PRICE VOLATILITY AND SUPPLY RESPONSE OF POULTRY IN THE PHILIPPINES: THE ARCH APPROACH

Introduction

- Price volatility is an estimate of the range within which prices can vary in the future (Weaver and Natcher, 2000 as cited by Rezitis, 2003).
- It is associated with price risk that intensifies inflationary pressures and reduces agricultural productivity (Kargbo, 2009). It continues to be a cause for concern among governments, traders, producers and consumers (Du, Yu and Hayes, 2009).

Introduction

Poultry is a prime mover of Philippine Agriculture (BAS, 2007).

- multi–billion in industry value: 2.7B in US dollars or 131B in Philippine peso (USDA Foreign Agricultural Service, 2009)
- estimated income of Php 82B (BAS, 2007)
- contributes 10% in gross value added to GNP (BAS, 2007)
- output is equivalent to 14% of the entire agricultural production of the Philippines (USDA Foreign Agricultural Service, 2009)

Introduction

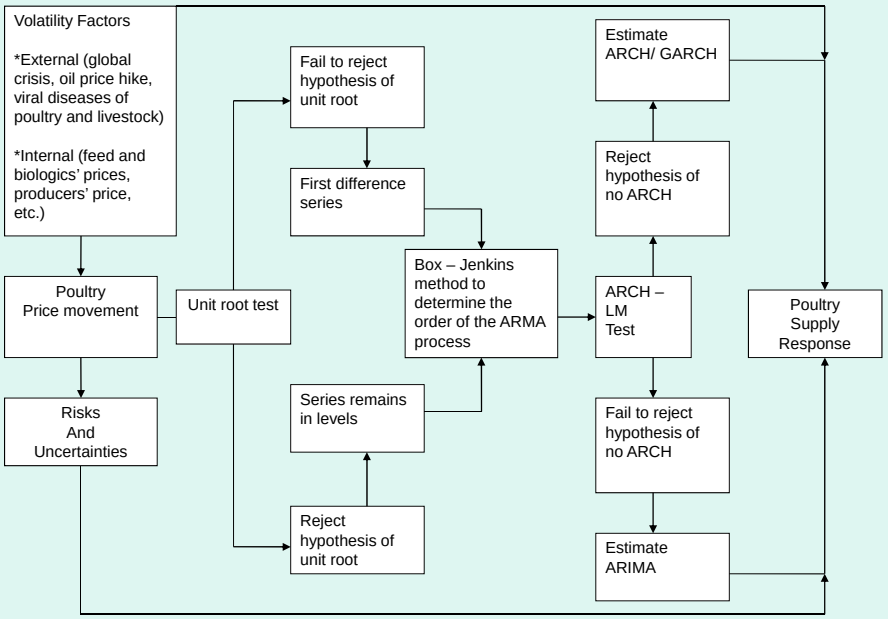
- Price volatility may weaken poultry's performance. It may develop risk aversion among poultry producers and stakeholders, resulting to opportunity losses.
- With industry size and influence, poultry's price volatility may also affect other markets.

Objectives

General: to analyze the volatility of prices and consequent supply response of the major poultry products in the Philippines

Specific:

- To provide an overview of the poultry industry
- To analyze the volatility of prices and the response of poultry supply to some economic factors
- To provide policy implications or recommendations of the findings



Conceptual Framework of the Study

Methodology

- Data (BAS and NSCB)
  - Monthly national time series data (1990 – 2009): prices of poultry products (live broiler, dressed chicken, chicken eggs and duck eggs), yellow corn, pork and beef and crude oil
  - Quarterly national time series data (1990 – 2009): supply of poultry products (live broiler, dressed chicken, chicken eggs and duck eggs)
  - CPI (monthly; 1990 – 2009)

Methodology

- Analytical Tools
  - Overview of poultry in the Philippines: descriptive statistics
  - Price volatility: ADF, ARCH–LM test and ARCH

$$P_t \mid \Omega_{t-1} = c_0 + \sum_{i=1}^{n} c_i P_{t-i} + \varepsilon_{2t}$$

$$h_t = b_0 + \sum_{i=1}^{q} b_{1i} \varepsilon_{2t-i}^2 + \sum_{i=1}^{p} b_{2i} h_{t-i}$$

$$\varepsilon_{2t} \mid \Omega_{t-1} \sim N(0, h_t)$$

Methodology

- Supply Response: ADF, Johansen Test, ECM and OLS

$$QP_n = \sum_{i=1}^{4} a_i D_{it} + a_{13} TR_t + PPP_t^e + PPCV_t + PSP_t + PSB_t + PCOP_t + PYC_t + QP_{t-i} + \varphi\mu_t + e_{1t}$$

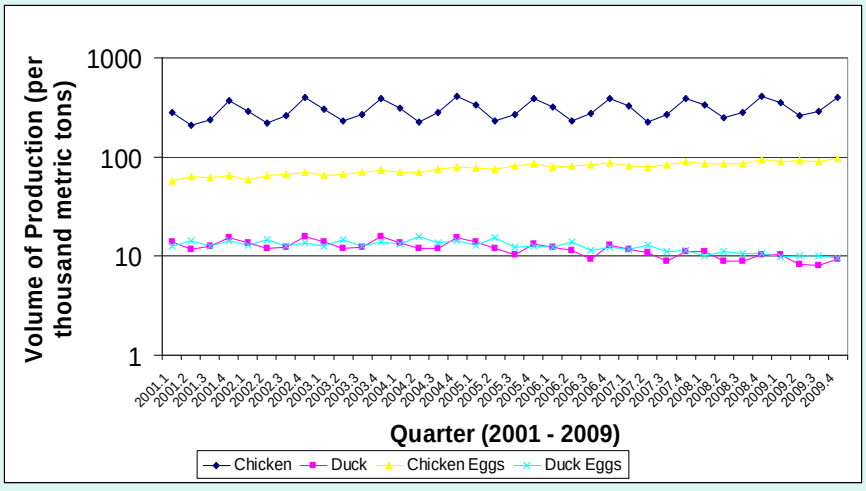
- Variables are in natural log and differenced forms.

Results: Overview of Poultry

- Chicken Production (3rd Qtr., 2009)
  - Region 3 (Central Luzon)
  - Region 4A (CALABARZON)
  - Region 10 (Northern Mindanao)
  - Region 11 (Davao Region)
  - Region 6 (Western Visayas)
  - Region 7 (Central Visayas)
  - Region 1 (Ilocos Region)
- Duck Production (3rd Qtr., 2009)
  - Region 3 (Central Luzon)
  - Region 2 (Cagayan Valley)
  - Region 12 (SOCCSKSARGEN)
  - Region 6 (Western Visayas)
  - Region 4A (CALABARZON)
  - Region 11 (Davao Region)
  - Region 1 (Ilocos Region)

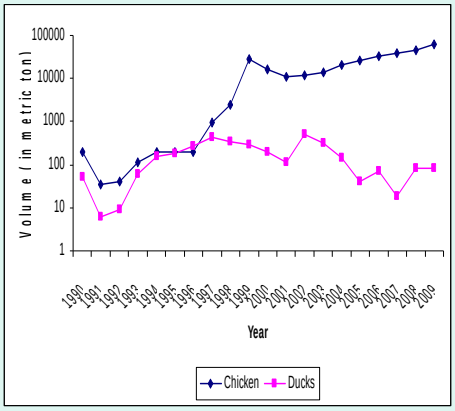
Results: Overview of Poultry

- Chicken Egg Production (3rd Qtr., 2009)
  - Region 4A (CALABARZON)
  - Region 3 (Central Luzon)
  - Region 7 (Central Visayas)
  - Region 10 (Northern Mindanao)
  - Region 6 (Western Visayas)
  - Region 11 (Davao Region)
  - Region 1 (Ilocos Region)
- Duck Egg Production (3rd Qtr., 2009)
  - Region 3 (Central Luzon)
  - Region 2 (Cagayan Valley)
  - Region 12 (SOCCSKSARGEN)
  - Region 6 (Western Visayas)
  - Region 10 (Northern Mindanao)
  - Region 4A (CALABARZON)
  - ARMM

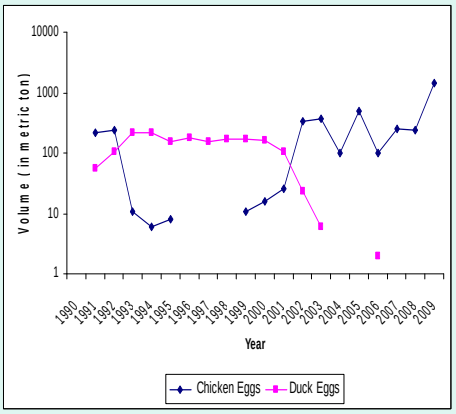


Quarterly Production of the Leading Poultry Products in the Philippines
2001 - 2009

Results: Overview of Poultry

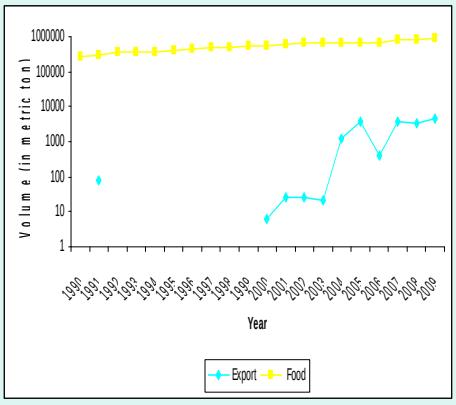


Chicken and Duck Importation (1990 – 2009)

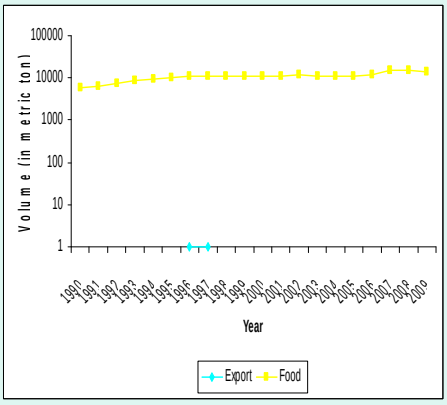


Chicken and Duck Egg Imports (1990 – 2009)

Results: Overview of Poultry

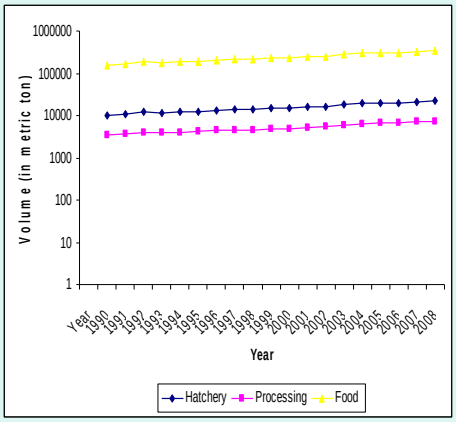


Dressed Chicken Utilization in the Philippines (1990 – 2009)

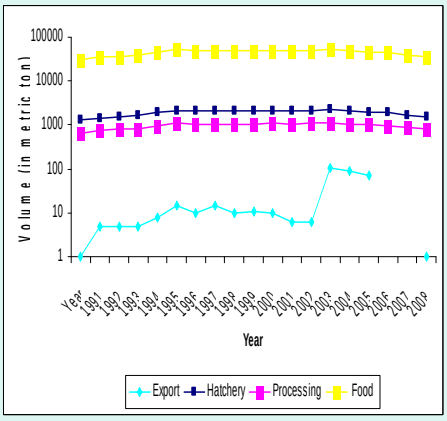


Duck Utilization in the Philippines (1990 – 2009)

Results: Overview of Poultry



Utilization of Chicken Eggs in the Philippines (1991 – 2009)



Utilization of Duck Eggs in the Philippines (1991 – 2009)

Results: Price Volatility

Table 1. Augmented Dickey – Fuller (ADF) Test Results for Stationarity

Variables	*L*	*FD*	*SD*
Monthly real price of chicken (broiler live)	-2.64	-7.82*	-9.64*
Monthly real price of chicken (fully dressed)	-2.34	-7.48*	-9.94*
Monthly real price of chicken egg	-2.35	-8.74*	-12.0*
Monthly real price of duck egg	-2.58	-4.34*	-9.77*
Monthly real price of pork	-2.14	-5.54*	-8.10*
Monthly real price of beef	-1.53	-4.79*	-8.13*

*indicates rejection of null hypothesis of non – stationarity at 5% level of significance

*L represents level form.

*FD represents first difference.

*SD represents second difference.

Results: Price Volatility

Table 2. ARCH – LM Test Results for ARCH Effects

Variable	LM statistic	Probability
Real price of chicken (broiler live)	0.8304	0.36
Real price of chicken (fully dressed)	24.4296	0.00
Real price of chicken egg	28.4231	0.00
Real price of duck egg	19.0237	0.00

Results: Price Volatility

Table 3. ARIMA Results for Broiler Chicken Price Volatility

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.001635	0.000949	-1.722755	0.0862
AR(1)	0.502997	0.116491	4.317887	0.00
MA(1)	-0.798889	0.082777	-9.651115	0.00

R-squared	0.101255	Mean dependent var	-0.001469
Adjusted R-squared	0.093607	S.D. dependent var	0.037214
S.E. of regression	0.035429	Akaike info criterion	-3.83004
Sum squared resid	0.294977	Schwarz criterion	-3.786272
Log likelihood	458.7748	Hannan-Quinn criter.	-3.812401
F-statistic	13.23792	Durbin-Watson stat	1.876942
Prob(F-statistic)	0.000004		

Inverted AR Roots	0.5
Inverted MA Roots	0.8

Results: Price Volatility

Table 4. ARCH Results for Price Volatility of Duck Eggs

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.002782	0.001722	-1.615185	0.1063
D(LOG(RPDER(-1)))	-0.333322	0.079415	-4.197223	0.00
Variance Equation				
C	0.00085	5.14E-05	16.51342	0.00
RESID(-1)^2	0.324323	0.093182	3.480555	0.0005
R-squared	0.216069	Mean dependent var		-0.001123
Adjusted R-squared	0.206019	S.D. dependent var		0.041769
S.E. of regression	0.037219	Akaike info criterion		-3.936061
Sum squared resid	0.324149	Schwarz criterion		-3.877704
Log likelihood	472.3913	Hannan-Quinn criter.		-3.912542
F-statistic	21.49857	Durbin-Watson stat		2.464399
Prob(F-statistic)	0.00			

Note: D(LOG(RPDER(-1))) – logarithmic value of the first difference of duck egg price lagged by one month
RESID(-1)^2 – squared residual lagged by one month

Results: Price Volatility

Table 5. ARCH Results for Price Volatility of Dressed Chicken

Variables	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.002485	0.00142	-1.749851	0.0801
D(LOG(RPCFDR(-1)))	0.117423	0.052104	2.253601	0.0242
D(LOG(RPCFDR(-2)))	-0.116456	0.055253	-2.107671	0.0351
Variance Equation				
C	0.000302	1.94E-05	15.56916	0.00
RESID(-1)^2	0.910866	0.145112	6.276996	0.00
R-squared	0.069383	Mean dependent var		-0.001334
Adjusted R-squared	0.053338	S.D. dependent var		0.030372
S.E. of regression	0.029551	Akaike info criterion		-4.519711
Sum squared resid	0.202593	Schwarz criterion		-4.446545
Log likelihood	540.5857	Hannan-Quinn criter.		-4.49022
F-statistic	4.324249	Durbin-Watson stat		1.96203
Prob(F-statistic)	0.002158			

Note: D(LOG(RPCFDR(-1))) – logarithmic value of the first difference of dressed chicken price lagged by one month
D(LOG(RPCFDR(-2))) – logarithmic value of the first difference of dressed chicken price lagged by two months
RESID(-1)^2 – squared residual lagged by one month

Results: Price Volatility

Table 6. ARCH Results for Price Volatility of Chicken Egg

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.006229	0.001545	-4.03159	0.0001
D(LOG(RPCER(-1)))	0.099526	0.059201	1.681143	0.0927
D(LOG(RPCER(-3)))	-0.143965	0.042997	-3.348235	0.0008
	Variance Equation			
C	0.000348	3.61E-05	9.645922	0.00
RESID(-1)^2	1.192699	0.138989	8.581278	0.00
RESID(-2)^2	0.103733	0.055962	1.85361	0.0638
R-squared	-0.03572	Mean dependent var		-0.000893
Adjusted R-squared	-0.058236	S.D. dependent var		0.040501
S.E. of regression	0.041663	Akaike info criterion		-4.212596
Sum squared resid	0.399243	Schwarz criterion		-4.124532
Log likelihood	503.0863	Hannan-Quinn criter.		-4.177096
Durbin-Watson stat	2.476229			

Note: D(LOG(RPCER(-1))) – logarithmic value of the first difference of dressed chicken price lagged by one month
D(LOG(RPCER(-3))) – logarithmic value of the first difference of dressed chicken price lagged by three months
RESID(-1)^2 – squared residual lagged by one month
RESID(-2)^2 – squared residual lagged by two months

Results: Supply Response

Table 7. ADF Test Results for Stationarity of Variables in Poultry Supply Response Models

Variables	*L*	*FD*	*SD*
Real price of chicken (broiler live)	-2.49	-10.74*	-8.26*
Real price of chicken (fully dressed)	-2.32	-5.11*	-6.44*
Real price of chicken egg	-2.15	-4.74*	-15.67*
Real price of duck egg	-2.35	-8.57*	-7.95*
Expected real price of chicken (broiler live)	0.56	-9.08*	-6.53*
Expected real price of chicken (fully dressed)	-0.39	-11.03*	-6.55*
Expected real price of chicken egg	-0.65	-5.50*	-9.71*
Expected real price of duck egg	-1.26	-9.64*	-10.19*
Expected price variance of chicken (broiler live)	-8.06*	-6.42*	-7.50*
Expected price variance of chicken (fully dressed)	-5.60*	-7.84*	-7.13*
Expected price variance of chicken egg	-3.41*	-6.77*	-8.86*
Expected price variance of duck egg	-6.18*	-8.55*	-7.46*
Real price of pork (lean meat)	-2.04	-5.52*	-6.01*
Real price of beef (lean meat)	-1.51	-4.10*	-7.74*
Real price of diesel (per liter)	-0.61	-5.51*	-7.79*
Real price of yellow corn grain	-3.70*	-7.83*	-8.76*
Chicken production	-1.17	-4.56*	-9.90*
Chicken egg production	0.97	-4.55*	-10.07*
Duck production	-0.66	-2.57	-8.48*
Duck egg production	-1.57	-2.36	-8.04*

* indicates rejection of the null hypothesis of non-stationarity at the 5% significance level.

Results: Supply Response

Table 8. Cointegration Test (Johansen) Results for the Commodities in Supply Response Estimation

	Trace Statistics						
Commodity	*k = 0*	*k ≤ 1*	*k ≤ 2*	*k ≤ 3*	*k ≤ 4*	*k ≤ 5*	*k ≤ 6*
Chicken production, live broiler price (3)	202.22*	144.56*	97.03*	66.74*	43.42*	21.93*	8.71*
	(125.62)	(95.75)	(69.82)	(47.86)	(29.80)	(15.49)	(3.84)
Chicken production, fully dressed price (3)	170.41*	126.91*	96.89*	68.58*	42.00*	25.35*	9.68*
	(125.62)	(95.75)	(69.82)	(47.86)	(29.80)	(15.49)	(3.84)
Chicken egg production (3)	189.52*	141.01*	102.87*	72.62*	46.18*	24.93*	8.32*
	(125.62)	(95.75)	(69.82)	(47.86)	(29.80)	(15.49)	(3.84)
Duck egg production (4)	158.58*	108.52*	67.79*	40.20*	18.93*	7.61*	2.82*
	(125.62)	(95.75)	(69.82)	(47.86)	(29.80)	(15.49)	(3.84)

The Trace test was used to test the null hypothesis that the number of cointegrating vectors is less than or equal to k, where k is equal to 0 to 6.

* Indicates that the null hypothesis is rejected at the 5% level.

The critical values at the 5% level are shown in parentheses below test statistic.

The lag length chosen by the AIC criteria is shown in parentheses after relevant poultry product.

Results: Supply Response

Table 9. Results of Supply Response Estimation for Chicken (Dressed Chicken Price)

Variables	*Coefficient*	*t-statistic*	*Prob.*
Constant	-0.1308	-4.9690	0.0000
Trend	-0.0003	-1.0648	0.2909
Quarter 2	-0.1257	-6.8518	0.0000
Quarter 3	0.2792	14.7230	0.0000
Quarter 4	0.5105	29.7922	0.0000
Lagged expected real price of dressed chicken (Δ)	-0.0751	-0.4549	0.6507
Expected price variance of dressed chicken	-0.3802	-0.7652	0.4469
Lagged real price of pork (Δ)	-0.3411	-1.1553	0.2522
Lagged real price of beef (Δ)	0.4651	1.5591	0.1238
Lagged real price of diesel (Δ)	0.0930	1.2002	0.2344
Lagged real price of yellow corn (Δ)	0.2517	1.6531	0.1031
Error-correction	-0.5224	-4.4197	0.0000
R-squared	0.9675		
Durbin-Watson	1.8162		
N	77		

Results: Supply Response

Table 10. Results of Supply Response Estimation for Chicken (Live Broiler Price)

Variables	*Coefficient*	*t-statistic*	*Prob.*
Constant	-0.1447	-8.8071	0.0000
Trend	-0.0003	-1.2681	0.2092
Quarter 2	-0.1158	-6.5978	0.0000
Quarter 3	0.2868	16.2840	0.0000
Quarter 4	0.5223	31.1486	0.0000
Lagged expected real price of live broiler (Δ)	0.0999	0.4350	0.6650
Expected price variance of live broiler	-6.9143	-2.2225	0.0297
Lagged real price of pork (Δ)	-0.3165	-0.9884	0.3266
Lagged real price of beef (Δ)	0.3539	1.1753	0.2441
Lagged real price of diesel (Δ)	0.1031	1.3160	0.1927
Lagged real price of yellow corn (Δ)	0.2449	1.6113	0.1119
Error-correction	-0.6110	-4.8269	0.0000
R-squared	0.9669		
Durbin-Watson	1.8732		
N	78		

Results: Supply Response

Table 11. Results of Supply Response Estimation for Chicken Egg

Variables	*Coefficient*	*t-statistic*	*Prob.*
Constant	-0.0684	-4.1693	0.0001
Trend	0.0000	0.0489	0.9612
Quarter 2	0.1350	7.7136	0.0000
Quarter 3	0.0620	4.7064	0.0000
Quarter 4	0.1218	8.5786	0.0000
Lagged expected real price of chicken egg (Δ)	0.3019	3.2410	0.0019
Lagged expected price variance of chicken egg (Δ)	-0.3074	-1.7128	0.0916
Lagged real price of pork (Δ)	-0.1536	-0.7620	0.4488
Lagged real price of beef (Δ)	-0.1665	-0.8049	0.4239
Lagged real price of diesel (Δ)	-0.0457	-0.8309	0.4091
Lagged real price of yellow corn (Δ)	-0.1963	-1.8237	0.0729
Error-correction	-1.0427	-7.0577	0.0000
Lagged chickeg egg production (Δt-1)	0.4115	3.4288	0.0011
R-squared	0.7320		
Durbin-Watson	1.8518		
N	77		

Results: Supply Response

Table 12. Results of Supply Response Estimation for Duck Egg

Variables	*Coefficient*	*t-statistic*	*Prob.*
Constant	-0.1266	-1.8228	0.0730
Trend	-0.0001	-0.1452	0.8850
Quarter 2	0.1186	1.9249	0.0587
Quarter 3	-0.0109	-0.3461	0.7304
Quarter 4	0.2087	3.7679	0.0004
Lagged expected real price of duck egg (Δ)	0.3759	0.9285	0.3566
Expected price variance of duck egg	1.5292	0.9648	0.3383
Lagged real price of pork (Δ)	0.5003	0.9582	0.3416
Lagged real price of beef (Δ)	0.0995	0.1946	0.8464
Lagged real price of diesel (Δ)	0.0913	0.6514	0.5171
Lagged real price of yellow corn (Δ)	0.4281	1.5345	0.1298
Error-correction	-0.6549	-4.7392	0.0000
Lagged duck egg production (Δt-1)	-0.7168	-10.0249	0.0000
R-squared	0.9537		
Durbin-Watson	1.7645		
N	77		

Conclusions

- Poultry is an important industry in the Philippines and is a potentially strong catalyst of enterprise and economic development.
- Short–term time–varying price volatility is present in the leading poultry products of the country.
- Price volatility can affect negatively the supply of chicken eggs and live broiler.

Conclusions

- Supply response analysis under price uncertainty has implications on the behavior of the poultry producers towards use of expectations in planning and decision–making and towards risks.

Policy Implications/Recommendations

- Upgrading information network's capability and service – customized content and services
- Improvement of market coordination and hedging options
- Establishment of a monitoring system for price volatility and its spillovers
- Improving statistical agencies' data collection and organization in online databases
- Improvement of extension work for the transmission of relevant market information to those who have less access to online databases

Policy Implications/Recommendations

- Support for increased access to interconnected information systems
- Further market research pertaining to price asymmetry, market power, factors and changes of price volatility with the use of advanced GARCH models
- Research to improve poultry breeds

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