# Estimation of technical efficiency of broiler production in Peninsular Malaysia: A stochastic frontier analysis

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## Abstract

*This study analyzed the technical efficiency of poultry production in Peninsular Malaysia using the stochastic frontier production function analysis. Time series data were collected for this purpose. The frontier function involved variables such as farm, farmer and economic variables. An econometric technique of the stochastic frontier production function approach was applied whereby technical efficiency was measured together with a systemic inefficiency farm in the inefficiency model. The results showed that during the early period, technical progress was rather slow, but subsequently improved during the second period. This is due to changing structure and labor saving technologies which focus towards modernization of the broiler industry. However several policy reforms are needed to enhance the global competitiveness of Malaysian broiler industries especially pertaining to technology policy. It can be concluded that improved extension linkage to sensitize the producers of the need to use new technology such as close house systems. In addition, the government must boost efforts to produce and develop genetically improved breeds of poultry of a higher feed conversion ratio.*

***Keywords***: A stochastic frontier analysis, Technical efficiency, Broiler industry

## 1. Introduction

Poultry farming constitutes a major livestock activity in Peninsular Malaysia and poultry rearing has been popular and its development continues to expand resulting in one of the most important sectors of the animal husbandary with an annual output of more than RM250 million (Thuraisingham et.al, 1971). With the successful control of Ranikhet disease in the early 1950's, more farmers were interested in poultry farming, and by 1957 more and more large scale poultry farms with carrying capacity between 1,000 and 15,000 birds were established. By the year 1968, the development in the poultry industry had focused in the broiler or table bird sector. Between 1968 and 1973, the broiler number in the country increased by 44% from 2.9 million to 4.1 million. At present, the broiler industry is made up of many small farmers to highly specialised farmers with advanced technology mostly integrated in operations. The remainder of the poultry meat locally produced from culled breeders and layers of commercial farms.

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Broiler farm operations are basically located in the states of Johore, Perak, Pinang/P. Wellesley, Melaka, Selangor, which collectively carry about 75 to 80 percent of broiler population and the rest are from the East Coast states.

Thus the industry is able to transform from a backyard industry some fifty years ago to a modern poultry industry. Its expansion and growth is further boosted by the replacement of conventional type of housing with closed house system. Expansion of the poultry industry is also prominently involved vertical integration by the use of production contracts. This type of system made it possible for better coordination as well as better production control and increased efficiency, since economies of scale is manifested through hatcheries, processing and better marketing outlets. Contract farmers also benefited through technical advice, expertise, better market information and access to up to date technology from the integrators. Most of the big broiler players have moved up the ladder in the industry and become vertically integrated. This type of operation has a systematic control and a better type of organization which involve supply of inputs to the poultry farmers.

The broiler industry has continued to expand and considered as one of the largest food component sector in Malaysia. However, the industry is becoming less competitive due to high production cost. The broiler industry is dependent on imported materials for feed formulation. The export market growth is not favorable enough to support the industry. Finally, the outbreak of Avian Influenza also affected the productive performance of the industry. Hence, adaptation of new technology, right marketing strategy and disease control will ensure the future growth of the broiler industry.

The study of technical efficiency in poultry production is important. This study is primarily concerned with investigating the productive efficiency of poultry producers since efficiency in production is important especially in agriculture, livestock and industrial production. A country which is dependent on agriculture, focuses more attention to this sector, so that a substantial amount of allocation goes to building up infrastructures, such as roads, water supply and a proper drainage system.

## 2. Literature review

Lately, efficiency measurement has received more attention and become a centre of focus for many research. Extensive research has been developed to this field which has resulted in new technique being developed to address related issues pertaining to efficiency measures. Subsequently, a methodology known as parametric approach was developed and now known as stochastic frontier approach. This approach uses functional form which reflects the technological practices associated with the production process. This approach allows for the random error such as bad weather, management practices, and insufficiency incorporated in the model. In addition, proper choice of functional form is important so that measurement error is minimized.

One of the most popular functional forms is the Cobb-Douglas production function and is used by researchers namely Aigner, Lovell and Schmidt (1977), Meeusen and va dan Broeck (1977), Battese, Coelli and Colby (1989) and Mahedevan (2000). In recent years, the translog form has become more popular among researchers and are adopted by Green( 1980), Khumbhaker( 1991), Lundrall and Battese (2000) and many others in these fields.

The Stochastic Frontier Analysis (SFA) was developed for some time, but recently it has received more attention from research in many fields. In studying the production process, one might be probably interested in behavioural few of inputs in relation to outputs without due respect to some biasness that might occur during the production process. As a result, maximum output beyond attainable by the firm during the production process, might be linked to market distortion for input factors. Since the maximum output is not attainable, the concept of frontier production function has been introduced, which means that no existing firm is able to surpass the frontier except for the most efficient one.

Many authors used this concept to measure the efficiency of a firm. For example Farrell (1957), proposed a measure of efficiency of a firm known as *technical efficiency*, which stressed the ability of a firm to obtain maximum output from a given sets of inputs.

A study on the technical efficiency of broiler farms in the central region of Saudi Arabia perhaps is most relevant to the present investigation (Khalid, 2001). He found that substantial technical inefficiency exists in broiler farms in the central region of Saudi Arabia. The mean technical efficiency was estimated to be 89 percent, 83 percent, and 82 percent for all, small, and large farms respectively. Based on the average of all the farms, we can conclude that on the average all the farms were producing output about 89 percent of the potential, with the present inputs used and the current technology being employed. This means that technical inefficiency caused actual production to fall below potential production by slightly less than 11 percent. However, the study by Irwis and Francis (2003), on the performance of broiler farms including technical efficiency showed the same result with mean technical efficiency estimated to be 89 percent. In order to improve technical efficiency, one of the ways is by reducing the level of employment of inputs by applying the proper inputs mix. However, in a similar study on the productivity and technical efficiency of poultry egg production in Nigeria, the average technical efficiency was 0.763 (Ojo, 2003). Thus, in the short run, there is a scope for further improvement by 23.7% if the new technology and techniques used by the best practised farms were adapted. Khalid Al-Rwis (2001), investigated the broiler

production in Saudi Arabia using the non-parametric approach of data envelopment analysis (DEA), with constant and variable returns to scale. The results showed that the mean technical, allocative and economic efficiencies under variable returns to scale (VRS) were 81 percent, 81.9 percent and 66.4 percent respectively. This approach is less efficient when compared to the method employed earlier.

Generally, efficiency measurements have received special attention by many researchers. The two most popular functional forms are the Cobb-Douglas and the Translog models. Originally the Cobb-Douglas was applied by many researchers such as Aigner, Lovell and Schmidt in 1977. Subsequently, the Translog model had been adopted by Green (1980), Khumbhaker (1991), Lundrall and Batesse (2000). Since maximum output cannot be attainable during the production process, the concept of frontier has been introduced. Following this, Farrel (1957) used this concept to measure technical efficiency based on the ratio of observable output to potential output. The short fall of observed output were attributed to technical inefficiency. Hence, Stochastic Frontier Analysis recognised the existence of technical inefficiency and random error which is not under the control of farmers.

Stochastic Frontier models are equipped with two components. The first is known as the random error, while the second component is the inefficiency parts. Following this, Stochastic Frontier model is also often referred as composed error model. Finally, in empirical literature, the Stochastic Frontier analysis has been practiced and applied in industries such as agriculture and health industries.

## 3 Methodology for stochastic frontier

This study used the time series data covering the year 1998-2006, which were obtained from yearly report produced by the Veterinary Department of Malaysia. Much of the microeconomic theory implicitly assumes a certain kind of framework and is concerned with examining the major economic forces which operate within it (Hugh Gravelle and Ray Rees, 1993). It is assumed that a firm will act rationally and show some kind of optimizing behaviour. In other words, a producer is assumed to seek the best alternative out of possible set of alternatives open to him. For example, to determine the output supply and factor demand equations for firms with optimising behaviour, either profit maximising or cost minimising firms, two different approaches which can be primal or dual approach are needed.

The aim of a producer or a firm is to achieve maximum profit. Secondly, to quantify the amount of labour machinery and raw materials needed in the production process. Finally, a producer or a firm try to minimise the cost of production. Thus, a firm has two alternatives to arrive at optimum level that is either cost minimising or profit maximising. As a result, a producer is confronting with an optimization problem, in

which case, a producer is not in its best practice. Accordingly, it creates a gap between a potential output and an observed output which is of interest to many researchers. On this score, it would be beneficial to measure the inefficiency parts of the producer and the extent by which the distances it creates which involve the efficiency of a firm.

Towards this end, Farrell (1957) proposed a measure of efficiency of a firm which is made up of two components: *technical efficiency,* which reflects the ability of a firm to obtain maximal output from a given sets of input whereas the *allocative efficiency* reflects the ability of a firm to use the inputs in optimal proportions, given their respective prices. These two measures are further elaborated based on either input or output-oriented measures. As a result, efficiency measurement is considered either from input or output oriented measures. Secondly, efficiency is dynamic and it changes through time, which is either a time-variant or a time-invariant-technical efficiency.

Most of the empirical research on productivity and technical efficiency depends on the economic theory of production which describes a well-defined relationship between input and output. The substantial growth in productivity depends on many factors such as the quantitative expansion of physical inputs (labour and capital), while total factor productivity (TFP) growth measures the qualitative improvement in factor inputs and efficiency. At the national level, growth of the total productivity (TFP) reflects the portion of growth in gross domestic product that is not explained by the growth in inputs. At the unit level, growth of the total productivity (TFP) implies the upgrading of skilled manpower, application of best technology, creation of new technology, better management policies, and inculcation of new work ethics. Thus, it can be seen that output growth can be explained by three obvious elements namely change in technical efficiency, scale effects and technological progress that had taken place.

On the other hand, computation of technical efficiency requires a decomposition of the residual (stated earlier) into separate estimates of measurement error and technical inefficiency and the latter is both time varying and firm specific. Finally, this study employed a method proposed by researchers such as Battese and Coelli (1995).

Battesse and Coelli (1995) provided a model where inefficiency effects are incorporated and can be written as:-

(1) *y*¡ = *f*(**x**¡ , ) + e¡ = *f*(**x** , ) + ¡ - ¡

Where, ¡ is the output from firm i

is the vector of unknown input coefficients **X** is the matrix of input variables

¡ is the random error i

¡ is the technical inefficiency i

Both ¡ and ¡ are the causal effect of deviation in production from the frontier. ¡ is systemic component, which captures the remedial and non-remedial factors that exist related to the broiler industry that cause inefficiencies. These factors are beyond the control of farmers such as flood, labour market conflicts, strikes, natural catastrophe and left-out explanatory variables. The ¡ are the random variables which are assumed to be independently, and identically distributed with zero mean and constant variance N (0, ), and independent of the m¡ . The ¡ is a non-negative term which represents the various combined effects of socio-economic organizational factors that hindered a producer from obtaining its maximum output. m¡ are assumed to account for technical inefficiency in production, independent and identically distributed as truncation at zero of the normal distribution ( , ). When a firm is fully efficient, then m takes the value of 0, and when a firm faces uncertainty, m takes the value of less than zero. In other words, the value of m which is firm specific, reflects its ability to produce at its present level. The model defined by equation 1 is referred to as the stochastic frontier production function; hence it could be rewritten as follows,

*(2)* *y*¡ = *f*(**x** , ) + exp ¡ TE¡

The technical efficiency of a firm is defined as a ratio between the observed output (Y¡) to the corresponding frontier output (Y¡) with the present technology usage.

(3) TE = $\dfrac{y_¡}{f(\mathbf{x}, \;) \,.\, \exp \;¡}$

In this case, f(**X**. ) represents the deterministic parts of production frontier. If TE= 1, it represents the best practice frontier firm, meaning that the production is efficient and lies on the border. On the contrary, if TE is less than 1, it represents the least technically efficient firm and lies below the frontier. Batesse and Coelli (1995) further defined technical inefficiencies in term of time period because the $m_s$

may change overtime as opposed to Lee and Taylor (1978) who measured the average efficiency by applying the truncated normal distribution. According to Batesse and Coelli (1995), most of the distributions (either half-normal or exponential distributions) have a mode at zero, then the possibility of occurrence of inefficiency effects are close to zero, meaning that most of the firms are efficient.

## 4. Econometric specification

The present study follows the framework of Battese and Coelli (1995) and it follows that productive functional forms need to be recognized. Specifically this study focuses the translog functional form and Cobb-Douglas form for obvious reasons. Firstly, the translog form is more flexible for inducing substitution effects across the inputs used in addition to its usefulness for estimation and approximation purposes, while

the Cobb-Douglas is commonly known for its simplicity. Accordingly, the functional forms (either the translog or the Cobb-Douglas) are subjected to the likelihood ratio test before final estimations are performed. The following translog and Cobb-Douglas models are proposed for the broiler industry in Peninsular Malaysia such as follows:

(4) Model $P_{m1}$:Translog: $\ln Y_i = \beta_0 + \beta_1 \ln K_i + \beta_2 \ln L_i + \beta_3 T + \beta_4 \ln(K_i)^2 + \beta_5 \ln(L_i)^2 + \beta_6 (T_i)^2 + \beta_7 \ln(K_i * L_i) + \beta_8 \ln(K_i * T_i) + \beta_9 \ln(L_i * T) + v_i - u_i$

(5) Cobb-Douglas: $\ln Y_i = \beta_0 + \beta_1 \ln K_i + \beta_2 \ln L_i + \beta_3 T_i + v_i - u_i$

Where:

*Y* Represents the output produced by a firm i ,

*L* Represents the input contributed by the labour force,

*K* Represents the input contributed by the capital in the production process while T stands for the spatial time effect,

$v_{it}$ Captures the statistical noise,

$u_i$ Represents the firm specific technical efficiency (time-invariant),

DM is the dummy variable to capture the break out of infectious diseases such as bird flu.

With reference to the technical inefficiency effect models, firm specific variables would be incorporated in the model which is as follows:

Model technical Inefficiency ($m_1$):

(6) $$M_1 = \beta_0 + \beta_1 DD + \beta_2 FD + \beta_3 W + \beta_4 T + \beta_5 T * W + \beta_6 T^2 + \beta_{10} dm_i + \varepsilon_{it}$$

Where,

*DD* Represent the dummy variable for disease (Bird flu) which is = 1, if there is a breakout, otherwise 0

*FD* Is the amount of feed used in metric tone

*W* Is the dummy variable for weather, unfavourable condition takes the value of 1, otherwise 0

*T* for time

*T* * *W* Is Cross term for time and weather

$T_2$ Is the squared term for time

m *t* Represents technical efficiency (time and firm specific),

Time factor is assumed as *T* = 1,2,3,...., 4),

These variables are included in the model to indicate their possible influence on the technical efficiencies of the broiler industry in Peninsular Malaysia.

For the technical efficiency effects, it could be presumably more robust models assuming technical efficiency to time-invariant or time-variant technical efficiency.

Thus, the former and the latter models are structured in the error component models. Accordingly, certain assumptions regarding the distribution of error component $\mu_{it.}$ are made .Truncation of the normal distribution with zero mean and $s^2$, that is~*N* (t, $s^2$), the distribution of the error term is half normal. On the other hand, if the specification parameter t is assumed to be greater than zero, that is t >0.

## 5 Results and discussion

The results of the computer analysis using the program FRONTIER 4.1 are presented in Table 1 below. For all the coefficients of inputs based on the maximum-likelihood estimates of the parameters of the stochastic frontier production function, given the inefficiency effects are also included. From the estimation of technical efficiency models, the value of the gamma estimated in this model is 0.98; hence, suggesting that most of the composite error variance is considered by the variance in this model. This also indicates that a larger proportion of error is due to the inefficiency incorporated with the production process and not due to the random error. This indicates the weakness in the inputs mix and the technology used during the study period which was responsible for slower growth of the poultry industry in Peninsular Malaysia.

For both models, that is the Cobb-Douglas and the Translog, the tests for the null hypothesis that there is no technical inefficiency effects (ö¡=0) is rejected. The results for the likelihood ratios are equal to 280.2 and 181.3 respectively, indicating that they are quite significant at 0.01 probability level. The results revealed that the inefficiency effects are significantly different from zero; as such the whole technical inefficiency model is capable of explaining the poultry industry technical inefficiency. Statistically, the results indicated that the disease ($ö_1$), feed price ($ö_2$), and weather ($ö_3$), are the dominant contributing factors to the technical inefficiency effects of the poultry industry in Peninsular Malaysia.

The estimate for the coefficient associated with disease, $d_1$ is small and negative but significant. The inclusion for this variable is for the fact that some regions in Peninsular Malaysia are more susceptible to harsh environment and therefore they are disease prone areas. The estimate for the coefficient associated with feed, $d_2$ is negative. This variable serves as a proxy for technical inefficiency. The inclusion of this variable denotes an unfavourable period where the production cost is spiralling, which may influence the price of broiler to increase. Due to this reason, the producers tend to be more innovative and efficient by employing new technology. The relationship is not quite strong, but it is significant.

The estimate for the coefficient weather, $d_3$, is negative and insignificant. The inclusion of this variable is to reflect the fact that environmental stress is usually confronted by many producers due to yearly occurrence of rainfall especially during the month of November and December. To contain the problem of stress in order to reduce mortality among the flocks, the producers made certain adjustments such as strategic locations for proper housing, and ensure sufficient supply of medications for the birds. These two measures may boost the industry by becoming more efficient thus reducing the overall technical inefficiency.

The coefficient for the variable '$T$' is negative which may suggest that the farmers are becoming more efficient thus the technical inefficiency reduced throughout the study period. I also incorporated the cross term, $d_{TW,}$ to determine the changes of the inefficiency effects with respect to time. However, the relation is weak and insignificant.

Lastly, I also incorporated the second order term for time ($T^2$) to determine the inefficiency effects with respect to time. The coefficient associated with this variable is positive and significant. This implies that changes in technical inefficiency may not occur in the short-run. The existence of technical change is bias with respect to broiler production which is due to its inherent temporal heterogeneity of farms. In other words, the existence of farms of different sizes makes it difficult to control, supervise and coordinate. The trend towards modernization finally will enhance productivity, which is labour intensive and more amenable to mechanization but at the expense of time lag. The other hypothesis of importance is the choice between the Translog and Cobb Douglas.

The Cobb-Douglas model which had been estimated using the log-likelihood function obtained from the estimation which was 280.2661 for the Cobb-Douglas and the estimation obtained for the Translog of 181.3631, the likelihood ratio (LR) could be calculated as -2{280.2661-(181.3631)} is -197.806. The test is to justify the additional seven X variables for the Translog function. This value is compared with the upper five percent points for the Chi-squares distribution which is 18.307. The result, (refer to Table 1) shows that from the X coefficients($\beta_j$=0) of the seven additional variables in the Translog model, five variables are not significantly different from 0, while the other two variables are significantly different from 0. Thus, the null hypothesis that Cobb- Douglas is an adequate representation of data is accepted, given the specifications of the Translog frontier. In this case, the relationship between Y-output and X-inputs could be better explained by the Cobb-Douglas function.

## 6. Efficiency score

Table 2 shows the technical efficiency scores for both the Cobb-Douglas and Translog stochastic frontier estimates of broiler production in Peninsular Malaysia. The average technical scores are 0.986 for Cobb-Douglas and 0.947 for Translog. With reference to the results obtained from Table 2, using the Translog, there is one best score obtained and almost close to perfect score of 0.993. This finding is quite contrasting from those obtained using the Cobb-Douglas frontier estimates with almost all the score close to

Table 1

*Maximum likelihood estimates of stochastic production frontier of broiler production*

| | Cobb-Douglas Production Function | Translog Production Function |
|---|---|---|
| ***Frontier Model:*** | 2.501 | 72.843 |
| Constant | (0.078)$^{NS}$ | (1.022)** |
| Capital $InX_1$ (no) | 0.060 | -15.998 |
| | (0.023)$^{NS}$ | (1.197)** |
| Labour $InX_1$ (no) | 0.938 | -3.871 |
| | (0.022)$^{NS}$ | (1.908)** |
| $1/2\,(InX_1)^2$ | | -2.391 |
| | | (0.144)$^{NS}$ |
| $1/2\,(InX_1)^2$ | | 1.793 |
| | | (0.129)$^{NS}$ |
| $1/2\,(InX_1)^2$ | | -0.53 1 |
| | | (1.005)** |
| $1/2\,(InX_1)^2$ | | 0.402 |
| | | (0.247)$^{NS}$ |
| $1/2\,(InX_1)^2$ | | 0.806 |
| | | (0.355)$^{NS}$ |
| $1/2(InX_1)^2$ | | 0.28 1 |
| | | (0.159)$^{NS}$ |
| $1/2(\,InX_1)^2$ | | -0.040 |
| | | (0.533)$^{NS}$ |
| *Inefficiency Model:* | | |
| Disease (No of Occurrence) | -1.405 | -2.63 |
| | (0.107)$^{NS}$ | (0.116)$^{NS}$ |

| | | | |
|---|---|---|---|
| Feed Price(High price) | ä$_2$ | 7.396 | -3.39 |
| | | (0.094)$^{NS}$ | (0.153)$^{NS}$ |
| Weather (occurrence of flood) | ä$_3$ | 5.034 | -0.826 |
| | | (0.105)$^{NS}$ | (0.834)$^{NS}$ |
| Time (technology effect) | ä$_4$ | -0.153 | -2.545 |
| | | (0.167)$^{NS}$ | (0.559)$^{NS}$ |
| | δ$_5$ | -0.371 | 0.421 |
| | | (0. 137)$^{NS}$ | (0.474)$^{NS}$ |
| | | Cobb-Douglas Production Function | Translog Production Function |
| | δ$_6$ | 0.134 | 1.214 |
| | | (0.099)$^{NS}$ | (0.272)$^{NS}$ |
| Sigma –squared | | 0.0 10 | 0.036 |
| | | (0.0009) | (0.006) |
| Gamma | | 0.999 | 0. 988 |
| | | (0.0002) | (0.004) |
| Log Likelihood Ratio of One Sided Error | | 280.266 | 18 1.363 |

Figures in parentheses denote the value of t-ratios *** significant at 0.01 probability level

** significant at 0.05 probability level

NS not significant

0.99. Hence, there is a quite contrasting difference between the scores obtained from Translog and using the Cobb-Douglas. Therefore there is quite a variation between the two results which may suggest that the Translog frontier technique estimation is more superior for the estimation purposes in explaining the broiler industry in Peninsular Malaysia. The results suggest that the overall efficiency scores are much lower in Translog frontier when compared to Cobb-Douglas. However, due to wide variation in scores manifested by the Translog frontier, this estimation will be more relevant for the rest of our discussion.

The variations in technical efficiency obtained by using the Translog production frontier are shown in Figure 1. During the earlier period of the study (1998), the technical efficiency scores were not so favourable especially during quarter 1 and 2, and this could be related to the economic downturn during the period, where the demand was not favourable and probably some of the farmers may have stopped operating the production of table birds. For the rest of the period, the farmers are better off and are close to upper bound score of one.

However in the fourth-quarter of 2001, it was not a favourable period for the farmers which may be due to unfavourable conditions such as the break out of bird flu and the increase cost of production which may be due to more expensive feed prices. Apparently, for the rest of the period, the efficiency scores are better, but not fully as efficient when compared with the earlier period. During this period, especially in 2004, South East Asia was overwhelmed by the bird flu which is endemic to this part of the world.

Figure 2 shows the percentage of technical efficiency achieved by the poultry industry in Peninsular Malaysia. It shows that 14.58 percent of the observed producers achieved 98 to 100 percent technical efficiency score category. The figure also shows that the highest percentage that is about 48.96 percent of producers is in the category of 95 to 98 percent technical efficiency score. Hence, it shows that about half of the producers studied are mostly efficient farmers, meaning that they are high achievers, with 95 to 100 percent technical efficiency score which is higher than those scoring below the average category. However, f

Figure 2 also illustrates that the percentage achieved for technical efficiency scores between 30 to 75 percent and 75 to 80 percent are the same. Both of these efficiency scores are in the lower category group. In general, although the efficiency distribution is more skewed to the higher level, some fluctuation between the ranges of 30 to 100 percent technical efficiency score still exists. This phenomenon suggests that there is a shift towards adoption of new technology but at different phases. According to Veterinary Department (1984), the growth and development of poultry industry is possible due to efficient control of notifiable disease such as Newcastle disease, and the genetic improvement such as the use of high egg producing strains of birds coupled with higher standards of animal husbandary management and nutrition. The expansion of poultry production attract the feed millers to produce poultry feeds; whereby the industry would be less dependent on imported poultry feeds. All these actors contribute to the increased efficiency resulting in the lower cost of production, with the lowering of poultry prices and therefore creates triggering mode for poultry meat.

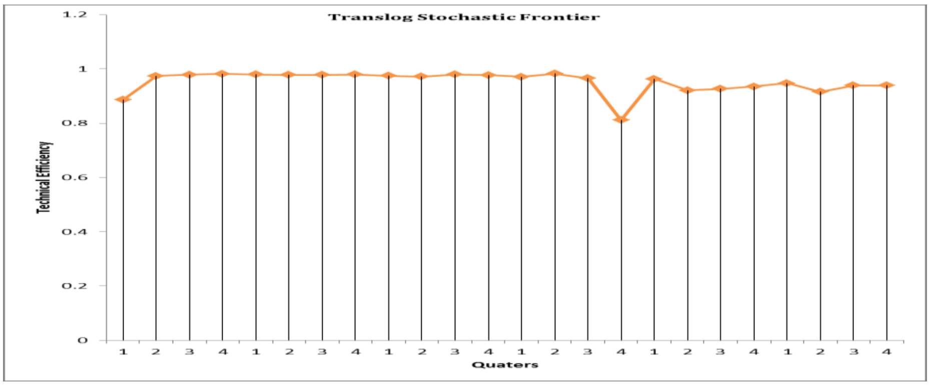


*Figure 1*: Technical efficiency scores of poultry industry in Peninsular Malaysia

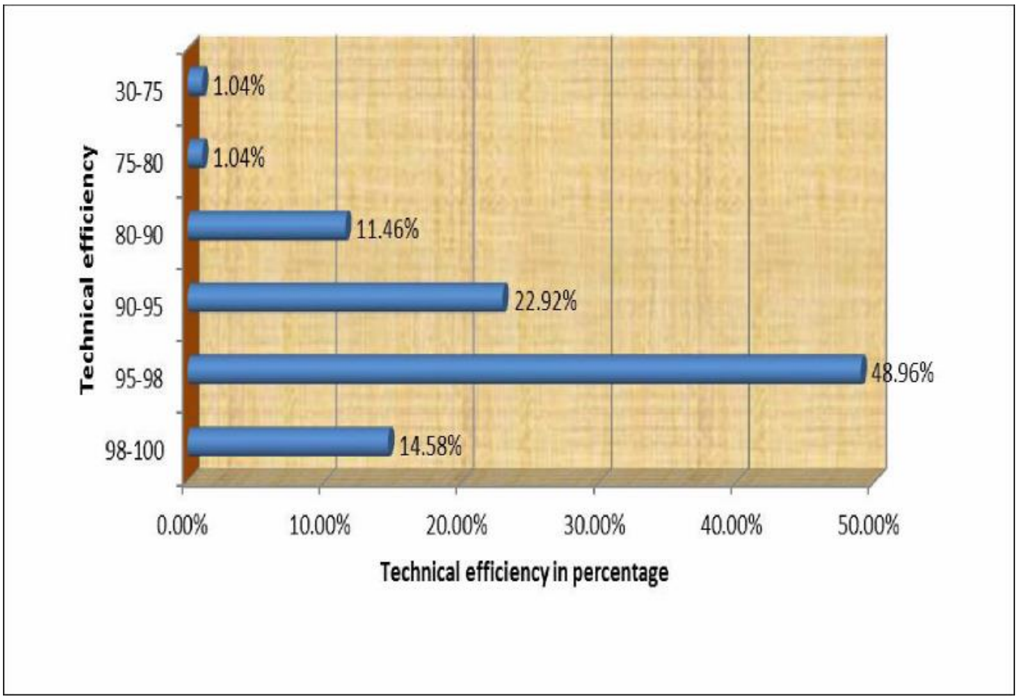


*Figure 2*: Technical efficiency for the broiler industry

Over the past decade, the nature of the Malaysian poultry industry has changed from an entirely subsistence, non-commercial enterprise to an industry which is relatively highly developed technically and commercially. Nowadays, with the introduction of 'Close House' system, which is a new system of poultry production, it is possible for poultry farmers to shift from commercial to highly commercial type of farming. The changing management system in the poultry industry might have some contagion effect on the poultry industry as a whole. For the high achievers poultry producers, the adoptation of new poultry production system may increase their income level, prepare for further expansion by building more additional poultry houses, hire more efficient labours and acquire more sophisticated equipments, and this in turn will improve efficiency and productivity.

## 7. Conclusion

The purpose of this study is to evaluate the technical efficiency as well as to determine the variations in technical efficiency among the producers the broiler industry in Peninsular Malaysia. According to this analysis, some relatively substantial technical inefficiency exist in poultry industry in Peninsular Malaysia. The mean technical efficiency was estimated to be 0.947 for Translog Model and 0.986 for the Cobb-Douglas Frontier production function. The existence of variations between the two models were due to inefficiencies present in the two models. Most of the units in Cobb-Douglas model were operating close to the best practice farms, while for the Translog model the operating units were less efficient. Thus, the existence of variations in technical efficiency levels for the Translog model was more manifested and given priority in this study. However, the level of technical efficiency is quite higher compared to another study on broiler farms in Saudi Arabia (Khalid Al-rwis, 1988) which was below 90 percent.

In general, the results suggest relatively a few inefficient producers, especially the lower category group with technical efficiency less than 90 percent. Therefore, more efforts should be focused on these groups in assisting those farms identified with low levels of technical efficiency. The Veterinary Department should play a pivotal in identifying these problems at the farm level, which could involve management practices including feeds, assuming that the disease aspects are taken care off.

Another interesting finding is the negative sign for the capital (day old chick) coefficient. This suggests that a more efficient chick production system, with the introduction of new breeds which may possess a superior genetic potential with faster growth rate and of hardy type should be looked into. Virtually, this may reduce the marketing age for the birds, as well as reducing the production cost, and increase productivity and efficiency.

The investigation seems more pertinent when it comes to test the existence of variations among the poultry units related to the efficiency and performance despite the fact that there is an on-going transformation process among the producers from traditional to commercial units. The increase in efficiency that could lead to a more profitable undertaking is the ultimate aim of this research, so that the industry is becoming more sustainable and is able to be more competitive in the open global market. The findings seem to support the cointegration approach, because with the merging of small farms units, and semi-commercial with commercial farms, the industry is becoming more viable due to economies of scale.

Unfortunately, the study does not include poultry price regime for the analysis. This is another aspect that should be looked into. There is no such warning system as to the price hike. Alternatively, a group of workers can be organised to access and investigate the situation so that the relevant data can be accumulated either weekly, monthly or yearly for the study. The econometric forecasting methods are usually relevant and applicable because most agricultural products are subjected to seasonal price movements including poultry meat (if time-series data are available). The application of this method will in the long run be beneficial to the consumers as a whole.

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**Appendix 1**

Table 2

*Technical Efficiency Scores estimated from Cobb-Douglas (CD) and Translog Stochastic Production Functions for Broiler industry.*

| No observed | Cobb-Douglas (CD) eff.-est. | Translog Stochastic PF effi estimate |
|---|---|---|
| 1 | 0.995 | 0.778 |
| 2 | 0.995 | 0.890 |
| 3 | 0.994 | 0.901 |
| 4 | 0.994 | 0.975 |
| 5 | 0.994 | 0.969 |
| 6 | 0.995 | 0.970 |
| 7 | 0.995 | 0.983 |
| 8 | 0.995 | 0.994 |
| 9 | 0.995 | 0.955 |
| 10 | 0.995 | 0.976 |
| 11 | 0.995 | 0.986 |
| 12 | 0.995 | 0.979 |
| 13 | 0.995 | 0.978 |
| 14 | 0.995 | 0.989 |
| 15 | 0.995 | 0.991 |
| 16 | 0.994 | 0.972 |
| 17 | 0.994 | 0.975 |
| 18 | 0.994 | 0.980 |
| 19 | 0.994 | 0.979 |
| 20 | 0.994 | 0.986 |
| 21 | 0.995 | 0.976 |
| 22 | 0.995 | 0.983 |
| 23 | 0.995 | 0.979 |
| 24 | 0.995 | 0.972 |
| 25 | 0.995 | 0.979 |
| 26 | 0.995 | 0.974 |
| 27 | 0.995 | 0.979 |
| 28 | 0.995 | 0.986 |
| 29 | 0.995 | 0.976 |
| 30 | 0.995 | 0.980 |
| 31 | 0.994 | 0.984 |

| No observed | Cobb-Douglas (CD) eff.-est. | Translog Stochastic PF effi estimate |
|---|---|---|
| 32 | 0.994 | 0.973 |
| 33 | 0.995 | 0.985 |
| 34 | 0.995 | 0.97 1 |
| 35 | 0.995 | 0.976 |
| 36 | 0.995 | 0.981 |
| 37 | 0.994 | 0.972 |
| 38 | 0.995 | 0.963 |
| 39 | 0.995 | 0.974 |
| 40 | 0.994 | 0.980 |
| 41 | 0.995 | 0.974 |
| 42 | 0.995 | 0.984 |
| 43 | 0.995 | 0.979 |
| 44 | 0.995 | 0.976 |
| 45 | 0.995 | 0.984 |
| 46 | 0.995 | 0.973 |
| 47 | 0.995 | 0.978 |
| 48 | 0.995 | 0.985 |
| 49 | 0.995 | 0.975 |
| 50 | 0.995 | 0.975 |
| 51 | 0.995 | 0.956 |
| 51 | 0.995 | 0.970 |
| 52 | 0.995 | 0.986 |
| 53 | 0.995 | 0.989 |
| 54 | 0.995 | 0.984 |
| 55 | 0.995 | 0.986 |
| 56 | 0.995 | 0.976 |
| 57 | 0.995 | 0.964 |
| 58 | 0.995 | 0.964 |
| 59 | 0.995 | 0.966 |
| 60 | 0.995 | 0.973 |
| 61 | 0.995 | 0.963 |
| 62 | 0.995 | 0.966 |
| 63 | 0.995 | 0.353 |
| 64 | 0.995 | 0.969 |
| 65 | 0.995 | 0.955 |
| 66 | 0.995 | 0.955 |
| 67 | 0.995 | 0.980 |

| No observed | Cobb-Douglas (CD) eff.-est | Translog Stochastic PF effi estimate |
|---|---|---|
| 68 | 0.995 | 0.963 |
| 69 | 0.995 | 0.945 |
| 70 | 0.995 | 0.942 |
| 71 | 0.995 | 0.960 |
| 72 | 0.995 | 0.840 |
| 73 | 0.995 | 0.936 |
| 74 | 0.995 | 0.939 |
| 75 | 0.995 | 0.887 |
| 76 | 0.995 | 0.949 |
| 77 | 0.995 | 0.954 |
| 78 | 0.995 | 0.992 |
| 79 | 0.995 | 0.938 |
| 80 | 0.995 | 0.856 |
| 81 | 0.995 | 0.939 |
| 82 | 0.995 | 0.932 |
| 83 | 0.995 | 0.938 |
| 84 | 0.995 | 0.985 |
| 85 | 0.995 | 0.940 |
| 86 | 0.995 | 0.939 |
| 87 | 0.995 | 0.854 |
| 88 | 0.995 | 0.93 1 |
| 89 | 0.995 | 0.951 |
| 90 | 0.995 | 0.938 |
| 92 | 0.995 | 0.932 |
| 93 | 0.995 | 0.922 |
| 94 | 0.995 | 0.936 |
| 95 | 0.995 | 0.949 |
| 96 | 0.995 | 0.950 |
| 97 | 0.995 | 0.935 |
| 98 | 0.995 | 0.917 |
| 99 | 0.995 | 0.925 |
| 100 | 0.995 | 0.983 |
| 101 | 0.995 | 0.912 |
| 102 | 0.995 | 0.811 |
| 103 | 0.995 | 0.834 |
| 104 | 0.995 | 0.884 |
| 105 | 0.995 | 0.878 |

| No observed | Cobb-Douglas (CD) eff.-est. | | Translog Stochastic PF effi estimate |
|---|---|---|---|
| 106 | 0.995 | | 0.865 |
| 107 | 0.995 | | 0.873 |
| 108 | 0.995 | | 0.908 |
| 109 | 0.995 | | 0.875 |
| 110 | 0.995 | | 0.955 |
| 111 | 0.995 | | 0.962 |
| 112 | 0.995 | | 0.981 |
| 113 | 0.995 | | 0.978 |
| 114 | 0.995 | | 0.989 |
| 115 | 0.995 | | 0.993 |
| mean efficiency = | 0.986 | mean efficiency = | 0.947 |