# PROFIT EFFICIENCY IN BROILER PRODUCTION: EVIDENCE FROM GREATER ACCRA REGION OF GHANA

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**Abstract**

*The study examines profit efficiency and its determinants in broiler production in the context of profit maximization as an incentive for optimum production. The study uses the stochastic frontier approach with the application of the Cobb – Douglas profit function. A cross sectional data was obtained from one hundred poultry producers in Greater Accra Region using a multistage sampling method. The results of the study indicated that price of labor significantly reduced profit but the price of day old chick increased profit. The result further revealed that broiler producers were able to realize 54% of their frontier profit on the average. Number of years of experience in broiler production was found to reduce inefficiency whilst farms owned by sole proprietors were less economically efficient. The study recommends that the inputs should be made available to farmers at competitive prices and the quantity of labor use should be declined because the current level is uncompetitive. Training should also be provided to less experienced farmers to enable them adopt the best poultry farming practices.*

**Key words:** *Broiler, efficiency, competitiveness, Ghana*

## 1. Introduction

Chicken has become one of the most important meats consumed in the world (Watt Executive Guide, 2012). Its importance in terms of consumption in Africa is becoming significant (Shane, 2006). In Ghana, chicken meat consumption constitutes a vital source of animal protein needed to meet daily protein requirement (Kwadzo *et al.*, 2013). Between year 1997 and 2010, per capita broiler meat consumption in Ghana increased from 1kg to 4kg (USDA, 2011).  MoFA (2010) noted that from year 2000 to 2009, chicken accounted for an average of 58% of total meat import into Ghana, among beef, bovine, mutton, pork, duck and chevon. Rising incomes, increased urbanization, and food production deficits have spurred an ever increasing demand for chicken which has resulted in the dumping of imported poultry products. In addition, the cheaper price and consumer friendly packaging associated with imported chicken has given it more preference to the local broiler meat (Egyir & Adu – Nyarko, 2012). This phenomenon has presented an opportunity for

international food marketers to supply chicken to Ghana due to its high demand but has negatively impacted on the local broiler market threatening its very survival.

This has resulted in the decline of broiler production in the Greater Accra Region of Ghana amidst rising cost of labor, feed, day old chicks and other variable inputs (Koney, 1993; Aning, 2006). Although the livestock industry grew by 5.1 % in 2010, the poultry subsector declined by 12.81 % (Institute of Statistics, Social and Economic Research (ISSER), 2011). By year 2010, commercial domestic poultry production was only able to meet 10 per cent of total poultry demand (ISSER, 2011). Kwadzo *et al.* (2013) revealed that broiler production is currently perceived to be 'dying' as consumer preference has shifted towards imported substitutes due mainly to price sensitivity. However, the increased demand for chicken still presents an opportunity for domestic commercial chicken production to become more financially viable and sufficiently competitive to enjoy a significant portion of the market. Aning (2006) is of view that the poultry sector can serve as a means of livelihood income for producers and provide employment for the labor force in addition to the source of reliable protein it provides if the current market share attributed to it becomes sizeable relative to the imported chicken. Also, the issue of market segmentation and product differentiation makes it possible for the presence of market share for local broiler production. Some households prefer live broiler birds because of its safeness and taste and they are also preferred during festivities like Christmas, Easter among others (USDA, 2013).

Notwithstanding the potential market of domestic broiler industry, key constraints in the form of high cost of production (feed, drugs and high energy prices) and mortality rates due to improper feeding practices, ignorance of management needs and poor distribution of vaccines; continue to militate against broiler production (Koney, 1993). These production constraints negatively affect the farmers' profit and consequently affecting the sub - sector's viability and competiveness. This implies the success of local broiler production necessitates the strengthening of the viability of its production to derive maximum returns to the producers thereby becoming an incentive to increase the supply of broiler whilst enhancing competitiveness. This is in line with the Ghana government's priority to increase the supply of broiler meat whilst implementing measures to increase the profits of the farmers (Kwadzo *et al.*, 2013). Hence the study assesses the profit efficiency in broiler production and its drivers; which are of paramount importance to local broiler production's survival and competitiveness in Ghana. The study is organized into four sections. Following section one, section two presents the methods used to address each of the objectives, the area of study, the sampling procedure and sample size used for the study. Section three presents the results and discussions of the study. The conclusions and policy recommendations are presented in section four.

## 2. Methodology

### 2.1 Theoretical Framework for Stochastic Profit Frontier Model (SFP)

The stochastic frontier approach which was independently proposed by Aigner *et al.* (1977) and Meeusen and Van Den Broeck (1977) was adopted to model the profit efficiency. The model separates the deviations of the realized gross profits from the frontier profit into pure noise and inefficiencies effects. Following Jabbar *et al.* (2005) the stochastic profit function was represented as:

$$\pi_i = f(x_{ji}, s_{ki}; \beta) exp(v_i)^* exp(-u_i) \qquad (1)$$

$\pi_i$ refers to the normalised gross profit by the i-th farm $f(x_i; \beta)\exp(v_i)$ is the stochastic frontier profit, $\beta$ represents the estimated coefficients, $v_i$ represents the random noise in the data and $u_i$ represents farm specific economic inefficiencies. $x_j$ is the normalised price of the inputs and $s_k$ are the level of fixed factors used in the production process. The profit efficiency of the i-th farm is given in equation (2) and it is consistent with Jabbar *et al.* (2005) specification of profit efficiency.

$$PE_i = \frac{E(\pi_i/x_i),\ s_i, x_i}{E(\pi_i/x_i, u_i = 0)} = \frac{f(x_i s_i\ ;\ \beta)^* \exp(v_i - u_i)}{f(x_i s_i\ :\ \beta)^* \exp v_i} = \exp(-u_i) \tag{2}$$

And profit efficiency becomes;

$$PE_i = \exp(-u_i) \tag{3}$$

Thus the profit efficiency effects become $PE_i = (\exp\{-u_i\}|\varepsilon_i)$ as employed by Battesse and Coelli (1995). The study assumes that the profit inefficiency effects are truncated at zero of the normal distribution with mean $\mu_i$ and a variance $\sigma_{u_i}^2, \left[\mu_i \sqcup (\mu_i, \sigma_u^2)\right]$. The economic inefficiency effects are related to the exogenous variables as defined in equation (4)

$$\mu_i = z_i \delta \tag{4}$$

The single step maximization of the Loglikelihood function produced the ML estimate of the profit frontier model, the economic inefficiency function and the farm specific profit efficiency estimates using FRONTIER 4.1. The log likelihood function was parameterized in terms of $\sigma_s^2 = \sigma_v^2 + \sigma_u^2$ and $\gamma = 0 \le \sigma_u^2/\sigma_s^2 \ge 1$ (Battese & Corra, 1977). If $\gamma = 1$, it meant that the deviations in profit were as a result of economic inefficiency only, but at an extreme value of zero indicated that economic inefficiency was absent and the deviations are determined only by the distribution of the pure noise component. But if $\gamma$ was between zero and one, it implied that profit variability was dependent on both pure noise and economic inefficiency effects.

## 2.2 Empirical Model Specification

The Cobb-Douglas model was assumed for the deterministic part of the profit frontier which is specified as:

$$\pi_i = \beta_0 + \sum_{j=1}^{3} \beta_j \ln x_{ji} \sum_{k=1}^{2} \ln s_{ki} + v_i - u_i \tag{5}$$

$\pi_i$ is the gross profit per broiler price as received by the i-th farm, measured in cedis. Gross profit is defined as total revenue minus total variable cost. $x_{1i}$ is the price of feed per broiler price received by the i-th farm for the production year, measured in cedis. $x_{2i}$ is the price of labour per broiler price and $x_{3i}$ is the price of day old chicks per broiler price. $s_{1i}$ is the level of capital inputs used for the production year measured in cedis. $s_2$ is the size of

farm house measured in meter square (mm$^2$). The economic inefficiency effects $u_i$ were assumed to be a linear function of the exogenous variables and it was given by;

$$u_i = q(z_j, \delta) = \delta_0 + \sum_{j=1}^{6} z_{ji} \, \delta_j \qquad (6)$$

Where $\delta'$ the estimated coefficients of the inefficiency are model and $z_{ji}'s$ represent the exogenous explanatory variables. $z_{1i}$ is the age of the farmers measured in years. $z_{2i}$ represented Household size: this variable is the size of the household of a particular respondent. It is measured as the number of the household members including household head, the spouse(s), children, and all other relatives or individuals living and feeding in the same pot with the household head. This measure of household size was applied by Ogundele and Okoruwa (2006). $z_{3i}$ which represented non-broiler income was dummied who variable where by farmers who have other source(s) of income apart from broiler production is represented by a value of 1 and 0 for otherwise. $z_{4i}$ which represented ownership was dummied. For the ownership status, if a farm was owned one persona value of 1 was assigned and 0 if ownership was more than 1. $z_{5i}$ represented liveratio which is defined as the ratio of birds ready for market to the total number of day old chicks used during the production season. $z_{6i}$ represented experience denoting the number of years the producer has been engaged in broiler production.

## 2.3 Statement of Hypothesis

The following hypotheses are considered for investigation to the study;
- $H_0 = \gamma = \delta_0 = \delta_1 = \delta_2 = \cdots \delta_6 = 0$, the null hypothesis that technical nefficiency is absent at every level. The stochastic profit frontier model is justified for the analysis if economic inefficiency is present in the data.
- $H_0 = \gamma = 0$, the null hypothesis specifies that inefficiency effects are non-stochastic and hence the model is appropriate to be estimated using the ordinary least squares method whilst nesting the exogenous factors into the mean profit function.
- $H_0 = \delta_0 = \delta_1 = \delta_2 = \cdots \delta_6 = 0$, the null hypothesis that the simpler half normal model is an adequate representation of the inefficiency effects and hence the variance of the inefficiency effects is zero or the economic inefficiency effects are unrelated to the exogenous variables.
- $H_0 = \delta_1 = \delta_2 = \cdots \delta_6 = 0$, the null hypothesis that the exogenous variables do not jointly explain the variation in inefficiency effects in broiler production.

## 2.4 Data and Sampling Technique

Cross sectional data was collected from one hundred (100) broiler farmers from the Greater Accra Region of Ghana with the use of a multi-stage sampling method. The first stage of the sampling was cluster; where the Greater Accra Region was put into five clusters namely Dodowa – Oyarifa area, Ashiaman – Tema area, Achimota – Ofankor area, Dansoman area and Ablekuma area. After the farmers were put into clusters, the purposive sampling procedure only selected broiler producers in each cluster. A final selection was made with the use of a simple random sampling method. In order to ensure a fair representation of the region, clusters with higher proportion of farmers had a relatively a higher sample chosen from clusters as compared to clusters with smaller population of broiler producers.

**2.5 Study Area**

The Greater Accra Region of Ghana was the area of study. The Region is where the capital city of the Ghana is situated. It is the smallest among the ten regions in Ghana in terms of land size (Ministry of Local Government and Rural Development (MLGRD), 2006). It has a land size of 3,245 square kilometres which accounts for 1.4 % of the total land area of Ghana. It shares inland borders with only the Eastern, Central and Volta Regions and a coastal border with the Gulf of Guinea. It has a total population of about 3,910,000 which constitute about 16.1% of the total population in Ghana; making it the second largest to the Ashanti Region (Ghana Statistical Service, 2011). The Region has an undulating landscape though it is predominantly lowland with an average height of 250ft above sea level. The region has a mainly savannah grassland vegetation with some mangrove and swampy areas coupled with few scattered forests (Ministry of Local Government and Rural Development (MLGRD), 2006).

The Greater Accra region has the highest concentration of industries, administrative offices and commercial activities in Ghana. In addition, the region is also involved in several farming activities especially in the peri – urban centres.  These farming activities include horticulture, growing of vegetables and cereals, aquaculture and livestock production. In terms of livestock production, one of the most important in the region is poultry. Poultry production in the Region is ranked number four (4) in Ghana, after the Ashanti and Brong Ahafo and Eastern regions respectively (MoFA, 2010). The Region has over four hundred (400) poultry farmers who are both into broiler and layer production with the majority located in the peri urban centres (Greater Accra Poultry Farmers Association (GAPFA), 2011). Poultry farms are relatively scattered in the Region with areas like Oyarifa, Dansoman, Dodowa, Ashiaman, Kpone, Ablekuma, Old Kasoa Barrier, Gbawe, and Michele Camp dominating (Field Data, 2012).

**3.  Results and Discussion**

The summary statistics in Table 1 reveals that age of the farmers range between 20 to 76 years but their experience in broiler production ranges from 1 to 39 years. The dispersion in both age and experience was the same and quite large which was at 13 years. The respondents have household size ranging from 1 to 24 at a mean membership of 5. The results also suggest that most of the respondents have other source of income apart from broiler production since the mean is close to 1. With regards to ownership of the farm majority of the farms were singularly owned by two or more farmers whilst a sizeable number of the farms were jointly owned. The results further reveal that 94% of the day old chicks become ready for market whilst 6% are culled from the flock due to mortality and disease incidence on the average.

**Table 1. Summary Statistics of the Exogenous Variables**

| Variable | Unit | Minimum | Mean | Maximum | SD |
|---|---|---|---|---|---|
| Age | Years | 20.00 | 43.00 | 76.00 | 13.22 |
| Experience | Years | 1.00 | 9.46 | 39.00 | 13.22 |
| HHS | Count | 1 | 4.75 | 24.00 | 2.72 |
| NBI | Dummy | 0 | 0.85 | 1 | 0.35 |
| Ownership | Dummy | 0 | 0.66 | 1 | 0.47 |
| Liveratio | Ratio | 0.61 | 0.94 | 1 | 0.06 |

**Source:** Field Survey, 2012

### 3.1Testing of Hypothesis

The first hypothesis that economic inefficiency is absent in the production process at every level was rejected as indicated in Table 3.As a result the variations in the observed gross margins from the frontier gross margins were contributed mainly by economic inefficiency effects which justified the use of the stochastic profit frontier model for the study. The hypothesis that the inefficiency effects are non-stochastic was rejected at 1% level of significance meaning the inefficiency effects were stochastic and therefore they were not unrelated to the exogenous variables. The study also rejected the simpler half normal distribution for the inefficiency effects in favour of the truncated model with mean $\mu_i$ and variance $\sigma_{u_i}^2$. The last hypothesis which states that the exogenous variables do not jointly explain the inefficiency effects was also rejected meaning the farmer characteristics and farm specific variables were able to influence the ability of the farmer to obtain the frontier profit in the production process.

**Table 2. Hypothesis Test for Model Specification and Statistical Assumptions of Stochastic Frontier Model**

| Null Hypothesis | Loglikelihood value | Test statistic ($\lambda$) | Critical Value | Decision |
|---|---|---|---|---|
| 1. $H_0 : \gamma = \delta_0 = \delta_1 = \delta_2 = ...\delta_6 = 0,$ | - | -160.78*** | 19.38 | Reject $H_0$ |
| 2. $H_0 : \gamma = 0$ | -158.57 | 4.42** | 2.71[a] | Reject $H_0$ |
| 3. $H_0 : \delta_0 = \delta_1 = .\delta_2 = ...\delta_6 = 0$ | 158.57 | 15.22** | 14.08 | Reject $H_0$ |
| 4. $H_0 : \delta_1 = \delta_2 = \delta_3 = \delta_4 = ...\delta_6 = 0$ | 129.23 | 12.04* | 10.65 | Reject $H_0$ |

[a]Values of test of one sided error from the FRONTIER 4.1 Output file. The correct critical value for the hypothesis of the one sided error is obtained from table 1 of Kodde and Palm (1986, p. 1246), whilst the rest are obtained from chi-square table.***, ** and * show statistical significance at 1, 5 and 10% level, respectively.
**Source:** Field Data, 2011

### 3.2 Estimates of the Profit Frontier Model

The results as indicated in Table 4 shows that 89% of the variation in gross profit from the frontier profit was due to economic inefficiency effects whilst 11% was due to pure noise. This indicated that profit variability was largely determined by inefficiency effects rather than random distribution of the deviations from the frontier profit. The study found that the price of day old chick increased profit. This revealed that the marginal value productivity of day old chick was greater than its price. Therefore additional investment in day old chick can increase profit. Price of feed and level of farm house positively influence profit with a weak relationship. As a result the producers pay competitive price for feed input. But Jabbar *et al.* (2005) finds the price of feed to reduce profit in broiler production. The study further revealed that the price of labour reduces profit because the marginal value contribution of labour was lower than its price. This implies that the farmers paid labour higher than its true price because the marginal value productivity is lower than the price. As a result additional cost to use more labour reduced profit. However the findings of

Olumyowa and Abiodan (2011) indicated that the price of labour increases profit in broiler production.

**Table 3.  Maximum likelihood estimates of profit function**

| Variable | Parameters | Estimates | t-ratio |
|----------|-----------|-----------|---------|
| Constant | $\beta_0$ | 8.668 | 7.791 |
| Price of Feed | $\beta_1$ | 0.272 | 0.696 |
| Price of Labour | $\beta_2$ | -0.457*** | -2.581 |
| Price of chick | $\beta_3$ | 1.012* | 1.911 |
| Capital | $\beta_4$ | -0.047 | -0.355 |
| Farmhouse | $\beta_5$ | 0.056 | 0.355 |
| Gamma | $\gamma$ | 0.89*** | 22.65 |
| Loglikelihood | | -150.96 | |

**Source:** Field Data, 2012

### 3.3.  Profit Efficiency

Figure 1 depicts the range of profit efficiency scores for the farmers and it reveals that the proportion of farmers progressively increased through the range of the profit efficiency scores. The peak proportion was reached at efficiency range of 71% to 80% which is represented by 24% of the farmers.  The results further revealed that between the range of 81% to 90% has the least proportion of farmers represented by 2%.The mean profit efficiency was 54% which implied 46% of the frontier profit was lost due to economic inefficiency at the given input prices and technology. The results indicated that producers can increase their profits by 46% on the average to strengthen their competitiveness in the short run through the adoption of best farm practices that have allocative efficiency. The results of Jabbar *et al.* (2005) indicate that broilers producers in Bangladesh obtain 30% of their frontier profit on the average. In a related study of profit efficiency of broiler production in Nigeria by Olumyowa and Abiodan (2011) the mean profit efficiency was 68.4% in the range of 17% to 90%.
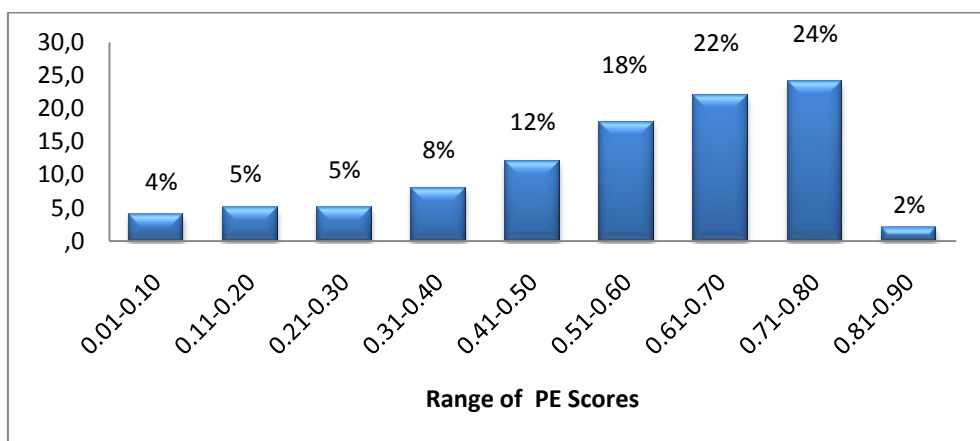


**Fiqure 1 Profit Efficiency Distribution**

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**3.4 Determinants of Profit Inefficiency**

Number of years of experience in broiler production significantly increased profit efficiency as indicated in Table 5. This was due to the ability of more experienced farmers to adopt the best farm practices through continuous learning process to produce the frontier output using the least cost combination of the productive inputs available. OIumyowa and Abiodan (2011) study confirms the results of this study in relation to experience in broiler production. Their study indicated that farming experience reduced profit inefficiency in broiler production. Again, the result of the study indicated that the variables age, non-broiler income and the ratio of saleable birds to total day old chicks reduced the level of inefficiency of broiler production but the relationships were weak. The ratio of saleable birds to day old chicks reduced inefficiency because higher ratio implies lower mortality rate to achieve high technical performance. The findings of the study also revealed that poultry farms owned by sole-proprietors were less efficient than the farms owned through partnership agreements. This implies that two or more owners of the farm strive more to optimize profits to increase their share of profits. In a related study of wheat production in Pakistan farmers who practice

**Table 4.  Maximum Likelihood Estimates of the Inefficiency Model**

| Variables | Parameters | Estimate | t-ratio |
|---|---|---|---|
| Constant | $\delta_0$ | 4.380 | 0.7435 |
| Age | $\delta_1$ | -0.086 | -1.604 |
| Household size | $\delta_2$ | 0.023 | 0.100 |
| NBI | $\delta_3$ | -1.079 | -1.100 |
| Ownership | $\delta_4$ | 6.566* | 1.708 |
| Live Ratio | $\delta_5$ | -8.382 | -1.052 |
| Experience | $\delta_6$ | -0.199*** | -2.039 |

***, * correspond to 1% and 10% significance level respectively
**Source:** *Field Data, 2012*

share cropping were more efficient than farmers who had self-ownership right to use land. This was because they were under economic pressure to share the profits from their production process with the owners of the land and this motivates them to strive more to obtain higher production potential (Ahmad *et al*., 2005).

**4.  Conclusions and Policy Recommendations**

This study which assessed profit efficiency of broiler production in the Greater Accra region of Ghana found that the price of day old chicks increased profit whilst the price of labor reduced profits. The study further concludes that commercial broiler producers in the region were able to realize 54% of their frontier profit on the average. Also economic inefficiency at the given level of inputs and prices is more pronounced than the pure noise effect and profit realized from broiler production can increase by 46% if the producers stacked to the best farm practices and use the least cost combination of the inputs. Farm experience significantly reduced economic inefficiency whilst sole-proprietorship status of the farm increases economic inefficiency. This study recommends that more experience farmers should share their production methods with the less experienced farmers to increase their efficiency in profit and sole-proprietors should reconsider their production practices to use best farm practices to optimize profits.

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