Price linkages in value chains: methodology

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Market access and value-chains in fisheries and aquaculture

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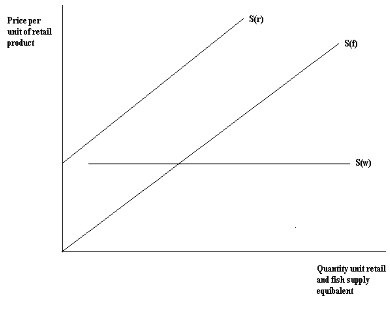
Introduction

- The ex-vessel price of fish defines the profits and welfare of fishermen and their communities and is ultimately set by the end-user/retail demand for the commodity.
- Demand and supply functions are commonly specified for both farm and retail sectors, and the equilibrium is solved under general competitive conditions Gardner (1975).
- The assumption of perfect competition seems appropriate when applied to setting the ex-vessel price of fish but inappropriate for setting price at the processing-distribution-retailing (PDR) sector of the fish market.
- In many industrialised countries a few supermarket chains account for a very large share of retail sales and seafood products. Therefore, non-competitive pricing at the PDR sector of the market may have important welfare implications for fishermen and fish farmers.

Theoretical framework: Assumptions

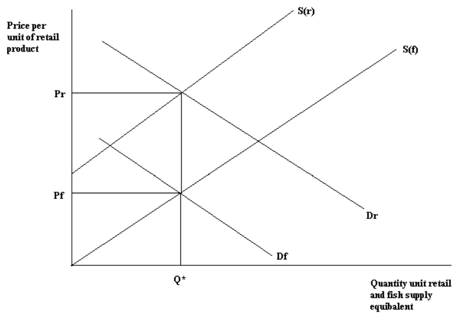
- The demand for fish from the fisherman or fish farmer is derived from demand for the end-user/retail commodity.
- The retail price will reflect the fish price plus the cost of marketing the commodity from the vessel or fish farmer to the retail level. “Marketing” in this context includes transportation, processing and distribution to the point of end use.
- The impact of a shock to fish landings on retail price will depend on the structure of the relationship between the two sectors.
- Let the retail/vessel price margin be the difference between the retail and vessel price…

Theoretical framework: fixed proportions relationship



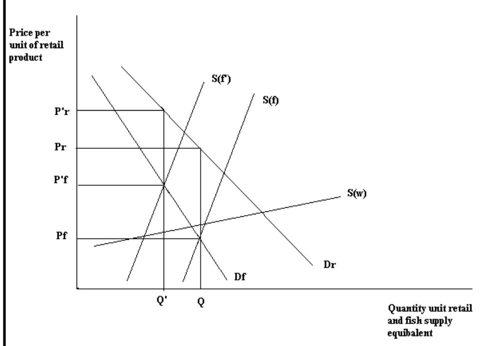
- Perfectly elastic supply of marketing inputs. The cost of using these inputs is constant per unit produced.
- Supply of the fish commodity at the retail level S(r) is the sum of fish supplied S(f) and the fixed supply of marketing inputs S(w).

Theoretical framework: fixed proportions relationship



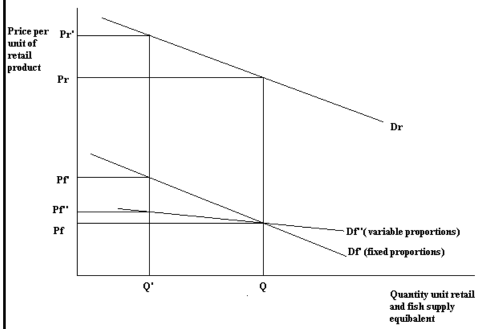
- Given the <u>demand function for fish</u> at the <u>retail level</u> (Dr), this gives the <u>derived demand for fish at the vessel level</u> (Df).
- The <u>ex-vessel price</u> *(Pf)* is set by the intersection of the ex-vessel supply of fish *(Sf)* and the derived demand for fish product *(Df)*.
- The <u>retail price</u> (Pr) is set by the intersection of the retail demand (Dr) for fish and the retail supply of fish (Sr).

Theoretical framework: Variable marketing cost



- <u>Non-constant relationship between fish supply and marketing inputs</u>. Increases in fish supply will cause changes in the margin.
- The upward sloping (*Sw)* represents the need to use proportionally <u>larger amounts of marketing inputs to process increased levels of fish supply</u>.
- <u>Decreases in fish supply</u> <u>cause an increase in</u> both ex-vessel and retail <u>price but a decrease in the margin</u>.

Theoretical framework: Substitution between commodity and marketing costs



- Assuming that the initial supply of fish is constant and set at *Q*, a decrease in harvest to *Q'* under fixed proportions will increase the price to *Pf'*.
- If it is possible to substitute marketing inputs for the higher priced fish the derived fish demand curve *(Df'')* is more elastic and the price of fish increases to only *Pf''*, .
- A decrease in fish supply can be associated with an increase in margin. The attributes of products may change over time, or at the same point in time.

Modelling Imperfect Competition in the PDR Sector

- In sectors with high concentration ratios, it is possible that individual firms play an active role in price-setting and that in setting prices, each firm pays close attention to the likely reactions of other firms.
- The outcome of such interdependent or oligopolistic behaviour will be determined by the extent to which the major players in an industry can coordinate actions to take advantage of whatever monopoly rents are available.
- The more concentrated an industry, the more likely it is in achieving the joint-profit maximising price and capturing monopoly rents.
- Price is set to equate marginal revenue to marginal cost, and thus is higher than marginal cost, since demand is not perfectly elastic (Holloway, 1991).

Modelling Imperfect Competition in the PDR Sector

- 'Lerner mark-up rule', relates retail price (Pr) to marginal cost (c) for a profit-maximising imperfect competitor by the formula.

$$P_R(1+1/\eta)=c$$

where η is the price elasticity of demand perceived by the price setter.

- If elasticity does not depend on other variables, we can write:

$$P_R = m \cdot c$$

where m is a constant proportional markup. In a competitive market, *m=1* and in an imperfectly competitive market, *m>1*.

- A shift in the retail demand curve will have no effect on price, and a change in costs will have the same effect, regardless of whether *m* is equal to or exceeds one.

Modelling Imperfect Competition in the PDR Sector

- if elasticity is not constant profit maximising quantity and price can be derived as,

$$Q^* = (a-c)/2; \quad Pr^* = (a+c)/2$$

Where a is a constant and marginal cost, *c*, is also constant.

- The elasticities of *Pr** with respect to shifts in demand and in costs can be written:

$$(\eta P_{Ex}) = a/(a+c); \quad (\eta P_c) = c/(a+c).$$

- If elasticity increases with price then imperfectly competitive price-setting behaviour should result in larger price responses to demand shifts and smaller responses to cost changes than would be generated by perfect competition.

Structural model

- A competitive equilibrium three equation model to measure variations in the marketing margin (M_i), retail price (Pr_i) and ex-vessel price (Pe_i) is due to Holloway (1991).
- Explanatory factors, which are the same for each equation, are defined as:
  - a) Marketing costs (MC_i).
  - b) Retail demand shifter (RD_i).
  - c) Fish supply (L_i)
- The Holloway model can be written as:

$$M_i = \beta_m + \beta_{mmc} MC_i + \beta_{mrd} RD_i + \beta_{mq} L_i + \varepsilon_1$$

$$pr_i = \beta_{pr} + \beta_{prmc} MC_i + \beta_{prrd} RD_i + \beta_{prq} L_i + \varepsilon_2$$

$$pf_i = \beta_{pf} + \beta_{pf} MC_i + \beta_{pfrd} RD_i + \beta_{pfq} L_i + \varepsilon_1$$

- Linear restrictions will test for competitive conditions.

Structural models: variables & data

- Ex-vessel, ex-farm (Pf) and retail prices (Pr) for 10 different species have been collected weekly in Spain by the Ministry of Food and Agriculture (MARM) from 2004 to 2011. Hake; sardines; anchovy; flounder; horse mackerel; blue whiting; mackerel; trout; and mussels. Import price from EUROSTAT used for salmon.
- Marketing costs (MC). Estimations of total labor costs and expenses in services and products different that merchandise in the wholesale and retail sectors are collected yearly (2006 – 2009) in a survey conducted by the Spanish Institute of Statistics (INE).
- Retail demand shifter (RD). Summarized in the evolution of the Consumer Price Index. Includes all foodstuffs and the general non-food index reduced to a single factor using principal components analysis.
- Supply (L). Monthly traded quantities in the largest Spanish wholesale market of MercaMadrid for each of the selected species were used in an attempt to have a proxy of landings and imports.

Structural models: Results

Goodness of fit		Equation 1	Equation 2	Equation 3
Blue whiting	R2	0.704	0.785	0.726
	DW	1.440	1.372	1.412
	F	15.067***	5.736***	14.390***
Anchovy	R2	0.471	0.812	0.553
	DW	1858	2376	1945
	F	3.242**	6.155***	4.167**
Mackerel	R2	0.558	0.688	0.584
	DW	1852	1402	1842
	F	12.423***	7.271***	14.077***
Hake	R2	0.385	0.819	0.392
	DW	1.878	1.959	1.918
	F	4.231**	5.572***	2.782*
Salmon	R2	0.812	0.983	0.805
	DW	1.780	1.187	1.739
	F	4.835***	2.654**	2.595**

Parameters		Equation 1	Equation 2	Equation 3
Blue whiting	MC	-2.000***	0.253**	2.259***
	RD	-0.436	0.475***	0.900
	L	0.443***	-0.017	-0.461***
Anchovy	MC	0.457	-0.065	-0.470
	RD	0.294	0.308	-0.373
	L	0.205***	-0.051***	-0.260***
Mackerel	MC	-3.204***	-0.021	3.157***
	RD	0.928	0.234*	-0.749
	L	0.485	-0.042***	-0.529***
Hake	MC	-0.897	0.002	0.952
	RD	1.082***	1.510***	-1.143**
	L	0.084	0.009	-0.063
Salmon	MC	-0.185	-0.073***	0.115
	RD	0.456	0.719***	0.231
	L	0.122***	0.003	-0.120**

Structural models: Results

- Five species resulted in significant F test for all the three equations and only salmon shows relatively high R^2 values.
- Prices and margins appear to be affected by other non included variables. These effects vary from one species to another.
- There is not a common pricing behavior for all seafood products.

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Structural models: Testing for perfect competition

- To consider perfect competition verify H_1 and reject H_2.

		Equation 1	Equation 2	Equation 3
Blue whiting	$H_1: \beta_2 + \beta_3 = 0$	0.133	4.911**	0.007
	$H_2: \beta_1 = 0$	3.084*	1.354	3.133*
Anchovy	$H_1: \beta_2 + \beta_3 = 0$	0.76	2.814	0.525
	$H_2: \beta_1 = 0$	2.074	0.597	5.984**
Mackerel	$H_1: \beta_2 + \beta_3 = 0$	2.007	2.531	3.051*
	$H_2: \beta_1 = 0$	2.393	15.728***	12.591***
Hake	$H_1: \beta_2 + \beta_3 = 0$	10.966***	16.853***	7.155**
	$H_2: \beta_1 = 0$	1.297	1.343	4.822
Salmon	$H_1: \beta_2 + \beta_3 = 0$	1.707	77.192***	0.056
	$H_2: \beta_1 = 0$	1.708	8.079***	0.582

- None of the five species satisfy the conditions for all three equations. Perfect competitive market can be rejected.

Reduced form model

- Rely on statistical techniques to capture price linkage, where some form of cointegration among the prices defines the market and allows for predicting the consequence of price and random shocks in the price chain (Asche et al, 2007).
- If cointegration is proven, perfect competition stands and a shock in ex-vessel price will lead to a shock of similar magnitude in the rest of the chain. Otherwise, non-competitive pricing is in effect.
- This requires time series data on prices at different stages of the supply chain. For estimation, a sufficient number of observations is required.

Reduced form models: variables & data

- Ex-vessel, ex-farm (Pf), wholesale (Pw) and retail prices (Pr). Monthly series from the Ministry of Food and Agriculture (MARM) from 2004 to 2011.
- Import price. Monthly series of key species collected from EUROSTAT (2004 – 2011).
- Species. Four wild species (hake, anchovy, mackerel, blue whiting) and one farmed (trout).
- Share of imports. Hake 60,5%, anchovy 61,9%, mackerel 33,1%, blue whiting 6,7%, trout 5,7%.

Reduced form models: results

	Domestic prices only			Imports included		
	Rank	Trace test	Lmax test	Rank	Trace test	Lmax test
Blue whiting	0	0.0001	0.0001	0	0.000***	0.000***
	1	0.2103	0.2477	1	0.000***	0.000***
	2	0.4500	0.4510	2	0.2727	0.1768
Anchovy	0	0.5639	0.4831	0	0.000***	0.000***
	1	0.7982	0.6965	1	0.096**	0.045***
	2	0.8794	0.8808	2	0.6648	0.6287
Mackerel	0	0.0094	0.0124	0	0.000***	0.001***
	1	0.2544	0.3113	1	0.001***	0.001***
	2	0.4458	0.4468	2	0.2690	0.2550
Hake	0	0.0358	0.0065	0	0.000***	0.000***
	1	0.7446	0.8009	1	0.003***	0.008***
	2	0.6381	0.6398	2	0.1532	0.1487
Trout	0	0.002***	0.008***	0	0.000***	0.000***
	1	0.084**	0.070**	1	0.000***	0.000***
	2	0.5145	0.5158	2	0.010***	0.006***

Reduced form models: results

- Wild fishery products do not cointegrate when only local prices are taken into account. Inclusion of imports results in cointegration in almost all species.

- Aquaculture products result in cointegration in any case. Price linkages operates whenever imports are considered or not.

- All successful models link retail price with imports. Local price also affect retail in all cases but hake and trout. Wholesalers' are significant for all species retail price with the exception of hake.

Conclusions

- When considering domestic seafood production and retailing, a perfect competitive framework does not fit with observed data. Results from structural models are confirmed by lack of cointegration between local ex-vessel price, wholesale and retail.

- Inclusion of import price series result in significant cointegration across prices of the value chain for almost all wild species. Imports improve price transmission along the value chain.

- Prince linkages are verified in aquaculture species even in markets dominated by far by local production (mussels). Price transmission is more effective in aquaculture than in wild fisheries.

- Despite of difference across species, all retail prices are affected at a larger or shorter extent by import prices more than what they are by local supply.

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