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Intra Household Allocation of Consumption: a Model and some Evidence from French Data

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ABSTRACT. – The goal of this paper is twofold. First, we reproduce upon French data previous tests of the so-called "income pooling" hypothesis, a consequence of traditional models of household behaviour according to which only total income – and not income distribution across members – should matter. We find that income pooling is rejected: for a given level of total income, the share of husband's and wife's own income significantly affects the structure of consumption.

Our second purpose is more innovative. We construct a theoretical model of collective decision making, based upon the efficiency assumption of collective decision making. Both our setting and the traditional, household preference model can be nested within a family of functional forms. The collective model generates specific restrictions upon the parameters that can the tested. Those restrictions turn out not to be rejected by the data.

Association intra-familiale de la consommation. Un modèle et des tests sur données françaises

RÉSUMÉ. – L'article a un double objectif. D'une part, et à la suite de travaux récents, il teste sur données françaises l'hypothèse d'agrégation du revenu au niveau du ménage. Une conséquence des modèles traditionnels, qui supposent l'existence d'une fonction d'utilité unique au niveau du mélange, est en effet que les comportements doivent dépendre uniquement du revenu total, et pas de la répartition de celui-ci. Cette hypothèse se trouve rejetée sans ambiguïté par les données.

En second lieu, nous développons un modèle « collectif » de comportement, fondé sur la seule hypothèse d'efficacité Paretienne des décisions. Ce modèle et l'approche traditionnelle peuvent être dérivés comme cas particuliers d'une même forme générale; en particulier, nous présentons des tests économiques de l'approche collective. Celle-ci n'est pas rejetée par les données.

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1 Introduction

Collective models of household behaviour have attracted increasing attention from the profession during the recent years. A number of empirical studies [1] have strongly suggested that some implications of the traditional "household utility" approach were not satisfied empirically. A consequence of this setting that has been repeatedly tested is the "income pooling" hypothesis. If households can be described as maximizing a single utility function under a budget constraint, then only total income should matter in their consumption decisions. The various sources of income ("who earns what") should be irrelevant. This conclusion has been challenged, in particular by THOMAS [1990] and SCHULTZ [1990].

Simultaneously, several theoretical models of collective decision making within the household have been elaborated, and shown to generate falsifiable implications. Following previous attempts by MANSER and BROWN [1980] and MCELROY and HORNEY [1981], CHIAPPORI [1988, 1992] studied a simple "collective" model of labour supply, under the sole assumption that the decision process is cooperative – in the sense that it always leads to Pareto efficient outcomes. An equivalent interpretation is that household members first agree upon a "*sharing rule*", defining how income should be distributed – depending on wages and non labour incomes – then freely choose their consumption and labour supply behaviour. Chiappori showed that this setting is sufficient to generate conditions on labour supplies that can be empirically tested. However, actual tests of this "cooperative hypothesis", that is of a Pareto efficient collective decision making within the household – or, equivalently, of the "sharing rule" framework – are not to the best of our knowledge available so far.

The goal of the present paper is twofold. First, we reproduce upon French data previous tests of the traditional approach. Namely, we investigate whether the income pooling hypothesis can be accepted for consumption data. Our conclusions are in line with previous work. Income pooling is rejected: in other words, for a given level of total income, the share of husband's and wife's own income significantly affects the structure of consumption.

The second purpose of the paper is more innovative. Going a step further the simple rejection of the traditional approach, we design a test of the "cooperative hypothesis". To do so, we construct a theoretical model of collective decision making which nests both the "traditional" single utility approach and the "cooperative" hypothesis within a more general

1. See for instance the special issue of the Journal of Human Resources [1990] on this topic. For a general discussion of "traditional" vs. "collective" approaches, cf. Chiappori [1992] and Bourguignon and Chiappori [1992].

specification of consumption behaviour, for fixed full-time employment of (adult) household members. In that framework, the cooperative hypothesis, that is the assumption of efficient collective decision making within the family, generates specific restrictions upon the parameters of the model that can be tested. More surprising, we show that this may be done by observing *aggregate* household consumption of goods, rather than, as one would expect, *individual* consumptions – i.e. we need not to assume that goods are "assignable" in the usual sense. If individual consumption is observed for some goods, we show that, in addition to the test of the cooperative hypothesis, it is almost the full intra-household decision process – i.e. the "sharing rule" – that may be recovered from available data. Where only total consumption is available, the information to be obtained about that intra-household allocation process is more partial.

The paper is in two parts. The first section describes the cooperation decision making model, and discusses in theoretical terms its testability as well as the identifiability of the sharing rule behind it. The second part presents an empirical test of the traditional approach (income pooling) and the implementation of the test of the cooperative hypothesis on French data. Interestingly enough, the latter is not rejected. While our data set falsifies the traditional approach, it thus seems not to be inconsistent with the cooperative hypothesis.

2 The Theoretical Framework

2.1. Cooperation and the Sharing Rule in a Model with Flexible Labour Supply

The models of cooperative intra-household allocation recently analyzed by Chiappori [1988, 1992] may be summarized as follows. Consider a household with two members $i(=m, f)$ whose "egoistic" preferences are defined over a vector of private consumption goods c_i, and leisure, l_i, [2] through the utility function:

$$U_i(c_i, l_i)$$

2. Note that we assume public goods away. This is a severe restriction that is to be weakened in further work – see Bourguignon and Chiappori [1992]. In the present setting this implies that we cannot really consider consumption allocation issues related to children.

where $U_i(\ )$ has all the usual properties. To be a little more general, we may also assume that both members "care" for each other in a Beckerian sense (BECKER, 1981), so that their true utility W_i is in fact given by:

$$W_i[U_i(c_i, l_i), U_j(c_j, l_j)], \qquad j \# i$$

where W_i has all the usual properties of a "social" utility function. [3]

The crucial assumption of cooperation between the two members m and f is that the allocation of goods and leisure they will decide lies somewhere on the Pareto frontier corresponding to W_m, W_f [4] and the budget constraint:

$$(1) \qquad p(c_m + c_f) + w_m . l_m + w_f . l_f = T(w_m + w_f) + y_0 = Y$$

where p is the price vector of consumption goods, T is total time available, w_i is the wage rate of member i, y_0 is non-labour income and Y is total potential income. [5] The Pareto frontier is generated by the solution of the maximization program:

$$(2) \qquad \underset{c_m, c_f, l_m, l_f}{\text{Max}} \quad \theta W_m[U_m, U_f] + (1-\theta) W_f[U_f, U_m]$$

where θ may be any scalar between 0 and 1. A particular point on the Pareto-frontier corresponds to a specific value of θ, which, somehow, corresponds to the "weight" given to each member in the welfare of the household.

We now show that there is an equivalence between assuming that a household allocates goods and labour according to some specific value of θ and assuming that it shares the total (full) income of the household among its two members in a specific way. In other words, the set of possible values for θ generates the whole Pareto frontier and corresponds to a set of "sharing rules" of the total household income among its members.

To see that, let Y_i be the (full) income of the household allocated to member i. The maximization problem (2) under the budget constraint (1) then is strictly equivalent to:

$$(3) \qquad \underset{Y_m, Y_i}{\text{Max}} \, \theta . W_m(V_m, V_f) + (1-\theta) . W_f(V_m, V_f)$$

subject to:

$$Y_m + Y_f = Y$$

3. Note that one may get a step further by assuming away the weak separability between (c_m, l_m) and (c_f, l_f) in the preceding function. This would correspond to the "altruistic" case where the utility of a member i would be defined as a function of his/her own private consumption, leisure, and those of his/her spouse (see BOURGUIGNON and CHIAPPORI [1992]).

4. Which, from that point of view, is equivalent to the frontier defined by $U_m(\ )$ and $U_f(\ )$.

5. We assume here that non-labour income is not appropriated by either member. This is in opposition with THOMAS [1990].

The terms V_m and V_f in the maximisation program stand for the indirect individual utility functions defined in the standard way:

$$V_i(Y_i, w_i, p) = \text{Max } U(c_i, l_i)/p.c_i + w_i.l_i = Y_i$$

For a given θ, the solution of (2) gives a "sharing rule" where the optimal (full) income Y_i^* given to member i appears as a function of the price system and total full income. Of course, this sharing rule satisfies the adding up identity:

$$(4) \qquad Y_m^*(p, w_m, w_f, Y) + Y_f^*(p, w_m, w_f, Y) = Y$$ [6]

In principle, the sharing rule functions $Y_i^*(\ )$ should satisfy some properties since they are solutions of programme (2). However, this maximization programme is conditional on θ. As this latter parameter may be chosen arbitrarily by the household members, inclusively as a function of the exogenous variables (Y, p, w_m, w_f), the sharing rule functions which somehow describes the kind of cooperative agreement reached by the members of the household may have any shape – as long as they satisfy the accounting identity (4).

Of course, individual labour supply and consumption demand functions which may be derived from this cooperative framework do not exhibit the standard properties derived from the rational consumer model. Replacing total income Y_i by the sharing rule $Y_i^*(Y, p, w_m, w_f)$ shows that the labour supply function of individual i depends directly on his/her wage rate w_i as in the standard model but also indirectly through the sharing rule function. Likewise, labour supply by member i depends on the wage rate of the other member through the sharing rule $Y_i^*(\ )$, and not only through the full household income, Y. CHIAPPORI [1988] analyzes the properties of the labour-supply functions derived from the cooperation hypothesis and shows how the usual Slutsky conditions are modified. He also shows how, in theory, the "sharing rule" $Y_i^*(p, w_i, w_j, y)$ may be recovered and the cooperative hypothesis may be tested using observation on labour supply in cross-sectional data.

2.2. Testing the Cooperative Hypothesis on Household Consumption Data in the Case of Fixed Labour-Supply

Using labour-supply behaviour for recovering the sharing rule and testing the cooperative hypothesis may be debatable. In particular, there may not be enough flexibility on the demand side of the labour-market to believe

6. It may seem odd to define a sharing rule on "full" income, that is, including the virtual income corresponding to the opportunity cost of the leisure of household members. There is nothing wrong with that. This simply means that the sharing rule may imply that one member must necessarily work, and transfer part of his actual labour income to his/her partner. This will happen, for instance, when $Y_i^* < w_i T$.

that all individuals are on their supply curve. Interestingly enough, we show in the present subsection that, even when one fails to observe the individual consumption of a good like leisure in typical cross-sectional household surveys, it is still possible, under the hypothesis of cooperative behaviour, to recover some information on the sharing rule and to test the hypothesis that the allocation of goods within the household truly obeys the Pareto rule.

We assume in what follows that the labour supply of both members of the household is fixed. This is either because both individuals are rationed on the labour-market, or because of some separability property between leisure and other consumption goods in individual preferences.

A consequence of this assumption, within the rational single utility framework, is that substitution effects between leisure and consumption are assumed away. Hence, each spouse's income should enter household consumption of goods through pure income effects. According to the traditional approach, consumption should thus depend on total income, and not on the labour income of each household member. This property is generally referred to as "income pooling".

Let us now consider the cooperative framework. Let $U_i(c_i)$, $i=m, f$, be the utility of individual i conditionally on his/her labour-supply. Following the argument in the previous section, the assumption that the household allocates efficiently consumption goods is equivalent to assuming the existence of a sharing rule. Let that rule for individual m be given by the function $Y^*_m(y_m, y_f, Y)$, where y_i is individual i's labour earnings – that is $w_i . L_i$, L_i being fixed – and Y is total family income:

$$Y = y_m + y_f + y_0$$

where y_0 is, as before, non-labour household income. [7] The budget $Y^*_f(\ )$ given to individual f depends on the same arguments. Both incomes are linked by the overall budget identity:

$$Y^*_m(y_m, y_f, Y) + Y^*_f(y_m, y_f, Y) = Y\,(= y_m + y_f + y_0) \qquad (5)$$

If all households face the same price vector – as it is usually assumed in cross-sectional studies – we may simply ignore its influence on consumption choices. So, the consumption of good i by individual $j(=m, f)$ is given by his/her total budget alone and depends on the same arguments as the sharing rule:

$$C_{ij}(y_m, y_f, Y) = F_{ij}[Y^*_j(y_m, y_f, Y)] \qquad (6)$$

where $F_{ij}(\ )$ is simply the Engel curve of individual j for good i.

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7. Notice the minor change of variables in the arguments of the sharing rule in comparison with the preceding section. Total income, rather than non-labour income is now considered as an independent variable, along with both members' earings. This is done for the sake of analytical convenience and has no bearing on further results.

We consider in the present section the case where only total consumption of the two member household is observed. From (5) and (6), total consumption of good i thus writes:

$$\text{(7)} \qquad C_i(y_m, y_f, Y) = F_m[Y^*_m(y_m, y_f, Y)] + F_{ij}[Y - Y^*_m(y_m, y_f, Y)]$$

Clearly, the fact that the two earnings variables enter the consumption of all goods through the sharing rule function impose strong restrictions across goods. Indeed, differentiating the preceding expression, for constant total income Y, with respect to $y_k (k=m, f)$ yields:

$$\text{(8)} \qquad \partial C_i/\partial y_k = [\partial Y^*_m/\partial y_k](F'_{im} - F'_{ij})$$

This expression has three important implications. Eliminating the good specific Engel curve coefficients by taking ratios of the partial derivatives with respect to y_m and y_t leads to:

$$\text{(9)} \qquad \frac{\partial C_i/\partial y_m}{\partial C_i/\partial y_f} = \frac{\partial C_j/\partial y_m}{\partial C_j/\partial y_f} = \frac{\partial Y^*_m/\partial y_m}{\partial Y^*_m/\partial y_f}$$

Thus the first implication of the cooperative hypothesis is that the ratio of marginal propensities to consume a good with respect to the income of both spouses, *at constant total family income*, must be the same across goods.

The second implication is that the common value of the preceding ratio across goods is equal to the **marginal rate of substitution between both member's earnings in the sharing rule.** Indeed, since total family income is kept constant, the last term in (9) shows the proportion in which the earnings of both spouses must vary in order to leave the sharing rule unchanged. This means that, under the cooperative hypothesis, it is possible to recover some information about the sharing rule by simply observing the (supposedly common) ratio of the marginal propensities to consume with respect to both members' earnings.

The final implication of the cooperative hypothesis is obtained by eliminating the partial derivative of the sharing rule across two goods in (8). Doing so, one finds:

$$\text{(10)} \qquad \frac{\partial C_i/\partial y_k}{\partial C_j/\partial y_k} = \frac{F'_{im} - F'_{if}}{F'_{jm} - F'_{jf}}$$

This means that it is possible to recover from the marginal propensities to consume with respect to members' earnings, at constant total family income, some partial information on the difference in the Engel curve slopes of the two members.

Of course, the preceding information about individual preferences, as well as that on the sharing rule given by (9) are very partial. It is worth stressing, however, that the test of the cooperative hypothesis and the recovery of the information just mentioned do not require more than the standard observation of the total consumption of a few goods in a household.

However, the cooperative hypothesis imposes still more restrictions when one considers the derivatives of the definition of household consumption under that hypothesis with respect to total income. Indeed, up to the present stage we only used properties associated with marginal propensities to consume defined with respect to both members' earnings. Taking the partial derivative of (7) with respect to Y and making use of (8) permits to identify the individual Engel curve derivatives (that is the individual marginal propensities to consume). F'_{if} and F'_{im} are given by:

(11)
$$F'_{if} = \frac{\partial C_i}{\partial Y} - \frac{\partial C_i}{\partial y_m} \cdot \frac{\partial Y^*_m / \partial Y}{\partial Y^*_m / \partial y_m}$$

and

$$F'_{im} = \frac{\partial C_i}{\partial Y} + \frac{\partial C_i}{\partial y_m} \left[\frac{1 - \partial Y^*_m / \partial Y}{\partial Y^*_m / \partial y_m} \right]$$

Given symmetry, the same relationships would hold if derivation were taken with respect to y_f rather y_m.

F'_{im} depends, by definition, only on $Y^*_m(\ )$, so that differentiating the second relationship in (11) in the direction given by:

(12)
$$dY^*_m = \frac{\partial Y^*_m}{\partial Y} dY + \frac{\partial Y^*_m}{\partial y_m} dy_m = 0$$

leaves the left-hand side unchanged. Performing the differentiation on the right-hand side and denoting:

$$A = \frac{\partial Y^*_m / \partial Y}{\partial Y^*_m / \partial y_m}, \qquad B = \frac{1 - \partial Y^*_m / \partial Y}{\partial Y^*_m / \partial y_m}$$

yields:

(13)
$$\frac{\partial^2 C_i}{\partial^2 Y} + (B - A) \frac{\partial^2 C_i}{\partial Y\, \partial y_m} - AB \frac{\partial^2 C_i}{\partial y_m^2} + \frac{\partial C_i}{\partial y_m} \left[\frac{\partial B}{\partial Y} - A \frac{\partial B}{\partial y_m} \right] = 0$$

the same being true when replacing the derivatives with respect to y_m by derivatives with respect to y_f. (13) must be satisfied for all goods i, with the same functions A and B [8] of the three basic variables Y, y_m, y_f. Under these conditions, observing the consumption of at least two consumption goods imposes additional restrictions – on top of (9) – on any parametric specification of the household consumption functions $C_i(\ )$, and thus additional tests of these specifications and/or the cooperative hypothesis.

If these tests are passed (13) provides, in the same way as (9) above, new information on the sharing rule. If enough goods are observed, relations

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8. Following the same definitions as above, function A may be defined as the marginal rate of substitution between total income and member *m's* earnings in the share of total income going to member *m*, whereas function B is the same marginal rate of substitution in the share of total income going to member *f*.

(13), under the restrictions mentioned above which come from the cooperative hypothesis, permit to identify the expressions $A-B$, AB and $(B_Y - A.B_j)$. Of course, there must be restrictions on the functional form of the original consumption functions $C_i(\ \ )$ in order for the first two terms to be consistent with the partial derivatives in the last one. The analysis of these new restrictions is rather complex and is left for further work, though. In any case, there seems to be some possibility that, provided that the household consumption functions satisfy some properties still to be determined, the observation of the household consumption behaviour with respect to a few goods permits to identify A and B. Together with the right-hand term of (9) this would permit to identify all the partial derivatives of the sharing rule with respect to the three variables Y, y_m and y_f and to recover the whole sharing rule, up to some constant! It would then become possible to also recover the individual marginal propensities to consume directly from (13)! Again, we shall not go through that exercise in the present paper, but we shall see in the simple example dealt with in the empirical part of the paper that indeed, beyond the tests of the cooperative hypothesis (13) permits to recover some properties of the sharing rule. [9]

2.3. Recovering the Sharing Rule when some Individual Consumption is observed

The preceding results are interesting because one would have expected that it was possible to recover the sharing rule (or part of it) only when some **individual consumption** is observed. In such instance, observing how that "assignable" consumption depends on the various components of family income clearly permits to identify how that income is shared among members.

This was precisely the route followed for instance by LAZEAR and MICHAEL [1986] and others to identify the share of family income going to children by only observing the consumption of children specific goods in the family. In the present two member family framework, the sharing rule may be directly recovered using the individual consumption function (6). Taking derivatives with respect to Y, y_m and y_f on both sides permit to identify the "marginal rates of substitution of the sharing rule", that is:

$$(14) \qquad [\partial Y_m^* / \partial y_m] / [\partial Y_m^* / \partial y_f] \qquad \text{and} \qquad [\partial Y_m^* / \partial y_m] / [\partial Y_m^* / \partial Y]$$

Integrating back, it is then possible to identify the sharing rule up to some transformation. Following the same argument, it may easily be seen that the whole sharing rule can be recovered, up to constant, if the consumption of one good by the other individual is also observed.

The central result of the present paper, however, is that even when such "assignable" consumption goods are not observed, it is still possible to

9. This is done in the appendix.

recover part, and possibly the integrality, of the sharing rule, under the cooperative hypothesis. That hypothesis always gives enough structure to the household consumption functions so that recovering some properties of the sharing rule and individual preferences is possible. As the individual assignability of consumption goods is always debatable, this result may be of importance, provided that the cooperative hypothesis is not rejected right away by the data. The rest of this paper is devoted to such a test on French household data. However, for lack of space, we do not try here to recover the empirical information available on the sharing functions.

3 Some Preliminary Tests in the Case of France

Some preliminary experiments with the preceding ideas have been conducted in the case of France. Because the econometric specification consistent with the model is rather complicated we only explore here a few simple properties of the data without getting into econometric technicalities. More rigorous econometric work is presently in progress and more precise estimates shall be presented in future publications.

The data comes from the household survey "Budget des Familles" conducted by INSEE on a sample of 12,000 French households in 1984-1985. The survey is designed for the analysis of living standards and contains detailed information on earnings and incomes from property and transfers, on expenditures on non-durables as well as durable goods, and finally on most socio-demographic characteristics of individuals and households. To be consistent with the fixed labour-supply model presented in the previous section, our subsample consists of *couples where both members are full-time wage-earners* whose labour supply is assumed to be constrained at the legal maximum. Ideally, we also should have selected, within this category of households, a subsample of couples without children. In effect, children and expenditures on them may be considered as public goods by both parents, whereas the model analyzed above allows only for private goods. It turned out, however, that considering only childless couples leads to too limited a size of the sample. For this reason, couples with one child (at schooling age or younger) are also included in the sample which thus comprises 843 households. The main overall characteristics of the sample are reported in Table 1.

Labour income variables, y_i, are individual wages net of social contributions but including overtime, premia, pensions, and a monetary evaluation of benefits in kind. Non-labour income, y_0, includes various transfers, of which the most important is housing benefits and income from various types of assets. Note that the virtual income of home owner-occupiers,

TABLE 1

Main Characteristics of the Sample

	Mean	Std dev
Age of head	35.4	9.94
Age of spouse	33.5	9.94
Difference of age	1.83	3.88
Monthly hours of work:		
head	174	24.8
spouse	167	16.2
Years of education:		
head	15.6	4.15
spouse	15.6	4.00
Difference of education	-1.2×10^{-3}	4.31
Monthly wage		
of head	7,189	2,993
of spouse (Francs)	5,790	2,180
Ratio of female wage to male wage	.86	.30
Non labour income (Francs)	2,744.3	6,686
Total disposable income (Francs)	158,497	54,224

certainly the most important asset return, is not observed. This is controlled for in the regressions that follow through a dummy variable for those households. A more satisfactory procedure is still to be designed. Note also that all incomes are before taxes.

Expenditures on non-durable goods are recorded in the survey on diaries covering two-week periods and extrapolated to the year. It is well-known that this may cause problems due to the infrequency of purchases – see, for instance, ROBIN [1988], BLUNDELL and MEGHIR [1987], MEGHIR and ROBIN [1992]. Clothing expenditures are recorded over a longer period (two-month), but this difference with other non-durables is not taken into account. On the other hand, although clothing expenditures happen to be fully "assignable" – *i.e.* the final beneficiary of these expenditures in the family is identified – this originality of the present survey is not exploited in the present paper which, as mentioned before, focuses exclusively on non-assignable goods and total family consumption. The assignability of clothing shall be the object of future research. Other non-durable consumption items considered in the present study include food taken at home, food taken outside, cosmetics and beauty products, health, vacation, cultural and sport expenditures.

The total income variable in the econometric analysis that follows is the total annual income of the family, and not, as it is often the case in consumption studies, the total expenditures on the goods and services included in the analysis. In theoretical terms, this means that we do not make the usual separability assumption between the goods whose consumption is studied and others (including future consumption through savings). In the present cooperative game theoretical framework, that separability raises additional problems that we have no space to get into. [10]

With the help of this data, the objective of the present section is twofold. First, we want to test the "income pooling hypothesis", that is the traditional specification according to which consumption decisions in households result from a centralized process based on the total income of the family. This is done by testing whether the coefficients of the various components of family income – earnings of both members and property or transfer income – are significantly different in explaining the total expenditures of various consumption goods.

Assuming that the preceding test fails, the second objective of this section is to test whether the consumption data at our disposal are consistent with the cooperative game hypothesis about consumption allocation within the household. Following the theoretical analysis in the preceding section, two steps are necessary. First, a fairly general functional form must be selected for the household consumption functions $C_i(Y, y_m, y_f)$ and the parametric tests of the cooperative hypothesis corresponding to relationships (9) and (13) above must be made explicit. Second, these empirical tests must be performed.

This analysis of the data shows that: (i) the income pooling hypothesis is clearly rejected, and (ii) the cooperative hypothesis cannot be rejected, at least under the assumption that the underlying preferences and sharing rule lead to consumption functions that are quadratic with respect to the various individual components of family income.

All above tests are made somewhat difficult by the fact that consumption data in budget surveys are typically observed with purchassing frequency biases. So a number of households appear as not consuming a particular item, when, in fact, they do, but are simply not observed to do so during the time of the survey. [11] Several techniques have been proposed to handle that difficulty. However, using them would considerably complicate the tests we want to perform. We have performed tests on simplified functional forms using both the BLUNDELL-MEGHIR infrequency estimator and OLS, without finding noticeable differences. The more elaborate tests below are based upon (simultaneous) ordinary least-square estimates, which are known to be consistent in presence of purchasing infrequency – see KEEN [1987].

In what follows, it is assumed that individual Engel curves and the sharing rule are such that the family consumption function $C_i(Y, y_m, y_f)$ has the following polynomial form:

$$(15) \quad C_i = a_i Y + b_i Y^2/2 + c_i y_f + d_i y_m + e_i y_f^2/2 + f_i y_m^2/2 + g_i y_m y_f + z\,\beta_i$$

10. To some extent writing consumption expenditures as functions of total income and its components may correspond to the reduced form of a model where the consumption of the goods we consider would structurally depend on total non-durable expenditures.

11. Given the rather aggregate nature of the consumption goods which are considered in the analysis, zero consumption is likely to be more frequent due to low purchasing periodicity than to individual preferences.

where z includes the following usual socio-demographic variables: age and schooling level of both spouses, the presence of a child, the living area, and home-ownership status. So, household consumption functions are assumed to be quasi-quadratic in Y, y_m, y_t – only the two cross terms $Y . y_m$ and $Y . y_f$ are missing. [12]

In that framework, testing the pooling hypothesis is equivalent to testing that all the coefficients of those terms in (15) which include the variables y_f and y_m are zero. Table 2 gives the unrestricted GLS estimates obtained for the nine goods included in the analysis. The results of the Log-likelihood ratio test of the hypothesis that all coefficients c_i, d_i, e_i, f_i and g_i are all equal to zero appear in Table 3. There are 45 such restrictions and the corresponding χ^2 value leads to the clear rejection of the pooling hypothesis.

In order now to test the cooperative hypothesis, it is first necessary to derive the restriction on the coefficients of (15) implied by the general restrictions (9) and (13). It comes easily from the first part of (9) that:

$$\text{(16)} \qquad \frac{\partial Y_m^*/\partial y_m}{\partial Y_m^*/\partial y_f} = \frac{d_i + f_i . y_m + g_i . y_f}{c_i + e_i . \partial y_f + g_i . y_m}$$

and

$$\text{(17)} \qquad b_i - f_i . A . B + (d_i + f_i . y_m + g_i . y_f) . [B_y - A . B_{y_m}] = 0$$

for all i. In (17), A and B have the same definition, in terms of the sharing rule, as in the preceding section.

It is shown in the Appendix that these relationships are equivalent to restrictions on the coefficients of household consumption functions (15) such that these functions take one of the two following forms:

$$\text{(18)} \quad C_i = a_i . Y + \lambda_i . [b . Y^2/2 + c . y_f + d . y_m + e . y_f^2/2 + f . y_m^2/2 + g . y_m . y_f] + z\,\beta_i$$

or

$$\text{(19)} \quad C_i = a_i . Y + \lambda_i . [y_m + c . y_f + k . Y^2/2] + \mu_i [(y_m + c . y_f)^2/2 + K . Y^2/2] + z\,\beta_i$$

where (b, c, d, e, f, g) on one hand, and (k, K) on the other, are constant parameters which do not depend on the good i that is considered.

Table 3 gives the log-likelihood ratios corresponding to the restrictions (R1) and (R2) imposed on the GLS estimates of the nine consumption equations. The corresponding χ^2 tests involve respectively 33 and 40 degrees of freedom and they are both above the critical 5 per cent probability

12. This is to make easier the whole procedure, and in particular the application of conditions (13). A possible inconvenient of that functional form is that it eliminates the term in B-A in (13) and would probably prevent the identification of the sharing rule if we were to pursue in that direction.

TABLE 2

Ols Estimates

	Women's clothing	Men's clothing	Food at home	Restaurant	Health	Vacation	Cosmetics, beauty	Books, music	Enter-tainment
Intercept	-1.33×10^{-1}	-1.62×10^{-1}	5.99×10^{-2}	1.47×10^{-1}	-1.05*	-3.62×10^{-1}*	-1.44×10^{-1}	-1.95×10^{-1}	2.44×10^{-1}*
y_m	1.06×10^{-2}	-1.40×10^{-1}*	-1.16×10^{-1}	2.68×10^{-1}*	-1.40×10^{-1}	-2.86×10^{-2}	-1.21×10^{-2}	-4.04×10^{-2}	1.84×10^{-2}
y_f	6.26×10^{-2}	-2.11×10^{-1}*	-1.08×10^{-1}	2.92×10^{-1}*	-1.48×10^{-1}	5.41×10^{-3}	-5.09×10^{-2}	-7.49×10^{-2}	-1.15×10^{-2}
y_m^2	4.51×10^{-4}	2.35×10^{-3}	5.10×10^{-3}	-4.97×10^{-3}*	8.15×10^{-4}	2.17×10^{-3}	-3.71×10^{-4}	1.65×10^{-3}	2.64×10^{-3}
y_f^2	-2.89×10^{-3}	5.72×10^{-3}*	4.71×10^{-3}	-6.04×10^{-3}*	2.30×10^{-3}	2.07×10^{-3}	1.06×10^{-3}	3.8×10^{-3}	2.35×10^{-4}
$y_m y_t$	1.12×10^{-3}	5.94×10^{-3}	1.01×10^{-2}	-2.05×10^{-2}*	4.21×10^{-3}	6.98×10^{-4}	9.90×10^{-4}	1.51×10^{-3}	2.73×10^{-3}
y	5.05×10^{-3}	2.04×10^{-1}*	1.92×10^{-1}	-2.51×10^{-1}*	2.46×10^{-1}*	3.89×10^{-2}	6.24×10^{-2}	7.72×10^{-2}	1.3×10^{-2}
y^2	-2.92×10^{-4}	-3.75×10^{-3}*	-6.24×10^{-3}	8.36×10^{-3}*	-3.79×10^{-3}	-1.15×10^{-3}	-9.13×10^{-4}	-1.72×10^{-3}	-9.27×10^{-4}
Age_m	-2.24×10^{-3}	2.66×10^{-3}	3.71×10^{-2}*	-8.25×10^{-3}*	7.35×10^{-3}*	2.14×10^{-3}	1.75×10^{-5}	-1.7×10^{-3}	-5.15×10^{-3}*
Δ Age	-6.10×10^{-4}	-2.48×10^{-3}	-1.08×10^{-2}	5.29×10^{-3}	-1.36×10^{-2}	-1.66×10^{-3}	-1.35×10^{-3}	-2×10^{-3}	-2.76×10^{-3}
$Educ_m$	1.21×10^{-2}*	8.97×10^{-3}	-1.83×10^{-3}	1.60×10^{-2}*	1.54×10^{-2}	1.53×10^{-2}*	1.38×10^{-3}	1.65×10^{-2}*	-1.99×10^{-3}
Δ Educ	-4.79×10^{-3}	-4.66×10^{-3}	8.79×10^{-3}	-9.38×10^{-3}	-7.71×10^{-3}	-8.68×10^{-3}*	-4.88×10^{-3}	-9.86×10^{-3}	-4.41×10^{-3}
Presence of Child (0 or 1)	-1.09×10^{-1}*	-9.53×10^{-2}	3.25×10^{-1}*	-2.20×10^{-2}	3.32×10^{-2}	-9.84×10^{-2}*	2.49×10^{-2}	1.5×10^{-2}	-4.5×10^{-2}
Home owner dummy	8.31×10^{-2}*	3.07×10^{-2}	1.63×10^{-1}	-1.49×10^{-1}*	1.53×10^{-1}*	6.11×10^{-3}	-1.36×10^{-2}	9.64×10^{-3}	2.25×10^{-2}
Paris dummy	1.25×10^{-1}*	1.68×10^{-2}	8.54×10^{-2}	2.20×10^{-1}*	4.87×10^{-2}	1.41×10^{-1}*	7.21×10^{-2}*	5.63×10^{-2}	2.99×10^{-2}
R^2	8.62	6.11	16.11	22.02	5.55	18.71	6.40	5.48	2.85
Number of non zero obs.	701	629	843	704	544	610	685	827	560

Incomes and expenditures are divided by 10,000. Significativity at the 5% level indicted by *. The dependent variables are the expenditures on the goods reported in the first row. $\Delta Age = Age_m\ Age_f$. $\Delta Educ = Educ_m - Educ_f$. Sample size: 843 households.

TABLE 3

Tests of the Models

	Unrestricted	Pooled	R1	R2
−2 log likelihood	471.82	544.70	525.18	515
χ^2		72.88	53.36	43.18
Number of restrictions		45	40	33
Probability		0.5%	7.7%	11.1%

	R2	Pooled
−2 log likelihood	515	544.70
χ^2		29.7
Number of restrictions		12
Probability		0.3%

	R1	Pooled
−2 log likelihood	525.18	544.70
χ^2		19.5
Number of restrictions		5
Probability		0.15%

level. So, the cooperative hypothesis which, given the functional form (15), leads to the alternative functional forms (18) or (19) cannot be rejected. [13]

4 Conclusion

Three conclusions can be drawn from the paper. First, the empirical tests performed upon French data bring about results that essentially confirm previous work by THOMAS [1990, 1992] and SCHULTZ [1990] in other countries: the intra-household composition of family income seems to influence household behaviour, even when total income is fixed.

Second, the paper provides a very simple way of testing Chiappori's "cooperative" or "sharing rule" hypothesis. The test can be performed on cross-sectional household consumption data. In particular, it does not require, as was suggested by Chiappori, the estimation of either a complete

13. In theory, the test of the cooperative hypothesis should be that the restriction (18) or (19) is not rejected. There is no problem in the case where, as it presently happens, neither (18) nor (19) is rejected independently. Things would be different in the opposite situation.

labour supply model, or (the equivalent of) a Slutsky matrix. Also, it can be performed whether consumption goods are assignable or not. This suggests, more generally, that testing "collective" models of household behaviour may not be as difficult a task as it was sometimes suggested. It should be stressed in this respect that most "collective" models proposed so far – including Nash-bargaining models – are nested within the present "cooperative" framework. Hence they should satisfy the test developed in the present paper as well as additional restrictions.

The scope of the technical developments analyzed in the present paper thus seems rather broad. As seen in the theoretical part of the paper, the same analytical tools used for hypothesis testing should also provide, under the cooperative hypothesis, partial information upon the sharing rule within the household and individual preferences of household members. They thus may help, so to speak, "opening the black box".

Finally, and perhaps somewhat suprisingly, a first empirical implementation upon French data suggests that actual behaviour might prove not to be inconsistent with the cooperative hypothesis. Although this conclusion is still preliminary and should be qualified and complemented in a number of ways, it certainly is a very encouraging first step.

APPENDIX

Proof of (18) and (19)

Equation (16) gives, for all $i \geqslant 2$ and all y_m, y_f:

$$\frac{d_i + f_i y_m + g_i y_f}{c_i + g_i y_m + e_i y_f} = \frac{d_1 + f_1 y_m + g_1 y_f}{c_1 + g_1 y_m + e_1 y_f}$$

We may set $d_1 = 1$; identification gives:

(20) $$c_1 d_i = c_i$$

(21) $$g_1 f_i = f_1 g_i$$

(22) $$g_1 e_i = e_1 g_i$$

(23) $$e_1 f_i = f_1 e_i$$

(24) $$g_1 d_i + c_1 f_i = g_i + f_1 c_i$$

(25) $$e_1 d_i + c_1 g_i = e_i + g_1 c_i$$

(20) to (23) give $\frac{c_i}{c_1} = \frac{d_i}{d_1} \equiv \lambda$, and $\frac{f_i}{f_1} = \frac{g_i}{g_1} = \frac{e_i}{e_1} \equiv \mu_i$; then (24) and (25) become:

(26) $$\begin{cases} (\lambda_i - \mu_i)(g_1 - c_1 f_1) = 0 \\ (\lambda_i - \mu_i)(e_1 - c_1 g_1) = 0 \end{cases}$$

From now on, we shall forget the index 1. (26) has two sets of solutions:

i) $\lambda_i = \mu_i$

ii) $g = cf$ and $e = cg = c^2 f$ — in which case, since only $\mu_i f$ matters, we may set $f = 1$.

1) *Case* $\lambda_i = \mu_i$. Then (forgetting the $z\,\beta_i$ term)

$$C_i = a_i Y + b_i Y^2 + \lambda_i \left[c y_f + y_m + \frac{1}{2} e y_f^2 + \frac{1}{2} f y_m^2 + g y_m y_f \right]$$

$$\stackrel{\text{def}}{\equiv} a_i Y + b_i Y^2 + \lambda_i D(y_m, y_f)$$

We now use condition (17) which writes in the present case for goods i and 1:

(27) $$\begin{cases} f_i . AB - (d_i + f_i . y_m + g_i . y_f)\Delta = b_i \\ f . AB - (d + f . y_m + g . y_f)\Delta = b \end{cases}$$

where $\Delta = B_Y - A . B_{y_m}$. The LHS of both equations are in the proportion λ_i to each other, so that b_i and b must necessarily be in the same proportion, λ. Thus, the quadratic consumption function satisfying the cooperative hypothesis in this first case is:

(18) $$C_i = a_i . Y + \lambda_i . [b . Y^2/2 + c . y_f + d . y_m + e . y_f^2/2 + f . y_m^2/2 + g . y_m . y_f] + z\beta_i$$

Going back to (9) and using (18), it is easy to show that:

LEMMA 1: The sharing rule Y_m^* is necessarily of the form:

(28) $$Y_m^*(Y, y_m, y_f) = \varphi[Y, D(y_m, y_f)]$$

Proof: It is an immediate consequence of

$$\frac{\partial C_i/\partial y_m}{\partial C_i/\partial y_f} = \frac{\partial Y_m^*/\partial y_m}{\partial Y_m^*/\partial y_f} = \frac{\partial D/\partial y_m}{\partial D/\partial y_f}$$

On the other hand, the second equation of (27) gives some more information on the sharing rule:

LEMMA 2: In addition to (28) the sharing rule Y_m^* satisfies the following partial differential equation:

$$AB - (B_Y - A . B_D) . D_{y_m} = \text{Const.}$$

with

$$A = \frac{\varphi_Y}{D_{y_m} . \varphi_D}; \qquad B = \frac{1}{D_{y_m} . \varphi_D} - A$$

where subscripts stand for partial derivatives.

2) *Case* $e = cg = c^2 f$; then

$$C_i = a_i Y + b_i Y^2 + \lambda_i (cy_f + y_m) + \mu_i (cy_f + y_m)^2/2$$

As in preceding case, using (17) for goods i and 1 leads to

$$\mu_i . [AB - (y_m + c . y_f) . \Delta] - \lambda_i . \Delta = b_i$$
$$\mu_1 . [AB - (y_m + c . y_f) . \Delta] - \lambda_1 \Delta = b$$

Eliminating the term in brackets across the two equations yields:

$$b_i = K . \mu_i + k . \lambda_i$$

where k and K are constant parameters. Hence the final form of the consumption function in the present case:

(19) $$C_i = a_i . Y + \lambda_i . [y_m + c . y_f + k . Y^2/2] + \mu_i . [(y_m + c . y_f)^2/2 + K . Y^2/2] + z\beta_i$$

As in the previous case, it is also possible to recover information on the sharing rule.

LEMMA3: The sharing rule Y_m^* is necessarily of the form:

(29) $$Y_m^*(Y, y_m, y_f) = \psi(Y, y_m + c y_f)$$

and it satisfies the following partial differential equation:

$$AB - (B_Y - A \, . \, B_{y_m}) = cst$$

with

$$A = \frac{\psi_Y}{\psi_{y_m}}; \qquad B = \frac{1}{\psi_{y_m} - A}$$

where subscripts indicate partial derivatives, and the y_m subscript corresponds to the partial derivative with respect to the second argument of ψ.

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