PREDICTIONS OF SPANISH FOOD CONSUMPTION USING A DEMAND SYSTEM

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Abstract

In this paper we present a demand model, the AIDS, that is used to generate food demand predictions for Spain up to the year 2000. Combining both a policy scenario which assumes that price and expenditure growth rates take the mean value of the last five periods and estimated parameters from the model, we obtain predictions from 1990 to 2000 for a disaggregated set of food commodities. As regards growth rates of household expenditure for the prediction period, alcoholic beverages have the highest average value, 12.77% and the following groups are: non alcoholic beverages, 10.76%, tobacco, 10.07%, and food, 6.44%. With respect to growth rates of household consumption, the average values are 1.12%, 0.78%, 0.74% and –1,42% for non-alcoholic beverages, tobacco, food and alcoholic beverages, respectively.

Résumé

Ce travail présente un modèle de la demande, dit AIDS, utilisé pour les prévisions de la demande des produits alimentaires de l'Espagne jusqu'à l'année 2000. En combinant un scénario de politique qui suppose les prix et les taux de croissance des dépenses comme ayant la valeur moyenne des cinq dernières périodes et de valeurs estimées d'après le modèle, on obtient des prévisions de l'année 1990 à l'année 2000 pour une série désagrégée de produits alimentaires. Quant aux taux de croissance des dépenses des ménages pour la période de prévision considérée, les boissons alcoolisées présentent la valeur moyenne la plus élevée, 12.77%, et elles sont suivies par les boissons sans alcol, 10.76%, le tabac, 10.07%, et les produits alimentaires, 6.44%. Par rapport aux taux de croissance de la consommation des ménages, les valeurs moyennes sont respectivement 1.12%, 0.78%, 0.74% et –1.42% pour les boissons sans alcool, le tabac, lec produits alimentaires et les boissons alcolisées.

Knowledge of future food demand needs of a country is essential for both improved development planning and policy decision making. This is especially important in a country like Spain where the average food expenditure share (food expenditure/total expenditure) was 31.3 per cent between 1964 and 1989. Although this share fell from 39.8 per cent in 1964 to 21.9 per cent in 1989, food products is still a substantial expenditure category when consumers divide total income among different groups of goods.

In this paper we present a demand model, the flexible Almost Ideal System (AIDS) of Deaton and Muellbauer (1980a) that is used to generate food demand predictions for Spain up to the year 2000. The demand system used was implemented under a particular scenario, that is, we consider that prices and expenditure growth rates are the average value of last five ones. Combining this assumption with some estimated parameters we obtain food demand predictions for four different categories: *food*, *non-alcoholic beverages*, *alohoolic beverages* and *tobacco*. This article is structured as follows. In section 2 we present the econometric model, the AIDS. Section 3 explains the data and the estimation method used in this paper. Section 4 provides results and section 5 presents a brief conclusion.

The model

The Marshallian demand equations (in share form) for the AIDS are:

$$w_{it} = \alpha_i + \sum_j \gamma_{jy} \log p_{jt} + \beta_i \log\left(\frac{y_t}{P_t}\right) \quad (1)$$

$$(i = 1, ..., n, t = 1, ..., T)$$

where

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

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

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

For some future year (t + 1) the AIDS will be:

$$w_{it+1} = \alpha_i + \sum_j \gamma_{ij} \log p_{jt+1} + \beta_i \log\left(\frac{y_{t+1}}{P_{t+1}}\right) \quad (3)$$

$$(i = 1, ..., n, t = 1, ..., T + 1)$$

and subtracting (1) from (3) yields the predicted change in the budget share between t and t + 1:

$$w_{it+1} - w_{it} = \sum_j \gamma_{ij} \log\left(\frac{p_{jt+1}}{p_y}\right) + \beta_i \log\left(\frac{y_{t+1}}{y_t}\right) - \beta_i(\log P_{t+1} - \log P_t) \quad (4)$$

$$(i = 1, ..., n, t = 1, ..., T + 1)$$

The future year value of prices and total expenditure can be written in terms of the corresponging current year value as follows:

$$p_{jt+1} = (1 + \delta_{jt})\, p_{jt}$$

$$y_{t+1} = (1 + \sigma_t)\, y_t$$

where δ_{jt} and σ_t are the prices and expenditures growth rates, respectively.

Data and estimation

Spanish annual time-series of personal consumption expenditures and prices obtained from National Accounts, Vol. II, Detailed Tables, OCDE, for the period 1964-1989 were used when estimating the AIDS model. Current and constant expenditures were aggregated into four categories:

Group 1: *Food*
Group 2: *Non-alcoholic beverages*
Group 3: *Alcoholic beverages*
Group 4: *Tobacco*

In estimating AIDS we shall begin writting (1) and including an additive error term:

$$w_{it} = \alpha_i + \sum_j \gamma_{ij} \log p_{jt} + \beta_i \log\left(\frac{y_t}{P_t}\right) + u_{it} \quad (5)$$

$$(i = 1, ..., n, t = 1, ..., T)$$

This standard AIDS specification generates equations which are non-linear in the parameters. To avoid non-linear estimation, we follow Deaton and Muellbauer (1980a) in their use of the Stone (1954) index as a convenient approximation:

$$\log P_t^* = \sum_j w_{ij} \log p_{jt} \quad (6)$$

Writting this Stone index for t + 1 and subtracting we obtain:

$$\log P_{t+1}^* - \log P_t^* = \sum_j w_{jt} \log (1 + \delta_{jt}$$

Substituting P_t by P_t^* in (4) and operating we obtain the equation used to calculate the predicted budget shares:

$$w_{it+1} = w_{it} + \sum_j \gamma_{ij} \log (1 + \delta_{jt}) + \beta_i [\log (1 + \sigma) - \sum_j w_{jt} \log (1 + \delta_{jt})] \quad (7)$$

One of the less satisfactory features of AIDS is its static character, therefore, the dynamization is one of the best ways to improve results. We, as Deaton and Muellbauer (1980b), introduce two dynamic regressors in the static specification (5), the lagged en-

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dogenous variable and a time trend, thus, we obtain a dynamic version of AIDS:

$$w_{it} = \alpha_i^* + \alpha_{i1} w_{it-1} + \alpha_{i2} t + \sum_j \gamma_{ij} \log p_{jt} + \beta_i + \left(\frac{y_t}{P_t^*}\right) + u_{it} \quad (i = 1, \dots, n,\ t = 2, \dots, T) \quad (8)$$

We also estimate two simpler dynamic specifications which include only either the lagged endogenous variable or the time trend. As in the static AIDS, we impose theoretical restrictions on the three dynamic versions. The unrestricted and homogeneous static versions were estimated by means of OLS, and we used SURE for the symmetric and dynamic specifications.
In this way, twelve versions of AIDS have been estimated, three static and nine dynamic, and we have tested first, second and third-order autocorrelation by means of the Godfrey (1978) test, as well as ARCH errors using the Engle (1982) test. These specification tests allow us to select the version whose errors more closely resemble a white noise.
The version whose error terms display the best stochastic propieties is the unrestricted version of the dynamic specification in which we have introduced an endogenous lagged variable and a time trend, that is, model (8). **Table 1** shows the Godfrey test and the Engle test values for this model. As it can been seen, none of the four groups of goods displays either first-order autocorrelation or ARCH problems.
For our selected dynamic version, the equation used to calculate the predicted budget shares can be easily written as:

Table 1 ***Specification test.***

	Godfrey			Engle		
	Ord. 1	Ord. 2	Ord. 3	Ord. 1	Ord. 2	Ord. 3
Food	0.30	3.11	3.86	0.79	1.38	3.21
Non-alcoh. beverages	3.23	3.32	7.87*	0.60	0.50	0.51
Alcoholic beverages	3.64	6.68*	6.80	0.52	1.71	4.16
Tobacco	0.07	3.64	5.18	0.11	0.41	0.96

(*) 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).

$$w_{it+1} = w_{it} + \alpha_{i1}(w_{it} - w_{it-1}) + \alpha_{i2}(t_{+1} - t) + \sum_j \gamma_{ij} \log(1 + \delta_{jt}) + \beta_i[\log(1 + \sigma_t) - \sum_j w_{jt} \log(1 + \delta_{jt})] \quad (9)$$

Using these predicted budget shares, it is possible to calculate future expenditure (e_{it+1}) and quantity demanded (x_{it+1}) for a representative household:

$$e_{it+1} = w_{it+1}\, y_{t+1}$$

$$x_{it+1} = e_{it+1} / p_{it+1}$$

Therefore the growth rate of expenditure and consumption are respectively:

$$(e_{it+1} / e_{it}) - 1$$

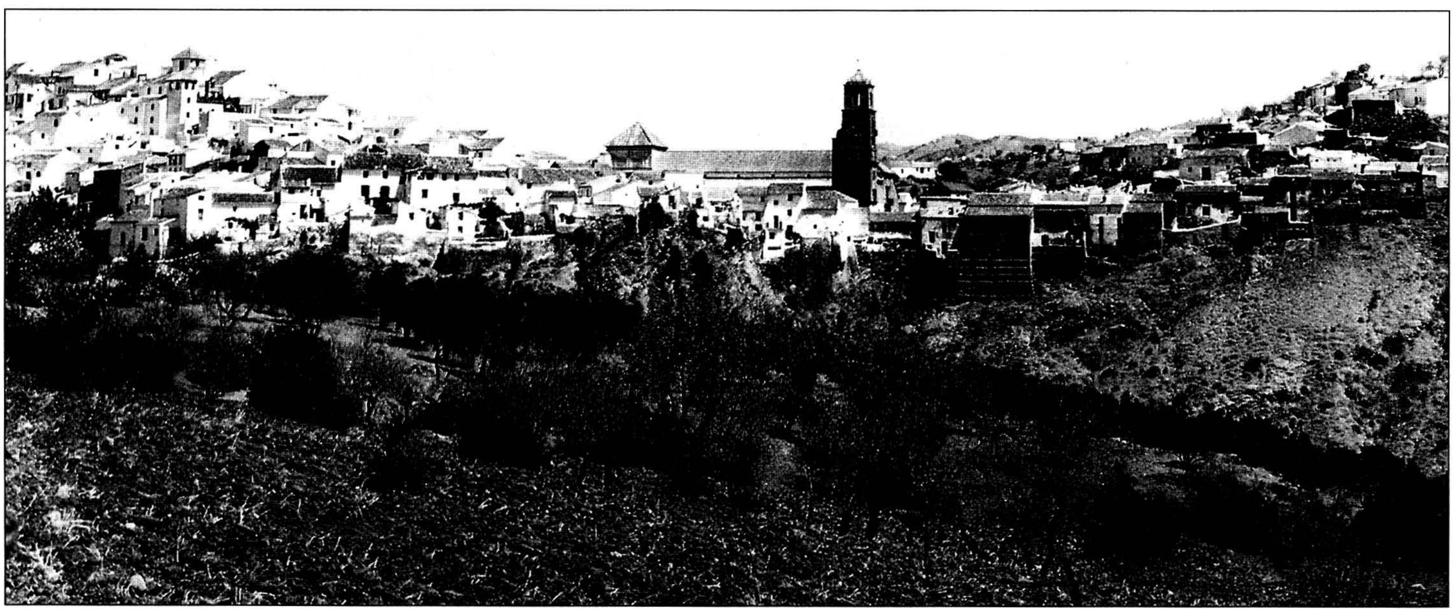
$$(x_{it+1} / x_{it}) - 1 = [e_{it+1} / (1 + \delta_{jt})\, e_{it}] - 1$$

Results

Food demand predictions are generated combining the estimated parameters from the selected model with assumptions about the future course of prices and total expenditure.
The predictions reported in this paper are based on growth rates from **table 2** which are obtained as the average value of the rates from the last five years.
For a representative consumer, the annual growth rates for expenditure and consumption were predicted up to the year 2000 as we see in **figures 1** and **2**.
As regards expenditure growth rates, in **figure 1** we observe that growth rates of *alcoholic beverages* have fallen slightly till the end of the prediction period. There has been also a decline in the values of *food* and

Table 2 ***Growth rates.***

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Food price	5.92	4.67	6.34	5.48	5.56	5.91	5.65	5.60	5.76	5.66	5.69
Non alcoh. bever. price	11.62	12.16	8.70	7.86	8.53	9.32	9.70	9.38	8.92	8.95	9.13
Alcoh. bever. price	16.07	17.10	12.96	12.95	13.80	14.65	14.59	14.34	13.88	14.04	14.22
Tobaccco price	11.75	12.62	8.52	7.80	7.77	8.57	9.50	9.13	8.55	8.55	8.68
Total expenditure	7.68	6.74	7.84	7.09	7.13	7.57	7.34	7.29	7.38	7.30	7.34



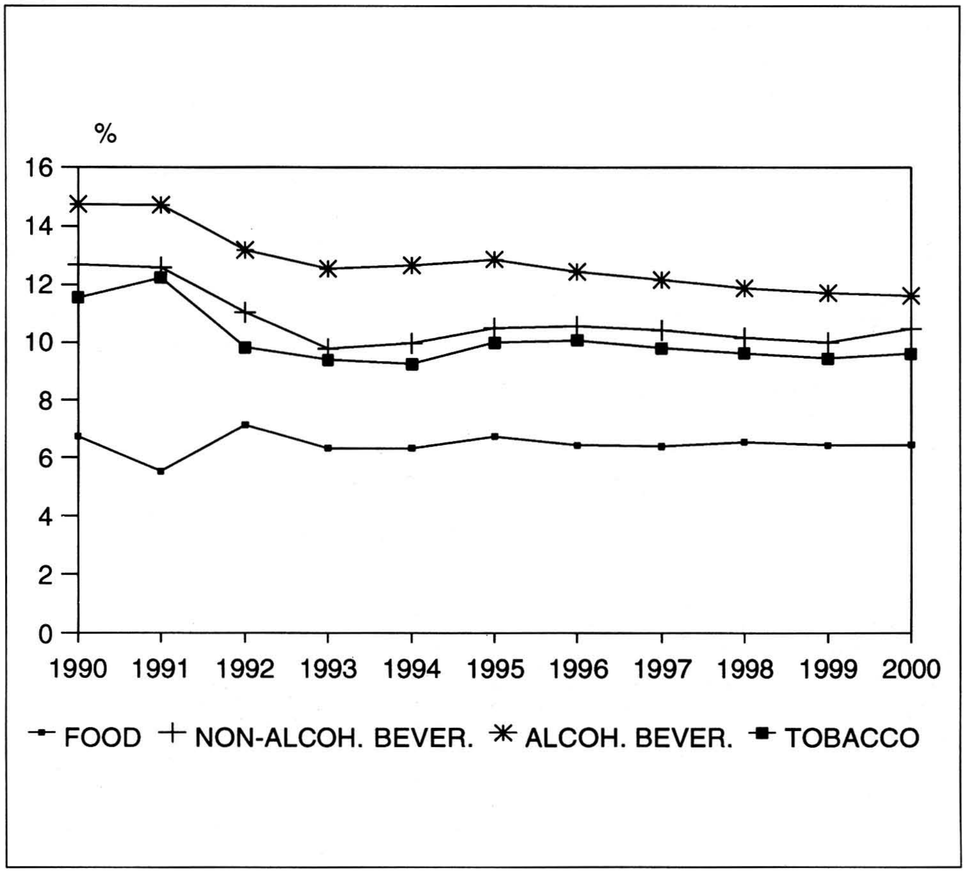


Figure 1 - Growth rates of household expenditure.

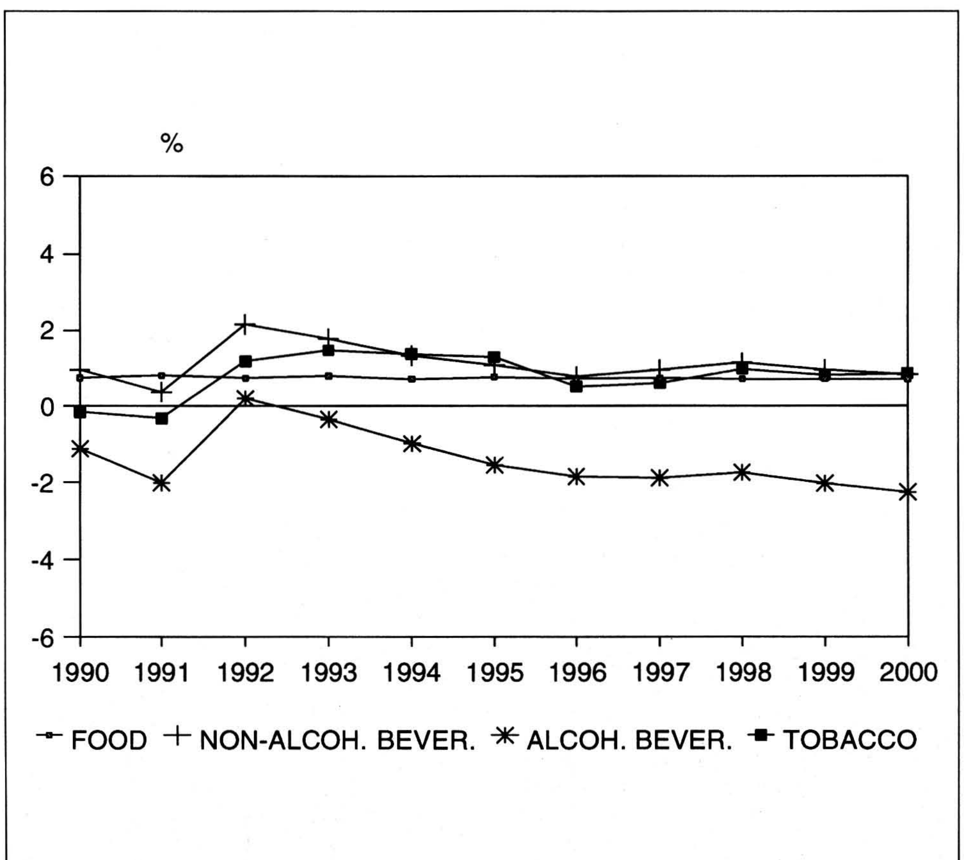


Figure 2 - Growth rates of household consumption.

non-alcoholic beverages, but only in the first three or four years, that is, until 1993 or 1994, then the rates have remained stable. As regards *tobacco*, we can see that the values have stayed relatively stable throughout the prediction period. In addition, we have calculated the average rates and we find that *alcoholic beverages* have the highest value, 12.77%, that is, this category will grow at a mean annual rate of 12.77% during the entire prediction period. The following groups of goods according to these values are *non-alcoholic beverages*, 10.76%, *tobacco*, 10.07%, and *food* that exhibit the lowest mean rate, 6.44%.

In **figure 2** we observe growth rates of household consumption. As it can be seen, we find that after 1992 the rates of *food*, *non-alcoholic beverages* and *tobacco* maintain themselves constant up to the end of the prediction period. As regards *alcoholic beverages*, we observe that the values have fallen steadily and even become negative in 1993 and up to the end of the prediction period. According to these predictions the growth rate of *non-alcoholic beverages*, *tobacco* and *food* exhibits values above 0 with average rates of 1.12%, 0.78% and 0.74%, respectively, whereas the growth in the consumption for *alcoholic beverages* shows a mean value of −1.42%.

Conclusions

In this article we have presented an econometric demand model that is used to obtain food demand predictions in Spain up to the year 2000. These demand predictions are calculated combining estimated parameters of AIDS with a particular policy scenario about prices and expenditure growth rates. The predictions generated by the demand system indicate that the expenditure in *beverages* and *tobacco* in Spain will continue growing at relatively high rates during this decade, in particular, the mean values are 17.77%, 10.76% and 10.07% for *alcoholic beverages*, *non-alcoholic beverages* and *tobacco*, respectively. *Food*, on the other hand, exhibits the lowest mean rate, 6.44%. With respect to consumption growth rates, *non-alcoholic beverages*, *tobacco* and *food* exhibit average values above 0, that is, 1.12%, 0.78% and 0.74%, respectively, whereas *alcoholic beverages* shows an average figure that indicate negative growth, −1.42%. ●

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