STRUCTURAL CHANGE IN SPANISH SEAFOOD CONSUMPTION

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ABSTRACT

This study analyses seafood consumption at home in Spain using three different cross sections (1980, 1990, and 1998). Price indices for seafood and other items are calculated for each household. The empirical analyses consists of the estimation of double hurdle models of seafood consumption for each survey, separately. Socio-economic variables play an important role and with a similar pattern in the three periods. The more important results concern economic fundamentals. Seafood demand is inelastic and substitute of meat and eggs and dairy products in 1980, and elastic and complement other animal food items in 1990 and 1998. Expenditure elasticity does not decrease between 1980 and 1998. The large variations in aggregate seafood consumption in Spain during the 90s have been explained previously as changes in consumption tastes or in demographics during this period. The main conclusion of this study is a very important change in tastes or in buying habits since the 80s, the seemingly erratic trend in aggregate seafood consumption in the 90s being explained by the demand elasticity.

Keywords: Fish expenditure, seafood consumption, Spain.

INTRODUCTION

A number of factors have been identified in the literature as contributing to changes in consumption habits. These include fragmentation in household composition, increasing disposable incomes, and an increase in the number of women working outside the home leading to a general loss in traditional cooking skills and less time available to prepare food in the home. As a consequence, the aggregate response of seafood consumption to changes in such fundamental economic variables depends on both within-group changes (preference or taste changes) and between-group changes (structural changes). In this paper, Spanish household expenditure on seafood is analyzed using Household Budget Survey datasets for 1980/81, 1990/91 and 1998. The aim of the paper is to analyze the factors influencing Spanish household decisions to purchase seafood and how much to spend on seafood items.

The analysis of seafood consumption in Spain is based mainly on the series of the Consumption Survey of The Ministry for Agriculture, Fisheries and Food (MAPYA), where the detailed socio-demographic characterization has been exploited. Highlights of some socio-demographic factors explaining characteristics of household consumption of seafood usually noted are: fish consumption is negatively related with women being in work, Seafood consumption is less in households with children, fish consumption is negatively related to household size and to income level, fish consumption is larger in cities and metropolitan areas, and there are regional differences in seafood consumption.

Based on MAPYA surveys, Millán (2002) summarizes the main characteristics of the Spanish seafood consumption in 1998 and its evolution over the previous decade. In the 1980s and 1990s, there was decreasing consumption of seafood products, although not at a regular pace: at the end of the 1980s and in the mid-1990s there was a remarkable decline, while at the start of the 1990s, consumption rose. Many factors influence seafood consumption: income, prices, general economic conditions and socio-economic variables. A relevant fact about the evolution of seafood consumption in Spain is that there is no clear trend in the different components of consumption (Millán, 2002:288).

The analysis of seafood consumption must embody the variation in the explanatory variables. A very detailed but static description is not informative: databases with substantial variation in the variables are required. Hence, price effects are usually analyzed with time series data. On the other hand, demographic characteristics are studied using survey data because more variation is available. The main problem in using survey data is the significant proportion of households that report zero consumption. Lin and Milon (1993) and Yen and Huang (1996) focuses their analyses on socio-demographic and economic factors affecting seafood consumption using double-hurdle models, and Manrique and Jensen (1998, 2001) used double-hurdle models for explaining Spanish household demand for seafood products using the Survey of Consumption Expenditure 1990/91, by the Spanish Statistical Office (INE).

How food demand responds to changes in prices, in addition to income and household characteristics, is important from a consumption policy point of view and even more from a producer perspective. However, prices are not included frequently in cross section analysis of consumption. As an example, prices are not in the regressions by Manrique and Jensen (1998, 2001). In the present paper, three different cross-sections with disaggregated product categories ("headings") and regional variation allows the use of price indices to construct household-specific price indices for seafood, and other food items.

The structure of the paper is as follows. In the next section, the data are introduced and discussed. It follows a short presentation of the specification and estimation of the model and the discussion of the results. To conclude, a summary of results and some implications of the research.

DATA

The data we use for the estimation of the demand system is microdata belonging to the Surveys of Consumption Expenditure 1980/81 (hereafter '1980') and 1990/91 (hereafter '1990') and the longitudinal data for 1998 ('1998') of the Household Budget Continuous Survey, organized by the Spanish Statistical Office INE. Regrettably, microdata from the MAPYA survey are not available.

The data from the 1980 and 1990 surveys have been used in the collection prepared by Arévalo et al. (1998) and Alonso-Colmenares *et al.* (1999) at the University Carlos III of Madrid. They are available at the Internet (www.eco.uc3m.es/investigacion). We have used the files with household characteristics and the consumption by headings. There are 24 food and drink categories, with two for seafood products, four for meat products and three for eggs, milk and dairy products.

For the 1998 data, we have used the goods files of the Households Budget Continuous Survey. We aggregate the expenditures in the 24 food headings and have not used the quantity data for food products. Household information comparable to those available in 1980 and 1990 is selected from the household files. These data (and those of the following surveys) have become available for free via the Internet (www.ine.es). The Households Budget Continuous Survey, started by INE in the third quarter of 1997 in the current form, provides information on the nature and purpose of consumption expenditures, as well as on diverse characteristics respecting the way of life of households. The data that requires the use of the longitudinal file have a flexible year for the household information reference year. Hence the longitudinal data 1998 uses purchases from the third quarter to 1997 to the second quarter of 1999. Food items have been aggregated in the 24 headings of the Surveys of Consumption Expenditure 1980 and 1990

The variables used in this analysis are listed and described in Table 1. The dependent variable in the analysis is household expenditure on seafood, taking the form of a binary variable in the decision to purchase seafood. The dependent variable is assumed to be explained as a linear combination, reflecting tastes, of a vector of variables consisting of income, seafood, other food prices and various socioeconomic characteristics. Some interesting variables in the literature (such as a working female) are not used

because of accessibility difficulties or lack of comparability between 1980, 1990 and 1998. We have aggregated the Autonomous Communities of Spain into four regional variables.

Table I: Variables

Variable	Description
Dependent	
PART	1= Household buying seafood; 0= otherwise.
SHARE	Share of seafood in total expenditure
Independent	
LFEX	Logarithm of food expenditure
LFP	Logarithm of seafood price, normalized by other food price
LMP	Logarithm of meat price, normalized by other food price
LEP	Logarithm of eggs and dairy products price, normalized by other food price
LAGE	Logarithm of the age of head of household
SEX	1= Female head of household ; 0= male head of household
LSIZ	Logarithm of the number of household members
CHILD	Number of household members aged eighteen years or less
ELDER	Number of household members older than 65 years
den1	1= Density: Sparsely populated area; 0= otherwise (reference in equations)
DEN2	1= Density: Intermediate area; 0= otherwise
DEN3	1= Density: Highly populated area; 0=otherwise
el1	1= No education or primary education; 0= otherwise (reference in equations)
EL2	1= Secondary education; 0= otherwise
EL3	1= Higher education; 0= otherwise
reg1	1= Region with Mediterranean Coast, excl. Balearic Islands; 0=otherwise (reference)
REG2	1= Balearic Islands, Canary Islands, Ceuta and Melilla; 0=otherwise
REG3	1= Region with Cantabric Coast (Northern and Northwestern); 0=otherwise
REG4	1= Inner region; 0=coastal region

Usually, unit values for each beverage are calculated by dividing expenditure by quantities. However, for 1980 and 1990 we use only the headings, the unit value method being not available. Yen and Huang (1996) use regional price data and four periods to obtain 36 different prices, avoiding the quality problem. We use price indices for 17 Regions, 3 years and 24 headings. In this way, different groups of food price indices for each household are obtained, and continuous series of prices with a lot of variation are available.

The proportion of households buying seafood is high, in general. The exception is the one-adult household, with or without children, with participation around 70%. One-adult households are excluded from the analysis. Sample size is 21761 households in 1980 (91% of households), 18748 in 1990 (88.9%) and 8774 in 1998 (89%). The descriptive statistics of the dependent variables are shown in Table II.

Table II: Participation and share expenditure of seafood consumption

Year	1980			1990			1998		
Variable	Mean	Std. Dev.	Max	Mean	Std. Dev.	Max	Mean	Std. Dev.	Max
PART	0.909	0.288	1	0.925	0.264	1	0.923	0.267	1
SHARE	0.099	0.075	0.764	0.111	0.084	0.933	0.110	0.092	0.804

THE MODEL

When cross-sectional data are used for demand analyses of specific products, a large number of zero purchases are expected due to the short period in which data are recorded. The reasons for recorded zero expenditure are infrequency of purchase, no participation, or a corner solution. Infrequency of purchase is because the survey period is too short to allow consumers to report any purchase of a specific product. No participation or abstention is due to consumers are not willing to buy the product (both vegetarians and meat lovers). Corner solutions arise when consumers do not purchase the product at current prices and income levels. In early studies, the Tobit model was widely used, but this is only appropriate if all zero observations are corner solutions with the same explaining variables that a positive consumption.

Different versions of double-hurdle models have been used. The idea behind these models (including infrequency of purchase) is that a consumer has to overcome two hurdles before recording a positive expenditure, i.e. decisions to: (1) participate in the market (be a potential consumer) and (2) actually consume. The double-hurdle model, originally formulated by Cragg (1971), assumes that these two decisions with regard to purchasing an item are each determined by a different set of explanatory variables. A different latent variable is used to model each decision process, with a Probit part determining participation, and a Tobit part determining the expenditure level (Blundell and Meghir, 1987)

The participation decision takes the form:

$$y_{ip}^* = w_i^T \boldsymbol{a} + \boldsymbol{e}_i \tag{Eq. 1}$$

The expenditure decision is based on:

$$y_{ie}^* = x_i^T \boldsymbol{b} + \boldsymbol{h}_i \tag{Eq. 2}$$

The variables y_{ip}^* and y_{id}^* are latent variables describing the household's decision to participate in seafood consumption and to buy a given quantity of seafood, respectively; w_i and x_i are the vectors of variables explaining the participation and the consumption decision, respectively. The error terms follow the normal distribution, and can be correlated if both decisions are jointly adopted:

$$(\boldsymbol{e}_i, \boldsymbol{h}_i) \sim N(0, \Sigma) \quad \text{where } \Sigma = \begin{bmatrix} 1 & \boldsymbol{rs} \\ \boldsymbol{rs} & \boldsymbol{s}^2 \end{bmatrix} \tag{Eq. 3}$$

$\boldsymbol{r}$: correlation coefficient

In the double-hurdle model (DH), a zero quantity is explained as voluntary abstention from buying for non economic reasons in the first hurdle, or attributed to economic reasons, corner solution, in the second hurdle. The actual consumption determined by:

$$y_i = x_i^T \boldsymbol{b} + \boldsymbol{h}_i \qquad \text{if} \quad y_{ip}^* > 0 \text{ and } y_{ie}^* > 0$$
$$y_i = 0 \qquad \text{otherwise} \tag{Eq. 4}$$

In the Tobit infrequency of purchase model (Tobit IP), a zero quantity is explained as being too short the reference period to be observed participation in the first hurdle, or to corner solution, in the second hurdle. Actual consumption determined by:

$$\Phi\left(w_i^T\alpha\right)y_i = x_i^T\beta + \eta_i \qquad \text{if } y_{ip}^* > 0 \text{ and } y_{ie}^* > 0$$
$$y_i = 0 \qquad \text{otherwise} \tag{Eq. 5}$$

There are single-hurdle models, assuming that when consumers have decided to buy, they always consume a positive amount, without corner solutions. If no participation is due to voluntary abstention, we get the censored model:

$$y_i = y_{ie}^* = x_i^T\beta + \eta_i \qquad \text{if } y_{ip}^* > 0$$
$$y_i = 0 \qquad \text{otherwise} \tag{Eq. 6}$$

If no participation is because of infrequency of purchase, but once the consumer decides to buy there are no corner solution, the simple infrequency of purchase model (IP) is obtained:

$$\Phi\left(w_i^T\alpha\right)y_i = y_{ie}^* = x_i^T\beta + \eta_i \qquad \text{if } y_{ip}^* > 0$$
$$y_i = 0 \qquad \text{otherwise} \tag{Eq. 7}$$

Hence, there are eight alternative models, according to the reason of the first hurdle (voluntary abstention or infrequency of purchase), the existence or not of a second hurdle due to economic factors (corner solutions or not), and the dependence or independence of the participation and the expenditure decisions.

The signs of the associated coefficients in the Probit regressions are unclear, in principle, because of the sign of the derivative of the participation equation. The total marginal effects are used in the empirical analysis. The total marginal effect of a given explanatory variable x_j is given by:

$$\frac{\partial E\left(y_i\right)}{\partial x_{ij}} = \frac{\partial P\left(y_i > 0\right) E\left(y_i \mid y_i > 0\right)}{\partial x_{ij}} \tag{Eq. 8}$$

EMPIRICAL RESULTS

The eight models in the previous section are estimated using maximum likelihood methods, separately for each of the three cross sections. There is no economic theory to suggest the explanatory variables to include in the first and second steps of the decision model. Newman *et al.* (2001, 3003) observe that an underlying assumption of the double-hurdle model is that the first hurdle is a function of non-economic factors determining household decisions to participate in the market. Therefore, income (or expenditure) is excluded from the first equation. However, food expenditure is an arguable candidate to explain whether to consume seafood or not, and (the log of) food expenditure is included in this analysis. We agree with the omission of prices in the first set of explanatory variables. Table III show the logarithm of the likelihood function at the maximum, for each of the 24 estimations (8 models*3 samples).

Table III: Maximum of the logarithm of the likelihood function

Decision	Independent				Dependent			
Model	Censored	IP	DH	Tobit IP	Censored	IP	DH	Tobit IP
1980	19138	19143	20647	20793	20708	21413	20662	23128
1990	15129	15138	16454	16546	16397	17188	16535	18616
1998	6194.0	6211.7	7027.5	7045.5	6920.4	7259.4	7032.9	8035.4

It is clear that the Tobit-IP model is selected. It means that we cannot distinguish between seafood consumers and, say, vegetarians, and that the best statistical model considers that no participation is due to infrequency of purchase or economic reasons. Table IV shows the parameter estimation for the Tobit-IP model for the three samples.

Table IV: Maximum of the logarithm of the likelihood function

Variable	1980 Estimate	Std. Error	1990 Estimate	Std. Error	1998 Estimate	Std. Error
	N=21761		N=18748		N=8774	
Participation						
Constant	1.2247	0.0138**	1.3211	0.0150**	1.4656	0.0193**
LFEX	0.1896	0.0124**	0.1663	0.0135**	0.1620	0.0169**
LAGE	0.0361	0.0159*	0.0023	0.0216	0.0156	0.0423
SEX	-0.0094	0.0142	-0.0228	0.0150	0.0064	0.0248
LSIZ	-0.0406	0.0189*	-0.0002	0.0188	0.0298	0.0320
CHILD	0.0093	0.0056	0.0150	0.0070*	0.0360	0.0153*
ELDER	-0.0048	0.0118	-0.0221	0.0110*	0.0021	0.0217
DEN2	-0.0074	0.0119	0.0125	0.0201	0.0120	0.0245
DEN3	-0.0324	0.0145*	-0.0098	0.0165	-0.0026	0.0213
EL2	-0.0011	0.0101	0.0180	0.0131	-0.0009	0.0268
EL3	-0.0316	0.0126*	-0.0316	0.0149*	-0.0473	0.0234*
REG2	-0.0956	0.0178**	-0.0307	0.0203	-0.0275	0.0354
REG3	-0.0718	0.0116**	-0.0065	0.0136	-0.0375	0.0236
REG4	0.0240	0.0100*	-0.0035	0.0116	-0.0238	0.0218
Expenditure						
Constant	0.0800	0.0006**	0.0913	0.0008**	0.0913	0.0010**
LFEX	-0.0176	0.0041**	-0.0500	0.0103**	-0.0670	0.0156**
LFP	0.0271	0.0070**	-0.0214	0.0133**	-0.0682	0.0194**
LMP	0.0305	0.0072**	-0.0219	0.0155**	-0.0684	0.0234**
LEP	0.0214	0.0012**	0.0251	0.0013**	0.0336	0.0015**
LAGE	0.0070	0.0014**	0.0218	0.0019**	0.0235	0.0032**
SEX	-0.0002	0.0014	-0.0044	0.0015**	-0.0074	0.0023**
LSIZ	-0.0184	0.0016**	-0.0222	0.0018**	-0.0306	0.0027**
CHILD	-0.0004	0.0004	-0.0006	0.0006	0.0001	0.0010
ELDER	0.0001	0.0010	0.0018	0.0012	0.0027	0.0020
DEN2	-0.0114	0.0009**	-0.0098	0.0016**	-0.0017	0.0020
DEN3	-0.0190	0.0011**	-0.0058	0.0016**	-0.0057	0.0018**
EL2	0.0065	0.0008**	0.0116	0.0012**	0.0075	0.0022**
EL3	0.0106	0.0011**	0.0164	0.0013**	0.0074	0.0021**
REG2	-0.0070	0.0016**	-0.0070	0.0018**	-0.0087	0.0027**
REG3	0.0046	0.0011**	0.0117	0.0014**	0.0161	0.0021**
REG4	0.0035	0.0009**	0.0052	0.0012**	0.0065	0.0019**
-SIGMA	0.0353	0.0006**	0.0428	0.0008**	0.0524	0.0010**
-RHO	-0.2507	0.0035**	-0.2786	0.0039**	-0.3211	0.0052**

* Significant at p=0.05
** Significant at p=0.01

The right hand variables in each sample have been normalized at their means for ease of estimation and comparison. In our models, the total marginal effects (not reported) are very close to those of the expenditure decision. Observe that the expenditure variable is highly significant in the participation decisions. The total marginal effects are used for the interpretation of results and computation of elasticity at the mean of the positive consumption sub samples. However, for expenditure and prices we can obtain more meaningful measures in elasticity terms. They are computed and presented in Table V.

Table V: Expenditure and compensated price elasticities

Variable	1980		1990		1998	
	Estimate	Std. Error	Estimate	Std. Error	Estimate	Std. Error
Expenditure	1.197	0.011 [a]	1.209	0.010 [a]	1.283	0.013 [a]
Prices						
Seafood	-1.054	0.038	-1.296	0.086 [b]	-1.445	0.131 [b]
Meat	0.250	0.064 [c]	-0.178	0.111	-0.574	0.163 [c]
Eggs and Dairy	0.281	0.067 [c]	-0.182	0.129	-0.575	0.197 [c]
Other Food	-0.369	0.065 [c]	0.776	0.138 [c]	1.713	0.219 [c]

[a] Significant from 1 at p=0.01   [b] Significant from -1 at p=0.01   [c] Significant from 0 at p=0.01

Expenditure elasticity is stable or even increasing. This indicates that the responsiveness of household expenditure on seafood to changes in food expenditure is not declining over time: an important result in forming expectations of future seafood consumption.

The results concerning price elasticity are perhaps the single most important contribution of this paper. Demand is inelastic in 1980, where demand is slightly more than unitary in 1990. On the contrary, the own-price elasticity is very elastic in 1998. This finding suggests that very important taste changes have been taken place since the 1980s, concerning the main economic variable. Moreover, it offers an explanation of the large variations observed in time series of seafood consumption in the 90s. It is noteworthy that the price elasticities are calculated using the different samples separately. Price elasticities calculated using separate cross-sections explain time variation that previous analyses have misinterpreted as structural change of an unknown kind.

The cross price elasticities reflect other taste changes since early 80s. Seafood is only a minor substitute for meat and other animal products and complement for other food. In 1990, seafood consumption is independent from other animal food, while it is clearly substitute for other food. In 1998, seafood is a strong complement for meat and egg and dairy products, with very high substitution for other food. Probably, there is no single explanation behind these changes. A first one is related to changes in attitudes towards proteins and health concerns. A second explanation is based on changes in purchasing behavior.

Compared to the effects of major economic values, the evidence on socio-demographic characteristics seems less interesting. The total effects are very similar in the three samples. Thus, there is little taste change concerning demographic characteristics. The number of children and the number of people older than 65 years are not significant related to seafood consumption. This suggest than large changes in demographic structure of the households, towards less children and with an increase in average life are irrelevant in explaining changes in seafood consumption at-home

The results indicate that seafood consumption is positively related to the age of the household head, and negatively related to be a woman the household head (not in 1980), and to household size. Seafood consumption is higher in sparsely populated areas, and increases with the education level of the household head, although the difference between secondary and tertiary education is declining.

The regional effects are negative for REG2. This illustrates that REG4 (Inner Spain) is very important in seafood consumption, with higher consumption than in the coastal Mediterranean area. REG3 (Northern and Northwestern Coastal Regions) shows very significant positive effects. Perhaps surprisingly, but in line with previous descriptive literature, seafood consumption is lesser in the islands.

CONCLUSIONS

Our results indicate the importance of differentiating between the discrete market participation versus the expenditure decision. The estimated price and expenditure elasticities of seafood consumption show that fundamental economic factors (prices) are, by and large, more interesting and valuable than demographic or socio-economic changes in explaining changes in seafood consumption in Spain.

A fundamental taste change since the 80s resulted in a very important increase in price elasticity for seafood. There is a change in the pattern of substitution too. This result and the non-decreasing evolution of food expenditure elasticity suggest that seafood consumption could increase if the supply of seafood products allows for moderate prices. This is a very important result concerning seafood consumption projections.

The main implication of the results reported in this paper is that economic incentives are essential in understanding seafood consumption, well above changing demographics or lifestyles. Certainly, the household characteristics included in the analysis appear to explain a significant portion of the continuous component of the purchase process. The socio-demographic variables present in general sensible estimates on these variables, in general reinforcing the previous literature on seafood consumption in Spain.

Finally, some suggestions for further research follow. Firstly, it is interesting to disaggregate the seafood group according to species and/or product form (fresh, frozen, smoked, etc.). Given the high elasticity values obtained for seafood as a group, we expect a very important substitution pattern. Secondly, it is the possibility of estimation of demand systems. Finally, concerning the results of the participation equation, it seems that within-household heterogeneity is larger than between-household heterogeneity. This fact suggest the analysis of very recently and freely available panel data since the third quarter of 1997

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ENDNOTES