

## Original Research Article

### Financial Risk Threshold Determination in Broiler Enterprise in Delta State, Nigeria

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#### Abstract

Increasing concern about the problem of risk associated with poultry business has highlighted the need for its comprehensive understanding. A clear knowledge of financial risk in broiler enterprise will pave the way to efficient mitigation strategies among broiler producers. This study investigates financial risk programming, and threshold analysis in broiler enterprises in Delta State, Nigeria. Probabilistic (multi-stage) sampling procedure was adopted in selecting 200 broiler farmers for the study. Structured questionnaire was used to collect 6 years time series data (2004-2009) from the respondents. Collected data were analyzed using descriptive statistics, QSB version of linear programming model, and threshold model. The results of the study showed that broiler enterprise is profitable with optimum net profit of ₦47,925 and ₦357,558 per small scale and large scale producers, respectively. An optimum profit of ₦389.9 per bird was earned by broiler producers. The output of QSB version of linear programming showed that at the stocking rate of 20, 692 birds, financial risk is optimized at 15%. The threshold regression model revealed that the broiler enterprise in the study area generally operated below the risk threshold. Simple regression indicated that expected return is positively and significantly ( $P < 0.05$ ) related with financial risk. Incorporating financial risk as a constraint in the broiler farm plan is a useful contribution that will enhance efficient farm planning. The optimal return and financial risk threshold provided in this study will improve the confidence level of stakeholders in poultry industry such as current and potential investors, insurance institution and institutional lenders. This will translate to growth in the broiler subsector of the poultry industry in Delta State.

**Keywords:** Financial risk; risk threshold; risk programming; broiler enterprise.

**Note:** Naira (₦) is Nigeria national currency

#### INTRODUCTION

The poultry industry is of considerable economic relevance because it serves as a source of food, income, employment and self sufficiency in cheap animal protein (Bosnjak and Rodic, 2008; Hodges, 2009). The poultry industry in Nigeria is capitalized to about ₦2 trillion and employs no fewer than 30 million Nigerians on the whole. An inadequate supply of chicken meat to the ever increasing population of Nigerians still exists. A number of people in Delta State hinge their livelihood directly or indirectly on the broiler subsector of the poultry industry. Broiler producers take investment decision with an expected profit. However, financial risk through fluctuation in output (Goodwin et al., 2005) and unsteady profit are major sources of discouragement to investors and a threat to the growth and survival of broiler enterprises. Financial risk is the probability of profit shortfall. It is important that broiler producers are aware of the actual financial risk level in broiler production. This calls for serious and concerted research efforts to ensure financial stability in the industry.

In spite of the increased relevance of the poultry subsector, high demand – supply gap for poultry meat still exist in Nigeria. Furthermore, growth in broiler production has stagnated due to perceived financial risk. The risks associated with financial returns to investment can be attributed to:

Output risk, output price risk, input price risk, mortality risk, negligence of recommended best management practices by broiler producers, near absence of efficient risk management strategies among producers.

At present, empirical data on optimal return, financial risk threshold and efficient financial risk management strategies in the Nigerian poultry industry are scarce. A broiler farm plan that is based on optimal return, financial risk threshold, and strategic financial risk management will perform better and bring desired development to the poultry industry.

The previous research works on the risk hypothesis are mostly centered on the probability methodologies ignoring optimization techniques. Analyzing the issue of financial risk threshold in the poultry sector, however, may detect many appealing facts. In fact, it is likely that the link between risk and expected returns may vary across scales of operations, and such relationship may even change over time. The approach of financial risk thresholds, in this regard, proves very useful for its potentiality to decompose the poultry agribusiness risk into low, optimal and upper stochastic risk levels.

The useful research questions that emanated from this study are: Is there financial risk in broiler enterprise? What is the financial risk threshold in broiler enterprise? Is there any relationship between expected return and risk level?

The broad objective of this study was to investigate

financial risk programming, and risk threshold analysis in broiler enterprise in Delta State. Specific objectives were to:

- i. Determine the optimal net return in broiler production
- ii. Ascertain the financial risk threshold in broiler enterprise
- iii. Estimate the causality between expected return and financial risk in broiler enterprise in Delta State.

This study was predicated on risk theory of profit as put together by Hawley (1893), Schumpeter (1934), and Knight (1957). The risk theory of profit was considered appropriate because profit risk is synonymous with financial risk in business. The risk theory of profit stipulates that risk in business may arise from all the factors that relate to profit. Hawley (1893) related risk-taking to profit-seeking. He therefore postulated that risk-taking is an inevitable component of profit functions. Entrepreneurs who take risk must have a sound claim to an additional reward-known as profit. Hence business men would not assume risk without expecting adequate compensation in excess of actuarial value (the premium on calculable risk). Profit is an inducement to suffer the consequences of being exposed to risk in their entrepreneurial adventures (Hawley, 1893). According to Dwivedi (2008), actuarial risk is burdensome, irksome; it gives rise to trouble and disutility of various kinds to the entrepreneur.

An entrepreneur must bear risk to be qualified for profit. If an entrepreneur avoids risk he would cease to be an entrepreneur and would not receive any profit. To that extent, profit is a residue. Hence Hawley's risk theory of profit is also termed residual theory of profit. Profit is the target or expectation of entrepreneurs. Expected profits are hardly attained without deviation. The variability or deviation of the expected and actual profit often assumes a probability. This degree of variability of profit with known probability is termed financial risk. To this extent, financial risk is a stochastic or random variable.

A dynamic economy is characterized by generic changes in business features including profit on a continuous basis and entrepreneurs with foresight continue to take advantage of the changes. According to Knight (1957), the emergence, disappearance and re-emergence of profit, is a continuous process. To that extent, profit is a random decision variable. Until the uncertainty ends with the sale of products, the amount of reward (profit) cannot be determined with accuracy by the entrepreneur.

A broiler is a type of chicken raised specifically for meat production. It grows much faster with high feed conversion ratio and low level of activity. Broilers often attain harvest weight of 2 to 2.5 kg in 8 to 10 weeks. A commercial broiler enterprise involves the production of broiler mainly for sales. In Nigeria, the poultry industry holds a great promise in addressing the problem of economic melt down.

In recent times, the experience of producers has shown

that broiler production has been suffering some setbacks arising from the risk of poultry inputs and output price variations. Many of the existing poultry farms are folding up and prospective investors are becoming increasingly skeptical to invest. The situation threatens the continuous survival and growth of the poultry sub-sector (Aihonsu, 1999; Bamiro et al., 2009). Before now, investors based their risk fears on intuitive knowledge, educated guess work and sheer speculations without empirical facts on financial risk in poultry business. Such fears may be baseless in the absence of empirical evidence on financial risk threshold in broiler enterprise: Risk threshold is the optimal or suitable risk level in an enterprise.

## MATERIALS AND METHODS

The study was conducted in Delta State, Nigeria. Probabilistic (multi-stage) sampling method was used to select a sample of 200 broiler farmers from the three Agricultural Zones of Delta State. Structured questionnaire was the instrument used to collect 6 year (2004-2009) time series data. Secondary data were obtained from CBN yearly publications. Data were summarized using inferential statistics and descriptive statistics percentage, and standard deviation. The QSB version of linear programming model was employed to determine the optimal net return and optimal financial risk level. Profit function was used to obtain the indices of profitability.

### Analytical Framework

#### Risk Estimation Method

Standard deviation is a widely used measurement of variability in statistics and probability theory. Standard deviation is important in finance, where the standard deviation on the rate of return on an investment is a measure of the volatility of the investment. To that extent, profit standard deviation is a measure of uncertainty. Finance standard deviation is a representation of the risk associated with a given investment.

Financial risk is an important factor in determining how to efficiently manage an investment because it determines the variation in returns on the investment and gives investors a mathematical basis for investment decision (known as mean-variance optimization). The overall concept of financial risk is that, as it increases, the expected return on investment will increase as a result of the risk premium earned. In other words, investors should expect a higher return on an investment when the said investment carries a higher level of risk or uncertainty. When evaluating investments, investors should estimate both the expected return and the uncertainty

of future returns. Standard deviation provides a quantified estimate of the risk in future returns. Standard deviation of return (financial risk estimate) is presented as:

$$\sigma(r) = \sqrt{\frac{1}{N-1} \sum_{i=1}^N (r_i - r)^2} \quad (1)$$

Where:

$\sigma(r)$  = Standard Deviation of return,  $r_i$  = observed return  
 $r$  = mean return;  $N$  = number of cases

### Risk Optimization

Arising from existing literatures, it does appear that primary objective of risk optimization models is to identify the most efficient plan, based on risk parameter. Perez (1986) demonstrated the use of linear programming (LP) for optimization of risk in shrimp industry. Hatch et al. (1987), followed up by investigating the usefulness of risk configuration in the formulation of optimal plans for aquaculture. They recommended Target- MOTAD (Minimization of Total Absolute Deviation) as an efficient LP model which encapsulates risk parametrically. Dunning (1989) developed an additional LP model to investigate the economic optimization of shrimp farming in Ecuador. Stanley (1993) adopted this model to describe optimal management strategies for a typical aquaculture farm in Honduras. Also, Akanni and Akinleye (2004) adopted LP model to analyze risk in small scale poultry business in Abeokuta metropolis in Nigeria. In this present study, the latest version of LP model known as Quantitative system for Business Analysis (QSB) package was adopted. This model involves the criterion of maximizing net return, subject to financial risk (variation in net return) and other constraints.

The LP model is expressed as:

$$\text{Maximize } \Pi = \Pi_L + \Pi_s \quad (2)$$

Subject to:  $X_{sl} + X_{ss} \leq M$  (Stock size constraint)

$X_{sl} + X_{rs} \leq N$  (Financial risk constraint)

$X_{prl} + X_{prs} \leq O$  (Production risk constraint)

$X_{frl} + X_{frs} \leq P$  (Feed price risk Constraint)

$X_{brl} + X_{brs} \leq Q$  (Broiler price risk constraint)

$X_{lbl} + X_{lbs} \leq R$  (Labour use constraint)

$X_{sml} + X_{sms} \leq S$  (Starter mash constraint)

$X_{fml} + X_{fms} \leq T$  (finisher mash constraint)

$X_s \geq 0$  (Non negatively condition). Where:  $\Pi$  = Enterprise net profit (₦);  $\Pi_s$  = contribution of small scale to enterprise

net profit (₦);  $\Pi_L$  = large scale contribution of) to enterprise net profit (₦);  $X_{ss}$  = small scale stock size;  $X_{sl}$  = large scale stock size;  $X_{rs}$  = small scale financial risk;  $X_{rl}$  = large scale financial risk;  $X_{prs}$  = small scale production risk;  $X_{prl}$  = large scale production risk;  $X_{frs}$  = small scale feed price risk;  $X_{frl}$  = large scale feed price risk;  $X_{brs}$  = small scale broiler price risk;  $X_{brl}$  = large scale labour use;  $X_{sms}$  = small scale starts mash;  $X_{sml}$  = large scale starter mash;  $X_{fms}$  = small scale finisher mash;  $X_{fml}$  = large scale finisher mash  $M, N, O, P, Q, R, S, T$  are the various activity levels.

### Financial Risk Threshold Model

The observed financial risk and the financial risk threshold value (optimum risk) derived from LP model were used to configure the risk threshold model. The piece-wise linear regression (spline function), was adopted for this purpose. In this model, the difference between the observed (actual) and the threshold (estimated) risk values, was captured as a dummy variable. It is specified as:

$$\hat{O} = \beta_1 + \beta_2 (\sigma_{ri} - \hat{O}^*) D + \mu \text{ (Gujarati, 2001)} \quad (3)$$

Where:

$\hat{O}$  = Total financial risk parameter,

$\sigma_{ri}$  = Individual poultry farm observed financial risk

$\hat{O}^*$  = Financial risk threshold value;

$D$  = Dummy of 1 if  $\sigma_{ri} > \hat{O}^*$ ; 0 otherwise

A test of null hypothesis that there is no significant difference between the observed risk and the risk threshold value was conducted by noting the statistical significance of the estimated differential slope coefficient ( $\beta_2$ ).

## RESULTS AND DISCUSSION

### Optimum Net Profit

The result of the optimum profit in broiler enterprise is shown in linear programming output in Appendix 1. The recommended plan shows a maximized objective of ₦8,063,506 from producing 20,676 units of broiler (50% of 25625) and (49% of 15759). Market signals are given only in price per unit of products and resources. As a result, broiler

### Appendix 1: Optimum Profit in Broiler Enterprise

Maximum number	Variable	Solution	Opportunity cost	Objective coefficient	Minimum objective coefficient
1	$X_1$	+50004929	+488.17	+8938750.0	+8245444.0
2	$X_2$	+49990472	+414.37	+7188750.0	+4624060.5

enterprise profit requires to be a breakdown so that there will be uniformity in analysis of market indices. When presented in the same unit and measures as provided by the market, broiler business operator can then determine whether the market price of broiler is high enough to make it worth the use of valuable resources (e.g. feed) to produce broiler, and what quantity to produced will be an optimum (yielding optimal net profit). Finding the optimal solution for unit cost and return can in the long run lead to more sustainable development in the broiler enterprise. The mean per small scale producer is ₦47,925 whereas the mean profit per large scale producer is ₦357,550. The optimum profit of ₦389.99/bird is feasible as shown in the result of this study. This result supports the earlier finding of Nasiru et al. (2006) that opportunity exist for profit maximization in broiler production at both small and large scales, provided resource utilization is optimized. The net return observed in the broiler enterprise is high enough to retain investor and can encourage prospective investors to the enterprise. This finding confirms the assertion of Aiyedun (2005) that expected return is the most important factor that influenced farmer's investment decision.

The resource condition shows that the limiting factor to profitable broiler production are variations in feed cost (feed cost risk), the use/supply of broiler starter and broiler finisher rations. The shadow price in the optimal plan represents the marginal value productivity (MVP) of factors of production. It shows the addition to the profit maximizing function based on the use of extra unit of the limiting factors. Feed price variation caused broiler starter ration to have the highest opportunity cost of ₦488.99 compared to ₦414.37 for broiler Finisher ration. This is the amount forgone due to the feed price variation (risk). Any plan put in place to stabilize price of feeds (starter and finisher mash) will go a long way in increasing profit from broiler production. Government policies and projects as well as farm management techniques should therefore be put in place to reduce or mitigate the rather rapid feed price fluctuations (risk) measure such as future market, own-farm production of feeds, diversification and stock-pilling of feed can be used to reduce the effect of seasonal and periodic price fluctuation. This is subject to the

availability of finance. Large scale broiler producers with enough capital bases may be more likely to cope compared to resource poor poultry farmers in the study area. This finding is similar to that report by Akanni and Akinleye (2004). The broiler enterprise was profitable with means of ₦7,188,750 and ₦8,938,750, for small-scale and large scale producers per annum, respectively. The mean net returns of ₦47,925 and ₦178, 775 per farmer per production cycle for small-scale and large scale producers, respectively, were evident in the study. Optimum return per matured broiler is ₦389.99 in one production cycle of two months.

### Financial Risk Threshold in Broiler Enterprise

The optimum financial risk (the risk threshold) is shown in Appendix 2 Financial risk was factored in the broiler revenue plan as a constraint to revenue in both large and small scale broiler enterprises. The optimum financial risk (risk threshold) in broiler enterprise was determined to be 15%. This is the maximum financial risk that can be tolerated in the enterprise. This indicates that broiler producers could experience a profit shortfall of 15% and still remain resilient in the business.

The result of the linear programming (LP) shows that at the stock size of 20, 692 birds (large scale > 500 birds) optimum financial risk is 15%. Though small scale producers (i.e. below 500 birds) had lower financial risk (14%), they could increase their stock size and earn higher profit at a risk of 15.13%. At higher stock size, financial risk might increase but not beyond maximum risk of 15.13%. The difference in financial risk at small scale (14%) and the maximum risk level, in the enterprise (15.13%) is 1.13%. Where resources are available to increase stock, it is uneconomical to operate small scale broiler enterprises in the study area.

### Financial risk threshold analysis

The financial risk threshold model is restated as:

$$\hat{O}r = \beta_1 + \beta_2 (\sigma_{ri} - \hat{O}^*) D + \mu \quad (4)$$

Where,  $\beta_1 = 0.115$ , and  $\beta_2 = 0.067$  risk threshold equation becomes

### Appendix 2: Revenue Optimization Condition Maximize +8938750x<sub>1</sub> +7188750x<sub>2</sub>

Subject to:

No.	Large scale	Small scale	Maximum/limit	Constraints
1	+1.00000x <sub>1</sub>	+1.00000x <sub>2</sub>	≤+20692.0	Stock size
2	+151300x <sub>1</sub>	+140000x <sub>2</sub>	≤+145700	Financial risk
3	+12.6160x <sub>1</sub>	+13.2240x <sub>2</sub>	≤+12.9200	Production risk
4	+148.180x <sub>1</sub>	+129.190x <sub>2</sub>	≤+138.680	Feed price risk
5	+365.880x <sub>1</sub>	+337.720x <sub>2</sub>	≤+351.800	Matured broiler price risk
6	+1500.00x <sub>1</sub>	+1350.00x <sub>2</sub>	≤+1425.00	Labour use
7	+1375.00x <sub>1</sub>	+870.000x <sub>2</sub>	≤+1122.50	Feed1(broiler starter)
8	+4114.40x <sub>1</sub>	+2128.40x <sub>2</sub>	≤+3121.40	Feed2(broiler finisher)



$$\begin{aligned}\hat{O}_r &= 0.115 + 0.067D + \mu \\ t &= (30.98) * (12.75)*.\end{aligned}\quad (5)$$

Note: The value in parenthesis are the corresponding t-values.

#### Testing of Hypothesis 1

$H_0$ : *There is no significant difference between the observed financial risk and the financial risk threshold in broiler industry.*

The above null hypothesis of no significant difference between the observed enterprise financial risk and threshold risk value was tested by the statistical significance of the estimated differential slope coefficient ( $\beta_2 = 0.67$ ), using t-statistics. The result showed that there is a significant difference ( $P < 0.05$ ) between the threshold risk level and the observed risk level in broiler industry in Delta State, Nigeria.

The result of the threshold model using t-statistics, indicated that the estimated differential slope coefficient ( $\beta_1 = 0.115$ ) was significant ( $P < 0.05$ ). This is lower stochastic risk level (12%) The upper stochastic risk level can be obtained by the sum of  $\beta_1 + \beta_2$ , (i.e.  $0.115 + 0.067 = 0.18$ ) i.e 18%. The threshold model demarcates the financial risk in broiler enterprise into 3 components, viz.: the low risk region, the threshold risk and the stochastic (upper) risk region. The study revealed that majority (87.3%) of the broiler farms operated below the risk threshold while the remainder 12.7% of the broiler farm firms operated in the high financial risk region (above the threshold risk level). Of this, 10% were large scale farms whereas the remaining 2.7% were small scale broiler farms. This shows that the high risk bearers were mainly large scale producers. This result indicates that the broiler enterprise generally operated below the financial risk threshold level. This finding agrees with the earlier finding of Kehkha et al. (2005) that large scale producers can take up high risk because they expect high returns. Also Samuelson and Nordhaus (2003); Umoh (2008), associated high profit with high financial risk in their separate studies.

#### Relationship between Expected Return and Financial Risk

The simple regression presented in Table 1 shows the functional relationship between expected return and financial risk in broiler enterprise.

**Table 1:** Relationship between Expected Return and Financial Risk

	Coefficients	Standard Error	T-Stat	Remarks
Intercept	0.53164	0.013618323	47.5566	sig.
$SD_{Roi}$	0.39622957	0.086834669	4.563	sig.

$$\begin{aligned}E_{Roi} &= 0.53 + 0.39SD + \mu \\ t &= (47.56)* (4.56)*.\end{aligned}\quad (6)$$

Note: The values in parentheses are the corresponding t-values

Where  $E_{Roi}$  is the expected return and SD is the standard deviation of return which is the financial risk estimator. Expected return is positively related to expected financial risk. The positive sign in the expected return – risk function indicates that higher risk attracts higher expected return to broiler entrepreneurs of Hawley (1893) that profit is the payment for risk taking. The optimum financial risk can therefore be used to predict the optimum profit in an investment. The optimum financial risk value ( $STD_{Roi}$ ) obtained from the linear programming output is 0.15. This risk value was inserted in the prediction equation to obtain an equivalent optimum expected return to investment ( $E_{-Roi}$ ) of ₦59 for every ₦100 invested. This was used as a response equation to predict optimum return on investment, given optimum risk ( $STD_{Roi}$ ) = 0.15 (15%). This is the maximum risk that can be tolerated in the broiler enterprise.

The corresponding return on investment at this point was estimated to be ₦59 for every ₦100 invested in broiler business. Thus the expected value at risk (VaR) is ₦59 for every ₦100 invested in broiler enterprise in Delta State, Nigeria. The risk at this point is 15%. This implies that there is the possibility of income shortfall of 15% of ₦59 (i.e ₦8.85). Hence the worst outcome will be ₦59 minus ₦ 8.85. This gives a worst expected return of ₦50.15 for every ₦100 invested in broiler business. Even at this, the broiler enterprise is substantially profitable. The response equation further shows that the lower the risk, the lower the expected return. On the other hand, the higher the expected return, the higher the risk level that the enterprise should expect. This finding agrees with the earlier report of Samuelson and Nordhaus (2003) that higher return is associated with higher risk in any investment.

Accurate prediction of financial reward (return) of broiler producers under risky business environment is an important factor that will contribute to the development of broiler poultry system. There is positive relationship between expected return and financial risk. At 15% financial risk expected return on investment was estimated to be 59% (₦59) for every ₦100 invested in broiler enterprises. The 15% of ₦59 is ₦8.85. This is the profit short fall possible, such that ₦50. 15 for every ₦100 invested, is the worst profit scenario.

#### CONCLUSIONS AND RECOMMENDATIONS

Profit risk in broiler enterprise in Delta State was investigated in this study. Profit is the reward for risk-taking by entrepreneurs in broiler business. The study revealed that the optimum profit earned by entrepreneurs in broiler business was substantial. Broiler enterprise generally

operated in the low risk region below profit risk threshold of 15%. Thus the profit short fall of ₦8.85 for every ₦100 invested in broiler business is possible, whereas a worst rate of return of about ₦53 for every ₦100 invested is possible in broiler business. Putting into consideration the ruling interest rate of 17%, broiler business has demonstrated a relatively high risk bearing capacity which can sustain and attract more investment to broiler enterprise in Delta State. The study has helped to fill the gap in financial risk study by providing empirical data on the positive relationship between expected return and risk in broiler enterprise. The study, by using linear programming technique has incorporated financial risk as a parameter in the broiler farm plan for optimum performance. This study revealed that broiler enterprise operated in the low risk region within the period of the survey. This should allay the high risk fear which investors earlier speculated in broiler business. The result of this study should boost the confidence of existing and potential investors, thereby stimulating aggregate investment and growth in the broiler sub sector in Delta State, Nigeria.

On the basis of the research findings, the following recommendations are proffered:

1. To avoid the effect of intra-seasonal feed price variation, commercial broiler farmers should stockpile feed at the beginning of the production season.
2. Contract farming arrangement, if possible, should be encouraged between hostellers and broiler farmers. This will ensure ready market and steady financial flows to broiler farmers.
3. Extension agents should educate broiler farmers on the need to incorporate risk into their farm plans, since risk cannot be avoided completely. If all these recommendations are implemented, it will lead to tremendous development in the poultry industry.

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