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FOOD DEMAND IN SPAIN: AN APPLICATION OF THE ALMOST IDEAL SYSTEM

J. A. Molina*

This paper provides an analysis of food demand in Spain for the period 1964-1989 estimating the Almost Ideal Demand System (AIDS) with annual time-series of food expenditures divided into six categories. A dynamic version of the model incorporating habit effects captures the behaviour of the Spanish food consumer over the period investigated. The theoretical hypotheses of homogeneity and symmetry are rejected, but the model provides plausible expenditure and price elasticities.

1. Introduction

The Almost Ideal Demand System (AIDS) introduced by Deaton and Muellbauer (1980a) has been used in the last few years to describe the food expenditure structure in several western countries. Some very good examples are Blanciforti and Green (1983) and Moschini and Meilke (1989) using US data; Chesher and Rees (1987) and Burton and Young (1992) in the UK; Fulponi (1989) in France; Mergos and Donatos (1989) in Greece; Hayes, Walh and Williams (1990) in Japan; Chen and Veeman (1991) in Canada; and Pierani and Rizzi (1991) using Italian data.

The purpose of this paper is to present empirical evidence about food consumption behaviour in Spain. Several static and dynamic versions of the Almost Ideal System are estimated using Spanish aggregate annual time series data from 1964 to 1989. The applicability of restrictions emanating from demand theory are tested and expenditure and Marshallian and Hicksian price elasticities are computed. This application of the AIDS model to food demand in Spain is especially attractive because there is no empirical evidence available about food demand in that country.

In Section 2 the Almost Ideal System is defined and its theoretical properties are shown. In Section 3 the data are described. In Section 4 the estimation method and results are presented. Finally, in Section 5 the most important conclusions are discussed.

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2. The Demand System for Food

The approach used in this paper in modelling and estimating the demand for food is to assume weak separability of preferences which is a necessary and sufficient condition for a two-stage budgeting process. In the first stage, consumers decide how much to spend on food. Next the demand for specific foods is determined by the prices of the individual foods and the total expenditure on food from the first stage.

The system used here to model the second stage budgeting process is the AIDS in its budget-share form:

$$w_{it} = \alpha_i + \sum_j \gamma_{ij} \log p_{jt} + \beta_i \log (y_t/P_t) \quad (1)$$

$$(i = 1,\ldots,n, t = 1,\ldots,T)$$

where w_{it} is the budget share of food i in period t, p_{jt} are food prices, y_t is food expenditure and P_t is a price index defined by:

$$\log P_t = \alpha_0 + \sum_k \alpha_k \log p_{kt} + \tfrac{1}{2} \sum_k \sum_j \gamma_{kj} \log p_{kt} \log p_{jt}. \quad (2)$$

The conditions which are required to make the model consistent with the theory of demand are:

- adding-up: $\sum_i \alpha_i = 1; \sum_i \gamma_{ij} = \sum_i \beta_i = 0 \qquad (j = 1,\ldots,n);$ (3)
- homogeneity: $\sum_j \gamma_{ij} = 0 \qquad (i = 1,\ldots,n);$ (4)
- symmetry: $\gamma_{ij} = \gamma_{ji} \qquad (i \neq j, i,j = 1,\ldots,n).$ (5)

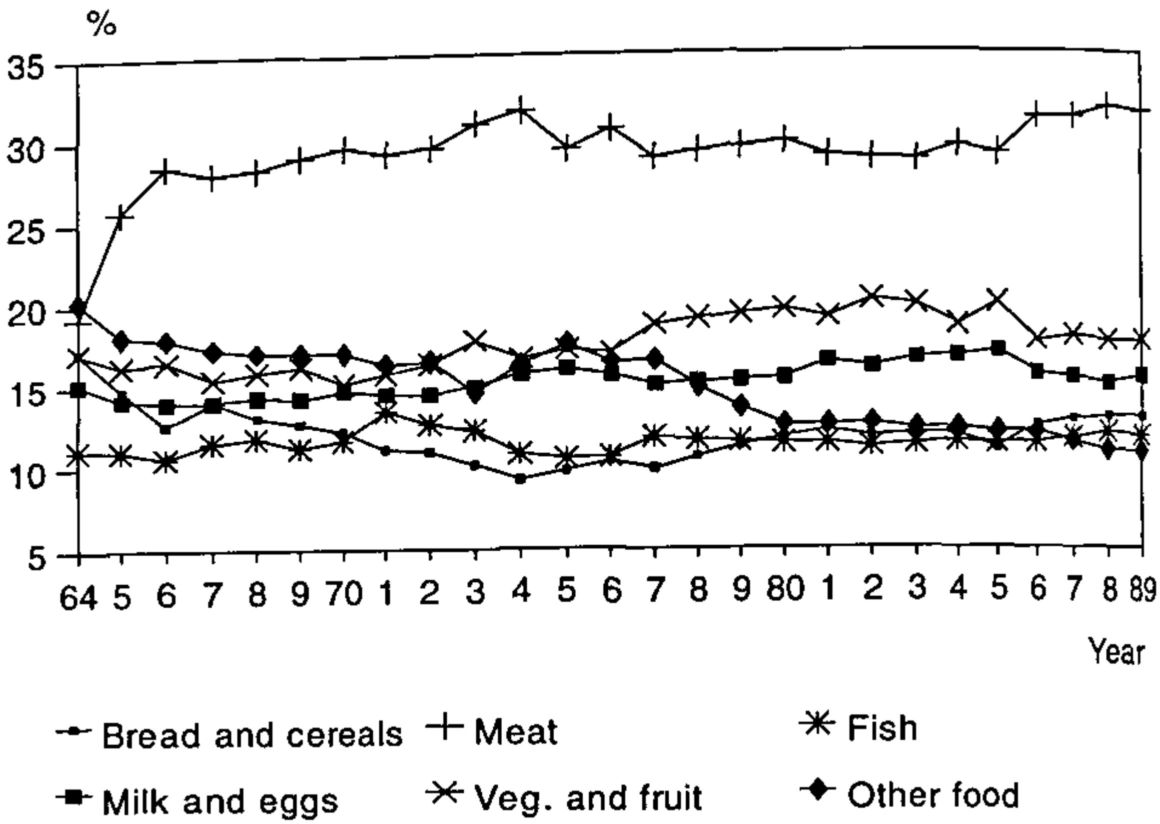
Conditions (4) and (5) are linear restrictions which may be tested by standard techniques, whereas condition (3) is imposed by the model and so is not testable. The negativity condition implies that the matrix of Hicksian price effects must be negative semidefinite.

3. Data

Spanish annual time-series of personal consumption expenditure obtained from several issues of *Contabilidad Nacional de España* (INE) for the period 1964-1989 were used when estimating the AIDS model. Current and constant expenditures were aggregated into six categories: *bread and cereals, meat, fish, milk and eggs, vegetables and fruit* and *other food.*

Food demand patterns in Spain are shown in Figure 1. The highest average share corresponds to *meat,* 29.04 per cent. There was a substantial increase from about 19 per cent in 1964 to about 29 per cent in 1970. *Bread and cereals* and *fish* have the smallest mean shares, 11.94 per cent and 11.46 per cent, respectively. *Bread and cereals* consumption declined up to the mid-1970s and remained practically stable for the rest of the sample period. On the other hand, the portion of the budget spent on *fish, milk and eggs* and *vegetables and fruit* was relatively stable during the last 30 years. Finally, *other food*'s share decreased gradually throughout the sample period.

Figure 1 Budget Shares of Major Food Categories in Spain



Source: *Contabilidad Nacional de España*, 1964-1989.

4. Estimation and Results

The standard AIDS specification (1) generates equations which are non-linear in the parameters. To avoid non-linear estimation, the paper follows Deaton and Muellbauer (1980a) and uses the Stone (1954) index, P_t^*, as a convenient approximation to P_t, where:

$$\log P_t^* = \sum_j w_j \log p_{jt}. \tag{6}$$

Three static versions of the model are estimated: (1) unrestricted; (2) with homogeneity imposed; and (3) with both homogeneity and symmetry imposed. One of the less satisfactory features of the AIDS is its static character. A dynamic version of the model specifies α_i to be linear functions of a lagged endogenous variable and a time trend (see Deaton and Muellbauer, 1980b), that is:

$$w_{it} = \alpha_i^* + \alpha\, w_{it-1} + \alpha_{i1}\, t + \sum_j \gamma_{ij} \log p_{jt} + \beta_i \log (y_t/P_t^*) + u_{it}. \tag{7}$$

Two simpler dynamic specifications include either the lagged endogenous variable or the time trend. As in the static AIDS, theoretical restrictions are imposed on the three dynamic versions. The unrestricted and homogeneous static versions are estimated by OLS, while SURE is used for the symmetric and dynamic specifications.

The resulting 12 versions of AIDS were tested for first, second and third-order autocorrelation by means of the Godfrey (1978) test, and ARCH errors were tested using the Engle (1982) test.

On the basis of the various tests, the preferred specification is the unrestricted dynamic version with lagged endogenous variable but not time trend. Table 1 shows the Godfrey and Engle test values for this version. As can be seen, none of the six groups of foods displays either first-order autocorrelation or ARCH problems. The preferred model rejects both homogeneity and symmetry.

Table 1 Specification Tests for the Preferred Dynamic Model

	Godfrey			*Engle*		
	Ord.1	*Ord.2*	*Ord.3*	*Ord.1*	*Ord.2*	*Ord.3*
Bread and cereals	2.78	5.93	5.95	0.02	0.73	1.39
Meat	2.44	2.93	6.45	0.01	0.02	0.28
Fish	0.15	5.62	14.0*	0.28	0.29	2.11
Milk and eggs	1.01	2.25	7.41	3.06	3.23	5.94
Vegetables and fruit	1.87	8.90*	8.99*	0.15	1.16	3.20
Other food	1.39	1.61	2.25	1.51	2.29	2.35

* Reject no autocorrelation at 5 per cent level of significance. Critical values: $\chi^2(1)_{0.05} = 3.84$, $\chi^2(2)_{0.05} = 5.99$, $\chi^2(3)_{0.05} = 7.81$.

Table 2 shows that the test-values for homogeneity, and joint homogeneity and symmetry are greater than their critical values at the 5 per cent level of significance, according to both the Wald (W) and Corrected Wald (CW) tests. These results are in accord with those of Blanciforti and Green (1983), Fulponi (1989) and Mergos and Donatos (1989).

Table 2 Wald Test for Homogeneity and Symmetry

	W	*CW†*
Homogeneity (5 d.f.)	30.54*	16.12*
Homogeneity and symmetry (20 d.f.)	126.45*	66.76*

* Reject theoretical hypotheses at 5 per cent level of significance. Critical values: $\chi^2(5)_{0.05} = 11.07$, $\chi^2(20)_{0.05} = 31.4$.

† Mauleón (1984): CW = W · CF, where CF = $(1 - n/t) \cdot (1 - \bar{k}/T)$, where n is the number of equations in the system, $\bar{k}$ the average number of parameters per equation and T the sample size.

Tables 3 and 4 show short-run elasticities evaluated at sample means. Expenditure elasticities appear in Table 3. Weak separability of preferences permits the estimation of elasticities with respect to total expenditure (e_{iY}) as well as with respect to food expenditure (e_{iYF}). As regards the second, *bread and cereals, meat* and *fish* are necessities, whereas *milk and eggs, vegetables and fruit* and *other food* are luxuries. According to e_{iY}, *bread and cereals, meat, fish* and *milk and eggs* are necessities, whereas *vegetables and fruit* and *other food* are luxuries. However, *milk dnd eggs* are a luxury in the long run, and in fact the elasticities for *milk and eggs, vegetables and fruit,* and *other food* are very close to unity.

Table 3 Expenditure Elasticities of Demand for Food in Spain

	e_{iYF} [a]	e_{iY} [b]
Bread and cereals	0.5951* (8.09)	0.5236* (8.09)
Meat	0.9088* (13.62)	0.7997* (13.62)
Fish	0.8146* (9.08)	0.7169* (9.08)
Milk and eggs	1.0358* (15.82)	0.9115* (15.82)
Vegetables and fruit	1.3325* (10.7)	1.1726* (10.7)
Other food	1.2180* (11.02)	1.0718* (11.02)

t-values appear within parentheses. * implies significant at 5 per cent level.

Notes: [a] Elasticity formula as in Ray (1980).

[b] Manser (1976): $e_{iY} = e_{iYF} \cdot e_{FY}$, where e_{iY} is the individual food expenditure elasticity with respect to total expenditure, e_{iYF} represents the individual food expenditure elasticity with respect to total food expenditure, and e_{FY} denotes the total food expenditure elasticity with respect to total expenditure. Molina (1993): $e_{FY} = 0.88$.

Table 4 shows that all Marshallian and Hicksian own-price elasticities are negative. As expected, the Hicksian elasticities are, in absolute terms, smaller than the Marshallian ones.

Table 4 Price Elasticities of Demand for Food in Spain

	Bread and Cereals	*Meat*	*Fish*	*Milk and Eggs*	*Veg. and Fruit*	*Other Food*
Marshallian						
Bread and cereals	–0.17 (–1.85)	–0.48* (–2.86)	–0.18 (–1.74)	0.25 (1.76)	0.07 (0.48)	–0.11 (–1.26)
Meat	–0.28* (–3.4)	–0.77* (–5.28)	0.12 (1.37)	0.21 (1.55)	0.12 (1.1)	–0.33* (–3.89)
Fish	0.30* (2.78)	–0.005 (–0.02)	–0.35* (–2.55)	–0.13 (–0.74)	–0.25 (–1.78)	–0.45* (–3.99)
Milk and eggs	0.06 (0.76)	–0.04 (–0.28)	0.07 (0.86)	–0.89* (–6.57)	–0.39* (–3.74)	0.32* (3.88)
Vegetables and fruit	–0.21 (–1.36)	–0.17 (–0.6)	–0.19 (–1.08)	–0.41 (–1.57)	–0.68* (–2.81)	0.32 (1.94)
Other food	–0.15* (–9.15)	0.20* (5.55)	–0.44* (–22.8)	–0.13* (–6.84)	–0.07 (–1.77)	–0.61* (–4.46)
Hicksian						
Bread and cereals	–0.10 (–1.12)	–0.30* (–1.86)	–0.11 (–1.16)	0.34* (2.4)	0.17 (1.12)	–0.02 (–0.29)
Meat	–0.17* (–2.05)	–0.51* (–3.51)	0.22* (2.68)	0.35* (2.58)	0.28* (2.35)	–0.20* (–2.41)
Fish	0.40* (3.58)	0.23 (1.15)	–0.26* (–1.99)	–0.01 (–0.07)	–0.11 (–0.75)	–0.33* (–3.02)
Milk and eggs	0.18* (2.24)	0.26 (1.8)	0.19* (2.28)	–0.73* (–5.5)	–0.21 (–1.92)	0.48* (5.86)
Vegetables and fruit	–0.05 (–0.35)	0.21 (0.75)	–0.04 (–0.24)	–0.22 (–0.85)	–0.44 (–1.73)	0.51* (3.23)
Other food	–0.01 (–0.7)	0.55* (15.2)	–0.30* (–15.7)	0.05* (2.81)	0.13* (3.3)	–0.79* (–5.77)

t-values appear within parentheses. * implies significant at 5 per cent level. Elasticity formulas as in Ray (1980).

All Marshallian own-price elasticities are inelastic. *Milk and eggs* have the highest own-price elasticity in absolute terms. By contrast, *bread and cereals* and *fish* are insensitive to changes in their own price.

Hicksian values provide the most accurate picture of cross-price substitution since they are a measure of substitution effects net of income effects. Cross-price effects are generally weak. Sixteen of 30 effects have values above zero, implying that net substitutability prevails.

5. Conclusions

In this article an Almost Ideal Demand System for six food groups in Spain has been presented, the hypotheses of consumer theory tested, and demand elasticities computed.

Several static and dynamic versions of AIDS were estimated and the preferred specification was an unrestricted version with a lagged endogenous variable. This specification indicates the presence of habits in Spanish consumers' food-consumption behaviour and rejects the theoretical restrictions of homogeneity and symmetry.

Bread and cereals, meat, fish and *milk and eggs* are necessities whereas *vegetables and fruit* and *other food* are luxuries though most of the elasticities are close to unity. As regards price elasticities, all food categories are price inelastic. Cross-price effects are low, but with substitutability prevailing.

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