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THE PRICE VOLATILITY OF BEEF AND PIG MEAT IN ROMANIA

ABSTRACT

This paper analyzes the prices and price volatility for beef and pigmeat in Romania and compares them with international prices and price volatility. GARCH type processes are used to estimate price volatility.

The empirical results indicate that the growth trend in pigmeat prices, in Romania and globally, is accompanied by high volatility throughout the period with significant increases in 2008, 2010 and 2014 for Romania and 2007–2008, 2012 and 2014 for world prices.

Beef prices on both markets show a steady upward trend until 2015 and a high volatility during the global economic crisis, only to fall sharply afterwards. After 2015, beef prices experienced a significant decrease and a slightly increased volatility worldwide.

Generally, the increased price volatility periods can be associated with significant increases in the corresponding prices or other global events (financial crisis, food price crises).

Key words: price volatility, agricultural prices, Romania, GARCH.

JEL Classification: C51, E30, Q11.

1. INTRODUCTION

The volatility of agricultural prices is driven by shocks in production and consumption. There is a seasonal and partially predictable price fluctuation that can occur because many farmers with small farms of 2 hectares or less are forced to sell their products immediately after harvest due to lack of storage or processing facilities, which leads to low selling prices during this period, and then even buy in subsequent periods, leading to rising prices.

In addition to seasonal prices, there is also the weather unpredictability that can affect the supply of agricultural products and lead to price volatility.

There may also be inter-year volatility due to the lack of information and poor market integration of farmers holding small farms, who can make wrong decisions about how much and what they should produce.

Poor rural infrastructure combined with lack of information can lead to higher costs that increase supply shocks that are reflected in volatile prices. External shocks can be also transmitted on the domestic market.

All these causes that lead to price volatility affect farmers' living standards and, above all, food security in the current global food price hike. (HLPE, 2011)

Demand shocks are triggered by population and income growth, urbanization and increased consumption of meat and milk, biofuel market expansion. The consumption growth rate presents different trends for different commodities groups, e.g. dairy and meat products present opposite trends, with growth rate of dairy products above population growth.

This explains the need to study the volatility of agricultural prices. Volatility of agricultural prices is a signal for price developments that is important for ensuring food security. Consumers, mainly the very poor ones, are affected by the high prices of agricultural products, producers are affected in low-price periods, which, if they are frequent or significant, induce low incomes for farmers and can affect the standard of living or viability of small farms. Thus poorer countries are more affected by changes in food prices (Regmi *et al*., 2001).

2. THE EVOLUTION OF PRICES FOR MEAT PRODUCTS

Global food prices were higher than prices for all commodities (Figure 1) until 2005, when the relationship reversed, especially during the financial crisis. Beginning with the end of 2014, the initial relationship was restored and the food prices exceeded the level of general prices.

Changes in food prices appear to be lower than for all commodities and the price variation in meat is the highest.

The trends and fluctuations described in the preceding paragraph refer to international prices, the variation in domestic prices of an economy may be different, and the extent to which the global price variation is transmitted on domestic markets depends on how integrated they are, on the degree of openness of the economy. Domestic prices also depend on internal factors such as import / export taxes or charges, domestic pricing policies through subsidies, infrastructure level. The instability in supply and demand coupled with the lack of market-related information of most market participants can cause increased price volatility (HLPE, 2011).

The variation coefficient for the prices of meat products for Romania is higher than for the world market (Table 1), showing higher price variability in Romania.

The world meat prices fell substantially in 2014–2015 due to demand growth rate decrease, e.g. pigmeat price fell to the level of 2010 in contrast with the period of continuously increases from 2002 to 2014.

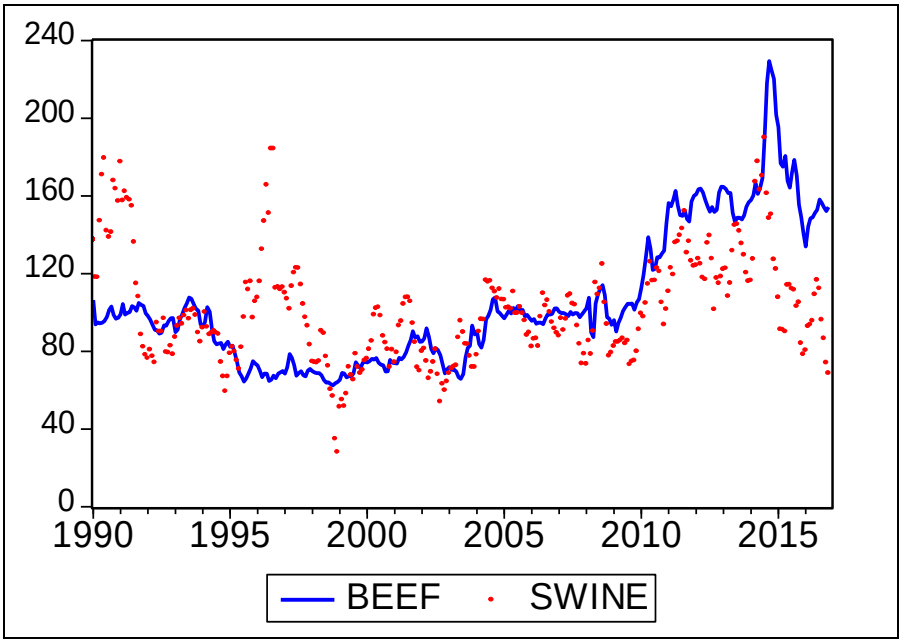

Figure 1. World prices, real terms (2005 = 100), in the period 1990–2016.

Table 1

Variation coefficient

	Romania	World
Beef	10.4514	6.7812
Pig meat	81.3599	36.9274

Source: authors' own calculations.
Data source: Eurostat and IMF International Financial Statistics

In Romania, price variation is much higher compared to what has happened worldwide, mainly for sheep and poultry meat (Figure 2).

As regards beef and pigmeat, prices appear to be more stable in Romania. To analyze this situation and the persistence of price shocks, we need to estimate the volatility of prices, which we shall present in the next section.

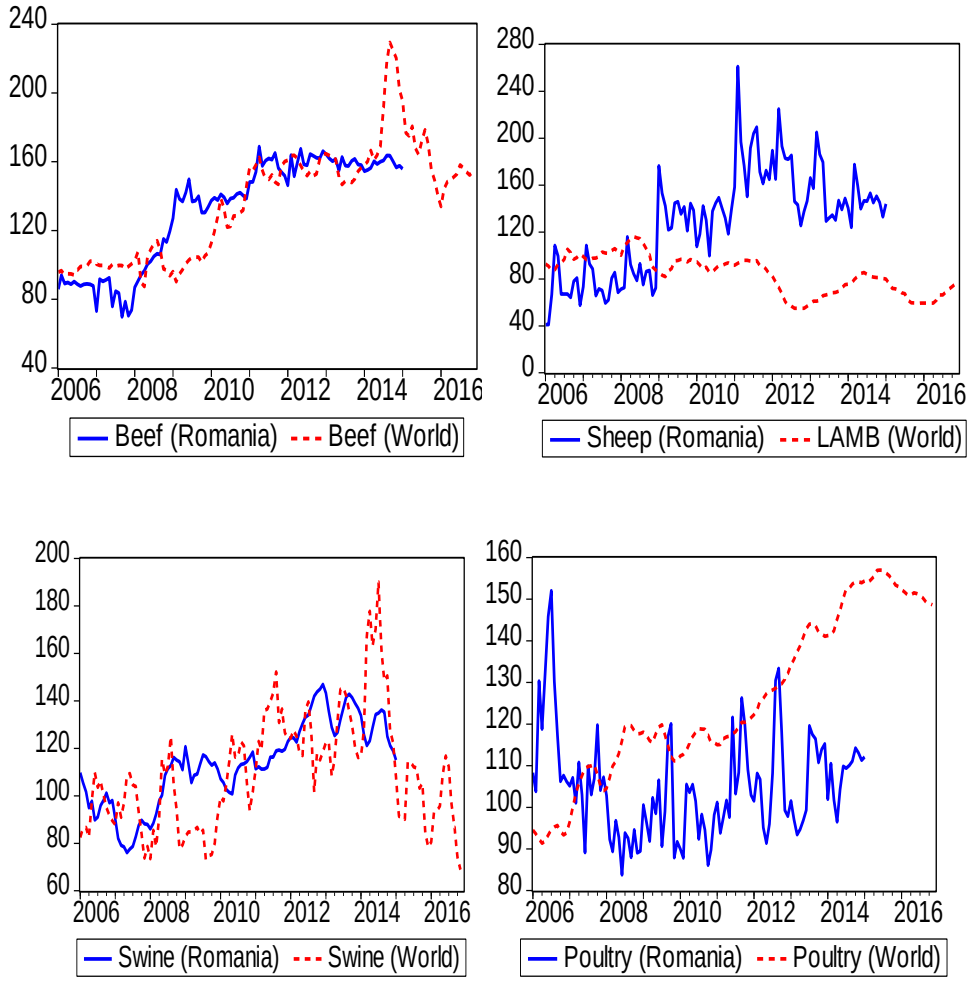

Figure 2. Agricultural prices of meat products, real terms (2005 = 100), in the period 2006–2016.

3. DATA AND METHODOLOGY

The data used in this paper are monthly time series for the period January 2006 to January 2015 in the case of Romania, source Eurostat and the world food and all commodity prices for the period January 2006 to November 2016, source IMF International Financial Statistics. All variables were transformed into logarithms and differenced in order to obtain stationarity.

Let p_t be the price of an agricultural product, then the log return series on t is defined as:

$$r_t = ln(p_t) - \ln(p_{t-1}) \quad (1)$$

In this paper processes from the family of Autoregressive Conditional Heterockedasticity are used in order to model time varying conditional variance of the beef and pigmeat price. Different ARCH, GARCH and EGARCH models are tested in order to select the model that better describes price volatility.

Volatility can be measured as the conditional variance in an ARCH/GARCH/ EGARCH process that evolves over time.

The GARCH (p, q) model (Generalized Auto-Regressive Conditional Heteroscedastic model) is given as:

$$r_t = \mu + \varepsilon_t \quad (2)$$

$$\sigma_t{}^2 = \omega + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}{}^2 + \sum_{j=1}^{p} \beta_j \, \sigma_{t-j}{}^2 \quad (3)$$

Where $\omega > 0, \alpha_i \geq 0 \; i = 1, \dots, q, \; \beta_j \geq 0 \; \mathrm{j} = 1, \dots, \mathrm{p}, \sum \alpha_i + \sum \beta_j < 1.$ The latter constraint implies that the unconditional variance of ε_t is finite whereas its conditional variance $\sigma_t{}^2$evolves over time as an autoregressive moving-average (ARMA) process. $\varepsilon_t = \sigma_t \, z_t$ where z_t is white noise.

ω denotes the long term volatility, α_i denotes the magnitude of the response to shocks and β_j indicates the impact of volatility in the previous periods on current volatility. A large value for α signifies that volatility has a more pregnant reaction to shocks. The sum $\sum \alpha_i + \sum \beta_j < 1$ is known as persistence parameter. If the sum is near 1 the shock persistence is large and if it is ≥ 1 the process is explosive.

When $\beta_j = 0 \; \mathrm{for} \; \mathrm{j} = 1, \dots, \mathrm{p}$ the process is ARCH.

The EGARCH model is defined as:

$$\ln(\sigma_t^2) = \omega + \beta \ln(\sigma_{t-1}^2) + \gamma \frac{u_{t-1}}{\sqrt{\sigma_{t-1}^2}} + \alpha \left[\frac{|u_{t-1}|}{\sqrt{\sigma_{t-1}^2}} - \sqrt{\frac{2}{\pi}} \right] \quad (4)$$

This time the parameters could be negative so that if the relationship between return and volatility is negative, the parameter γ is also negative.

4. RESULTS AND DISCUSSIONS

4.1. THE PRICE VOLATILITY OF BEEF

The best models that describe the price and price volatility for beef is a GARCH (1, 1) process with Student-t distribution with 10 degrees of freedom for innovations. Other alternative GARCH models were tested for several orders such as GARCH (1, 2), GARCH (2, 1) and GARCH (2, 2) and several distributions for innovations (Gaussian normal distribution, Generalized Error Distribution, Student-t distribution) but they cannot outperform the simple GARCH (1, 1) process.

Table 2 provides the estimated parameters of GARCH (1, 1) price variance equation that satisfy the GARCH conditions.

The long term volatility is low for Romania and worldwide (Table 2), but the shock persistence is high ($\alpha+\beta$ is 0.93 and 0.91 respectively).

Table 2

Best fit volatility (conditional variance) models for beef prices

Parameters	Romania	World
ω	0.000107 (5.62E-05)	0.000141 (7.65e-05)
α	0.211567 (0.098070)	0.227298 (0.088556)
β	0.720004 (0.103427)	0.688189 (0.094295)
Error Distribution	Student's t distribution, df=10	Student's t distribution, df=10

Source: authors' own calculations.
Note: standard errors in brackets ( ).

The beef prices on both markets indicate a steady upward trend until 2015 and a high volatility during the global economic crisis, to fall sharply afterwards. After 2015, international prices have experienced a significant diminution and slightly increased volatility.

Beef price volatility (Romania) significantly increased in 2008–2009, and again in 2011, 2012, which coincides with a rise in world food prices. The food crisis of 2006–2008 had major implications on developing countries, especially for the countries with large imports of agricultural products (Swinnen 2011).

Several trigger factors explain the increase in prices in both periods: bad crops due to weather conditions, high oil prices, depreciation of the US dollar. International trade in many agricultural goods is denominated in USD, and a depreciation of the US currency has led to an increase in the international prices.

Generally, increased price volatility periods can be associated with significant increases in the corresponding prices or other global events (financial crisis, food price crises).

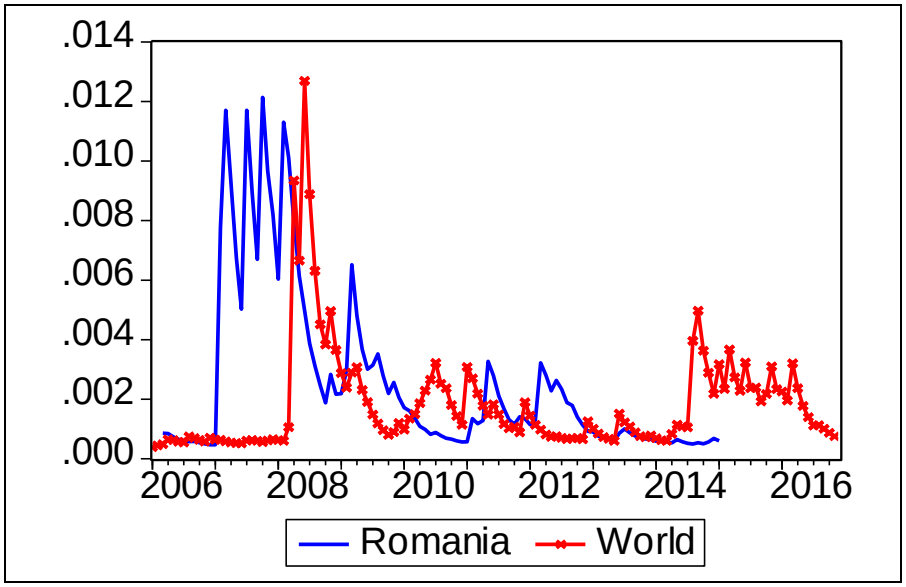

Figure 3. Beef price volatility.

4.2. THE PRICE VOLATILITY OF PIGMEAT

The best models that describe the price and price volatility for beef is a EGARCH (1, 1) process with GED (Generalized Error Distribution) distribution for innovations. Other alternative GARCH and EGARCH models were tested for orders below 2 and several distributionS for innovations (Gaussian normal distribution, Generalized Error Distribution, Student-t distribution), but they cannot outperform the EGARCH (1, 1) model.

Table 3 provides the estimated parameters of the best fit model for price variance equation, EGARCH (1, 1).

Table 3

Best fit volatility (conditional variance) models for pig meat prices

Parameters	Romania	World
$\omega - \alpha\frac{\pi}{2}$	-11.32104 (1/.418304)	-0.158418 (0.000962)
$\gamma + \alpha$	0.499694 (0.252360)	-0.131352 (0.080316)
β	-0.588829 (0.203700)	0.945341 (0.012388)
Error Distribution	GED with df=1.25	GED with df=2.2

Source: authors' own calculations.
Note: standard errors in brackets ( )

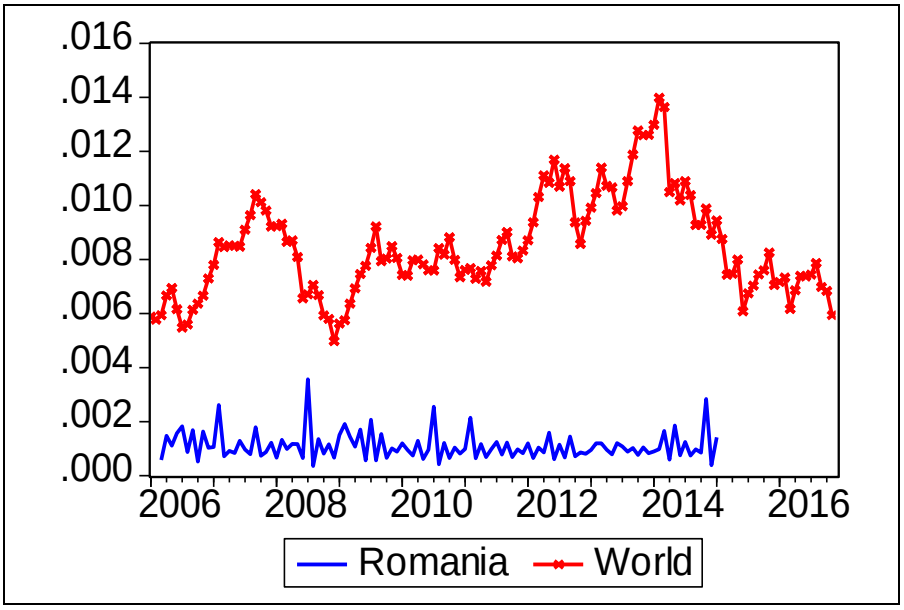

Figure 4. Pigmeat price volatility.

The growth trend in pigmeat prices, in Romania and globally, is accompanied by high volatility throughout the period, with significant increases in 2008, 2010 and 2014 for Romania and 2007–2008, 2012, and 2014 for the world prices.

Inflation in food prices can be a serious problem in countries like Romania, which have no implemented assistance mechanisms for those affected, with a low per capita income, where consumers may spend more than half of the budget on basic or low-processed food.

From the perspective of livestock farmers (supply side), high volatility is detrimental to investments and profitability.

5. CONCLUSIONS

This study analyzes the price volatility of beef and pigmeat products in Romania and their relation to international market prices. The results show that the variation coefficient of these prices is higher in Romania than on the international market, so we can say that prices in Romania are more dispersed.

The estimated models are GARCH and EGARCH for beef and pigmeat prices, both for Romania and for the world prices.

Beef price volatility has about the same magnitude in Romania and worldwide, but there is a gap in shock transmission. For pigmeat, price volatility is lower in magnitude in Romania but has a larger variability.

In the aftermath of the 2007–2008 global financial crisis, Romania experienced an increase in price volatility (in 2007–2009 for beef and in 2008 for pigmeat), followed by another surge in 2010/2011 that coincides with world price increases up to the 2007/2008 level.

Generally, increased price volatility periods can be associated with significant increases in the corresponding prices or other global events (financial crisis, food price crises).

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