DOCUMENTS DE TREBALL
DE LA FACULTAT DE CIÈNCIES
ECONÒMIQUES I EMPRESARIALS

Col·lecció d'Economia

E08/190

Price transmission and market power analysis in the Spanish seafood market chain

Jordi Guillen

Ramon Franquesa

Adreça correspondència:
Departament de Política Econòmica i Estructura Econòmica Mundial
Grup de Recerca en Economia Mundial – Gabinet d'Economia del Mar
Facultat de Ciències Econòmiques i Empresarials
Universitat de Barcelona
Espai de Recerca en Economia 310
Diagonal 690. Barcelona 08034
Tel.: 93 403 72 37. Fax: 93 403 72 42
Email: jordi@gemub.com

Abstract: Spain is one of the largest seafood markets in Europe and the world. Seafood consumption has traditionally been very high in Spain; in 2005, for instance, around 36.7 kg per capita were consumed (MAPA, several years). However, little attention has been paid to the market and how the different levels of the market chain interact. This paper uses weekly data to analyse the price transmission elasticity of the main twelve seafood products in the Spanish market chain (Ex-vessel, Wholesale and Retail stages). We then investigate the price transmission asymmetry in these market stages. The results have significant implications for demand analysis, market power and margins in the seafood value chain.

JEL Classification: Q22, Q11, L11.

Keywords: price transmission, market power, asymmetry, seafood products.

Resum: Espanya es un dels principals mercats de productes pesquers d'Europa i el món. El consum de productes pesquers ha estat tradicionalment molt important a Espanya (en 2005 es varen consumir al voltant de 36,7 kg per persona) (MAPA, diversos anys). Malgrat això, el mercat i cóm interactuen els diversos nivells de la cadena de comercialització han gaudit de poca atenció. En aquest estudi, utilitzant dades setmanals, s'analitza per als dotze principals productes pesquers l'elasticitat en la Transmissió de preus al llarg de la cadena de comercialització a Espanya (llotja, mercat central i detallista). Finalment s'investiga la presencia d'asimetria en la transmissió de preus entre aquests nivells de mercat. Els resultats obtinguts tenen importants implicacions a l'hora d'analitzar la demanda, poder de mercat i marges al llarg del mercat per als productes pesquers.

Paraules clau: transmissió de preus, poder de mercat, asimetria, productes pesquers.

Introduction

Spain is one of Europe's largest seafood markets. Its consumption levels are high, as witnessed by the high volume of fish caught and imported. Seafood consumption in Spain was about 36.7 kg per capita in 2005.

Although several studies of species, fleets and their production have been carried out, little attention has been paid to the Spanish market and to how the different levels of the market chain interact.

The 12 fresh seafood species (hake, small hake, sardine, anchovy, mackerel, blue whiting, horse mackerel, megrim, salmon, trout, striped venus and Mussels) analysed in this study are the main fish species consumed in Spain. These 12 products account for 60% of the total amount of fresh seafood sold in all the wholesale markets, and for 40% of the total value.

We used 104 weekly observations between 2005 and 2006 to investigate the presence of market power by analysing elasticity and asymmetry in the price transmission of fresh seafood products among the Farm, Wholesale and Retail stages of the market chain in Spain.

The results have significant implications for demand analysis and margins in the seafood value chain.

Methodology

The relationships between two stages in the value chain, based on a simultaneous equilibrium, have been described by the theory of derived demand. The demand equation and the supply equation are derived from the profit maximisation problem facing the agent at the highest and the lowest level respectively. The interaction of derived supply and primary demand at the retail level determines the retail price, while the interaction between primary supply and derived demand at the producer level determines the producer price. The difference between the retail and producer price is the margin (or marketing margin) (Hicks, 1956; Gardner 1975).

However, these estimates require high levels of data, and in practice they are often impossible to perform (Asche et al., 2002). Therefore, only the prices at the different levels of the market chain are usually analysed, especially for primary products, as can be seen in Goodwin & Holt (1999), Miller & Hayenga (2001), Asche et al. (2002), etc.

The analysis carried out by George & King (1971) on a large number of commodities shows that linkages between a product's prices (margins) throughout the market chain often involve a constant combination of both absolute and percentage margins. The justification for this pricing up (establishing margins) is mainly empirical, as described in Thomsen (1951), Buse & Brandow (1960), Dalrymple (1961), Shepherd (1962) and Waugh (1964).

Therefore, the price of a certain product at a certain level in the value chain can be expressed as a function of the price of the same product at a different level of the value chain, as shown in Equation 1:

$$P_r = c + b \cdot P_f \quad \text{(Eq. 1)}$$

Where P_r is the retail price, P_f is the ex-vessel (first-sale) price; c stands for a constant mark-up and b for a proportional mark-up.

Causality

Numerous studies have investigated the direction of price influences (causality) on market stages in the food and commodities markets. Most of the literature on fresh product markets states that, in the long-run, the causal relation is a priori considered to be upward (from the retail to the production sector). In the short-run, variations in the upstream (production level) prices precede changes in the downstream (retail) level prices.

However, special attention should be paid to the wholesale market stage, which is often neglected in two-stage market chain analyses. It is important to consider a three-stage market chain in analyses, since the wholesale stage has been shown to be an important factor in price responses (Ward, 1982), affecting prices at both the retail and first-sale stages. This was illustrated in Ward (1982), who considered the shipping point price instead of the farm or ex-vessel price in the first-sale stage. Some studies show that wholesale markets influence prices at other stages of the market chain (Bernard & Willet, 1996), since the wholesale market is often the place where the largest amount of supply and demand is met.

An exogeneity (or causality) test is required to analyse the direction of the influences between market levels. In this paper, we use the well-known Granger Causality Tests (Granger 1969), which have already been employed to analyse price transmission among market stages (Ward, 1982; Tiffin & Dawson, 2000; Jiménez-Toribio, et al., 2003; García del Hoyo, 2002; Bakucs & Ferto, 2005; etc.).

Elasticity of price transmission

Following George & King's (1971) approach, the elasticity of price transmission between two stages of the market chain can be estimated. George & King (1971, p.61) define the elasticity of price transmission as "the ratio of relative change in retail price to the relative change in the farm-level price". Likewise, Hildreth & Jarrett (1995) define the elasticity of price transmission as "the relative change in retail price to the relative change in producers' price when other factors affecting processors behaviour are held constant".

Thus, the elasticity of price transmission measures the percentage change in the price at a certain stage of the market chain, in relation to the relative change in the price of the same product at a different stage in the market chain. In this paper, the elasticity of price transmission is measured between the first-sale and wholesale stages, the first-sale and retail stages and the wholesale and retail stages.

The elasticity of price transmission between two stages of the market chain can be calculated as:

$$\varepsilon_T = \frac{\partial P_r}{\partial P_f} \cdot \frac{P_f}{P_r} \qquad \text{(Eq. 2)}$$

The parameter $\frac{\partial P_r}{\partial P_f}$ can be obtained by estimating the regression that relates retail and ex-vessel prices (Equation 1). When the variables are considered in their log form, the regression coefficients are equal to the elasticity of price transmission.

Long-run price transmission coefficients

Often, price transmission elasticities do not fully reveal the extent of price changes at a certain stage, due to changes in the price at another stage of the market chain. This is because price changes are not fully transmitted through the different levels of the market chain in the same time period. Usually, price change adjustment between market levels takes several periods. Thus, a static approach to price transmission elasticities is often inappropriate.

Therefore, Von Cramon-Taubadel (1998) distinguished between short-run elasticity, which measures the speed of reaction of a price to a change in the leading price, and long-run elasticity, which describes the total magnitude of this reaction.

The literature provides explanations for this lag between different market chain stages:

- Heien (1980) and Worth (1999) state that repricing may be costly due to the time required to put on new labels, and to the loss of goodwill from consumers who want stability in prices. In this respect, Balke & Fomby (1997) indicate that the fixed costs of adjustment may prevent economic agents from adjusting prices continuously. Therefore, adjustments only take place when deviation from the equilibrium exceeds a critical threshold. In such cases, the benefits of adjustment exceed the costs and motivate economic agents to move the system back into equilibrium.

- Heien (1980) also points out the importance of storage in price transmission. Wohlgenant (1989) showed that inventory holding by retailers explains much of the delay in price adjustment between wholesale and retail.
- Ward (1982) mention the perishable nature of products, which leads retailers to delay the transmission of upstream price rises in the fear that they will not be able to sell their whole stock.
- Brorsen et al. (1985) introduce risk into the analysis.
- Kinnucan & Forker (1987) suggest that market power and the way data are processed could be two other reasons for lagged price transmission.

Price transmission asymmetry

In the literature, the analysis of price transmission asymmetries is often related to market power. Thus testing for the existence of price transmission asymmetries is often used to investigate the existence of market power. Market power may be used at some stage in the market chain to avoid fully transmitting decreases in supply price, whilst perfectly transmitting price increases.

Therefore, price transmission asymmetry may be a source of distortion in the transmission of information throughout the stages of the market chain. This may lead to inefficiencies in the market, preventing optimal allocation. In this respect, an increase in primary production would be associated with a decrease in the input price. If this price decrease is not fully transmitted to the retail level, then the retail price may be higher than the market clearing price, leading to excess production.

Moreover, the presence of asymmetry in vertical price transmission is often considered collusive behaviour. This may be reinforced in some food sectors, as the retail and wholesale stages seem to be more concentrated than the production stage.

However, explanations other than market power have been given for asymmetric price transmission. These include inventor holding and valuation (Wright & Williams, 1982 and Wohlgenant, 1989), the perishable nature of goods (Ward, 1982), public intervention (Kinnucan & Forker, 1987), the existence of repricing costs (Worth, 1999), price expectations (Aguiar & Santana, 2002), etc.

In order to investigate the presence of price transmission asymmetry, we followed a similar methodology to that used by Houck (1977). Houck's method was based on the earlier works of Farrel (1952), Tweeten & Quance (1969) and Wolffram (1971) and subsequently used by Ward (1982) to capture the dynamics of price transmissions between market stages.

In order to investigate the presence of price transmission asymmetry, we estimated Equation 1, including Pf^+ and Pf^- variables and accounting for the positive and negative price changes at the first-sale stage.

In order to avoid multicollinearity problems, asymmetry was estimated in two different equations (Equations 3 and 4). Thus, the positive and negative price variation variables were in different equations. Houck (1977, p.571) addressed this problem, pointing out that "when a variable is segmented into increasing and decreasing components, it is possible that the two segments will be highly correlated with each other".

$$P_r = a + b\,P_f + c\,P_f^+ \quad \text{(Eq. 3)}$$

$$P_r = a + b\,P_f + c\,P_f^- \quad \text{(Eq. 4)}$$

where the variables accounting for the positive and negative price changes, used here in their absolute terms, are defined as follows:

$$P_f^+ = \Delta P_f = P_f - P_{f-1} \quad \text{if } \Delta P_f > 0 \quad \text{(Eq. 5)}$$

$$P_f^- = \Delta P_f = P_f - P_{f-1} \quad \text{if } \Delta P_f < 0 \quad \text{(Eq. 6)}$$

Thus, when the coefficient c is significant (and therefore different to 0), there is asymmetry.

Then, there are 4 possible cases in which "c" is significant and asymmetry exists:

- "c" in P_f^+ significant and >0 (+) implies that when the upstream price increases, the price downstream increases more than proportionally.
- "c" in P_f^+ significant and <0 (-) implies that when the upstream price increases, the price downstream increases less than proportionally.
- "c" in P_f^- significant and >0 (+) implies that when the upstream price decreases, the price downstream decreases less than proportionally.
- "c" in P_f^- significant and <0 (-) implies that when the upstream price decreases, the price downstream decreases more than proportionally.

Only the estimation of price transmission asymmetry between the first-sale and retail stages has been specified in this section. However, we also used analogous procedures to analyse the presence of price transmission asymmetry between the first-sale and wholesale stages, and between the wholesale and retail stages.

The Data

For this analysis, we used 104 weekly price observations from 2005 and 2006 of 12 fresh seafood species at 3 different stages of the Spanish market chain.

The 12 fresh seafood species analysed (hake, small hake, sardine, anchovy, mackerel, blue whiting, horse mackerel, megrim, salmon, trout, striped venus and mussels) are the most consumed in Spain.

Out of these 12 fresh seafood species, 8 can be considered wild fish species (hake, small hake, sardine, anchovy, mackerel, blue whiting, horse mackerel and megrim). The main production source of the other 4 species is aquaculture. Two of these are fish species (salmon and trout), and the other 2 are shellfish (striped venus and mussels). Out of the 4 farmed species, domestic Spanish production is the main source of trout and mussels.

All 12 species account for 60% of the total amount of fresh seafood sold in all the wholesale markets, and 40% of the total value. The three different market chain levels (Ex-vessel, Wholesale and Retail) are the most significant ones.

This wide range of species enabled us to study the Spanish seafood market in detail.

The Figures below show the price evolution of the 12 seafood species at the three different market stages.

Figure 1: Hake price evolution

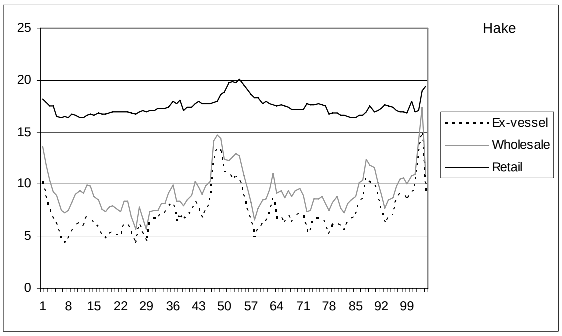


Figure 2: Small hake price evolution

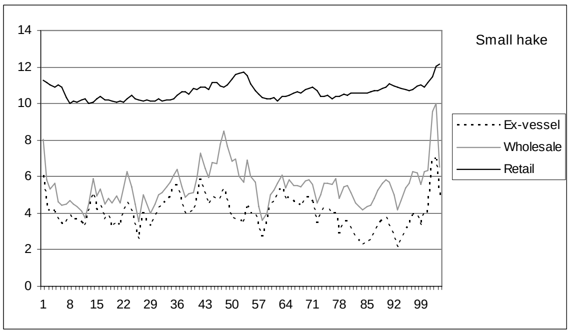


Figure 3: Sardine price evolution

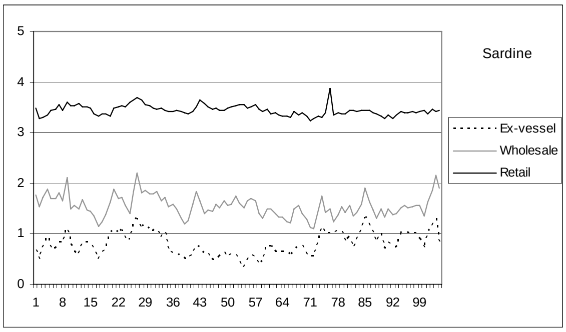


Figure 4: Anchovy price evolution

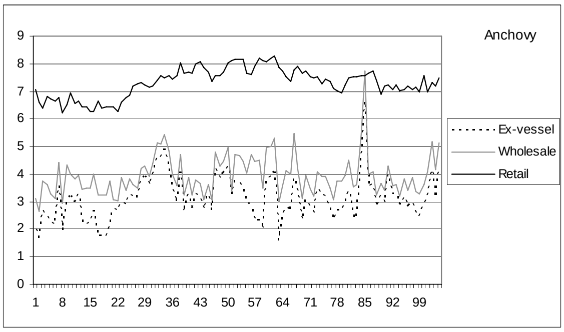


Figure 5: Mackerel price evolution

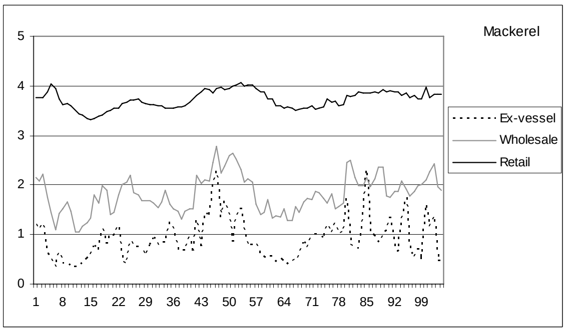


Figure 6: Blue whiting price evolution

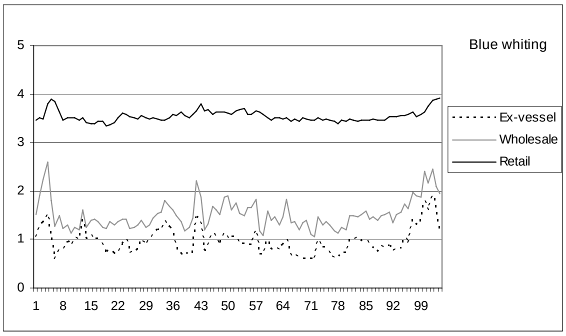


Figure 7: Horse mackerel price evolution

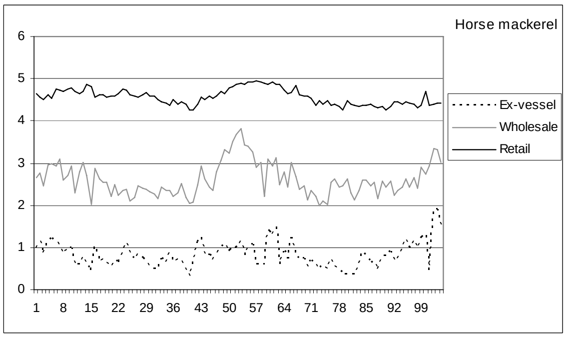


Figure 8: Megrim price evolution

Figure 9: Salmon price evolution

Figure 10: Trout price evolution

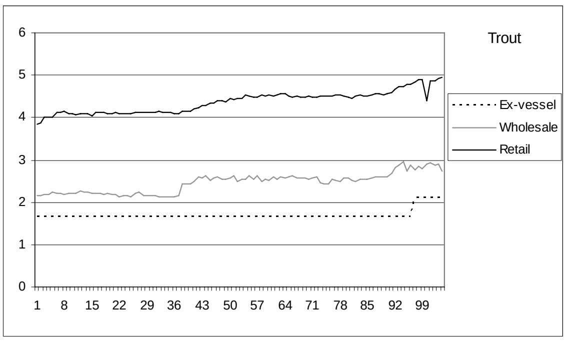


Figure 11: Striped venus price evolution

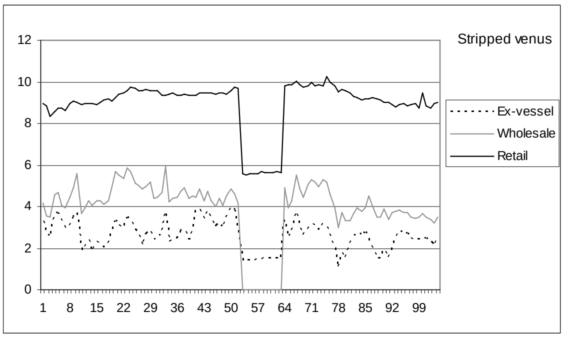
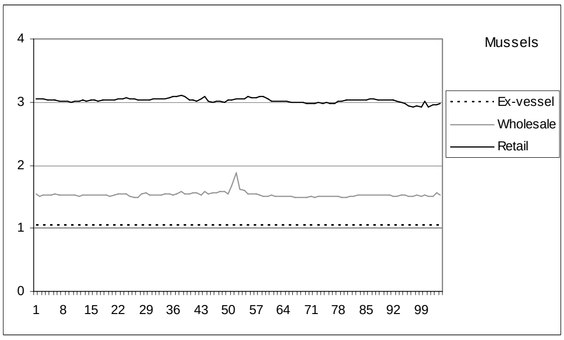


Figure 12: Mussel price evolution



These figures indicate that the different fresh seafood species' prices follow different evolution patterns.

Moreover, prices for wild species at the Ex-vessel and Wholesale stages show high variability and similar trends. Prices at the retail stage present lower variations. This can be explained by the existence of more available substitutes and sources as well as higher costs other than raw fish at the downstream (retail) stage.

Furthermore, it can be seen that aquaculture species farmed at the domestic level show lower volatility levels. This may be due to the more regular seafood supply and the lower risks. Moreover, variations increase as products move down the market chain (retail).

For a more formal and in-depth analysis, some descriptive statistics (mean, standard deviation and the coefficient of variation) for the prices of the 12 seafood species at the 3 different market stages are presented in Table 1.

Table 1: Descriptive statistics for the 12 fresh seafood species analysed

	Ex-vessel			Wholesale			Retail		
	Mean	Std. Dev.	CV	Mean	Std. Dev.	CV	Mean	Std. Dev.	CV
Hake	7.34	2.10	28.61	9.35	2.03	21.74	17.43	0.82	4.71
Small hake	4.02	0.90	22.50	5.50	1.11	20.24	10.64	0.45	4.22
Sardine	0.80	0.23	28.38	1.55	0.21	13.73	3.44	0.10	2.91
Anchovy	3.11	0.79	25.39	3.94	0.75	18.99	7.30	0.53	7.25
Mackerel	0.90	0.41	45.57	1.82	0.37	20.57	3.72	0.18	4.78
Blue whiting	0.96	0.27	27.66	1.51	0.30	20.09	3.54	0.12	3.30
Horse mackerel	0.83	0.30	36.64	2.61	0.39	15.01	4.57	0.18	4.03

Megrim	5.36	1.15	21.37	6.34	1.21	19.15	12.14	0.68	5.61
Salmon	3.63	0.74	20.30	4.55	0.77	16.94	8.33	0.71	8.49
Trout	1.68	0.12	7.15	2.46	0.23	9.39	4.37	0.26	5.90
Striped venus	2.60	0.71	27.16	4.35	0.68	15.55	8.92	1.20	13.46
Mussels	1.05	0.00	0.00	1.53	0.05	2.97	3.03	0.04	1.22

The data in Table 1 supports previous conclusions. For wild species, the price variability (coefficient of variation) decreases as the product goes down the market chain (from ex-vessel to retail stages), as does the standard deviation. This may be due to the existence of more available substitutes and sources, rather than the higher costs other than raw fish at the downstream (retail) stage (which may lead to lower coefficient of variations, but similar standard deviation coefficients). In contrast, farmed species do not show a clear group trend.

Analysis

Table 2 reveals the degree of correlation between the log of the price series for the 12 seafood species in the 3 different market stages.

In this Table, the 3 market stages, Ex-vessel, Wholesale and Retail, are coded as E, W and R respectively. Number 1 stands for hake, 2 for small hake, 3 for sardine, 4 for anchovy, 5 for mackerel, 6 for blue whiting, 7 for horse mackerel, 8 for megrim, 9 for salmon, 10 for rout, 11 for striped venus and 12 for mussels.

Table 2: Correlation matrix of the log prices for the 12 seafood species in the 3 different market stages

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12
E1	1	0.38	-0.14	0.35	0.34	0.46	0.38	0.65	-0.14	0.43	-0.04	na	0.94	0.79	0.09	0.24	0.52	0.60	0.43	0.63	-0.13	0.57	-0.36	0.37	0.59	0.72	-0.14	0.44	0.53	0.42	-0.19	0.69	0.37	0.49	-0.10	-0.24
E2	0.38	1	-0.25	0.03	-0.03	0.29	0.28	0.34	-0.27	0.23	0.23	na	0.43	0.74	0.09	0.06	-0.05	0.29	0.18	0.47	-0.21	-0.07	0.17	0.11	0.42	0.19	0.01	0.15	-0.18	0.35	0.19	0.39	-0.26	-0.11	0.21	-0.12
E3	-0.14	-0.25	1	0.24	-0.03	0.17	0.00	-0.22	0.32	0.21	-0.24	na	-0.23	-0.16	0.61	0.22	0.06	0.06	-0.12	-0.27	0.32	-0.03	-0.06	-0.26	-0.34	-0.27	0.27	-0.23	0.04	-0.05	-0.22	-0.19	0.31	0.20	-0.10	-0.16
E4	0.35	0.03	0.24	1	0.29	0.19	0.08	-0.04	0.08	0.05	0.08	na	0.16	0.17	0.38	0.85	0.25	0.19	0.06	0.03	0.19	0.13	0.05	0.21	0.25	0.17	0.23	0.55	0.30	0.19	-0.14	0.23	0.31	0.21	0.18	0.11
E5	0.34	-0.03	-0.03	0.29	1	0.07	-0.11	0.14	0.18	-0.06	-0.06	na	0.24	0.33	-0.06	0.17	0.63	0.18	-0.03	0.16	0.25	0.26	-0.15	0.18	0.27	0.25	-0.11	0.30	0.40	-0.06	-0.34	0.21	0.34	0.19	0.16	0.07
E6	0.46	0.29	0.17	0.19	0.07	1	0.41	0.46	-0.41	0.54	0.04	na	0.42	0.40	0.43	0.27	0.28	0.83	0.35	0.51	-0.42	0.07	-0.31	0.18	0.18	0.27	0.12	-0.03	0.19	0.41	0.01	0.30	-0.10	0.06	-0.42	-0.16
E7	0.38	0.28	0.00	0.08	-0.11	0.41	1	0.53	-0.40	0.41	0.31	na	0.45	0.41	0.35	0.08	0.17	0.54	0.67	0.54	-0.46	0.22	-0.08	0.19	0.33	0.46	0.14	0.00	0.37	0.60	0.24	0.47	-0.12	0.16	-0.32	-0.24
E8	0.65	0.34	-0.22	-0.04	0.14	0.46	0.53	1	-0.28	0.37	0.16	na	0.74	0.61	0.03	-0.02	0.32	0.58	0.41	0.91	-0.37	0.42	-0.30	0.20	0.37	0.59	-0.21	0.05	0.37	0.38	0.06	0.54	0.06	0.29	-0.34	-0.33
E9	-0.14	-0.27	0.32	0.08	0.18	-0.41	-0.40	-0.28	1	-0.15	-0.29	na	-0.17	-0.13	-0.25	0.13	0.10	-0.34	-0.29	-0.47	0.96	0.24	-0.01	-0.37	-0.16	-0.12	-0.21	0.23	-0.04	-0.41	-0.33	-0.06	0.63	0.41	0.52	-0.15
E10	0.43	0.23	0.21	0.05	-0.06	0.54	0.41	0.37	-0.15	1	-0.13	na	0.40	0.42	0.19	0.09	0.21	0.55	0.31	0.34	-0.21	0.49	-0.43	-0.05	0.16	0.47	-0.05	0.01	0.20	0.48	-0.21	0.48	0.30	0.54	-0.31	-0.58
E11	-0.04	0.23	-0.24	0.08	-0.06	0.04	0.31	0.16	-0.29	-0.13	1	na	-0.03	0.12	0.20	0.04	0.05	0.13	0.12	0.30	-0.22	-0.15	0.68	0.21	0.28	0.08	0.20	0.23	0.13	0.30	0.38	0.10	-0.36	-0.25	0.19	0.03
E12	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
W1	0.94	0.43	-0.23	0.16	0.24	0.42	0.45	0.74	-0.17	0.40	-0.03	na	1	0.78	0.07	0.14	0.42	0.57	0.55	0.66	-0.22	0.52	-0.38	0.35	0.54	0.71	-0.16	0.26	0.45	0.43	-0.04	0.67	0.21	0.41	-0.19	-0.29
W2	0.79	0.74	-0.16	0.17	0.33	0.40	0.41	0.61	-0.13	0.42	0.12	na	0.78	1	0.10	0.12	0.45	0.55	0.38	0.65	-0.09	0.43	-0.18	0.27	0.63	0.62	-0.10	0.34	0.34	0.49	-0.06	0.71	0.20	0.36	0.09	-0.29
W3	0.09	0.09	0.61	0.38	-0.06	0.43	0.35	0.03	-0.25	0.19	0.20	na	0.07	0.10	1	0.34	0.10	0.36	0.26	0.12	-0.21	-0.23	0.06	0.17	0.05	0.04	0.50	-0.12	0.23	0.39	0.14	0.08	-0.17	-0.13	-0.25	0.02
W4	0.24	0.06	0.22	0.85	0.17	0.27	0.08	-0.02	0.13	0.09	0.04	na	0.14	0.12	0.34	1	0.13	0.24	0.17	-0.02	0.17	0.03	0.00	0.11	0.12	0.08	0.11	0.38	0.08	0.10	-0.02	0.20	0.18	0.15	0.08	0.05
W5	0.52	-0.05	0.06	0.25	0.63	0.28	0.17	0.32	0.10	0.21	0.05	na	0.42	0.45	0.10	0.13	1	0.39	0.19	0.34	0.15	0.41	-0.21	0.29	0.38	0.51	0.01	0.34	0.62	0.19	-0.22	0.41	0.40	0.38	0.06	-0.07
W6	0.60	0.29	0.06	0.19	0.18	0.83	0.54	0.58	-0.34	0.55	0.13	na	0.57	0.55	0.36	0.24	0.39	1	0.42	0.60	-0.35	0.31	-0.37	0.19	0.38	0.56	-0.08	0.14	0.45	0.58	-0.10	0.54	0.08	0.26	-0.40	-0.21
W7	0.43	0.18	-0.12	0.06	-0.03	0.35	0.67	0.41	-0.29	0.31	0.12	na	0.55	0.38	0.26	0.17	0.19	0.42	1	0.35	-0.38	0.24	-0.25	0.39	0.37	0.47	0.14	0.04	0.35	0.50	0.35	0.49	-0.13	0.17	-0.29	-0.21
W8	0.63	0.47	-0.27	0.03	0.16	0.51	0.54	0.91	-0.47	0.34	0.30	na	0.66	0.65	0.12	-0.02	0.34	0.60	0.35	1	-0.47	0.29	-0.15	0.31	0.48	0.57	-0.05	0.16	0.38	0.48	0.09	0.54	-0.09	0.10	-0.25	-0.16
W9	-0.13	-0.21	0.32	0.19	0.25	-0.42	-0.46	-0.37	0.96	-0.21	-0.22	na	-0.22	-0.09	-0.21	0.17	0.15	-0.35	-0.38	-0.47	1	0.16	0.12	-0.30	-0.08	-0.16	-0.14	0.34	-0.05	-0.42	-0.34	-0.08	0.61	0.34	0.66	-0.02
W10	0.57	-0.07	-0.03	0.13	0.26	0.07	0.22	0.42	0.24	0.49	-0.15	na	0.52	0.43	-0.23	0.03	0.41	0.31	0.24	0.29	0.16	1	-0.51	0.00	0.33	0.66	-0.29	0.46	0.50	0.28	-0.39	0.59	0.76	0.91	-0.02	-0.57
W11	-0.36	0.17	-0.06	0.05	-0.15	-0.31	-0.08	-0.30	-0.01	-0.43	0.68	na	-0.38	-0.18	0.06	0.00	-0.21	-0.37	-0.25	-0.15	0.12	-0.51	1	0.02	0.02	-0.43	0.22	0.06	-0.34	-0.17	0.40	-0.33	-0.41	-0.50	0.51	0.27
W12	0.37	0.11	-0.26	0.21	0.18	0.18	0.19	0.20	-0.37	-0.05	0.21	na	0.35	0.27	0.17	0.11	0.29	0.19	0.39	0.31	-0.30	0.00	0.02	1	0.56	0.38	0.21	0.28	0.35	0.28	0.25	0.33	-0.15	-0.08	0.02	0.26
R1	0.59	0.42	-0.34	0.25	0.27	0.18	0.33	0.37	-0.16	0.16	0.28	na	0.54	0.63	0.05	0.12	0.38	0.38	0.37	0.48	-0.08	0.33	0.02	0.56	1	0.66	-0.04	0.53	0.36	0.41	0.09	0.75	0.12	0.24	0.28	-0.03
R2	0.72	0.19	-0.27	0.17	0.25	0.27	0.46	0.59	-0.12	0.47	0.08	na	0.71	0.62	0.04	0.08	0.51	0.56	0.47	0.57	-0.16	0.66	-0.43	0.38	0.66	1	-0.23	0.43	0.68	0.66	-0.20	0.88	0.39	0.56	-0.18	-0.28
R3	-0.14	0.01	0.27	0.23	-0.11	0.12	0.14	-0.21	-0.21	-0.05	0.20	na	-0.16	-0.10	0.50	0.11	0.01	-0.08	0.14	-0.05	-0.14	-0.29	0.22	0.21	-0.04	-0.23	1	0.01	0.06	0.19	0.31	-0.17	-0.30	-0.30	0.09	0.18
R4	0.44	0.15	-0.23	0.55	0.30	-0.03	0.00	0.05	0.23	0.01	0.23	na	0.26	0.34	-0.12	0.38	0.34	0.14	0.04	0.16	0.34	0.46	0.06	0.28	0.53	0.43	0.01	1	0.41	0.21	-0.24	0.46	0.47	0.38	0.51	0.05
R5	0.53	-0.18	0.04	0.30	0.40	0.19	0.37	0.37	-0.04	0.20	0.13	na	0.45	0.34	0.23	0.08	0.62	0.45	0.35	0.38	-0.05	0.50	-0.34	0.35	0.36	0.68	0.06	0.41	1	0.56	-0.23	0.51	0.39	0.39	-0.16	-0.02
R6	0.42	0.35	-0.05	0.19	-0.06	0.41	0.60	0.38	-0.41	0.48	0.30	na	0.43	0.49	0.39	0.10	0.19	0.58	0.50	0.48	-0.42	0.28	-0.17	0.28	0.41	0.66	0.19	0.21	0.56	1	0.04	0.62	-0.01	0.19	-0.29	-0.17
R7	-0.19	0.19	-0.22	-0.14	-0.34	0.01	0.24	0.06	-0.33	-0.21	0.38	na	-0.04	-0.06	0.14	-0.02	-0.22	-0.10	0.35	0.09	-0.34	-0.39	0.40	0.25	0.09	-0.20	0.31	-0.24	-0.23	0.04	1	-0.12	-0.68	-0.45	0.10	0.11
R8	0.69	0.39	-0.19	0.23	0.21	0.30	0.47	0.54	-0.06	0.48	0.10	na	0.67	0.71	0.08	0.20	0.41	0.54	0.49	0.54	-0.08	0.59	-0.33	0.33	0.75	0.88	-0.17	0.46	0.51	0.62	-0.12	1	0.35	0.55	-0.02	-0.32
R9	0.37	-0.26	0.31	0.31	0.34	-0.10	-0.12	0.06	0.63	0.30	-0.36	na	0.21	0.20	-0.17	0.18	0.40	0.08	-0.13	-0.09	0.61	0.76	-0.41	-0.15	0.12	0.39	-0.30	0.47	0.39	-0.01	-0.68	0.35	1	0.88	0.19	-0.39
R10	0.49	-0.11	0.20	0.21	0.19	0.06	0.16	0.29	0.41	0.54	-0.25	na	0.41	0.36	-0.13	0.15	0.38	0.26	0.17	0.10	0.34	0.91	-0.50	-0.08	0.24	0.56	-0.30	0.38	0.39	0.19	-0.45	0.55	0.88	1	0.02	-0.66
R11	-0.10	0.21	-0.10	0.18	0.16	-0.42	-0.32	-0.34	0.52	-0.31	0.19	na	-0.19	0.09	-0.25	0.08	0.06	-0.40	-0.29	-0.25	0.66	-0.02	0.51	0.02	0.28	-0.18	0.09	0.51	-0.16	-0.29	0.10	-0.02	0.19	0.02	1	0.10
R12	-0.24	-0.12	-0.16	0.11	0.07	-0.16	-0.24	-0.33	-0.15	-0.58	0.03	na	-0.29	-0.29	0.02	0.05	-0.07	-0.21	-0.21	-0.16	-0.02	-0.57	0.27	0.26	-0.03	-0.28	0.18	0.05	-0.02	-0.17	0.11	-0.32	-0.39	-0.66	0.10	1

It should be noted that the result for E12, which are mussels at the ex-vessel stage, was not available (na), as the prices of this product were constant during the study period.

The analysis considers all prices in cents, rather than euros. Therefore, prices were multiplied by 100 so that the log of the prices did not have a negative value.

The correlation matrix in Table 2 also shows the following:

- The high value species (hake, small hake and megrim) have similar trends to other species (a higher sum of correlation coefficients). Most of the farmed species (salmon, striped venus, and mussels) and the lowest value species (sardine) have the least similarities to other species. This may be due to the lower number of farmed and shellfish species.
- Prices at the retail stage had more similar trends (a higher sum of correlation coefficients), while prices at the ex-vessel stage had less similar trends.
- The degree of correlation between the ex-vessel and the wholesale market was higher for most of the species analysed, as can be seen in Table 3.

Table 3: Correlation coefficients between market stages for the 12 species analysed

	E-W	E-R	W-R
Hake	0.94	0.59	0.54
Small hake	0.74	0.19	0.62
Sardine	0.61	0.27	0.50
Anchovy	0.85	0.55	0.38
Mackerel	0.63	0.40	0.62
Blue whiting	0.83	0.41	0.58
Horse mackerel	0.67	0.24	0.35
Megrim	0.91	0.54	0.54
Salmon	0.96	0.63	0.61
Trout	0.49	0.54	0.91
Striped venus	0.68	0.19	0.51
Mussels			0.26

The above Table shows that the sum of the correlation coefficients were higher between the ex-vessel and wholesale markets than between the wholesale and retail markets or the ex-vessel and retail markets.

Moreover, there was a positive relationship between the species' prices and the correlation coefficients.

This relation between prices and correlation coefficients was stronger and higher in the more upstream stages. The prices and correlation coefficients between ex-vessel and wholesale market elasticity (relation) were 0.17, with a significance level (R-sq.) of 0.5. This elasticity implies that when the species value increased by 1%, the correlation coefficients between ex-vessel and wholesale markets increased by 0.17%.

Table 4 presents the results of the Granger causality test, used to analyse the relation between markets for the 12 seafood species.

Table 4: Granger causality test results for the 12 species analysed

	E-W	E-R	W-R
Hake		→	→
Small hake		→	→
Sardine	←		→
Anchovy			←
Mackerel	→	→	→
Blue whiting		→	→
Horse mackerel		→	→
Megrim		→	→
Salmon		→	→
Trout	←		→
Striped venus			→
Mussels			

Where "→" stands for relations that were accepted at a 5% significance level.

The above Table indicates that most of the retail prices were influenced by wholesale prices (10 out of 12) and by ex-vessel prices (7 out of 12). The exception was anchovy, for which wholesale prices were influenced by retail prices. The influence between ex-vessel and wholesale markets was not as clearly defined. Ex-vessel prices were only influenced by wholesale prices in 2 cases (out of 12). In contrast, mackerel wholesale prices were influenced by ex-vessel prices.

These results are in accordance with most of the previous literature on seafood and food product markets. Heien (1980) confirmed that in the short-run, variations in production level prices preceded changes in retail level prices in 57% of the cases analysed. A bidirectional causal relation between the production and retail stages was present in 13% of the cases. Out of the 22 food commodities analysed using Granger-Sims causality tests, only 9% presented a unidirectional causal relationship from the retail to the production stage (Sims, 1972). Freebairn (1984) used the same Granger-Sims causality tests for 17 food products in Australia. He found a unidirectional causal relationship from the production to the retail stage in 35% of cases, a unidirectional causal relationship (6% of the cases) from the retail to the production stage and no bidirectional causal relations. However, Jiménez-Toribio, et al. (2003) and García del Hoyo (2002) used the same Granger's methodology and found that wholesale prices of red sea bream and striped venus in Spain were influenced by ex-vessel prices. Hartmann, et al. (2000) used cointegration and exogeneity tests and found that the auction (first-sale) prices of hake in France influenced both the wholesale and retail stages.

Table 5 presents the results for the elasticity of price transmission, in which the relations among the 12 seafood species and 3 markets stages were analysed.

Table 5: Elasticity of the price transmission for the 12 species analysed

	E-W	E-R	W-R
Hake	0.72	0.10	0.12
Small hake	0.61	0.03	0.14

Sardine	0.25	0.01	0.11
Anchovy	0.57	0.13	0.18
Mackerel	0.31	0.04	0.14
Blue whiting	0.60	0.05	0.09
Horse mackerel	0.27	0.03	0.13
Megrim	0.80	0.15	0.17
Salmon	0.83	0.29	0.32
Trout	0.67	0.46	0.57
Striped venus	0.42	0.35	0.14
Mussels			0.12

This analysis of the 12 species shows that the highest elasticities of price transmission occurred between the ex-vessel and wholesale prices. The elasticities of price transmission between ex-vessel and retail prices were the lowest, with the exception of striped venus.

Moreover, there was a positive relationship between the species' prices and the elasticities of price transmission, especially between the ex-vessel and wholesale market levels.

Table 6 shows the long-run coefficients of the price transmission elasticity for the 12 species analysed.

Table 6: Long-run coefficients for the 12 species analysed

	E-W	E-R	W-R
Hake	0.89 (1,1)	0.22 (0,1)	0.29 (0,1)
Small hake	1.15 (1,1)	0.20 (2,2)	0.83 (1,1)
Sardine	0.31 (1,1)	0.04 (0,2)	0.19 (2,1)
Anchovy	0.51 (1,1)	0.37 (0,1)	0.59 (0,1)
Mackerel	0.42 (2,2)	0.15 (2,1)	0.28 (1,2)
Blue whiting	0.74 (1,1)	0.17 (0,1)	0.21 (0,2)
Horse mackerel	0.46 (1,2)	0.16 (1,2)	0.33 (1,2)
Megrim	0.72 (1,1)	0.44 (0,1)	0.53 (0,1)
Salmon	0.83 (1,1)	0.55 (0,3)	0.67 (0,3)
Trout	ns (0,2)	1.08 (0,3)	0.63 (1,3)
Striped venus	0.74 (1,1)	0.47 (1,1)	0.29 (1,1)
Mussels			0.29 (0,2)

Where "ns" for trout means that the result was not significant. Brackets show the number of significant lags for the dependent and independent terms respectively.

The above Table presents the long-run coefficients for the 12 species analysed. It can be seen that the highest long-run coefficients were between the ex-vessel and wholesale prices. The coefficients between the ex-vessel and retail prices were the lowest, with the exception of striped venus.

These results are in accordance with Gonzales et al. (2003), who used cointegration methodology. They found that the long-run relations between shipping and retail stages in France for cod and salmon were 0.40 and 0.54.

Moreover, it seems that there was a positive relationship between the species' prices and the long-run coefficients (as for the elasticities of the price transmission).

Finally, a comparison of these results with price transmission elasticities (Table 5) shows that the long-run coefficients were higher than the price transmission elasticities (in 31 of the 33 cases analysed, and with a 20% higher mean). This means that the price change adjustment between market levels was often larger and took several periods.

Table 7 shows the positive and negative price transmission asymmetry results for the 12 seafood species between the 3 markets levels.

Table 7: Asymmetry for the 12 species analysed

	E - W		E - R		W - R	
	Pos.	Neg.	Pos.	Neg.	Pos.	Neg.
Hake			- -	++	- -	++
Small hake				++	- -	++
Sardine	++				- -	+
Anchovy	++		- -	++	- -	++
Mackerel		++		++	- -	++
Blue whiting				++	- -	++
Horse mackerel			- -	+	- -	++
Megrim			- -	++	- -	++
Salmon		++	- -	++	- -	+

Trout					- -	++
Striped venus				++	- -	++
Mussels					-	

Where 2 positive or negative signs mean that the "c" coefficient was significant (therefore asymmetry exists) at a 5% level, while only one sign means that the coefficient was significant at a 10% level.

These results clearly show that price transmission asymmetry is relevant (at least between some market levels). Asymmetry was observed in 25 of the 32 (78.13%) relations between market stages. In addition, asymmetry was found in all 12 products analysed (100%).

There was more asymmetry in our results than in those of Pelztman (2000) and Meyer & von Cramon-Taubadel (2004), who used similar methodologies and revealed asymmetry in 66% (out of 285 tests) and 68% (63 out of 93) of the cases.

In this study, the major trends observed in the price transmission asymmetry results were as follows:

- When the upstream (producer and wholesale) price decreased, the retail price decreased less than proportionally.
- When the upstream price increased, the retail price increased less than proportionally.

Both trends occurred together in 16 out of the 25 (64%) cases in which asymmetry was present. However, even when there was price transmission asymmetry; market power did not seem to be responsible for this behaviour. When upstream price decreased, the retail price decreases less than proportionally, which is a clear sign of market power. However, when the upstream price increased, the retail price increased less than proportionally. This is in contrast to the market power perception.

Hence, the reason for the asymmetric price transmission seems to be lower volatility in the retail market stage, explained by the existence of more available substitutes and sources. Another explanation for the presence of price transmission asymmetry could involve the repricing costs (menu costs). This type of price asymmetry could help to explain the existence of high margins between wholesale and retail, and first-sale and retail market stages.

Concluding remarks

This paper analyses the price transmission behaviour throughout the market chain for the twelve main seafood products consumed in Spain. We used 2005 and 2006 weekly data in the analyses.

Out of these 12 fresh seafood species analysed, 8 can be considered wild fish species (hake, small hake, sardine, anchovy, mackerel, blue whiting, horse mackerel and megrim). The main production source of production for the other 4 species is aquaculture. Two of these farmed species are fish (salmon and trout), and the other 2 are shellfish (striped venus and mussels). Out of the 4 farmed species, domestic Spanish production is the main source of trout and mussels.

During the study, price transmission elasticity was analysed, as well as the long-run coefficients of price transmission elasticity and price transmission asymmetry for the twelve seafood products in three different market stages (Ex-vessel, Wholesale and Retail).

The price volatility differed between market chain levels and products (wild/farmed). Prices were normally less volatile in downstream levels (retail) and in farmed species.

Price causality analysis confirmed that upstream levels (wholesale and ex-vessel levels) led to changes in the downstream level (retail). However, the wholesale stage appeared to be the benchmark, but no strong evidence was found.

Price transmission elasticity showed that the retail stage was not as greatly affected by upstream price changes. The wholesale and ex-vessel levels are more closely interrelated.

The long-run coefficients of the price transmission elasticity were higher than the “static” price transmission elasticities. This implies that the price change adjustment between market levels takes some time to be fully transmitted.

Finally, price transmission asymmetry is relevant, especially when analysing the retail market. However, market power does not seem to explain this asymmetry. When the upstream price decreased, the retail price decreased less than proportionally, which is a clear market power sign. However, when the upstream price increased, the retail price increased less than proportionally. This contradicts the market power perception. Hence, it seems that lower volatility in the retail market stage—which may be due to the higher number of available substitutes and sources—explains the asymmetric price transmission.

References

Aguiar, D.R.D. & Santana, J.A. 2002. Asymmetry in Farm to Retail Price Transmission: Evidence from Brazil. *Agribusiness*, 18(1):37-48.

Asche, F.; Menezes, R. & Ferreira Dias, J. 2002. Transmission of Price Signals in Cross Boundary Value Chain. *EAFE Proceedings*. Faro Portugal.

Bakucs L.Z. & Ferto, I. 2005. Marketing Margins and Price Transmission on the Hungarian Pork Meat Market. *Agribusiness*, 21(2)273-286.

Balke, N.S. & Fomby, T.B. 1997. Threshold Cointegration. *International Economic Review*, 38(3):627-645.

Brorsen, B.W.; Chavas, J.P.; Grant, W.R. & Schnake, L.D. 1985. Marketing Margins and Price Uncertainty: the Case of the US Wheat Market. *American Journal of Agricultural Economics*, 67:521-528.

Buse, R. C. & Brandow, G. E. 1960. The Relationship of Volume Prices and Costs to Marketing Margins for Farm Foods. *Journal of Farm Economics,* 42:362-370.

Dalrymple, D. G. 1961. On the Nature of Marketing Margins. *Agricultural Economic* 824. Michigan Agricultural Experiment Station. East Lansing.

Farrel, M.J. 1952. Irreversible Demand Functions. *Econometrica*, 20:171-186.

Freebairn, J.W. 1984. Farm and Retail Food Prices. *Review of Marketing and Agricultural Economics*, 52(2):71-90.

García Del Hoyo, J.J. (Ed.). 2002. *Análisis Bioeconómico y Estadístico de Pesquerías Andaluzas.* Servicio de Publicaciones de la Consejería de Agricultura y Pesca.

Gardner, B.L. 1975. The Farm-Retail Price Spread in a Competitive Food Industry. *American Journal of Agricultural Economics* 57(3):399-409.

George, P.S. & King, G.A. 1971. *Consumer Demand for Food Commoditites in the United States with Projections for 1980.* Giannini Foundation Monograph No. 26. University California, Berkeley.

Gonzales, F.; Guillotreau, P.; Le Grel, L. & Simioni, M. 2002. Asymmetric Price Transmission with Consistent Threshold along the Fish Supply Chain. *IIFET Proceedings*.

Goodwin, B.K. & Holt, M.T. 1999. Price Transmission and Asymmetric Adjustment in the U.S. Beef Sector. *American Journal of Agricultural Economics,* 81(3):630-637.

Granger, C.W.J. 1969. Investigating Causal Relations by Econometric Models and Cross-Spectral Methods. *Econometrica,* 37(3):424-438

Hartmann, J.; Jaffry, S. & Asche, F. 2000. Price Relationships along the Value Chain: An Analysis of the Hake Market in France. *IIFET Proceedings*.

Heien, D.M. 1980. Mark up Pricing in a Dynamic Model of the Food Industry. *American Journal of Agricultural Economics,* 62:11-18.

Hicks, J.R. 1956. *A Revision of Demand Theory*. Oxford, Clarendon Press.

Hildreth, C. & Jarrett, F.G. 1995. *A Statistical Study of Livestock Production and Marketing*. Cowles Commission Monograph No. 5. John Wiley & Sons, Inc. New York.

Jiménez-Toribio, R.; García-Del-Hoyo, J.J. & García-Ordaz, F. 2003. Vertical Integration and Price Transmission in the Spanish Distribution Channel of the Striped Venus. *EAFE Proceedings*.

Kinnucan, H.W. & Forker, O.D. 1987. Asymmetry in Farm-Retail Price Transmission for major dairy Products. *American Journal of Agricultural Economics,* 69: 285-292.

Miller, D.J. & Hayenga, M.L. 2001. Price Cycles and Asymmetric Price Transmission in the U.S. Pork Market. *American Journal of Agricultural Economics*, 83(3):551-562.

Ministerio de Agricultura Pesca y Alimentación (MAPA). Several years. *La alimentación en España*. Madrid.

Peltzman, S. 2000. Prices Rise Faster than They Fall. *Journal of Political Economy*, 108(3):466-502.

Shepherd, G. S. 1962. *Marketing Farm Products-Economic Analysis*. 4th ed. Iowa State University press, Ames.

Sims, C. A. 1972. Money, Income and Causality. The American Economic Review.

Thomsen, F.L. 1951. *Agricultural Marketing.* Mc Graw-Hill book co., Inc. New York.

Tiffin, R. & Dawson, P.J. 2000. Structural Breaks, Cointegration and the Farm-Retail Price Spread for Lamb. *Applied Economics*, 32:1281-1286.

Tweeten, L.G. & Quance, C.L. 1969. Positivistic Measures of Aggregate Supply Elasticities: Some New Approaches. *American Journal of Agricultural Economics*, 51:342-352.

von Cramon-Taubadel, S. 1998. Estimating Asymmetric Price Transmission with the Error Correction Representation: An Application to the German Pork Market. *European Review of Agricultural Economics,* 25: 1-18.

Ward, W.R. 1982. Asymmetry in Retail, Wholesale, and Shipping Price Point Pricing for Fresh Vegetables. *American Journal of Agricultural Economics,* 64:205-212.

Waugh, F.V. 1964. *Demand and Price Analysis*. Technical Bulletin No. 1316. US. Department of Agriculture. Washington DC.

Wohlgenant, M.K. 1989. Demand for Farm Output in a Complete System of Demand Functions. *American Journal of Agricultural Economics,* 71(2)241-252.

Wolffram, R. 1971. Positivistic Measures of Aggregate Supply Elasticities: Some New Approaches – some Critical Notes. *American Journal of Agricultural Economics*, 53:356-359.

Worth, T. 1999. The F.o.b.-Retail Price Relationship for Selected Fresh Vegetables. Economic Research Service/USDA - Vegetables and Specialties.

Wright, B.D. & Williams, J.C. 1982. The Economic Role of Commodity Storage. *The Economic Journal*, 92:596-614.