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# Can Mastitis 'Contaminate' Poultry? Evidence on the Transmission of Volatility between Poultry and Other Commodity Prices

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## Abstract

This paper analyzes the volatility transmission between poultry and other commodity prices. The main question it addresses is as follows: Is there any commonality in the volatility processes of poultry and other agricultural food commodities' prices? Using standard dispersion indicators to measure the degree of poultry prices volatility and the GARCH-type models to specify poultry international price volatility at time 't' as a function of lagged shocks, we obtain the following results: poultry prices experienced less volatility in recent years relatively to other commodity prices; and the transmission of price volatility from other commodities to poultry prices is rather weak. These results could help to design better risk management tools in agribusiness.

**Keywords:** poultry, commodity prices, volatility, transmission

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## Introduction

After the 2007-2008 large changes in food prices, a huge amount of literature has burgeoned in recent years concerning international price volatility. The volatility of commodity prices in international markets makes business unpredictable and increases the degree of risk faced by economic agents. In fact, financial planning could become more difficult leading to both economic and financial uncertainty in the management of agribusinesses. The analyses of risk management generally focus on the best design of insurance or on portfolio allocation and other income stabilization tools used to help economic agents to cope with volatility. At the public level, policy interventions are designed either to stabilize prices or to diversify risk. Risk diversification can act as insurance only if the shocks are idiosyncratic and if the propagation of volatility between commodity prices is limited. However, little is known about the transmission of price volatility between different agricultural products. Yet, the degree of volatility is not the same for all commodities. While globally the food price index has shown to be more volatile over the last years, the evolution seems to be different among different commodities. The analysis of international poultry prices for instance didn't clearly show an increased instability during the period that follows the 2008 global price spike. Poultry prices, although upward sloping, remained fairly stable (Figure1). This fact corroborates the result obtained by Ano Sujithan et al. (2014) who noted that 'volatility peaks are not simultaneous inside the set of food commodities and that not all were more volatile during the 2007-2008 and 2010-2011 prices surges'. At the same time, trade in the global poultry sector has continuously increased during this period.

Nevertheless, on the question of whether volatility is increasing over time for all commodities, the literature is not very prolific. Therefore, this paper tries to analyze the volatility transmission between poultry and other commodity prices. The main question it addresses is as follows: Is there any commonality in the volatility processes of poultry and other agricultural food commodities' prices?

The analysis of the transmission of volatility has been more prolific in finance disciplines. Volatility spillovers arise because of information flows between different markets (Ross 1989). Therefore, as commodity markets become more integrated, risk and uncertainty can spread from one commodity market to another leading to a transmission of crises between segments of agribusiness sector. For instance, shocks on the dairy production activity like the appearance of a cattle disease (Mastitis for example), can contaminate poultry trade and production through the propagation of price volatility and uncertainty. However, preliminary look at the empirical data tends to astonishingly show that the poultry sector seems to have been preserved from the 2007-2008 and 2010-2011 global commodity price volatility. Hence, this paper tries firstly to analyze the degree of volatility of international poultry prices comparatively to that of other food prices; and, secondly to analyze the price volatility transmission between poultry and some substitute and complement agricultural food commodities' prices.

Following this introduction, the second section presents the methodologies that will be used to analyze the transmission of price volatility. The third section presents results while the fourth section gives some implications deriving from these empirical findings. The last section concludes the paper.

## Data and Empirical Method

The empirical method of this paper consists firstly on measuring the degree of volatility of poultry prices in order to compare it to that of other commodities; and, secondly, on modeling the variance transmission.

*Measuring Price Volatility*

Following Ano Sujithan et al. (2014), this paper uses standard dispersion indicators to measure the degree of poultry prices volatility and to compare it to the dynamics of other agricultural food commodities' price volatility. More precisely, we can use either the conditional variance or the standard deviation to analyze the degree of volatility of international poultry prices comparatively to that of other food prices. To have a unit-free measure of the volatility of commodity prices, the empirical literature generally uses the standard deviation of the natural logs of prices which has been shown to be approximately equal to the coefficient of variation (Gilbert and Morgan 2010). In fact, the main problem arising when we measure the volatility is that price series generally have trends so that in this measurement exercise, we need to be sure that trend movements are not included in the volatility measure. However, detrending price series could induce some arbitrary choices about the trend model; and this could reduce the robustness of the volatility measure. To get rid of these undesirable weaknesses, empirical literature conventionally measures volatility as the standard deviation of changes in logarithmic prices (or price returns). Therefore, this paper follows this convention and measure volatility as the standard deviation of changes in natural logs of prices.

To compute the conditional variance (from which we will derive, at each date in the sample, the standard deviation), we adopt the generalized autoregressive conditional heteroscedasticity (GARCH) framework where observed lead and/or lag relations give the causality in the second moments. GARCH models are the most used procedure of modeling and forecasting conditional variances in financial markets. Introduced by Engle (1982) and generalized by Bollerslev (1986), these models specify an autoregressive moving average process for the variance process followed by a time series. The variance of the dependent variable is modeled at each date as a function of past values of the dependent variable and other explanatory variables.

The dataset used includes monthly commodity price data over the period from January 1980 to July 2013. We collect these data on world commodity prices from the International Monetary Fund (IMF) commodity prices database online at www.imf.org/external/np/res/commod/ index.aspx. The set of commodity prices used includes: poultry prices, beef prices, fish meal prices, a food price index including cereal, vegetable oils, meat, seafood, sugar, bananas, and oranges price indices. We will also consider non-food commodities like the energy price index including crude oil (petroleum), natural gas, and coal price indices; and an all-commodity price index including both fuel and non-fuel price indices.

Poultry prices are chicken's whole bird spot prices, ready-to-cook and iced; expressed in US cents per pound. Beef prices are cost, insurance and freight (CIF) U.S. import prices of Australian and New Zealand 85% lean fores, expressed in US cents per pound. Fish meal prices are 65% protein pellets of Peru fish meal cost, insurance and freight (CIF) U.S. import prices, expressed in US Dollar per metric ton. The energy price index is an aggregated price index of fuel (2005=100) including crude oil (petroleum), natural gas, and coal price indices. Figure 1 gives the evolution of these commodity prices.

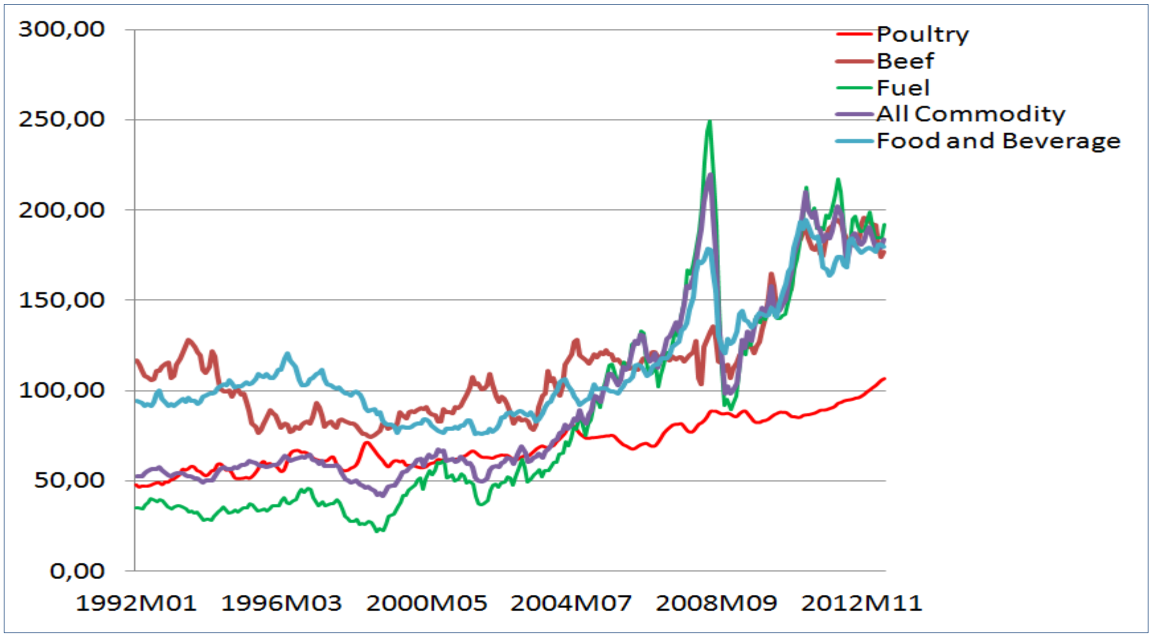


**Figure 1.** Evolution of Poultry and Some Commodity Prices from January 1992 – July 2013.

**Notes.** Author's construction based on IMF commodity price data. The figure shows that poultry prices are relatively more stable when compared to other commodity prices.

A rapid look at Figure 1 shows that commodity prices have experienced much more volatility in recent years and reveals the price upsurges of 2007-2008 and 2010-2011. However, poultry prices have shown to express less volatility than other commodity prices and didn't show a clear pick during the 2007-2008 and 2010-2011 periods. This conjecture can be better analyzed in an econometric model of volatility transmission.

*Modeling Volatility Transmission*

In order to get an answer to the above-mentioned question, this paper uses the econometric approach to the empirical analysis of the volatility of international commodity prices. To analyze the propagation of volatility between poultry and other commodities, the paper uses two complementary approaches: the GARCH and the vector autoregressive frameworks.

Firstly, we use the above-described GARCH model where we add the volatility of other commodity prices as explanatory variable in the variance equation of the first difference of logarithmic poultry prices. In fact, a GARCH model consists of a mean equation and a conditional variance equation. This basic specification can be extended by adding exogenous or predetermined variables both in the mean equation and in the conditional variance equation. Therefore, in our empirical exercise, we include the conditional standard deviation of other commodity prices in the mean equation of the log difference of poultry prices to get the

GARCH-in-Mean or GARCH-M model (Engle, Lilien, and Robins 1987). We also include this conditional standard deviation of other commodity prices in the conditional variance equation of the log difference of poultry prices to get the effect of uncertainty in one agribusiness sector, or in one commodity market, on the volatility of poultry prices.

By adding the conditional standard deviation in the mean equation of the log difference of poultry prices, the model analyzes the effect of the expected risk in one agribusiness sector on the expected return of the poultry sector and can assess the risk-return tradeoff. Also, by adding the conditional standard deviation in the variance equation of the log difference of poultry prices, the model can assess the possibility of the transmission of volatility from one agribusiness sector, or from one commodity market, to the poultry sector.

Secondly, we use the VAR framework to derive impulse response functions of poultry price volatility to shocks affecting selected commodity prices' volatility.

## Empirical Findings

*The Relative Stability of Poultry Prices*

Following the evidence provided by many authors (Engle et al. 1993; Lamoureux and Lastrapes 1993; West et al. 1993) in support of the GARCH (1, 1) among other specifications, we use this first order for ARCH and GARCH terms in the econometric model. We compute conditional variance from the estimated variance equation and we take its square root as the measure of price volatility. Figure 2, Figure 3 and Figure 4 give these figures graphically. Figure 2 plots in a single graph the volatility dynamics of all commodities under consideration while Figure 3 removes non-agricultural prices in order to have only the volatility of poultry and that of its substitutes (beef, fish, food and beverage). Figure 4 plots these volatility dynamics in multiple graphs.

Both Figure 2 and Figure 3 show an increased volatility in my selected commodity prices during the 2007-2008 and 2010-2011 periods. The volatility peaks have been more pronounced for beef prices followed by the aggregated index of food prices. Fish meal prices exhibit a more complicated volatility dynamics. However, poultry price volatility has shown a different dynamics. A closer inspection of Figure 3 reveals that poultry sector has registered less volatility that other commodities under consideration and didn't clearly show an increased volatility during the 2007-2008 and 2010-2011 global instability periods. This result is better visible in multiple graphs.

 

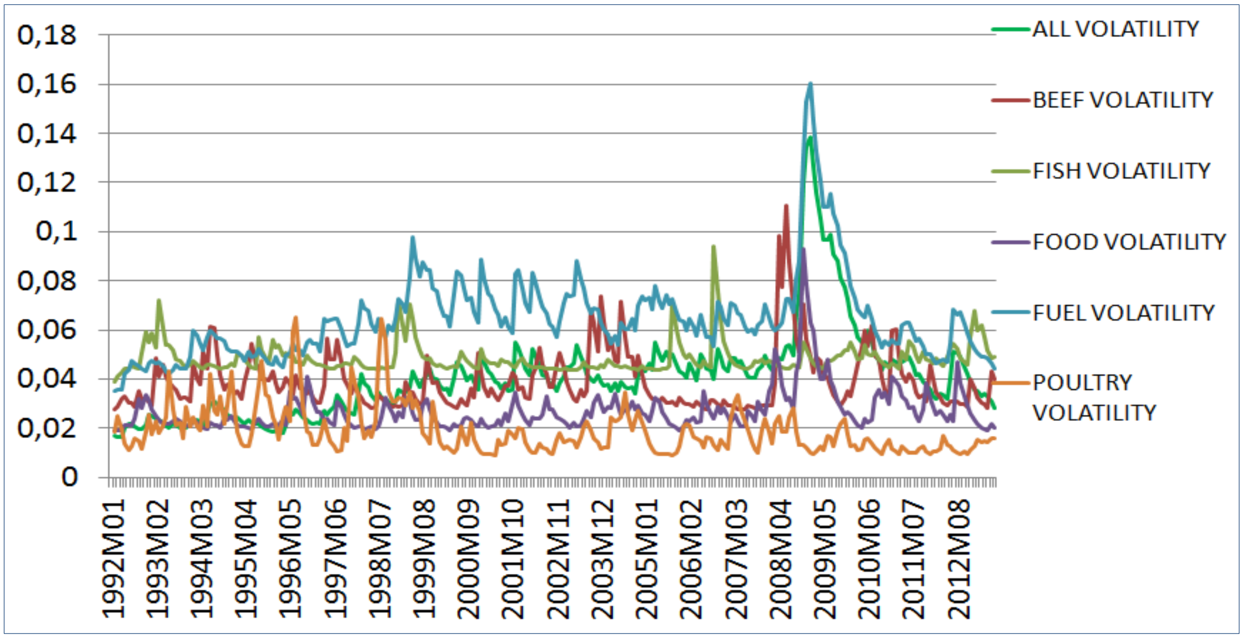


**Figure 2.** The Dynamics of Poultry and Other Commodity Prices' Volatility.

**Notes**. All volatility= standard deviation of log difference of all commodity price index; Beef volatility= standard deviation of log difference of beef prices; Fish volatility= standard deviation of log difference of fish meal prices; Food volatility= standard deviation of log difference of food price index; Fuel volatility= standard deviation of log difference of energy prices; Poultry volatility= standard deviation of log difference of poultry prices.

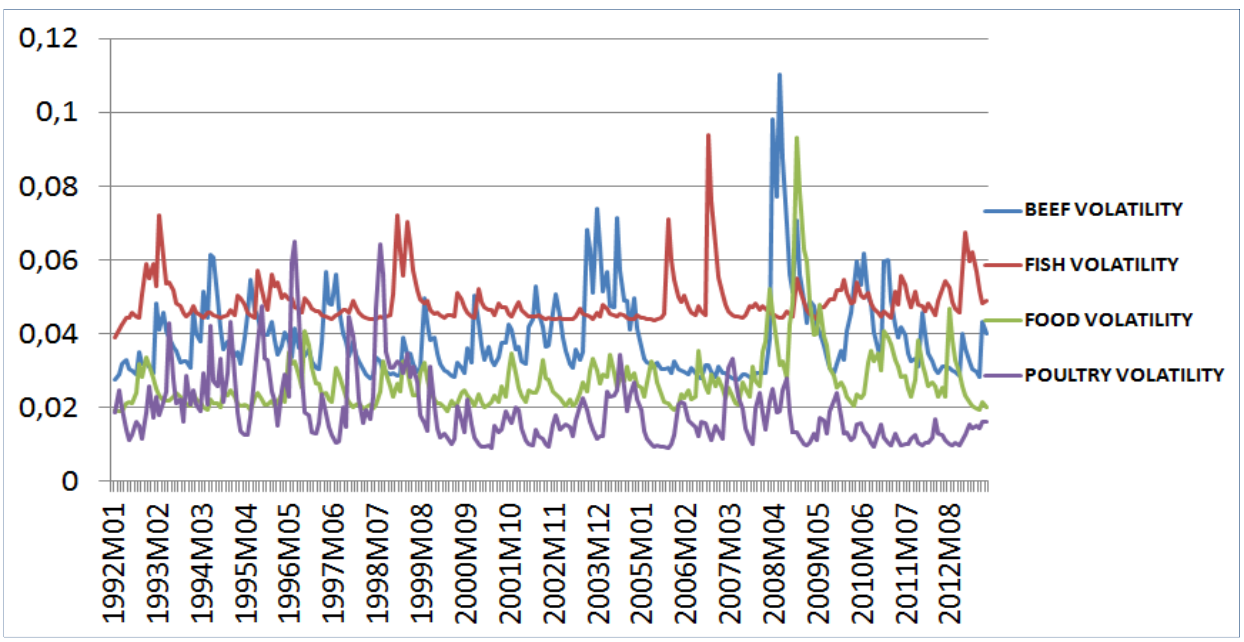


**Figure 3.** The Dynamics of Poultry and Other Commodity Prices' Volatility (Without non-agricultural prices).

**Notes.** BEEF VOLATILITY= standard deviation of log difference of beef prices; FISH VOLATILITY= standard deviation of log difference of fish meal prices; FOOD VOLATILITY= standard deviation of log difference of food price index; POULTRY VOLATILITY= standard deviation of log difference of poultry prices.

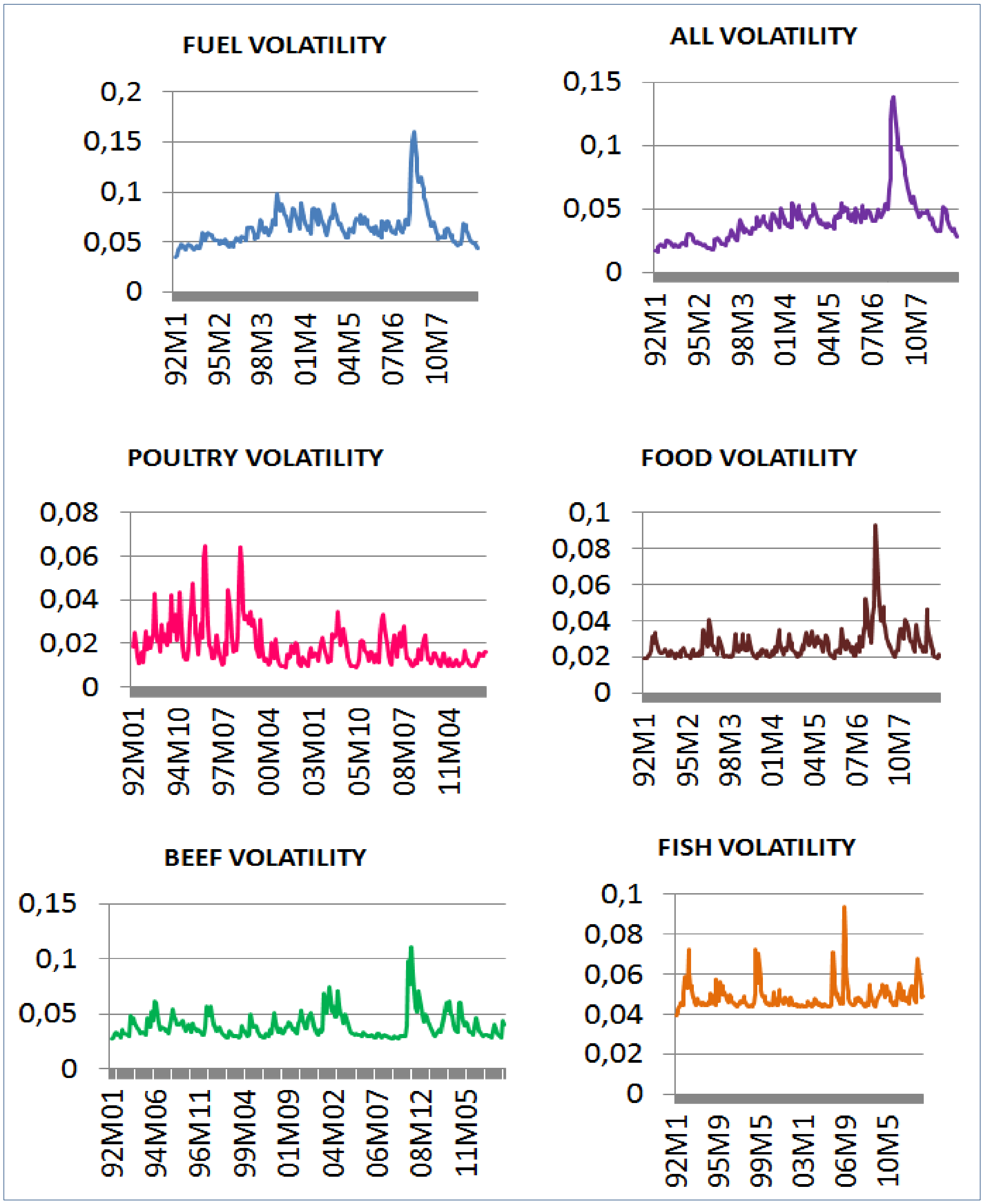


**Figure 4.** The Dynamics of Poultry and Other Commodity Prices' Volatility.

**Notes.** Fuel volatility= standard deviation of log difference of energy prices; All volatility = standard deviation of log difference of all commodity price index; Poultry volatility = standard deviation of log difference of poultry prices; Food volatility = standard deviation of log difference of food price index; Beef volatility = standard deviation of log difference of beef prices; Fish volatility = standard deviation of log difference of fish meal prices.

Figure 4 shows the same results as previously: poultry prices have experienced less volatility comparatively to other commodities under consideration and poultry price volatility didn't show a clear increase during the recent global instability episodes.

 

These results are confirmed by the summary statistics of commodity prices' volatility. Table 1 presents summary statistics of the volatility measure (conditional standard deviation of log difference) of poultry prices and that of other commodities under consideration.

**Table 1.** Poultry and Other Commodities' Price Volatility.

| | SDALL[a] | SDBEEF[b] | SDFISH[c] | SDFOODPI[d] | SDFUEL[e] | SDPOULTRY[f] |
|---|---|---|---|---|---|---|
| Mean | 0.0407 | 0.0391 | 0.0480 | 0.0283 | 0.0480 | 0.0190 |
| Median | 0.0388 | 0.0356 | 0.0484 | 0.0256 | 0.0484 | 0.0159 |
| Maximum | 0.1382 | 0.1110 | 0.0617 | 0.0919 | 0.0617 | 0.0652 |
| Minimum | 0.0162 | 0.0275 | 0.0280 | 0.0198 | 0.0280 | 0.0091 |
| Standard dev. | 0.0190 | 0.0119 | 0.0051 | 0.0084 | 0.0051 | 0.0096 |
| Sum[g] | 10.482 | 10.056 | 12.354 | 7.2733 | 12.354 | 4.8831 |
| Observations | 257 | 257 | 257 | 257 | 257 | 257 |

**Notes.** Descriptive statistics obtained from the computation of the standard derivations of selected commodity prices. Standard deviation is computed as the square root of the conditional variance fitted from the variance equation in the GARCH (1, 1) model of log difference of commodity prices. Results show that the poultry price volatility has the lowest mean and median. a= standard deviation of log difference of all commodity price index; b= standard deviation of log difference of beef prices; c= standard deviation of log difference of fish meal prices; d= standard deviation of log difference of food price index; e= standard deviation of log difference of energy prices; f= standard deviation of log difference of poultry prices; g=Sum of the concerned commodity price volatility over the period from January 2012 to June 2013.

Table 1 gives the same results as Figures 2, 3 and 4. Poultry price volatility has the lowest median, the lowest mean, and the lowest sum. Even its standard deviation is among the lowest; just slightly greater than that of fish and that of fuel price volatilities. Therefore, poultry prices have experienced less volatility than other commodities.

All in all, it appears that poultry sector has shown to be resistant to the recent global commodity price instability. This could mean that the transmission of volatility and uncertainty from other commodities to poultry sector is rather weak.

*The Resistance of Poultry Prices to Variance Spillovers*

To analyze the transmission of volatility from other commodities to poultry sector, we once again use the GARCH (1, 1) model of log difference of poultry prices where we add the conditional standard deviation of other commodities as explanatory variable. Results are shown in Table 2.

Table 2 shows that the coefficient of all commodity prices' volatility and the coefficient of beef prices' volatility are insignificant in the variance equation of poultry prices. Therefore, the volatility of other commodity prices didn't statistically explain the volatility of poultry prices. This result means that there is not a transmission of volatility from other commodities to poultry sector or in other words, shocks in other commodities can't contaminate poultry. Therefore, we can state that "Mastitis can't contaminate poultry"[1] not just because poultry didn't produce milk but, and it is what this paper shows, because price volatility and uncertainty didn't transmit from other commodities to the poultry sector.

**Table 2.** Variance Equation of Log Difference of Poultry Prices.

| Variable | SD ALL[a] | | SD BEEF[b] | | SD FISH[c] | | SD FOOD[d] | | SD FUEL[e] | |
|---|---|---|---|---|---|---|---|---|---|---|
| Constant | 7.54$^{E-6}$ | | 7.51$^{E-6}$ | | 0.0002 | | 9.77$^{E-5}$ | | 0.0002 | |
| | (0.926) | | (0.47) | | (16.03) | *** | (2.81) | | (16.1) | *** |
| $[RESID(-1)]^2$ | 0.173 | | 0.168 | | 0.156 | | 0.477 | | 0.156 | |
| | (3.411) | *** | (3.69) | *** | (3.44) | *** | (3.15) | *** | (3.44) | *** |
| GARCH(-1) | 0.826 | | 0.835 | | 0.837 | | 0.434 | | 0.837 | |
| | (23.05) | *** | (26.97) | *** | (25.26) | *** | (3.89) | *** | (25.3) | *** |
| Other price volatility | -0.7$^{E}$-5 | | -0.0001 | | -0.005 | *** | -0.002 | | -0.005 | |
| | (-0.63) | | (-0.301) | | (-13.6) | | (2.38) | ** | (13.6) | *** |
| $R^2$ | 0.0190 | | 0.012 | | 0.0051 | | 0.010 | | 0.0052 | |
| Observations | 257 | | 257 | | 257 | | 257 | | 257 | |

**Notes.** Variance equation estimates from the GARCH (1, 1) model of log difference of poultry prices. Z statistics in parenthesis. *,**,*** denote significance at 10%, 5% and 1% respectively. The all commodity and beef prices' volatilities didn't affect poultry price volatility. Fish, fuel and food prices' volatilities have shown up with significant coefficients in poultry price volatility equation; but these results are rather weak as regard, for instance, the R2 s. a= standard deviation of log difference of all commodity price index; b= standard deviation of log difference of beef prices; c= standard deviation of log difference of fish meal prices; d= standard deviation of log difference of food price index; e= standard deviation of log difference of energy prices.

To further investigate the resistance of poultry prices to variance spillovers, we derive impulse response functions from a Vector Autoregression (VAR) model of commodities' price volatility. These impulse response functions trace the effect of a one-time shock to the innovation of the volatility of one of the commodities under consideration on current and future values of the poultry price volatility. In this sense, they help to analyze the "volatility of volatility" following a tradition in the recent literature on time variation in volatility (Weber 2013; Corsi at al. 2008). Figure 5 gives, graphically, these impulse response functions.

[1] This assertion didn't mean that we have undertaken the analysis of the causal relationship between the Diary sector (or more specifically between the appearance of Mastitis) and poultry prices but rather, it is meant to put forth the idea of the resistance of poultry prices to global instability where even such "paradoxical" contamination could exist.

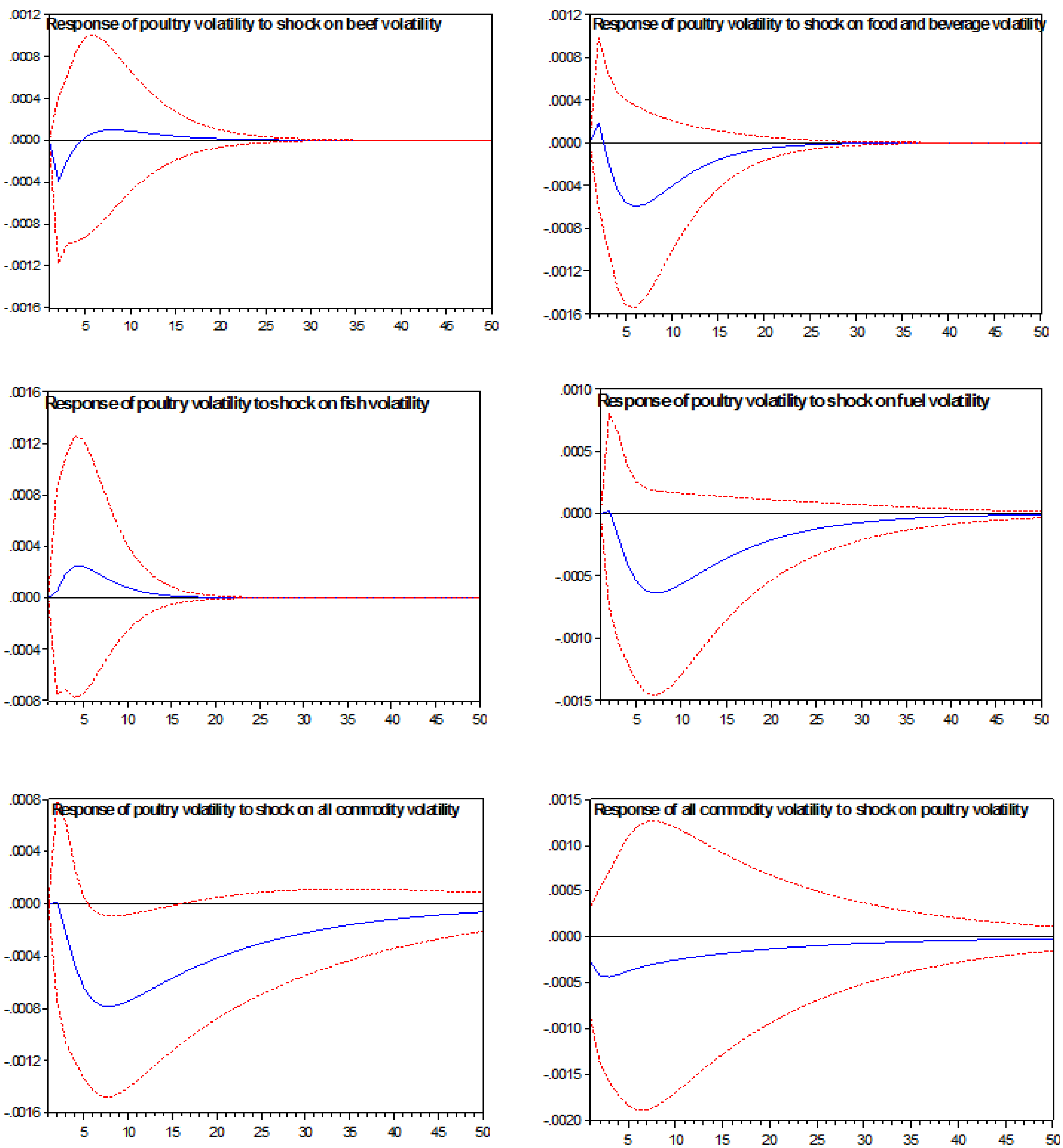


**Figure 5.** Impulse Response Functions of Poultry Price Volatility to Other Commodities' Volatility.
**Notes**. Response to Cholesky one standard deviation innovations (plus and minus two standard deviations)

These impulse response functions tend to confirm our previous findings. Shocks to other commodities' price volatility have very brief effects on poultry price volatility. For instance, a shock on the fish price volatility has very negligible effects that die out in less than fifteen months. Moreover, shocks on the all commodity price index's volatility reduce poultry price volatility up to fifty months later. Likewise, shocks on food and beverage price index's volatility increase volatility of poultry prices for less than five months then, negatively affects it up to twenty months. Shocks on beef price volatility reduce poultry price volatility for two to five months and later exert very negligible positive effects that die out in less than twenty months. Given the above findings, we can conclude that poultry prices have been resistant to the 2007-2008 and 2010-2011 global instability.

## Implications

*Policy Implications*

As poultry seems less vulnerable to external volatility, policies aiming to promote poultry production and trade should concentrate on preventing and managing its intrinsic volatility. Efforts should mainly be oriented towards the management of this sector's idiosyncratic shocks such as the appearance of diseases (avian influenza or Newcastle's disease) or the recall of poultry derived products.

Although the volatility transmission is generally related to market activity variables such as the volume of trade, the flow of orders or the arrival of new information (Weber 2013), its consequences go far beyond financial difficulties. In fact, the contaminated sector, by facing excessive volatility, could fail to realize its production potential because of reduced investment both at the primary production level and at the processing level (Buckley 2012).Yet, underinvestment in agriculture is one of the main explanations given to the 2007-2008 and 2010-2011 price spikes (World Bank 2007). This could lead to more instability in the commodity markets and to more price volatility. Therefore, commodity price stabilization programs such as producer subsidies, buffer stock programs and price supports are implemented in reaction to high price volatility. However, developing countries can't efficiently implement these programs because they involve sizeable amounts of resources. As poultry is relatively resistant to external volatility, such countries should specialize in this sector.

Some authors such as Sarris (2000) have suggested the use of international hedge funds in the management of risk inherent in the volatility of commodity prices. Such interventions must therefore consider poultry as a relatively safe asset in the composition of the portfolio.

*Lessons for Risk Management in Agribusiness: Is Poultry a Safe Asset?*

Speculative influences have been emphasized by Cooke and Robles (2009) or Gilbert (2010) as one of the main explanations given to the 2007-2008 and 2010-2011 price spikes. The modeling of volatility transmission helps to analyze the risk of holding an asset or the value of an option. Understanding the transmission of volatility processes between poultry and other commodities could therefore help to design better risk management tools in agribusiness. In fact, as the empirical results show that poultry prices are resistant to volatility spillovers from other commodity prices, poultry could be considered as a relatively safe asset when building a portfolio. At the production level, actors of agribusiness can diversify their activities by including poultry as a 'safe' component of their business (at least from financial point of view).

 

However, this does not mean that poultry is a totally safe activity. As any other business, this sector has its own risk and uncertainty (the risk of appearance of diseases such as avian influenza or Newcastle's disease for instance). What our empirical results mean is that, from the financial point of view, poultry could not be contaminated by other commodities' uncertainty.

## Conclusions

Price volatility is welfare decreasing and harmful both for the production and commercialization of agricultural products (Zheng et al. 2008). This paper analyzes the volatility transmission from some selected commodity prices to poultry prices. Using the conditional standard deviation of the log difference of prices as the measure of volatility and a GARCH (1, 1) model to compute this volatility, we obtain the following results: poultry prices experienced less volatility in recent years relatively to other commodity prices; the transmission of price volatility from other commodities to poultry prices is rather weak. These results could help to design better risk management tools in agribusiness. In particular, actors of agribusiness could consider poultry as a relatively safe activity when they choose their portfolio of activities. Moreover, as poultry prices have shown to be less sensitive to other commodities' uncertainty, policy intervention should concentrate on managing this sector's idiosyncratic shocks such as the avian influenza or Newcastle's disease.

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