efficiency. However, information on some variables of interest was not available. In particular, we wished to assess the effect of production development upon technical efficiency, but the survey information collected was inadequate.

$$EFF_i = \alpha_1 + \beta_1 Age + \beta_2 ED + \beta_3 OY + \beta_4 MEM + \beta_5 SH + \beta_6 SW + \beta_7 ORP + \beta_8 PROP + \beta_9 Dfood + \beta_{10} Dwicker + \varepsilon_i$$

Where:

EFF_i is efficiency index for enterprise *i*;

Age is the age of the head of enterprise (in years);

ED is the formal education level of the head of enterprise (in years);

OY is the operating years of the enterprise (in years);

MEM is the number of members in the enterprise (in persons);

SH is the number of shareholders (in persons);

SW is the skilled worker (in persons);

ORP is the dummy variable for organization plan equal to 1 if organization plan exists, 0 otherwise;

$PROP$ is the dummy variable for production plan equal to 1 if production plan exists, 0 otherwise;

$Dfood$ is the dummy variable for cottage food enterprise equal to 1 if the enterprise produces cottage food product, 0 otherwise; and

$Dwicker$ is the dummy variable for wickerwork product enterprise equal to 1 if the enterprise produces wicker work product, 0 otherwise.

ε_i is error terms

4.3 Findings

4.3.1 Technical efficiency of individual product items

Technical efficiency (TE) reflected the ability of decision making unit to maximize output from a given resource or the potential to reduce input use as a result of adopting best production technique or best management practice, while scale efficiency (SE) measures wasted input due to deviation from technically optimal scale or from constant returns to scale

(CRS) (Charnes and et.al, 1996, p.134). The optimally sized, or scale efficient firm operates at the minimum point on the aggregate average cost curve. The overall technical efficiency can be decomposed into pure technical efficiency and scale efficiency. As stated earlier, each enterprise produced individual product items more than one item then the pure technical and scale efficiency of individual product items were presented in Table 2. The empirical study showed that the cottage food products had the highest level of pure TE at the average value of 0.643 followed by the woven fabric and wickerwork products with the average value of 0.483 and 0.436, respectively. This implied that when comparing to the best performer in each type of product, inputs could be decreased by about 36, 52 and 56 per cent, while the firm still maintained the same output level. The results for scale efficiency showed the opposite consequence that the highest level at the average value was found in the wickerwork products with the value of 0.878 followed by the woven fabric and cottage food products with the average value of 0.792 and 0.676, respectively. In addition, individual product items analysis indicated that, of 53 cottage food products, about 57 per cent were in the region of increasing returns to scale, 13 per cent at constant returns to scale and 30 per cent under decreasing returns to scale. For wickerwork products, of 300 products, about 66 per cent operated at increasing returns to scale, 5 per cent at constant returns to scale and 29 per cent under decreasing returns to scale. Woven fabric, of 370 products, about 54 per cent operated in the region of increasing returns to scale, 4 per cent at constant returns to scale and 43 per cent under decreasing returns to scale.   These results indicated that only 13, 5 and 4 per cent of cottage food, wickerwork and fabric woven products were operating at their own optimal scale, while most products were being produced below their optimal point in which the product volume should be improved. Inefficiency due to scale comprised approximately about 32 per cent of the overall technical inefficiency of 57 per cent in the cottage food products, 12 per cent of those of 63 per cent in wickerwork products and 21 per cent of those of 66 per cent in woven fabric products. Therefore, to improve production efficiency of all product items, increasing in product volume were recommended rather than decreasing the volume.

From the distribution of TE among individual product items, it was found that the cottage food products had the largest number of products, about 42 per cent, in very high efficiency (0.8001-1.0000) category compared to 15 and 24 per cent in wickerwork and woven fabric products, respectively (Table2). Most products in wickerwork and woven fabric were produced in low efficiency (0.2001-0.4000) category with the percentages of 49 and 33, respectively.

These empirical results suggested two important findings. First, there were significant possibilities to increase efficiency levels in the production of rural community enterprises by improving production scale and eliminating technical inefficiencies. Second, the results indicated that scale inefficiency had more significant effect on the technical efficiency of cottage food product than pure technical inefficiency, while reverse effects were found in wickerwork and woven fabric products. Therefore, the way to improve technical efficiency of, particularly wickerwork and woven fabric products would be to adopt the practices of efficient products. In the mean time, the scale of production should be taken into account for cottage food products.

Table 2: Pure technical and scale efficiency of individual product items in different categories

score	TE			SE		
	1	2	3	1	2	3
Very low (0.0000-0.2000)	13.2	8.7	16.0	5.6	1.0	0.0
Low (0.2001-0.4000)	18.9	49.0	32.7	20.8	2.0	12.7
Average (0.4001-0.6000)	18.9	22.3	20.0	9.4	4.3	9.5
High (0.6001-0.8000)	7.5	4.7	7.8	17.0	10.7	11.9
Very high (0.8001-1.0000)	41.5	15.3	23.5	47.2	82.0	65.9
Total	100.0(53)	100.0(300)	100.0(370)	100.0(53)	100.0(300)	100.0(370)
Average	0.643	0.436	0.483	0.676	0.878	0.792

Note: 1 represents cottage food enterprises
2 represents wickerwork product enterprises
3 represents woven fabric enterprises
Number in parentheses are number of products.

The technical inefficiency as described above was called radial technical inefficiency. This suggested that if the inefficiency was eliminated then all products would be produced on the frontier line. However, Koopmans (1951) stated that the producers who met technical efficiency or absolutely technical inefficiency had to be the producer units located on the frontier and did not face input slack problems (problem of non-radial technical inefficiency). Results presented in Table 3 showed a summary of input slack problems of products. In overall, the input slack problem was not the crucial problem, for all products, in terms of the degree of seriousness since the percentage of slack of total input varied between 0.11 and 7.43. However, the most problematic type of products which had number of products confronting input slacks was woven fabric enterprises.

Table 3: Input slacks problems of individual product items

Input value/unit of output	No. of products			Average slack			Slack as % of total input		
	1	2	3	1	2	3	1	2	3
Raw material value	8	54	79	1.64	5.68	57.49	1.00	0.76	1.93
Labour used value	3	72	14	0.20	5.50	6.34	0.14	1.49	0.57
Depreciation of fixed capital	4	15	118	0.29	0.06	2.71	0.70	0.11	7.43

Source: calculation
Note: 1 represents cottage food enterprises
2 represents wickerwork product enterprises
3 represents woven fabric enterprises

To investigate the impacts of enterprise-specific factors on the technical efficiencies, a tobit regression was applied, in this study, where the VRS technical efficiency scores were regressed against the age, formal education, operating year, the existence of organization plan, the existence of production plan, member, shareholder, skilled labour, dummy for cottage food and dummy for wickerwork products. The total products in the first stage of 723 products were integrated into 61 enterprises which were applied in the second stage of estimation. The estimation of factors affecting technical efficiency was presented in Table 4. The empirical results of technical efficiency indicated that the negative signs of the estimated coefficients of the age, formal education level, member, shareholders and dummy variable for wickerwork product enterprise were found. The positive sign estimated coefficients were in the operating year, the existence of organization and production plans, skilled labour and cottage food enterprise. Most of parameters had signs as expected in theory except the formal education level of the head of enterprises, member and shareholders. However, only operation year and the dummy for cottage food products enterprise were statistically significant, to explain the technical efficiency, at the 5 and 10 per cent level. The results indicated that more operating years reflected greater specialization in production which was associated with higher technical efficiency. This might point that the longer the operation, the better the organization management. Most of the enterprises operated their business in group form so organization management was more crucial factor to explain the relative technical efficiency than the personal characteristic of the head of enterprises.

Additionally, the type of products was found to be related significantly in a positive way with technical efficiency when enterprises were producing cottage food. This was due to the fact that the cottage food enterprise could adjust themselves in terms of the input combination and output easier than the other two enterprises because of the smaller value in input per output. The other variables, member and shareholders were not found to have significant association with technical efficiency which could be denoted that not all members or shareholders of community enterprises would participate in production process so members or shareholders did not reflect the number of labours or number of skilled labours involved in the production process.

Table 4: Estimates of parameters of technical inefficiency of total enterprises

Input	Coefficient	Standard deviation	t-value
Constant	0.382	0.323	1.181
Age (years)	-0.0005	0.0054	-0.099
Formal education (years)	-0.012	0.011	-1.066
Operating year (years)	0.011	0.005	1.973**
Organization plan	0.002	0.098	0.016
Production plan	0.115	0.138	0.835
Member (persons)	-0.00009	0.00056	-0.161
Shareholder (persons)	-0.0003	0.0008	-0.424
Skilled labour (persons)	0.003	0.003	1.094
Cottage food product	0.198	0.114	1.736*
Wickerwork product	-0.119	0.093	-1.278
Log Likelihood functions	-13.247		

Source: calculation
Note ** significant at .05 level
* significant at .10 level

5. Summary and conclusions

This study used nonparametric approach to measure overall technical scale and pure technical efficiencies in the individual product items of rural micro and community enterprises in the Upper North of Thailand. Tobit regression was employed to investigate factors affecting technical efficiency of rural micro and community enterprises. Technical and scale efficiencies were estimated for 723 product items in two periods of time, 2002 and 2004, while 61 enterprises were applied in tobit analysis. The empirical results indicated that the overall technical inefficiency could be reduced by 56, 63 and 66 per cent for cottage food, wickerwork products and woven fabric by operating at optimal scales and by reducing pure technical inefficiency by 36, 56 and 52 per cent through the use of the best practices. It can be concluded that cottage food products were more likely for its improvement by focusing on scale efficiency but for wickerwork products and woven fabric, pure technical efficiency should be considered. In addition, individual products items analysis indicated that most of products were producing in the region of increasing returns to scale. There were 57 per cent for cottage food products, 66 per cent for wickerwork products and 54 per cent for woven fabric. Therefore, these product items could increase their technical efficiency by continuing to increase their size. However, after taking the radial technical inefficiency the problem of slack input remained in the production, particularly woven fabric products.

The results of tobit model used to identify the sources of technical inefficiencies of rural community enterprises indicated that operating year of the enterprise and dummy variable for cottage food products were correlated significantly and positively with the technical efficiency of rural micro and community enterprises.

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