Price transmission and volatility along the Spanish fresh fish market chain

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Abstract

Fishermen are suffering from low product prices despite increasing fishing costs, while consumers have to pay high prices at the retail level. Supply concentration at the retail level and increased fish trade, especially for aquaculture products, could lead towards retail market power. Analyzing price transmission in supply chains is important because imperfect price transmission may be a result of market power. In this paper, price transmission and volatility in the market chain is examined for the Spanish fresh fish market using weekly prices of 10 fresh fish products in the main 3 stages of the market chain (ex-vessel, wholesale and retail) for the period 2004-2013.

Keywords: *price transmission, volatility, market power, market chain, fish.*

Résumé

Les pêcheurs souffrent à cause des prix bas des produits de la mer, malgré l'augmentation des coûts de la pêche, alors que les consommateurs paient des prix élevés au niveau du détail. La concentration de l'offre au niveau de la vente au détail et l'augmentation de la commercialisation du poisson, en particulier des produits de l'aquaculture, pourraient déterminer le pouvoir de marché du commerce de détail. Analyser la transmission des prix tout au long de la chaîne d'approvisionnement est important parce que la transmission imparfaite des prix pourrait être le fait du pouvoir de marché. Dans cet article, nous allons examiner le marché espagnol du poisson frais en considérant la transmission des prix et la volatilité dans la chaîne de commercialisation. A cette fin, nous allons considérer les prix hebdomadaires de 10 produits de poisson frais dans les 3 principales phases de la chaîne de commercialisation (première vente, vente en gros et détail) pour la période 2004-2013.

Mots-clés: transmission des prix, volatilité, pouvoir de marché, chaîne de commercialisation, poisson.

1. Introduction

Fishermen claim that they are receiving low prices for their landings, while consumers have to pay high prices at the retail level. In addition, fishermen are facing increasing fishing costs, such as fuel (Cheilari *et al*., 2013), but cannot transmit these increases onto their customers. This leads to the existence of important price margins between retail and ex-vessel prices.

Recent changes in the market chain of fish products, such as concentration in the supply of fish products at the retail level by large supermarket chains and an increase in the value and volume of fish traded internationally, particularly for aquaculture products, could lead towards retail market power.

The absence of complete pass-through of price changes and costs from one market to another has important implications for economic welfare. Price transmission studies provide important insights into how changes in one market are transmitted to another, and consequently reflect the extent to which markets function efficiently.

It is important to study whether markets function efficiently because imperfect price transmission can be a sign of the existence of market power (Pelztman, 2000; Meyer and von Cramon-Taubadel, 2004). However, other reasons for asymmetric price transmission include inventor holding and valuation, perishable/storability (depending on the nature of goods), public intervention, fixed-price contracts, the existence of repricing costs (menu costs), spatial dispersion, and price expectations.

Thus, in this paper, we examine asymmetric price transmission in the Spanish fresh fish market. Spain is one of the largest fish producer and consumer countries in Europe. In 2011, Spanish production of seafood species accounted for 994 thousand tonnes from capture fisheries, 272 thousand tonnes from aquaculture and net imports of 555 thousand tonnes (FAO, 2014a). The Spanish fish market is characterised by the high diversity of species, a wide range of prices, and the importance of whole fresh fish in terms of market share (see for instance FAO, 2014a).

The Spanish fresh fish market is examined by looking at the causality, elasticity, asymmetry and volatility in price transmission for the main 10 fresh fish products commercialised in Spain. These fish products account for more than 60% of total fresh fish consumption in Spain.

Therefore, these results are important because they provide us with a better understanding of how the fresh fish market functions and have relevant implications in the analysis of demand, margins and welfare allocation through the market chain. In addition to this, the results and conclusions obtained may be relevant to other areas, especially those with similar market and consumption patterns, such as the Southern European and Mediterranean countries.

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2. Data

For this analysis, we used weekly price observations of the 10 main fresh seafood products at 3 different stages of the Spanish market chain. The data was obtained from the Spanish food market observatory (MAGRAMA, 2014a) and covers the period January 2004 to December 2013.

The 10 fresh fish products analysed are anchovy (*Engraulis spp.*), blue whiting (*Micromesistius poutassou*), hake between 2.5 and 5 kg (*Merluccius merluccius*), Atlantic horse mackerel (*Trachurus trachurus*), Atlantic mackerel (*Scomber scombrus*), megrim (*Lepidorhombus spp.*), sardine (*Sardina pilchardus*), Atlantic salmon (*Salmo salar*), small hake of 1.5 kg (*Merluccius merluccius*), and rainbow trout (*Oncorhynchus mykiss*). These products represent the most consumed fresh fish products in Spain. They account for at least 60% in quantity and 55% in value of total fresh fish consumption in Spain (MAGRAMA, 2014b). This wide range of products enables us to study the Spanish seafood market in detail.

Eight of these products (hake, small hake, sardine, anchovy, mackerel, blue whiting, horse mackerel and megrim) come from wild fisheries. Salmon and trout originate from aquaculture. Most mackerel, blue whiting, horse mackerel, megrim and trout sold on the Spanish market are produced domestically. For anchovy, sardine, hake and small hake Spanish production competes with significant levels of imports (Asche and Guillen, 2012; Camanzi *et al.*, 2012; Mulazzani *et al.*, 2012). In the case of salmon, national production is null and consequently Spanish supply is based on imports (STECF, 2013). The salmon first-sale (ex-vessel) price in the analysis thus corresponds to the import price.

The three different market chain levels (ex-vessel, wholesale and retail) are the most significant ones for fresh fish products. Indeed, around 60% of the fresh fish products consumed in Spain are commercialised through the wholesale market stage (Mercasa, 2010).

The Figure below shows the price evolution of the 10 fresh fish products at the three different market stages.

Figure 1 shows that the different fresh fish prices follow different evolution patterns. Nevertheless, prices at the ex-vessel and wholesale market stages show a higher variability (volatility).

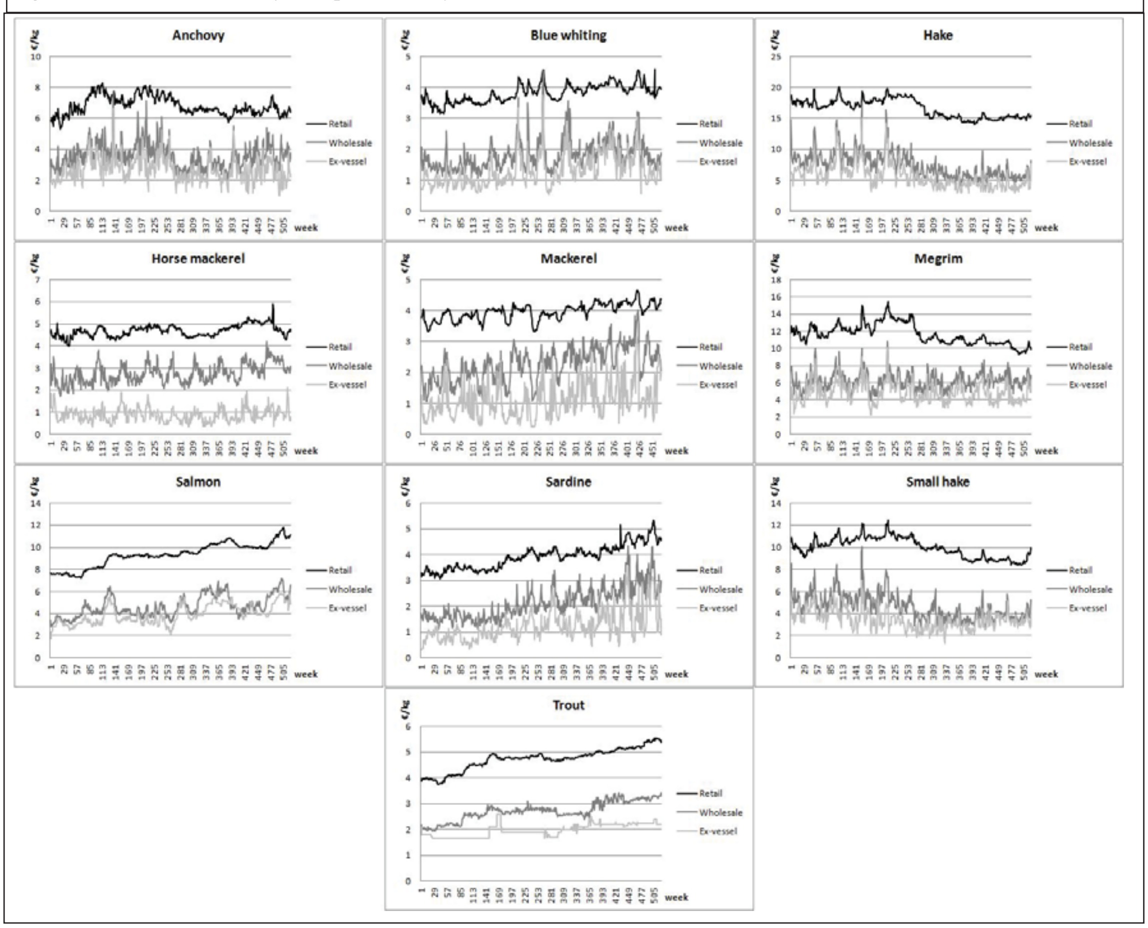
3. Methodology

3.1. Price transmission: relationship between market stages

Price transmission refers to the process in which upstream (producer) prices affect downstream (retail) prices. The relationships between different stages in the value chain (upstream and downstream), based on a simultaneous equilibrium, have been described by the theory of derived demand. However, this method is very data demanding, and, in practice, is 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 and Holt (1999), Miller and Hayenga (2001), Asche *et al.* (2002), among others.

The price difference of a product between two stages of the market chain is the margin. The analysis performed by George and King (1971) on a

Figure 1 - *Price evolution of the species analysed.*



large number of commodities shows that linkages between a product's price (margins) throughout the market chain often involve a constant combination of both absolute and percentage margins. The justification for these margins is mainly empirical, as already described in Thomsen (1951), Buse and Brandow (1960), and Shepherd (1962) among others.

Therefore, the price of a product at any stage in the market chain can be expressed as a function of the price of the product at a different market stage, as shown in Equation 1:

$$P_d = c + bP_u \tag{1}$$

Where P_d is a downstream price, P_u is an upstream price; 'c' stands for a constant mark-up and 'b' for a proportional mark-up.

3.2. Volatility

Volatility is a statistical measure of the variability (dispersion) of a variable or index. Volatility is often measured by using the standard deviation, variance or coefficient of variation of a variable.

The standard deviation (SD) measures the dispersion variables have from their average.

$$SD = \sqrt{\frac{\sum_{i=1}^{n} (P_i - P)^2}{(n-1)}} \tag{2}$$

Where P_i corresponds to each price of the time series, P is the average price, and n is the number of price observations.

While the coefficient of variation (CV) is obtained from the ratio between the standard deviation and the mean.

$$CV = \frac{SD}{X} \tag{3}$$

3.3. Causality

Causality is the relation between an event (the cause) and a second event (the effect), where the "effect" event is a consequence of the "cause" event. In economics, it is useful to determine whether a time series variable is useful in forecasting another time series variable. In price transmission analysis, causality is used to determine whether a price at a market stage changes as a consequence of changes in a price at another market stage.

Numerous studies have investigated the direction of price influences on market stages in food markets. For fresh product markets, in the long-run, the causal relation is often considered to be upward (from the retail to the production sector). However, in the short-run, variations in the upstream prices tend to precede changes in the downstream prices.

A causality test is required to analyse the direction of the influences between market levels. In this paper, we use the Granger Causality Tests (Granger 1969), which have often been employed to analyse price transmission between market stages (i.e. Ward, 1982; Tiffin and Dawson, 2000; Jiménez-Toribio, *et al.*, 2003; García del Hoyo, 2002; Bakucs and Ferto, 2005). A time series is said to Granger cause another one if the values of the first series provide statistically significant information about values of the second series.

3.4. Price Transmission Elasticity

Price transmission elasticity is defined as "the relative change in retail price to the relative change in producers' price when other factors affecting processors behaviour are held constant" (Hildreth and Jarrett, 1995). So, the elasticity of price transmission measures the percentage change in the price at a downstream stage of the market chain, in relation to the relative change in the price of the same product at an upstream 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 price transmission elasticity between two stages of the market chain can be calculated from:

$$\varepsilon_T = \frac{\partial P_d}{\partial P_u} \cdot \frac{P_u}{P_d} \tag{4}$$

The parameter $\frac{\partial P_d}{\partial P_u}$ that represents the variation of prices at the downstream level when the prices at the upstream level change can be obtained by estimating the regression coefficient that relates downstream and upstream stage prices (equation 1). When the variables are considered in their log form (equation 5), the regression coefficient is equal to the elasticity of price transmission (equation 6).

$$Ln(P_d) = c + ln(bP_u) \tag{5}$$

$$\varepsilon_T = \frac{\partial P_d}{\partial P_u} \cdot \frac{P_u}{P_d} = \frac{\partial Ln(P_d)}{\partial Ln(P_u)} \tag{6}$$

3.5. Price Transmission Asymmetry

Price transmission asymmetry, or asymmetric price transmission, refers to a pricing phenomenon occurring when downstream prices react in a different manner to upstream changes in prices.

The presence of asymmetry in vertical price transmission is often considered to be due to collusive behaviour. Testing for the existence of price transmission asymmetries is often used to investigate the existence of market power. Market power can be used at some stage of the market chain to avoid fully transmitting decreases in supply price, whilst perfectly transmitting price increases. This may be reinforced in some food sectors, as the retail and wholesale stages are often more concentrated than the production stage.

Table 1 - *Price transmission asymmetry cases.*

	Positive price change (P_u^+)	Negative price change (P_u^-)
C is significant and positive	when upstream prices increase, downstream prices increase more than proportionally	when upstream prices decrease, downstream prices decrease less than proportionally
C is significant and negative	when upstream prices increase, downstream prices increase less than proportionally	when upstream prices decrease, downstream prices decrease more than proportionally

Table 2 - *Descriptive statistics for the fish products analysed.*

	Ex-vessel				Wholesale				Retail			
	Mean	Std. Dev.	C.V.	Obs	Mean	Std. Dev.	C.V.	Obs.	Mean	Std. Dev.	C.V.	Obs.
Anchovy	2.67	0.75	28.23	520	3.55	0.81	22.68	521	6.82	0.60	8.79	521
Blue Whiting	1.31	0.51	38.79	520	1.82	0.49	26.91	521	3.81	0.29	7.65	521
Hake	5.64	1.93	34.20	520	7.52	2.12	28.24	521	16.60	1.49	9.00	521
Horsemackerel	0.88	0.31	35.42	520	2.76	0.44	15.94	521	4.69	0.26	5.64	521
Mackerel	1.12	0.59	52.39	468	2.27	0.55	24.25	469	3.96	0.26	6.68	469
Megrim	4.83	1.13	23.46	520	6.20	1.01	16.30	521	11.67	1.21	10.33	521
Salmon	3.92	0.87	22.09	520	4.65	0.96	20.69	521	9.34	1.06	11.32	521
Sardine	1.24	0.59	47.36	520	2.14	0.63	29.47	521	3.92	0.47	11.95	521
Small Hake	3.44	0.85	24.61	520	4.62	1.17	25.40	521	9.98	0.91	9.14	521
Trout	1.96	0.24	12.47	520	2.71	0.37	13.58	521	4.73	0.42	8.95	521

However, market power is not the only cause of asymmetric price transmission and alternatives include inventor holding and valuation (Wright and Williams, 1982 and Wohlgenant, 1989), the perishable nature of goods (Ward, 1982), public intervention (Kinnucan and Forker, 1987), the existence of repricing costs (Worth, 1999), and price expectations (Aguiar and Santana, 2002).

The presence of price transmission asymmetry is investigated following Guillen and Franquesa (2010) based on Houck (1977). Houck's method was developed from the earlier works of Farrel (1952), Tweeten and Quance (1969) and Wolffram (1971) and subsequently used by Ward (1982) to capture the dynamics of price transmissions between market stages.

To investigate the presence of price transmission asymmetry, Equation 1 has been estimated, including P_u^+ and P_u^- terms that account for the positive and negative price changes at an upstream stage, respectively. In order to avoid multicollinearity problems, asymmetry has been estimated in two different equations (Equations 7 and 8), one considering the positive and another one the negative price variations.

$$P_d = a + b\,P_u + c\,P_u^+ \qquad (7)$$

$$P_d = a + b\,P_u + c\,P_u^- \qquad (8)$$

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

$$P_u^+ = \Delta P_u = P_u - P_{u-1} \qquad if\,\Delta P_u > 0 \qquad (9)$$

$$P_u^- = \Delta P_u = P_u - P_{u-1} \qquad if\,\Delta P_u < 0 \qquad (10)$$

Therefore, when the coefficient c is significant, and therefore different to 0, there is asymmetry. Consequently, there are 4 possible cases of price transmission asymmetry (see Table 1).

4. Results

4.1. Volatility

Descriptive statistics (mean, standard deviation and coefficient of variation) for the prices of the 10 fish products at the 3 market stages are presented in Table 2.

The highest value products (hake, megrim, salmon and small hake) are the ones that show the highest volatility measured with the standard deviation.

Data in Table 2 confirm that prices at the ex-vessel and wholesale stages display higher variability than those at the retail stage. Measured with the standard of variation, the arithmetic mean of the volatility is rather similar, 0.78 at the ex-vessel, 0.86 at the wholesale and 0.70 at the retail levels. However, the arithmetic mean of the coefficient of variation at the ex-vessel level is 32%, 22% at the wholesale and 9% at the retail levels. The coefficient of variation normalises the variability by the mean.

The species whose main production comes from aquaculture (salmon and trout) show the lowest price volatility measured with the coefficient of variation.

4.2. Causality

Results from the Granger causality test, used to analyse the relation between markets stages are presented in Table 3.

From Table 3, it is confirmed that in the short run, variations in the ex-vessel and wholesale stages prices often precede changes at the retail stage prices. At a 5% significance level, nine (90% of the cases) causal relationships have been identified from the ex-vessel to the retail stage, of which four of them are bidirectional (anchovy, hake, salmon and sardine). While ten (100% of the cases) causal relationships from the wholesale to the retail stage have been detected, of which six are bidirectional (anchovy, blue whiting, hake, salmon, small hake and sardine). Between the ex-vessel and the wholesale stages two bidirectional relations (mackerel and megrim) have been found, two from the ex-vessel to the wholesale level (blue whiting and small hake) and three from the wholesale to the ex-vessel level (salmon, sardine and trout).

These results are in accordance with most of the previous literature on seafood and food product markets. Heien (1980) confirms that in the short-run, variations in production level prices precede changes in retail level prices in 57% of the cases analysed, bidirectional causal relations between the production and retail stages are present in 13% of the cases. Freebairn (1984) using the Granger-Sims cau-

Table 3 - *Granger causality test results.*

	Ex-vessel - Wholesale Wholesale – Ex-vessel	Ex-vessel - Retail Retail – Ex-vessel	Wholesale - Retail Retail- Wholesale
Anchovy	1.63 (0.20)	**11.33 (0.00)**	**11.26 (0.00)**
	1.88 (0.15)	**9.16 (0.00)**	**12.10 (0.00)**
Blue whiting	**10.98 (0.00)**	**42.29 (0.00)**	**44.49 (0.00)**
	0.56 (0.57)	2.59 (0.08)	**4.72 (0.01)**
Hake	0.21 (0.81)	**11.52 (0.00)**	**16.23 (0.00)**
	0.66 (0.52)	**6.70 (0.00)**	**12.51 (0.00)**
Horse mackerel	1.67 (0.19)	**4.82 (0.01)**	**10.32 (0.00)**
	2.58 (0.08)	0.36 (0.70)	2.02 (0.13)
Mackerel	**5.69 (0.00)**	**25.66 (0.00)**	**40.17 (0.00)**
	7.69 (0.00)	1.99 (0.14)	0.76 (0.47)
Megrim	**3.69 (0.03)**	**10.56 (0.00)**	**9.99 (0.00)**
	3.65 (0.03)	2.67 (0.07)	0.31 (0.73)
Salmon	2.99 (0.05)	**3.54 (0.03)**	0.10 (0.90)
	4.49 (0.01)	0.29 (0.75)	0.03 (0.97)
Sardine	0.19 (0.83)	**6.48 (0.00)**	**19.36 (0.00)**
	3.40 (0.03)	**3.82 (0.02)**	1.36 (0.26)
Small hake	0.35 (0.70)	**11.42 (0.00)**	**12.75 (0.00)**
	3.69 (0.03)	**13.51 (0.00)**	**23.15 (0.00)**
Trout	**5.46 (0.00)**	**14.35 (0.00)**	**26.84 (0.00)**
	1.51 (0.22)	0.38 (0.68)	**6.67 (0.00)**

sality tests for 17 food products in Australia, finds a unidirectional causal relationship from the production to the retail stage in 35% of cases, one unidirectional causal relationship from the retail to the production stage and no bidirectional causal relations. García del Hoyo (2002) and Jiménez-Toribio *et al.* (2003) use the same Granger's methodology to find that wholesale prices of red sea bream and striped venus in Spain are influenced by ex-vessel prices. Hartmann *et al.* (2000) use cointegration and exogeneity tests to find that the auction (first-sale) prices of hake in France influence both the wholesale and retail stages.

4.3. Price Transmission Elasticity

The price transmission elasticities between the different market stages of the 10 fish products analysed are reported in Table 4.

All price transmissions elasticities are significant. Results show that the highest elasticities of price transmission occur between the ex-vessel and wholesale levels, while, with the exception of megrim,the lowest are between the ex-vessel and retail levels. Similarly, the largest proportion of the variance explained by the price transmission elasticity is between the ex-vessel and wholesale levels followed by the wholesale and retail and lastly by the ex-vessel and retail levels.

Table 4 - *Price transmission elasticities, standard errors and proportion of variance explained.*

	Ex-vessel - Wholesale		Ex-vessel - Retail		Wholesale - Retail	
	Elasticity (S.E.)	R-adj.	Elasticity (S.E.)	R-adj.	Elasticity (S.E.)	R-adj.
Anchovy	0.57 (0.022)	0.56	0.17 (0.011)	0.30	0.24 (0.014)	0.36
Blue Whiting	0.59 (0.014)	0.78	0.15 (0.006)	0.53	0.22 (0.010)	0.52
Hake	0.78 (0.015)	0.82	0.20 (0.009)	0.47	0.25 (0.010)	0.57
Horse Mackerel	0.26 (0.016)	0.33	0.03 (0.007)	0.05	0.18 (0.013)	0.18
Mackerel	0.29 (0.017)	0.37	0.06 (0.005)	0.23	0.20 (0.007)	0.61
Megrim	0.55 (0.018)	0.64	0.19 (0.017)	0.18	0.14 (0.027)	0.05
Salmon	0.79 (0.020)	0.75	0.39 (0.015)	0.55	0.40 (0.018)	0.48
Sardine	0.47 (0.018)	0.57	0.19 (0.008)	0.51	0.38 (0.008)	0.81
Small Hake	0.73 (0.030)	0.54	0.08 (0.016)	0.05	0.26 (0.012)	0.46
Trout	0.80 (0.035)	0.51	0.58 (0.021)	0.60	0.62 (0.010)	0.88

Moreover, there is a positive relationship between the products' prices and the elasticities of price transmission, especially between the ex-vessel and wholesale levels, as shown from the outcomes of the regression that relates the price transmission elasticities with their price (see Table 5).

Table 5 - *Price transmission elasticity between the ex-vessel and wholesale markets as a function of ex-vessel price.*

	Coefficient	Std. Error	Prob.
Constant	0.328	0.085	0.009
Ex.vessel Price	0.076	0.027	0.031
R-adj	0.497		
Durbin-Watson stat	0.999		

4.4. Price Transmission Asymmetry

Outcomes on the positive and negative price transmission asymmetries for the 10 fish products between the 3 markets levels are presented in Table 6.

Table 6 shows the relevance of price transmission asymmetry. Asymmetry is found in all 10 products analysed (100%). In addition, asymmetry is observed in 46 of the 60 (76.67%) relations between market stages.

The results clearly show that price transmission asymmetry is relevant, especially concerning the retail level. Asymmetry was observed in 27 of the 30 (90%) relations between market stages.

More asymmetric price transmission relations are found in these results than in those of Pelztman (2000) and Meyer and 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, respectively.

5. Discussion

Price fluctuations are a common feature of well-functioning agricultural and food markets; but when these fluctuations are large and unexpected (volatile) they can have a negative impact on the food security and wealth of consumers, producers and entire countries (FAO, 2014b).With the presence of volatility there is more uncertainty, which may lead to non-optimal investment decisions. Estimations and forecasts are less robust when there is volatility as, amongst other effects, unit root (stationarity) tests are potentially unreliable in the presence of volatility (Cavaliere and Taylor, 2008).

Unfortunately, price volatility in fresh food and fisheries markets is common. For example, price volatility in agricultural markets has increased significantly since 2007,

Table 6 - *Price transmission asymmetries.*

	Ex-vessel - Wholesale		Ex-vessel - Retail		Wholesale - Retail	
	Positive	Negative	Positive	Negative	Positive	Negative
Anchovy	**0.100 (0.028)**	**0.209 (0.000)**	**-0.108 (0.000)**	**0.166 (0.000)**	**-0.209 (0.000)**	**0.194 (0.000)**
Blue Whiting	-0.029 (0.499)	**0.094 (0.029)**	**-0.124 (0.000)**	**0.174 (0.000)**	**-0.212 (0.000)**	**0.225 (0.000)**
Hake	-0.057 (0.253)	**0.197 (0.000)**	**-0.153 (0.000)**	**0.197 (0.000)**	**-0.206 (0.000)**	**0.240 (0.000)**
Horsemackerel	-0.048 (0.178)	0.057 (0.113)	**-0.039 (0.011)**	**0.035 (0.023)**	**-0.200 (0.000)**	**0.147 (0.000)**
Mackerel	**-0.122 (0.002)**	**0.285 (0.000)**	**-0.043 (0.000)**	**0.082 (0.000)**	**-0.215 (0.000)**	**0.221 (0.000)**
Megrim	0.062 (0.234)	-0.027 (0.586)	**-0.157 (0.002)**	**0.184 (0.000)**	-0.031 (0.654)	**0.261 (0.000)**
Salmon	-0.015 (0.903)	0.082 (0.545)	**-0.283 (0.002)**	**0.310 (0.003)**	**-0.316 (0.009)**	**0.521 (0.000)**
Sardine	0.015 (0.765)	**0.343 (0.000)**	**-0.073 (0.001)**	**0.223 (0.000)**	**-0.300 (0.000)**	**0.260 (0.000)**
Small Hake	0.097 (0.242)	**0.234 (0.005)**	-0.024 (0.599)	**0.179 (0.000)**	**-0.217 (0.000)**	**0.267 (0.000)**
Trout	**-0.796 (0.000)**	-0.075 (0.717)	**-0.428 (0.000)**	0.025 (0.837)	**-0.542 (0.000)**	**0.331 (0.000)**

with high price increases between November 2007 and June 2008 and between August 2010 and June 2011 due to bad harvests, while strong price decreases were registered between July 2008 and July 2010 (Sumpsi, 2011).

Indeed, price volatility is often related to disequilibrium between demand and supply. In fisheries this may be exacerbated due to weather, physical and chemical factors that make fisheries catches uncertain, together with the overexploitation of fish stocks that leads to lower and more uncertain catches (Worm *et al*., 2009). On the demand side, with the increasing GDP per capita and purchasing power of emerging countries (i.e. China and Brazil) there has been an increase in demand, especially concerning the consumption of animal products. Moreover, there is an increase in demand for certain products around Christmas period in some countries, such in Spain (Asche and Guillen, 2012; Guillen and Maynou, 2014).

This study confirms that price volatility differs between levels and products in the Spanish fresh fish market, with the results indicating that prices are on average less volatile in downstream levels (i.e. retail), in the cheapest products and in farmed species.

Tveterås *et al.* (2012) estimated that fish prices have a volatility that is less than half of other food products. The standard deviation of the Fish Price Index was found to be 5.6% compared to the 12.2% for the FAO's Food Price Index for the period 1990-2010. Indeed, the Fish Price Index appeared to be more stable and less subject to price spikes, such as the ones occurred for cereals, dairy, and oils in 2008 and 2011. This low volatility for fish products is because aquaculture products' low prices have brought fish prices down, together with a more stable supply of aquaculture fish that has resulted in a reduction in price volatility (Barret, 1996; Tveterås, 2012).

However, it should be noted that the Fish Price Index is constructed from trade statistics (imports), while other food indexes use mostly wholesale market data. This can result in different ranges of volatility, since ex-vessel and wholesale prices are often more volatile than import and retail ones. Often local fish products receive higher prices than imports (Asche and Guillen, 2012; Guillen and Maynou, 2014), while imports often have a more stable supply and receive a lower price, being perceived as basic products. This often leads to local fish supplies having more volatile prices than imports, especially the most expensive products that have less substitutes.

This is also represented by the positive relationship between the products' prices and the elasticities of price transmission, because most expensive products have less substitutes and price changes are transmitted more between market levels. On the contrary, prices of the cheapest products, which often have a larger range of substitutes and potential supply sources, exhibit lower volatility and prices changes are not so fully transmitted to downstream levels of the market chain. In this latter case, the own price flexibility is very inflexible and consequently the price is almost indifferent to local production (Mulazzani and Camanzi, 2011). Hence, minimum fish prices (minimum ex-vessel prices at which unsold fish is bought up in the EU) may not prove to be a very efficient way of increasing prices for low price products that have a large range of substitutes and supply sources, and may only guarantee a certain minimum revenue for fishermen.

Asymmetric price transmission occurs when downstream prices react in a different manner to upstream changes in prices. The presence of asymmetric price transmission is not in line with predictions of the canonical economic theory (e.g. perfect competition and monopoly), which expect that downstream responses to upstream changes should be symmetric in terms of absolute size and timing. Asymmetric Price Transmission is often related to market power. The presence of market power is important from a welfare point of view because it often implies a welfare redistribution from agents downstream to agents upstream (presumably consumers to large companies), and consequently it has serious political and social consequences. There is asymmetric price transmission in the Spanish fresh fish market, especially when analysing the retail market. The entrance into the downstream market stages of important amounts of production from other sources (i.e. imports) can exacerbate asymmetric price transmission, since it can be exploited by traders and retailers even if they do not have a dominant position. However, market power does not seem to fully explain the asymmetry found in the Spanish fresh fish market chain. The main trends observed in the price transmission asymmetry results in this study are:

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

Both asymmetric price transmission trends occur in 37 out of the 40 (92.5%) cases in the relations where the retail level is present. However, market power does not seem to be the reason despite the existence of price transmission asymmetry, because the retail price increases less than proportionally when the upstream prices increase, which is contradictory to the existence of market power.

Hence, the lower volatility in the retail market stage, which may be due to the higher number of available substitutes and supply sources, explains the asymmetric price transmission in the Spanish fresh fish market chain. The presence of this asymmetric price transmission and lower volatility could also be explained by the existence of repricing costs (menu costs) at the retail market level (Worth, 1999). The repricing costs include the cost of changing a retail price (i.e. labour involved in repricing fresh produce) and also the potential loss of goodwill from consumers who prefer stable prices.

6. Conclusions

This paper analyses volatility and price transmission in the Spanish fresh fish market.Results confirm that prices are on average less volatile in downstream levels (i.e. retail), in cheap products and in farmed species.

Cheap products often have a larger range of substitutes and potential supply sources, therefore, cheap product prices have a lower volatility and price changes are not so fully transmitted to downstream levels of the market chain.This is explained by the positive relationship between the products' prices and the elasticities of price transmission. On the other hand, the most expensive products have less substitutes and price changes are transmitted more between market levels.

Indeed, lower volatility in the retail market stage is the main reason of asymmetric price transmission in the Spanish fresh fish market chain and not market power.

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