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The Intertemporal Behaviour of French Consumers

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In this paper we model the intertemporal behaviour of French consumers, testing for the intertemporal separability hypothesis. In order to do this, we use the SNAP structure which generates an intertemporal demand system. This system is estimated, the theoretical hypotheses are tested and some elasticities are calculated. Our results indicate that French consumers reject the intertemporal separability hypothesis and that nonseparability over time is concentrated on beverages and gross rent, fuel and power.

Dans cet article, nous modélisons le comportement intertemporel des consommateurs français en testant l'hypothèse de séparabilité intertemporelle. Dans ce but, nous utilisons la structure SNAP qui engendre un système intertemporel de demande. Nous estimons ce système, nous testons les hypothèses théoriques et nous calculons quelques élasticités. Nos résultats indiquent que les consommateurs français refusent l'hypothèse de séparabilité intertemporelle et que cette non-séparabilité se concentre dans les secteurs des boissons, des loyers et de l'énergie.

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INTRODUCTION

Four decades ago new information became available on expenditure on goods which allowed new empirical research, the objective of which was the international comparison of the structures and habits of consumers. This empirical research was further extended as a result of the appearance of new methods in consumption theory, in particular the appearance of demand systems, which permitted a more complete and detailed analysis of consumer' decisions.

In demand systems intertemporal separability is normally assumed, so that current demands can be written as a function of current prices and current total expenditures. The question is whether this hypothesis is justified in demand analysis. The fact that preferences may not be intertemporally separable has long been recognised, for example, Gorman (1967) wrote "choices depend on tastes and tastes on past choices".

The purpose of this paper is to model the intertemporal behaviour of French consumers. In particular, we are going to test the intertemporal separability hypothesis using French annual time-series expenditure divided into six categories. In order to do this, we use the "Simple Non-additive Preferences" (SNAP) structure for intertemporal preferences proposed by Browning (1991) which generates a demand system dependent on one period lagged and one period lead prices, as well as current prices. We estimate the SNAP demand system in order to answer the question as to whether French consumers reject, or not, the intertemporal separability hypothesis implicit in the SNAP. The theoretical hypotheses are then tested and the expenditure and non-current Marshallian own-price elasticities are calculated.

The paper is divided into six sections. In section I the Frisch demands and profit function are defined. In section II the SNAP demand system is obtained from a profit function based on a PIGLOG cost function. In section III the data are explained and we carry out a brief descriptive analysis. In section IV we present the results which we have obtained estimating the model and, finally, the most important conclusions of this paper are summarised in the last section.

I. FRISCH DEMANDS AND PROFIT FUNCTION

We consider an intratemporal model of consumer choice:

$$\text{Max } u = u(\mathbf{q}) \qquad \text{subject to } \mathbf{pq} = y \tag{1}$$

where $u(\mathbf{q})$ is the utility function, $\mathbf{q}$ is the vector of quantities purchased, $\mathbf{p}$ is the corresponding vector of prices and y is total expenditure. If we assume that the utility function is increasing, strictly concave and twice differenciable, and we further suppose internal solutions, these are characterised by first-order expressions:

$$\nabla u(\mathbf{q}) = \lambda \mathbf{p} = \frac{\mathbf{p}}{r} \tag{2}$$

$$\mathbf{pq} = y \tag{3}$$

where ∇ is the gradient, λ is a Lagrangian multiplier representing the marginal utility of the expenditure, and the reciprocal quantity r is defined as the marginal cost of utility or as the price of utility. Given the properties of utility function, condition (2) can be inverted to give:

$$\mathbf{q} = f(\mathbf{p}/r) \tag{4}$$

where $f(\cdot)$ are monotone decreasing functions. Frisch (1932) used a version of these functions to measure the marginal utility of money and, following Browning (1982), we refer to the functions (4) as Frisch demands or marginal utility constant demands. Frisch demands characterise quantities purchased in terms of a single quantity, namely the ratio of the commodity price to the price of utility. The conceptual idea is that consumers are money compensated for a price change until the price of utility returns to its original value. These functions are zero degree homogeneous in r and $\mathbf{p}$, have symmetric derivates and have downward slopes.

Therefore, knowing that r is the price of utility, we can obtain the Frisch demands by means of an alternative method, that is to say, from a dual representation of individual preferences (i.e., functions defined on prices and some measure of welfare), namely the profit function in consumption, that leads in a straightforward way to demand functions.

We consider an analogy with production theory and we suppose that the consumer uses inputs, the goods, to obtain an output, the utility. The profit function is then defined as the maximum profit that the consumer achieves when he sells his utility at the hypothetical price r (inverse of the marginal utility of income), given the utility function and the prices of the goods. For a general utility function, $u = u(\mathbf{q})$, we can write [1]:

$$\pi(\mathbf{p}, r) = \underset{u,\mathbf{q}}{\text{Max}}\ \{ru - \mathbf{pq};\ u = u(\mathbf{q})\} \tag{5}$$

This function is convex and linear homogeneous in $(r, \mathbf{p})$, increasing in r and decreasing in $\mathbf{p}$. An alternative expression of the profit function that uses the expenditure function is:

$$\pi(\mathbf{p}, r) = \underset{u}{\text{Max}}\ \{ru - c(\mathbf{p}, u)\} \tag{6}$$

From the profit function (5) we can obtain, by differentiation, the Frisch demands:

$$-\frac{\partial \pi(\mathbf{p}, r)}{\partial p_i} = \pi_i(\mathbf{p}, r) = q_i = f_i(\mathbf{p}, r) \quad \forall \mathrm{i} \tag{7}$$

After defining the Frisch demands and the profit function in an intratemporal model, we can now consider the intertemporal case. We assume a finite horizon of T periods and suppose that the intratemporal utility, functions have the above mentioned properties. In this case, under intertemporal additive preferences, the utility function of a rational consumer is [2]:

$$u(\mathbf{q}^1, \ldots, \mathbf{q}^T) = \sum_{t=1}^{T} u^t(\mathbf{q}^t) \tag{8}$$

where $u^t(\mathbf{q}^t)$ is the intratemporal utility function corresponding to the period t. If we assume the existence of perfect capital markets, then the budget constraint of a consumer is given by (9), where A is the consumer's total wealth:

$$\sum_{t=1}^{T} \widehat{\mathbf{p}}^t \mathbf{q}^t = A \tag{9}$$

[1] A complete exposition of the profit function in consumption can be seen in Browning (1982).

[2] Intertemporal additivity preferences is a very extended assumption, see, for example, Heckman and MaCurdy (1980); MaCurdy (1981 and 1983); Browning (1982, 1986, 1989 and 1991); Attfield and Browning (1985); Browning, Deaton and Irish (1985); Blundell, Browning and Meghir (1989); and Laisney and Wahelhals (1990).

where $\widehat{\mathbf{p}}^t = \delta(t, 0)\ \mathbf{p}^t$, with $\mathbf{p}^t$ as the vector of current prices in period t, $\delta(t, 0)$ being the discunt rate and $\widehat{\mathbf{p}}^t$ being the vector of discounted prices. The first-order conditions analogous to (2) are:

$$\nabla u^t(\mathbf{q}^t) = \lambda \widehat{\mathbf{p}}^t \tag{10}$$

from which we can derive the Frisch demand functions in an intertemporal context:

$$\mathbf{q}^t = \mathbf{q}^t(\widehat{\mathbf{p}}^t, r) \tag{11}$$

The explicit consideration of intertemporal allocation leads to the use of Frisch demands, because such functions take the marginal utility of (discounted) wealth as fixed, which is what rational agents are themselves trying to equate over time. In other words, Frisch demands characterise the rational allocation in a model with intertemporal dependences, that is, if the past affects the present, then rational agents will take account of present actions on future preferences.

As Deaton and Muellbauer (1980b) indicate, such representations have proved particularly fruitful in empirical allocation models that assume intertemporal separability. Under additive separability, the dual profit function is especially convenient; it represents consumers' preferences because it perfectly maintains the additive structure of the direct utility function, that is, additive utility is equivalent to additive profits, in the sense that the overall profit function is the sum of the individual profit functions corresponding to each subutility function:

$$\pi(\widehat{\mathbf{p}}^1, \ldots, \widehat{\mathbf{p}}^T, r) = \underset{\mathbf{q}}{\text{Max}} \left[r \sum_{t=1}^{T} u^t(\mathbf{q}^t) - \sum_{t=1}^{T} \widehat{\mathbf{p}}^t \mathbf{q}^t \right]$$

$$= \sum_{t=1}^{T} \underset{\mathbf{q}}{\text{Max}} [r\ u^t(\mathbf{q}^t) - \widehat{\mathbf{p}}^t \mathbf{q}^t] = \sum_{t=1}^{T} \pi^t(\widehat{\mathbf{p}}^t, r) \tag{12}$$

and the corresponding Frisch demand functions are:

$$\mathbf{q}^t = -\nabla \pi^t(\widehat{\mathbf{p}}^t, r) = \mathbf{q}^t(\widehat{\mathbf{p}}^t, r) \tag{13}$$

However, despite the fact that intertemporal additivity is a very extended assumption, is it nevertheless justified in the models of consumer behaviour? To answer this question, we are going to assume a nonseparable preferences structure that will allow us to test the hypothesis of additivity.

II. THE EMPIRICAL MODEL: SNAP

Browning (1991) defines an intertemporal preference structure that nests additivity over time in a simple way. This is the SNAP structure, which is specified by means of the following intertemporal profit function:

$$\pi(\widehat{\mathrm{p}}^1, \ldots, \widehat{\mathrm{p}}^T, r) = -\sum_{t=1}^{T-1} \Phi^t(\widehat{\mathrm{p}}^t, \widehat{\mathrm{p}}^{t+1}, r) \tag{14}$$

where each $\Phi^t(\cdot)$ is a loss function which is concave and linear homogeneous in $(\widehat{\mathrm{p}}^t, \widehat{\mathrm{p}}^{t+1}, r)$ and increasing in $(\widehat{\mathrm{p}}^t, \widehat{\mathrm{p}}^{t+1})$. From (14) we can derive the Frisch demands directly by applying Hotelling's theorem:

$$\mathrm{q}^t = \nabla_t \Phi^{t-1}(\widehat{\mathrm{p}}^{t-1}, \widehat{\mathrm{p}}^t, r) + \nabla_t \Phi^t(\widehat{\mathrm{p}}^t, \widehat{\mathrm{p}}^{t+1}, r) \tag{15}$$

with ∇_t being the gradient of the profit function with respect to prices in t. Thus current demands have two components: a demand that takes account of the past and another that ignores the past but takes account of the future.

In our nonseparable preferences model, we must consider uncertainty and its consequences. Uncertainty causes several differences in the Frisch demand functions with respect to those considered under certainty. These differences result from the fact that, in the first case, the agent will have new information in the future that will be incorporated in the marginal utility of income (inverted) which will, in turn, be modified. Therefore, under uncertainty, the demands depend on the current prices of goods and the price of utility r_t which varies over time. However, under the SNAP structure, the Frisch demand functions are given by (15). Therefore, if under uncertainty the utility price varies over time, we obtain:

$$\mathrm{q}^t = \nabla_t \Phi^{t-1}(\mathrm{p}^{t-1}, \mathrm{p}^t, r_t) + \nabla_t \Phi^t(\mathrm{p}^t, \mathrm{p}^{t+1}, r_t) \tag{16}$$

Under this nonadditive preferences structure, consumer's demand depends on one-period lagged and one-period lead prices, as well as on current prices. Therefore, the SNAP structure allows a good to be a substitute or a complement for itself in the periods immediately before and immediately after the current one. The term autocomplementary

can be used for a good that is a complement to itself in the previous period; similarly the words autosubstitutable or autoindependent could equally be of application.

In order to develop a Marshallian demand system which maintains the intertemporal dependences from the SNAP structure, we consider that, when we want to determine the most appropriate functional form for the demand equations, we should follow a basic criterion, that is, the kind of data available for econometric estimation. Because our analysis of consumer behaviour will be based on aggregate data, some restrictions on the structure of individual preferences are required.

Consistent demand equations can be obtained according to Muellbauer (1975 and 1976), who uses the PIGLOG cost function:

$$\log\ c(\mathrm{p}^t, u) = \log\ a(\mathrm{p}^t) + b(\mathrm{p}^t)u \tag{17}$$

where $a(\cdot)$ is linear homogeneous and $b(\cdot)$ is zero homogeneous.

Substituting the expenditure function (17) in the profit function (6) and applying the first-order condition, we obtain:

$$c(\mathrm{p}^t, u) = \frac{r_t}{b(\mathrm{p}^t)} \tag{18}$$

taking logarithms and substituting in the profit expression, we derive the profit function associated with (17):

$$\begin{aligned}\pi(\mathrm{p}^t, r_t) &= r_t u - c(\mathrm{p}^t, u)\\ &= \left[\log\left(\frac{r_t}{b(\mathrm{p}^t)}\right) - \log\ a(\mathrm{p}^t) - 1\right]\frac{r_t}{b(\mathrm{p}^t)}\end{aligned} \tag{19}$$

and, if we incorporate lagged prices, the intratemporal loss function will be:

$$\begin{aligned}&\Phi^{t-1}(\mathrm{p}^{t-1}, \mathrm{p}^t, r_t)\\ &= -\left\{\log\left[\frac{r_t}{b(\mathrm{p}^t)}\right] - \log\ a(\mathrm{p}^t) - 1 + \log\ d(\mathrm{p}^{t-1})\right\}\frac{r_t}{b(\mathrm{p}^t)}\end{aligned} \tag{20}$$

where $d(\cdot)$ is a zero homogeneous function.

To obtain the Marshallian demands corresponding to the SNAP structure, we substitute the loss functions (20) into (16). Note that these demands depend on the current price of utility r_t, which is unobservable. Consequently, such functions cannot be estimated. The solution is to express this parameter in terms of observable variables, using the first-order condition (18), that is:

$$r_t = y_t b(\mathbf{p}^t) \tag{21}$$

Moreover, in the estimation we adopt the following expressions for prices:

$$\log\ a(\mathbf{p}^t) = \alpha_o + \sum_k \alpha_k \log p_{kt} + \frac{1}{2}\sum_k \sum_j \gamma_{kj} \log p_{kt} \log p_{jt} \tag{22}$$

$$\log\ b(\mathbf{p}^t) = \sum_k \beta_k \log p_{kt} \tag{23}$$

$$\log\ d(\mathbf{p}^t) = \sum_k \theta_k \log p_{kt} \tag{24}$$

By rearranging terms, we obtain the budget share demand functions for SNAP:

$$w_{it} = \alpha_i + \sum_j \gamma_{ij} \log p_{jt} + \beta_i \log\left[\frac{y_t}{a(\mathbf{p}^t)}\right] + \beta_i \sum_k \theta_k \log p_{kt-1} + \delta_i \left[\frac{b(\mathbf{p}^t)}{b(\mathbf{p}^{t+1})}\right] \tag{25}$$

This system is a static Almost Ideal Demand System (AIDS) proposed by Deaton and Muellbauer (1980a), except for the last two terms. The SNAP shows similar advantages to the AIDS, namely it exactly satisfies the axioms of choice and it perfectly aggregates over consumers. Other good features of this model refer to the functional form; it is consistent with household-budget data and simple to interpret. It can also be used to test theoretical restrictions on the parameters, namely homogeneity and symmetry.

The theoretical restrictions from the SNAP model are:

- Adding-up: $\sum_i \alpha_i = 1$ and $\sum_i \gamma_{ij} = \sum_i \beta_i = \sum_k \theta_k = 0 \quad \forall j$ (26)
- Current homogeneity: $\sum_j \gamma_{ij} = 0 \quad \forall i$ (27)

OPTIMIZATION PROBLEMS:

$$\text{Max. } u(\mathbf{q}^1, \ldots, \mathbf{q}^T) = \sum_{t=1}^{T} \beta_t\ u^t(\mathbf{q}^t) \quad \text{subject to} \quad \sum_{t=1}^{T} \hat{\mathbf{p}}^t \mathbf{q}^t = A$$

$$\pi(\hat{\mathbf{p}}^1, \ldots, \hat{\mathbf{p}}^T, r) = \underset{\mathbf{q}}{\text{Max}}\left[r \sum_{t=1}^{T} \beta_t\ u^t(\mathbf{p}^t) - \sum_{t=1}^{T} \hat{\mathbf{p}}^t \mathbf{q}^t \right]$$

SNAP STRUCTURE:

Profit function:

$$\pi(\hat{\mathbf{p}}^1, \ldots, \hat{\mathbf{p}}^T, r) = -\sum_{t=1}^{T-1} \Phi^t(\hat{\mathbf{p}}^t, \hat{\mathbf{p}}^{t+1}, r)$$

Frisch demands:

$$\mathbf{q}^t = \nabla_t\ \Phi^{t-1}(\mathbf{p}^{t-1}, \mathbf{p}^t, r_t) + \nabla_t\ \Phi^t(\mathbf{p}^t, \mathbf{p}^{t+1}, r_t)$$

PIGLOG COST FUNCTION:

$$\log\ c(\mathbf{p}^t, u) = \log\ a(\mathbf{p}^t) + b(\mathbf{p}^t)u$$

SNAP DEMAND SYSTEM FROM A PIGLOG COST FUNCTION:

Profit function:

$$\pi(\mathbf{p}^t, r_t) = r_t\ u - c(\mathbf{p}^t, u) = \left[\log\left(\frac{r_t}{b(\mathbf{p}^t)}\right) - \log\ a(\mathbf{p}^t) - 1\right]\frac{r_t}{b(\mathbf{p}^t)}$$

Loss function:

$$\Phi^{t-1}(\mathbf{p}^{t-1}, \mathbf{p}^t, r_t) = -\left\{\log\left[\frac{r_t}{b(\mathbf{p}^t)}\right] - \log\ a(\mathbf{p}^t) - 1 + \log\ d(\mathbf{p}^{t-1})\right\}\frac{r_t}{b(\mathbf{p}^t)}$$

SNAP demand system:

$$w_{it} = \alpha_i + \sum_j \gamma_{ij} \log p_{jt} + \beta_i \log\left[\frac{y_t}{a(\mathbf{p}^t)}\right] + \beta_i \sum_k \theta_k \log p_{kt-1} + \delta_i\left[\frac{b(\mathbf{p}^t)}{b(\mathbf{p}^{t+1})}\right]$$

Figure 1

The SNAP model from a PIGLOG cost function

- Lagged homogeneity: $\sum_j \theta_j = 0$ (28)
- Intratemporal symmetry: $\gamma_{ij} = \gamma_{ji} \quad \forall i \neq j$ (29)
- Intertemporal symmetry: $\theta_i = -\delta_i \quad \forall i$ (30)
- Myopic: $\delta_i = 0 \quad \forall i$ (31)

The restriction that we are especially interested in is:

- Intertemporal separability: $\theta_i = \delta_i = 0 \quad \forall i$ (32)

Note that if we accept (32), then the model (25) is an intratemporal AIDS, in which current demands depend only on current variables (prices and expenditure).

We can then calculate the expenditure and non-current Marshallians own-price elasticities. Expenditure effects allow us to classify goods into necessities and luxuries, whereas non-current price elasticities show which goods are autocomplementary, autosubstitutable or autoindependent. To obtain these, set $w_{it-1} = w_{it} = w_{it+1}$ and $b(\mathrm{p}^{t-1}) = b(\mathrm{p}^{t}) = b(\mathrm{p}^{t+1})$; this only results is insignificant differences in the estimated elasticities. Thereafter, we obtain the following expressions:

- Expenditure:

$$e_{it} = \frac{\partial \log q_{it}}{\partial \log y_t} = 1 + \frac{\partial \log w_{it}}{\partial \log y_t} = 1 + \frac{\beta_i}{w_{it}} \qquad (33)$$

- Non-current Marshallian price:

$$e_{iit\pm 1} = \frac{\partial \log q_{it\pm 1}}{\partial \log p_{it}} = \frac{\partial \log w_{it\pm 1}}{\partial \log p_{it}} = \frac{\beta_i \theta_i}{w_{it}} \qquad (34)$$

III. DATA

French annual time-series of non-durable goods expenditures obtained from OECD National Accounts, Vol. II (Detailed Tables) for the period 1964-1992 were used to estimate the empirical model. All

data are expressed in billions. Current and constant expenditures were divided into six categories:

Group 1: *Food.*
Group 2: *Beverages.*
Group 3: *Clothing and footwear.*
Group 4: *Gross rent, fuel and power.*
Group 5: *Medical expenses.*
Group 6: *Other non-durable goods.*

Before carrying out the econometric analysis, we shall provide a descriptive analysis in Table 1. First, we analyse the time evolution of budget shares, that is, expenditure on a good relative to total expenditure and, secondly, we carry out an inflation analysis, calculating the annual average rates for each expenditure for the total sample period and for several subperiods. We have chosen the limit years according to the most representative years of the last three decades from an economic point of view, i.e. both oil crises, 1973 and 1979, and, further, trying to have subperiods with a similar number of years.

Table 1

Descriptive analysis

Budget shares (%)	1964	1970	1975	1980	1985	1992	Mean
Food	29	25	22	20	19	16	22
Beverages	5	4	3	3	2	2	3
Clothing and footwear	11	9	9	8	7	6	8
Gross rent, fuel and power	12	16	18	20	21	22	18
Medical expenses	9	11	9	8	9	11	10
Other non-durable goods	31	32	37	39	38	39	36
Rates of inflation (%)	**1965-69**	**1970-73**	**1974-78**	**1979-85**	**1986-89**	**1990-92**	**1965-92**
Food	3.38	6.58	9.11	9.52	3.17	2.09	6.20
Beverages	3.33	7.59	9.85	9.70	3.05	4.42	6.53
Clothing and footwear	2.48	5.33	10.79	9.94	5.15	2.94	6.66
Gross rent, fuel and power	7.20	6.74	10.06	11.84	4.00	4.12	8.02
Medical expenses	4.57	2.12	2.15	7.99	2.29	0.82	4.16
Other non-durable goods	4.80	5.36	10.51	10.37	3.57	2.83	7.04

With respect to budget shares, it can be seen that *food* and *gross rent, fuel and power* have the largest average shares of non-durable goods, 22% and 18%, respectively, whereas the *beverages* group exhibits the smallest, only 3%. The time evolution indicates that expenditures on *food, beverages* and *clothing and footwear* have steadily decreased over the whole sample period, from 29%, 5% and 11% to 16%, 2% and 6%, respectively. By contrast, *gross rent, fuel and power* increased from the beginning of the sample period up to the early 1990's, from 12% to 22%. As can be seen, the *medical expenses* share remained reasonably stable and we cannot observe any clear trends. However, this evolution must be evaluated with caution since the group *medical expenses* has not been homogeneous along the sample period.

As regards the rates of inflation, we observe that, as expected, the *gross rent, fuel and power* group display the highest average value along the whole sample period, 8,02%, and *medical expenses* the smallest, 4,16%. We also detect an increasing trend in the annual average rates in all magnitudes up to the period 1973-1978 or up to 1979-1985, that is, immediately after the oil crises. The rates then show a clear decrease, with values being relatively small.

IV. ESTIMATION AND RESULTS

We start by adding additive error terms to equations (25). This error term is intended to capture taste shifts, measurement errors in the dependent variable and the effects of left-out variables. Thus, we have:

$$w_{it} = \alpha_i + \sum_j \gamma_{ij} \log p_{jt} + \beta_i \log \left[\frac{y_t}{a(\mathrm{p}^t)}\right] + \beta_i \sum_k \theta_k \log p_{kt-1} + \delta_i \left[\frac{b(\mathrm{p}^t)}{b(\mathrm{p}^{t+1})}\right] + u_{it} \quad (35)$$

When estimating we use (23) and the Stone (1954) price index for $a(\mathrm{p}^t)$:

$$\log a(\mathrm{p}^t) = \log P_t^* = \sum_j w_j \log p_{jt} \quad (36)$$

Due to the adding-up condition, $\sum_i u_{it} = 0$, for all t, the covariance matrix is singular and the likelihood function undefined. The usual procedure followed in this study has been to drop one of the equations

(*other non-durable goods*), to estimate the remaining system and to calculate the parameters in the omitted equation, via the adding-up condition.

According to Browning (1991), we estimate the model by nonlinear three-stage least squares. When estimating we adopt the following instruments set: the current and lagged absolute prices, the current and lagged real GDP and a time trend.

We then apply two specification tests. First, we test the first-order autocorrelation by means of the Breusch-Godfrey (1978) test, which is a Lagrange multiplier that, under the null hypothesis, is distributed as a standard normal. Secondly, we use the Engle (1982) statistic, which has a χ^2 (1) distribution to test the dynamic heteroscedasticity or ARCH errors. Table 2 shows the specification tests. In this table we can see that there exists neither first-order autocorrelation nor dynamic heteroscedasticity problems in any equation; that is to say, our estimated SNAP demand system has the appropriate corrected properties from an econometric point of view in order to obtain relevant economic results.

Table 2
Specification tests

	Breusch-Godfrey	Engle
Food	0.590	0.557
Beverages	0.631	0.001
Clothing and footwear	−0.124	0.399
Gross rent, fuel and power	−0.673	0.037
Medical expenses	1.757	2.035
Other non-durable goods	0.367	0.070

Critical values: standard normal at the 5% level: 1.96; $\chi^2(1)_{0.05} = 3.84$.

Table 3 shows the results of the hypotheses tests. According to the value of the Wald test, the theoretical conditions of current homogeneity and symmetry (intratemporal and intertemporal) are, as usual, rejected, except lagged homogeneity, which was incorporated in the estimated demand system. The rejection of myopic behaviour indicates that the effect of future variables can not be set to zero in the determination of current demands. With respect to the intertemporal separability hypothesis, we observe that, as can be expected, it is also rejected; that is to say, current demands can be written as a function of current variables, as well as one-period lagged and one-period lead prices.

Table 3
Hypotheses tests

	Wald
Current homogeneity (5 d.f.)	59.39*
Lagged homogeneity (1 d.f.)	1.37
Homogeneity (6 d.f.)	63.64*
Intratemporal symmetry (15 d.f.)	550*
Intertemporal symmetry (5 d.f.)	25.58*
Symmetry (20 d.f.)	634*
Intertemporal separability (5 d.f.)	28.28*
Myopic behaviour (5 d.f.)	494*

* Rejected theoretical hypotheses at the 5% level. Critical values: $\chi^2(1)_{0.05} = 3.84$, $\chi^2(5)_{0.05} = 11.07$, $\chi^2(16)_{0.05} = 12.59$, $\chi^2(15)_{0.05} = 24.99$, $\chi^2(20)_{0.05} = 31.41$.

With respect to the significance of individual parameters, Table 4 shows that 65% of estimated parameters are statistically significant at the 5% level. In particular, we observe that the price of *clothing and footwear* and expenditure coefficients are significant in all equations. By contrast, the price of *food* is only significant in its own equation. Another feature to note about the estimates is that for two goods, *beverages* and *gross rent, fuel and power*, the product β_i and θ_i is significant, whereas the rest of the groups are classified as autoindependent.

We close this section with a discussion of the expenditure and price elasticities implied by the parameter estimates calculated at the means of the samples. As regards expenditure elasticities (e_i), we observe that the six effects are significant at the 5% level. *Food, beverages* and *clothing and footwear* are necessities, whereas the rest of the groups are luxuries. These results are in accord with those of Abramovici (1993), which have been obtained with French data in 1992. With respect to non-contemporaneous Marshallians own-price effects (e_{ii}), the individual significance of $\beta_i\theta_i$ parameters is confirmed according to the values of non-current price elasticities. *Beverages* and *gross rent, fuel and power* exhibit a significant auto effect. The negative sign of *beverages* indicates that this good is autocomplementary and the sign of *gross rent, fuel and power* shows that this good is autosubstitutable.

Table 4
Parameters and elasticities

	α_i	γ_{i1}	γ_{i2}	γ_{i3}	γ_{i4}	γ_{i5}	γ_{i6}	β_i	θ_i	δ_i	$\beta_i\theta_i$	e_i	e_{ii}
Food	1.793	0.121	−0.045	0.033	−0.002	−0.011	−0.088	−0.123	0.240	−0.634	−0.029	0.44	−0.13
	(9.3)*	(6.5)*	(−2.1)*	(2.4)*	(−0.9)	(−1.7)	(−3.1)*	(−15)*	(1.7)	(−3.4)*	(−1.7)	(12)*	(−1.7)
Beverages	0.204	−0.008	0.026	0.015	0.016	−0.004	−0.047	−0.021	−0.184	−0.007	0.003	0.40	0.13
	(3.2)*	(−1.4)	(3.9)*	(4.6)*	(2)*	(−2.2)*	(−5.5)*	(−8.5)*	(−3)*	(−0.1)	(2.8)*	(5.7)*	(3.5)*
Clothing and footwear	−0.276	−0.015	0.052	0.026	−0.079	−0.014	0.025	−0.025	0.100	0.551	−0.002	0.72	−0.03
	(−2)*	(−0.9)	(3.2)*	(3.3)*	(−3.9)*	(−3.2)*	(1.1)	(−3.9)*	(1.1)	(4.2)*	(−1.1)	(10)*	(−1.2)
Gross rent, fuel and power	−0.476	−0.056	0.050	−0.037	0.104	−0.008	−0.057	0.054	−0.267	0.261	−0.014	1.29	−0.08
	(−1.3)	(−1.6)	(1.2)	(−2.1)*	(2)*	(−0.1)	(−1.1)	(3.4)*	(−3.8)*	(0.8)	(−2.5)*	(15)*	(−2.6)*
Medical expenses	0.054	−0.038	0.001	0.092	0.184	0.085	−0.317	0.023	−0.098	−0.133	−0.002	1.23	−0.02
	(0.2)	(−1.3)	(0.1)	(6.9)*	(5.3)*	(11)*	(−8.6)*	(2.4)*	(−2.2)*	(−0.5)	(−1.6)	(13)*	(−1.6)
Other non-durable goods	−0.299	−0.003	−0.086	−0.130	−0.223	−0.054	0.485	0.092	0.209	−0.037	0.019	1.25	0.05
	(−0.8)	(−0.1)	(−2.2)*	(−7.2)*	(−4.6)*	(−5.1)*	(9.7)*	(6.4)*	(1.1)	(−0.1)	(1.1)	(31)*	(1.2)

* Rejected non-individual significance at the 5% level, *t*-rates at the 5% level: 1.96.

V. CONCLUSIONS

In this paper we have tested the intertemporal separability hypothesis in France, using annual time-series expenditures. To do this, we have used the SNAP structure for intertemporal preferences which gives close forms for demands that depend on current variables and lead and lagged prices. We have estimated the SNAP system and our results indicate that *intertemporal separability is rejected in France, that is to say, French consumers, in their consumption decisions, consider both current variables, as well as one-period lead and one-period lagged prices, to be relevant.*

As could be expected, *all theoretical hypotheses are rejected* and the elasticities show that *food, beverages and clothing and footwear are necessities, whereas gross rent, fuel and power, medical expenses and other non-durable goods are luxuries*. The non-current Marshallian own-price effects show that only *beverages and gross rent, fuel and power display any significant autodependency over time. In particular, beverages is autocomplementary and gross rent, fuel and power is autosubstitutable; the rest of the goods are autoindependent.*

REFERENCES

Abramovici G., "La consommation des ménages en 1992", INSEE résultats, 47-48, 1993.

Attfield C.L. and Browning M., "A Differential Demand System, Rational Expectations and the Life-Cycle Hypothesis", *Econometrica*, 53, 1985, p. 31-48.

Blundell R., Browning M. and Meghir C., "A Microeconometric Model of Intertemporal Substitution and Consumer Demand", Discussion Paper n°89-11, University College London, 1989.

Breusch T.S. and Godfrey L., "A Review of Recent Work on Testing for Autocorrelation in Dynamic Simultaneous Models", in Currie, Nobay and Peel (eds.), *Macroeconomic Analysis: Essays in Macroeconometrics and Econometrics*, Croom Held London, 1981.

Browning M., "Profit Function Representations for Consumer Preferences", Discussion Paper 82/125, University of Bristol, 1982.

Browning M., "The Cost of Using Frisch Demand Functions that are Additive in the Marginal Unity of Expenditure", *Economics Letters*, 21, 1986, p. 205-207.

Browning M., "The Intertemporal Allocation of Expenditure on Non-Durables, Services and Durables", *Canadian Journal of Economics*, 22, 1989, p. 22-36.

Browning M., "A Simple Nonadditive Preference Structure for Models of Household Behavior Over Time", *Journal of Political Economy*, 99, 1991, p. 607-637.

Browning M., Deaton A. and Irish M., "A Profitable Approach to Labour Supply and Commodity Demands Over the Life-Cycle", *Econometrica*, 53, 1985, p. 503-543.

Deaton A. and Muellbauer J., "An Almost Ideal Demand System", *The American Economic Review*, 70, 1980a, p. 312-326.

Deaton A. and Muellbauer J., *Economics and Consumer Behaviour*, Cambridge University Press, 1980b.

Engle R.F., "Auroregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdon Inflation", *Econometrica*, 50, 1982, p. 987-1007.

Frisch R., *New methods of Measuring Marginal Utility*, Tubigen: J.C.B. Mohr, 1932.

Gorman W., "Tastes, Habits and Choices", *International Economic Review*, 8, 1967, p. 218-222.

Heckman J.J. and MaCurdy T., "A Life-Cycle Model of Female Labour Supply", *Review of Economic Studies*, 47, 1980, p. 47-74.

Laisney F. and Wagenhals G., "Labour Supply, Commodity Demands and the Taxation of Households", in Florents, Ivaldi, Laffont and Laisney (eds.). *Microeconometrics*, Basil Blackwell, 1990.

MaCurdy T.E., "An Empirical Model of Labour Supply in the Life-Cycle Setting", *Journal of Political Economy*, 89, 1981, p. 1059-1085.

MaCurdy T.E., "A Simple Scheme for Estimating an Intertemporal Model of Labour Supply and Consumption in the Presence of Taxes and Uncertainty", *International Economic Review*, 24, 1983, p. 265-289.

Muellbauer J., "Aggregation, Income Distribution and Consumer Demand", *Review of Economic Studies*, 62, 1975, p. 525-543.

Muellbauer J., "Community Preferences and the Representative Consumer", *Econometrica*, 44, 1976, p. 979-999.

Stone R., "Linear Expenditure Systems and Demand Analysis: an Application to the Pattern of British Demand", *The Economic Journal*, 64, 1954, p. 511-527.