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# The effectiveness of the European agricultural quality policy: a price analysis

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## Abstract

The European rural development policy, the second pillar of the Common Agricultural Policy, is currently playing an increasing role. One of its key instruments is the support for quality standards through Protected Geographical Indications (PGI). The analysis presented in this article investigates prices for two varieties of beef (PGI and non-PGI). The research setting is a specific area in northern Spain, where «*Ternera de Navarra*» (Navarra beef) is produced. The results show that quality production systems achieve higher and more stable prices in the long term. Another major point emerging from the analysis, given the nature of the beef production sector, is that the PGI product is better able to stand up to consumer confidence crises, such as that triggered by the bovine spongiform encephalopathy outbreak.

**Additional key words**: prices, protected geographical indication, rural development.

## Resumen

**La efectividad de la política agraria europea de mejora de la calidad: un análisis de precios**

La importancia de la política europea para el desarrollo rural está siendo ampliamente debatida. Uno de los instrumentos más importantes es la ayuda a las producciones a través de las Indicaciones Geográficas Protegidas (PGI). En este trabajo se presenta un análisis sobre los precios de dos variedades de carne, una acogida a las PGI y otra no acogida. El trabajo se centra en la producción de carne en un área específica del norte de España, en donde se produce la carne «Ternera de Navarra». Los resultados indican que la carne acogida a las PGI obtiene mayores precios y más estables a largo plazo. Adicionalmente, el análisis muestra que los productos acogidos a las PGI son más capaces de hacer frente a las crisis derivadas de la pérdida de confianza de los consumidores, lo que para un sector como la producción de carne resulta de gran interés.

**Palabras clave adicionales**: desarrollo rural, indicaciones geográficas protegidas, precios.

## Introduction

Recent developments in the agro-food system are proving a challenge to producers in the less favoured regions of the European Union. The growing concentration of large-scale distribution centres has flooded the market with large and easy-to-handle quantities of homogeneous products. At the same time, consumer demand for differentiated products and willingness to pay a quality premium are heightening the role of geographical indications. As well as offering a guarantee of better quality, these quality schemes also appeal to certain social values with which some consumers identify. Many studies, among them Glitsch (2000), Henson and Northern (2000), Fearne *et al*. (2001), Davidson *et al*. (2003) or Barrena *et al*. (2003), include «origin» as one of the attributes to be considered by the consumer. Despite some cross-country differences, the results in all cases identify origin as one of the top-priority indicators of meat quality.

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Abbreviations used: ADF (augmented Dickey-Fuller), BSE (bovine spongiform encephalopathy), PGI (protected geographical indication), VEC (vector error correction).

There are fewer studies focusing specifically on attitudes towards Protected Geographical Indications (PGI) beef, the main ones being Loureiro and McCluskey (2000), Calvo (2002), Roosen *et al*. (2003) and Gracia and Pérez y Pérez (2004). Roosen *et al*. (2003) assess the capacity of labelling to boost consumer confidence in fresh meat products, by analysing the effectiveness of two mechanisms (private brands and geographical indications) in three European countries: France, UK and Germany. The results show that in all three countries PGIs are more highly valued as quality cues than private brands.

Both Loureiro and McCluskey (2000) and Calvo (2002) focus their attention on a Spanish PGI («Ternera de Galicia»). The first of these studies, which analyses the impact of a meat origin label on the quality perceived by consumers, reaches the conclusion that such a label enhances perception of the intrinsic attributes of the meat. This adds value and raises the quality expectations of the consumer, both at time of purchase and during consumption. The second paper, which estimates consumers' willingness to pay for PGI-labeled meat, finds that the role of PGI certification is relevant only for higher quality/higher price products.

Gracia and Pérez y Pérez (2004) use a hedonic analysis to explore consumer behaviour in relation to beef in a Spanish region. One of their main conclusions is that a PGI label appears to be the main price-determining attribute for beef.

Some authors (Loureiro and McCluskey, 2000; Rossen *et al*., 2003) report further evidence to support a higher appreciation for PGI meat based on the link between the product and a particular type of production system. Thus, geographical labelling is used with local products with a strong territorial identification and reputation and/or typical products associated with specific production methods. Quality, reputation and general characteristics in these local products are primarily attributed to their geographical origin.

Meanwhile, international trade negotiations within the World Trade Organization and agreed commitments have put pressure on developed countries to remove or reduce any instruments in their agricultural policies that might distort international trade. European Union Agricultural policy is gradually turning away from price and market support, which was the first pillar, towards the second pillar, *i.e.,* the rural development policy. The latter includes support for PGI labels, as a means to promote products from less-favoured regions.

Previous analyses (Gómez *et al*., 2003, 2006) on the effectiveness and suitability of this instrument to promote rural development in such regions, particularly those in mountainous areas, have focused on beef production units in an attempt to identify success factors. One of the findings of that analysis was the effectiveness of the PGI in integrating closed cycle farms[1] and providing them with the means to promote their products and ensure their survival. They were also found to play a role in promoting trust between actors in the food chain, especially where distance made relationships harder to develop. This helped to reduce information asymmetries and facilitate marketing outside the production area.

Furthermore, since PGI products are differentiated goods, they have the potential to strengthen farmers' competitive capacity by helping them to secure a market niche. By focusing on a beef-producing region, the overall aim of this study is to compare some of the economic issues found to be associated with PGI and non-PGI production. In this way, the paper aims at contributing to the design of sustainable development policies in less favoured areas using these production systems.

The focus of the analysis is *Ternera de Navarra* (Navarra beef) PGI label, produced in the north of Spain, under which more than 700 livestock farms, the majority closed cycle operations, have been producing beef for more than 10 years. In recent years, beef cattle production in this region represents around 15% of total animal production, a percentage exceeded only by the pork sector. The share of PGI certified meat production in the regional market has been following an increasing trend and currently accounts for over 30% of the region's total beef production. *Ternera de Navarra* is among Spain's top certified fresh meats and accounts for 10% of total domestic certified production. Another feature that makes the region in question particularly suitable for a case study and brings the need for analysis into sharper focus is the fact that extensive livestock rearing is widely practised in the highland areas of Navarra. It is widely acknowledged that these farmers contribute significantly towards nature conservation (Bignal and McCraken, 1996). Grazing cows help keep grasslands in their natural state, prevent the growth of scrub, contribute to biodiversity and create the micro-habitat necessary for

[1] Closed cycle farms are cattle breeding farms that finish their own calves.

species survival (Evans *et al.*, 2003). Their economic viability at once sustains these farms and helps to guarantee environmental functions.

Thus, the objective is to analyse to what extent the PGI label contributes to increase perceived prices and thereby help farm operations to improve their economic performance. Gómez *et al.* (2003) found that, when extensive closed cycle farms in this region applied for PGI certification, they were well able to meet official requirements[2]. This confirmed the view, expressed by various regional experts, that the PGI certificate had emerged in order to protect the region's majority group of extensive livestock farmers[3]. In addition to raising prices, farmers may be seeking to stabilize them. If the price of PGI certified beef presents less variation than that of unlabelled beef, it will help to reduce uncertainty in the market. Therefore the analysis also considers the possible effect of bovine spongiform encephalopathy (BSE) on beef prices.

## Data and methodology

This study examines certified versus uncertified beef prices[4]. In absence of farmers perceived price series, the analysis uses monthly wholesale beef prices for the period March 1996 to January 2006. The data are drawn from a report published monthly by the Regional Government Department for Rural Development and the Environment (Gobierno de Navarra, various years). The report in question lists regional monthly average prices for a series of products including those used in the present study. Some descriptive statistics for both price series are given in Table 1. The data for the sample period shows a higher average price and less price variation for PGI certified beef than for the non-certified variety.

The implicit hypothesis in using wholesale beef prices instead of farmer perceived prices is that the relationship between the two price series is the same for both products. There are no previous studies analysing price relationships at different points of the food chain for certified and non-certified versions of the same product, despite an abundant literature on prices in the meat market. The literature has devoted particular attention to analysing the extent to which markets are linked spatially and throughout the marketing chain, especially with respect to the degree of shock transmission between different agents (Meyer and Von Cramon-Taubadel, 2004; Vavra and Googwin, 2005; Goodwin, 2006). Nevertheless, the cited authors recommend caution when interpreting findings based exclusively on price analysis, because the evidence obtained from the literature is inconclusive. Results vary widely depending on the product considered, the methodology applied and even the frequency (weekly or monthly) of the data selected. One fairly general observation in this research, nevertheless, is that retail prices tend to adjust more slowly than producer or wholesale prices, where exogenous shocks have a bigger impact, thus revealing the presence of market power at some points in the food chain. In addition, effects on prices are transmitted during the same period from farmer to wholesaler and from wholesaler to retailer[5].

**Table 1.** Descriptive statistics of prices series

| Statistic | $PR_{pgi,t}$ | $PR_{nopgi,t}$ |
|---|---|---|
| Mean | 3.37 | 3.15 |
| Variance | 0.15 | 0.24 |
| Coefficient of variation | 4.53 | 7.88 |
| Minimum | 2.94 | 2.40 |
| Maximum | 3.79 | 3.70 |
| Number of observations | 119 | 119 |

There is not much research on meat price relationships in the geographical context considered. Findings from related studies[6] (either in product similarity or in spatial proximity) are used as a reference. The alluded findings support the preference to use wholesale rather than retailer prices, as a proxy for farmer perceived prices.

The two price series are shown in Figure 1, where it can be seen that the price of PGI beef remains higher

[2] Compulsory requirements for farmers registered with the PGI concern breed of cattle, feeding regime and production system, which means that not all types of farms are eligible for this type of quality guarantee system (Atance *et al*., 2004).

[3] According to the same authors, those outside the PGI scheme are fattening specialists engaged in large-scale intensive production.

[4] In both cases, prices are for top class beef, which is the majority of the output, at carcass weights from 270 to 350 kg.

[5] See, for example, Goodwin and Holt (1999) or Lloyd *et al*. (2006).

[6] See, among others, contributions by Sanjuán and Dawson (2003), Bakucs and Fertö (2006), Ben-Kaabia and Gil (2007) and Rossini and Depretis (2008).

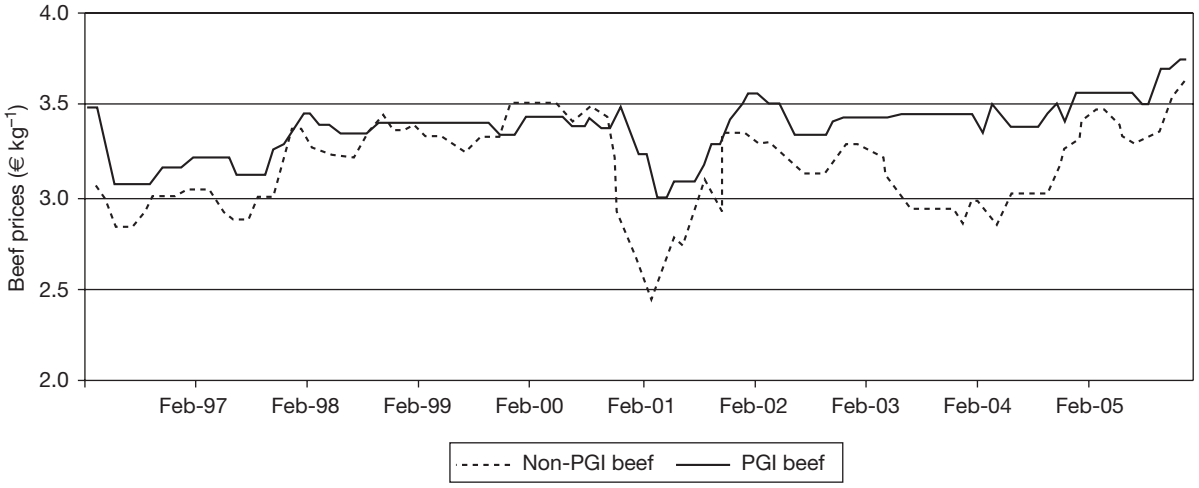


**Figure 1.** Beef price time series. PGI: protected geographical indication. *Source:* Gobierno de Navarra (various years).

than that of non-PGI beef throughout the whole period, except for the month of November 1998[7], and the period from December 1999 to October 2000. The latter period was when the first signs of the «mad cow» food crisis began to show, causing prices of both types of beef, especially the non-PGI variety, to plummet in 2001[8]. In order to consider the impact of this situation on price evolution, an exogenous variable is introduced to capture the number of cases of bovine spongiform encephalopathy detected per month in Spain from November 2000, when the first case was detected, to January 2006. The evolution of this variable is shown in Figure 2. A somewhat increasing trend can be observed in the first few years of the sample period and the last months of 2003. Thenceforth the trend changes, although there are still some months with a significant number of cases[9]. Since that crisis, PGI beef prices have remained higher than non-PGI beef prices, with consistently

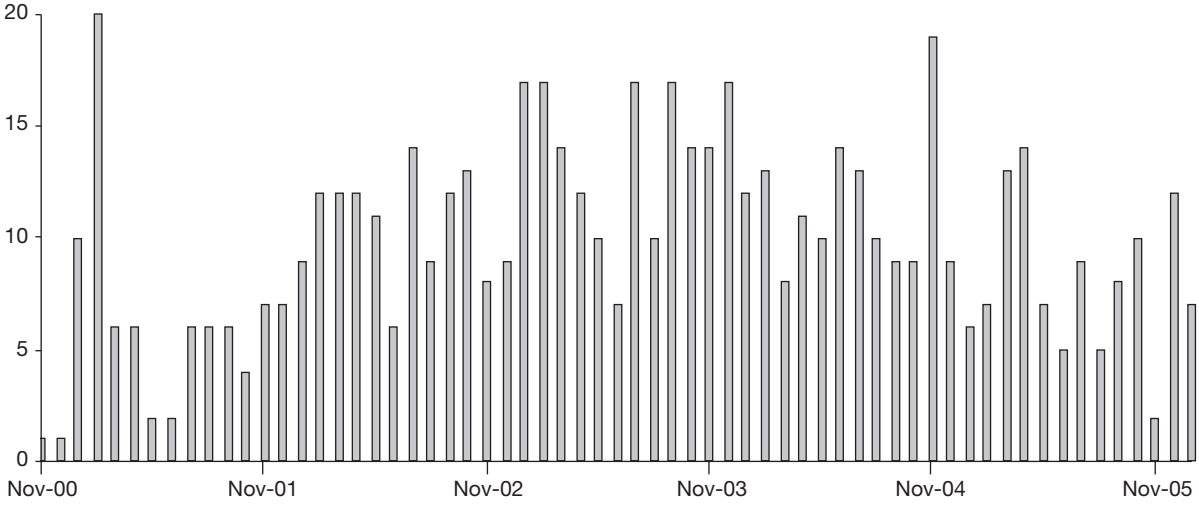


**Figure 2.** Number of bovine spongiform encephalopathy cases in Spain. *Source:* Ministerio de Medio Ambiente y Medio Rural y Marino (2009).

[7] Both prices show very similar levels: €3.44 kg$^{-1}$ for non PGI beef versus €3.40 kg$^{-1}$ for certified beef. According to PGI officials, a shortage of non-PGI beef caused its price to rise above that of PGI beef.

[8] During the period considered, the region reported 20 cases of BSE, with both types of farms being affected. Both prices may therefore have been affected by the BSE crisis.

[9] Specifically, for the years considered in this analysis (2000-2006), the numbers of reported cases in Spain were 2, 83, 134, 173, 138, 103 and 68.

greater price spreads between the two varieties, despite some reduction in recent months.

The price series analysis shows prices of PGI beef to be higher than those of non-PGI beef. The objective, therefore, is to determine whether and to what extent the prices of these two substitute products are related and whether the observed relationship holds over time. The hypothesis is that participation in a PGI production scheme allows the farmer to obtain a higher price for a similar product, and that the difference will hold over time. If the relationship holds in the long-term, it follows that the characteristics observed in the two price series, particularly a higher mean and less variance, also hold, thus confirming a stable margin between the two.

The theoretical approach used to test for this relationship is co-integration, which enables the analysis of both long-term and short-term relationships between non-stationary price series. The two alternatives for the analysis of price transmission are either to consider horizontal price linkages and take the market integration approach, or to examine vertical price linkages along the food supply chain. The literature contains numerous studies of vertical co-integration in which the price of the same product is analysed at different points of the food chain (Lloyd *et al*., 2001; Sanjuán and Dawson, 2003; Cruz and Ameneiro, 2007; Rojas *et al*., 2008). There are fewer studies of horizontal price co-integration of the same product in different regional markets. Some examples are Goodwin and Schroeder (1991) on cattle price co-integration in United States, Boshnjalu *et al.* (2003) on the sheep market in Spain, or Sanjuan and Gil (2001) on the European pork and lamb markets. One variation on this last horizontal approach is to consider price linkages between close substitutes in the same market (for the case of beef, see Leeming and Turner, 2004, or Chopra and Bessler, 2005). Recent related research includes Asche *et al*. (2007) on Scottish and Norwegian salmon prices, and Ghoshray (2007) on price linkages between US and Canadian durum wheat. This context provides the framework for the present study, which examines linkages between two price series for substitute products in the same market, PGI and non PGI beef.

The rationale for the selected methodology is that it enables the analysis of relationships between non-stationary series without first having to remove the stationary component. If there are two non-stationary, or integrated I(1), price series, such as prices of PGI beef ($PR_{pgi,t}$) and non-PGI beef ($PR_{nopgi,t}$), then there may exist a value of $\beta$ such that (Greene, 2003):

$$PR_{pgi,t} - \beta\ PR_{nopgi,t} = \varepsilon_t \qquad [1]$$

will be I(0). In other words, any difference between the two price series will be stable around a fixed mean, suggesting that the two price series increase at approximately the same rate. If this is true, the two series are said to be co-integrated and the vector $(1,-\beta)$ is the co-integration vector. That is, if two series I(1) are co-integrated, then a combination of the two is I(0) (stationary). According to Stock and Watson (1988), the only way for two series to be co-integrated is for them to have some type of common trend that is cancelled with the linear combination (co-integration vector).

Having tested the hypothesis of non-stationarity and the existence of co-integration of the two price series, the above-mentioned relationship is given by the Vector Error Correction (VEC) estimate using Johansen's procedure in a first stage. Starting with a VAR(p):

$$Y_t = \mu + \Pi_1 Y_{t-1} + \ldots + \Pi_p Y_{t-p} + \varepsilon_t \qquad [2]$$

where $Y_t$ is a price column vector $\begin{pmatrix} PR_{pgi,t} \\ PR_{nopgi,t} \end{pmatrix}$, $\mu$ is a constants vector, and $\varepsilon_t$ is a vector of independently distributed random noise with zero mean and variance covariance matrix $\Omega$. Taking first differences:

$$\begin{aligned} Y_t - Y_{t-1} = \\ = \Delta Y_t = \Gamma_1 \Delta Y_{t-1} + \cdots + \Gamma_{p-1} \Delta Y_{t-p+1} + \Pi Y_{t-1} + \varepsilon_t \end{aligned} \qquad [3]$$

where:

$$\Gamma_i = -I + \Pi_1 + \cdots + \Pi_i \quad \text{and} \quad \Pi = -I + \Pi_1 + \cdots + \Pi_p$$

Expression [3] is a VEC, where matrix $\Pi$ (which here is a $2 \times 2$ matrix) describes the long-term relations between variables. For expression [3] to be balanced (given that the first difference series of a non-stationary series is a stationary series), $\Pi Y_{t-1}$ needs to be stationary, implying that the matrix describes co-integration relations. Furthermore, matrix $\Pi$ can be broken down into the product of two $m \times r$ matrices:

$$\Pi = \gamma\alpha' \qquad [4]$$

where $\gamma$ is the matrix of parameters measuring the adjustment speed of the co-integration vectors and $\alpha$ is the matrix of the co-integration vectors. Here, with two variables, there can be only one co-integration relation, therefore $\gamma$ and $\alpha$ will be $2 \times 1$ vectors.

To estimate the effects of the mad cow crisis on the prices of the two varieties of beef, an exogenous variable is included to capture the monthly number of

BSE cases detected in Spain[10]. This is done by estimating a two-stage VEC model. The first stage is an estimation of the model using the Johansen procedure described earlier, and the second is the consideration of exogenous variable and additional constraints. Residuals from the first stage are used in the second stage to compute generalized least squares estimators. In this case, regressors with lower absolute t-ratios are sequentially eliminated.

## Model estimation and results

The Augmented Dickey-Fuller[11] (ADF) unit root test is used to test the hypothesis of both price level series being non-stationary[12], which is confirmed. Then the hypothesis of co-integration between two variables is tested, following the procedure proposed by Maddala and Kim (1998), which is based on the unit root test of the residuals of the linear regression of the price variables. The t-ratio for this test is –3.29 for a critical value of –2.88[13], which confirms the existence of co-integration between PGI and non-PGI beef prices. The full VEC model is then estimated including, as deterministic elements, a trend variable and a time dummy to capture changes induced by the BSE crisis (this takes a value of 0 up to November 2000 and 1 thenceforth), although only the trend variable is significant. The choice of the number of lags, in this case 10, is based on the Akaike criterion. The estimated trend and BSE variable coefficients are given in Table 2.

Estimated goodness of fit is calculated by testing for residual autocorrelation, normality and heteroscedasticity. The results are shown in Table 3.

There is no indication of autocorrelation or heteroscedasticity, though there is a lack of normality that is more due to excess kurtosis than excess skewness. Hendry and Juselius (2001) note that it is preferable for residual lack of normality to be due to excess kurtosis than skewness, since statistical inference is quite sensitive to residual skewness, whereas it is moderately robust to the presence of kurtosis. The logical conclusion therefore is that there are no serious residual problems in the estimated VEC model.

**Table 2.** Trend and BSE[1] coefficients in the estimated error correction vector[2]

| Equation | $\Delta PR_{pgi,t}$ | $\Delta PR_{nopgi,t}$ |
|---|---|---|
| Trend | 0 | –0.010 (–2.693) |
| $\Delta BSE_t$ | 0 | –0.006 (–2.518) |

[1] BSE: bovine spongiform encephalopathy. [2] t-ratios in brackets.

The final estimates of the co-integration and speed adjustment vectors are as follows (t-ratios in parentheses):

$$\begin{pmatrix} \Delta PR_{pgi,t} \\ \Delta PR_{nopgi,t} \end{pmatrix} = \begin{pmatrix} 0 \\ 0.305 \\ (4.218) \end{pmatrix} \left[ 1 \underset{(-43.779)}{-1.02} \right] \begin{pmatrix} PR_{pgi,t-1} \\ PR_{nopgi,t-1} \end{pmatrix} \quad [5]$$

The PGI beef *vs* non-PGI beef price difference data are reflected in vector $\beta$. For any two prices, if $\beta_1 = \beta_2$ price transmission is complete. In this case, given that $\beta_1$ is normalized to unity, the fact that $\beta_2$ reaches a value of 1.02 means that there is a long-term proportional relationship between the price of PGI beef and that of non-PGI beef. The nature of the relationship implies that the price of PGI beef is 2% higher than that of non-PGI beef

**Table 3.** Tests for the residual of the error correction vector estimated[1]

| Hypothesis | $\Delta PR_{pgi,t}$ | $\Delta PR_{nopgi,t}$ |
|---|---|---|
| Non-normality | | |
| Jarque-Bera | 0.24 (0.81) | 145.26 (0.00) |
| Multivariate: | | |
| — Autocorrelation (Breush-Godfrey) | 8.01 (0.99) | |
| — Skewness | 15.66 (0.00) | |
| — Kurtosis | 131.13 (0.00) | |
| — VARCH | 46.86 (0.39) | |

[1] p-values in brackets.

[10] The variable is introduced in first differences because, to maintain the balance of the model, the variable needs to be stationary, and this hypothesis is rejected by the Augmented Dickey-Fuller (ADF) test which yields a value of 1.76 where the critical value at the 5% level is -3.41.

[11] JMulti software developed by Lutkepohl and Kratzig and available at www.jmulti.com was used to obtain these and all the rest of the results obtained in the price analysis.

[12] The equation was estimated including both constant and trend and the lags for each of the series, using the Akaike criterion. Seasonal dummies were also included in order to capture the observed seasonality. The estimated ADF statistics were $t_{PR_{pgi,t}} = -2.23$ and $t_{PR_{nopgi,t}} = -2.80$.

[13] The critical values of the ADF test are downward biased and must be calculated using the method proposed by MacKinnon (1991), as noted in Maddala and Kim (1998).

The factor loading matrix α contains information about exogeneity and could thus be used to determine the leading price in the market in which they are competing. If it takes a value of zero, the price in question will be weakly exogenous and therefore set outside ordinary market processes. In such a case, this will be the leading price.

Since the adjustment speed associated with PGI beef is significantly equal to zero, there is no variation in the price of PGI beef due to changes in price differences, and hence any adjustment must be made through changes in non-PGI beef prices. A long-term causality relationship running from PGI beef to non-PGI beef can be said to exist, but there is none running in the opposite direction.

The factor loading associated with non-PGI beef is not high, suggesting that, when there is a deviation in the long-term relationship between the two prices, return to equilibrium takes time.

These results show that the price of PGI beef evolves independently and appears to determine the evolution of non-PGI beef prices, which adjust to market forces in the long term, suggesting that the PGI beef is a price leader for this product. These results confirm those presented by Ghoshray (2007), where the higher quality product (in that case Canadian durum wheat) is found to be the price leader. The fact that, despite being more highly valued by consumers, PGI beef represents a smaller share of total beef sales[14] in the market may be due to production sector difficulties in increasing supply and integrating the product into the food supply chain [Bardají *et al*. (2009) mention, among other things, that geographical origin and designation of origin appear to generate little interest among retailers].

The analysis of the impact of the BSE crisis supports the above findings. When the BSE variable is introduced in first differences, it is significant only in the non-PGI beef price equation, with an estimated value of –0.006[15] (t-ratio = –2.518). This suggests that the crisis had a direct effect only on the non-PGI beef market, and that effects were transmitted to PGI beef in the short term through the autoregressive term of the estimated VEC. The negative sign of the BSE coefficient is as expected, in that increases in the number of reported cases are associated with a price fall, confirming the results of previous studies by other authors (Leeming and Turner, 2004). This shows that demand forces prevailed over supply forces (or factors) in the turmoil that hit the beef market. These results also reveal the higher level of protection provided by PGI beef against price falls of this nature.

## Conclusions

Aimed at assessing one of the economic aspects of PGI certification, the prices of protected products, this price analysis enables to conclude that prices associated with the PGI label are not only higher, but also more stable. Thus, if the proposal is to measure the effectiveness of this instrument in terms of its price-raising capacity and potential to improve farm performance, it is possible to conclude that PGI certification does indeed achieve these objectives, at least in the case analysed here.

The analysis also reveals something else of major importance in a context like that of the beef production sector, namely, that the PGI product is better able to stand up to crises leading to a loss of consumer confidence, such as that caused by the BSE outbreak. This quality label therefore also helps to reduce perceived risk to farmers operating in the sector.

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[14] Although, as already noted, the PGI share is growing. For example, the region's main abattoir reported a constant increase in the amount of PGI-reared livestock slaughtered, from 117,000 kg month$^{-1}$ in 1996 to over 232,000 kg month$^{-1}$ in 2005. This is an increase of nearly 100%. Over the same period, the corresponding averages for livestock reared under alternative non-PGI conditions were 478,000 and 702,000, that is, an increase of 47%.

[15] This shows that the value of price elasticity to BSE scares is –0.02, computed in the mean values. In other words, a 10% increase in the number of BSE cases triggers a 0.2% drop (€0.63 kg$^{-1}$) in the price of non-PGI beef.

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