Structure of the fish value chains and dynamics of price-cost margins
A multivariate analysis of cointegration results [1]

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ABSTRACT

Fish are marketed with various intermediaries between producers and final consumers. The number and the nature of the intermediaries, market structures at each stage of the value chain and other factors related to the organisation of markets may substantially affect the transmission of information throughout the chain. The present study tries to better understand the distortion of information transmitted through prices in a great variety of European case studies. On the basis of some fifty cointegration relations tested pair-wise in the Salmar EU-funded research project (Asche *et al.*, 2002), along with proportionality and exogeneity of prices, a typology of the cointegration results is produced with a multifactorial analysis. Interestingly, a significant relation between proportionality and price leadership was found, in line with other empirical variables such as the degree of processing, the origin of species -wild-caught or farmed-, the position within the chain, etc.).

Keywords : Cointegration, fish value chains, price leadership, proportionality

1. INTRODUCTION

Agricultural economists consider the marketing margins as a function of the difference between retail and farm price of a given food product. Two types of cost make up the final price : the farm price and the marketing input which includes the processing cost and the profit margin of the various intermediaries between producers and consumers.

Things are not expected to be different in the case of fisheries, in spite of the number of intermediaries. The latter are meant to minimise the transaction and menu costs between each far side of the value chain. Translated into price modelling using time series of prices at different stages, retail and ex-vessel or farm prices are usually expected to be cointegrated and proportional. On the basis of a big empirical study (Asche *et al.* 2002) looking at more than fifty cointegration relationships between prices, this has not been exactly the case as nearly half of the series proved to be non proportional.

Many reasons might be found behind this lack of proportionality. We scrutinised through a multifactorial analysis the strong relationship between non proportional series and the statistical direction of price mechanisms. Unexpectedly, we found that proportionality coincided with weak exogeneity down the chain (at the retail level). The discussion turns out to price formation along the fish value chain, in particular since the technological change of fish farming (Atlantic salmon for instance). A survey on the behaviours of primary processors and retailers sheds some light to the market behaviours.

2. THEORETICAL BACKGROUND OF PRICE COINTEGRATION

The issue of market pricing and price transmission along the value chain has always been a core issue of industrial and agricultural economics (Olive 2002, Gardner and Rausser 2001). A great deal of theoretical and empirical studies has existed in the food industry since the pioneer work of Waugh (1964). This effort has been intensified for the recent decade due to the progress of time series econometrics and the development of the so-

[1] This paper presents the preliminary results of an ongoing EU-funded project (SALMAR, QLK5-CT1999-01346). It has been carried out with the support of the European Commission and does not necessarily reflect its views.

called cointegration approach (Schroeter, J. and Azzam A. 1990, 1991 ; Fanchon, P. and Wendel, J. 1992 ; Goodwin 1992).

With a straightforward model of price transmission down the chain developed elsewhere (Gardner 1975 ; Wohlgenant 1989 ; Asche *et al.* 2002, Guillotreau *et al.* 2002), the different assumptions lead to the mere equalisation of derived demand and consumer demand elasticities, hence the expected relationship between farm and retail prices :

$$P_r = a.P_f^b \qquad (1)$$

And with logarithms : $P_{r,t} = \ln a + b \ln P_{f,t} + \mu_t$ (2)

Where P_r is the retail price, P_f the farm price, a is the mark-up parameter, b is the price transmission elasticity and μ is a white noise. When price series are found non stationary, it is not possible to use OLS and cointegration techniques are largely used by economists (Asche *et al.* 1999). When two price series such as P_r and P_f are found non-stationary and the residual series ε_τ is stationary in the following equation, then P_r and P_f are said to be cointegrated :

$$P_{r,t} - \Psi P_{ft} = \varepsilon_t , \qquad (3)$$

Increasingly, the multivariate procedure of Johansen is preferred to the Engle-Granger test. The former is based on a vector autoregressive (VAR) system, most of the times combined with an error-correcting vector (VECM). One of the advantage of the Johansen procedure is to allow hypothesis testing on the coefficients α and β in the following equation where $\alpha = [\alpha_1 , \alpha_2]'$ is the adjustment matrix (VECM) and $\beta = [\beta_1 , \beta_2]'$ is the cointegration matrix :

$$\begin{bmatrix} \Delta p_{1t} \\ \Delta p_{2t} \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} \begin{bmatrix} \beta_1 & \beta_2 \end{bmatrix} \begin{bmatrix} p_{1,t-1} \\ p_{2,t-1} \end{bmatrix} + \sum_{i=1}^{k-1} \begin{bmatrix} \Gamma_{i,11} & \Gamma_{i,12} \\ \Gamma_{i,21} & \Gamma_{i,22} \end{bmatrix} \begin{bmatrix} \Delta p_{1,t-i} \\ \Delta p_{2,t-i} \end{bmatrix} + \begin{bmatrix} \mu_1 \\ \mu_2 \end{bmatrix} + \begin{bmatrix} \tau_1 \\ \tau_2 \end{bmatrix} t$$

$$+ \begin{bmatrix} \Phi_{r1} \ldots \Phi_{r11} \\ \Phi_{s1} \ldots \Phi_{s11} \end{bmatrix} \begin{bmatrix} D_{1t} \\ . \\ . \\ D_{f-1,t} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} \qquad (4)$$

Matrix Γ grasps the long run adjustment of prices, $[\tau_1 , \tau_2]$ are the parameters of the linear trend t, D_t are centred seasonal dummies which sum to zero over a full year (for instance, $f = 12$ in case of monthly data) (Tiffin and Dawson 2000).

Imposing restrictions on the parameters in the cointegration vectors β [i.e. whether $\beta'=(1,-1)$ produces a test of proportionality because the elasticity of price transmission is then equal to one.

A similar advantage is provided with a test on the α vector. The adjustment matrix can be used to test for the absence of error-correcting behaviour (also known in the literature as the test of weak exogeneity). If α_1 equals to zero, then Δp_{1t} does not respond to the equilibrium error $\beta_1 P_{1,t-1} + \beta_2 P_{2,t-1}$ (no error-correcting behaviour) whereas $\Delta P_{2,t}$ does (otherwise there would be no cointegration). As a result, the variable $P_{1,t}$ is said to be weakly exogenous with respect to the parameters β. This price might be either the farm price or the retail price. This "leading" price means that movements in other prices are derived from its own movements. It does not mean that the stake-holders at this specific level are price-makers, but they are probably facing more uncertainty (weather conditions, availability of resources, volatility of consumers…) that affects the rest of the segments along the market chain. Some authors go beyond that by associating the statistical causation of weak exogeneity and the Stackelberg leadership (Kuiper and Meulenberg 1999).

3. A MULTIFACTORIAL ANALYSIS OF COINTEGRATION RESULTS

3.1 The database

On the basis of former methodology, 57 relations between prices at different stages of various seafood value chains have been tested pair-wise and form the individuals of the database (the rows of the matrix). The value chains concern fresh and smoked salmon produced either in Norway or in the United Kingdom and consumed in France, in Finland or in the UK, salmon trout produced and consumed in Finland, fresh or processed cod (dried, salted, breaded) exported by the UK or Norway and consumed in France, the UK and Portugal. Salmonid represent 82 % of individuals, the rest being codfish. Each relation represents a segment of the chain (e.g. between producers and exporters, or between wholesalers and supermarkets).

As far as the variables are concerned (columns of the matrix), each price model is qualified by a number of cointegration results (Asche *et al.*, 2002) and structural features. The first variable lies in the cointegration test itself (binary variable for cointegration or no cointegration). All series having been found non stationary, the second step was to look whether the residuals ε_τ in equation (3) were stationary. Most of the tests have proved the cointegration of the series, hence resulting in a modality shared by a majority of relations, thus not really interesting to discriminate the population. Therefore this variable has no been further used in the analysis.

All other 14 variables are binary variables (yes or no). The second one refers to the proportionality test described above by $\beta'=(1,-1)$ in (4) : the "yes" category means that the proportionality test was accepted at a 5% level. Variables 3 and 4 captured the results of the weak exogeneity tests as previously defined : α_1 or $\alpha_2 = 0$ in (4). V3 tests for the exogeneity found in the upstream price (e.g. producer) and V4 in the donwstream price (retailer) ; again, the weak exogeneity test is accepted with a p-value greater than 0,05 (Asche *et al.* 2002). All other variables are *ad hoc* variables giving some insight to the structural identity of the price relation :

- V5 : fished or farmed origin of species ; the hypothesis here has been made that uncertainty affects the supply side to a greater extent for wild fish than for farmed fish, thus creating conditions for higher exogeneity up the chain.
- V6 : processed[2] product or not, due to the lower proportion of raw fish costs in the price of final products because of processing costs.
- V7 : international or national value chain, because transaction costs and exchange rates for international trade may affect the quality of price transmission.
- V8 to V12 : the countries covered by the study and involved in the price relation, respectively Finland, France, Norway, Portugal and the United Kingdom.
- V13 to V15 : the species, respectively cod, salmon and salmon trout.

3.2 The multiple correspondence methodology

Our data set is called fully *disjonctive* because individuals are crossed by nominal variables for which they own only one single modality (e.g. proportional / exogenous upstream / wild fish / etc.). When using multivariate analysis, it gives an interesting statistical property because an individual is located (allowance made for the dilatation along the axis) at the average distance of the modalities she owns and a modality at the average distance of the individuals possessing this modality (Bry, 1995).

Let's note I the number of individuals (e.g. relations between prices) and K the number of variables (cointegration, proportionality, exogeneity up, exogeneity down, etc.), each of them having J_k modalities (for instance proportional and non proportional). Then the factorial position of an individual i along the Factor α is obtained by equi-weighing the positions of the K modalities she owns (one by variable) :

$$F_\alpha(i) = \frac{1}{\sqrt{\lambda_\alpha}} \sum_{j/i\_owns\_j} \frac{1}{K} \Phi_\alpha(j) \qquad (5)$$

λ_α being the Eigen value of Factor F_α (plan of individuals) or factor Φ_α (plan of modalities).

[2] By 'processed fish', we mean a fish that has been processed by any mean which is likely to postpone its consumption, by opposition to fresh products (for instance, whenever the fish is cured, smoked, marinated, frozen and breaded, salted, dried, canned, etc.)

The procedure is the same for the position of each modality j on the factorial plan :

$$\Phi_\alpha(j) = \frac{1}{\sqrt{\lambda_\alpha}} \sum_{i/i\_owns\_j} \frac{1}{I_j} F_\alpha(i) \qquad (6)$$

The property is also interesting to compare two modalities in the same factorial plan. The closer the two modalities the greater the number of individuals sharing exclusively these two modalities. With $I_{jj'}$ the number of individuals owning both modalities j and j' (also called co-occurrence of j and j') in the case of a disjonctive database, a relation between the position of j along axis α [Φ_α(j)] and the position of j' along the same axis [Φ_α(j')] can be shown as follows:

$$\Phi_\alpha(j) = \frac{1}{\sqrt{\lambda_\alpha}} \sum_{j'=1}^{J} \frac{I_{jj'}}{K.I_j} \Phi_\alpha(j') \qquad (7)$$

and we know that :

$$\sum_{j'=1}^{J} I_{jj'} = \sum_{k=1}^{K} \sum_{j' \in C_k} I_{jj'} = \sum_{k=1}^{K} I_j = K.I_j \qquad (8)$$

It means that each modality j is located (allowance made for the dilatation along the axis) at the average distance of all modalities weighed by the co-occurrence with modality j. In other words, two modalities will be all the more attracted to each other that they are frequently associated in the population.

3.3 The results

The choice of active variables is crucial in the analysis. After the elimination of a few non-correlated variables, we finally kept in the analysis the three major tests of the cointegration results, i.e. proportionality and exogeneity up and exogeneity down, along with two structural variables (degree of processing, geographic area covered by the value chain) for which we were expecting an impact on these tests (hence 5 active variables with two modalities per variable : yes/no, processed/non processed, national/international). The rest of the variables were added as illustrative variables, i.e. without any contribution to the factorial plan, but only showing the link between each of the secondary variable and the plan.

The individuals were filtered in order to eliminate the non cointegrated relations and the relations with missing tests of exogeneity. In overall, 49 relations were kept out of the 57 initially. The results gave the following map along the two major axes concentrating 55% of total Eigen values (33% on F_1 and 22% on F_2) :

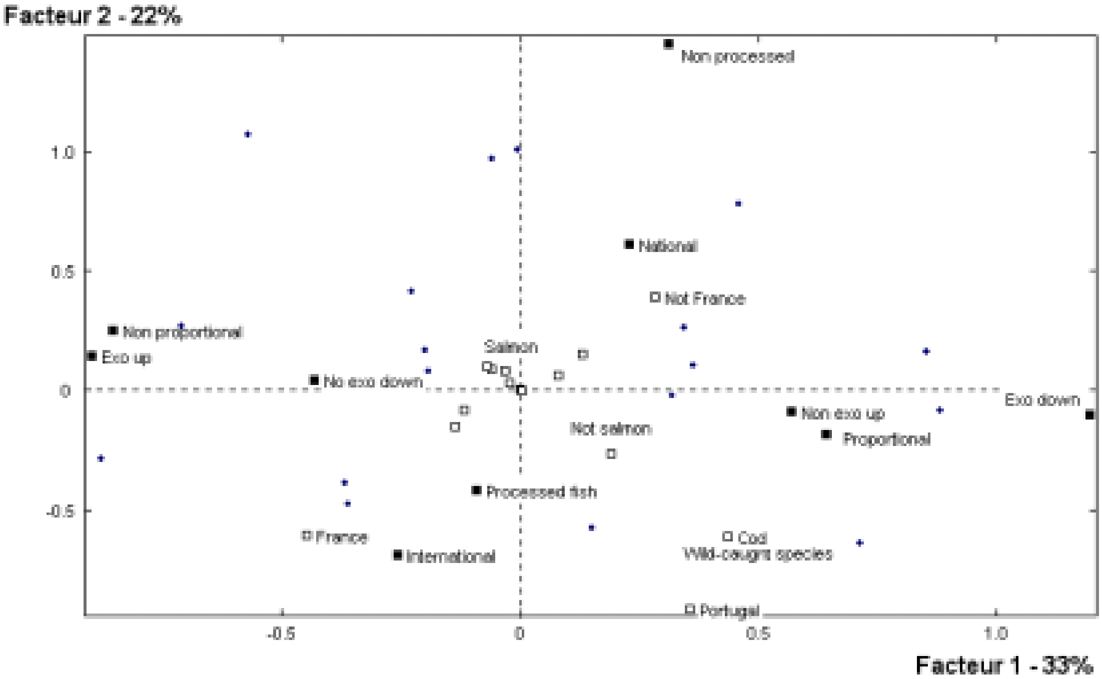

Figure 1 Factorial map (F1-F2) of modalities

Legend :
full squares = modalities of active variables
empty squares = modalities of illustrative variables)
spots = individuals (price relations)

With respect to what has been written in previous section, in particular on the basis of equations (7) and (8), the most striking result is the proximity between non proportionality and exogeneity of the upstream price, significantly opposed along the horizontal axis (F_1) to the close proportional and non exogeneous modalities. Indeed, the modality 'exogeneity down' is further away on the right hand-side of the axis, again in opposition along F_1 to its inverse modality (no exogeneity down). Such a result would mean that many price relations tested for a few European value chains have these two modalities (proportionality and exogeneity down) in common. More properly, whenever a relation has been found non proportional, the upstream price has proved to be weakly exogeneous. Note that the statistical causality can be tested even though proportionality was not found, because the transmission of information through prices may still be perfect, as long as we consider the existence of a technological trend for instance (Asche *et al.*, 2002).

The second axis (vertical) associates two features of the value chains : the geographic area and the degree of fish processing. It only means that a great proportion of relations tested across the national borders were including more elaborated goods (e.g. salted fish between Norway and Portugal, smoke salmon between UK and France, etc.) than for the domestic chains. Once stabilised through processing, elaborated products may travel more easily than fresh fish (better storability, higher value for money with respect to freight costs, etc.).

4. DISCUSSION : A RELATION BETWEEN PROPORTIONALITY AND WEAK EXOGENEITY ?

4.1 Proportionality would cause exogeneity down the chain ?

Chi-square tests complete usefully the previous multivariate analysis. Full results are displayed in table 1 and 2 for 49 tested relations (those relations non cointegrated or with close-to-critical values for the weak exogeneity tests have been removed). For both exogeneity up and down, the hypothesis of dependence with proportionality is accepted with a 5% risk of error.

WEIGHT **% COLUMN** **% ROW**	**Proportional** (p>=0,05)	**Non propor-** **tional**	**TOTAL**
Exo up (p>=0,05)	7 25.00 36.84	12 57.14 63.16	19 38.78 100.00
No exo up	21 75.00 70.00	9 42.86 30.00	30 61.22 100.00
TOTAL	28 100.00 57.14	21 100.00 42.86	49 100.00 100.00

KHI2 = 3.96 / 1 DEGREE OF FREEDOM
PROB (KHI2 > 3.96) = 0.047 / TEST-VALUE = 1.68

Table 1 Exogeneity up and proportionality

Let's first consider the causation from proportionality to exogeneity. A non proportional relation has 57% chance to be found exogenous at the upstream stage of the chain (table 1). Symmetrically, a proportional relation will be exogenous downstream in 39% of cases (table 2). However, it can be neither exogenous down nor up in roughly the same proportion. Consequently, it is easier to predict how exogenous will be a non proportional relation than a proportional.

WEIGHT **% COLUMN** **% ROW**	**Proportional** **(**p>=0,05)	**Non propor-** **tional**	**TOTAL**
Exo down (p>=0,05)	11 39.29 84.62	2 9.52 15.38	13 26.53 100.00
No exo down	17 60.71 47.22	19 90.48 52.78	36 73.47 100.00
TOTAL	28 100.00 57.14	21 100.00 42.86	49 100.00 100.00

KHI2 = 4.03 / 1 DEGREE OF FREEDOM
PROB (KHI2 > 4.03) = 0.045 / TEST-VALUE = 1.70

Table 2 Exogeneity down and proportionality

The results appear to be far more significant with an opposite causation, explaining proportionality from the results of weak exogeneity. A relationship with no exogeneity upstream is found proportional in 70% of the cases (table 1). A relationship with exogeneity up the chain is non proportional in 63% of the cases. Symmetrically, whenever exogeneity down has been proved, 85% of the relationships were found proportional (table 2). In other words, a proportionality is likely to be demonstrated when the price mechanism is rather driven by demand forces.

However, it can be argued that proportionality and exogeneity tests are not accepted on a binary basis (yes or no). They are estimated with a risk of error and a probability of rejection. Therefore the distribution of probabilities have led to split up the individuals into categories :

Proportionality			Exogeneity up			Exogeneity down		
p-value<=0,05	1	Not propor. (20)	p-value<0,05	1	No exo. Up (29)	p-value<=0,05	1	No exo down (37)
0.05< p <0.20	2	Proportional (13)	0.05=<p<0.20	2	Exo. Up (8)	p-value>0.05	2	Exo down (10)
0.2< p <0.6	3	Proportional (8)	p-value>=0.20	3	Exo. Up (10)			
p-value > 0.6	4	Proportional (7)						
TOTAL		48			47			47

* The number of individuals for each category is reported in the parentheses.

Table 3 New categories for the three variables of proportionality and weak exogeneity

As a matter of fact, this new distribution gives poorer results with respect to the relation between proportionality and exogeneity up, and the chi-square test of dependence between the two variables is rejected (see tables 4 and 5 in annex). However, the relation between proportionality and exogeneity down is still significant at a 5% level. For instance, no exogeneity down was found out of 19 cases of non-proportionality.

Two hypotheses can be made out of this result : either it is a pure statistical artefact, or an economic phenomenon. The former option would mean that the weak exogeneity test is not independent from the result obtain to the proportionality test. Coming back to equation (4), it would mean that the α-values are linked with the β-values. In that case, why such a link would only concern α_1 (weak exogeneity downstream) and not α_2 (weak exogeneity upstream) ? The second hypothesis would credit the economic explanation that proportionality is likely to be found whenever exogeneity is found downstream. Such a result is further discussed in the next section in line with empirical pricing methods.

4.2 Evidence of full-costing along the fish value chain

According to the findings in agricultural economics, the willingness to pay of consumers determines price setting conditions all along the chain. Prices are rather known to be determined at the retail level by what consumers are willing to pay, then farm prices being obtained by subtracting all marketing costs from retail prices (Waugh 1964). In other words, given the control over the production technology in agriculture, the major uncertainty comes from the unpredictable (or so) behaviour of consumers. The latter are sensitive to price changes and may substitute products to a large extent. In that case, regressions of margins (or farm price) on retail prices indicate such a direction of price mechanisms, from retail to farm price.

A recent empirical study of the factors affecting marketing margins (hence proportionality) provides with a few explanations of circumstances where price transmission is not so perfect : mark-up pricing, influence of market power, substitution between the farm price and the marketing input, lagged responses by market middlemen causing an asymmetry of price transmission, public policies of price floor, structural changes and demand shifters, quality, seasonality, etc. (Wohlgenant 2001). It is probably a combination of some of these factors that has caused rejection of the proportionality test in some instances. It is notwithstanding striking to observe a greater number of proportional relationships when exogeneity has proved to come from the downstream level, i.e. from retail to farm price.

Granger himself defines causality between two time series X_t and Y_t as follows : "X_t causes Y_t if X_t contains information not available in Y_t that helps forecast Y_t" (Granger 1969, cited in Fackler and Goodwin 2001). Although the interpretation of Granger causality may lead to misunderstanding[3], some hypotheses might be put forward. If proportionality is associated to a higher level of information transmission along the market chain, any unmanageable risk is likely to affect the quality of the transmission. Other studies have shown the impact of risk on marketing margins, sometimes introducing a premium in the margin (Brorsen *et al.* 1985). Consequently, risk regarding the consumer behaviour is perhaps not so unmanageable for the retailing sector because it still leads to constant margins for any middleman of the chain. On the other hand, uncertainty of the supply conditions in the seafood value chains appears to be far more influential as adjustments to the long run pattern of margins require a longer period of time.

In order to learn a bit more about market behaviours along the seafood value chain, a survey of the French industry has been undertaken. Some 80 companies have been face-to-face interviewed about their trading relationships, half of them being primary processors the other half made up with retailers from the six major

[3] « The tests allow inferences only about lead/lag relationships and have little to say about actual causal elements leading to dynamic adjustments » (Fackler and Goodwin 2001).

retailing companies representing more than 50% of market shares (Clarke *et al.* 2002), and probably more than 2/3 of the domestic fish market. A major result is the increasing proportion of sub-contracts between the big retailing chains and the processors (Guillotreau *et al.* 2002), in particular with respect to fish fillets (whitefish, salmon). Consequently, the market is increasingly demand-driven, the processors buying fish specifically for the supermarket and hypermarket fish stores (in the sample, 42% of processors' total sales go to supermarkets) or processing fish bought directly by the retailers. When they were asked how the fish was purchased under the auction market, nearly 20% of processors spoke of dedicated purchase. Symmetrically, 28% of the retailers reported to order fish prior to the auction sales and 23% frankly admitted to sub-contract to the processors.

Transaction costs are decreasing in proportion with the learning effect of trading fish for the big retailers. Vertical integration, formal or informal contracts provide them with better knowledge of cost conditions up the chain. Respectively 64% and 79% of the retailers said their suppliers were committed in terms of quality for salmon and whitefish (against only 33% -salmon- and 41% -whitefish- of commitment on prices). The introduction of industrially farmed species such as Atlantic salmon (*Salmo salar*) in Norway and Scotland has also certainly contributed to reduce uncertainty with regard to the supply of fish. The greater the amount of information up the chain hold by the retailers and the more likely they can impose pricing conditions to the whole industry (Clarke *et al.* 2002). A good example lies in the practice of markup pricing, as it may partly explain why proportionality may not hold sometimes.

Unlike industrial companies, traders are more likely to adopt a direct-costing approach when dealing with food products (Langlois 1993, Asche *et al.* 2002, Olive 2002). Asked about their pricing behaviour regarding fish fillets, 31% of the interviewed processors reported to apply a fixed coefficient on the price of raw fish, 5% look at competitors' prices, 28% discriminate prices according to the type of customer, and 36% use a mixture of all these methods. On the same question, more than half (54%) of the retailers apply a fixed coefficient on the cost of fish fillets, and 36% use another method based on a variable coefficient. The latter consists in setting a goal of fixed unit margin (covering all fixed costs + a profit margin) and to change the markup coefficient in order to achieve this objective whatever the cost of fish (the markup will decrease if the cost of fish increases and reciprocally if the price drops down). Such a behaviour would mean that an additive model would be perhaps more appropriate than a multiplicative model when dealing with proportionality. Direct or full-cost pricing behaviours are more widespread practices than economists would acknowledge.

5. CONCLUSION

The need for synthesising a great deal of information on price transmission along the European seafood value chains (EU-funded Salmar project) has led to use the multifactorial methodology. The results were obtained first with cointegration techniques and various tests on the price relationships. Unexpectedly, a relation has been found between price leadership (statistical causation from downstream to upstream) and proportionality between two price levels : proportionality was more likely to be observed with weak exogeneity down the chain.

Beyond a pure statistical artefact due to a biased test of weak exogeneity, we tried to look for an economic explanation through a survey made on the fish processing and retailing sectors. A sort of learning effect arising with the growing role of supermarkets on the fish markets has increased the stock of knowledge and information down the value chain in Europe. Together with the globalisation of fish supply (salmon farming, whitefish markets), the concentration of the retail sector has resulted in a new market organisation and presumably new pricing behaviours. For instance, markup pricing is perhaps expanding and the fish market may look increasingly like any other food market as described by agricultural economists.

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WEIGHT % COLUMN % ROW	No exo up (P<0,05)	Exo up P(>=5 -20%)	Exo up P>=0, 20	TOTAL
Non Prop (P<0,05)	8 27.59 42.11	4 50.00 21.05	7 70.00 36.84	19 40.43 100.00
Prop P(5-20%)	11 37.93 84.62	1 12.50 7.69	1 10.00 7.69	13 27.66 100.00
Prop P(20-60%)	5 17.24 62.50	1 12.50 12.50	2 20.00 25.00	8 17.02 100.00
Prop P>0,60	5 17.24 71.43	2 25.00 28.57	0 0.00 0.00	7 14.89 100.00
TOTAL	29 100.00 61.70	8 100.00 17.02	10 100.00 21.28	47 100.00 100.00

KHI2 = 8.72 / 6 DEGREES OF FREEDOM
PROB (CHI-2 > 8.72) = 0.190 / TEST-VALUE = 0.88

Table 4 Proportionality (4 categories) and exogeneity up (3 categories)
(Number of individuals : 47)

WEIGHT % COLUMN % ROW	No exo down (P<0,05)	Exo down (P> =0,05)	TOTAL
Non Prop (P<0,05)	19 51.35 100.00	0 0.00 0.00	19 40.43 100.00
Prop P(5-20%)	8 21.62 61.54	5 50.00 38.46	13 27.66 100.00
Prop P(20-60%)	5 13.51 62.50	3 30.00 37.50	8 17.02 100.00
Prop P>0,60	5 13.51 71.43	2 20.00 28.57	7 14.89 100.00
TOTAL	37 100.00 78.72	10 100.00 21.28	47 100.00 100.00

KHI2 = 8.91 / 3 DEGREES OF FREEDOM
PROB (CHI-2 > 8.91) = 0.031 / TEST-VALUE = 1.87

Table 5 Proportionality (4 categories) and exogeneity down (2 categories)
(Number of individuals : 47)