E C O N O M I C S B U L L E T I N

Multiple Markets Within the EU? Empirical Evidence From Pork and Poultry Prices in 14 EU Member Countrties

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Abstract

The present study investigates the price dynamics of two agricultural commodities, pork and poultry, in order to determine whether there is a single or multiple markets within the EU. The investigation relies on the notion of a price club (meaning a group of countries in which prices obey the LOP) and on a clustering algorithm which allows for endogenous selection of such clubs. Overall, the empirical results indicate that the EU markets for pork and poultry are far from the ideal ones in which prices are uniform.

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1. Introduction

The analysis of spatial price relationships has been long used in economics to assess the functioning (integration) of geographically separated markets. When goods and information flow freely among them, shocks occurring in one market will evoke responses in other markets. Arbitrage activities will ensure that price differences of homogeneous goods in separated locations will be, at most, equal to transportation costs. However, when localized markets are not well integrated, profitability opportunities will not be fully exploited resulting, thus, into efficiency losses (e.g. Asche et al., 1999; Serra et al., 2006).

This study investigates the spatial relationships of pork and of poultry prices in 14 EU countries in order to determine whether there is a single EU market or multiple markets within the EU for these two agricultural commodities. Stigler (1969) and Sutton (1991) defined market as an area in which the prices are uniform, allowances being made for transportation costs and/or quality differences. Geographically separated markets form a single market when price differences or price ratios for those markets remain stable over time. Stable price differences around zero or equivalently, stable price ratios around unity offer evidence in favor of the strong version of the Law of One Price (LOP); stable price differences around non zero constants or equivalently, stable price ratios around different from unity constants offer evidence in favor of the weak version of the LOP (e.g. Asche et al., 1999; Robinson, 2007; Sosvilla-Rivero and Gil-Pareja, 2004). Borrowing terminology from the literature on asymptotic stochastic convergence (e.g. Bernard and Durlauf, 1995 and 1996; Goldberg and Verboren, 2005; Hobijn and Franses, 2000) one may call localized markets in which the LOP holds a *price club* (price cluster). For a single EU market all localized markets must be members of the same price club; multiple markets within the EU are consistent with the existence of multiple price clubs. The price clubs in this work are identified endogenously through a clustering algorithm which relies on the empirical values of statistics suitable for testing the LOP restrictions in cointegrating vectors.

Price dynamics in the EU members is an issue of great concern and the focus of intense public debate. Survey evidence from supermarkets around the Union suggests that "*Border still seems to matter in Europe*" , "*The EU remains divided into 15 separate markets for supermarket goods, where prices in neighboring countries are not much related*" (Internal Market Scoreboard, 2001 and 2004). Despite the importance of the topic there is a scarcity of formal studies on spatial price interrelationships for agricultural commodities in the EU. To the best of knowledge, the only earlier works have been those by Sanjuan and Gil (2001), Serra et al. (2006), and Zanias (1993). None of them, however, has explored the possibility of different price clubs to exist in the internal European market. Traditionally the EU policymakers have intervened less in the pork and the poultry markets relative to those of other livestock products such as beef meat, lamb meet, and milk. The rather limited intervention creates a favorable environment for a smooth price transmission process across space. Zanias (1993) provided empirical evidence that a high degree of intervention is associated with a low degree of integration in the long term. At the same time, both the pork and the poultry industry in the EU exhibit high levels of concentration. As noted by Sexton et al. (1991) market power can be an impediment to full price transmission. Therefore, with respect to the price dynamics, the pork and the poultry markets in the EU present more interest relative to the markets of other livestock commodities. In what follows, section 2 contains the analytical framework, section 3 the empirical results, while section 4 offers conclusions and suggestions for future research.

2. Analytical Framework

Let us denote the natural logarithms of the I(1) prices of the same good in the geographically separated markets i and j and in time t by p_t^i and p_t^j, respectively. For the weak version of the LOP to hold it must be the case that

$$p_t^i = p_t^j + \beta + \varepsilon_t \qquad (1),$$

where $\beta \neq 0$ is a constant and ε_t is a zero-mean stationary error term (e.g. Asche et al., 1999). In other words, p_t^i and p_t^j must be cointegrated variables with cointegrating parameters (1, -1, -β). When (1) is true,

$$\lim_{k \to \infty} E_t(p_{t+k}^i - p_{t+k}^j) = \beta \qquad (2),$$

implying that at every moment of time we expect the natural logarithms of prices to differ by β no matter what are the current and past price levels. For the strong version of the LOP to hold it must be the case that

$$p_t^i = p_t^j + \varepsilon_t \qquad (3).$$

In other words, p_t^i and p_t^j, must be cointegrated variables with cointegrating parameters (1, -1, 0). When (3) is true,

$$\lim_{k \to \infty} E_t(p_{t+k}^i - p_{t+k}^j) = 0 \qquad (4),$$

suggesting that at every moment in time we expect the prices to be equal, no matter what are the current and past price levels. Cointegration of two I(1) price series is a necessary condition for the LOP (weak or strong version) to hold. It is not, however, sufficient. To see it notice that if the coefficient of p_t^j in (1) was $\gamma \neq 1$, the price difference could be written as

$$p_t^i - p_t^j = (\gamma - 1)p_t^j + \beta + \varepsilon_t \qquad (5).$$

The Right Hand Side of (5) is now non stationary suggesting that stochastic shocks to logarithmic differences persist into indefinite future (that means, the LOP does not hold).[1]

The Vector Error Correction Model (VECM) (Johansen, 1988; Johansen and Juselius, 1990) has been extensively used to study spatial price linkages (e.g. Asche et al., 1999; Gosh, 2003; Sanjuan and Gil, 2001). If P_t denotes a (nx1) vector of I(1) logarithmic prices the VECM may be written as

$$\Delta P_t = \sum_{\phi=1}^{k-1} \Gamma_\phi \Delta P_{t-\phi} + \Pi^* P_{t-k}^* + \varepsilon_t \qquad (6),$$

where Γ_ϕ and Π^* are parameter matrices, and P_{t-k}^* is the price vector in period t-k augmented by 1. In particular,

[1] Notice that (2) and (4), respectively, are the conditions for asymptotically relative and asymptotically perfect stochastic convergence of two time series (e.g. Bernard and Durlauf, 1995 and 1996; Proietti, 2005). This certainly justifies the use of the term *price club* for spatially separated markets in which the LOP holds.

$$\Pi^* = \begin{bmatrix} \pi_{11} \,.......\, \pi_{1n} \;\; \beta_1 \\ .... \\ \pi_{i1} \,.......\, \pi_{in} \;\; \beta_i \\ .... \\ \pi_{n1} \,........\, \pi_{nn} \;\; \beta_n \end{bmatrix}$$ and $P^*_{t-k} = (p_{1t-k}, ..., p_{it-k}, ..., p_{nt-k}, 1)'$. The rank of Π^*, denoted by r, determines how may linear of combinations of prices are stationary. When $0 < r < n$ there exist r cointegrating vectors and one can factor Π^* as $\Pi^* = a\rho'$ with a being a (nxr) matrix of the adjustment parameters and ρ being a ((n+1)xr) matrix containing the error-correcting mechanism of the system. In VECM model presented in (6) the constants β_i, (i=1, 2, …, n) have been included in the cointegrating vectors to test for the strong version of the LOP. Technically, inclusion of constants in a cointegrating vector is allowed when none of the series exhibits a linear deterministic trend. Tests for the presence of linear deterministic trend in the pork and the poultry price series are carried out in section 3 using the $\tau_{\beta\tau}$ statistic (Enders, 1995).

The number of cointegrating vectors can be determined using the Trace and the Max tests (Johansen and Juselious, 1990). A necessary condition for the weak version of the LOP to hold is that the rank of Π^* is n-1 suggesting that the n prices series are pairwise cointegrated or equivalently, that they share a single common stochastic trend (Stock and Watson, 1988). The sufficient condition is that the (n-1)x(n+1) matrix ρ' of the cointegrating vectors can be written as

$$\rho' = \begin{bmatrix} 1 & -1 & 0 \ldots. 0 & 0 & -\beta_1 \\ 0 & 1 & -1 \ldots. 0 & 0 & -\beta_2 \\ \ldots & & & & \\ 0 & 0 & 0 \ldots..1 & -1 & -\beta_{n-1} \end{bmatrix} \qquad (7)$$

implying n-1 restrictions on the price-related parameters. The weak version of the LOP, in turn, is a necessary condition for the strong version of the LOP. The sufficient condition is that (7) can be written as

$$\rho' = \begin{bmatrix} 1 & -1 & 0 \ldots. 0 & 0 & 0 \\ 0 & 1 & -1 \ldots. 0 & 0 & 0 \\ \ldots & & & & \\ 0 & 0 & 0 \ldots..1 & -1 & 0 \end{bmatrix} \qquad (8)$$

implying 2(n-1) restrictions on the price-related parameters and the constants. The test statistic for restrictions on the elements of cointegrating vectors are

$$\Phi = T\sum_{i=1}^{n-1}[(\ln(1-\lambda_i^R) - \ln(1-\lambda_i^U)] \qquad (9),$$

where λ_i^U and λ_i^R are the eigenvalues from the unrestricted and the restricted matrix Π^*, respectively. These statistics follow the Chi-squared distribution with degrees of freedom the number of restrictions (Johansen and Juselius, 1990).

Since the weak version of the LOP is a necessary (but not a sufficient) condition for the strong version of the LOP it appears reasonable to identify first price clubs where the weak version of the LOP holds and then to search for price clubs where the strong version of the LOP holds within clubs where the weak version holds. The structure of the clustering algorithm for the endogenous selection of clubs where the weak version of the LOP holds may be summarized as:

(1) at the initial stage each localized market represents a separate (single-member) price club; thus, there are n such clubs $C_i = i,\ i = 1, 2, ..., n$;
(2) compute the empirical value of the test statistic for the weak version of the LOP for each possible pair of markets [i, j] , i<j and obtain the corresponding p-value (denoted as $p^{[i,j]}$) from the table of the Chi-squared distribution with 1 degree of freedom;
(3) if max ($p^{[i,j]}$) is less than 0.05, stop and conclude that all clubs consist of only one member; else choose the pair [i, j] for which $p^{[i,j]}$ is maximum;
(4) combine clusters C_i and C_j;
(5) iterate (2)-(4) until $p^{[i,j]}$ is less than 0.05 or until all localized markets belong to a single club; the $p^{[i,j]}$ when combining club i with k_i members and club j with k_j members is obtained from the tables of the Chi-squared distribution with $k_i + k_j - 1$ degrees of freedom.

Given that P_t consists of logarithmic prices, prices in countries which belong to a price club where the weak version of the LOP holds maintain (on average) a proportional relation to each other over time.

The structure of the clustering algorithm for the endogenous selection of clubs where the strong version of the LOP holds (which is applied to each club where the weak version of the LOP holds) is the same as that described above. The only difference is that the $p^{[i,j]}$ for testing the strong version of the LOP is obtained from the tables of the Chi-squared distribution with $2(k_i + k_j - 1)$ degrees of freedom. The algorithm tests for both the necessary and the sufficient conditions for the LOP, it does not depend on the ordering of the price series and it is consistent (that means, it finds true price clubs when enough data are available).[2] Prices differences in countries which belong to a club where the strong version of the LOP are (on average) zero over time.

3. The Empirical Results

The data for the empirical analysis are monthly price series from 14 EU countries over the period 1995:1 to 2006:6. The countries are Austria (AT), Belgium (BE), Germany (DE), Denmark (DK), Spain (ES), Finland (FI), France (FR), Greece (GR), Ireland (IR), Italy (IT), the Netherlands (NE), Portugal (PT), Sweden (SE), and the United Kingdom (UK). The prices, which are expressed in Euro/100 kg, are those received by producers at the slaughterhouse and they have been obtained from the European Commission (2007). Tables 1 and 2 presents descriptive statistics. With regard to pork, the highest prices (on average) have been recorded in Greece and in Italy and the lowest in the Netherlands and in Denmark. With regard to poultry, the highest prices (on average) have been recorded in Greece and in Finland and the lowest in the Netherlands and in Spain.

Prior to the application of the clustering algorithm, the natural logarithms of price series have been tested for the presence of linear deterministic trend using the $\tau_{\beta\tau}$ statistic.

[2] Alternative clustering algorithms have been proposed in the literature. The algorithm by Hobijn and Franses (2000) utilizes multivariate stationarity tests on the difference of time series, while that by Proietti (2005) searchers for a monotonic downward trend shared by multiple time series.

For the pork prices series, the empirical values of that statistic ranged from a low of –0.904 for FR to a high of 0.10 for ES; for the poultry price series, they ranged from a low of –0.62 for NE to a high of 1.37 for SE. With 5 percent critical values of –(+) 2.79 the null hypothesis (deterministic trend is not present) cannot be rejected for any of the 28 price series. Subsequently, the presence of unit roots in the series has been tested using the DFGLS test by Elliot et al. (1996). For pork prices, the empirical values of the test statistic ranged from a low of –1.81 for FR to a high of –0.85 for the UK. With a 5 percent critical value of –1.945 the null hypothesis (stochastic trend is present) cannot be rejected for any of the 14 pork price series. For poultry prices the null hypothesis has been rejected for GR (empirical value –2.71), for SE (empirical value –2.11), and for the UK (empirical value –2.25). Non stationary and stationary series cannot be mixed. Therefore, GR, SE, and the UK do not belong to the same price club (for poultry) with any of the remaining countries. Whether GR, SE, and the UK can form a club where the strong version of the LOP holds will be investigated using LS regressions and standard tools of inference on parameter restrictions.[3] Finally, for the I(1) series the aggregation algorithm has been applied only to groups of localized markets in which the price logarithms are pairwise cointegrated since pairwise cointegration is a necessary condition for LOP (weak or strong version).[4]

Table 3 presents the aggregation history of the clustering algorithm in the search for pork price clubs where the weak version of the LOP holds. In square brackets the clusters that are formed at each iteration are reported; C_l refers to the club formed in the lth iteration (for instance, at iteration 4 AT is added to the cluster comprising DK, PT, DE, and ES).[5] There are four such clubs. The first consists of seven members (DK, PT, DE, ES, AT, GR, and the NE); the second consists of three members (FR, the UK, and IR); the third consists again of three members (IT, FI, and SE); and the fourth consists of just one member (BE). It is noteworthy that, except from FR, all the leading producers in the EU (ES, DE, the NE, and DK) belong to the same club. The existence multiple price clubs implies that the EU market for that commodity is not a single one.

Table 4 presents the aggregation history of the clustering algorithm in the search for pork price clubs where the strong version of the LOP holds. As noted above, the search is now restricted within price clubs where the weak version of the LOP holds. Within the fist such club there are four clubs; one consists of three members (DE, AT, and ES), another consists of two members (DK, and the NE), while GR and PT are single-membered clubs. Within the second such club, there are two clubs; one with two members (FR and UK) and another with one member (IR). Within the third such club there are again two clubs; one with two members (FI and SE) and another with one member IT.

Proximity of localized markets is thought to be an important factor for the LOP (strong version). The cost of transporting goods to neighboring countries is lower compared to that of transporting goods to more distant ones. Also, preferences in neighboring countries are likely to be similar (it is known that, with few exceptions, North-Central Europe opts for heavy pork carcasses, whereas Southern Europe opts for lighter animals). The notion that proximity plays a role in the LOP is only partially supported by the empirical results. DE and AT are adjacent markets and the same is true for FI and SE; the UK and FR (though not literary adjacent) are not far away from each other. However, PT does not belong to the same club with ES, and IR does not belong to the same club with the UK. With regard to the algorithm's performance, note that the endogenously selected price clubs (strong version of

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[3] For stationary series which do not exhibit linear deterministic trends (like those of poultry prices in GR, SE, and the UK) there is no need to test for the weak version of the LOP because such series hold (on average) proportional relationships.

[4] All tests have been carried out using the PcGive 10 program.

[5] Note that the *p*-values in the search do not have to be monotonic (see Proietti, 2005).

the LOP) are largely consistent with the average prices reported in Table 1. For example, while the average prices in ES and in DE differ by less than 2 Euros, the average prices in ES and in PT differ by more than 5 Euros or the average prices in IR and in the UK differ by almost 16 Euros. Therefore, the clustering algorithm seems that has captured the situation on the ground rather well.

Table 5 presents the aggregation history of the clustering algorithm in search for poultry price clubs where the weak version of the LOP holds. There are 6 such clubs. The first consists of four members (DE, ES, DK, and the NE); the second consists of three members (BE, FR, and IT); the third consists again of three members (GR, SE, and the UK) (the localized markets with the I(0) price series); AT, FI, IR, and PT are clubs with one member. It appears that the EU poultry market is even more fragmented than the pork market. A possible reason for this may be the larger heterogeneity of poultry relative to pork and the preference of consumers for poultry produced by national firms.

Table 6 presents the aggregation history of the clustering algorithm in search for poultry price clubs where the strong version of the LOP holds. The search is again restricted within price clubs where the weak version of the LOP holds. Within the first such club there are three clubs; one with two members (ES, and DK) and two with a single member (DE) and (NE). FR, IT, and BE form a price club on the basis of the strong version of the LOP as well. This, however, is not true for any pair of the three I(0) price series. FR and IT and FR and BE are adjacent countries which provides some support for the argument that proximity plays a role in the strong version of the LOP. The clustering algorithm again is largely consistent with the real world data given that the differences in average prices between DK and ES on the one hand and FR and IT and BE and IT on the other are among the lowest in the 14 series considered.

5. Conclusions

The functioning of geographically separated markets has been a long-standing concern for the EU policy makers and the focus of intense public debate. The EU Commission in the context of the Internal Market Strategy has reinforced the monitoring and benchmarking of price differences. Formal research on spatial price relationships, however, is scarce. The present study investigates the price dynamics of two agricultural commodities, pork and poultry, in order to determine whether there is a single or multiple markets within the EU. The investigation relies on the notion of a price club (meaning a group of countries in which prices obey the LOP) and on a clustering algorithm which allows for endogenous selection of such clubs.

Overall, the empirical results indicate that the EU market for pork and poultry are far from the ideal one in which prices are uniform. This is quite disconcerting for at least three reasons. First, the EU policymakers traditionally have intervened less in the pork and the poultry markets relative to those of other livestock products such as beef meat, lamb meet, and milk. The rather limited intervention creates a favorable environment for a smooth price transmission process across space. Second, since the early 1990s agricultural sector-specific measures have been taken to remove institutional barriers to intra-Community trade. Specifically, the Monetary Compensatory Amounts (MCAs) which acted as export subsidies/taxes were eliminated in 1992. Non-tariff barriers in the form of sanitary restrictions have been dealt with through the “mutual recognition principle”, whereby products acceptable for sale in one member state must be accepted in another as well. Third, the completion of the Single Market and the establishment of the EMU has been expected to facilitate price uniformity in all economic sectors, including the agricultural one.

At the microeconomic level, a number of factors may play a role in preventing the LOP to hold. The most important among them can be: a) collusive behavior as a channel of business strategy which is facilitated by vertical or horizontal integration. Both the pork and the poultry industry in the EU are characterized by high and increasing levels of concentration; b) market segmentation based on national consumption habits/preferences or created by firms proactively though product differentiation. As far as preferences are concerned Northern Europe opts for heavy pork carcasses, whereas Southern Europe opts for lighter animals. With regard to product differentiation, competition in the poultry market (even at national level) largely takes place among few firms with well established brand names and company images. This may allow national firms to charge premiums ("psychological prices") on their products.

The time series approach adopted in this work is one among a number of potential avenues for investigating spatial price relationships and market integration. Future empirical studies may utilize the notion of σ-convergence (that means, tendency of price inequality to decrease with time) or may opt to analyze the dynamics of the cross-section distribution of prices focusing on other potentially interesting phenomena such as persistence, switching, and catching-up. Given the importance of the topic further work is certainly warranted.

References

Asche, F., Bremnes, H., and C. Wessels (1999). Product Aggregation, Market Integration, and Relationships Between Prices. *American Journal of Agricultural Economics*, 81:568-81.

Bernard, A., and S. Durlauf (1995). Convergence in International Output. *Journal of Applied Econometrics*, 10:161-73.

Bernard, A., and S. Durlauf (1996). Interpreting Tests of Convergence Hypothesis. *Journal of Econometrics*, 91:161-73.

Elliot, G., T. Rothenberg, and J. Stock (1996). Efficient Test with Autoregressive Unit Root. *Econometrica*, 64:813-36.

Enders, W. (1995). *Applied Econometric Time Series*. John Wiley, NY.

European Commission (2007). Agricultural Markets_prices. http://europa.eu.int/comm/ Agriculture/public/prices/index_en.htm.

European Commission (2001). The Internal Market Scoreboard. No 8, May 28.

European Commission (2004). The Internal Market Scoreboard. No 13, July 13.

Goldberg, P., and F. Verboren (2005). Market Integration to the Law of One Price: Evidence from the European Car Market. *Journal of International Economics*, 65:49-73.

Ghosh, M. (2003). Spatial Integration of Wheat Markets in India: Evidence from Cointegration Tests. *Oxford Development Studies*, 31:159-71.

Hobijn, B., and P. Franses (2000). Asymptotically Perfect and Relative Convergence in Productivity. *Journal of Applied Econometrics*, 15:59-81.

Johansen, S. (1988). Statistical Analysis of Cointegration Vectors. *Journal of Economic Dynamics and Control*, 12:231-54.

Johansen, S., and K. Juselius (1990). Maximum Likelihood Estimation and Inferences on Cointegration With Application to Demand for Money. *Oxford Bulletin of Economics and Statistics*, 52:169-209.

Proietti, T. (2005). Convergence in Italian Regional per-capita GDP. Applied Economics, 37: 497-506.

Robinson, T. (2007). The Convergence of Electricity Prices in Europe. *Applied Economics Letters*, 14:473-76.

Sanjuan, A., and J.Gil (2001). Price Transmission Analysis: A Flexible Methodological Approach Applied to European Pork and Lamb Markets. *Applied Economics*, 33:123-31.

Serra, T., Gil, J., and B. Goodwin (2006). Local Polynomial Fitting and Spatial Price Relationships: Price Transmission in EU Pork Markets. European Review of Agricultural Economics, 33: 415-36.

Sexton, R., Kling, C., H. Carman (1991). Market Integration, Efficiency of Arbitrage, and Imperfect Competition: Methodology and Application to US Celery. American Journal of Agricultural Economics, 73:568-80.

Sosvilla-Rivero, S., and S. Gil-Pareja (2004). Price Convergence in the European Union. *Applied Economics Letters*, 11:39-47.

Stigler, G. (1969). *The Theory of Price*. London, McMillan.

Stock, J., and M. Watson (1988). Testing for Common Trends. *Journal of the American Statistical Association*, 83:1097-1107.

Sutton, J. (1991). *Sunk Costs and Market Structures*. Cambridge MA: MIT Press.

Zanias, P. (1993). Testing for Integration in European Community Agricultural Product Markets. *Journal of Agricultural Economics*, 44:418-27.

Table 1. Descriptive Statistics of the Pork Price Series

Country	Average	Standard Deviation	Country	Average	Standard Deviation
AT	145.22	24.03	GR	168.68	28.00
BE	138.91	24.51	IR	130.86	15.97
DE	145.25	24.30	IT	154.91	21.61
DK	128.25	20.25	NE	126.61	22.59
ES	143.33	24.51	PT	149.53	24.86
FI	136.30	12.63	SE	136.10	14.53
FR	137.74	20.93	UK	146.78	18.07

Table 2. Descriptive Statistics of the Poultry Price Series

Country	Average	Standard Deviation	Country	Average	Standard Deviation
AT	164.18	26.49	GR	173.94	25.52
BE	142.19	25.76	IR	155.96	31.56
DE	151.25	24.78	IT	146.88	27.79
DK	139.21	22.91	NE	131.25	22.95
ES	134.68	32.81	PT	145.39	30.62
FI	165.22	31.07	SE	159.34	22.81
FR	150.75	27.45	UK	141.62	19.35

Table 3. Search for Clubs Where the Weak Version of the LOP Holds: Aggregation History of the Algorithm for Pork

Iteration	Clubs C_l	p-value
1	[DK][PT]	0.866
2	[C_1][DE]	0.941
3	[C_2][ES]	0.923
4	[C_3][AT]	0.849
5	[C_4][GR]	0.829
6	[C_5][NE]	0.822
7	[FR][UK]	0.755
8	[C_7][IR]	0.813
9	[IT][FI]	0.652
10	[C_9][SE]	0.387

Table 4. Search for Clubs Where the Strong Version of the LOP Holds: Aggregation History of the Algorithm for Pork

Club where the weak version of the LOP holds			
1st (DK, PT, DE, ES, AT, GR, NE)	Iteration	Clubs C_l	p-value
	1	[DE][AT]	0.565
	2	[C_1][ES]	0.194
	3	[DK][NE]	0.179
2nd (FR, UK, IR)	Iteration	Clubs C_l	p-value
	1	[FR][UK]	0.105
3rd (IT, FI, SE)	Iteration	Clubs C_l	p-value
	1	[FI][SE]	0.636

Table 5. Search for Clubs Where the Weak Version of the LOP Holds: Aggregation History of the Algorithm for Poultry

Iteration	Clubs C_l	p-value
1	[DE][ES]	0.884
2	[C_1][DK]	0.917
3	[BE][FR]	0.552
4	[C_2][NE]	0.444
5	[C_3][IT]	0.285

Table 6. Search for Clubs Where the Stong Version of the LOP Holds: Aggregation History of the Algorithm for Poultry

Club where the weak version of the LOP holds			
1st (DE, ES, DK, NE)	Iteration	Clubs C_l	p-value
	1	[ES][DK]	0.854
2nd (BE, FR, IT)	Iteration	Clubs C_l	p-value
	1	[FR][IT]	0.215
	2	[C_1][BE]	0.213