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Individual Decisions and Household Demand for Consumption And Leisure

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Maria Concetta Chiuri*

Abstract

The standard microeconomic assumption of a household utility function raises two theoretical problems: it contradicts methodological individualism and it ignores economic phenomena like income and consumption sharing, division of labour, externalities and altruism within a household. This paper reviews two approaches, aggregation theory and more recent non-unitary models, to compare the different properties that household consumption and leisure demands have to satisfy in the two basic contexts. The paper also discusses some recent empirical evidence which seems to encourage further investigation in the non-unitary framework.

Keywords: consumption, labour supply, intra- household allocation

JEL Classification: D1, D7

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Introduction

Standard microeconomic theory considers the household as the basic decision unit in consumer theory, assuming either a household utility function or a representative agent preference structure. However, this approach has recently been challenged in economic literature, since it raises two types of problems (Bourguignon and Chiappori, 1992): 1) a methodological weakness and 2) the general question of assignability.

The methodological weakness is due to the use of a household utility maximisation problem contradicting neo-classical *individualism,* which requires each consumer to be characterised by his own preferences. The immediate consequence is that such models cannot explain why households would consume differently depending on who receives child tax benefits or on the actual income tax system.

The second problem arises from the use of aggregated preferences which completely avoids the analysis of *intra-household allocation*. This deals with the general question of *assignability*, i.e. how do families allocate their consumption among members? Such a question is crucially important above all on a normative ground, since a better understanding of the household decision making process can improve family policy instruments.

To face both problems two approaches are surveyed in the paper: the first is *exact aggregation theory*, which defines restrictions on either individual preferences or income distribution allowing for an aggregate demand consistent with *H* utility maximising household members and still behaving as if it were derived from a single-decision making unit (this is known in the literature as *income pooling hypothesis*, as the main property of *unitary* models). However, this result depends on fairly strong assumptions and further extensions of exact aggregation theory (i.e. *exact non linear aggregation* and *generalised exact aggregation theories*) show that in more general contexts aggregate demand functions have to satisfy more complex conditions, and to include indices of within household income distribution[1]. But the aggregation theories' approach, fundamental for coping with the gap between a micro and a macro analysis, cannot solve the assignability problem or model interdependencies, which are a peculiarity of family life. Household members transfer income or goods, produce and consume goods in common, are affected by externalities or caring effects caused by other members, and share time and risks.

The second approach, which will be discussed, avoids any restriction on either the structural form of individual preferences or income distribution and provides different interpretations on how the decision process takes place within a family, assuming either a cooperative or a non-cooperative environment. It will be shown that again the income pooling hypothesis is very restrictive and that the alternative solution is the one suggested by *non-unitary* models. We also find two areas of consumption theory still undervalued by non-standard approach: the effect of children and of uncertainty in future events on household consumption and leisure demand.

[1] A complete discussion of the main issues of exact aggregation theory is outside the scope of the present survey. The interested reader can refer to Stoker (1993) or Forni and Brighi (1991).

On the empirical side of this research area, the major issue is data availability. Data on consumption or non-labour income are generally collected at a household level; exceptions are data on labour income or gender specific consumption goods like men's or women's clothing. This is a relevant constraint for the testability of any non-standard model. Nevertheless, we can review a wide range of evidence which gives support to the non-unitary approach.

Thus, the paper is organised in four sections: first, we define the notation and the main issues in order to compare the different models; secondly, assuming the standard neo-classical approach of a household utility function, we examine the conditions under which the methodological individualism still holds. However, the questions of assignability and of family interdependencies (e.g. public goods, externalities or home production) are deeply examined only in section 3, where non-unitary models of household decision processes are discussed; in section 4 we review some recent empirical results.

1. A Common Notation

In order to define the notation we concentrate on the case of a two member household, named *A* and *B,* (usually but not necessarily husband and wife) with preferences described by U^A and U^B respectively, of any functional form; but all results easily apply to *H>2* member households.

The *n* good vector $\mathbf{X}=\left\{X^1, X^2,\ldots, X^n\right\}$ is the household purchased good vector and $\mathbf{p}=\left\{p^1, p^2,\ldots, p^n\right\}$ the price vector common to both household members; then the two individual consumption sub vectors can be derived from **X**: $\mathbf{x}^A=\left\{x^{1A},\ldots,x^{mA}\right\}$, $\mathbf{x}^B=\left\{x^{1B},\ldots,x^{sB}\right\}$, with $x^{iA}+x^{iB}=X^i$ (*i=1,...,n*). If for any *i* $x^{iB}=0$, but $x^{iA}\neq 0$, for any value of p^i, then X^i is also called *A*'s *exclusive good* (and similarly happens for *B*): examples of exclusive goods are gender specific goods, like clothing. Moreover the sum *m+s* in the individual consumption vectors is not necessarily equal to *n*, since some goods can be used in common. In that case the mathematical formulation is borrowed from the *public goods'* literature, and by definition, $X^k=x^{kA}=x^{kB}$.

Most models discriminate between members that can have either *egoistic preferences,* in which case the utilities are written respectively $U^A(\mathbf{x}^A), U^B(\mathbf{x}^B)$[2], or *altruistic preferences,* which can take either the form $U^A(\mathbf{x}^A,\mathbf{x}^B), U^B(\mathbf{x}^A,\mathbf{x}^B)$ or $W^A\left\{\mathbf{x}^A, U^B(\mathbf{x}^B)\right\}$, $W^B\left\{\mathbf{x}^B, U^A(\mathbf{x}^A)\right\}$. The distinction between the two altruistic forms lies in considering each individual caring for the other either in a form of paternalism (a wife buying clothes that she likes to see on her husband, or cooking low fat food, even though he would have preferred sausages, eggs and

[2] Formally egoistic preferences occur when $\dfrac{\partial U^k}{\partial x^h}=0$ with $h\neq k$ and *h,k=A, B*.

chips) or in a form of pure "caring" as defined by Becker (1981), (when she chooses what she knows he will appreciate).

A decision process within a household could differ from a single person family for three reasons:

(i) the demand system has to satisfy a household budget constraint, but, the total labour and non-labour income $w^A(T-l^A)+w^B(T-l^B)+y^A+y^B$ (where T is individual fixed time endowment, w^h, l^h are individual wage rate and leisure respectively) can be shared between the two individuals, so that a part of person *A*'s income can be consumed by person *B*, and vice versa;

(ii) they can consume some goods in common, or receive either negative or positive externalities from the other member;

(iii) they can exchange goods produced within the family.

In the next section, we discuss models that describe the household decision process leading to a household demand system depending on prices and only total household income. Since individual decisions are perfectly aggregable as if they were decisions of a single maximising individual, the literature refers to those as *unitary models*. However, it will be pointed out that this is a rather restrictive approach. In section 3 we introduce some more recent models: the *non-cooperative* models, various applications of *bargaining* theories, the *collective* models and the *exchange* models. Non cooperative models set the preference aggregation problem in a game framework, where the Nash equilibrium concept is related to different income distributions between household members. Both bargaining and collective models describe how Pareto efficient outcomes can be reached, in the household context. Finally exchange models introduce the concept of a household production function and model both income transfers and goods exchange within the household. All *non-unitary* models have the common requirement of leading to a household demand system depending on the price vector, total household income, as earlier, and also on at least one index of intra-household income distribution.

2. Exact Aggregation of Individual Choices

Consider a household aggregate demand function for a commodity *i*, with *i=1,...,n*, of the type:

$$X^i = X^i(\mathbf{p}, Y) \tag{1}$$

where Y is the sum of all the individual and family incomes, this section investigates the following question: *under which conditions is it possible to treat aggregate consumer* *behaviour as if it were the outcome of the decisions of a single maximising individual?* The answer to this question is referred to in the literature as the *theory of exact aggregation*[3].

More precisely, assume that each individual h, with $h=A,B,...$, within a family consumes private goods only and has a demand structure

$$x^{ih} = x^{ih}\left(\mathbf{p}, y^h\right) \qquad \forall\ i=1,...,n \tag{2}$$

here y^h could be either the initial individual endowment of income or the available income after an internal transfer[4]. Aggregation is the operation that substitutes an aggregate model, like (1), for an individual model like (2), to represent an economic phenomenon and overcome a lack of data; such an operation is the choice of two functions, g and f, such that:

$$X^i = g\left(\mathbf{x}^i\right) \quad \text{and} \quad Y = f\left(\mathbf{y}\right)$$

(where $\mathbf{y}$ and $\mathbf{x}^i$ are individual income and consumption vectors respectively). This allows for the empirical estimation of an individual demand model like (2); however, it might include a loss of information. By the definition in Malinvaud (1993), if the "aggregation error" involved is symbolically written as

$$E\left(\mathbf{y}\right) = X^i\left(\mathbf{p}, f\left(\mathbf{y}\right)\right) - g\left(\mathbf{x}^i\left(\mathbf{p}, \mathbf{y}\right)\right) \tag{3}$$

then exact aggregation at a particular value of the income vector $\mathbf{y}$ occurs if

$$E\left(\mathbf{y}\right) = 0\,. \tag{4}$$

In the household context the application of the aggregation literature is based on the standard neo-classical assumption that each member is maximising his utility function (where this exists) and it seeks to identify the conditions that simultaneously allow for the maximisation of an aggregating relation, called either a household utility function or a household welfare function, depending on whether individual preferences are identifiable. In the family context this approach is also called *unitary*.

Moreover, for the exact aggregation condition to hold, either restrictions on individual and consequently household preferences must be derived, such that the aggregate demand is independent of the actual individual distribution of income, or restrictions on income distribution must be imposed. In this latter case equation (4) holds only for a restricted class of prices and of individual income distribution. Both these cases are examined in greater detail in the next two sub-sections.

[3] Such literature is usually concerned with aggregation of preferences within a broader community, nevertheless we can easily apply its results to a narrower context like the family.

[4] This option is discussed in greater detail in section 3.

2.1 Restricting Individual Preferences: Exact Linear Aggregation

If the aggregate demand function for commodity *i* satisfies the following condition:

$$X^i\left(\mathbf{p}, \sum_h y^h\right) = \sum_h x^{ih}\left(\mathbf{p}, y^h\right) \tag{5}$$

then individual demands have *the property of "equality of individuals' income responses"* (see Malinvaud, 1993), i.e., if within a family dy^h is taken from individual *h* and transferred to individual *k*, for $k \neq h$, such that total income $Y = \sum_h y^h$ remains constant, a sufficient condition for (5) is $dx^{ik} = -dx^{ih}$, so that the aggregate consumption value will be unchanged.

The well known case that allows equation (5) to hold is a household where all members have the same preference structure, and this preference structure exhibits *homotheticity*. If for instance, the individual demands $x^{ih}(\cdot)$ are Cobb-Douglas functions with the same exponents, it can be proved that the aggregate household utility function is Cobb-Douglas as well, and the optimal aggregate demand is of type (1)[5].

The property of "equality of individuals' income responses" can also be found in the more economically convenient context of *quasi-homotheticity* (see Gorman, 1953 and 1961). The main result obtained using the so-called Gorman-polar form, in the aggregation field is in allowing a certain degree of individual heterogeneity, but still proving the existence of a *representative agent* perfectly reproducing an aggregate decision making process.

A macro relation, like that in (1) is the result of an exact aggregation procedure if and only if the individual relation (2) is of the form:

$$x^{ih} = a^{ih}(\mathbf{p}) + b^i(\mathbf{p})y^h. \tag{6}$$

The Gorman-polar form[6] satisfies the requirement of the "equality of individuals' income responses", since

$$\frac{\partial x^{ih}}{\partial y^h} = b^i(\mathbf{p}) \qquad \forall h = A, B, \ldots;$$

therefore a household relation can be derived from (6) and is of the form:

$$X^i = a^i(\mathbf{p}) + b^i(\mathbf{p})Y \tag{7}$$

5 The basic property of homothetic preferences, which ensures exact aggregation, is that individual expansion paths given by increasing y^h, with $\mathbf{p}$ constant and common to all the *H* members, are straight lines through the origin and therefore all expenditure elasticities are unity.

6 The Gorman-polar form is said to be quasi-homothetic because Engel curves are still straight lines, but they do not go through the origin, and the elasticities only tend to one as total expenditure increases.

where $a^i(\mathbf{p}) = \sum_h a^{ih}(\mathbf{p})$ and $\frac{\partial X^i}{\partial Y}\frac{\partial Y}{\partial y^h} = \frac{\partial x^{ih}}{\partial y^h} = b^i(\mathbf{p})$, since condition (5) holds. The linearity in aggregate income justifies the definition *exact linear aggregation* used in economic literature to refer to this approach.

Moreover, the household relation (7) exists and is integrable if and only if the individual relation (6) exists and is integrable[7]. Since the household relation is a linear function of total household income with the same slope as the individual relations, and there is a linear restriction between the household demands for different goods, it can be proved that the Slutsky equation of the aggregate demand satisfies the following condition[8]:

$$\frac{\partial X^i}{\partial p^j} + \frac{\partial X^i}{\partial Y} X^j = \sum_h \left(\frac{\partial x^{ih}}{\partial p^j} + \frac{\partial x^{ih}}{\partial y^h} x^{jh} \right). \tag{8}$$

This shows that the Slutsky substitution matrix of the household demand is the sum of the Slutsky matrices of the individual demands. Thus from Gorman's results it follows that the idea of a *representative agent*, usually applied in a perfectly competitive market to show that the market in aggregate behaves as a single agent, is applicable even in a non-market context like the family, if individual preferences have the Gorman polar form.

Finally note that heterogeneity in individual preferences is allowed in the Gorman polar form, but must be included in the term $a^{ih}(\mathbf{p})$ in equation (6)[9].

Gorman’s aggregation properties can be found also with endogenous labour income, in which case every individual h has an exclusive price for leisure, i.e. the individual wage rate w^h (see Simmons, 1979 and Muellbauer, 1981). In this context conditions for exact aggregation have to be found not in demand, but in single commodities (including leisure) expenditures. Formally, if

$$p^i x^{ih} = f^{ih}(\mathbf{p}, w^h, y^h) \text{ and } w^h l^h = f^{0h}(\mathbf{p}, w^h, y^h) \tag{9}$$

are respectively the expenditure of ith commodity and of leisure, both for individual h, then aggregation requires that there exist $n+1$ representative expenditures $F^i(\mathbf{p}, w, y)$ (with

7 If individual demand (6) satisfies the adding-up property (i.e., if $\sum_i p^i a^{ih}(\mathbf{p}) = 0$ and $\sum_i p^i b^i(\mathbf{p}) = 1$), it is homogeneous of degree zero in prices and income and the matrix of substitution terms is symmetric and negative semi-definite, (6) is also integrable.

8 The proof is directly obtained by differentiating property (5) expressed for good i with respect to the price of good j, once the individual cost functions have been substituted into (5); then use Shephard's Lemma on both sides in order to end up with (8), given that by definition the aggregate cost function is the sum of individual cost functions.

9 Either $a^{ih}(\mathbf{p})$ or $b^i(\mathbf{p})$ can take negative values, and if that turns out to be the case then individual income y^h has to be restricted to avoid negative demands.

$i=0,...,n$, and w and y the mean of individual wage rates and non labour incomes, respectively), such that

$$\sum_h \frac{f^{ih}\left(\mathbf{p}, w^h, y^h\right)}{H} = F^i\left(\mathbf{p}, w, y\right) \tag{10}$$

The household demand is here not the sum, but the mean of H individual demands. Muellbauer proves that equation (10) holds if and only if the individual functions (9) take the form:

$$f^{ih}\left(\mathbf{p}, w^h, y^h\right) = a^i(\mathbf{p})w^h + b^i(\mathbf{p})y^h + c^{ih}(\mathbf{p}) \tag{11}$$

i.e., the expenditures are linear in both individual wage rate and non-labour income. In this case the Engel curves are still linear and heterogeneity of consumer preferences is only limited to the term $c^{ih}(\mathbf{p})$ [10].

To summarise so far, for a household to behave as a single decision making unit, individual preferences need to be either homothetic, or quasi-homothetic and, if the labour supply decision is also considered, individual expenditures have to be linear in individual non-labour income and wage.

2.2 Restricting Income Distribution: A Bergson Household

Gorman's representative agent definition can still be valid even without imposing any restriction on individual preferences, but on within family income distribution; this is the main result in Samuelson (1956), assuming the existence of a household welfare function to be maximised, subject to a given level of household income[11], besides the utility maximising household members.

10 Exact aggregation in the case of endogenous labour income requires linearity in Engel curves and the condition that for every individual h the ratio between the derivative of his expenditure for good i with respect to his wage and the derivative for good j, i.e.

$$\frac{\partial f^{ih} / \partial w^h}{\partial f^{jh} / \partial w^h} = \omega_{ij}$$

is a value independent of the index h.

When the micro expenditures in (11) satisfy adding-up, when a's and b's are homogeneous of degree zero in $\mathbf{p}$ and c's are linearly homogeneous in $\mathbf{p}$; and when individual expenditures have a symmetric and negative semi-definite substitution term matrix, then they also satisfy the minimisation problem of an extended version of Gorman's cost function (see Muellbauer, 1981). The same integrability conditions are proved to be necessary and sufficient also for the existence of a household cost function.

11 Samuelson suggests that a household welfare function could be implemented either under a benevolent dictatorship or with a more realistic family agreement.

Samuelson's paper is chronologically the last of the trilogy - Scitovsky (1942); Gorman (1953); Samuelson (1956) - on *community preference fields*. First, Scitovsky introduces the idea of community indifference curves (CICs):

> in a two-good (e.g. X^1 and X^2) dimension, "given any amount of either X^1 or X^2, it tells us the minimum amount of the other required to keep each member of the community on his prescribed indifference curve" (Graaff, 1967, pp. 45-46).

Individual prescribed utility levels are derived from an initial arbitrary selection: in other words, no particular ethical judgement is chosen in order to draw the social indifference curves. A CIC $X(u^*)$ is the dual of a utility possibility frontier (UPF) $u(X^*)$, therefore each point in the latter corresponds to a minimum total requirement contour in the former[12].

Secondly, Gorman (1953) proves that $X(u^*)$ and $u(X^*)$ have a common equation: $F(X,u)=0$, called the equation of the community preference field.

Finally, Samuelson defines as *social welfare contours* the inner envelope of the Scitovsky community indifference contours: the two types of curves are tangent at the highest level of social welfare attainable along a Pareto utility frontier. They derive from the maximisation problem of a social welfare function (SWF) of the Bergson type:

$$\begin{aligned}&\max W\left[U^A\left(\mathbf{x}^A, l^A\right), U^B\left(\mathbf{x}^B, l^B\right), \ldots.\right]\\ &s.t. \sum_h \mathbf{p}' x^h + \sum_h w^h l^h = Y + \sum_h w^h T\end{aligned} \tag{12}$$

The SWF property of strong separability allows to solve the maximisation problem in two stage:

1) $$\begin{aligned}&\max_{\mathbf{x}^h} U^h\left(\mathbf{x}^h, l^h\right)\\ &s.t. \mathbf{p}\mathbf{x}^{h}{}' + w^h l^h = \varphi^h + w^h T\end{aligned}$$ with $h=A,B,\ldots,H$

2) $$\begin{aligned}&\max_{\varphi^h} W\left[V^A\left(\mathbf{p}, w^A, \varphi^A\right), \ldots., V^H\left(\mathbf{p}, w^H, \varphi^H\right)\right]\\ &s.t. \sum_h \varphi^h = Y + \sum_h w^h T\end{aligned}$$

the so called *two-stage budgeting*. With a Bergson SWF the household welfare maximisation is consistent with a decentralised individual utility maximisation problem (stage 1) conditional on a lump sum transfer φ^h, which is socially optimal, as long as it is chosen at a central level (stage 2). In particular the necessary condition for a socially optimal income

12 Note that CICs can cross each other.

distribution rule is such that the marginal household welfare of income must be equal for each member in the family. As a consequence, the community indifference curves associated with a Bergson SWF are the envelope of the Scitovsky ones because they are $X(u^{**})$ associated with the socially optimal distribution of utility levels u^{**}.

In summary household consumption demand $X^i = X^i(\mathbf{p}, \mathbf{w}, Y, T)$ is independent of income distribution, if allocations are consistent with the optimisation of a household welfare function strongly separable in individual preferences. However, note that here exact aggregation is valid only for a given vector of prices and total income, since the marginal social utility of each person's money will generally differ[13] for any other vector. For exact aggregation condition to hold for any vector of prices and aggregate income, one should assume *homothetic separability* or *quasi-homothetic separability* of the household welfare function (i.e. $W[U^A(\mathbf{x}^A, l^A), \ldots, U^H(\mathbf{x}^H, l^H)]$ has to have each U^h homothetic or quasi- homothetic, respectively).

Another limit of the Samuelson-Bergson approach is in the condition of full comparability and cardinality of individual preferences, necessary in order to equate the individual marginal utilities. Moreover Arrow's Impossibility Theorem states that the presence of a benevolent dictator only can ensure the optimal distribution of resources within the family.

2.3 The Decision Process In A Unitary Household: The Becker Approach

Both exact aggregation theory and Samuelson-Bergson model fail to deal with strong family interdependencies, such as public goods, altruism, etc.. In fact all goods considered so far have been private ones. Conversely, Becker (1974a) is the first attempt to model family relationships of those kinds. It shows how a socially optimal level of consumption can be achieved through a common agreement, without assuming the existence of a social planner that imposes the social welfare optimal income distribution within the family, as it was in the Samuelson-Bergson family.

Problems such as income transfer, public goods or externalities are all faced in a similar way. All household members, except for the head of the family, are assumed egoist. The head, i.e. the principal earner, internalises all family interdependencies, because of his altruistic personality and ensures the social welfare optimum in consumption decisions.

Restricting the family to a couple, consider the case of an altruistic head *A* and an egoistic, *B*. The definition of altruism used here is the one of caring, i.e. *A* is *effectively altruistic* towards *B*, if *A*'s utility function depends positively on the welfare of *B*:

[13] See also Jerison (1994) for discussion of necessary and sufficient conditions for *a Pareto consistent representative consumer* in the case a Samuelson-Bergson social welfare household. In particular a representative agent is said Pareto consistent if "it prefers one situation to another whenever all the consumers prefer the former to the latter" (Jerison, p.747)

$$U^A = U^A\left\{\mathbf{x}^A, l^A, U^B(\mathbf{x}^B, l^B)\right\} \tag{13}$$

and $\dfrac{\partial U^A}{\partial U^B} > 0$.

Thus in *A*'s decision choice there is a trade-off between his own aggregate consumption and the income transfer φ^B to *B* to maximise *B*'s utility. In mathematical terms *A*'s budget constraint is

$$\sum_i p^i x^{iA} + w^A l^A + \varphi^B = y^A + w^A T$$

where in y^A both exogenous labour and non-labour incomes are included. But since φ^B enters also in *B*'s budget constraint:

$$\sum_i p^i x^{iB} + w^B l^B = y^B + \varphi^B + w^B T$$

the altruist's constraint can be rewritten as:

$$\sum_i p^i \left(x^{iA} + x^{iB}\right) + w^A l^A + w^B l^B = y^A + y^B + \left(w^A + w^B\right)T \tag{14}$$

i.e. the total family budget line. At this stage, when (13) is restricted to be of the separable form

$$U^A = U^A\left\{V^A\left(\mathbf{x}^A, l^A\right), U^B(\mathbf{x}^B, l^B)\right\} \tag{15}$$

the optimal solution for *A* is determined by the first order condition:

$$\frac{\partial V^A / \partial x^{iA}}{\partial U^B / \partial x^{iB}} = 1 \qquad \forall\ i = 1,...,n \tag{16}$$

This is Becker's definition for altruism, relevant to concrete behaviour. It moves the optimum point from an endowment position towards a tangency point between the household budget line and *A*'s individual indifference curves, in an $(x^{iA}; x^{iB})$ diagram.

When the individual vectors $\mathbf{x}^A, \mathbf{x}^B$ include at least one public good, condition (16) implicitly satisfies the classic Samuelson requirement for the socially optimal public good demand. Moreover (16) can easily be applied to the endogenous labour supply case.

The efficient equilibrium in interdependencies between an altruistic and an egoistic person is ensured by the well-known Becker's *Rotten Kid Theorem*: even if a 'selfish beneficiary' *B* is interested in maximising his own consumption and utility, regardless of the effects on other's welfare,

> "if raising her [*B*] own income has the effect of lowering his [*A*] even more, he would reduce his contribution to her by more than the increase in her income (if his contribution had been larger than the increase in her income), because family income and hence the optimal level of her consumption goes down. ... But she as well as he would then be worse off, and she would be discouraged by her own selfish interest from actions that harmed him" (Becker, 1981 p. 5)

The theorem proves that both an altruist and an egoist internalise all the externalities affecting each other. Even though Becker addresses the household utility maximisation problem at the individual level, nevertheless, the personal interdependencies, as long as they affect the household budget constraint, are efficiently settled by the presence of an altruistic member who has to be the head of the family, taking care of all individual interests[14]. Aggregate demand in the case of effective altruism satisfies the income pooling hypothesis, since it is $X^i = X^i(\mathbf{p}, \mathbf{w}, Y, T)$. For this reason Becker's approach has been included in the unitary class: note that condition (16), which equalises the individual marginal utilities of income, coincides with the necessary condition for a Bergson household.

The necessary requirement for a Becker family is the altruist being the main family income earner. However, if the selfish member turns out to be the earner of most of household income, then all the socially optimal results collapse, since the altruist, no longer having power over the egoist, will decide to use his own income just for his own purposes.[15] This is a counterexample showing that Becker's idea of "caring", even if it fulfils the neo-classical theory of individualism, imposes fairly strong assumptions about the type of relations within a family: taken to the extreme, in order for the model to be true, the degree of caring should not be determined by the individual personality, but according to income power, so that there always exists a benevolent dictator allocating family resources.

3. *Non Unitary Models of Intra -Household Decisions*

The restrictions imposed on either individual preferences or income transfers discussed in section 2 seem not to contradict the neo-classical postulate of individualism. They represent the theoretical background of the *income pooling hypothesis* of the unitary approach, since they define necessary (and sufficient for the Gorman polar case) conditions for a household to behave as a single-decision making unit[16].

However, even though the general context designed by the Gorman-polar function perfectly reproduces an individual decision problem at a household level, it restricts heterogeneity in preferences to a function independent of income, and requires linearity in

[14] Bergstrom (1989 and 1996a) fixes some limits in which the Rotten Kids Theorem applies: in particular he shows that as long as each family member can choose an action that influences other members' income, but does not affect utilities directly, only then each person is interested in maximising total family income. The theorem does not apply in cases of asimmetric information (the example of lazy kids) or of no punisment strategies in a repeated game (the prodigal son) or the case of "the controversial night-light", where the choice of reading time at night taken by an egoistic wife (i.e. zero) is not the Pareto optimum.

[15] Becker's paper together with his (1991) book *A Treatise on the Family* gave rise to a relevant branch of economic literature, called New Home Economics. It covers nearly all aspects of family life, including inter-generational transfers. However even in these inter-temporal models the co-existence of an altruistic generation and a selfish one is essential for the final results (see Cigno, 1995, for examples of "ascending altruism" or "descending altruism").

[16] See section 4 for a discussion on the testability of unitary models.

Engel curves, which can be plausible for a very broad classification of goods. Conversely, the Samuelson-Bergson approach of two stage budgeting, hardly implementable in a household life, is strongly limited to a unique vector of prices and income distribution. Finally, the Becker approach, although open to model various family interdependencies, satisfies the income pooling hypothesis only under the requirement that altruism and economic power are closely linked.

This section will discuss the costs in terms of aggregation properties required whenever some of the strong assumptions imposed by exact aggregation theory on individual preferences are relaxed. In particular it will be shown in sub-section 3.1 that in Muellbauer (1976)'s theory of *generalised linearity* or *exact non-linear aggregation*, Engel curves are not constrained to be linear; instead household demands depend on two functions of individual incomes. When more than two indices of the distribution of incomes across family members and different individual attributes are included in an aggregate demand structure, it will no longer be the solution of a household utility maximisation problem. As a result it will contradict the income pooling hypothesis. These are the findings of the *generalised exact aggregation* literature developed by Lau (1982), Gorman (1981) and Lewbel (1989, 1990).

However, exact non-linear aggregation has still some of the limits of unitary models and in order to model more explicitly various family issues (public goods, externalities, income transfers etc.) either a cooperative and a non-cooperative approach has to be discussed. Both branches of literature underline their relevance, since either moment (cooperative or non-cooperative) can be part of a family daily life. The individuals earn some surplus from co-operation, otherwise they would prefer a single person life style. However, it is well known that there are some household choices that do not follow a full agreement. An example is in spending money, if money is given to the husband, he would prefer a higher consumption of certain goods than that usually decided by his wife.

The innovative result of various non unitary applications, compared with the standard unitary approach, is that either in a context of simultaneous and interdependent non-cooperative strategies or in a bargaining framework or under a more general Pareto efficient model, within family income distribution can affect decisions over consumption and labour supply.

3.1 Allowing For Higher Degrees Of Heterogeneity In Individual Preferences: Generalised Exact Aggregation

In Muellbauer (1976) exact aggregation is achieved through budget shares of private goods only. If:

$$\Lambda^i = \sum\nolimits_h \frac{p^i x^{ih}}{Y} = \sum\nolimits_h \frac{y^h}{Y}\frac{p^i x^{ih}}{y^h} \equiv \sum\nolimits_h \frac{y^h}{Y}\lambda^{ih}\left(\mathbf{p}, w^h, y^h\right) \tag{17}$$

is the average aggregate budget share for good *i*, the weights being individual non labour incomes y^h, then exact aggregation can be found in the aggregate budget share $\Lambda^i(\mathbf{p},\mathbf{w},g(\mathbf{p},\mathbf{w},\mathbf{y}))$ depending on prices and the function *g*. *g* represents an index of income distribution within the household and is a function of price and individual income vectors[17]. It can be interpreted as the budget share of the representative agent, having a level of total expenditure $y = g(\mathbf{p},\mathbf{w},\mathbf{y})$. This alternative approach defines an exact aggregation condition for demand as the following:

$$X^i = \frac{\Lambda^i(\mathbf{p},\mathbf{w},g)}{p^i} Y = \sum_h x^{ih}(\mathbf{p}, w^h, y^h). \tag{18}$$

Muellbauer proves that equation (18) holds iff the individual demand function is of the form:

$$x^{ih} = a^{ih}(\mathbf{p}) + b^i(\mathbf{p}) y^h + c^i(\mathbf{p}) g^h(\mathbf{p}, w^h, y^h) + d^i(\mathbf{p}) w^h \tag{19}$$

where $\sum_h a^{ih} = 0$[18].

The Engel curves derivable from (19) might not be linear since they depend on both the individual income y^h and the function g^h. However, the income expansion path of different household members must lie on parallel planes, but this is a less stringent assumption. Also the aggregate budget shares are linear in *g*, which justifies the name of *generalised linearity* (GL)[19] given to this approach. Finally, for aggregation purpose, heterogeneity elements will appear in either the vector coefficient $a^h(\mathbf{p})$ or the function g^h.

However, some new results are obtained at the aggregate level once the integrability conditions are imposed on Muellbauer's individual demand function. The link between the individual and the aggregate relation is built in at the budget share level, since it is there that the exact aggregation condition holds. Therefore the representative agent still exists, but his demand function will be different from the aggregate demand, since it has the form:

$$x^i = \frac{\Lambda^i(\mathbf{p},\mathbf{w},g)}{p^i} y. \tag{20}$$

17 In the Gorman-polar form *g* is only average income.

18 Note that if $c^i(\mathbf{p}) = 0$ then we go back to the Gorman polar form.

19 Two special cases of the GL form, well known in the literature, are the price independent generalised linearity (PIGL) and the log-form of the latter (PIGLOG). They are derived from the individual relation (19) independent of prices.

Integrability of the individual demand is necessary and sufficient for integrability of (20) but not of the aggregate demand (18)[20].

Thus, exact aggregation applied to individual budget shares eliminates the strong conditions required in Gorman's world of linear Engel curves, still allows for a household utility to exist, but the latter is no longer just a linear function of individual utilities.

With *generalised exact aggregation theory* more than two functions of individual income distribution can affect aggregate demand and individual demands also depend on individual attributes. Consider an individual demand function

$$x^{ih} = x^{ih}\left(w^h, y^h, z^h, \mathbf{p}\right) \tag{21}$$

where $\boldsymbol{z}$ is the vector of individual attributes, and an aggregate function

$$X^i = X^i\left(g^1\left(y^A,..,y^H,z^A,..,z^H\right),...g^q\left(y^A,..,y^H,z^A,..,z^H\right),\mathbf{p},\mathbf{w}\right). \tag{22}$$

dependent on the price vector and on q (with $q<H$) functions of income distribution and attributes[21], which satisfy the following properties: symmetry with respect to each individual values; functional independence of $g^1,...,g^q$; and invertibility of $g^1,...,g^q$.

Lau (1982) proves that the aggregate equation (22) exists and satisfies the condition:

$$\sum\nolimits_h x^{ih}\left(y^h,z^h,w^h,\mathbf{p}\right) = X^i\left(g^1\left(y^A,..,y^H,z^A,..,z^H\right),...g^q\left(y^A,..,y^H,z^A,..,z^H\right),\mathbf{p},\mathbf{w}\right)$$

iff the individual relation has the following functional structure

$$x^{ih}\left(y^h,z^h,w^h,\mathbf{p}\right) = a^{ih}(\mathbf{p}) + b^{1i}(\mathbf{p})g^{1*}\left(y^h,z^h\right)+\ldots+b^{qi}(\mathbf{p})g^{q*}\left(y^h,z^h\right) + c^i(\mathbf{p})w^h \tag{23}$$

provided that $g^l(\cdot) = \sum_{h=1}^{H} g^{l*}\left(y^h,z^h\right); \forall l = 1\ldots q$, and all terms in b cannot differ in the functional form across individuals [22].

Lewbel (1990) completely characterises a subset of (23), i.e., the *full rank* demand system:

[20] As shown in Jerison (1994), Muellbauer's maximising representative agent is Pareto consistent and has a welfare interpretation, but, contrary to Gorman's representative consumer, the related household welfare function, implicitly maximised together with his preferences, does not have a Bergson-Samuelson structure.

[21] Heineke (1993 p.216) writes that "any meaningful definition of exact aggregation must require that aggregate demand depends on prices and only "limited" information about the distribution of income and preferences in population". Conversely the higher the number q the less severe the restrictions imposed on heterogeneity.

[22] This condition is derived from the symmetry property of the functions g^l with respect to individual attributes and incomes. Lau's result is known in the literature as *the fundamental theorem of exact aggregation*. The individual demands are linear in $g^{1*},\ldots,g^{q*}$ and individual income expansion paths must lie on parallel hyperplanes.

$$\mathbf{x}^h = B(\mathbf{p})g^*\left(y^h, z^h\right) \tag{24}$$

where $B(\mathbf{p})$ is the matrix of the coefficients b^{li}, which has full rank if given **p**, the columns of B are linearly independent[23].

Stoker (1984) shows that a demand system which satisfies generalised exact aggregation theory and has full rank greater than two and $q < H < n$, satisfies a version of generalised Slutsky conditions (see Diewert, 1977), which imply the existence of H utility maximising individuals[24], but it can no longer be interpreted as the solution of a household welfare maximisation problem. Equivalently the idea of aggregate household preferences and of a representative consumer is lost. Conversely, if $H \geq n$ aggregate demand satisfies no symmetry restriction; however, in a household context this is hardly the case.

Therefore we have shown that further extensions of exact aggregation theory to more general contexts (i.e. *exact non linear aggregation* and *generalised exact aggregation theories*) require household demands to satisfy more complex conditions than those derived from a single utility maximisation problem, and to be a function of income distribution indices.

Some results from the generalised exact aggregation literature have been the source of inspiration behind the more recent non-unitary literature. In particular the aggregate demand being a function of the distribution of income, or satisfying a generalised form of Slutsky's symmetry are issues common to both branches of economic literature. In the next section we introduce various intra-household decision models aiming at modelling the household member choice over common goods, children consumption and use of time, risks, good production etc..

3.2 Interdependent Strategies Within A Household: A Non Co-operative Approach

In a *non-cooperative game,* players choose the strategy to maximise their own payoff, given the strategy of the other player, and an equilibrium point, the Nash equilibrium, is defined by a combination of mutual best replies, since in that case none of the players has an incentive to deviate[25].

In Ulph (1988) no income transfer is considered, but the same transfer value can be achieved by a direct purchase of goods by one member for the other person. The utility of each individual is assumed to depend on the entire commodity vector, since the consumption

[23] In particular those of (column) rank one are homothetic demand systems, those of rank two are of the PIGL form.

[24] Gorman (1981) derives the necessary conditions for the integrability of (24) and shows that in such a case the number of independent coefficients b^{li} cannot be greater than three.

[25] In this as in the next section we consider a two person household to simplify the notation. We take also the case of exogenous labour supply, included in y^h, since in both interdependent strategies leisure does not play a major role.

of a good by A can also raise B's utility in the paternalistic sense. But, as long as they have different tastes, there could be disagreement on the purchasing quantity. Thus the vector $\mathbf{x}^A$ contains the sub vector $\mathbf{x}_B^A$ of purchases made by A for B's consumption and similarly for $\mathbf{x}^B$.

A will choose the optimal $\mathbf{x}^A$ taking $\mathbf{x}^B$ as given:

$$\max_{\mathbf{x}^A} U^A(\mathbf{x}^A + \mathbf{x}^B)$$
$$s.t. \sum_i p^i x^{iA} \leq y^A$$

Assuming U^A strictly quasi-concave the solution of the problem is given by the following reaction function:

$$\mathbf{x}^A = R^A(\mathbf{x}^B, \mathbf{p}, y^A) \tag{25}$$

Similarly B's reaction function can be generated:

$$\mathbf{x}^B = R^B(\mathbf{x}^A, \mathbf{p}, y^B) \tag{26}$$

A Nash equilibrium is a pair $\hat{\mathbf{x}}^A, \hat{\mathbf{x}}^B$ that satisfy (25) and (26) simultaneously.

Then the basic results of Ulph's paper are summed up in two propositions:

Proposition 1: If in an equilibrium there is at least one commodity i which is individually purchased with a within family transfer so that a household level for the same can be distinguished from an individual demand, i.e.:

$$\tilde{x}^{iA} = \hat{x}^{iA} - \varphi^A / p^i \quad \text{and} \quad \tilde{x}^{iB} = \hat{x}^{iB} + \varphi^A / p^i \quad \text{where } 0 < \varphi^A \leq \hat{x}^{iA} p^i$$

then, different income distributions can locally achieve the same Nash equilibrium.

> “Thus we can re-distribute household income within certain limits and guarantee there is another Nash equilibrium with exactly the same total household demands for all goods.” (Ulph, 1988, p.14). ■

Proposition 2: If income is distributed sufficiently much in favour of one person, his preferred allocation of total household income can be sustained as a Nash equilibrium. ■

The latter proposition is based on the assumption that each household member cares sufficiently for the other that they would spend a positive amount of money on goods that the other person would exclusively consume.

Given the individual preferences and the total household income, if A's income share varies between zero and one, then three types of subintervals can be defined:

1) subintervals in which Nash equilibrium is just that allocation which maximises the utility of one member;

2) subintervals over which the distribution of household income is locally irrelevant;

3) subintervals where the distribution of household income does indeed affect commodity demands.

The Nash equilibria satisfy the following properties:

(i) household demands as well as individual utilities are homogeneous of degree zero in prices and both incomes, not in total household income;

(ii) in those intervals of point 1) all the standard properties of commodity demands are valid, i.e. the household behaviour is fully neo-classical since it is purely dictatorial;

(iii) in those described in point 2), demands satisfy the neo-classical property of being independent of the distribution of income. The same result can be achieved when husband and wife buy a good in common, but each of them buys also an exclusive good. Since the individual's most preferred level of the public good must be unique for the two members, the simultaneous solution of the two reaction functions gives a demand independent of the within household income distribution. However all the other neo-classical properties (Slutsky symmetry and negative semi-definiteness) do not hold[26].

Even though a household would seem the less appropriate environment to play a non-cooperative game over consumption (why would they not speak to each other to reach potentially higher utility levels?), Ulph's model, describing inefficient consumption choices for a household as a function of the within family income distribution, has been used in a cooperative framework as a threat point. Moreover, econometric applications, (see Udry, 1996, discussed in section 4) have shown its empirical relevance, especially in developing countries.

3.3 Interdependent Strategies Within A Household: A Bargaining Approach

If the non-cooperative context is abandoned, for a cooperative one, all individual interdependencies are modelled in a household welfare function maximisation problem. So far various cooperative solutions have been derived and different game theory bargaining models have been applied to the family world. They all offer solutions which are Pareto optimal and provide an internal distribution of household demands which depend on the bargaining power

[26] In Browning (1994) the same Nash equilibrium procedure is applied in an intertemporal context, where both consumption and saving are considered as public goods; nevertheless the differences in individual preferences over the purchasing quantity of both goods still stay.

of the family members[27] (McElroy and Horney, 1981; McElroy, 1990; Manser and Brown, 1980; Lundberg and Pollak, 1993 and 1994; Bergstrom, 1996).

The main idea is that the two members of the household pool their incomes and maximise, by bargaining, a household welfare function subject to the household income constraint. Three different cooperative solutions of the household game are here examined: the *Nash bargaining solution*, the *dictatorial marriage* and the *Kalai and Smorodinsky's solution*. Starting from a common threat or status quo point and a common negotiation set, these solutions differ in the *arbitration schemes*, defined by Luce and Raiffa as:

> "a function, i.e. a rule, which associates to each conflict, i.e. two-person non-strictly competitive game, a unique payoff to the players" (Luce and Raiffa, 1957, p. 121).

They reflect different ethical judgements given by an arbitrator of the cooperative game on the way the household members share the surplus gained from cooperation.

3.3.1 Nash Bargaining Solution

If the two individuals *A* and *B* were not married they could maximise their own utility function subject to an individual budget constraint, so that each person would have a well-defined continuous, quasi-convex indirect utility function:

$$V_0^A = V_0^A\left(\mathbf{p}, y^A\right) \quad \text{and} \quad V_0^B = V_0^B\left(\mathbf{p}, y^B\right)$$

which are homogeneous of degree zero in prices and income. These values represent the separate outcomes in case of divorce, as well as the threat point for each member.

Individual utility in the marriage case is assumed to depend not only on own consumption (taken to be a single good) but also upon the consumption of the spouse. Bargaining over the allocation of the entire household income achieves the cooperative Nash solution, maximising the product of the individual utility gains subject to a household budget constraint:

$$\begin{aligned} &\max N = \left[U^A(\mathbf{x}^A, \mathbf{x}^B) - V_0^A(\mathbf{p}, y^A, \alpha^A)\right] \cdot \left[U^B(\mathbf{x}^A, \mathbf{x}^B) - V_0^B(\mathbf{p}, y^B, \alpha^B)\right]. \\ &s.t. \sum_i p^i \left(x^{iA} + x^{iB}\right) \le y^A + y^B \end{aligned} \tag{27}$$

[27] A *bargaining game* is described by the set of players, the set of all feasible payoffs, the so-called *payoffs space*, and by the outcome in case of disagreement, i.e. the *threat point*, which is an element of the payoffs space. An assumption of bargaining theory is that there is some agreement preferred by both to the disagreement outcome. Thus players have a mutual interest in bargaining, although, in most cases, there is a conflict of interest over the particular agreement to be reached.

In McElroy and Horney (1981) α^A, α^B are two shift parameters, which include all the opportunities outside the marriage context whose change shifts the threat points (the so called *extra-household environmental parameters* in McElroy, 1990, EEP henceforth). The cooperative outcome reaches a Pareto optimal allocation of resources within the family conditional on the threat point. Moreover individual incomes enter in the individual demand separately, since they affect not only the feasible set, but also the threat point: the resulting household demand is of type $X^i = X^i(\mathbf{p}, \mathbf{y}, \alpha^A, \alpha^B)$. Since a change in price of a private good or in individual income also influences the disagreement outcome, McElroy and Horney derive a *Nash generalisation of the Slutsky equation,* where each effect, uncompensated and income compensated, of changing the price of good *j*, has an extra term, which represents the shift in the indirect utility. They claim, then, that the Nash generalisation can be empirically tested on household consumption data. This generalisation collapses to its standard neo-classical counterpart, when both threat points are independent of prices and incomes.

However, since there are couples for whom divorce is not a credible threat, due to high transaction costs, Lundberg and Pollak (1993) propose an alternative Nash bargaining model, called the “separate spheres”. They suggest a non-cooperative marriage, with voluntary contribution equilibrium for the purchasing of public goods, as a plausible alternative threat point to utility in divorce. This model makes a prediction substantially different from McElroy and Horney's one: if government child-allowances are paid to mothers rather than to fathers in two-parent households, Lundberg and Pollak's threat point is likely to shift in mother's favour. Therefore even the cooperative bargaining outcomes within household are likely to be more favourable to women. Instead in the threat point of McElroy and Horney, individual utility level in the event of a divorce would not be affected by whether the allowance is paid to mothers or fathers during their marriage. As a result the bargaining power and outcome would not be influenced.

In the separate spheres model the disagreement outcome depends on the within family income distribution in the case of each member specialising in the provision of different public goods (according to some socially prescribed gender roles assumed to act as focal points) but no income transfer is considered. However, if we allow for supplementary transfers, then the Nash-Cournot equilibrium would depend only on the total resources of the family[28].

A way to overcome the debate between McElroy and Horney and Lundberg and Pollak on the most credible threat point could be the approach suggested by Bergstrom (1996). He applies the Rubinstein(1982)-Binmore (1985) multi-period bargaining game with an outside option to the family world. In brief, the outside option is the divorce threat, that could exercise pressure on the member that makes the first offer on how to share the surplus gained from cooperating; the other member can either accept, or refuse and make a counteroffer, or ask for divorce. Thus either the partner’s utility level in the case of divorce or that one gained from not-cooperating will affect the final consumption choice, that maximises the generalised Nash product $U^{A\frac{\delta_A}{\delta_A+\delta_B}} U^{B\frac{\delta_B}{\delta_A+\delta_B}}$, with δ_h (*h*=*A*, *B*) being the subjective discount factor. The solution

[28] This is consistent with what found by Ulph (1988) in the case of public goods provision with individual subscriptions.

does not necessarily coincide with the Nash bargaining solution, as proved by Binmore (1985), but it might be a more general approach to modelling an inter-temporal relationship.

3.3.2 Dictatorial Solution

The game by Bergstrom taken in each single stage could lead to a *dictatorial solution*, since a member has dictatorial power to decide the gain from the marriage even for the other. Generally speaking, a dictatorial power can be due to a relevant role in earning the household income, and the dictator's best strategy is to offer to the partner just a sufficient gain to induce the latter to accept. Therefore the dictator *D=A,B* maximises his own utility subject to the household budget constraint and to $U^k \geq V_0^k(\mathbf{p}, y^k)$, with $k \neq D$ and V_0^k being the utility *k* would get in a "single life".

This case does not require the existence of a social welfare function to maximise. Thus, the advantage of the dictatorial model is that it does not need full comparability of individual utilities.

3.3.3 Kalai-Smorodinsky Solution

Another bargaining solution is the *Kalai- Smorodinsky*, mentioned in Manser and Brown (1981). The final combination of individual utilities lies along the utility possibility frontier, with the individual utility gain being proportional to the distance between the threat point and the dictatorial outcome. More precisely, the household bargaining problem takes the form:

$$\begin{aligned} &\max_{\mathbf{x}}(U^h - V_0^h) \\ &s.t. \frac{(U^h - V_0^h)}{(U^k - V_0^k)} - \frac{(V^{h*} - V_0^h)}{(V^{k*} - V_0^k)} = 0 \end{aligned} \tag{28}$$

and subject to the household budget constraint, with $h \neq k = A, B$ and V_0^h and V^{h*} being individual *h*'s indirect utilities at the threat point and at the point reached by the dictator, respectively.

All the applications of game theory discussed so far and describing either non-cooperative or cooperative strategic interdependencies, provide an explanation for including indices of income distribution among explanatory variables for household consumption. At the same time, they seem to keep tight all family relationships, by imposing a theoretical structure that is insufficiently flexible. Moreover, two problems may rise with the bargaining approach, as argued in Chiappori (1988b and 1992). First, the empirical estimation of a bargaining model would ask the econometrician to impose an *a priori* hypothesis on the utility level in case of either divorce or of non-cooperation, in order to define the threat point, which may prove difficult to test. Secondly, even if the preference structure does not depend on the marital status, the Nash bargaining structure and the Kalai Smorodinsky one require cardinality in the representation of preferences, and this is a disadvantage carried out since the Samuelson-Bergson approach.

An alternative co-operative choice model, that overcomes these two limits, is the collective one, discussed in the next section. Although the initial model is quite restrictive (Chiappori, 1988a and 1992), assuming a household with only egoistic agents and no public goods, more recent pieces of literature claim to have extended its applicability both theoretically and empirically.

3.4 The Collective Model

A collective model considers Pareto efficient decisions within a household, but no restriction is imposed on the point of the Pareto frontier reached by the household. The starting paper is Chiappori (1988a) and since then a quite significant number of results have been added; the purpose of the present section is to review and discuss the most relevant ones.

Consider a household with two individuals A and B having egoistic preferences over consumption and leisure time. Formally, a household member $h \neq k = A, B$ defines his own consumption bundle and leisure demand by solving the following Pareto optimality problem:

$$\begin{aligned} &\max U^h(l^h, \mathbf{x}^h) \\ &s.t.\ \mu: \quad U^k(l^k, \mathbf{x}^k) \geq \bar{u}^k(\mathbf{p}, \mathbf{w}, \mathbf{y}, \alpha) \\ &\lambda: \quad \sum_i p^i\left(x^{iA} + x^{iB}\right) + w^A l^A + w^B l^B \leq \left(w^A + w^B\right)T + y^A + y^B \end{aligned} \tag{29}$$

It allows individual h to maximise his utility, compatible with a $\bar{u}^k$ level ensured to k and subject to the aggregate budget constraint, which includes the individual labour and non-labour incomes. The distribution of individual welfare,

$$\left[\bar{u}^A(\mathbf{p}, \mathbf{w}, \mathbf{y}, \alpha), \bar{u}^B(\mathbf{p}, \mathbf{w}, \mathbf{y}, \alpha)\right],$$

that the final aggregate bundle will satisfy, is assumed as an exogenous function of wages non-labour income, and some extra variables α called distributional factors, since they only affect the distribution of resources, not their total value.

Problem (29) can also be read as the maximisation of a social welfare function, in the form

$$W = U^A + \mu(\mathbf{p}, \mathbf{w}, \mathbf{y}, \alpha) U^B \tag{30}$$ [29]

[29] (29) for h=A, B, is equivalent to (30) or to a linear transformation of it. This equation can also be interpreted as A's utility function in case of altruism. In this way it is possible to extend Chiappori's model to the Becker 'caring', but it has to satisfy the requirement of separability in the personal bundle of each individual.

under the aggregate budget constraint, where the Lagrangean multiplier μ represents the weight of individual *B*'s preferences on the collective decision process. In other words, for each $\bar{u}^k$ there is a μ such that (29) and (30) are equivalent. The same can be said also for the following problem:

$$\begin{aligned} &\max U^h(l^h, \mathbf{x}^h) \\ &s.t. \sum_i p^i x^{ih} + w^i l^i \leq w^i T + y^h + \varphi^h(\mathbf{p}, \mathbf{w}, \mathbf{y}, \alpha) \end{aligned} \qquad (i=1,...,n;\ h=A, B) \quad (31)$$

which transforms the requirement of the other member's minimum utility level into an income transfer; provided that $\varphi^A + \varphi^B = y^A + y^B$, φ^h is called the income sharing rule, which ensures Pareto efficiency in the aggregate demands and labour supply, and therefore it allows individual $k \neq h$ to remain at a fixed level of utility $\bar{u}^k$, while *h* solves his maximisation problem.

Note that Chiappori's model satisfies the condition for generalised exact aggregation: the individual Marshallian demand $x^{ih}\left(\mathbf{p}, w^h, y^h + \varphi^h(\mathbf{p}, \mathbf{w}, \mathbf{y}, \alpha), T\right)$, derived from (31) can be aggregated in a household consumption demand X^i function of prices, individual wages, non labour incomes, and another function φ^A, once the condition $\varphi^B = y^A + y^B - \varphi^A$ is used in x^{iB}.

The collective problem also looks similar to the idea of two-stage budgeting suggested by Samuelson (1956). However this is partly true, since only the first of the two stages shown in section 2.2, is considered, i.e. the maximisation of an individual utility function given the across members income distribution, exogenously determined by a sharing rule. Such a rule is not necessarily the one maximising the overall Bergson household utility function, since no particular assumption is made about it. This generalisation allows the aggregate demand, satisfying the social welfare function (30), to be more general than the Bergson-Samuelson, the latter being valid only for a unique vector of prices and a corresponding socially optimal income distribution.

We instead interpret equation (30) as a Scitovsky household welfare function, because it satisfies Scitovsky's definition of community indifference curves $X\left(u^*\right)$, discussed in section 2.2. In fact the exogenous rule prescribes the indifference curves of each member along which the other one can take his decision, provided that both decisions need to satisfy the household budget constraint[30]. Moreover note that the collective model contains the cooperative bargaining models and common preference models as special cases.

Regarding *testability* and *integrability* of the model, a key role is played by the labour income variable because of the availability of data at the individual level; conversely, consumption, unless it is the case of an exclusive good (for instance a gender specific), is generally observed at a household level. We first assume that there is at least one exclusive consumption good, together with leisure; we then consider the case of no exclusive goods. A

[30] A similar approach is in Apps and Rees (1988). They compare the effects of a lump sum tax in a pure Samuelson-Bergson household with that one in a household with a weighted sum of individual utilities, where the weights express intra-household distributional judgements.

result widely used in the collective literature (see Bourguignon *et al.* 1994, Bourguignon *et al.* 1995, Chiuri and Simmons, 1997 and 1998) is stated in the next Proposition.

Proposition 3: Individual leisure $\ell^h(\mathbf{p},\mathbf{w},\mathbf{y},\alpha,T)$ and consumption demands $\aleph^i(\mathbf{p},\mathbf{w},\mathbf{y},\alpha,T)$ (with *i* being an exclusive good of individual *h*) solving the collective problem (33), are defined as *collectively rational* if and only if:

a) they are of the form

$$l^h\left(\mathbf{p},w^h,y^h+\varphi^h\left(\mathbf{p},\mathbf{w},\mathbf{y},\alpha\right),T\right)$$

$$\begin{aligned} x^{ih}\left(\mathbf{p},w^h,y^h+\varphi^h\left(\mathbf{p},\mathbf{w},\mathbf{y},\alpha\right),T\right) &\equiv \\ &\equiv X^i\left(\mathbf{p},w^h,y^h+\varphi^h\left(\mathbf{p},\mathbf{w},\mathbf{y},\alpha\right),T\right) \end{aligned}$$

or equivalently:

b) they satisfy the conditions:

$$\frac{\partial\aleph^{ih}}{\partial w^k}\Bigg/\frac{\partial\aleph^{ih}}{\partial\alpha}=\frac{\partial\ell^h}{\partial w^k}\Bigg/\frac{\partial\ell^h}{\partial\alpha}$$

$$\frac{\partial\aleph^{ih}}{\partial y^k}\Bigg/\frac{\partial\aleph^{ih}}{\partial\alpha}=\frac{\partial\ell^h}{\partial y^k}\Bigg/\frac{\partial\ell^h}{\partial\alpha} \qquad \text{for } k\neq h=A,B \quad (32)$$

Conditions (32) (and the ratio of the two) in Proposition 3 characterise collective rationality by using the generalised weak separability property (see Gorman, 1970) of some variables through the income sharing rule. Those conditions necessarily require at least two exclusive goods (leisure included), otherwise any demand satisfies conditions (32)[31]. ■

Once collective rationality has been tested, one could also retrieve the income sharing rule and individual preferences too, by applying the following results:

Proposition 4: If individual leisure demands are collectively rational, i.e.:

$$\ell^A\left(\mathbf{p},\mathbf{w},\mathbf{y},\alpha,T\right)=l^A\left(\mathbf{p},w^A,y^A+\varphi^A\left(\mathbf{p},\mathbf{w},\mathbf{y},\alpha\right),T\right),$$

[31] If collective rationality is satisfied, one could also test for a bargaining model, in a nested way: knowing for instance the expected effect of an extra environmental parameter on consumption and leisure demands it is possible to test whether the predicted sign is supported by empirical evidence.

$$\ell^B(\mathbf{p},\mathbf{w},\mathbf{y},\alpha,T) = l^B\left(\mathbf{p}, w^B, y^A + y^B - \varphi^A(\mathbf{p},\mathbf{w},\mathbf{y},\alpha), T\right) \tag{33}$$

then the income sharing rule function φ^A is uniquely identified, up to an additive function of $(\mathbf{p}, w^A, w^B, T)$, by the following differential conditions:

$$\frac{\partial \varphi^A}{\partial \alpha} = \frac{\dfrac{\partial \ell^A / \partial y^B}{\partial \ell^A / \partial \alpha}}{\dfrac{\partial \ell^A / \partial y^B}{\partial \ell^A / \partial \alpha} - \dfrac{\partial \ell^B / \partial y^B}{\partial \ell^B / \partial \alpha}} \quad \frac{\partial \varphi^A}{\partial y^B} = \frac{1}{\dfrac{\partial \ell^A / \partial y^B}{\partial \ell^A / \partial \alpha} - \dfrac{\partial \ell^B / \partial y^B}{\partial \ell^B / \partial \alpha}}$$

$$\frac{\partial \varphi^A}{\partial y^A} = \frac{\dfrac{\partial \ell^A / \partial y^A}{\partial \ell^A / \partial y^B}}{\dfrac{\partial \ell^A / \partial y^B}{\partial \ell^A / \partial \alpha} - \dfrac{\partial \ell^B / \partial y^B}{\partial \ell^B / \partial \alpha}} - 1 \tag{34}$$

Conditions (34) can be obtained by differentiating system (34) first w.r.t. α, y^B and y^A, and then by solving for $\dfrac{\partial \varphi^A}{\partial \alpha}; \dfrac{\partial \varphi^A}{\partial y^s}$ with s= A, B. It is also possible to derive similar conditions in terms of any other exclusive good. Results in Proposition 4 are based on Proposition 9 in Bourguignon *et al.* (1995). ■

Define $\tilde{\varphi}^h = y^h + w^h T + \varphi^h$, once the sharing rule is identified by conditions (34), then the following statement applies:

Remark 1 Individual preferences can be easily retrieved, by the following integrability conditions:

(i) $\dfrac{\partial x^{ih}}{\partial p^j} + \dfrac{\partial x^{ih}}{\partial \tilde{\varphi}^h} x^{jh}$ is symmetric in i and j;

$\dfrac{\partial x^{ih}}{\partial w^h} + \dfrac{\partial x^{ih}}{\partial \tilde{\varphi}^h} l^h$ is symmetric in i and l^h;

$\dfrac{\partial x^{ih}}{\partial w^k} = \dfrac{\partial x^{ih}}{\partial \tilde{\varphi}^h} \dfrac{\partial \tilde{\varphi}^h}{\partial w^k}$ with $k \neq h$;

$\dfrac{\partial x^{ih}}{\partial \alpha} = \dfrac{\partial x^{ih}}{\partial \tilde{\varphi}^h} \dfrac{\partial \tilde{\varphi}^h}{\partial \alpha}$;

(ii) and the matrix $\left[\dfrac{\partial x^{ih}}{\partial p^{j}}+\dfrac{\partial x^{ih}}{\partial \tilde{\varphi}^{h}}x^{jh}\right]$ bordered by the compensated derivatives w.r.t. the wage w^h and by compensated derivatives of leisure demand w.r.t. prices is negative semi-definite.

The symmetry restrictions in (i) are the classical integrability conditions treating $\tilde{\varphi}^h$ as if it were total individual income. This is because the structure of the $\tilde{\varphi}^h$ function has no direct impact on the integrability or levels of quantity demanded other than through an income effect. In terms of the expenditure function we just add the condition that $g^h\left(\mathbf{p}, w^h, \bar{u}^h\right) = \tilde{\varphi}^h$; the question of the existence of the cost function precedes this equation. (For formal proof see Chiuri and Simmons (1998), Remark 2.) ■

Bourguignon *et al.* (1995) also prove that when leisure is not explicitly taken into account and no exclusive, but private goods can be observed, the income sharing rule can still be identified but up to an additive constant (or function, depending on the specific case) and a permutation of members by using second derivative, thus weaker conditions (see Bourguignon *et al.* Proposition 5). When leisure is the only exclusive good, still second derivative restrictions on leisure demands are found in Chiappori (1988) to uniquely recover, up to an additive constant, individual preferences, the sharing rule φ^A and the individual consumption choices x^A, x^B (see his Proposition 1).

The main credit of a collective model is that no restriction is *a priori* imposed on the utility functional form, in order to infer the intra-household allocation. Given any individual preference structure, collective demand functions satisfy the property that the ratio of the individual marginal propensities to consume any two goods is the same for all sources of income, or distributional factors except for his own, because individual consumption is affected by the partner's own labour income and household non-labour income only through the sharing rule.

However, within family income transfer is not the only form of family interdependencies, as all the game theory models and Becker's approach have already shown. Avoiding the presence of family common goods or the production of either public or private goods could draw misleading predictions on behavioural responses to family policy interventions. Another drawback of the Chiappori model is that all non-market time is pure and exclusive leisure time, which seems a rather unrealistic assumption. Moreover, no element of rationing is considered in the time offered on the labour market by each household member. The questions we ask are then: do all the collective properties still hold when family issues, as public goods or household production functions, are taken into account? and does empirical evidence support the collective approach? Both theoretical and empirical research has recently been investigating, trying to give an answer to the questions addressed. The debate in some aspects is still open.

3.4.1 The Collective Model With Public Goods

The extension of the Chiappori initial framework, with only private goods, to stronger non-separabilities certainly reduces the testability of the model. There are, however, also in this case testable conditions stemming from properties of household consumption and leisure demands.

When public goods affect individual preferences in a non separable form, a collective problem as the one in (30) is still decentralisable, but it needs a redefinition. Consider a collective household welfare function of the form:

$$\begin{aligned} &\max W\left(\mathbf{X}, l^A, l^B, \mu\right) = \mu(\mathbf{p}, \mathbf{w}, \mathbf{y}) U^A\left(\mathbf{x}^A, l^A\right) + \left(1 - \mu(\cdot)\right) U^B\left(\mathbf{x}^B, l^B\right) \\ &s.t. \ \sum_i p^i X^i + w^A l^A + w^B l^B = w^A T + w^B T + y^A + y^B \end{aligned} \tag{35}$$

where the two individual consumption vectors include also public goods, and the distribution function μ is assumed continuously differentiable and homogeneous of degree zero in prices, wages and income.

Browning and Chiappori (1998) find that the aggregate collective demand function satisfies a generalised Slutsky's symmetry restriction. The matrix of terms:

$$\frac{\partial X^i}{\partial p^j} + \frac{\partial X^i}{\partial Y} X^j + \frac{\partial X^i}{\partial \mu}\left[\frac{\partial \mu}{\partial p^j} + \frac{\partial \mu}{\partial Y} X^j\right] = a_{ij} + b_i c_j \qquad \forall\ i,j=1,\ldots,n \tag{36}$$

is equal to the sum of a symmetric matrix of terms a_{ij} plus a rank one matrix of terms $b_i c_j$ (with $Y = y^A + y^B$). An extension to q household members (with q smaller than the number of goods n that affect individual utilities) shows that the latter matrix is of rank q-1.

However, in (35) both public and private goods are treated in aggregate and the major weakness of this approach is in leaving the within household decision process over public goods unexplained: given the level of public goods maximising (35), how do family members define individual subscription for the purchase of those goods consumed in common? This is the major interest in Chiuri and Simmons (1997), where both cooperative and non-cooperative decisions are examined, assuming also a predetermined income sharing rule. For each case some testable restrictions are derived. We summarise here the main results.

Define x^s as the household public good, p^s as its price, and redefine the two individual consumption vectors $\mathbf{x}^A, \mathbf{x}^B$ as including private goods only. Then, problem (35) can be decentralised in two distinct individual maximising problems as the following one:

$$\begin{aligned} &U^h\left(\mathbf{x}^h, l^h, \Psi^h(\mathbf{p}, \mathbf{w}, \mathbf{y})\right) \\ &s.t. \sum p^{ih} x^{ih} + w^h l^h = y^h + w^h T + \varphi^h = \tilde{\varphi}^h \end{aligned} \qquad \text{for } h = A, B \tag{37}$$

for any given level of public good, Ψ^h is an exogenous function, homogeneous of degree zero, reproducing the *ex ante* individual subscription $S^h(\cdot)$ to the public good provision, i.e. $\Psi^h = \sum_h S^h / p^s = x^s$, and $\tilde{\varphi}^h$, homogeneous of degree one in $(\mathbf{p}, \mathbf{w}, \mathbf{y})$ is still the share of total incomes for individual h private good expenditures.

The consumption and leisure demand system satisfying (37) is of the form:

$$\aleph^{ih} = x^{ih}\left(\mathbf{p}, w^h, \tilde{\varphi}^h(\mathbf{p},\mathbf{w},\mathbf{y}), \Psi^h(\mathbf{p},\mathbf{w},\mathbf{y})\right)$$

$$\ell^h = l^h\left(\mathbf{p}, w^h, \tilde{\varphi}^h(\mathbf{p},\mathbf{w},\mathbf{y}), \Psi^h(\mathbf{p},\mathbf{w},\mathbf{y})\right)$$

called *universal decentralised* (UD) in Chiuri and Simmons[32]. If there are two private and exclusive consumption goods and leisure, then household demands are always UD.

Proposition 5: Taken $n \geq 2$, then individual leisure $\ell^h(\mathbf{p},\mathbf{w},\mathbf{y},T)$ and consumption demands $\aleph^i(\mathbf{p},\mathbf{w},\mathbf{y},T)$ can be represented as (38) iff there are functions $\tilde{X}^{ih}(\cdot), \tilde{L}^h(\cdot)$ which are homogeneous of degree zero in $\mathbf{p}, w^h$ such that:

$$\begin{aligned} \aleph^{ih} &= \tilde{X}^{ih}\left(\mathbf{p}, w^h, T, x^{1h}, x^{2h}\right) \\ \ell^h &= \tilde{L}^h\left(\mathbf{p}, w^h, T, x^{1h}, x^{2h}\right) \end{aligned} \qquad \text{each } i>2;\ k \neq h = A, B \qquad (38a)$$

in which case:

$$\begin{aligned} \frac{\partial \aleph^{ih}}{\partial w^k} &= \frac{\partial \tilde{X}^{ih}}{\partial x^{1h}}\frac{\partial x^{1h}}{\partial w^k} + \frac{\partial \tilde{X}^{ih}}{\partial x^{2h}}\frac{\partial x^{2h}}{\partial w^k} \\ \frac{\partial \ell^h}{\partial w^k} &= \frac{\partial \tilde{L}^h}{\partial x^{1h}}\frac{\partial x^{1h}}{\partial w^k} + \frac{\partial \tilde{L}^h}{\partial x^{2h}}\frac{\partial x^{2h}}{\partial w^k} \end{aligned} \qquad \text{each } i>2;\ k \neq h;\ \text{each } h \qquad (39)$$

Similarly there is a linear restriction between partial derivatives of h's demands with respect to y^k. Thus UD gives a functional restriction between any three exclusive goods consumed by a household member, i.e. a linear restriction between some partial derivatives of these demands. We can think of UD as having two arbitrary base functions x^{1h}, x^{2h}; the individual demands for other goods are determined in terms of these functions, the individual wage and prices (see Chiuri and Simmons, proof of Theorem 1). In the special case in which either $\tilde{\varphi}^h$ or Ψ^h is the null function, then conditions (32) in Proposition 3 do apply. ■

Some extra restrictions in terms of Slutsky matrix can be found applying comparative statics on problem (37). The demand system (38) satisfies a symmetry plus rank two condition, even though rather different from what Browning and Chiappori find in the centralised case. Finally, when either efficient or inefficient decisions over public consumption goods are taken explicitly into account, the system (38) has to satistisfy extra conditions imposed respectively by either the Lindhal equilibrium or the Nash equilibrium in

[32] Note that the representation in (38) is not unique, e.g. given a Ψ^h any monotone transformation of Ψ^h is another acceptable function.

individual contributions to the public good provision (for proofs see Chiuri and Simmons). Those conditions however would require observability of individual contributions to the purchase of public good, which is hard, but not impossible to retrieve.

3.4.2 The Collective Model With Household Production Functions

Apps and Rees' (1996 and 1997) criticism to both bargaining models and to the Chiappori generalisation lies in the complete omission of the production aspect of family life:

> "..so time spent at home is allocated entirely to pure leisure; the only form of exchange is that of pure leisure for outside market income. Thus, household economic activity is based on specialisation in consumption roles supported by transfers, and not by the exchange of household goods that arise out of a division of labour between household and market production" (Apps and Rees, 1996, p. 200).

Conversely, the exchange models of Apps and Rees and of Chiappori (1997) introduce the concept of a household production function in the collective approach; they jointly analyse income transfers and goods exchange within the household.

Consider the following extension of (29):

$$\begin{aligned}
&\max U^h(l^h, x^{jh}, \mathbf{x}^h) \\
&s.t. \quad U^k(l^k, x^{jk}, \mathbf{x}^k) \geq \overline{u}^k \\
&\qquad w^A l^A + w^B l^B + w^A t^A + w^B t^B + \sum_i p^{ih}\left(x^{iA} + x^{iB}\right) \leq \left(w^A + w^B\right)T + y^A + y^B \\
&and \quad x^{jA} + x^{jB} = z = f\left(t^A, t^B\right)
\end{aligned} \tag{40}$$

individual utilities are defined over market goods (the two individual vectors $\mathbf{x}^A, \mathbf{x}^B$ now include market goods only), individual leisure and over a domestic, but still private good x^j. x^j might not have an equivalent commodity sold on the market, in which case the price is endogeneously fixed within the family. Otherwise the price is exogenously set by the market and the household sticks to that value in order to make Pareto efficient allocations of resources. Those two cases lead to quite distinct conclusions on the possibility of retrieving the income sharing rule from data.

The decentralisation of problem (40) can be obtained by first maximising a profit function:

$$\max p^j f\left(t^A, t^B\right) - w^A t^A + w^B t^B \tag{41}$$

where the price p^j is either exogenous or is set by the family at the equilibrium level p^j*, (where marginal rate of substitution between x^j and x^i equal the marginal cost of producing *z*, i.e. the ratio between the wage rate and the marginal product, divided by p^i) and then by maximising each member's utility, subject to a budget constraint:

$$\sum_{i\neq j} p^i x^{ih} + p^j x^{ih} + w^h l^h = \varphi^h + y^h \qquad \forall\ h = A, B \qquad (42)$$

that has to add up to an exogenous income sharing rule.

Chiappori (1997) proves that when p^j is exogenous and the production function $f\left(t^A, t^B\right)$ has constant returns to scale, then it is possible first to retrieve the function $f(\cdot)$ up to a multiplicative constant[33], and then the income sharing rule function $\varphi^h(\cdot)$ up to an additive constant.

If instead the price p^j is endogenous the retrieval of the production function with constant return to scale allows us to identify the function $p^j\left(w^A, w^B\right)$ and from (42) it follows that:

$$\varphi^h\left(\mathbf{p}, w^A, w^B, y^A, y^B\right) = F^h\left(\mathbf{p}, w^h, p^j\left(w^A, w^B\right), l^h\left(\mathbf{p}, w^A, w^B, y^A, y^B\right)\right)$$

therefore restrictions can be derived to identify the income sharing rule $\varphi^h(\cdot)$ up to an additive function of both wages.

However, in both cases, in order to test for collective rationality and to identify the income sharing rule it is necessary to observe individual time use: the availability of time use survey therefore precedes the empirical estimation of a collective model with household production functions.

We find also that two important issues in household economics should be further developed by non-unitary models. They are the presence of children, affecting both the consumption pattern and time use of parents, and within inter-temporal settings, how future uncertainty is shared within a family. We discuss briefly both the issues as extensions of the collective approach since we believe that there is scope for empirical applications of the non-standard approach in both areas, given the evidence provided so far, based on unitary models[34].

3.4.3 Collective Models And The Effect Of Children On Household Demands

Any estimation of household consumption or labour supply, either in a cross-section or in a time-series analysis, cannot avoid considering whether each family in the sample has children or not. The way standard literature usually deals with the issue is by estimating a

33 Note that $f\left(t^A, t^B\right) = t^A F(\tau)$ with $\tau = t^B / t^A$ and the efficiency assumption also implies that:

$$\frac{\partial f / \partial t^A}{\partial f / \partial t^B} = \frac{F(\tau)}{\partial F / \partial \tau} - \tau = \frac{w^A}{w^B}.$$

34 See Browning (1992) for a survey on the first topic and Blundell (1988) or Browning and Lusardi (1996) or Deaton (1992) for the second one.

consumption/leisure demand system depending on a vector of child variables (e.g. number, age), in a common unspecified way. The system is obtained from the maximisation problem, in which parents are assumed to have a common utility, whereas children's preferences are not identifiable[35].

However, empirical evidence consistently shows that this could be an over- simplistic approach: in fact, families with children behaves differently than families without, although a direct measure of the costs in terms of family consumption and time attributable to children cannot usually be computed due to a lack of data specifically designed for this purpose.

In order to overcome such problem, the assumption of homothetic separability of adult goods, from children's consumption in the household utility function, is often made in empirical literature[36] (the so called Rothbarth method). Alternatively, a theoretical justification for a different expenditure patterns for families with and without children is provided by Barten (1964), who considers cost functions that allow for good specific price deflators, depending on family composition[37]. However, the weakness of the approach is that childless families and those with children are restricted to buy the same vector of goods, in order to be comparable.

Other indirect measures of child costs are provided by all the literature on equivalence scales, that aims at making a welfare comparison possible between families with and without children. However, in order to make it feasible, a normative judgement is required; as a result, the value for "adult equivalent" depends on the particular cardinalisation of utility chosen[38].

Conversely, adopting a collective perspective there is no need to compare the welfare of households with children and those without: we could instead easily interpret a child as a public good, since both parents care for child's consumption. Results in Proposition 5, testing for collective rationality, when both private and public goods are considered, are then applicable. Moreover Bourguignon (1999) suggests testing for a bidimensional sharing rule: in other words an extension of the testing procedure described in Propositions 3 and 4 that would allow for an income share on children's goods, together with those for adults' ones, all summing up to total household income.

As far as the household labour supply concerns, the use of a collective approach could help in modelling the effect of children, especially when at pre-school age, on the parental use of time. The application of a collective model with a household production function, for the "quality of child's time", as called by the literature on child care, could explain the

[35] See for example Blundell and Walker (1982), Kooreman and Kapteyn (1986) or Lundberg (1988).

[36] See Gorman (1976) or Gronau (1988). This aims to provide an indirect measure of children consumption and costs, by estimating household expenditures on adult only goods using the subsample of childless families. Then the cost of a child can be approximately obtained by subtraction, once the identity of adults preferences, independently of child's presence, is established.

[37] The cost of a child is then computed as a difference in the cost functions of two families with identical "deflated" consumption pattern, provided that households with similar consumption patterns must share the same level of welfare.

[38] See Pollak and Wales (1979).

simultaneous choice of the female participation in the labour market and the use of child care[39]. Both choice variable might have an explanatory power in the decision on labour supply, coming through the income sharing rule function, even when, either the wife is not working or when no market child care is used.

3.4.4 Collective Models And The Effect Of Uncertainty On Inter-Temporal Household Consumption Pattern

Most of the life cycle literature fails to make any distinction on whether it is a household or a single individual that takes decisions on the inter-temporal allocation of resources, when future income could have an element of uncertainty, or when preference shocks can also occur. Each agent, so defined, usually maximises an inter-temporally additive expected utility function, with a constant discount factor, faces perfect capital markets, and his expectations are rational. As a result, under the specific assumption of a quadratic utility function, the household consumption path is independent of the income path, since the household in each period consumes so as to keep the marginal discounted expected utility of expenditure constant over time.

However, consumption data consistently reject (since Hall, 1978) the orthogonality condition, which keeps the marginal propensity to consume out of future income independent of uncertainty in this income[40]. Thus, recent literature has been considering non-quadratic preferences, allowing for imperfection in capital markets, considering problems like habit formation or durable goods that require non-time additivity in preferences, and controlling for the household composition, in order to provide explanations on why household inter-temporal consumption has usually a hump shape that follows closely the real income pattern[41].

Despite all the theoretical and empirical difficulties already existing in the life-cycle literature, we do believe that there are open issues, for which a household utility function constrained by aggregate income is too restrictive. As a matter of fact, all the variables appearing in an Euler equation are the result of an aggregation process, which could, however, loose relevant pieces of information regarding the inter-temporal allocation decision process.

The subjective discount rate should reflect different degrees of impatience according to the household members. In the real world it could also be the case that they are offered individually different interest rates; e.g. in the specific case of insurance plans or pension schemes, individual characteristics, such as type of job[42] or individual life expectancies. Since

39 An application is in Chiuri (1999).

40 Marginal utility of expenditure is linear in consumption for quadratic preferences.

41 Another big limitation of empirical literature, only very recently under debate, is that age patterns of consumption are based on the age of the household head only; this widely used technique leads to a misleading age-profile of consumption (see Deaton and Paxon, 1998).

42 There are specific package of insurance or pensions directly offered by the employers.

borrowing constraints depend on the level and the riskiness of family income, it might be the case that a single person household and a two earner family, both earning the same income per person, have different borrowing limits and rates, because they face different risks.

The latter argument applies also to households with precautionary savings. A two earner household faces a lower aggregate risk on income if individual shocks are negatively correlated than a one earner household with same expected income. Therefore the former has a lower need of savings for prudence (see the evidence in Guiso and Jappelli, 1994). Browning (1995) also finds that saving rate decreases with the share of wife in household income in a sample of Canadian households, which is consistent with a non-unitary view of the household, even though it contradicts the predictions of a non-cooperative model (Browning 1994), where a woman with higher life expectancy, would prefer higher saving rates.

Another implication of inter-temporal unitary models with uncertainty is full risk sharing. If a family, having two members, *A* and *B* with individual utilities defined over within period consumption x^h_t, maximises an expected household welfare function, as:

$$\sum_{h=A}^{B} \lambda^h E_1\left[\sum_{\tau=1}^{T} \beta^{h\,\tau-1} U^h\left(x_\tau^h\right)\right] \tag{43}$$

(λ^h is a fixed individual weight, $0 \le \lambda^h \le 1$ and the notation $E_t[\cdot]$ denotes an expectation conditional on information at time *t*) subject to the household budget constraint:

$$A_{\tau+1} = \left(A_\tau + y_\tau^A + y_\tau^B - x_\tau^A - x_\tau^B\right)(1+r) \tag{44}$$

(44) begins with an initial wealth A_1 and satisfies the condition of $A_T = 0$. β^A, β^B are individual discount rates; *r* is the deterministic rate of return on invested asset, A_t is financial wealth at the beginning of period τ, and $Y_\tau = y_\tau^A + y_\tau^B$ is household total labour income, affected by future uncertainty.

Such a household is *fully risk sharing*, whenever optimal individual consumption is derived *ex post*. In fact, even though each personal income:

$$y_{ts}^h = \bar{y}_t^h + \eta_{ts} + \kappa_{ts}^h \tag{45}$$

is affected by an aggregate shock η_{ts} and an idiosyncratic shock κ_{ts}^h, for each state *s* of the world ($\bar{y}_t^h$ being the deterministic component), the maximisation of (43) subject to (44) has the following f.o.c.:

$$\lambda^h \beta^{h\,\tau-1} U_x{}^h\left(x_{ts}^h\right) = \mu_{ts} \tag{46}$$

where μ_{ts} is the Lagrangean multiplier associated with the budget constraint (44), divided by the probability that state *s* occurs. Condition (46) is independent of idiosyncratic shocks, but depends on the household aggregate shock only. Thus, whatever happens, all individuals have the same insured level of marginal utility of consumption.

Dynarsky and Gruber (1997) test the full risk sharing hypothesis on a US sample. They find that household consumption growth is a function of idiosyncratic shocks. Dynarsky and Gruber shows that household savings and other income sources are not able to provide full insurance to household members. Moreover, earning instability is not the only source of consumption instability.

Conversely, consider a household welfare function defined as:

$$W\left(X_{\tau},\lambda_{\tau}\right)=E_{1}\left[\sum_{\tau=1}^{T}\left(1-\lambda_{\tau}\right)\beta^{A\tau-1}U^{A}\left(x_{\tau}^{A}\right)+\sum_{\tau=1}^{T}\lambda_{\tau}\left(y_{\tau}^{A},y_{\tau}^{B}\right)\beta^{B\tau-1}U^{B}\left(x_{\tau}^{B}\right)\right] \tag{47}$$

where the within period welfare function is an additive function of individual utilities, but individual weight λ_t, $(0\leq\lambda_t\leq 1)$ is now a function of the distribution of current household income. We analyse the consequences of the uncertainty in individual labour income, on current and future optimal consumption, when the *ex post* collective welfare function (47) is maximised subject to an inter-temporal budget constraint as (44). Deriving the Bellman equation and applying to the latter the envelope theorem, the following f.o.c. can be obtained[43]:

$$\left(1-\lambda_{t}\right)\beta^{At-1}U^{A\prime}\left(x_{t}^{A}\right)=\lambda_{t}(\cdot)\beta^{Bt-1}U^{B\prime}\left(x_{t}^{B}\right) \tag{48}$$

Condition (48) determines the degree of risk sharing within the family: since the function $\lambda_t\left(y_t^A,y_t^B\right)$ varies across states, the degree of sharing between family members varies with it. The collective household so specified is partially *income* sharing (not income pooling), but it is also *partially risk sharing*, since the degree of sharing varies across states. Any small change in individual income shifts the ratio of marginal utilities through a direct effect on λ, and through an indirect effect through the optimal $x_t^k\left(Y_t,\lambda_t\left(y_t^A,y_t^B\right)\right)$. As a result, consumption variation of a collective household depends on the distribution of risks within the family.

4. Empirical Tests On Household Decision Making

On the empirical side of intra-household decision models, the major issue is data availability. Data on consumption or non-labour income are generally collected at a household level; exceptions are only data on labour income or gender specific consumption goods like men's or women's clothing. This is a relevant constraint for the testability of any non-standard model. Nevertheless, few results can be reviewed, all of them supporting the non-unitary view of household decision process. The review of the main results in the recent empirical literature is organised in three subsections: 1) the income pooling hypothesis; 2) the testability of unitary vs. non-unitary conditions of consumption and leisure demands; 3) the testability of non-unitary approaches.

43 See Chiuri (1998).

TABLE 1

MODELS OF HOUSEHOLD DECISION MAKING

Reference	*Decision Model*	*Within Household Allocation*	*Individual Interdependencies*
■ **Unitary Models**:			
• Gorman (1961),	▪ Restrictions on preferences	Income Pooling Hypothesis (IPH)	_
• Samuelson (1956)	▪ Restrictions on income distribution	IPH	_
• Becker (1974)	▪ Household with an altruist and *H-1* egoists	If distribution much in favour of the altruist, IPH	Caring altruism; public goods, externalities, income transfers.
■ **Non-Unitary Models:**			
•Ulph (1988)	▪ Non-cooperative Nash equilibrium	Income distribution relevant, but in some subintervals irrelev.	Paternalistic altruism; public goods; good transfers.
• Manser, Brown (1980); McElroy, Horney (1981)	Bargaining: ▪Nash solution ▪Dictatorial solution ▪Kalai Smorodinsky	Distribution relevant because of the threat point, i.e. the utility level when divorced	Paternalistic altruism; public goods; good transfers
• Lundberg, Pollak (1993)	Bargaining: Nash solution	Distribution relevant because of the threat point, i.e. Nash subscript. equilib. for public good	Paternalistic altruism; public goods; good transfers.
• Chiappori (1988a, 1992); Bourguignon et al. (1995); Browning, Chiappori(1998); Chiuri, Simmons (1997)	▪ Collective model	Allocation depending on an exogenous function $\varphi^h(\cdot)$ of income distribution (and an exogenous subscription on public good)	Egoistic preferences or caring altruism; private (public) goods; income transfers; (children; risk sharing).
• Apps, Rees (1997); Chiappori (1997)	▪ Collective and exchange model	Allocation depending on an exogenous function $\varphi^h(\cdot)$ of income distribution and on the household production function	Egoistic preferences or caring altruism; private (public) goods; income, good transfer; household production.

4.1 Testing the Income Pooling Hypothesis

As shown in section 2, a demand derived from a unitary model should not be affected by the within family income distribution. On the contrary, non-unitary models provide different interpretations of why the distribution of earnings should determine even the aggregate consumption.

Schultz (1990) finds that in Thailand an increase in a woman's unearned income from outside the household has a larger negative effect on the probability that she joins the labour force than does an equal increase in her husband's unearned outside income. Women's unearned income also positively affects fertility. This effect is not evident for male unearned income.

Bourguignon, Browning, Chiappori and Lechene (1993) test the income pooling hypothesis using a French sample of household consumption data. Assuming an aggregate consumption function that is quasi-quadratic in both total and individual labour incomes, the empirical implementation provides enough evidence to reject the hypothesis of the coefficient of individual labour incomes being zero.

Bourguignon *et al.* (1994) find in Canada that the shares of the family budget for men's clothing and for women's clothing are positively related to the shares of family income earned respectively by men and women. They also test for a particular functional form of the Chiappori's income sharing rule, also assumed to shift with demographic changes.

Thomas (1990) finds evidence that in Brazilian families, unearned income of the mother has a much stronger positive effect on fertility and on measures of child health, such as caloric intake, weight, height and survival probability than unearned income of the father (for child survival probabilities the effect is almost twenty times bigger). This is also the view expressed by the World Bank (1995) which underlines that a public policy designed in order to reduce gender inequality would have effects that could go beyond a direct welfare improvement of women in a family, benefiting future generations.

A similar evidence is provided by Hoddinnott and Haddad (1995). Using African data they show that raising wives’ share of cash income increases budget share of food and reduces the budget share of alcohol and cigarettes. Their results are robust to changes in functional forms.

Browning (1995) tests the income pooling hypothesis using Canadian saving rates of five years. The parameter estimates suggest that the household saving rate decreases with the share of the wife in household income. The same result provides also enough evidence to reject a non-cooperative approach[44], where the woman, expected to live longer than her husband, should prefer saving to consumption.

[44] See Ulph (1988) or Browning (1994).

4.2 Testing The Properties of Household Demands

Browning and Chiappori (1998), using a sample of Canadian households and assuming a quadratic log demand system, find that traditional Slutsky symmetry cannot be rejected for single-person households, whereas it is rejected for the two-person families survey. Conversely, the implementation of the tests derived from the collective setting, i.e. a symmetry and a rank condition, depending on the number of decision-makers in the household (see equation (36)) gives enough evidence not to reject any of them.

Fortin and Lacroix (1997) test the neo-classical model of household labour supply against the collective one, in the Chiappori (1988a) form with egoistic preferences and private goods only. In both contexts assuming quadratic indirect utility functions, they derive conditions for income pooling, symmetry and negative semi-defineteness of the Slutsky matrix, and for the identification of the parameters of a linear income sharing rule respectively. The income pooling restriction is rejected by Canadian data for all age sub-groups except for couples aged between 24 and 35 with no pre-school children. Symmetry restrictions are strongly rejected. The collective model cannot be accepted only in the case of young couples with pre-school children. The justification found by the authors is that probably children create strong non separabilities, not captured by the model.

However, Chiuri (1999) has further results from a sample of Italian households with pre-school children: she derives a set of nested tests from the standard household utility model and from the collective one, both including a household production function measuring the quality of time provided to the children. The application of the tests shows that the collective model as specified cannot be rejected. For this demographic group she also finds enough evidence against the income pooling hypothesis and against the Slutsky inter-person symmetry condition. However, the identification of the income sharing parameters shows that the distribution of the household non-labour income does not affect the household labour supply system.

4.3 Testing For Different Non Unitary Models

An attempt to test empirically bargaining models against non-cooperative ones within a game framework is in Kooreman and Kapteyn (1990). Assuming two different Stone Geary utility functions, they derive (i) the inefficient Nash equilibrium, solving simultaneously for two reaction functions; (ii) the dictatorial outcomes, as a Stackelberg leader payoff; (iii) all the co-operative Pareto optimal outcomes along the contract curve, the dictatorial solutions given by the extremes. The Nash equilibrium outcomes are used as threat point and the Pareto optimal solution is derived solving the problem:

$$\begin{aligned} &\max W(U^A(l^A,l^B),U^B(l^A,l^B)) \\ &s.t. U^A(l^A,l^B) \geq \Psi_N^A(w^A,w^B) \\ &\quad U^B(l^A,l^B) \geq \Psi_N^B(w^A,w^B) \end{aligned} \tag{49}$$

where the value Ψ_N^i is the indirect utility at the Nash equilibrium. The result of this simplification is that the Pareto optimal solution is indistinguishable from a Bergson household optimal solution.

They estimate the actual leisure demands together with the individual preferred levels: this extra piece of information contained in the survey, is used to solve for the underidentification of the model. For those households, for which regularity conditions for actual hours of work are satisfied, the parameter denoting their position along the contract curve is not significant. However, the hypothesis of those families having a couple with same preferences is rejected by the Wald test.

Udry (1996) has stronger evidence on the test of Pareto efficient against inefficient resource allocation for production activities within a family. The test is implemented on a sample from sub-Saharan Africa and shows that yields are much lower on plots controlled by women than on plots controlled by men, *ceteris paribus*. This is evidence against the efficient home production hypothesis, that would require the equality of the two productivities at the margin.

Lundberg, Pollak and Wales (1995) test the "separate spheres bargaining" assumption, using UK data. In the late 1970's a policy change in UK transferred a substantial child allowance to wives. Lundberg *et al.* find that this change in income distribution coincides with a shift in expenditure on women's clothing and children's goods. This natural experiment, as they call it, provides evidence supporting a threat point affected by a Nash equilibrium in the private subscription to the public good purchase, as in the “separate sphere bargaining” model, and would contradict the McElroy and Horney view of the Nash bargaining solution.

However surprisingly enough, Chiappori, Fortin and Lacroix (1998) find enough evidence that the sex ratio, i.e. the gender composition of the local population, may influence the labour supply decision of couples but not of singles. This result can also be easily read as evidence supporting the EEP view of the Nash bargaining approach.

Finally Apps and Rees (1996) provide empirical evidence supporting the idea of having a household production function within the household decision process. As discussed in section 3.4, in an exchange model a housewife (or equivalently a member specialised in domestic production) can be the beneficiary of an income transfer, as in the original Chiappori model, or it could well be the case that the husband specialised in market production is the final beneficiary, given the domestic production. By only observing the individual timing dedicated to household productions, Apps and Rees estimate both the exchange model and the pure transfer model, in order to provide a measure of the degree of misspecification involved in the latter. They show that by distinguishing activities at home from pure leisure, estimated models of husband’s and wife’s demands for leisure have stronger similarities and the gap between housewives and working wives demands is reduced.

Before drawing any definite conclusion on the issue of intra-household decisions, further research is needed. In particular, the evidence provided so far against the income pooling hypothesis could justify the introduction of a function of within household income distribution as a relevant explanatory variable in the estimation of household consumption and leisure demands. However, it would not be able to discriminate between more flexible forms of individual utility that allow for generalised exact aggregation or intra-household non-unitary models. Instead, since the main purpose of non-unitary models is in describing the within household decision process, tests on whether the final resource allocation is efficient or inefficient, and on whether the decentralisation process is based on individual welfare comparisons or on economic power or on personal abilities could be implemented. The studies mentioned in the last two subsections go in this direction.

Although the very limited data availability on individual consumption fixes a strong constraint on the testability of non-standard models, given the contradictory evidence produced so far on the degree of efficiency of allocation, it would be of interest to estimate the effect of education and other sociological variables on the household consumption pattern. The importance of this research work, in terms of policy implications had been already shown by Lundberg *et al.* (1995). Moreover a more systematic empirical study on the decision process regarding public goods would be necessary, together with one on the way socio-demographic variables affect the income transfer within a family.

Conclusion

Up to the seventies economic literature has denied any interest in the decision process within a household. The maximisation of a household utility function was enough to define the household main goal.

This paper has discussed the necessary and sufficient restrictions on individual preferences and the necessary restrictions on intra-family income distribution to consider an aggregate demand as derived from a single-decision making unit and still consistent with the methodological individualism. The main result of both types of restrictions is the theoretical justification for the income pooling hypothesis. However, a further generalisation of aggregation theory considers aggregate demand as a function of indices of income distribution and of other individual attributes.

Nevertheless, aggregation theories are incapable of explaining the intra-household decision making process, which include strong interdependencies between members. Numerous studies provide empirical evidence consistently not accepting the unitary approach. Various tests reject both the income pooling hypothesis and the classic Slutsky's symmetry.

Alternative work has been recently done in two directions: either assuming household members taking decisions non-cooperatively, or assuming them reaching Pareto efficiency through income transfers or exchanging goods. In both cases household consumption and leisure demands appear depending on the within household distribution of income, together with other variables such as sociological variables, individual abilities in home production, etc. depending on the model.

Empirical evidence testing the two approaches gives contradictory results. Some support the first, some the second approach. A more systematic study that could point out the variables determining the choice, and also capable of providing more powerful tests of each model could be relevant even on the normative ground.

Outstanding theoretical research problems are how the cost of children, and public good provision can affect household decision making. Econometric results indicate the need for theoretical models that could deal with both these issues in a more explicit way.

On the inter-temporal context, families seem not to be able to provide full risk sharing to its members, conversely to most of existing models in the life cycle literature. This result opens up new ways of modelling sharing risks within a household. In the paper we have also discussed a list of issues, within the inter-temporal consumption literature, for which it could be worth considering a non-unitary approach.

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