# Adopting Super-efficiency and Tobit Model on Analyzing the Efficiency of Teacher's Colleges in Thailand

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**ABSTRACT**

Teacher's colleges located throughout Thailand have taken many inputs and outputs to achieve high academic performance. Since the teacher's colleges have a variety of educational production, their efficiency is diversely different. Super-efficiency data envelopment analysis (SE-DEA) has a potential to assess technical efficiency of firms and Tobit regression specially uses to analyze an uncensored score. Therefore, this study adopted two-step approaches to evaluate the technical efficiency of 40 teacher's colleges which collected cross-section data in 2011 from Office of the Higher Education Commission in Thailand. The super-efficiency DEA was initially assessed the efficient score followed by the Tobit regression employed to determine what factors affect the technical efficiency. Interestingly, number of graduate students, research and development, and intensity funds were considered into the Tobit regression. The results showed that the 40 colleges perform in technical efficiency differently. Moreover, those factors illustrate a different significance at various confidence levels.

**Keywords:** Data envelopment analysis (DEA), super-efficiency, teacher's colleges, technical efficiency, Tobit regression.

## 1. INTRODUCTION

Teacher's colleges were originally formed by the college systems in Thailand. Currently, they compose one of the university systems. The name "Rajabhat University" is called instead of the teacher's colleges that formerly named "Rajabhat Institutes". Almost every province in Thailand establishes one college in order to widely open the opportunity to a local student who would like to be a teacher. The local student who nearly resides such a college has more good chance than the others. Consequently, the Rajabhat Universities are prevalently easier to gain admission than the government universities.

In 2012, there are 40 teacher's colleges located throughout the country (Chaaim, 2010). Those colleges have existed in Thai society since 1892 and have offered a variety of fields that focus more details on how to teach effectively (Juntep, 2012). Moreover, most colleges offer degree for undergraduate as well as graduate students. Meanwhile, the doctoral level can be found in some colleges. The teacher's colleges in Thailand are academic and research institutes for a higher education of local community. They grant a society a good education to improve the quality of life. In addition, they use several factors to achieve the goal in teaching for the purpose of getting more knowledge of a student. Some techniques have been adapted to improve the skills of teaching and to make the student easily understand.

The teacher's colleges comprise a variety of departments and units. All work together efficiently in order to achieve the high academic performance and give the benefit back to a society. Unfortunately, some teacher's colleges lack of funds and education aids to increase the teaching quality. As a result, they are unable to achieve the same level of academic performance. This problem highly pushes the authors to study technical efficiency of the teacher's colleges in Thailand. Two-procedure concept of super-efficiency data envelopment analysis (SE-DEA) and Tobit regression are adopted in using for research method.

The two-procedure concept was prevalently used to efficiency assessment of decision making units (DMUs). Some papers followed this approach to evaluate the efficiency of studied firms. They are the useful methods in analyzing the technical efficiency. The efficient score is firstly assessed based on the special technique of SE-DEA introduced by Anderson and Petersen (1993). Tobit regression is finally used to analyze factors affecting the efficient score.

Perrigot and Barros (2008), for example, adopted the two-procedure concept to study French retailers' efficiency. Their results showed that the efficiency of French retailers was relatively high, besides that the four drivers; benchmark, rigour, initiative, and awareness had a significant effect on the efficiency. Nahra, Mendez, and Alexander (2009) employed the same approach to analyze the operative efficiency of treatment units of outpatient substance abuse from the 1995 National Drug Abuse Treatment System Survey (NDATSS). Their findings indicated that the super-efficiency scores can be increased by having many staffs, volunteers, and providers. Their findings also indicated that the super-efficiency method is more productive than the traditional DEA model because it provides an additional efficiency score (more than one)

Duan and Li (2010) applied the concept of super-efficiency and Tobit model in analyzing the interprovincial energy efficiency of China. Their conclusion showed two principal factors that affect energy efficiency scores were the energy price and technical progress. Moreover, Shanghai and Hainan were the benchmark areas because the super efficiency scores were always higher than 1.000. Similarly, Wang and Li (2011) applied the super-efficient DEA to assess the efficiency of China's commercial banks in corporation with Tobit regression. The results found that the super-efficiency scores of commercial banks were relatively low and two factors that significantly affect the banking efficiency were the ownership and the bank's scale.

Surprisingly, the findings reveal that no literature uses the two-procedure concept to specifically analyze the technical efficiency of teacher's colleges in Thailand. Therefore, the research aims to find out how technical efficiency of the teacher's colleges shows, as well as what factors affect the technical efficiency. The research's motivations are as follows, (i) it is useful to analyze the role of leading teacher's colleges in the national level, (ii) the technical efficiency of teacher's colleges have not been analyzed, despite they are important to Thai society, (iii) inefficient colleges are possibly able to improve their efficiency through the identification of the efficiency ranking and converge to the best-practice frontier, (iv) the colleges have a good advantage in knowing what factors mostly affect the technical efficiency, and (v) this study can determine the influencing factors that enable the effective increase in the financial efficiency of firms.

## 2. METHOD

### 2.1 data collection

The study obtained the secondary data from Office of the Higher Education Communication of Thailand. The data type is the cross section data that collected through the 40 teacher's colleges in 2011. These colleges are located in the capital, central, and regional areas throughout the country. They have been established in Thailand for a long time and have great influence on Thai society. They are not only the experienced, largest, and well-known in education but also they effectively operate in academic administration. Furthermore, some of colleges have many campuses located across Thailand in order to extensively offer an admission to the local students who have less opportunity in earning higher education.

As the number of teacher's colleges in Thailand has 40 universities, those can be classified into five groups based on the locations as Table 1.

Table 1: Teacher's colleges located in different locations of Thailand

| Location | College's name |
|---|---|
| Bangkok (the capital of Thailand) | 1. Suan Sunandha Rajabhat University |
| | 2. Suan Dusit Rajabhat University |
| | 3. Chandrakasem Rajabhat University |
| | 4. Phranakhon Rajabhat University |
| | 5. Dhonburi Rajabhat University |
| | 6. Bansomdejchaopraya Rajabhat University |
| North | 7. ChiangMai Rajabhat University |
| | 8. Chiangrai Rajabhat University |
| | 9. Lampang Rajabhat University |
| | 10. Uttaradit Rajabhat University |
| | 11. Pibulsongkram Rajabhat University |
| | 12. Kamphaengphet Rajabhat University |
| | 13. Nakhon Sawan Rajabhat University |
| | 14. Phetchabun Rajabhat University |
| Northeast | 15. Udon Thani Rajabhat University |
| | 16. Rajabhat Maha Sarakham University |
| | 17.Loei Rajabhat University |
| | 18. Sakon Nakhon Rajabhat University |
| | 19. Nakhon Ratchasima Rajabhat University |
| | 20. Buriram Rajabhat University |
| | 21. Surindra Rajabhat University |
| | 22. Ubon Ratchathani Rajabhat University |
| | 23. Kalasin Rajabhat University |
| | 24. Roi Et Rajabhat University |
| | 25. Chaiyaphum Rajabhat University |
| | 26. Sisaket Rajabhat University |
| Central | 27. Phranakhon Si Ayutthaya Rajabhat University |
| | 28. Rambhai Barni Rajabhat University |
| | 29. Rajabhat Rajanagarindra University |
| | 30. Thepsatri Rajabhat University |
| | 31. Valaya Alongkorn Rajabhat University |
| | 32. Phetchaburi Rajabhat University |
| | 33. Kanchanaburi Rajabhat University |
| | 34. Nakhon Pathom Rajabhat University |
| | 35. Muban Chombueng Rajabhat University |
| South | 36. Suratthani Rajabhat University |
| | 37. Nakhon Si Thammarat Rajabhat University |
| | 38. Phuket Rajabhat University |
| | 39. Songkhla Rajabhat University |
| | 40. Yala Rajabhat University |

**2.2 analysis strategies**

Two-procedure concept of super-efficiency data envelopment analysis (SE-DEA) together with Tobit regression was used for the research's approaches. The concept of SE-DEA proposed by Anderson and Petersen (1993) was firstly conducted to assess the differently efficient scores of decision making units (DMUs). After technical efficiency scores were precisely reported by SE-DEA model, the Tobit regression was finally analyzed to consider how factors affecting the efficient scores.

**2.3 data envelopment analysis (DEA)**

Concept of data envelopment analysis (DEA) is, therefore, necessary to know before going through the SE-DEA model. DEA was initially proposed by Farrell (1957). He adopted the principle of frontier analysis for firm's efficiency assessment. Later, Charnes, Cooper, & Rhodes (1978) consolidated this concept as a nonparametric analysis in using efficiency measurement. DEA uses a linear programming methodology to convert inputs used

into outputs produced (Charnes, Cooper, & Rhodes, 1981). The attribution of this method is an unfunctional model that is able to analyze multi-inputs and multi-outputs. In addition, DEA defines a "frontier" in order to compare the relative performance of units/firms against the best producers. The efficiency score in DEA model is ranged from zero to one. The highest score (one) defines maximum efficiency, while a score of less than one shows a firm's inefficiency, indicating the relative displacement away from the frontier. The two ways to consider efficiency are to produce a greater quantity of outputs with the same number of inputs and to use fewer levels of inputs with the same quantity of outputs.

Moreover, the DEA concept is popularly used in measuring productive efficiency of units/firms by the consideration of multi-inputs and outputs. The qualitative and quantitative variables can be analyzed at a time through mathematical linear program in the purpose of finding the cause of inefficiency. Consequently, many researchers have conducted related studies based on this concept. Some researchers used the DEA approach to analyze the technical efficiency for their studies (Allen & Thanassoulis, 2004; Gattoufi, Oral, & Reisman, 2004; Hermans, Brijs, Wets, & Vanhoof, 2009; Wu, Xie, & Zhao, 2010).

The different concept of DEA depends on whether it is an input-oriented or output-oriented model and whether its condition presents a constant or variable-return-to-scale model. The input-oriented DEA model tries to minimize quantity of input, producing the same level of outputs as the unit in question. Meanwhile, the output-oriented DEA model finds the way to maximize quantity of output with the same amount of inputs as the unit in question. The constant-return-to-scale (CRS) model supposes that output level is proportional to the input level for a given unit. On the other hand, the variable-return-to-scale (VRS) model allows the output level is proportionally higher or lower than an increase in inputs.

As adapted from Charnes, Cooper, & Rhodes (1981), the output-oriented CCR-DEA model measure the efficiency scores $(E_j)$ for peer decision making units or DMUs ($j$ = 1, … , $z$). The efficiency assessment depends on the selected outputs ($Y_{ai}$, $a$ = 1, … , $n$) and inputs ($X_{bi}$, $b$ = 1, … , $m$), expressed by the linear programming methodology:

$$\text{Maximize: } E_j = \sum_{a=1}^{n} v_{aj} Y_{aj} \tag{1}$$

$$\text{Subject to the constraints: } \sum_{b=1}^{m} u_{bj} X_{bj} = 1 \tag{2}$$

$$\sum_{a=1}^{n} v_{as} Y_{as} \leq \sum_{b=1}^{m} u_{bs} X_{bs} \tag{3}$$

$$v_{aj}, u_{bj} > 0 \text{ for all } a, b, \text{ and } j. \tag{4}$$

The observed outputs $(Y_{aj})$ and inputs $(X_{bj})$ are treated as the constants. Output weight $(v_{aj})$ added to maximize the efficiency of unit $j$, while input weights $(u_{bj})$ conform the proposed constraints of Equation (2). Finally, the technical efficiency of each DMU $(j)$ is solved by adapting the linear program, providing the score with an upper bound of one. This upper limit is forced by constrainted set as Equation (3).

**2.4 super-efficiency data envelopment analysis (SE-DEA)**

Under the basic CCR-DEA concept, the unit showing the best performance with the efficiency score of one indicate that they are a part of the production frontier which cannot be compared with its frontier. A more advanced technique that incorporates the basic DEA principle has been termed "Super-efficiency Analysis" introduced by Andersen and Petersen (1993). They created the specific technique by relaxing the upper bound of one for the efficiency firm in the basic DEA model in order to compare with its production frontier empirically. Therefore, full information of such efficiency firms is restored without limitation of the upper bound. This technique has definitely consolidated the standard concept of DEA. Super-efficiency scores will be greater than or equal to one implying that the analysis provides the additional information regarding the relative performance of the efficiency firms. This technique leads to the determination of the relative placement regardless of the inefficiency firms. Since inefficient firms are unable to expand the range of

production frontier, the super-efficiency analysis will not change the technical score of inefficient firms. This will certainly be under the territory of the production frontier. Having an unlimited bound of measurement, the efficiency is able to give more information of the scores. Therefore, the determinant affecting the efficient score can further be analyzed.

An alternative method of DEA that allows the upper bound for the efficient units greater than or equal to one has been named "Super-efficiency Analysis". This distinctive technique not only can eliminate the upper bound of technical efficiency, but also provide the additional information regarding the relative performance of efficiency units. Regardless of the modified technique, the unit is still efficient when it is included in the determination of the frontier. Thus, the efficiency units located on the frontier implies that the unit is unable to be no less or more efficient when comparison with the other units along the frontier as well as the efficiency units are above the frontier, performing more efficiency than the other units. This technique is outstanding research method and has ability to reveal unrestricted data potentially.

Having an unbounded efficiency measurement extensively increases an ability to study the factors affecting the efficiency score for any given firms/units. Recently, several papers applied the technique of super-efficiency data envelopment analysis in using the main research's method. Such distinctive researches could be found in Zhu (2001), Chen (2005), Banker & Chang (2006), Khodabakhshi (2007), and Chen, Deng, & Gingras (2011).

Andersen and Petersen (1993) stated that the concept of super-efficiency DEA model can be computed by using the linear programming methodology as follows:

$$\text{Maximize: } E_j = \sum_{a=1}^{n} v_{aj} Y_{aj} \tag{5}$$

$$\text{Subject to the constraints: } \sum_{b=1}^{m} u_{bj} X_{bj} = 1 \tag{6}$$

$$\sum_{\substack{a=1 \\ s \neq j}}^{n} v_{as} Y_{as} \leq \sum_{\substack{b=1 \\ s \neq j}}^{m} u_{bs} X_{bs} \tag{7}$$

$$v_{aj}, u_{bj} \geq 0 \text{ , for all } a, b, \text{ and } j. \tag{8}$$

The linear program methodology is used to solve the above formulation for each unit, allowing continuous technical efficiency score with unrestricted bound. The difference of super-efficiency and traditional data envelopment analysis (CCR-DEA) models is the exclusion of unit *j* as the constraint set in Equation (7). As described before, when the unit *j* is included in Equation (7), making the maximum score of efficiency can be limited to one. Notably, the under evaluation unit is no longer in the second constraint ($s \neq j$). Thereby, the outputs are maximized without restriction.

**2.5 outputs and inputs measured in SE-DEA model**

SE-DEA methodology is used in this research in order to show the empirical results are consistent with those obtained from the CCR-DEA model. Moreover, the SE-DEA can provide additional information regarding the determinants of efficiency by using the smaller sample sizes. Interestingly, this paper employed three outputs and four inputs measured in the SE-DEA model. The number of publications *(Y1)*, graduated students *(Y2)*, and employed students *(Y3)* were conducted as the outputs measured. Meanwhile, four inputs comprise the number of teachers *(X1)*, students *(X2)*, full-time staffs *(X3)*, and part-time staffs *(X4)*.

In terms of outputs, the variable of publications *(Y1)* includes the manuscript that published in both international and internal academic journals. The variable of graduated students *(Y2)* was summarized only the students who expect to graduate and graduated in academic year 2011. In addition, the employed students' variable *(Y3)* included part-time and full-time jobs. On the other hand, the number of teachers *(X1)* included the number of lecturers, assistant professors, associated professors, and professors. Undergraduate students and graduate students were counted by the variable of students *(X2)*. The variable of full-time staffs *(X3)* and part-time staffs *(X4)* consist of the number of officials who are working at affiliated campuses.

**2.6 Tobit model**

Tobit model is further employed to analyze what determinants affect the technical efficiency. The Tobit model is also known as truncated or censored regression model. The technical efficient function of teacher's colleges in Thailand is written as Equation 1:

$$E_i = \alpha + \beta_1 P_i + \beta_2 I_i + \beta_3 S_i + \beta_4 Y_i \, e \quad (9)$$

where, $E_i$ indicates the technical efficiency scores of teacher's colleges, $P_i$ indicates personnel's quality, $I_i$ indicates intensity funds, $S_i$ indicates research and development, $Y_i$ indicates established years of the teacher's colleges, *i* indicates the number of teacher's colleges or decision-making units (DMUs), $\alpha$ indicates a constant term, $\beta_1$ - $\beta_3$ indicate the coefficient of independent variables, and *e* indicates an error term which $e \sim N(0, \sigma^2)$.

When SE-DEA scores are transformed into the dependent variable *(Y)*, the coefficients of the Tobit model can be interpreted as it is a coefficient of an ordinary least squares regression. This function indicated proportionate change of dependent variable with respect to one unit change in independent variables, while holding other factors constant.

**2.7 Hypotheses**

This study proposed some hypotheses to determine how factors affect the technical efficient score of Thai teacher's colleges.

*Hypothesis 1*: The teacher's college that has high personnel's quality *(P)* is likely to have high technical efficiency scores *(E)*.

*Hypothesis 2*: The teacher's college that has more intensity funds *(I)* is likely to have high technical efficiency scores *(E)*.

*Hypothesis 3*: The teacher's college that has more researches and developments *(R)* is likely to have high technical efficiency scores *(E)*.

*Hypothesis 4*: The teacher's college that has established for many years *(Y)* is likely to have high technical efficiency scores *(E)*.

**3. FINDINGS**

**3.1 super-efficiency's results**

The technical efficiency scores and ranks of the 40 teacher's colleges in Thailand are illustrated in Table 2. As the special technique of super-efficiency shows a considerable difference concerning all scores of technical efficiency, including inefficient firms, the teacher's colleges present different technical efficiency. There were seven DMUs with the score of more than one, namely, Kalasin Rajabhat University, Phranakhon Si Ayutthaya Rajabhat University, Ubon Ratchathani Rajabhat University, Thepsatri Rajabhat University, Dhonburi Rajabhat University, Rajabhat Rajanagarindra University, and Pibulsongkram Rajabhat University. Surprisingly, with the same approach, 33 teacher's colleges were inefficient in technology, including many colleges that located in Bangkok and central of Thailand such as Suan Dusit Rajabhat University and Suan Sunandha Rajabhat University. Comparing among the DMUs, Kalasin Rajabhat University performs the maximum efficiency score with 2.6934 and represents the best in technical performance. On the other hand, Phranakhon Rajabhat University has the minimum efficiency score with 0.1922 and shows the worst in groups.

Generally, the scores of the first seven DMUs could not be provided by the traditional data envelopment analysis (DEA) model. However, additional information could be obviously derived due to the special technique of super-efficiency method (Andersen and Petersen, 1993). The results also show a considerable difference concerning all scores of the technical efficiency, including the 33 inefficient firms. Based on the results shown in Table 2, several colleges need to improve a lot in their technical efficiency, especially the college that has less efficiency. For the colleges obtained efficient scores more than one, they have to keep their standardization so that they can compete with the others. Finally, the super-efficiency scores provide additional information for the purpose of studying factors affecting the technical efficiency scores of teacher's colleges by using Tobit regression in the next step.

Table 2: Technical efficiency scores of 40 Teacher's colleges in Thailand

| Rank | DMU | Score | Rank | DMU | Score |
|---|---|---|---|---|---|
| 1 | Kalasin Rajabhat University | 2.6934 | 21 | Surindra Rajabhat University | 0.6367 |
| 2 | Phranakhon Si Ayutthaya Rajabhat University | 2.1217 | 22 | Kamphaengphet Rajabhat University | 0.6000 |
| 3 | Ubon Ratchathani Rajabhat University | 1.6710 | 23 | Muban Chombueng Rajabhat University | 0.5916 |
| 4 | Thepsatri Rajabhat University | 1.5983 | 24 | Roi Et Rajabhat University | 0.5373 |
| 5 | Dhonburi Rajabhat University | 1.5246 | 25 | Nakhon Si Thammarat Rajabhat University | 0.5354 |
| 6 | Rajabhat Rajanagarindra University | 1.3971 | 26 | Buriram Rajabhat University | 0.5157 |
| 7 | Pibulsongkram Rajabhat University | 1.1244 | 27 | Suan Dusit Rajabhat University | 0.4971 |
| 8 | Sisaket Rajabhat University | 0.9762 | 28 | Suratthani Rajabhat University | 0.4898 |
| 9 | Sakon Nakhon Rajabhat University | 0.9406 | 29 | Rambhai Barni Rajabhat University | 0.4508 |
| 10 | Chaiyaphum Rajabhat University | 0.9100 | 30 | Nakhon Pathom Rajabhat University | 0.3942 |
| 11 | Valaya Alongkorn Rajabhat University | 0.8768 | 31 | Suan Sunandha Rajabhat University | 0.3616 |
| 12 | Chiangrai Rajabhat University | 0.8378 | 32 | Songkhla Rajabhat University | 0.3511 |
| 13 | Loei Rajabhat University | 0.8205 | 33 | Phetchabun Rajabhat University | 0.3470 |
| 14 | Kanchanaburi Rajabhat University | 0.7652 | 34 | ChiangMai Rajabhat University | 0.3226 |
| 15 | Phetchaburi Rajabhat University | 0.7642 | 35 | Yala Rajabhat University | 0.3202 |
| 16 | Bansomdejchaopraya Rajabhat University | 0.7002 | 36 | Chandrakasem Rajabhat University | 0.2977 |
| 17 | Udon Thani Rajabhat University | 0.6755 | 37 | Lampang Rajabhat University | 0.2713 |
| 18 | Nakhon Sawan Rajabhat University | 0.6626 | 38 | Phuket Rajabhat University | 0.2422 |
| 19 | Uttaradit Rajabhat University | 0.6598 | 39 | Rajabhat Maha Sarakham University | 0.2056 |
| 20 | Nakhon Ratchasima Rajabhat University | 0.6449 | 40 | Phranakhon Rajabhat University | 0.1922 |

**3.2 Tobit regression's results**

To further investigate the effects of concerned variables on the technical efficiency of those teacher's colleges, the study follows with a Tobit regression. The regression's model consists of three independent variables, personnel's quality (*P*), intensity funds (*I*), research and development (*S*), and established years *(Y)*. Super-efficiency scores derived from Table 2 were served as the dependent variable *(E).* Those variables efficiently function to carry out differently significant levels. The empirical results analyzed by the Tobit regression model are shown as Table 3.

Table 3: Tobit regression's results

| Variable | | Coefficient | Std. Error | Z-Statistic | Prob |
|---|---|---|---|---|---|
| Constant | (c) | 1.2041** [1] | 0.5516 | 2.1829 | 0.0290 |
| Personnel's Quality | (P) | 0.0980*** [1] | 0.0275 | 3.5668 | 0.0004 |
| Intensity Funds | (I) | 0.4538** [1] | 0.1737 | 2.6126 | 0.0235 |
| Research & Development | (R) | 0.0070* [1] | 0.0042 | 1.6636 | 0.0962 |
| Established Years | (Y) | - 0.0222 ns [2] | 0.0484 | -0.4589 | 0.8985 |

[1] *, **, and *** indicate the significant level at 10, 5, and 1%, respectively.
[2] *ns* indicates non-significant level

According to the observed results, three variables have different significance at various confidence levels. Considering the factor of personnel's quality (*P*), this factor has a positive sign which is consistent with the assumption. An increasing more personnel's quality would increase the technical efficiency with the significant level at one percent. When personnel's quality arises 9.80%, the efficient scores would increase 100%. Therefore, the personnel's quality is the variable that directly affects an increasing of the technical efficiency score. Those teacher's colleges need to hire a person who have high ability performance in order to improve the technical efficiency for the whole perspective.

The factor of intensity funds *(I)* was consecutively considered. This factor expected to show a positive sign which is consistent with the basic hypothesis that increasing of intensity funds would make the technical efficiency up with the significant level at five percent. The intensity funds that increase at 45.38% will make the technical efficient score elevate up to 100%. Undoubtedly, this factor has an ability to affect the technical efficiency scores. Refer to the result; it can say that, it will be better to have more funds, especially research's funds.

Next, the factor of research and development *(R)* show a positive sign which is consistent with the hypothesis. An increasing the number of research and development would increase the technical efficiency at ten percent significant level. When number of researches and developments increase 0.7%, making the technical efficiency arise to 100% successively. So, the technical efficiency scores could increase by encouraging a college to produce more researches and developments. This factor is very important to the country's development because policy-makers will guide the policy based the research from those colleges.

Finally, the factor of established years *(Y)* showed a negative sign which is surprisingly inconsistent with the assumption. Based on the analysis of Z-Statistic, the established year's variable is unable to explain the technical efficient score at any significant level because the result showed non-significant factor. This factor has been neglected when considering how determinants affect the technical efficiency. Its result can be referred that the technical efficiency of teacher's colleges in Thailand will be fluctuated regardless how many year such a college established in a community.

In conclusions, based on the Tobit regression model, the technical efficient score of those teacher's colleges in Thailand could be improved through three main variables, personnel's quality *(P)*, intensity funds *(I)*, and research and development *(R)* with differently significant levels. Meanwhile, the variable of established years *(Y)* could empirically not explain in this research.

## 4. DISCUSSION AND CONCLUSIONS

### 4.1 discussion

This study has shown the simplicity and advantage of the two-procedure concept; thus encouraging researchers to employ super-efficiency data envelopment analysis (SE-DEA) as well as Tobit regression to efficiency measurement a variety of aspects such as universities, hotels, insurance companies, science's schools, hospitals, etc. The use of super-efficiency scores provide more clear advantages than the traditional data envelopment analysis (DEA) models because the super-efficiency model uses all information in the studied samples by relaxing the upper boundary of the standard method.

The two-procedure concept could effectively function to carry out the technical efficiency of the 40 teacher's colleges in Thailand. The special technique of super-efficiency model is able to provide additional information of the technical efficiency scores of more than one. Besides, the Tobit regression is a suitable function that has a great potential to analyze factors affecting the technical efficiency for decision-making units (DMUs). These methods are effective technique in analyzing uncensored data.

As the 33 teacher's colleges could not reach the technical efficiency, revealing the situation of their operations in 2011 was not quite good. This reflects the big problems in educational management of Thailand. An academic institution must achieve the technical efficiency as much number as possible so that the potential in human development would increase consecutively. Since education is fundamental factor to develop the country, the country will shift from the developing country to developed country if Thailand has many efficient colleges.

For the developing country like Thailand, it is important to encourage the teacher's colleges to improve their technical efficiency because they closely located in local community and are able to reach a local student who will be the national force in the future. Furthermore, the variables of personnel's quality, intensity funds, and research and development are reasonable determinants in significantly affecting technical efficiency as the expected results of basic hypotheses.

### 4.2 conclusions

Teacher's colleges play an important role towards Thailand's education. They offer more skills and knowledges to a student who studies teaching program and wants to develop a local community. The 40 teacher's colleges established throughout Thailand comprise more backgrounds and expert in special study's fields. However, technical efficiency and determinants affecting the efficient score are the interesting issues that encourage to study. Therefore, two-procedure concept, adopting super-efficiency as well as Tobit regression analysis, is employed to be the research's methods.

The empirical results of super-efficiency data envelopment analysis (SE-DEA) showed that there are only seven out of forty colleges that perform the higher efficiency more than one. Meanwhile, nearly three-fourth of teacher's colleges faced the technical inefficiency. The best performance in technical efficiency was Kalasin Rajabhat University, located in the northeastern regions of Thailand. On the other hand, the teacher's college that performed poorly in technical efficiency was Phranakhon Rajabhat University, located in Bangkok, the capital of Thailand.

Considering factors affecting the technical efficiency scores, the results indicated that the first, second, and third hypotheses could be accepted at differently significant levels. Only, the fourth hypothesis was rejected because its variable showed non-significance. Three factors, personnel's quality *(P)*, intensity funds *(I)*, research and development *(R)*, are able to increase the technical efficiency. Meanwhile, the variable of established years *(Y),* could not lead to explain in the Tobit-regression model. It can be said that, such three variables place importance to technical efficiency of teacher's colleges in Thailand.

Lastly, the efficiency scores and ranks obtained from SE-DEA model could help inefficient colleges to improve their technical performance in order to be the leader among teacher's colleges in Thailand. Since there were many inefficiency teacher's colleges, their results have reflected some operation problems that have been occurred in educational sector of Thailand. This aspect shows that higher academic institutes need to improve their operations so that they can complete with the other academic institutes in the stage of international and internal levels.

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