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Comparative Analysis of Efficiencies of Smallholder Rubber Farmers in Peninsular Malaysia: Conventional and Data Envelopment Analysis Models.

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Abstract
The main aim of this paper was to compare the technical and scale efficiencies of smallholder rubber farmers in Malaysia using Conventional and Bootstrapped –Data Envelopment Analysis Models. Multistage sampling technique was used to select 206 rubber farmers for the study, while data were collected from them using well-structured questionnaire. Under the CDEA model, 128 farmers were technically efficient in variable returns to scale, while 11 were both technically and scale efficient in constant returns to scale. Findings revealed that, using CDEA, 128 farms were found to be technically efficient under variable returns to scale (VRS), 11 farms were both technically and scale efficient under constant returns to scale (CRS). Under BDEA model, 77 farmers were technically efficient in variable returns to scale (VRS). Factors that affected the efficiency of the farmers include; race, marital status, tapping system and farms' distance. It is therefore recommended to apply BDEA model in measuring technical efficiencies as this helps to give robust results. Also, more emphasis should be given in tapping system such as half spiral and alternate days tapping systems, and the smallholders distance away from his/her farms.

Keywords: Bootstrapped-DEA, Data Envelopment Analysis, Efficiency, Rubber, Production

Introduction

The word 'Efficiency" has been widely and extensively used in economics and its analysis has been an important issue in the field of economics studies (Ajibefun, 2008). Ever since the emergence of the seminal work of Farrell in 1957, in which they defined it in form of technical efficiency, which means either producing output at optimal level using given inputs or producing a given amount of output with minimum quantities of input. Before measuring efficiency of any data under cross sectional setting, there needs to initially determine the nature of the boundary of the production set, and there after the distance from observed point to the boundary of the production set is calculated or measured.

Several studies were carried out on efficiency of rubber production in Malaysia and other countries. Some studies were on either Allocative or Technical Efficiency or both (economic efficiency). Few of the studies include Sepien (1978) who examined rubber production of smallholders in Malaysia. Chew (1981), has also looked at the economics of production in Chinese rubber smallholdings in peninsular Malaysia. Future of Malaysian rubber industry was also investigated by (Othman, 2008). A stochastic frontier approach was used in measuring technical efficiency in rubber manufacturing industries in Malaysia using energy, capital and labour as variables with 313 firms, (Alias *et al,* 2012).The study indicated that although the manufacturing firms were 70% technically efficient, but they were still in need of technical and financial support in form of subsidy to boost the production level. Same parametric (stochastic frontier approach) was used in investigating thirty five (35) rubber smallholder farms in Besut district of Terengganu and the result indicated that more than fifty per cent (>50%) of the smallholders scored 80 per cent technical efficiency (Mustafa, 2011). As a result of high criticism on the DEA approach in estimating technical efficiency, Simar and Wilson (1998) and Simar and Wilson (2000) came up with a special technique called "Bootstrapping technique" for estimating the bias and correcting the efficiency estimates. The work on bootstrapping is specifically testing the reliability of data set via developing a pseudo-replicate data set (Olson and Lingh, 2007). Following the advent of bootstrapping technique by (Simar and Wilson 2007), several studies have also utilized the concept in estimating the efficiency. Notable among them is the study by (Abatania *et al,* 2012) in which they investigated 189 crop farms using bootstrapping DEA approach in Northern Ghana. Their results revealed that 77.26% and 94.21% are bias-corrected mean TE scores and scale efficiency scores respectively. They further revealed that Age of household's head, gender, hired labour and farm's locations significantly affect technical efficiency. This paper specifically examined the CDEA and BDEA to find the Bias-corrected efficiency scores which is the robust technique. The main objective of the study was to compare technical and scale efficiencies of smallholder rubber farmers in Negeri Sembilan State of Peninsular Malaysia, using CDEA and BDEA efficiency estimators.

Methodology

Study Area

The study was conducted in Negeri Sembilan (Peninsular Malaysia) which has five districts namely, Seremban, Tampin, Jempol, Rembau and Kuala Pilah districts. Negari Sembilan is a state in Peninsular Malaysia with long historical background. It is bounded by Selangor to the North, Pahang to the East, Melaka to the West and Johor to the South. The state is among the thirteen states of Peninsular Malaysia and one of the four states that are not under the ruler ship of a Sultan. Seremban is the capital and the largest city in Negeri Sembilan, other large cities includes Port Dickson, Bahau, Kuala Pillah and Nilai (Encarta, 2007). Negeri Sembilan is located between Latitude 2^0 and 3^0 North of the Equator and Longitudes 101^0 and 103^0 East of the Greenwich Meridian. Encarta, (2007) described the study area as having a population of approximately 1,098,500 and an ethnic composition of 56.6% Malay, 21.3% Chinese, 14% Indians and the remaining 8.1% constitute other ethnic nationals. The state has the highest percentage of Indians when compared to other Malaysian states. Up until today the state is known as the strongholds of *Adat Perpatih* in Malaysia. The area also has an average annual temperature of 27.1^0C and a mean annual precipitation of 1984 mm. The land area was recorded to be around 6,641 square kilometres. The state has an appreciable agricultural commodities such as rice, fruit vegetables like Banana, Pineapple, Guava, paw-paw) Cash crops and industrial crops like Palm-oil, rubber as well as fish and livestock production. (Encarta, 2007)

Nature and Sources of data Collected

Although the main source of data for this study constituted primary data, however, secondary data were also used as literature review and methodology related issues in support of the primary data and were obtained from journals, proceedings and other related academic materials. In collecting primary data, questionnaires were used.

A cross sectional data were collected from rubber farms covering farmers under Rubber Industrial Smallholders Development Authority (RISDA). The researcher got the help of some RISDA staff who serve as enumerators to aid in facilitating data collections especially by bridging the gap of communication between the researcher and the farmers during data collection exercise.

Sample size and sampling technique

A sample of size 206 rubber smallholder farmers was used in the study and was selected using a multistage sampling procedure. Five (5) rubber producing districts which included Seremban, Tampin, Rembau, Kuala Pilah and Jempol districts were selected purposively considering the intensity of rubber plants in those areas. The first stage involved selection of two villages from each of the five districts, making a total of ten (10) villages. The second selection was based on randomly selecting twenty two (22) smallholder rubber farmers from each selected village, making a total of two hundred and twenty (220) respondents. However, of the two hundred and twenty questionnaires administered, only two hundred and sixteen (216) were returned; while ten (10) of the returned questionnaires were discarded because of incomplete information. Finally, only 206 questionnaires were found to be useful in the analysis.

Analytical Technique

Estimation of Technical Efficiency (CDEA Model)

$$TE_j = \min_{\theta_j^{CRS},\ x} \theta_j^{CRS}$$

$$\theta_j^{CRS} X_i > X\lambda$$

$$\theta \geq 0$$

Where:

X = Input vector,

Y = Output vector,

θ_j^{CRS} = Technical efficiency of farm j under CRS.

Estimation of Scale efficiency (S.E) (CDEA Model)

Scale efficiency is estimated by taking the ratio of the two efficiencies measured under CRS and VRS. Scale efficiency also lies between 0 and 1 (0≤SE≤1). SE = 1 implies that inputs are scale efficient economy of scale, SE<1 implies that inputs are not scale efficient which can be a case of either IRS or DRS. (Gabdo, 2013)

$$SE_j = \frac{\theta_j^{CRS}}{\theta_j^{VRS}}$$

Where: θ_j^{CRS} = Technical Efficiency under CRS and θ_j^{VRS} =Technical Efficiency under VRS. When a convexity constraint ($\sum_{j=i}^{n} \lambda_j \leq 1$) was imposed on the first equation $TE_j = \min_{\theta_j^{CRS},\ x} \theta_j^{CRS}$,the equation became a non-increasing return to scale and this helps in decomposing scale inefficient farms in to either increasing return to scale or decreasing return to scale Vu(2010). The equations thus becomes

$$TE_j = \theta_j^{NIRS} = \min_{\theta_j^{CRS},\ x} \theta_j^{CRS} + \sum_{j=i}^{n} \lambda_j$$

Where: $\sum_{j=i}^{n} \lambda_j \leq 1$, θ_j^{NIRS} = Technical Efficiency under non-increasing returns to scale and other variables as defined earlier.

The decision rules are: if $\theta_j^{NIRS} = \theta_j^{VRS}$ and $SE_j < 1$, the farm is operating with decreasing returns to scale (DRS) otherwise increasing returns to scale (IRS) if $\theta_i^{NIRS} < \theta_i^{VRS}$ (Gabdo, 2013).

Tobit regression for the Determinants of technical efficiency

The farmers/farm specific characteristics were regressed against bias-corrected technical efficiency to determine factors influencing the technical efficiency. The equation determining factors influencing the technical efficiency is presented below:

$$TE_{bias-corrected} = \psi_0 + \psi_1 Z_1 + \psi_2 Z_2 + \psi_3 Z_3 + \psi_4 Z_4 + \psi_5 Z_5 + \psi_6 Z_6 + \psi_7 Z_7 + \psi_8 Z_8 + \psi_9 Z_9 + \psi_{10} Z_{10} + \varepsilon_i$$

Where: $Z_1, \ldots, Z_{10}$ represents gender, race, marital status, family size, tapping experience, educational level, topography, tapping system, farmer's age and farm distance from home respectively.

Determinants of Efficiency

In this study, estimation of determinants of efficiency was based on 10 different socio-demographic variables as follows:

X_1 = Gender
X_2 = Race
X_3 =Marital Status
X_4 =Farmily Size
X_5 =Tapping Experience
X_6 =Educational level
X_7 =Topography
X_8 =Tapping system
X_9 =Farmer's Age
X_{10} =Farm distance.
Y_1 =Efficiency Scores.

Results and Discussion

Output and Input Variables of smallholder farmers

Table 1 presents the descriptive statistics of rubber yield and six (6) variable inputs used. The variable inputs included farm size (ha), rubber task (number of rubber trees per hectare), farm tools, fertilizer (kg/ha), herbicides (lit/ha) and labour in man days/ha. The mean value of the rubber output was 4611.34 kg/ha, whiles its standard deviation, minimum and maximum values were 2913.36, 121.00 and 12,580.00 respectively. The mean values for farm size, rubber task, farm tools, fertilizer, herbicides and labour were 1.19, 532.03, 2.34, 356.35, 12.66 and 13.14, respectively. The mean value for farm size was 1.19 ha, the means an average of farm size that can produce 5611.34 kg of rubber was 1.19 ha. The average number of rubber trees per hectare that produced the 4611.34 kg was estimated to be 532.03. Also the result revealed that the average quantity of fertilizer per hectare and that of litres of chemical herbicides, enough to produce 4611.34 kg of rubber, were estimated to be 356.35kg 1and 2.66 litres respectively. The mean or average number of man days per hectare was found to be 13.14.

Technical and Scale Efficiencies for smallholder rubber farmers using CDEA model

Table 2 indicate technical efficiency scores on variable return to scale (VRS), constant return to scale (CRS) and non-increasing return to scale (NIRS) as well as scale efficiencies (SE). The result showed that about one hundred and twenty-eight (128) farms were found to be technically efficient under Variable Return to Scale (VRS) and only eleven (11) farms were found to be on the frontier under each of CRS and NIRS. More than fifty (50) farms had T.E scores less than 0.20 under CRS and NIRS. Regarding the scale efficiencies of the smallholders, it would be observed that approximately 11 farms were scale efficient and this constitutes only 5.4% of the farms. The mean TE scores under VRS were found to be 0.97, while that of CRS and NIRS were estimated to be 0.61 and 0.61 respectively. This translates that only 3% of the farms would be accounted for inefficiency under VRS assumption, while 39% would be accounted as inefficiency under each of CRS and NIRS assumptions.

Technical Efficiencies of Smallholder Rubber Farmers using CDEA and BDEA Models under VRS Assumptions

Table 3 presents the estimation of BDEA which generated the "Bias-corrected" (BC) efficiency scores of smallholder rubber farms under variable return to scale (VRS) assumptions. The table revealed that mean or average Bias corrected-TE scores is 0.96 and only 77 farms were found to be technically efficient under the BDEA. This finding is in line with previous studies that indicated that BC scores would always be less than the scores from CDEA. That shows that there is presence of bias in CDEA, and thus this bias is removed when the method of BDEA is applied. The standard deviation of the BC is 0.06. Ninety-four (94) farms have efficiency score range between 0.91-0.99. It was also found out that none of the farms have below 0.60 T.E score. More specifically, it would be observed that using CDEA, the Mean TE scores was 0.97 and 128 or 62.1% farms were technically efficient. However, as a result of bootstrapping which helped to remove bias, the mean value has dropped to 0.96 and the number of farms on the frontier had also drastically dropped by almost 50% from 128-77 farmers or 62.1% to 37.4%. This is an indication that CDEA is full of bias and thus need to be corrected. Thus, the wide margin or difference between the 128 technically efficient farms under CDEA and that of 77 technically efficient farms under BDEA indicates that is actually presence of bias in conventional or naïve DEA .Thus as a result of bootstrapping which enables to remove the bias, the number of technically efficient farms reduced to 77

Technical Efficiencies of Smallholder Rubber Farmers using CDEA and BDEA Models under CRS Assumptions

Table 4 presents the range of both CDEA and BDEA analysis for the rubber smallholder farms under constants return to scale (CRS) assumptions. A careful observation at the table revealed that although using

CDEA technique produced eleven (11) farms on the frontier, but the BDEA produced no single farm on the frontier. That is no farm was found to be fully (100%) technically efficient using BDEA model. As earlier explained, CDEA has some bias but BDEA has no bias or better still it's a bias-corrected model. Thus as a result of having all bias removed, no single farm was found to be on the frontier using BDEA. However, an appreciable number of farms, about fifty-five (55) farms (making 27.18%) were found to be at efficiency range of 0.81-0.90. Also, twenty-two (22) farms were between 0.91-0.99 technical efficiency. This result revealed that the is also a gap difference between the number of farmers at the efficiency range of 0.91-0.99, which also indicated a bias in CDEA, since about seven(7) number of farms were having bias. This bias when removed using BDEA model, the number of farms trimmed from 35 to 22 farms. Fifty-five (55) farms or 26.7% farms were found to be very poorly technically efficient of less than 0.2 efficiency score. This is an indication that one-quarter (1/4) of the respondents were poorly technically efficient under both the two models. The mean TE scores of BDEA were found to be 0.58 as against 0.61 with ordinary CDEA. The BDEA also recorded 0.32, 0.97, 0.06 and 0.74 for standard deviation, maximum, minimum and median respectively.

Technical Efficiencies of Smallholder Rubber Farmers using CDEA and BDEA Models under NIRS Assumptions

Table 5 disclosed both the CDEA and BDEA efficiency scores of the rubber smallholder farms under non-increasing returns to scale (NIRS) assumptions. The Bias-corrected mean technical efficiency score of BDEA was found to be 0.58 as against the CDEA estimate which is 0.61 which results to a gap of about 0.3 or 20%. Although about fifteen (15) farms (7.3%) were very near the frontier, but no single farm was found to be on the frontier. The Maximum, Minimum and Standard deviation of the BDEA efficiency score were 0.96, 0.06 and 0.32 respectively. The upper confidence interval has a mean of 0.61 while the lower confidence interval has a mean of 0.54.

Economic and Allocative Efficiencies of Smallholder Rubber Farmers

Table 6 presents the summary of economic and Allocative efficiencies of the 206 rubber smallholder farms under both the CRS and VRS assumptions, using CDEA model. Table 6 reveals that 3 and 4 smallholder farms were found to be allocatively efficient under constant return to scale and variable return to scale respectively, whereas for economic efficiency, only 1 and 4 smallholder farmers were found to be respectively efficient under constant and variable returns to scale. The mean values of Allocative efficiency scores are virtually the same under both CRS and VRS, and also the mean value of the economic efficiency are also similar under both CRS and VRS. An indication of only 3 farms found to be allocatively efficient, means that majority of the farms were allocatively inefficient. Thus this translates that there were high inputs congestion and hence needs to be reduced.

Determinants of Smallholder Rubber Farmers' Efficiency from CDEA Model

Table 7 presents the Tobit regression estimates of CDEA scores against the determinants of the efficiency. It was found that four of the twelve efficiency determinants were found to be statistically significant. This include race, location, tapping system and farm distance. However, in comparison with the Tobit bias-corrected scores from BDEA as shown in table 8 below, it would be observed that the number of determinants that were significant has increased by one (1). Under this Tobit regression estimate of BDEA, variables such as race, extension visits, tapping system and farm distance were found to be critical in determining efficiency of rubber smallholder farms. The main difference between the two tables (7 and 8) is that table 7 used the efficiency scores of the CDEA, while that of the table 8 used the scores of the bias-corrected TE of BDEA. That is after bootstrapping, the bias was removed and the bias-corrected technical efficiency scores were then used and regressed on the determinants or factors influencing efficiency.

Conclusion

The study undertook a comparative analysis of the efficiencies of smallholder rubber farmers in Peninsular Malaysia using CDEA and BDEA techniques. More farmers were technically efficient under CDEA technique relative to the BDEA technique. Socio-demographic characteristics such as race, marital status, tapping system and farm distance significantly affected the technical efficiency of the farmers. The study recommends the application of BDEA model in measuring efficiency as this helps to reduce bias and thus gives robust results. Also, more emphasis should be given in tapping system such as half spiral and alternate days tapping systems, as well as the smallholders distance away from his/her farms.

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Table 1: Frequency Distribution of Output and Input variables of smallholder rubber farmers

Variables	Mean	SD	Min	Max
Rubber Yield(kg/ha)	4611.34	2913.36	121.00	12580.00
Farm size (ha)	1.19	0.48	0.00	4.00
Rubber task(no/ha)	532.03	292.44	157.00	1800.00
Farm Tools (myr/ha)	2.34	1.60	0.00	7.00
Fertilizer (kg/ha)	356.35	298.57	50.00	1500.00
Herbicides (lit/ha)	12.66	9.44	4.00	45.00
Labour(man days)	13.14	2.03	8.00	15.00

Source: Field survey, (2015)

Table 2: Frequency distribution of technical and scale efficiencies for smallholder rubber farms

Efficiency Range	(VRS)	(%)	(CRS)	(%)	(NIRS)	(%)	SE	(%)
≤ 0.20	0.00	(0.00)	53.00	(25.73)	53.00	(25.73)	50.00	(24.27)
0.21-0.30	0.00	(0.00)	11.00	(5.34)	11.00	(5.34)	11.00	(5.34)
0.31-0.40	0.00	(0.00)	3.00	(1.46)	3.00	(1.46)	5.00	(2.47)
0.41-0.50	0.00	(0.00)	7.00	(3.40)	7.00	(3.40)	7.00	(3.40)
0.51-0.60	0.00	(0.00)	4.00	(1.94)	4.00	(1.94)	0.00	(0.00)
0.61-0.70	1.00	(0.49)	11.00	(5.34)	11.00	(5.34)	11.00	(5.34)
0.71-0.80	4.00	(1.94)	28.00	(13.59)	28.00	(13.59)	28.00	(13.59)
0.81-0.90	25.00	(12.14)	43.00	(20.87)	43.00	(20.87)	43.00	(20.87)
0.91-0.99	48.00	(23.30)	35.00	(16.99)	35.00	(16.99)	35.00	(16.99)
1.00	128.00	(62.14)	11.00	(5.34)	11.00	(5.34)	11.00	(5.34)
Summary								
Mean	0.97		0.61		0.61		0.62	
St.Dev	0.06		0.34		0.34		0.33	
Max	1.00		1.00		1.00		1.00	
Min	0.70		0.06		0.06		0.08	
Median	1.00		0.77		0.77		0.77	

Source: Field survey, (2015)

Table 3 Frequency distribution of smallholder rubber farmers according to their technical efficiencies under VRS assumptions

Efficiency Range	CDEA (%)	BDEA (%)
≤ 0.20	0.00 (0.00)	0.00 (0.00)
0.21-0.30	0.00 (0.00)	0.00 (0.00)
0.31-0.40	0.00 (0.00)	0.00 (0.00)
0.41-0.50	0.00 (0.00)	0.00 (0.00)
0.51-0.60	0.00 (0.00)	0.00 (0.00)
0.61-0.70	1.00 (0.49)	1.00 (0.49)
0.71-0.80	4.00 (1.94)	5.00 (2.47)
0.81-0.90	25.00 (12.14)	29.00 (14.08)
0.91-0.99	48.00 (23.30)	94.00 (45.63)
1.00	128.00 (62.14)	77.00 (37.38)
Summary		
Mean	0.97	0.96
St.Dev	0.06	0.06
Max	1.00	1.00
Min	0.70	0.70
Median	1.00	0.98

Source: Field survey, (2015)

Table 4: Frequency distribution of smallholder rubber farmers according to their technical efficiencies under CRS assumptions

Efficiency Range	CDEA (%)	BDEA (%)
≤ 0.20	53.00 (25.73)	55.00 (26.7)
0.21-0.30	11.00 (5.34)	8.00 (3.88)
0.31-0.40	3.00 (1.46)	5.00 (2.43)
0.41-0.50	7.00 (3.40)	6.00 (2.91)
0.51-0.60	4.00 (1.94)	8.00 (3.88)
0.61-0.70	11.00 (5.34)	13.00 (6.31)
0.71-0.80	28.00 (13.59)	33.00 (16.02)
0.81-0.90	43.00 (20.87)	56.00 (27.18)
0.91-0.99	35.00 (16.99)	22.00 (10.68)
1.00	11.00 (5.34)	0.00 (0.00)
Summary		
Mean	0.61	0.58
St.Dev	0.34	0.32
Max	1.00	0.97
Min	0.06	0.06
Median	0.77	0.74

Source: Field Survey, (2015)

Table 5: Frequency distribution of smallholder rubber farmers according to their technical efficiencies under NIRS assumptions

Range	CDEA (%)	BDEA (%)
≤ 0.20	53.00 (25.73)	56.00 (27.18)
0.21-0.30	11.00 (5.34)	8.00 (3.88)
0.31-0.40	3.00 (1.46)	5.00 (2.43)
0.41-0.50	7.00 (3.40)	6.00 (2.91)
0.51-0.60	4.00 (1.94)	6.00 (2.91)
0.61-0.70	11.00 (5.34)	15.00(7.28)
0.71-0.80	28.00 (13.59)	34.00 (16.52)
0.81-0.90	43.00 (20.87)	61.00 (29.61)
0.91-0.99	35.00 (16.99)	15.00 (7.28)
1	11.00 (5.34)	0.00 (0.00)
Summary		
Mean	0.61	0.58
St.Dev	0.34	0.32
Max	1.00	0.96
Min	0.07	0.06
Median	0.77	0.74

Source: Field survey, (2015)

Table 6: Frequency distribution of Allocative and technical efficiencies of smallholder rubber farmers

Efficiency Range	AE (CRS)	EE (CRS)	AE (VRS)	EE (VRS)
≤ 0.20	28.00	100.00	27.00	78.00
0.21-0.30	18.00	46.00	24.00	42.00
0.31-0.40	79.00	47.00	78.00	58.00
0.41-0.50	35.00	3.00	36.00	8.00
0.51-0.60	16.00	1.00	14.00	4.00
0.61-0.70	12.00	1.00	11.00	4.00
0.71-0.80	7.00	1.00	4.00	2.00
0.81-0.90	8.00	3.00	5.00	3.00
0.91-0.99	2.00	3.00	3.00	3.00
1	3.00	1.00	4.00	4.00
Summary				
Mean	0.42	0.21	0.41	0.21
St.Dev	0.19	0.19	0.19	0.20
Max	1.00	1.00	1.00	1.00
Min	0.02	0.00	0.02	0.01

Source: Field survey, (2015)

Table 7: Tobit regression estimates of determinants of smallholder rubber farmers' efficiencies from CDEA Model

Variables	Coefficients	SE	T-ratio	P-value
Constant	0.650	0.052	12.450	(0.000)***
Gender	0.007	0.007	1.040	(0.300)
Race	0.015	0.003	4.700	(0.000)***
Marital status	0.017	0.011	1.540	(0.125)
Family size	-0.000	0.002	-0.060	(0.953)
Tapping experience	-0.001	0.001	-1.010	(0.313)
Educational level	0.001	0.004	0.120	(0.901)
Topography	0.003	0.007	0.380	(0.707)
Tapping system	-0.023	0.010	-2.400	(0.018)***
Farmer's age	0.000	0.000	1.000	(0.319)
Farm distance	0.003	0.001	2.780	(0.006)***

1% level of significance = ***
5% level of significance = **
10% level of significance = *

Table 8: Tobit regression estimates of determinants of smallholder rubber farmers' efficiencies from BDEA Model

Variables	Coefficients	SE	T-ratio	P-value
Constant	0.656	0.054	12.100	(0.000)***
Gender	0.009	0.007	1.240	(0.216)
Race	0.015	0.003	4.750	(0.000)***
Marital status	0.020	0.011	1.770	(0.078)*
Family size	0.000	0.002	-0.100	(0.921)
Tapping experience	-0.001	0.001	-1.430	(0.155)
Educational level	-0.002	0.005	-0.420	(0.675)
Topography	0.003	0.007	0.490	(0.624)
Tapping system	-0.026	0.010	-2.630	(0.009)***
Farmer's age	0.000	0.000	0.270	(0.785)
Farm distance	0.003	0.001	2.830	(0.005)***

1% level of significance = ***
5% level of significance = **
10% level of significance = *