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Does Scale Matter in Profitability of Small Scale Broiler Agribusiness Production in Ghana? A Translog Profit Function Model

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Abstract

This paper examined whether scale matter in profitability of small-scale commercial broiler agribusiness production in Ghana, using the translog profit function model. Structured questionnaire was used to collect primary data on input and output prices and quantities from four hundred and forty-one (441) small-scale commercial broiler agribusinesses for the 2010 production year through a multiple-stage random sampling technique. Descriptive statistics and multiple regression analysis were used to analyze data collected for the study. Findings of the study show that by incurring an average variable cost of GH¢8.48 per broiler and selling each at GH¢14.80, small-scale broiler agribusinesses make a profit of GH¢5.59 per bird. Results of the translog profit function model indicate that feed and day-old chick prices are the two main factors that negatively and significantly affect profit in small-scale commercial broiler agribusiness production. Stock size of small-scale broiler agribusinesses was also found to positively and significantly affect profit in broiler production. This implies that profit of small-scale broiler agribusinesses increases with scale, hence scale matters in profitability of broiler production. Policy actions directed towards broiler producers to increase their production scale in order to reduce cost and increase profit should be encouraged.

Keywords: Scale, Profitability, Broiler, Agribusiness, Production, Translog, Ghana

1. Introduction

Ghana's commercial poultry sector has played significant role in contributing to the country's Gross Domestic Product (GDP), supplying the country's meat requirement and providing employment for Ghanaians over the years. The poultry sector together with livestock contributes 5 percent to the country's agricultural GDP (ISSER 2010) and inclusively employs about 75 percent of the Ghanaian population in the areas of processing, nutrition, health, product and by-products as well as vending at food joints, restaurants and chop bars (Anku 2005). According to a Ministry of Food and Agriculture and Department for International Development (MOFA/DFID, 2002) survey, the poultry sector of Ghana serves as a 'safety net', provides an important source of ready cash for emergency needs and high quality protein meat. However, since the mid 1990s, the share of domestic broiler production in the total poultry meat market supply (imports and domestic production) in Ghana has been on a decline. The sector which supplied about 95 percent of total domestic poultry meat requirement in the 1990s (Integrated Social Development Centre, 2004), could only meet about 11 percent in 2010, with the rest coming from imports (Randon & Ashitey, 2011). The decline in the domestic broiler market share has been traced to changes in government policies towards agriculture in general and the poultry sector in particular (Nkansala 2004).

Beyond 1990, Ghana's poultry industry experienced the effects of the Structural Adjustment Programme (SAP) whose policies included the removal of government support for drug costs, the discontinuation of government importation of feed mill ingredients and reduction of preference in interest rates for agricultural credit. These actions raised poultry production costs by over 60 percent, resulting in the closure of many poultry enterprises. In addition, the reduction of tariff rate on poultry imports by the Government of Ghana from 40 to 20 percent in 2006 led to a rapid rise in poultry imports. Available statistics from the Ministry of Food and Agriculture (MOFA 2010) indicate that while poultry imports from the USA and the European Union increased by about 632 percent from 9,160 Mt in 2000 to over 89, 889 Mt in 2009, the growth rate of domestic poultry meat consumption outstripped domestic production by about 105 percent over the same period. Domestic broiler production which was 4,656 Mt in 2009 could not meet domestic meat demand of 89,000 Mt, resulting in a short fall of about 84,344 Mt. Though domestic poultry meat production consistently increased by an average of 9.51 percent between 2000 and 2009, it could only satisfy about 11 percent of total domestic meat requirements within the same period, down from 32.8 percent in 2004, with the excess demand met by imports (MOFA 2010). This has resulted in a consumption gap which domestic production has the potential to meet. It is estimated that Ghana needs to produce about 100,000 Mt of poultry meat per annum to be able to meet the increasing domestic poultry meat demand. Achieving this domestic meat production target will require that broiler producers in Ghana expand their production scale. However, broiler producers will need to have adequate information on the extent of impact of production scale on profitability of their businesses to be able to make informed decision.

Profitability is a key factor that determines the survival of broiler businesses and a necessary condition for farmers to continue to remain in the poultry industry. Scale of operation has the potential of enhancing profitability of agricultural enterprises and to keep farmers in business. Despite the research interest in the scale of agricultural enterprises, its effect on profitability is an issue that has been continually analyzed and debated by agricultural economist over the years (Kern & Paulson 2011). It is thought that by expanding the scale of operation profitability may be enhanced. This is because larger farms obtain discounts by buying larger quantities of inputs resulting in lower cost of variable inputs for profitability. On the other hand, it has also been argued that as the scale of operation increases the amount of management time required by a farmer as well as the management decision to be made regarding marketing and inputs also increases. This results in high cost of production with low profits for the farm enterprise. There is therefore no consensus on the effect of production scale on profitability of agricultural enterprises. Besides, considering the fact that many large scale commercial broiler enterprises have folded up in Ghana for reasons of not obtaining maximum returns on their investment over the past decade, concerns have been raised by farmers as well as stakeholders about profitability of large enterprises. In this regard, the key question that arises for this study is: does scale matter in profitability of small-scale commercial broiler agribusiness production? Studies that have examined profitability in broiler agribusiness production across the world used linear profit function to determine marginal effect (Yusuf & Malomo 2007, Bandara & Dassanayake 2006). However, no systematic and comprehensive empirical studies have been undertaken to examine the effect of scale of operation on profitability of small-scale commercial broiler agribusinesses production in Ghana, using the translog profit function model. Anang *et al.* (2013) used the conventional cost, revenue and profit function to examine profitability of broiler and layer production in the Brong Ahafo Region of Ghana. The objective of this study is therefore to use the translog profit function model to determine whether scale of operation matter in profitability of small-scale commercial broiler agribusiness production in Ghana. The provision of the needed information on the extent of the effects of scale on profitability to enable broiler producers make informed decisions for progressive planning of their enterprises is the motivation for this study.

The rest of the paper is as follows. The next section is a discussion of the methodology used for the study. It includes the study area, data collection, sampling size and process and analytical technique employed in the study. The methodology section is then followed by discussion of the empirical results. The paper ends with a section on conclusions and policy implications.

2. Materials and Methods

2.1 Study Area

The study was carried out in the Greater Accra, Ashanti and Brong Ahafo Regions of Ghana, where considerable amount of commercial broiler agribusiness production takes place. The Greater Accra Region is found on the coastal belt of Ghana and lies between longitudes 1^o 8'E – 0^o 30W and latitude 5^o 70' – 6^o 8' N of the equator and has a total land size of 3.24 thousand square kilometers. The Ashanti Region with a total land area of 24.39 thousand kilometers, can be found in the middle belt of Ghana and located between longitudes 0^o 15' W – 2^o 15' and latitude 6^o N – 7^o 30' N of the equator. The ecological zone of the Ashanti region is moist and semi-deciduous, with a bimodal rainfall pattern. Brong Ahafo Region on the other hand lies mostly in the forest zone and covers an area of 39,557 square kilometers. It has a tropical climate, with high temperatures averaging 23.9^{o}C as well as a double maxima rainfall ranging, from an average of 1000 mm in the northern parts to 1400 mm in the southern parts. These three regions of the study have a high concentration of commercial activities, infrastructural facilities like veterinary care as well as weather that favours maize production for use by the broiler industry in Ghana.

2.2 Population, Sample Size and Technique

A multi-stage sampling technique was used to collect primary data from 441 small-scale commercial broiler enterprises who are members of the Ghana National Poultry Farmers Association (GNPFA) in the three study areas. Small-scale broiler enterprises are defined as farms with a stock size of between 50 to 5000 birds in a batch and using the deep litter intensive system of production. Purposive sampling method was first used to select the three dominant broiler producing regions in Ghana. Officials of the regional branches of the Poultry Farmers Association were interviewed to identify the Districts and Communities in the three regions where commercial broiler production is mainly undertaken. Based on this, five (5) districts were purposively selected from each of the three regions. Two (2) communities from each district were then selected to obtain a total of 30 communities. Finally, since small-scale commercial broiler enterprises are not evenly distributed within the communities, simple random sampling was applied in the third stage to select 462 broiler producers in a ratio proportional to their population size from the list of members obtained from the three Regional branches of the GNPFA. Though 462 small-scale commercial broiler agribusinesses were visited and personally interviewed, 441 questionnaires were used for the analysis. This is because some of the broiler agribusinesses could not provide the needed information on some of the questions contained in the questionnaires and required for the study, giving a recovery rate of 95.6 percent.

2.3 Sources and Method of Data Collection

Primary data on broiler production input and output quantities and their respective prices as well as farm and farmer socio-economic characteristics were collected by visiting and personally interviewing the sampled small-scale commercial broiler agribusinesses using the deep litter system of production with the aid of pre-tested structured questionnaire. The questionnaire consisted of both open-ended and close ended questions as well as yes and no questions.

2.4 Analytical Framework

The analytical framework used for the study was the normalized profit function model which has become increasingly popular for its application in empirical studies in production economics in recent years. This is because the profit function model used as a decision support tool is a more flexible methodological tool in analyzing various agricultural problems than the conventional production function model (Pudasaini 1981). Moreover, the profit function model yields statistically consistent estimates and also allows for the impact of institutional characteristics to be directly introduced into it. In this framework, the normalized restricted profit function was assumed to be a function of the quantities of fixed factors and the prices of variable factors used in production. Suppose a farm has the following production function:

$$Y = f(X; Z) \quad (1)$$

Where, Y is output, X a vector of variable inputs, and Z a vector of fixed inputs. The profit (π) function of this farm can be written as:

$$\pi = pf(X; Z) - CX \quad (2)$$

Where p is the price of output and C is a vector of prices of variable inputs X. Assuming that the firm maximizes profit then, the marginal condition states that the value of the marginal product of input used by the farm should be equal to the cost of that input used. This is specified as:

$$P\delta f/\delta X_i = C^*_i; \qquad \delta f/\delta X_i = C^*_i \quad (3)$$

$C^*_i = C_i/p_i$ is the normalized price of the i^{th} variable input of the farm. The normalized profit function (π^*) of the firm can be obtained as:

$$\pi^* = f(X; Z) - C^*_i X \quad (4)$$

Where $\pi^* = \pi / p$. Solving equation (4) gives the optimal quantities of variable inputs X^*_i's as functions of normalized prices of the variable inputs C^*_i, and of the quantities of the fixed inputs used by the farm, Z, as:

$$X^*_i = f_i(C; Z) \quad (5)$$

The equation (5) represents the input demand functions obtained by solving for the first order conditions for profit maximization. By substituting equation (5) into equation (4), the maximized value of profit for each set of values of (p, C_i,..C_m, Z_i … Z_n) is obtained, and this gives the normalized profit function as:

$$\pi^* = \pi^*/p = g^*(C, Z) \quad (6)$$

The profit function is decreasing and convex in the normalized prices of variable inputs and increasing in the quantities of fixed inputs and the price of output. The negative of the derivative of the normalized profit function with respect to the normalized variable input prices of the farm directly yields the input demand functions (Lau & Yotopoulos 1972).

2.4.1 Specification of Empirical Model

The empirical model used in this study to examine the effect of scale of operation on profitability of small scale commercial broiler producers using the deep litter system of production in Ghana was the normalized profit function model developed by Yotopoulos & Lau (1973). This was accomplished by fitting data collected to the more flexible translog profit function which imposes no restriction upon returns to scale or substitution possibilities. Guided by Battese *et al*. (1996) and Battese (1997), stock size of selected small scale commercial broiler enterprise was incorporated into a modified translog profit function specified as:

$$\begin{aligned} In\,\pi_i =\ & \beta_0 + \beta_1 In\,P_1 + \beta_2 In\,P_2 + \beta_3 DHLAB_3 + \beta_4 In\,P_4 + \beta_5 DFLAB_5 + \beta_6 In\,P_6 + \beta_7 InP_7 + \beta_8 In\,P_8 + \\ & \beta_9 InP_9 + \beta_{10} InFMSZE_{10} + 0.5\beta_{11} (InP_1)^2 + 0.5\beta_{12} (InP_2)^2 + 0.5\beta_{13} (InP_4)^2 + 0.5\beta_{14} (InP_6)^2 + \\ & 0.5\beta_{15} (InP_7)^2 + 0.5\,\beta_{16} (InP_8)^2 + 0.5\,\beta_{17} (InP_9)^2 + 0.5\,\beta_{18} (In\,FMSZE_{10})^2 + \beta_{19} lnP_1InP_2 + \beta_{20} lnP_1InP_4 + \\ & \beta_{21} lnP_1InP_6 + \beta_{22} lnP_1InP_7 + \beta_{23} lnP_1InP_8 + \beta_{24} lnP_1InP_9 + \beta_{25} lnP_1InFMSZE_{10} + \beta_{26} lnP_2InP_4 + \\ & \beta_{27} lnP_2InP_6 + \beta_{28} lnP_2InP_7 + \beta_{29} lnP_2InP_8 + \beta_{30} lnP_2InP_9 + \beta_{31} lnP_2InFMSZE_{10} + \beta_{32} lnP_4 InP_6 + \\ & \beta_{33} lnP_4InP_7 + \beta_{34} lnP_4 InP_8 + \beta_{35} lnP_4 InP_9 + \beta_{36} lnP_4 InFMSZE_{10} + \beta_{37} lnP_6 InP_7 + \beta_{38} lnP_6 InP_8 + \\ & \beta_{39} lnP_6 InP_9 + \beta_{40} lnP_6 InFMSZE_{10} + \beta_{41} lnP_7 InP_8 + \beta_{42} lnP_7 InP_9 + \beta_{43} lnP_7 InFMSZE_{10} + \beta_{44} lnP_8 InP_9 + \beta_{45} \\ & lnP_8 InFMSZE_{10} + \beta_{46} lnP_9 InFMSZE_{10} + \varepsilon \end{aligned} \quad (7)$$

Where, ***ln*** denotes natural logarithm; the dependent variable profit ($\boldsymbol{\pi_i}$) is re-scaled restricted normalized gross profit per farm for the $\boldsymbol{i^{th}}$ broiler enterprise defined as revenue per farm less variable cost per farm divided by farm-specific broiler output price and then by the sample mean of the normalized gross profit per farm. $\boldsymbol{DHLAB_3}$ and $\boldsymbol{DFLAB_5}$ are dummy variables equal to one if there is wage for hired labour and imputed wage of family labour and zero if otherwise. They both are to capture intercept change effect of the prices of hired and family labour. The estimator for profit responsiveness to the wage of hired and family labour could be bias without the inclusion of *DHLAB* and *DFLAB* (Battese 1997); $\boldsymbol{P_{i's}}$ are the re-scaled normalized variable input ***j*** (***i = j = 1, 2, 4, 6,7, 8***) prices obtained by dividing variable input prices by farm-specific broiler price and by the sample mean of the normalized input prices; $\boldsymbol{P_9}$ and ***FSZE*** are the cost of fixed capital input and stock size of selected broiler farm *i*. $\boldsymbol{\beta_s}$ are parameters to be estimated and $\boldsymbol{\varepsilon}$ represents the error term assumed to have zero mean and constant variance. Since the normalized profit and variable input prices have been re-scaled by their respective sample means, the first-order coefficient can be interpreted as profit elasticities with respect to the different input prices (Coelli *et. al.* 2005). Hence, the first order coefficients of the estimated translog profit function were used to evaluate the extent of effect of changes in variable input prices on profit levels of sampled small-scale broiler enterprises.

The definition and descriptions of the independent variables included in the translog profit function model in equation (7) are inputs mainly used in the deep litter system of broiler production. These are Feed, Day-old chick, Labour (hired and family), Medication/drugs, water, energy, transportation and litter material. The price of day-old chick is a key factor that is expected to affect profit in broiler production. Al-Masad (2010) found that an increase in the price of purchased chick leads to a drop in profit of broiler enterprises in Jordan. It is hypothesized that the price of day-old chick negatively affects profit of small-scale broiler enterprises. Feed cost constitutes the largest part of the total cost in broiler production. Kahn & Maki (1999) were of the view that the availability of feeds at competitive prices is the most important condition for profitable broiler production because it constitutes more than 75 percent of the total expenditure. Effiong & Onyenweaku (2006) found a negative effect of feed cost on profit. Feed cost is therefore hypothesized to negatively affect profit of small-scale broiler enterprises.

Labour is defined as both mental and physical effort and is an important input in agricultural production. How it is measured and valued is essential for establishing the cost of producing agricultural products and accurately showing labour's relative share in total production cost. It is divided into family and hired labour. In order to avoid the problem of zero observation in estimation, most studies implicitly assume equal productivity and aggregate hired and family labour. Although some studies considered hired and family labour separately in their models, such studies are confined to farmers with positive values of these two sources of labour, discarding zero observations cases (Heshmati & Mulugeta 1996). Discarding parts of the observations may not be appealing because the available data are not fully utilized. Some studies treat the zero-observation case by using values of one or an arbitrary small number greater than zero for the key input concerned. This procedure may result in serious bias estimator of the production function as noted by Battese (1997). Guided by Battese *et. al*. (1996) and Battese (1997), wage rate of hired labour was disaggregated from imputed wage rate of family labour in this study, by setting the log-value of the zero-observation of these two sources of labour to be zero with dummy variables to explicitly examine their effects on profit of small-scale commercial broiler agribusinesses. This procedure ensures that efficient estimators are obtained, using the full data set without introducing any bias. The wage rate of family labour for small-scale commercial broiler enterprises using family labour was imputed in this study as the average wage rate for hired labour for each region (Hauver 1989). These two labour source costs are therefore hypothesized to negatively affect profit of small-scale commercial broiler agribusinesses.

Drugs and medication are inputs required in broiler production to ensure good health of birds and to reduce mortality in production. Effiong & Onyenweaku (2006) found a negative and statistically significant effect of drug and medication cost on profit of broiler producers in Akwa Ibom State in Nigeria. Increase in the cost of drugs and medicine will make it difficult for farmers to check mortality in broiler production. The price of drug and medications is hypothesized to have a negative effect on profit of small-scale commercial broiler enterprises in this study. Other input price in this study was arrived at by multiplying the quantity of other inputs such as water, litter, transportation and energy with their respective prices and summing them together. This is also expected to have a negative effect on profit. Fixed cost items are the costs incurred by broiler producers in the use of fixed assets such as building, equipment, feeders and drinkers. The value of capital input was obtained by summing up the straight-line depreciation value of broiler farm equipments (such as feeders, drinkers etc), maintenance cost of farm structure and equipment. Abaelu (1999) stressed that fixed cost affects profit of livestock enterprises, especially in the short-run planning period. The depreciation value of the fixed input used by broiler producers was hypothesized to positively affect profit of small-scale commercial broiler agribusinesses in the study area. Finally, stock size is a critical variable upon which output in broiler agribusiness production depends. This variable was measured by the reported number of day-old chicks stocked at the beginning of production in a batch by the sampled small-scale commercial broiler agribusinesses. The stock size was used to represent the scale of operation in broiler agribusiness production and hence was hypothesized to have a positive effect on profitability.

3. Results and Discussion

3.1 Descriptive Statistics of Respondents

Table 1 presents the descriptive statistics of the socio-economic characteristics of small-scale commercial broiler agribusinesses sampled. It shows that the average age of the broiler agribusiness producers sampled is 43 years old. Having younger people in broiler business will be very essential at ensuring the future continuity of the broiler industry. The results also show that majority (63 percent) of the respondents have up to secondary education. The level of education attained by a farmer does not only increase his productivity, but also enhances his/her ability to understand and evaluate new production technologies (Obasi 1991). Only 26 percent of the respondents had training or attended a seminar in poultry management. This suggests that only about one-quarter of the respondents have technical training in broiler production. Though formal education is equally important, building the capacity of small-scale broiler producers through regular technical training in broiler production will also be helpful. The mean farming experience of the sampled broiler producers in the study area is about 8 years. The longer the number of years in broiler farming, the more exposed the farmer becomes and the more profitable the business is likely to be.

Table 1: Descriptive Statistics of Socio-Economic Characteristics of Respondents

Variable per bird/batch	Mean	Minimum	Maximum	St. Dev
Gross profit (GH¢/batch)	5.59	0.04	21.22	3.60
Farm size (No. of birds stocked)	1050.73	50.00	5000.00	946.77
Broiler output (No. of birds)	1011.82	45.00	4950.00	927.91
Age of farmer (years)	43.36	20	74	11.27
Formal Education (years)	12.23	0	28	6.43
Experience (years)	7.61	0.42	51	6.75
Mortality Rate (%)	2.61	0.00	16.00	3.46
Veterinary service contacts/batch	1.38	0	6	0.79
Number of batches in a year	1.87	1	3	0.68
Price of matured broiler (GH¢)	14.80	10.00	30.00	3.63
Price of day-old chick (GH¢)	1.85	1.20	3.00	0.39
Price of feed/kg (GH¢)	4.28	1.15	11.20	1.54
Wage of hired Labour (GH¢)	0.99	0.00	9.33	1.48
Imputed wage of family Labour (GH¢)	0.50	0.00	9.17	1.07
Cost of medication/vaccine	0.33	0.09	1.65	0.21
Other operating cost (GH¢)	0.52	0.09	3.12	0.37
Average Variable Cost (GH¢)	8.48	3.34	18.30	2.62
Capital input Cost (GH¢)	0.30	0.003	3.08	0.33
Average cost per broiler (GH¢)	8.78	3.46	19.63	2.73

Source: Author's Computation Survey Data, 2010.

The results further show that small-scale broiler producers had an average extension contact of 1.38 visits per batch and produced about 1.87 batches of broiler in a year. This indicates that the average broiler farmer produces less than two batches a year, instead of a potential of five batches per year (Atibudhi 2004). Seasonality of broiler demand may be attributed to the low number of batches produced in a year. Almost all the respondents sampled indicated that they produce mainly for festivities such as Christmas and New years. Efforts directed at creating demand for broiler products could help to increase the number of batches produced in a year for maximum use of farm structures and full benefit. The respondents raised an average stock size of about 1,051 birds in a batch, and produced an average of 1,012 matured broilers in a batch, indicating an average livability rate of about 95 percent. Shaikh & Zala (2011) have also recorded livability of 94.4 percent in small-scale broiler farms in their study in India. With an average variable cost of GH¢9.30 and average revenue of GH¢14.80, small-scale commercial broiler enterprises sampled made an average profit of GH¢5.59 on a bird. Though a high cost and intensive enterprise, the result indicates that broiler production in the study areas is quite a profitable venture. The results further show that feed and day-old chicks costs constitute the largest proportion of 72 percent of the total variable cost of broiler production. This finding is almost similar to the 79.5 percent found by Shaikh & Zala (2011) in their study. With the continuous increase in feed prices, small-scale broiler producers need to adopt better feed management practices in production to ensure the efficient use of feed by broilers. This will reduce the expenditure broiler producers incur on feed. Also, if small-scale broiler enterprises could have access to day-old chick at reduced prices, they would be able to maximize profit, all things being equal.

Table 2 further shows the descriptive statistic of profit and cost structure of the different sizes of small-scale commercial broiler producers sampled. It shows that profit of small-scale commercial broiler enterprises sampled increases with size. Small-scale commercial broiler producers with stock size of less than 1000 birds in a batch made gross profit of GH¢4.89 per bird, compared to commercial broiler enterprises with stock size of more than 3000 birds in a batch who made gross profit of GH¢6.40 per bird. The gross profit of broiler agribusinesses with larger stock size is statistically higher at 1 percent than those with smaller stock size. This suggests that larger farms are more profitable than smaller farms. This can be explained by the relatively declining average costs of broiler production. While the average variable cost of producing a matured broiler by small-scale commercial broiler enterprises with less than 1000 birds per batch is GH¢9.42, that of those with more than 3000 birds is GH¢6.31. The average variable cost of broiler producers with stock size of more than 3000 birds is significantly lower at 1 percent than the average cost of producers with stock size of less than 1000. This might explain why the unit price of broiler sold is statistically lower at 1 percent for broiler producers with more than 3000 birds than those with less than 1000 birds per batch. This finding establishes the importance of scale of operation in the profitability of small-scale broiler agribusiness production in the study area. Increasing the scale of operation of broiler enterprises will reduce per unit cost of broiler production and hence its selling price to make locally produced broiler more competitive. This will intend increase the demand for broilers ready for market to enable commercial broiler producers make more profit. This result is consistent with Bhagwat (1998) and Bamiro (2008) who found that larger broiler stocks are associated with higher gross profit. Efforts that are directed at increasing the scale of operation of commercial broiler production should be encouraged.

Table 2: Descriptive statistics of different sizes of small scale broiler enterprises

Variables (per bird)	Less than 1000 birds	1000 to 2999 birds	3000 and above
Gross profit (GH¢/batch)	4.89***	6.63***	6.40
Farm size (No. of birds stocked)	479.62	1513.96	3785.71
Broiler output (No. of birds)	457.20	1451.42	3724.21
Price of matured broiler (GH¢)	15.14**	14.58	12.93***
Price of day-old chick (GH¢)	1.93	1.76	1.64
Price of feed/kg (GH¢)	4.28	4.36	3.91
Wage of hired Labour (GH¢)	1.40	0.43	0.30
Imputed wage of family Labour	0.74	0.19	0.06
Cost of medication/vaccine	0.41	0.22	0.19
Other operating cost (GH¢)	0.65	0.34	0.23
Average Variable Cost (GH¢)	9.42***	7.30	6.31***
Capital input Cost (GH¢)	0.39	0.19	0.11
Average cost per broiler (GH¢)	9.81***	7.49	6.42***

Source: Author's Computation Survey Data, 2010. NB: *** Significant at 1 percent.

3.2 Regression Results of the effect of Scale on Profitability of Broiler Agribusiness Production

Table 3 shows the regression results of the parameter estimates of the modified normalized translog profit function model used to determine the effect of scale on profitability of broiler agribusinesses. These parameters represent percentage changes in profit as a result of a percentage change in broiler input prices, and farm size. The results show that all variable input prices in the model are highly significant at 1 percent and have the expected negative signs. This indicates that the estimated normalized translog profit function is non-increasing (convex) in input prices and that profit level of small-scale commercial broiler producers increases with decrease in variable input prices. The F-value of 100.1, with a p-value 0.000, indicates that the model is statistically significant at 1 percent. The coefficient of determination (R^2) of 0.921 means that approximately 92 percent of variability of profitability was accounted for by the explanatory variables in the model. According to Gujarati (2004) in determining model adequacy, broad features of the results, such as the R^2 and *F*-values, which were both statistically significant in this study, should be looked at. Also, the Durbin-Watson statistic value of about 1.80 which is closer to two indicates that there is no autocorrelation among the explanatory variables in the model. Hence, the regression result of the translog profit function model was adequate. The intercept coefficient for wage rate of hired labour (*DHLAB*) and imputed-wage of family labour (*DFLAB*) are both not significant. This implies that the estimators of the parameters in the translog profit function would not have been bias if the dummies were not included in the model.

The results of the estimated parameters of the variable input prices show that prices of day-old chick and feed have the highest coefficients, suggesting that they are the most important variable in the broiler industry. The coefficients of day-old chick and feed prices show that a percentage decrease in the prices of day-old chick and feed will result in a 0.38 and 1.33 percent increase in the profit of commercial broiler producers respectively. The result suggests that profit of small-scale broiler producers is highly responsive to feed prices, implying that a percentage reduction in the price of feed will significantly increase profit by more than proportionately. Considering the relatively high responsiveness of profit to feed and day-old chick prices, measures that will aim at reducing the prices of these two inputs would be most appropriate. This result is consistent with Ike &

Ugwumba (2011) who also found feed and day-old chick cost to be the two important factors affecting profit of small-scale broiler farmers in their study. The coefficients of the other variable input prices also negatively and significantly affect profit of small scale broiler producers in the study areas. This suggests that a decrease in the prices of other variable inputs such as hired and family labour, medication/drugs and other operating expenses will significantly increase profit of small-scale broiler producers. Measures that will ensure that broiler producers engage labour services, use medicines/drugs as well as use water, electricity and litter at affordable prices to increase profit should be encouraged. This result obtained for the other variable inputs is consistent with Effiong & Onyeaweaku (2006) who also found them to negatively affect profit of small scale broiler producers.

Table 3: Effect of Scale on Profitability of Small-scale Commercial Broiler Agribusinesses

Variable	Coefficient	Std. Error	t-Statistic
Constant	0.734	0.804	0.913
lnPDoc	-0.378*	0.211	-1.792
lnPFeed	-1.326***	0.135	-1.392
DHLab	-0.982	0.705	-1.392
lnWrteHLab	-0.331***	0.050	-6.680
DFLab	0.210	0.389	0.541
lnMWgFLab	-0.202***	0.054	-3.735
lnPMed	-0.313***	0.115	-2.724
lnOthers	-0.252**	0.126	-2.009
lnFxedCst	0.004	0.059	0.063
lnFmSze	3.797***	0.239	15.913
lnPDoc x lnPDoc	-0.622***	0.225	-2.768
lnPFeed x lnPFeed	-0.884***	0.097	-9.142
lnWgHLab x lnWgHLab	-0.071***	0.019	-3.690
lnMWgFLab x lnMWgFLab	-0.026*	0.014	-1.937
lnPMed x lnPMed	-0.075	0.105	-0.712
lnOthers x lnOthers	0.045	0.089	0.508
lnFxedCst x lnFxedCst	0.026	0.021	1.262
lnFmSze x lnFmSze	-1.536***	0.263	-5.835
lnPDoc x LnPFeed	0.356	0.249	1.431
lnPDoc x lnWgHLab	0.040	0.047	0.837
lnPDoc x lnWgFLab	0.008	0.046	0.181
lnPDoc x lnPMed	0.152	0.264	0.577
lnPDoc x lnOthers	-0.182	0.199	-0.914
lnPDoc x lnFxedCst	0.044	0.106	0.415
lnPDoc x lnFmSze	0.752*	0.398	1.891
lnPFeed x lnWgHLab	-0.040	0.027	-1.450
lnPFeed x lnMWgFLab	-0.033	0.026	-1.265
lnPFeed x lnPMed	-0.145	0.158	-0.917
lnPFeed x lnOthers	0.067	0.127	0.525
lnPFeed x lnFxedCst	0.022	0.076	0.289
lnPFeed x lnFmSze	1.521***	0.252	6.036
lnWgHLab x lnMWgFLab	0.006	0.010	0.563
lnWgHLab x lnPMed	-0.000	0.027	-0.001
lnWgHLab x lnOthers	-0.044	0.027	-1.626
lnWgHLab x lnFxedCst	-0.009	0.013	-0.701
lnWgHLab x lnFmSze	0.125**	0.052	2.387
lnMWgFLab x lnPMed	-0.020	0.026	-0.769
lnMWgFLab x lnOthers	-0.035	0.025	-1.434
lnMWgFLab x lnFxedCst	-0.012	0.012	-0.955
lnMWgFLab x lnFmSze	0.140***	0.050	2.818
lnPMed x lnOthers	-0.165	0.138	-1.200
lnPMed x lnFxedCst	-0.018	0.067	-0.276

lnPMed x lnFmSze	0.314	0.265	1.183
lnOthers x lnFxedCst	-0.013	0.063	-0.213
lnOthers x lnFmSze	0.361*	0.215	1.684
lnFxedCst x lnFmSze	-0.064	0.103	-0.625

R-squared	0.921	Mean dependent var	-0.668
Adjusted R-squared	0.912	S.D. dependent var	1.307
S.E. of regression	0.388	Akaide info criterion	1.044
Sum squared resid	59.240	Dubin-Watson stat	1.797
Log likelihood		-183.110	
F-statistic		100.129***	

Source: Author's Computation from Survey Data, 2010. Note: Asterisks indicate significance level for one-tail tests; *** denote 1%; ** denote 5% and * denotes 1% confidence level.

Scale of operation is a key factor that has the potential of increasing profitability of broiler enterprises. It helps in determining per unit cost of production by ensuring that production cost is spread over larger amounts of output. The coefficient of the parameter estimate of FMSZE (scale) in the model was found to be positive and statistically significant at 1 percent and consistent with the study a prior expectation. This indicates that a percentage increase in the stock size of commercial broiler enterprises (FMSZE) will increase profit by 3.80 percent. Profit of small-scale commercial broiler agribusinesses will therefore increase by more than proportionately if the scale of broiler production is increased by one percent. The extent of impact of scale of operation on profitability in the model estimated is greater than the other variables. The more broilers are raised in a production cycle or batch, the more profitable broiler operation will become. Thus, scale of operation really matters in profitability of small-scale commercial broiler agribusiness production. This result corroborates Effiong and Onyeaweaku (2006) who also found that scale of operation has a positive and significant relationship with profits. Singh *et al* (2010) also found that net return per bird increased with increase in the farm size in their study. Policies directed at encouraging commercial broiler producers to increase the size of their broiler operations should be encouraged.

5. Conclusion and Policy Implications

The study examined the effect of scale in profitability of 441 small-scale commercial broiler agribusinesses in the Greater Accra, Ashanti and Brong Ahafo Regions of Ghana, using a modified translog profit function model. Structured questionnaire was used to collect primary data on prices and quantities of input and output from the respondents through a multiple-stage random sampling technique. The result shows that prices of feed and day-old chicks are the two main factors that negatively affect profitability of small-scale commercial broiler enterprises. This suggests that reducing the prices of these key inputs will significantly make broiler products competitive and consequently increase profit. Scale of broiler production positively affects profit in broiler production. Increasing the scale of broiler production will significantly increase profit. The result of the study therefore indicates that scale matter in the profitability of small-scale broiler agribusiness production. Since prices of inputs are not within the control of broiler producers, their capacity should be built through regular workshops and seminars on proper farm management practices to enable them reduce production cost on feed to enhance profit. Policy actions directed towards broiler producers to increase their scale of operation to reduce cost and increase profit should also be encouraged.

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