TRENDS AND DETERMINANTS OF PRICE IN THE POULTRY SUB-SECTOR OF NIGERIA

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Abstract

This study analyzed the trends and determinants of price in the poultry sub-sector of Nigeria. A time series data, from the period of 1961-2014 were collected from the Food and Agricultural Organization database and other sources. Trend analysis, ADF unit root test, cointegration test error correction model, and impulse response were used to analyze the data. The unit root test using Augmented Dickey Fuller test (ADF) shows that all the variables have constant mean suggesting the presence of a long-term relationship. The Johansen cointegration test indicates the presence of two cointegrating equations suggesting the likelihood of long-run relationships between the variables. The error correction term (ECM) coefficient of 87.2 % indicates that the speed of adjustment of the dependent variable from the short run to the long run was high. Imports of poultry products, capital, inflation, interest rate and tariff rate were the significant variables affecting the domestic poultry product prices in the long run. We, therefore, recommend that a well-articulated import control measures should be adopted and not necessarily tariff increase. An outright ban and border control will go along to help stabilize domestic poultry prices.

Key words: *determinants, price, poultry, trends*

INTRODUCTION

The poultry sub-sector globally is highly dynamic and it is been challenged by the increasing cost of inputs which translates to the increasing price of poultry products. In developing countries, poultry production is evolving in response to rapidly increasing demand for poultry products with the attendant shortfall in supply leading to increasing level of imports. In developed countries, demand for poultry products is stagnating, while many production systems are increasing their efficiency. Historical changes in the demand for poultry products have been largely driven by human population growth, income growth and urbanization [1]. The poultry sub-sector is an important component of the Nigerian Agricultural Economy. Its importance derives from the fact that it is one of the key employers of labor as there are many poultry enterprises springing up.
Poultry is generally considered as a collective name to domesticated fowls kept primarily for meat, eggs and in some cases as ornamental. These include chicken, turkey, Guinea fowls, pigeons, Ostriches, Pheasant, Quails, Peafowl's, and swimming birds such as ducks, Geese, and Swans. They are domesticated birds kept for egg or meat production which include chickens (domestic fowls) turkeys, ducks and geese [8]. Poultry is the quickest source of meat and its production process involves the least hazardous and arduous in relation to another livestock enterprise. Hence, increased poultry production is one of the surest and quickest ways of increasing income and poverty alleviation.
In Nigeria, poultry production can be divided into three main sections name small, medium and large-scale production with 25% being provided by commercial farms, 15% semi-commercial and 60% from the backyard [1]. The two major events that have been recorded in the industry has been the ban on the importation of frozen poultry product which was introduced in 2003 and deepen the market for poultry product in Nigeria and the Avian

Influenza of 2007 which affected the industry on a negative note. The ban according to on the importation of frozen chicken into Nigeria has not only created jobs in the poultry industry but encouraged investments in poultry production. It is recorded that the poultry industry contributes about 25% of the country's Agricultural GDP.

Consequently, local supplies have been inadequate with an estimated 30% of the livestock slaughter imported from neighboring countries. In addition, inability to comply with international sanitary and photo-sanitary standard requirements has made it challenging for Nigeria to be a net exporter of live animals and livestock products internationally. Although the potential poverty-reducing and food security promoting opportunities of livestock development have not been fully tapped into in Nigeria, the role of livestock in food security and poverty reducing could be enhanced through research, extension, and training.

There has been a steady increase in population, urbanization, disposable income and export drive. Unfortunately, the poultry industry is beset by quite a number of challenges. These challenges range from the high cost of feed, poor quality chicks and pouts, inadequate basic infrastructures such as road, power and water supply to inaccessibility of veterinary services, credit facilities and inadequate investment by both the public and the private sectors.

The increasing rate of urbanization in Nigeria, and the subsequent soaring amount of wastes being generated in the poultry industry and the resultant human population explosion, and their human wastes present greater challenges for waste disposal and management, especially in the urban areas of this country. Of great concerns are the environmental pollutions resulting from poultry industry activities. One major challenge of commercial poultry is waste management from feed mills to the meat processing unit of the poultry industry. A Large quantity of poultry waste is inevitably generated on a continuous basis in commercial production to the extent of the intensity of operations. The waste if not managed properly, can be inimical to human health and the water quality. Repugnant odors from commercial poultry operations, especially when the wastes are not properly managed, has often been found to be a major source of conflicts within communities in cases where the enterprise is located near Residential areas. Nigeria has the highest number of poultry farms in Africa. Poultry meat and eggs are the most consumed animal protein; unrestricted by any religion or culture in Nigeria.

MATERIALS AND METHODS

Nigeria is a country located in West Africa along the Atlantic Ocean's Gulf of Guinea, its land borders are with Benin to the West Cameroon and Chad to the East and Niger to the North. It is between latitudes 4^0N and 14^0N and longitudes 3^0E and 15^0E Meridian. Nigeria's equatorial position gives its tropical climate but this does not mean a single environment. Nigerian are predominantly farmer producing and importing poultry products to meet their protein needs.

This study will adopt principally secondary data obtained from the Central Bank of Nigeria statistical bulletin, National Bureau of Statistics (NBS), State Agricultural Development Programmes (ADPs), Food and Agriculture Organization database, World Bank Statistical Bulletin, United Nations Development Programme (UNDP) statistical reports and other sources for a period of 1961-2014.

Unit Root Test using the ADF test and Philip-Perron technique to test if the time series data is stationary and descriptive statistics. The Johansen's Cointegration Test and Error correction estimate which shows the short run and long run relationship between the specified variables

Model Specifications
Growth rate analysis
The growth rates in poultry are computed using the following least squares method of fitting the semi-logarithmic function:

$$y = ab^t e_t \quad \text{.........................(1)}$$

where, Y = dependent variable (production,)
a = intercept term,
b = (1+r) and r is the compound growth rate
t = time period (t = 1, 2, 3………….n)
et = error term
Where the coefficients are obtained using OLS procedure and the compound growth rate is (Antilog of logb-1) *100, i.e. the percentage of growth rate [9].

Unit Root Test: Augmented Dickey-Fuller (ADF) Test (for stationary test)
The ADF test consist of estimating the following regression

$$\Delta Y_t = \beta_1 + \beta_1 + \delta Y_{t-} + \Sigma^m_{t=1} \propto_i \Delta Y_t\text{-}1 + e_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots......................(2)$$

where y is the series t is trend factor, e_t is the stochastic error term t-1 is the lag length. It is a one-sided test whose null hypothesis is δ=0 versus δ<o (hence large negative values of the test statistics lead to the rejection of the null) and Δ is the difference operator. Under the null, Y_t must be differenced to achieve stationarity; under the alternative, Y_t is already stationary and no differencing is required. The Augmented Dickey-Fuller (ADF) unit root test is employed to test the integration level and the possible integration of the variables. If the data set indicates integration property for the employed variables, there we proceed to test for cointegration among the variables employing [4,5] test techniques.

Cointegration Test
According to [6] two variables are said to be cointegrated if they have a long-term, or long run equilibrium, relationship between them. If two variables, dependent and an independent, are individually non-stationary but their residual (combination) is stationary, those variables are co-integrated on the long run. The researchers used the Johansen co-integration test to test co-integration since it is the only test which can estimate more than one co-integration relationship if the data set contains two or more time series as well as gives the maximum rank of co-integration [10].
According to [3] the Johansen's methodology

takes its starting point in the vector autoregression (VAR) of p order by:

$$Y_t = \mu + {}^A{}_1 y_t\text{-}1 +\ldots+ A_p y_t +{}^\Sigma{}_t\ldots\ldots\ldots\ldots..(3)$$

where y_t is an n 1 vector of variables that are integrated of order one or two, commonly denoted by 1(1) or 1(2), and t is an n-1vector of innovations. This VAR can be re-written as:

$$\Delta y_t = \mu + \pi y_t\text{-}i + {}^{p-1}{}_\Sigma s_i \Delta y_t\text{-}i\ {}^\Sigma{}_t\ldots\ldots\ldots........(4)$$
$$\qquad\qquad i = 1$$
$$\Pi = {}^p{}_\Sigma A_i - 1 \text{ and } s_i = - {}^p{}_\Sigma A_j \ldots\ldots\ldots......(5)$$
$$\quad i = 1 \qquad\qquad j = I + 1$$

If the coefficient matrix Π has reduced rank, r <n then there exist *nX r* matrices α and β each with rank r such that Π = αβ* and β*y_t. y_t is stationary r is a number of co-integrating relationships, the elements of α are known as the adjustment parameters in the vector error correction model and each column of β is a co-integrating vector.
It can be shown that for a given r, the maximum likelihood estimator of defines the combination of y_{t-1}that yields the r largest canonical corrections of Δy_t with y_{t-1} after correcting for lagged differences and deterministic variables when present. Johansen proposes two different likelihood ratio tests of the significance of these canonical correlations and thereby the reduced rank of Π matrix: the Trace Test (TT) and maximum Eigen value test are shown in equations (7) and (8) respectively.

$$J_{trace} = -T \Sigma^p 1n (1 - \lambda i) \ldots\ldots\ldots\ldots\ldots..(6)$$
$$\qquad\qquad i = r + 1$$
$$J_{max} = - T1n (1\text{-}\lambda r + 1)\ldots\ldots\ldots\ldots\ldots (7)$$

where *T* is the sample size λi and is the ith largest canonical correlation. The TT tests the null hypothesis of r co—integrating vectors against the alternative hypothesis of n co-integrating vectors. The maximum eigenvalue test, on the other side, tests the null hypothesis of r co-integrating vectors against the alternative hypothesis of r+1 co-integrating vectors.

Error Correction Model
The error correction model is specified as follows for poultry prices:

$$\Delta C_{t-1} = b_o + \Delta b_1 z_{1t-1} + \Delta b_2 y_{2t-1} + \Delta b_1 x_{1t-1} + \Delta b_2 x_{2t-1} + \Delta b_3 x_{3t-1} + \Delta b_4 x_{4t-1} + \Delta b_5 x_{5t-1} + \Delta b_6 x_{6t-1} + \Delta b_7 x_{7t-1} + ECM_{t-1} \ldots\ldots\ldots\ldots \ldots\ldots\ldots\ldots\ldots\ldots\ldots(8)$$

where
C= prices of poultry (in Naira)
X_1 = capital (capital allocated to agriculture in naira)
X_2 = inflation rate
X_3 = credit (credit allocated to agriculture in naira)
X_4 = interest rate
X_5 = labour (agricultural labour size in numbers)
X_6 = Tariff rate
X_7 = exchange rate

ECM = error correction term
t = time trend.

RESULTS AND DISCUSSIONS

Descriptive statistics of the variables
The summary statistics of the variables used in this study was examined and discussed considering the mean, median, minimum and maximum values. Other statistics considered include the standard deviation, CV (variance), skewness and kurtosis of variables.
The mean value of the dependent variables used in this study which include the production of poultry, the price of the poultry and the import of poultry, their mean values were 102,619 tons, 111,753 (naira) and 2,332.97 tons respectively.(Table 1).

Table 1. Summary Statistics, using the observations 1961 - 2014

Variable	Mean	Median	Minimum	Maximum
Production (output)	102619.	111355.	37360.0	192313.
Price	111753.	85700.0	-177547.	446088.
Import	2332.97	527.000	-295.667	19392.0
Capital	80081.6	43913.5	29.2000	229825.
Inflation	7.11989	7.96864	-31.3275	72.8355
Credit	119503.	87046.2	422.733	317764.
Interest rate	13.5904	14.6969	5.33747	31.6500
Labour	7.31279e+007	7.22619e+007	4.73354e+007	9.98183e+007
Tariff	8.61017	0.000000	0.000000	100.570
Variable	**Std. Dev.**	**C.V.**	**Skewness**	**Ex. Kurtosis**
Production (output)	43111.9	0.420115	0.107021	-1.05838
Price	162750.	1.45634	0.409493	-0.706966
Import	4352.25	1.86554	2.79763	7.22823
Capital	81354.4	1.01589	0.412491	-1.42227
Inflation	23.1144	3.24645	0.692896	0.571126
Credit	108267.	0.905974	0.353760	-1.37593
Interest rate	6.86015	0.504778	0.396601	-0.886074
Labour	1.54744e+007	0.211607	0.0684362	-1.19338
Tariff	16.2850	1.89137	3.56826	16.8454

Source: Food and Agriculture Organization database and CBN bulletin various issues

Unit root test of the variables
Prior to using the time series data for analysis, the variables were subjected to a stationary test using Augmented Dickey - Fuller test (ADF) to ascertain the order of integration of the variables.
The unit root test attempts to determine whether a given time series data is consistent with a unit root process. The presence of unit roots could lead to false inferences in regression between time series.
From the results of the Augmented Dickey-Fuller (ADF) unit root test presented in Table

2, all the variables were stationary at first difference. The coefficients compared with the critical values revealed that all the variables were stationary at first difference and on the basis of this; the null hypothesis of non-stationary was rejected and safe to conclude that the variables are stationary. This implied that the variables are integrated into order one. If two or more series are individually integrated (in the time series sense), the individual series are first-order integrated (I(1)) but some (cointegrating) vector of coefficients exists to form a

stationary linear combination of them. The series may drift apart in the short-run, then follow a common trend which permits a stable long-run relationship between them.

Table 2. Unit root test of the variables

Variables	Level		Difference		Order of integration
	test with constant	test without constant	test with constant	test without constant	
Production	2.75489	-0.52343	-0.74121	-2.13905	I(1)
Price	-1.69361	-1.49947	-3.16866	-3.19578	I(1)
Imports	-2.21822	-2.78978	-4.75049	-4.69971	I(1)
Capital	1.52881	0.196067	-1.22579	-7.63163	I(1)
Inflation	-1.24286	-1.02008	-5.37773	-5.48825	I(1)
Credit	1.16079	1.14675	-0.87916	-2.31344	I(1)
Interest	-0.16259	-1.43681	-1.7349	-1.76536	I(1)
Labour	1.85077	1.62657	-0.34174	-5.64888	I(1)
Tarrif	-0.95661	-1.52493	-2.93734	-2.91239	I(1)
exchange rate	1.366114	2.408458	-6.96388	-6.43637	I(1)

Source: Food and Agriculture Organization data base and CBN bulletin various issues
Note: I(1) are integrated at first difference while -4.1498, -2.0005 & -1.71793 are Mackinnon critical value for rejection of hypothesis of unit root applied at 1%, 5% & 10% respectively.

Trends of poultry prices in Nigeria from 1961-2014

The trend in poultry price is presented in Figure 1, poultry product prices showed a normal trend two times the periods under investigation. Prices started rising from 1960 and climaxed in 1975. Some factors like income population, liberal tariff, easy oil money, improved the first rise in price regime from 1975 to 1980. The prices crashed to the point that even local production was greatly affected. Demand at this point outpaced supply. The government liberalized importation of poultry products which the market major off-takers took advantage of to expand their operation to meet the surging demands. High records of dumping and smuggling were witnessed.

Price situation came up late 80's with the ban on importation of poultry products and introduction stringent tariff measure. This brought importation of poultry productions to all time low has been confirmed. This price situation climaxed in 1995 with a sharp vertical fall in prices. Since feed represents between 60-70% of the total cost of production, a lot of attention is channeled to Feed. Feed is not only cost but obviously the major one; the entire main driver has gone up by more than the general inflation level over the last few years. Animal feeds mills within this period ran out of yellow maize in the country and there was a ban on importation of yellow maize. And the local maize producers could not meet the demand of the population and feed millers. These pushed the maize prices up, so any price increases needed to cover not only the under-recoveries of the last few years out also the coming feed price increases. Prices of feed moved in the other direction which further weakened competitiveness position in the poultry industry – "no longer chicken feed" poultry product prices rose due to rise due to the demand and pressure on maize price. These results confirmed what [2] stated that high prices supply globally are a common feature of global poultry production, with feed cost representing around 70% or more of total production cost globally. Owning this period, producers depended on day-old chicks and poultry whose purity could not be ascertained. This resulted in stunted growth in poultry and low productivity among laying birds. Three was a low investment by individuals and corporate organizations reason being that Poultry production is a capital intensive volume-driven, low margin business and risk-laden.

The sharp and vertical fall in prices was as result of avian influenza which badly affected poultry industry. There was no demand for poultry products, which resulted in poultry product glut and sharp fall in poultry prices within the short period. The poultry products farmers which were very attractive poultry farmers suffered a great blow which made many operators close shops. The forecast clearly shows that the poultry prices are expected to increase in the six years.
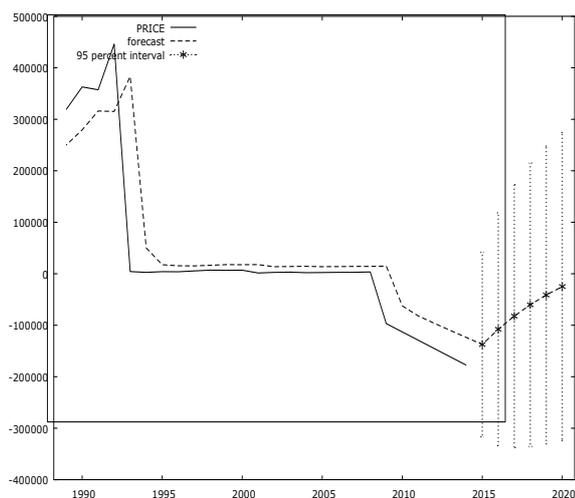
Fig 1. trend of poultry prices in Nigeria
Source: Computations from the data obtained from FAO stat various issues

Determinants of poultry price in Nigeria

The factors determining poultry price in Nigeria were examined in this section. Since the unit root test for the variables revealed that all the time series variables were integrated into the same order 1(1), cointegration test was done to establish the presence of long run relationship among the variable in the poultry production model. The error correction model shows the speed of adjustment of the dependent variable to changes in the independent variables included in the import model.

Cointegration estimates for the poultry price model

When linear combinations of variables are stationary, then cointegration becomes necessary. This implies that a long-run relationship may exist among them, which connotes that they may be disparity among them in the short run but in the long, there will be unity among them. To establish whether a long run relationship exists among the variables or not, cointegration test Johansen's multivariate method was carried out and reported in table 3 below. Using the trace statistics, the results points out that the null hypothesis of no cointegration among the variables are rejected in favor of the alternative hypothesis with four cointegrating variables at 1%,5% and 10% levels of significance because the values exceed the critical values. This indicates that there are at least four cointegrating variables, which implies that a unique long run relationship exists among the variable and the coefficient of estimated regression can be taken as equilibrium values.

Table 3. Unrestricted Cointegration Rank Test (Trace) for poultry price model

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.851843	301.8343	197.3709	0.0000
At most 1 *	0.650444	202.5412	159.5297	0.0000
At most 2 *	0.607626	147.8843	125.6154	0.0011
At most 3 *	0.504789	99.23627	95.75366	0.0282
At most 4	0.445582	62.69214	69.81889	0.1622
At most 5	0.262040	32.02061	47.85613	0.6110
At most 6	0.148940	16.21957	29.79707	0.6967
At most 7	0.126762	7.833379	15.49471	0.4834
At most 8	0.014981	0.784910	3.841466	0.3756

Trace test indicates 4 cointegrating Eqn(s) at the 0.05 level
 * denotes rejection of the hypothesis at the 0.05 level
 **MacKinnon-Haug-Michelis (1999) p-values
Source: Computations from the data obtained from FAO stat and CBN bulletin various issues. Note: ***, **, * are statistically significant at 1%, 5% and 10% respectively.

Error correction model for the factors affecting poultry price in Nigeria

Since the variables are integrated in the same order as presented in the unit root test, this led to the co-integration analysis which clearly shows the presence of four cointegrating equations. The result of the co-integrating equation as presented in Table 4.

The error correction term (ECM) which shows the speed of adjustment of the determinants of the price from the short run to the long run. The ECM coefficient of 87.2 % indicates that the speed of adjustment of the dependent variable from the short run to the long run was high.

Imports of poultry product were statistically significant at 10% and positively influencing the price of poultry products. This implies that an increase in the level of imports still forces the price of the domestic poultry products up.

The interaction of the world price of poultry products with the domestic price tends to force the domestic price up [7]. The capital was statistically significant at 5% and negatively influencing the increase in the prices of the poultry products. This implies that prices of poultry products decrease with the availability of capital for domestic investment in the poultry sub-sector.

Table 4. Error correction Regression result for the factors affecting poultry price

Variables	Coefficient	Std. Error	t-ratio	
Const	265013	176464	1.5018	
Δ Import_1	5.05346	2.72785	1.8525	*
Δcapital_1	-1.18453	0.571597	-2.0723	**
Δinflation_1	-1130.04	564.362	-2.0023	*
Δcredit_1	-0.21641	0.583204	-0.3711	
Δ Interest _1	-8159.53	2684.05	-3.0400	***
Δlabour_1	-0.00352394	0.00369976	-0.9525	
ΔTARIFF_1	1530.19	625.305	2.4471	**
Δ Exchange rate_1	-402.586	382.53	-1.0524	
Δ Production_1	-0.386313	0.862826	-0.4477	
Δ price_1	1.17295	0.112934	10.3862	***
ECM	0.871548	0.0935365	9.3177	***
Mean dependent var	113060.4	S.D. dependent var	164020.7	
Sum squared resid	1.04e+11	S.E. of regression	50411.45	
R-squared	0.925520	Adjusted R-squared	0.905537	
F(11, 41)	46.31642	P-value(F)	1.45e-19	
Log-likelihood	-642.2833	Akaike criterion	1308.567	
Schwarz criterion	1332.210	Hannan-Quinn	1317.659	
Rho	-0.104075	Durbin's h	-2.293204	

Source: Computations from the data obtained from FAO stat and CBN bulletin various issues. Note: ***, **, * are statistically significant at 1%, 5% and 10% respectively.

Inflation was significant at 10% and negatively influencing the prices of poultry products in Nigeria. This implies that the increase in the level of inflation forces the producer price down. The actual price received by the producers will not be a true reflection of the actual price due to inflationary pressures in the long run. This is also applicable to increase to the interest rate which was significant at 1% and negatively affecting the price of poultry products in the long run. This implies that the actual price paid for the poultry product does not reflect the true value in the long run due to the high level of inflationary trends.

Tariff and lag value of the price were statistically significant at 5% and 1% respectively and positively influencing the price of the poultry products. This implies that the increase in the tariff rate to checkmate the importation of poultry products will result in the increase in the domestic producer price of poultry products in the long run. The price of the poultry products in the previous year influences the increase in the price of the poultry products subsequently.

Impulse response of poultry prices
This means the test track the time path of the sudden changes that can be exposed to different variables of the model and how other variables respond to any sudden change in any variable of the model variables of the study. And Figure (2) Shows Impulse Response Function of poultry price to a sudden change rate of one standard deviation in each of the imports, labor, capital, credit, inflation, production, interest rate, exchange rate, and tariff.
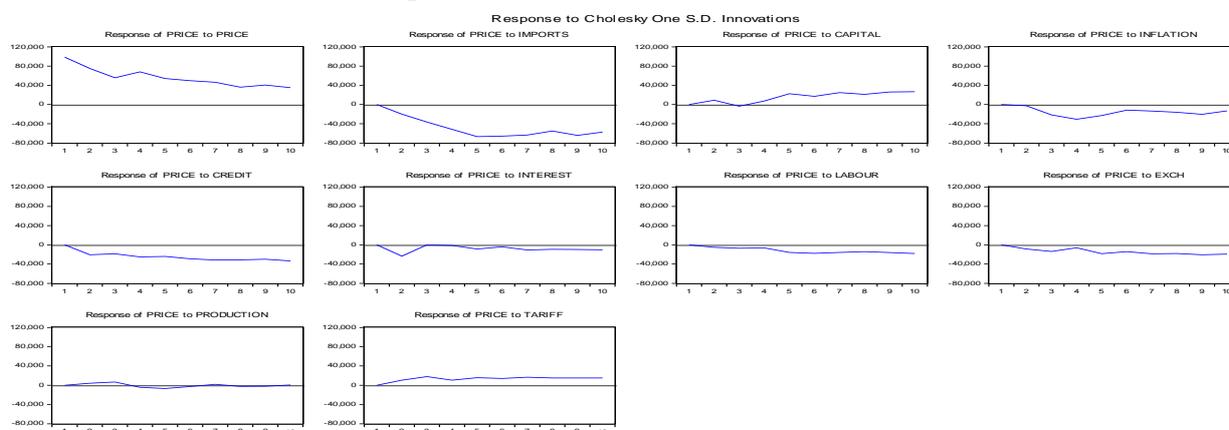

Fig 2. impulse response of poultry prices
Source: Computations from the data obtained from FAO stat

Price responds to shocks in the previous year's price by continuously decreasing. Price responds negatively to shocks from the import of poultry products as this forces the price of

products down in the short run. The price of poultry products responds positively to shocks in capital available for poultry production as this forces the price of poultry products up. Shocks in inflationary trends cause the downward trend the prices of poultry products in Nigeria. Shocks from credit, interest, labor and exchange rate affected the price of poultry products negatively, while the shock from domestic poultry production had a minimal impulse on the price of the poultry products. Shocks in the tariff rate resulted in positive trend in the price of the poultry products.

CONCLUSIONS

From the result of the trend analysis, it is obvious that the price of poultry products have continued to be on the increase. When there are import restrictive policies against the importation of poultry products, the prices of poultry products increases swiftly and with the failure of local production to meet the demand for the poultry products smuggling becomes imminent.

Imports do not really force the price of poultry products down rather it increases the price of poultry product in the long run but in the short run, it appears to be decreasing. Capital availability. Prices of poultry products decrease with the availability of capital for domestic investment in the poultry sub-sector. The increase in the level of inflation forces the producer price down. The actual price received by the producers will not be a true reflection of the actual price due to inflationary pressures in the long run. the increase in the tariff rate to checkmate the importation of poultry products will result in the increase in the domestic producer price of poultry products in the long run.

Recommendation

Based on the findings of this research, the following recommendation are proffered

(i)Continuous importation of poultry products into the country temporarily reduces the price of products but actually increases in the long run. Importation of poultry products into the country should be regulated and stopped completely.

(ii)A well-articulated import control measures should be adopted and not necessarily tariff increase. An outright ban and border control will go along to help stabilize domestic poultry prices

(iii)Capital availability for investment in the poultry production will lead to the stabilization of poultry prices in the long run. A special policy for the provision of capital to the poultry farmers should be instituted.

(iv)Inflation control should be insured in order o stabilize the price of poultry products.

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