

THE SPANISH HAKE MARKET: RELATIONSHIPS BETWEEN DIFFERENT HAKE PRODUCTS

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ABSTRACT

Seafood consumption has been traditionally very important in Spain (about 36.5 kg per capita consumed in 2003). Hake (*merluza*) is the main fish species consumed in quantity and value terms in Spain. But commercialised as hake can be found several fish species and presentations.

When many papers focus on product aggregation and market integration for several whitefish species using somehow aggregated data; the present study questions the product aggregation on one species, hake, depending on size, gear, origin, etc., by using disaggregated data on several markets in the Spanish market chain.

Then, as most economic time series are non-stationary, cointegration is employed to examine the relationships between the different hake products.

Keywords: hake, markets, product aggregation, cointegration

INTRODUCTION

Seafood consumption has been traditionally very important in Spain (about 36.5 kg per capita consumed in 2003). Hake (*merluza*) is the main fish species consumed in quantity and value terms in Spain. However, commercialised as hake it can be found several fish species and presentations.

Due to the difficulties in describing and predicting consumers behaviours, Deaton & Muellbauer [1] exposed two ways this problem could be simplified, either by aggregation (so that whole categories can be dealt as single units), or by separability (so the problem can be dealt with in smaller, and therefore more manageable units).

Given the large number of hake products, hake demand and prices should be implemented with some level of product aggregation. However, hake products show quite different behaviours as good [2].

Consistent aggregation ensures that behavioural properties which apply to the disaggregate relationships apply also to the aggregate relationships [3]. While improper aggregation can lead to biased estimates of derived demand elasticities, biased estimates of consumer elasticities and biased estimates of welfare loss associated with public policies, and misleading tests of market power [1,4].

Hence the present study tries to find the proper aggregation groups, in which different hake products can be classed by testing product aggregation depending on size, gear used, origin and species using disaggregated data from *Mercabarna*, the Barcelona's wholesale market. We have to acknowledge Mercabarna and Mr. Daniel Martinez, Head of the Fish market, for their advice and providing us the data for the analysis.

The results obtained with this data are different and even question some results from previous studies on seafood product aggregation and seafood market integration.

THEORY

It is generally accepted in economic theory that two or more products (or varieties of a product) can be classed in the same product group if they are close substitutes.

In fact, the firsts formal conditions for goods aggregation appeared in the literature are the Composite Commodity Theorem, based on the relationship between prices, from the works of Hicks [5] and Leontief [6]; and the separability theorem [7,8].

Normally, a weak separability assumption can be used to justify the creation of groups of goods that are investigated in isolation from the rest of the consumer's consumption. However, to formally test for weak separability is then necessary data on all goods in the consumer's bundle, consequently tests are very difficult to be able to be conducted and moreover, they have a low power [4], this brings too many times to assume weak separability without testing (as can be seen in [9]).

Alternatively, the Composite Commodity Theorem states that for several goods, if individual prices move in parallel (proportionally) over time, these goods can be treated as a single commodity group, and so characterized using a composite price index.

Following Deaton & Muellbauer [1], in the case of 2 goods ("i" and "j"), the Composite Commodity Theorem holds if the paths for the 2 price series can be described by the same common factor, θ_t , so:

$$P_{it} = \theta_t P_{i0} \quad \text{and} \quad P_{jt} = \theta_t P_{j0} \quad (\text{eq. 1})$$

The 0 subscript indicates an arbitrarily chosen base period. It should be noticed that θ_t can vary over time.

When the Composite Commodity Theorem holds, θ_t acts as the price for the combined group, and the group quantity is given as the index:

$$Q_t = P_{i0} \cdot q_{it} + P_{j0} \cdot q_{jt} \quad (\text{eq. 2})$$

This procedure is possible to straightforward extend for grouping any number of goods.

The Composite Commodity Theorem implies that the relationship between the two prices is constant and hence that the ratio P_{it} / P_{jt} remains fixed at P_{i0} / P_{j0} .

This can be used to derive the relationship between the prices. Specifically, from equation 2, it follows that:

$$P_{it} = b P_{jt} \quad (\text{eq. 3})$$

Where b is P_{i0} / P_{j0} .

Thus, for a group of goods which the Composite Commodity Theorem holds, prices move proportionally over time.

In accordance, Stigler and Sherwin [10] defined substitute products as those which are "in the same market" and whose relative prices "maintain a stable ratio".

Recently, through the work of Lewbel [4], the rigid conditions of the Hicks' Composite Commodity Theorem were relaxed, in the Generalized Composite Commodity Theorem (also known as GCCT).

The Composite Commodity Theorem is an exact relationship, while Lewbel [4] showed that the errors in regression (any deviation) could be unimportant for product aggregation. This was

done by stating that the price ratios may vary across observations as long as the distribution of the ratio of the commodity price to the group price is independent of the level of the group price. Hence, the relative difference between the individual commodity price and the aggregate commodity price must be independent of the aggregate commodity price.

Thus, Lewbel, by providing the Generalised Composite Commodity Theorem, which is empirically testable, the relationships between prices can play a crucial role in aggregation theory.

METHODOLOGY

One way to test for the Generalised Composite Commodity Theorem, when prices are non-stationary (and most economic time series are non-stationary), is to test whether the relative prices are cointegrated with the group indices. If they are not, the Generalised Composite Commodity Theorem holds.

Lewbel [4] employed the Engle & Granger [11] cointegration test; whilst, Davis [12] also employed the Engle & Granger cointegration test and then used multiple applications of Lewbel's simple test in conjunction with modified Bonferroni procedures.

However, nowadays, the most common cointegration test is the Johansen test [13,14] which is useful when prices are non-stationary, because it allows testing hypothesis on the cointegration parameters; while the Engle & Granger cointegration test does not [15].

Working with the Johansen test, Asche et al., [16] showed the existence of a relationship between product aggregation using the Generalised Composite Commodity Theorem and the Law of One Price (used in market delineation), because for both conditions to hold, prices must move proportionally over time.

When the Law of One Price (LOP) holds for non-stationary prices, the expected relative prices are constant (and equal to the parameter b), and any deviations from this relationship (like the error term in the LOP regression) are stationary. Then prices and the price index of the group (all non-stationary) cannot cointegrate with the relative prices (constant). So, when the LOP holds, the GCCT holds, and then products can be aggregated.

The LOP is normally tested by estimating equation 4, and then testing the null hypothesis of $a=1$:

$$\ln(P_{it}) = b + a \ln(P_{jt}) \quad (\text{eq. 4})$$

When $a=1$, and $b=0$, then the LOP holds and both prices can be considered equals. While when $a=1$, but $b \neq 0$, then prices have a proportional relationship, but their levels may differ due to factors such as transportation costs or quality differences (weak version of the LOP). On the other hand, when $a=0$, then both prices are not related; while if $a \neq 1$ and $a \neq 0$, the prices are somehow related.

It should be noticed that equation 4 is just equation 3 in logarithms, when $a=0$. Therefore there is a close relationship between the Generalised Composite Commodity Theorem and the Law of One Price, because if one holds, the other holds as well. So, the Law of One Price is sufficient for the GCCT to hold.

Finally, one last way to test for product aggregation is clearly deduced from Lewbel, [4] and Asche et al., [16] explanations as when prices and group's price index are non-stationary, the price ratios may vary across observations as long as the distribution of the ratio of the commodity price to the group price is independent of the level of the group price and stationary.

Then, it is deduced that it can be investigated whether the GCCT holds by investigating whether the ratio of non-stationary prices are stationary (as already performed in Asche et al., [17]).

This can be performed by running the Augmented Dickey-Fuller test (ADF) developed by Dickey and Fuller [18,19], which tests whether the series are non-stationary against the alternative hypothesis of stationarity.

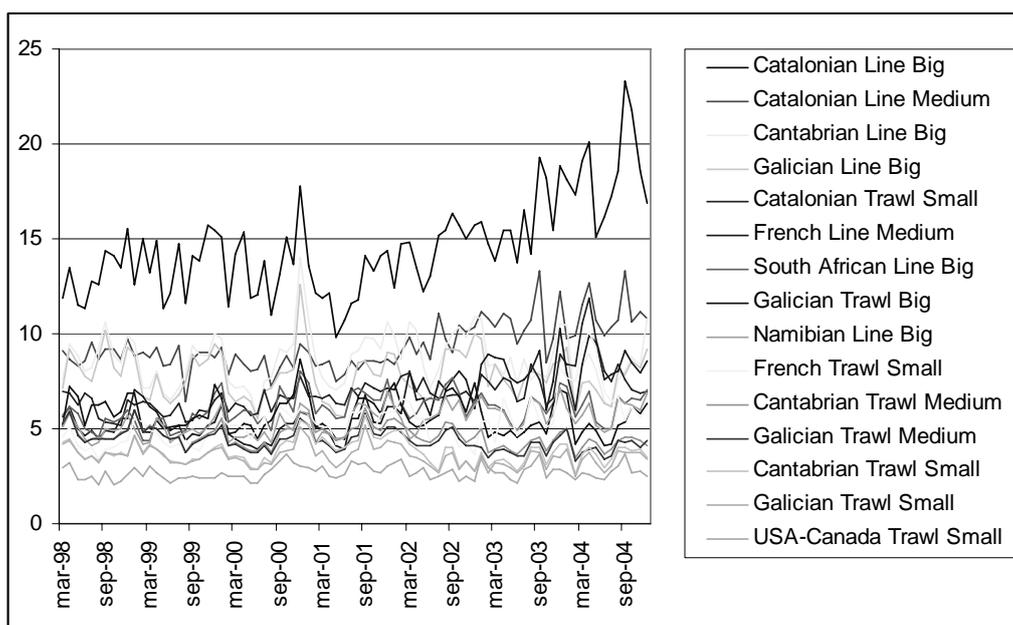
THE DATA

Mercabarna, Barcelona's wholesale market, is estimated to supply in a regular basis more than 8 million people (being its influence area larger than the Catalonia region itself). With around 100 thousand tonnes of seafood commercialised per year, accounts for around the 20% of the total seafood commercialised in the Spanish net of wholesale markets. Hake is one of the main species commercialised in Mercabarna, and it is supplied from a large range of sources, mainly from South Africa and Namibia, Mediterranean and Atlantic waters (Great Sole and the Cantabrian Sea).

For this analysis there are used the 82 monthly price observations for 15 different fresh hake products commercialised during the period March 1998 to December 2004 in Mercabarna. These 15 products are denoted first by its area of origin, then by the gear used to fish them (long line or trawler) and finally by its size: small (less than 500 gr.), medium (between 500 gr. and 1 Kg.) or big (more than 1 kg.). Thus, the 15 products analysed are: Galician Trawl Big, Namibian Line Big, South-African Line Big, Galician Line Big, Cantabrian Line Big, Catalan Line Big, Cantabrian Trawl Medium, Galician Trawl Medium, Catalan Line Medium, French Line Medium, Cantabrian Trawl Small, Catalan Trawl Small, French Trawl Small, Galician Trawl Small and USA-Canada Trawl Small hake. There were also other fresh hake products commercialised in Mercabarna, but they presented some missing observations, because they were not commercialised during all months of the period.

This range of products will allow testing for certain aggregation criteria like size, gear and origin. On next table it can be seen the price evolution for the 15 hake products analysed.

Figure 1: Price evolution for the 15 hake products analysed from Mercabarna



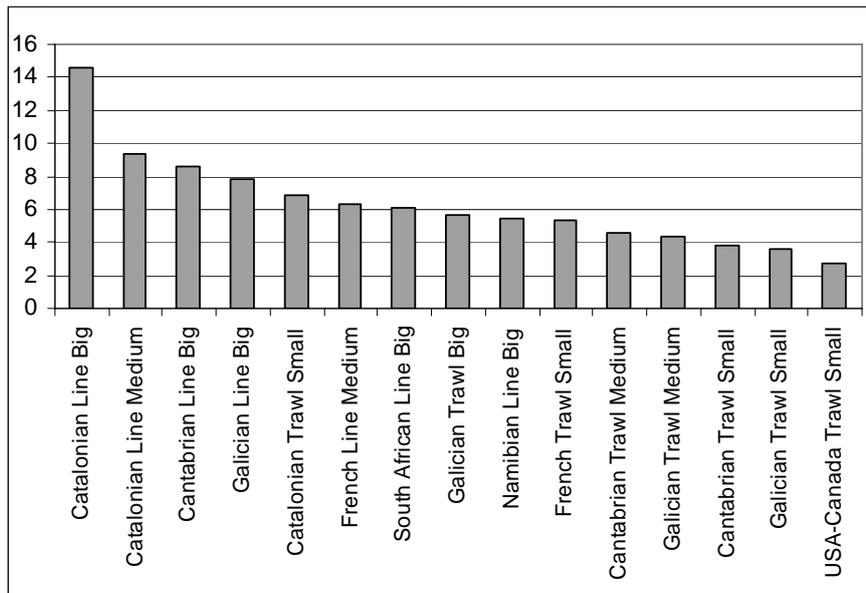
From the graph it can be seen that not all the different hake product prices follow fully similar evolution patterns, moreover, mean prices can be quite different. For its further analysis some descriptive statistics (mean, standard deviation, coefficient of variation and the volume-weighted mean price) for the 15 hake products prices and their logs are presented on next table.

Table 1: Descriptive statistics for the 15 hake products

	Mean	SD	CV	Ln Mean	Ln SD	Ln CV
Catalonian Line Big	14.61	2.56	17.50	2.67	0.17	6.32
Catalonian Line Medium	9.39	1.28	13.64	2.23	0.13	5.90
Cantabrian Line Big	8.63	1.41	16.28	2.14	0.16	7.53
Galician Line Big	7.82	1.22	15.57	2.05	0.15	7.51
Catalonian Trawl Small	6.91	1.10	15.85	1.92	0.15	7.60
French Line Medium	6.32	1.62	25.59	1.81	0.25	13.92
South African Line Big	6.05	0.83	13.72	1.79	0.14	7.74
Galician Trawl Big	5.70	0.93	16.29	1.73	0.16	9.25
Namibian Line Big	5.41	0.77	14.33	1.68	0.14	8.53
French Trawl Small	5.38	1.27	23.57	1.66	0.22	13.00
Cantabrian Trawl Medium	4.62	0.58	12.55	1.52	0.12	8.17
Galician Trawl Medium	4.39	0.56	12.86	1.47	0.13	8.62
Cantabrian Trawl Small	3.80	0.62	16.38	1.32	0.16	12.30
Galician Trawl Small	3.55	0.53	14.99	1.26	0.15	11.83
USA-Canada Trawl Small	2.70	0.38	14.10	0.98	0.14	14.00

Price variability (Coefficient of Variation) seems to be quite similar for these products; however, the price means show quite different and more interesting patterns, which can be seen on next graph.

Figure 2: Mean price for the 15 hake products analysed from Mercabarna



From this table can be seen the mean prices of the different hake products, which may somehow establish a ranking between the attractiveness (taste, freshness, quality, size, etc.) of these

several species being the Catalan long-line hake the most appreciated, followed by the Catalan medium hake, the Cantabrian long-line hake and the Galician long-line hake. Then it follows the Catalan Trawl Small hake, French Medium hake, South African long-line hake, the Galician Trawl Big, Namibian long-line hake and French Trawl Small hake. While at the end it can be found the Cantabrian Medium, Galician Medium, the Cantabrian Trawl Small, the Galician Trawl Small and the USA-Canada Trawl Small hake.

When considering the species, this ranking is in accordance with the more complete ones shown in Anderson [20] and Guillen & Franquesa [21], as the most preferred hake is the European hake (from the different Spanish regions and France), followed by the Cape hakes (from South Africa and Namibia) and finally the Silver hake (from USA-Canada).

Furthermore, this products' ranking clearly shows the preferences for the Mediterranean hake, and specially the local one. It also shows the preference for bigger hake, and for hake fished with long-line rather than the one fished by trawl.

ANALYSIS

On table 2, it can be seen the degree of correlation between the log of the price series for the 15 products analysed from the Mercarbana wholesale market.

Some interesting results can be obtained from the correlation matrix, see table 2. First, it can be seen that the degree of correlation depends on:

- the proximity between origins, which it can be related to both the species and its freshness, as for South Africa and Namibia, which both are exporting Cape hakes to the Spanish market. It also holds for Galicia and the Cantabrian; and for Catalonia and France;
- the gear used: long-line or trawler.
- and the weight class: small, medium or big.

As expected, the correlation decreases the farther apart the weight classes are far from each other.

Next it is investigated the stationary properties of the price series, using Augmented Dickey Fuller tests on the logs of the price series.

All ADF tests have been performed with EViews 4.1., and in order to determine the appropriate lag length, it has been start with a sufficiently high lag length (13), and was chosen the lag length that minimizes the Akaike Information Criterion. The test for unit root in levels included trend and intercept parameters, but in those series that the trend was found insignificant and the AIC was lower when not considering it, the trend parameter was removed. Results are shown on next table.

Table 2: Correlation matrix of the log prices of the 15 hake products analysed from Mercabarna

	Catalonian Line Big	Catalonian Line Medium	Cantabrian Line Big	Galician Line Big	Catalonian Trawl Small	French Line Medium	South African Line Big	Galician Trawl Big	Namibian Line Big	French Trawl Small	Cantabrian Trawl Medium	Galician Trawl Medium	Cantabrian Trawl Small	Galician Trawl Small	USA-Canada Trawl Small
Catalonian Line Big	1	0.79	0.23	0.35	0.53	0.71	0.36	0.13	0.56	0.50	-0.06	-0.06	-0.02	0.02	0.19
Catalonian Line Medium	0.79	1	0.17	0.23	0.65	0.84	0.29	-0.02	0.56	0.44	-0.09	-0.13	-0.10	-0.09	0.19
Cantabrian Line Big	0.23	0.17	1	0.87	0.14	0.26	0.59	0.82	0.53	0.06	0.59	0.53	0.49	0.51	0.31
Galician Line Big	0.35	0.23	0.87	1	0.04	0.27	0.54	0.85	0.60	-0.04	0.53	0.56	0.38	0.51	0.28
Catalonian Trawl Small	0.53	0.65	0.14	0.04	1	0.70	0.41	-0.05	0.50	0.84	0.03	-0.10	0.20	0.07	0.33
French Line Medium	0.71	0.84	0.26	0.27	0.70	1	0.35	0.04	0.65	0.57	0.02	-0.04	0.02	0.01	0.29
South African Line Big	0.36	0.29	0.59	0.54	0.41	0.35	1	0.57	0.84	0.39	0.45	0.33	0.46	0.38	0.45
Galician Trawl Big	0.13	-0.02	0.82	0.85	-0.05	0.04	0.57	1	0.49	-0.08	0.72	0.73	0.53	0.61	0.29
Namibian Line Big	0.56	0.56	0.53	0.60	0.50	0.65	0.84	0.49	1	0.41	0.32	0.25	0.28	0.27	0.44
French Trawl Small	0.50	0.44	0.06	-0.04	0.84	0.57	0.39	-0.08	0.41	1	0.04	-0.06	0.31	0.18	0.39
Cantabrian Trawl Medium	-0.06	-0.09	0.59	0.53	0.03	0.02	0.45	0.72	0.32	0.04	1	0.93	0.84	0.84	0.49
Galician Trawl Medium	-0.06	-0.13	0.53	0.56	-0.10	-0.04	0.33	0.73	0.25	-0.06	0.93	1	0.74	0.85	0.35
Cantabrian Trawl Small	-0.02	-0.10	0.49	0.38	0.20	0.02	0.46	0.53	0.28	0.31	0.84	0.74	1	0.93	0.65
Galician Trawl Small	0.02	-0.09	0.51	0.51	0.07	0.01	0.38	0.61	0.27	0.18	0.84	0.85	0.93	1	0.58
USA-Canada Trawl Small	0.19	0.19	0.31	0.28	0.33	0.29	0.45	0.29	0.44	0.39	0.49	0.35	0.65	0.58	1

Table 3: ADF unit roots tests for the log of the hake prices analysed

	In level	First differences
Galician Trawl Big	-1.50 (12)	-3.98 (11) *
Namibian Line	-1.37 (11)	-6.79 (10) *
South African Line	-0.98 (11)	-5.95 (10) *
Galician Line	-2.33 (13)	-3.91 (13) *
Cantabrian Line	-1.12 (11)	-5.06 (13) *
Catalan Line	-0.57 (11)	-9.62 (1) *
Cantabrian Trawl Small	-2.26 (12)	-9.21 (1) *
Catalan Trawl Small	-3.02 (12)	-10.08 (1) *
French Trawl Small	-3.02 (2)	-8.87 (1) *
Galician Trawl Small	-2.09 (12)	-2.83 (11) *
USA-Canada Trawl Small	-1.56 (11)	-5.34 (9) *
Cantabrian Medium	-1.83 (12)	-6.63 (6) *
Galician Medium	-2.05 (12)	-2.83 (11) *
Catalan Medium	-0.92 (3)	-9.38 (2) *
French Medium	-1.49 (9)	-4.94 (8) *

Where the number of lags is shown inside the parentheses, and * denotes when the null hypothesis of the existence of at least one unit root (non-stationarity) is rejected at a 5 % significance level.

The null hypothesis of the existence of at least one unit root cannot be rejected (at a 5% level) for any of the price series. While all the first differences of the price variables reject the null hypothesis of the existence of a unit root. So, it can be concluded that all the price series are non-stationary I (1) processes.

Then it could be tested whether the price series can be aggregated between them. It would be possible to consider hake as one and only appropriate category if all products could be aggregated together.

The next step, it is to try to find suitable groups where hake products can be aggregated together. In order to do so, first of all, unit roots tests are undertaken to the difference between the logs of price series with certain common features. These common features analysed are: size, gear used and origin.

One of the main distinctions between hake products is size. Guillen [2] shows the relation between size and product behaviour in hake, as the bigger hakes behave more as luxury goods than smaller ones that tend to behave as normal or even inferior goods. With these premises, it is first analysed if hake products can be classified depending on their size in big, medium and small categories.

Big hake category

First it is going to be test whether all of more than 1 kilogram commercialised in Mercabarna can be aggregated under a common category. In this case, the price series are divided by the Galician Trawl Big hake, which is the category which has the higher correlation degree among the others of this possible group.

Table 5: ADF unit roots tests for the log prices of bigger than 1kg hake divided by the log of the prices from the Galician Line Big hake

	In level	First differences
Namibian Line Big	-6.02 (6) *	-
South African Line Big	-4.87 (2) *	-

Galician Trawl Big	-4.99 (0) *	-
Cantabrian Line Big	-6.17 (1) *	-
Catalan Line Big	-0.57 (11)	-6.08 (9) *

As already seen before in the previous ADF tests, the number of lags is shown in parentheses, and * denotes when the null hypothesis of the existence of at least one unit root (non-stationarity) is rejected at a 5 % level.

It seems that all the hake products but long-line hake from Catalonia can be aggregated together, as the ratio between prices is stationary, except for the Catalan long-line hake. Then it is not possible to aggregate these species under the category “*Big hake*”.

But it could be possible to aggregate under one category “*non-local big hake*” the Galician Trawl big hake, the Namibian long-line hake, the South-African long-line hake, the Galician long-line hake and the Cantabrian long-line hake.

Medium hake category

Next, it is going to be test whether medium hake (from 500 grams to 1 kg) commercialised in Mercabarna can be aggregated under a common category. In this case, the price series are divided by the Cantabrian Medium hake, which is the category which has the higher correlation degree among the others of this possible group.

Table 6: ADF unit roots tests for the log prices of medium hake divided by the log of the prices from the Cantabrian Trawl Medium hake

	In level	First differences
Galician Trawl Medium	-3.12 (1) *	
Catalan Line Medium	-2.97 (1)	-5.22 (7) *
French Line Medium	-1.93 (2)	-9.61 (1) *

From these results the Cantabrian and the Galician medium hake could be aggregated in one hake group, but not the Catalan and French medium hake. Then it is not possible to group these species under the category “*Medium hake*”, but the Cantabrian and the Galician medium hake under the category “*non-Mediterranean Medium hake*”.

This consequence, apart from the freshness level, could be produced because hake between 500 grams and 1 kg, it is normally fished by trawl in the Atlantic, while in the Mediterranean may be fished by long-line or minor gears.

Small hake category

It is continued by testing whether small hake (less than 500 grams) commercialised in Mercabarna can be aggregated under a common category. In this case, the price series are divided by the Cantabrian Trawl Small hake, which is the category which has the higher correlation degree among the others of this possible group.

Table 7: ADF unit roots tests for the log prices of medium hake divided by the log of the prices from the Cantabrian Trawl Small hake

	In level	First differences
Catalan Trawl Small	-3.40 (1)	-5.03 (6) *

French Trawl Small	-1.26 (11)	-3.67 (10) *
Galician Trawl Small	-2.62 (1)	-13.21 (1) *
USA-Canada Trawl Small	-6.50 (0) *	-

These results show that the Cantabrian Trawl Small hake could be aggregated together with the USA-Canada Trawl Small hake, but surprisingly not with the Galician Trawl Small (although it was rejected at a 5% significance level, but not at a 10%). Moreover, as in previous cases, the aggregation of the Catalan Trawl Small and the French Trawl small hake in the group was rejected at a 5 % level (although for Catalan and Galician Trawl Small hake it was rejected at a 5% significance level, but not at a 10%).

Then it seems not possible to group all these species under the category “*Small trawl hake*”, but taking into account previous results seems possible the existence of one “*non-Mediterranean small trawl hake*” category, with the Cantabrian Trawl Small, the USA-Canada Trawl Small hake, and maybe the Galician Trawl Small.

From the results obtained when analysing the possibility to aggregate hake products depending on its size, it seems necessary to perform aggregation tests in order to know if “*Mediterranean hake*” can be an appropriate category.

Mediterranean hake category

Then, it is proceeded to test the existence of a Mediterranean hake group, with all French and Catalan hake products. In this case, the price series are divided by the Catalan Line Medium hake.

Table 8: ADF unit roots tests for the log prices of medium hake divided by the log of the prices from the Catalan Line Medium hake

	In level	First differences
Catalan Line Big	-6.57 (0) *	
Catalan Trawl Small	-2.71 (1)	-13.79 (0) *
French Line Medium	-4.71 (0) *	
French Trawl Small	-2.69 (1)	-13.33 (0) *

From these results it can be observed that it is not possible to aggregate all French and Catalan hake products under the same category “*Mediterranean hake*”. But the Catalan Big long-line hake, the Catalan Medium long-line hake and the French Medium long-line hake could be aggregated under a common category, which could be called “*Mediterranean long-line hake*”.

In this case, the null hypothesis of non-stationarity for the Catalan Trawl Small hake and French Trawl Small hake was rejected at a 5 % level, but not at the 10% level, which left opened the possibility for a “*Mediterranean hake*” group, but could not be confirmed.

Furthermore, more categories were also checked (like non-Mediterranean hake, Mediterranean small trawler hake, non-Mediterranean trawler hake, long-line hake, etc.) with similar and complimentary results to the previously shown here.

CONCLUDING REMARKS

Hake product preferences in Mercabarna (and extensively in Catalonia) are for the fresher hake (with the closer origin), and especially for Mediterranean hake. It also shows the preference for bigger hake than small one, and for hake fished by long-line to the one fished by trawl. These preferences, reinforced by

the important and traditional consumption behaviour, suggest that the existence of a homogeneous hake category can be hindered

Likewise, the aggregation test results obtained show that it is not possible to consider that all hake products can be suitably aggregated under the same common category (hake); but in several ones.

The aggregation results show that several products can be aggregated under different categories depending on the size for imported hakes (not Mediterranean), while for Mediterranean hake a distinction is established between long-line and trawler hake. So, as detailed below, hake products can be aggregated under the categories:

- “*Big (long-line and trawler) non-Mediterranean hake*”,
- “*Long-line (big and medium) Mediterranean (Catalonian and French) hake*”, and maybe it could be also included the small Mediterranean (trawler) hake.
- “*Medium (trawler) non-Mediterranean hake*”.
- “*Small (trawler) non-Mediterranean hake*”.

Although, it is not clear (there is no strong evidence for all products); it could be possible that “*Medium (trawler) non-Mediterranean hake*”, and “*Small (trawler) non-Mediterranean hake*”, could be aggregated together in one category

These results are different to most of the current results obtained on seafood product aggregation and seafood market integration literature. Examples of this mismatch are found in: Asche et al., [17], who analysed 6 different sizes (from 1 to 7 kg) of Norwegian salmon and found that all could be aggregated together under a common category; Asche et al., [22], who using Eurostat’s monthly import prices for the period 1983-1995 found that the 4 frozen whitefish species analysed behaved as a single species with a single price; Asche et al., [23], who analysed the monthly Japanese price import data for 4 salmon products (wild coho salmon, farmed coho salmon, farmed salmon trout and wild sockeye salmon) for the period 1994-2000 and found them to cointegrate and behave as a single market.

Furthermore, Jaffry et al., [24] analysed the main 13 species of the Spanish seafood finding that the species could be divided in several groups, in one of them, hake appear to cointegrate with cod and monkfish. While results from these analysis show that this kind of results can be questioned.

Then, since only by consistent aggregation can be ensured that the behavioural properties which apply to the disaggregated relationships apply also to the aggregated relationships; it is important to analyse the validity of the categories and work with more disaggregated data when necessary. Even though this will imply, as explained by Davies et al., [25], higher data collection costs, missing observations, multicollinearity, and limited degrees of freedom.

Finally, it should be considered that these results for fresh hake products are obtained from Barcelona’s wholesale market data, and this market supplies regularly more than 8 million people. However, it could be probable that these results may slightly diverge if a similar analysis was performed in other markets; due to different consumer preferences, product transportation distances and supply availability.

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