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Economic efficiency of feedlot cattle farms in Thailand

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Abstract

The main purpose of this study is to measure and investigate factors affecting economic inefficiency of feedlot cattle farms in Thailand. The data envelopment analysis (DEA) approach and farm-level cross-sectional survey data of cattle farms in two provinces of the Southern Region in Thailand are used to estimate economic efficiency scores. Then, a Tobit regression is estimated and examined the effect of farm-specific socio-economic and management factors on farm efficiency. Through this, the likelihood of changes in inefficiency scores is explained by the above factors. The empirical results suggest two important findings. First, the economic efficiency scores of some farms were considerably low. Second, there is confirmation that farm size, the considerable variability of cattle breed and the difference in concentrated feed used have influenced the economic inefficiency of cattle farms while the differences in producers' age, education and experience, rough feed, the number of farm visits per year and belonging to farmer groups do not have different impacts on economic efficiency in Thai cattle production in different farms.

Keywords: Thai feedlot cattle farms, data development analysis, economic inefficiency, Tobit regression, socio-economic and management factors

1. Introduction

Cattle raising has been identified as 1 of 14 main products in Thai agriculture. Although, the growth rates of cattle farms and heads have been recognised, beef production in Thailand has not been sufficient for domestic consumption. Therefore, production improvement is the main concern of this sector.

There are at least four causes for worry concerning the future development of cattle production in Thailand. First, cattle are normally raised by small farms. Second, the majority of beef/cattle come from the Northeast, which is also the poorest region of Thailand. Third, a few studies indicate that, at the farm level, the key constraints are the availability of know-how on farming, inputs and disease problems. Finally, the Thai government has significantly influenced Thai agriculture through a variety of policies over the past three decades. They could cause imperfect competition in those inputs and in output markets. Because of the above factors, economists and policy makers have raised the question of the economic efficiency of cattle production in Thailand, especially at farm level.

The main purpose of this study is to measure and investigate factors affecting economic inefficiency of cattle farms in Thailand. To estimate efficiency scores, the data envelopment analysis (DEA) approach is applied to farm-level cross-sectional survey data of cattle farms in two districts of two provinces in the Southern Region of Thailand. Previous studies have investigated economic efficiency and its components at both the farm and aggregate levels in Thai agriculture (e.g., Krasachat, 2000, 2001a, 2001b, 2004a, 2004b). However, this study, to the best of our knowledge, has been the first application of DEA in order

to measure and explain economic efficiency and its components of feedlot cattle farms in Thailand. This enables more detailed understanding of the nature of economic efficiency in cattle production in Thailand.

This paper is organised into five sections. Following this introduction, the analytical framework is described. Next, data and their sources are described. The last two sections cover the empirical findings of this study, and conclusions and policy implications.

2. Analytical Framework

Following Fare, Grosskopf and Lovell (1985), Coelli et al. (2005) and Sharma, Leung and Zaleski (1999), the VRS model is discussed below.

Let us assume there is data available on K inputs and M outputs in each of the N decision units (i.e., farms). Input and output vectors are represented by the vectors x_i and y_i, respectively for the i-th farm. The data for all farms may be denoted by the $K \times N$ input matrix (X) and $M \times N$ output matrix (Y). The envelopment form of the input-oriented VRS DEA model is specified as:

$$\begin{aligned} &\min_{\theta,\lambda} \theta, \\ &\text{st} \quad -y_i + Y\lambda \geq 0, \\ &\qquad \theta x_i - X\lambda \geq 0, \\ &\qquad N1'\lambda = 1 \\ &\qquad \lambda \geq 0, \end{aligned} \tag{1}$$

where θ is the input technical efficiency (TE) score having a value $0 \leq \theta \leq 1$. If the θ value is equal to one, indicating the farm is on the frontier, the vector λ is an $N \times 1$ vector of weights which defines the linear combination of the peers of the i-th farm. Thus, the linear programming problem needs to be solved N times and a value of θ is provided for each farm in the sample.

In order to investigate the economic efficiency or cost efficiency, the cost minimisation DEA is specified as:

$$\begin{aligned} &\min_{\lambda,x_i^*} w_i' x_i^*, \\ &\text{st} \quad -y_i + Y\lambda \geq 0, \\ &\qquad x_i^* - X\lambda \geq 0, \\ &\qquad N1'\lambda = 1 \\ &\qquad \lambda \geq 0, \end{aligned} \tag{2}$$

where w_i is a vector of input prices for the i-th farm and x_i^* is the cost-minimising vector of input quantities for the i-th farm. The total economic efficiency or economic efficiency can be calculated as:

$$\text{EE} = w_i' x_i^* / w_i' x_i . \tag{3}$$

Allocative efficiency can be specified and calculated as:

$$\text{AE} = \text{EE/TE}. \tag{4}$$

Note that this procedure will include any slacks into the allocative efficiency measure, reflecting an inappropriate input mix (Ferrier and Lovell 1990). Efficiency scores in this study are estimated using the computer program, **DEAP** Version 2.1 described in Coelli (1996).

In order to examine the effect of farm-specific socio-economic and management factors on farm efficiency, a regression model is estimated where the level of inefficiency from DEA is expressed as a function of these factors. However, as indicated in Dhungana, Nuthall and Nartea (2000), the inefficiency scores from DEA are limited to values between 0 and 1. That is, farmers who achieved Pareto efficiency always have an inefficiency score of 0. Thus, the dependent variable in the regression equation cannot be expected to have a normal distribution. This suggests that the ordinary least squares regression is not appropriate. Because of this, Tobit estimation, as mentioned in Long (1997), is used in this study.

3. Data

The data used in this study is based on a direct interview survey of 100 randomly selected cattle farm households in two districts of two provinces in the Southern Region of Thailand. The selected districts were Cha-am (Phetchaburi) and Pran Buri (Prachuap Khiri Khan) which are predominantly cattle producing areas in the Southern Region of Thailand. The data were for 2004. The farms selected were owner operated and had faced a similar economic and marketing environment for inputs and outputs.

One output and six inputs are used in the empirical application of this study. The five inputs groups are concentrated feed, rough feed, feeder cattle, family labour, land and "other inputs". Because the variable of other inputs is measured in value terms, the calculation of the unit price for this input is far from satisfactory. Following Ferrier and Lovell (1990), the unit price of this input equals baht 1 for all farms. Note that land has been one of the most important factors of Thai cattle production. Because of lack of data on the price of land, the average expenditure of land rent (Ministry of Agriculture and Cooperatives, 2004) in the Southern Region (i.e., baht 4.54/rai) is used and also included in the variable of other inputs for all farms.

4. Empirical Results

Several farm-specific factors are analysed to assess their influence on productive efficiency. The farmer's age is defined in terms of years while the farmer's experience and education of cattle raising is also defined in terms of years and years of schooling, respectively. In addition, the amount of agricultural extension received by farmers is defined in terms of the number of farm visits per year. The number of cattle per farm is intended to examine the impact of farm size on the economic inefficiency of the cattle farms in Thailand while dummy variables introduced as proxy for cattle breed are employed to investigate the effects of differences in cattle breed on the economic inefficiencies of cattle farms. In addition, dummy variables are introduced as proxy for the differences in types of concentrated feed and rough feed used in different farms. Finally, the sample cattle farms also differ in terms of belonging to farmer groups which is represented by a dummy variable (1 for belonging to a farmer group, 0 for otherwise).

The empirical results indicate that there are significant possibilities to increase efficiency levels in Thai cattle farms. The producers who have used ready mixed cattle feed achieved higher levels of allocative and economic efficiencies and a smaller farm is likely to be economically more efficient compared to a larger one. In addition, the producers who have used native and Brahman mixed cattle are likely to achieve lower levels of allocative and economic efficiencies while there is no confirmation that of producers' age, education and experience, the differences in rough feed, the number of farm visits per year and belonging to farmer groups have influenced the technical, allocative and economic inefficiencies of cattle farms.

5. Conclusions and Policy Implications

This study applied the DEA approach to measure farm-specific economic inefficiency using the 2004 farm-level cross-sectional survey data of Thai cattle farms. Then, a Tobit regression is estimated and examined the effect of farm-specific socio-economic and management factors on farm efficiency.

There is confirmation that farm size, the considerable variability of cattle breed and the difference in concentrated feed used have influenced the economic inefficiency of cattle farms while the differences in producers' age, education and experience, rough feed, the number of farm visits per year and belonging to farmer groups do not have different impacts on economic efficiency in Thai cattle production in different farms.

The results indicate advantages in ready mixed cattle feed used by producers and small farms in Thai cattle production. Therefore, the development policies of the above areas should be used to increase the cost efficiencies of these inefficient farms in Thailand.

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