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by

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Public Economics

Center for Economic Studies
Discussions Paper Series (DPS) 00.28
<http://www.econ.kuleuven.be/ces/discussionpapers/default.htm>

November 2000



**DISCUSSION
PAPER**

Collective household models: principles and main results

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February, 2002

Abstract

In the traditional approach to consumer behaviour it is assumed that households behave as if they were single decision-making units. This approach has methodological, empirical and welfare economic deficiencies. A valuable alternative to the traditional model is the collective approach to household behaviour. The collective approach explicitly takes account of the fact that multi-person households consist of several members which may have different preferences. Among these household members, an intrahousehold bargaining process is assumed to take place. In addition to providing an introduction to the collective approach, this survey intends to show how different collective household models, each with their own aims and assumptions, are connected.

Key words: collective household models, household bargaining, intra-household allocation, consumption behaviour, labour supply.

1. Introduction

In his *Foundations of Economic Analysis*, Samuelson begins the chapter dealing with the basic theory of consumer behaviour with the following assertion: “If one were looking for a single criterion by which to distinguish modern economic

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theory from its classical precursors, he would probably decide that this is to be found in the introduction of the so-called subjective theory of value into economic theory” (Samuelson, 1947, p. 90). Indeed, one of the cornerstones of traditional microeconomic theory is the assumption that an individual’s desires and tastes are captured by her own rational preferences that determine her behaviour. It is usually assumed that preferences, in turn, can be represented by a fixed utility function. The consumer’s choice problem can thus be reduced to the maximization of this utility function, subject to her budget constraint that defines the set of alternatives between which she can choose. This particular set-up leads to the well-known restrictions of adding-up, homogeneity, symmetry and negative semidefiniteness of the Slutsky matrix on demand functions, which can be tested by means of observable consumption and labour supply. Conversely, demand that satisfies these theoretical restrictions can be shown to be integrable to a rational preference ordering.

As to a definition of this ‘consumer’, traditional microeconomics remains rather obscure. State of the art references of consumer theory like Deaton and Muellbauer (1980) and Barten and Böhm (1982) treat ‘households’ and ‘consumers’ all alike, or pay no attention to a precise definition. The same applies to most empirical applications with regard to household consumption or labour supply, where single individual households are lumped together with households consisting of several members (see Blundell and Walker, 1986, Browning and Meghir, 1991, Banks et alii, 1997 and Blundell and Robin, 2000, for some recent examples).

Implicitly, the traditional approach assumes that a household, even if it consists of different individuals, acts as a single decision-making unit. Consequently, household consumption and labour supply are considered to be the observable result of the maximization of (fixed) household preferences, constrained by a household budget restriction. This will hereafter be referred to as the *unitary model*.

This unitary model, however, is increasingly coming under fire. It is attacked by methodological, empirical and welfare economic arguments. *Methodologically*, one can argue that the notion of subjective preferences is inseparable from methodological individualism, which asserts that social theories should run in terms of the behaviour of individuals (see, e.g., Blaug, 1980). This would plead for an approach that explicitly takes into account the notion that a household is a group of individuals, with different preferences, and among whom an intrahousehold decision-making process takes place. Of course, as long as household preferences coincide with those of one individual, it all goes beautifully for the unitary model, which assumes that households act as a single decision-maker. A distinction between individual preferences and household preferences then becomes somewhat irrelevant to model household behaviour. Historically, there is perhaps something

to say for this. Early contributors to the theory of consumption behaviour, e.g., use words like ‘consumer’, ‘household manager’ or ‘household leader’ throughout their treatises on an equal basis (Kauder, 1965). This seems to suggest that household preferences used to coincide with those of a specific household member.¹ But the moment this changes, the problem gets more complicated.

In fact, a household can be seen as a micro-society that consists of several individuals with their own rational preferences. Observed household consumption and labour supply can in this sense be considered as the social state chosen by the household members. Referring to Arrow’s impossibility theorem, however, an aggregate of individuals does not necessarily behave as a single individual with her own rational preferences. Accordingly, it can be argued that the unitary model acts as an *empirical strait-jacket* for observable household consumption and labour supply. A first restriction of the unitary model is that individual nonlabour incomes of the household members are pooled in a single household nonlabour income. This ‘income pooling hypothesis’ implies that the source of this exogenous income does not play any role in the household’s allocation with regard to labour supply and consumption. Not surprisingly, this restriction has been strongly rejected in numerous empirical studies (see, e.g., Thomas, 1990, Bourguignon et alii, 1993, Browning et alii, 1994, Lundberg et alii, 1997 and Fortin and Lacroix, 1997). A second empirical drawback touches upon the symmetry of the Slutsky matrix. This boils down to, e.g., the requirement that marginal compensated wage changes of two individuals in a household have the same effect on each other’s labour supply. This theoretical restriction is also empirically rejected (see, among many others, Fortin and Lacroix, 1997 and Browning and Chiappori, 1998). Finally, when an individual is not participating in the labour market (i.e., is at a corner solution), then it is the reservation wage, rather than the market wage, of that individual that affects the labour supply decision of another household member. This assumption seems to be far from innocuous (Blundell et alii, 1998 and Blundell and MaCurdy, 1999).

Somewhat distanced from the positive modelling of household behaviour, is the *normative welfare analysis*. Here too, the unitary model embraces some, perhaps unexpected, difficulties. Without very strong assumptions, the unitary model leaves no room to determine the intrahousehold allocation of consumption and labour supply, and consequently, of welfare. Traditional welfare economic models (e.g., on optimal taxation) only consider the distribution of welfare over households. Either this implies that the welfare of individuals within a household is unimportant, or that the intrahousehold distribution is optimal for the policy maker (see, e.g., Bourguignon and Chiappori, 1994). Apps and Rees (1988) and Brett (1998) have shown, however, that when evaluating the welfare effects of tax changes, intrahousehold distributional effects cannot, in general, be ignored.

Moreover, taking the distribution of welfare within a household into account may drastically change the level of poverty or inequality (Haddad and Kanbur, 1990). Alderman et alii (1995) argue that acceptance of the unitary model, when it is inappropriate, has more serious consequences for policy prescriptions than rejecting the unitary model when it is appropriate. Knowledge of the intrahousehold decision process may be important, especially in programs that target individuals in certain groups (e.g., women or children). For some other studies that focus on the implications of using unitary models for welfare economic problems, see Lundberg and Pollak (1996), Phipps and Burton (1996) and Strauss et alii (2000).

Early attempts that account for the fact that households may consist of different individuals with their own preferences are Samuelson (1956) and Becker (1974a, 1974b). Samuelson (1956) imposes such a structure on the household decision-making problem that the household utility function collapses to a unitary one. His solution amounts to the assumption of a weakly separable household utility function, with the individuals' utility functions as subutility functions. The form of this aggregation function would be achieved by consensus among the individuals.²By making use of this argument, one can of course also assume that the household members decide to behave like some imaginary single individual with rational preferences, without having recourse to weakly separable preferences. Becker's (1974a, 1974b) approach is closely related to Samuelson's. But instead of assuming that household members agree to behave as an imaginary individual, he resorts to a benevolent head of the family, who takes into account the preferences of all household members. Again this concurs with weakly separable rational household preferences. Two important remarks should be made with regard to these approaches. Firstly, one may argue that Arrow's impossibility theorem pops up once again, if household members are trying to reach some rational consensus household model. Secondly, both approaches again put household consumption and labour supply in the strait-jacket of the unitary model that is too restrictive.

Two more fruitful approaches that explicitly take into account several decision-makers in a household, make use of game theoretic elements. The first of these approaches models household behaviour in a non-cooperative framework (see, e.g., Leuthold, 1968, Ashworth and Ulph, 1981, Browning, 2000 and Chen and Woolley, 2001). In these models, household members are assumed to maximize their utility, taking the other individuals' behaviour as given. In general, this Nash equilibrium setting implies other restrictions on observable household behaviour than the unitary approach. One potential drawback of these non-cooperative models, however, is that they do not necessarily result in Pareto efficient intrahousehold allocations. That is, in many cases, it is possible to make an individual better off, without making the other household members worse off. The second approach is that of, e.g., Manser and Brown (1980) and McElroy and Horney (1981). They

incorporate in a household model elements of cooperative game theory, and more specifically of axiomatic bargaining theory. Household members are the agents that try to come to an agreement on how to divide the gains of cooperation; in this case, the gains of living together. Depending on the bargaining power of the household members, a specific Pareto efficient intrahousehold allocation of welfare is obtained. Manser and Brown (1980) derive the implications on demand for bargaining concepts like the dictatorial, the Nash and the Kalai-Smorodinsky solution. McElroy and Horney (1981), on the other hand, focus on the Nash bargaining solution and derive conditions for a Nash demand system to collapse to a traditional unitary model.

An important criticism of the approach of choosing a particular bargaining concept to model household behaviour, is that if its empirical implications are rejected, then it is impossible to determine whether the particular choice itself is rejected or the bargaining setting in general, as opposed to the unitary model. Therefore, Chiappori (1988a, 1992) and Apps and Rees (1988) take an alternative starting point. The *only* assumption they make, is that intrahousehold decisions are Pareto efficient. Thus contrary to, e.g., Manser and Brown (1980), no restriction is imposed a priori on which point on the Pareto frontier will be chosen by the household. Even this weak restriction makes it possible to derive some testable implications of the model and to identify an important part of the intrahousehold decision-making process and individual preferences. We will hereafter refer to this as the *collective* approach to household behaviour. It can be shown that this collective model leads to household preferences that are dependent on wages, prices and individual nonlabour incomes. The presence of the latter in the household's preferences reflects the fact that the distribution of the bargaining power within a household may depend on the level of each of these variables. What is important in light of the empirical deficiencies of the unitary model, is that this collective approach is able to raise these. The income pooling hypothesis, e.g., no longer needs to be satisfied. The same goes for a collective generalization of Slutsky symmetry.

Gradually, the collective approach has found acceptance in recent microeconomic theory. While Chiappori (1988a, 1992) initially concentrated on labour supply behaviour in a cross-sectional context, the approach has been extended in several directions. Browning et alii (1994), e.g., derived a collective model to describe household consumption on cross-sections. Browning and Chiappori (1998), on the other hand, consider an environment of relative price variation for a number of commodities. In Chiappori (1997), household production is introduced in a collective model of labour supply. Due to the multitude of collective household models, it is sometimes difficult to see the wood for the trees. In addition to providing a more thorough introduction to collective household models, this

survey intends to show how the different models, each with their own aims and assumptions, are connected. Starting from Browning and Chiappori's (1998) general model, it is shown that many collective household models are special cases of the latter.

The paper is structured as follows. Section 2 describes the basic concepts of the collective approach to household behaviour. Central in this discussion is the general collective household model of Browning and Chiappori (1998). In Section 3, attention is focused on several collective models that are nested within the general model. Both specific labour supply and consumption models are discussed. The fourth section contains a superficial discussion on the alternative approach of choosing particular bargaining concepts to model household behaviour. For the sake of completeness, Section 5 devotes some attention to non-cooperative models of household behaviour. Section 6 concludes.

2. The collective approach to household behaviour: a general model

As already mentioned in the introduction, this section focuses on the general collective household model of Browning and Chiappori (1998). Although this model could include leisure (as the complement of labour supply), this was not made explicit in their paper. To be able to place the specific collective models of the next section, we will slightly extend the Browning and Chiappori model to include leisure. Before the collective approach is reviewed, however, we will start with the traditional unitary model. This will allow for both an introduction of some core notation and a discussion of the deficiencies of the unitary model.

2.1. The unitary model as an introduction to collective household models

The standard theory of consumer behaviour is an example *par excellence* of the economic problem: households have needs and desires that they want to satisfy. But they have to make choices, since they are limited in their possibilities. A fundamental assumption of the unitary approach to household behaviour is that a household's needs and desires are fully captured by a rational preference ordering over alternative consumption and leisure bundles.³ These *preferences* are usually assumed to be representable by an, up to a monotone increasing transformation, unique well-behaved utility function. Formally, the utility function for a household consisting of two working-age individuals A and B equals:

$$u = v(\mathbf{q}, q_0^A, q_0^B),$$

where v is a strongly quasi-concave, increasing and twice continuously differentiable function in its arguments. These are the household's consumption vector $\mathbf{q} = (q_1, \dots, q_n)' \in \mathbb{R}_+^n$, and the individuals' leisure amounts q_0^A and q_0^B , both $\in \mathbb{R}_+$. Household resources, however, are limited. The *full budget constraint* of the two-person household equals:

$$\mathbf{p}'\mathbf{q} + w^A q_0^A + w^B q_0^B \leq y^A + y^B + y^H + w^A T + w^B T,$$

where $\mathbf{p} = (p_1, \dots, p_n)' \in \mathbb{R}_{++}^n$ is the price vector, $w^I \in \mathbb{R}_{++}$ is the wage rate of household member I ($I = A, B$), $y^I \in \mathbb{R}_+$ is the personal nonlabour income of I ($I = A, B$), y^H is the households' nonlabour income that cannot be assigned to one of its members and T is the time endowment. The household's choice problem can now be reduced to the following maximization problem:

$$\max_{\tilde{\mathbf{q}}} v(\tilde{\mathbf{q}}),$$

subject to

$$\tilde{\mathbf{p}}'\tilde{\mathbf{q}} \leq y^S + w^A T + w^B T,$$

where $\tilde{\mathbf{q}} = (\mathbf{q}', q_0^A, q_0^B)'$ denotes the household consumption and leisure bundle, $\tilde{\mathbf{p}} = (\mathbf{p}', w^A, w^B)'$, the 'full' price vector, and $y^S = y^A + y^B + y^H$ the aggregate nonlabour income. This maximization problem results in a set of $n + 2$ differentiable Marshallian commodity and leisure demand functions:

$$\tilde{\mathbf{q}} = \mathbf{g}(y^S + w^A T + w^B T, \tilde{\mathbf{p}}). \quad (2.1)$$

These demand functions have the following well-known properties:

adding up: $\tilde{\mathbf{p}}'\mathbf{g}(y^S + w^A T + w^B T, \tilde{\mathbf{p}}) = y^S + w^A T + w^B T$

homogeneity: $\mathbf{g}(\theta(y^S + w^A T + w^B T), \theta\tilde{\mathbf{p}}) = \mathbf{g}(y^S + w^A T + w^B T, \tilde{\mathbf{p}})$, $\theta \in \mathbb{R}_{++}$

Slutsky symmetry: $\mathbf{S} = \mathbf{S}'$, where $\mathbf{S} = \frac{\partial \mathbf{g}}{\partial \tilde{\mathbf{p}}'} + \frac{\partial \mathbf{g}}{\partial (y^S + w^A T + w^B T)} \tilde{\mathbf{q}}'$

negativity: $\boldsymbol{\xi}'\mathbf{S}\boldsymbol{\xi} \leq 0$, for all $\boldsymbol{\xi} \in \mathbb{R}^{n+2}$.⁴

The empirical testing of these restrictions went hand in hand with developments in consumer theory. Except for the natural adding up condition, each of these restrictions were repeatedly rejected in various studies (see Deaton and Muellbauer, 1980 and Blundell, 1988 for some evidence and interpretation). The successive rejections of the restrictions on demand in no way led to a falsification of the standard theory of consumer behaviour. Many rejections were interpreted as being due to data problems, inadequate functional forms or other specification issues, rather than to the basic theory itself (see, e.g., Keuzenkamp and

Barten, 1995). Except for a few refinements (dynamic models with habit formation, incorporation of demographic effects in demand analysis, etc.), they did not end up fundamentally changing the standard consumer theory.

Apart from the above theoretical restrictions on demand, the unitary model implies the ‘income pooling hypothesis’. This asserts that the source of the non-labour income does not play any role in the household’s allocation problem. It is easily seen from equation (2.1) that marginal changes of the different nonlabour incomes have the same effect on demand, i.e. $\frac{\partial \mathbf{g}}{\partial y^A} = \frac{\partial \mathbf{g}}{\partial y^B} = \frac{\partial \mathbf{g}}{\partial y^H} = \frac{\partial \mathbf{g}}{\partial y^S}$. This restriction has also been rejected on numerous occasions (see Bourguignon et alii, 1993, Browning et alii, 1994, Lundberg et alii, 1997 and Fortin and Lacroix, 1997, for a few examples). Contrary to the statistical testing and rejection of the usual restrictions of demand theory, it can perhaps be argued that rejections of the income pooling hypothesis paved the way for a more fundamental reinterpretation of consumer theory. The distinguishing characteristic of this reinterpretation is the fact that households consist of several individuals, who may have different preferences, and among whom an intrahousehold decision-making process takes place.

2.2. A general collective household model

2.2.1. Preferences, commodities and the household budget constraint

In what follows, we will continue focusing on households consisting of two working-age individuals A and B . Contrary to the unitary approach to household behaviour, *each* of these individuals is characterized by her or his own rational preferences. *Preferences* are assumed to be very general, in that they are defined over both one’s own consumption and leisure and the other individual’s consumption and leisure. Thus, externalities in consumption or leisure are allowed. These externalities can be positive or negative. There would be a positive externality with regard to leisure, e.g., if both household members were to enjoy each other’s company and spend their leisure time together. A negative externality, e.g., would occur if one individual were to dislike the other individual’s consumption of tobacco. Further, there is no restriction on the character of the *commodities* in the consumption vector. Commodities can be consumed privately, publicly or both. Soft drinks clearly have a private character, since for each bottle of coke consumed by one individual, there is one bottle less for the other. Rent, e.g., is a public good. Consumption of it by one individual does not affect the supply available for the other household member, and (at least if one wants to maintain the household) no individual can be excluded from consuming it. Other commodities can be both privately or publicly consumed. If both household members like watching the same television programmes, expenditures on pay TV are a public good. These

(or some of these) expenditures would be a private good if only one household member were to watch television.

Preferences of individual I ($I = A, B$) are assumed to be representable by the following direct utility function:

$$u^I = v^I(\mathbf{q}^A, \mathbf{q}^B, q_0^A, q_0^B, \mathbf{Q}), \quad (2.2)$$

where v^I is a twice continuously differentiable strongly concave utility function with the consumption vectors $\mathbf{q}^A = (q_1^A, \dots, q_n^A)'$ and $\mathbf{q}^B = (q_1^B, \dots, q_n^B)'$, both $\in \mathbb{R}_+^n$, the leisure amounts q_0^A and q_0^B , both $\in \mathbb{R}_+$, and the vector of public consumption $\mathbf{Q} = (Q_1, \dots, Q_n)' \in \mathbb{R}_+^n$ as arguments. The utility function v^I is assumed to be strictly increasing in \mathbf{q}^I , q_0^I and \mathbf{Q} . Given that externalities can be positive or negative, v^I is not necessarily increasing in \mathbf{q}^J and q_0^J , for $J \neq I$.

The *full budget constraint* of the household is:

$$\mathbf{p}'(\mathbf{q}^A + \mathbf{q}^B + \mathbf{Q}) + w^A q_0^A + w^B q_0^B \leq y^A + y^B + y^H + (w^A + w^B)T, \quad (2.3)$$

where \mathbf{p} , w^A , w^B , y^A , y^B and y^H are defined as before. This budget constraint thus captures all the household's endowments, which are used to finance household purchases of consumption and leisure.

2.2.2. Pareto efficient or collective household behaviour

Given that preferences are defined on an individualistic basis, nothing has been said on *household preferences* thus far. In any case, household purchases are the observable result of some intrahousehold decision-making process. This can take a myriad of forms. Manser and Brown (1980) and McElroy and Horney (1981), e.g., follow an axiomatic bargaining approach and assume that households behave as if they take decisions on the basis of particular bargaining rules like the Nash or Kalai-Smorodinsky solution. Other authors, on the contrary, suppose non-cooperative household behaviour (see, e.g., Bourguignon, 1984, Kooreman and Kapteyn, 1990, Browning, 2000 and Chen and Woolley, 2001).

Instead of focusing on a particular bargaining rule, Chiappori (1988a) and Apps and Rees (1988) only assume that the household decision-making process results in Pareto efficient outcomes. That is, chosen consumption bundles and leisure are such that an individual's welfare cannot be increased without decreasing the welfare of the other household member. In Browning and Chiappori (1998), some arguments for this *collective household approach* are given. Firstly, in the particular context of a repeated game and under the assumption of perfect information on each other's preferences, it is plausible that the household members could develop Pareto efficient allocation mechanisms. Secondly, one can

argue that the assumption of Pareto efficiency is the most natural generalization of the assumption of utility maximization in the unitary model with several household members. What is important here, is that the latter is a particular outcome of the collective household approach. And finally, many widespread bargaining rules generally assume Pareto efficiency. Examples are the Nash, Kalai-Smorodinsky, utilitarian and egalitarian solutions (see, e.g., Thomson, 1994).

By making use of standard instruments of welfare economics, we can easily describe the collective household model. A bundle $(\mathbf{q}^A, \mathbf{q}^B, q_0^A, q_0^B, \mathbf{Q})'$ is a Pareto optimal allocation of consumption and leisure within the household if it is a solution to the following maximization problem:

$$\max_{\mathbf{q}^A, \mathbf{q}^B, q_0^A, q_0^B, \mathbf{Q}} v^A(\mathbf{q}^A, \mathbf{q}^B, q_0^A, q_0^B, \mathbf{Q})$$

subject to

$$(1) \quad v^B(\mathbf{q}^A, \mathbf{q}^B, q_0^A, q_0^B, \mathbf{Q}) \geq \bar{u}^B \quad (2.4)$$

$$(2) \quad \mathbf{p}'\mathbf{q} + w^A q_0^A + w^B q_0^B \leq y^S + (w^A + w^B)T,$$

where \bar{u}^B is some required utility level for individual B , $y^S = y^A + y^B + y^H$ and $\mathbf{q} = \mathbf{q}^A + \mathbf{q}^B + \mathbf{Q}$. Thus, the maximization problem (2.4) seeks an allocation that maximizes individual A 's welfare, subject to some preallocated welfare level for household member B and to the household budget constraint. By varying \bar{u}^B , all Pareto efficient allocations can be traced out. This set of Pareto efficient allocations forms the boundary of the utility possibility set, which captures all attainable vectors of utility levels for the household. Given that it is assumed that the individual utility functions are strongly concave and that the budget constraint defines a convex set, the utility possibility set is strictly convex. This is an important result, because it allows to characterize all Pareto efficient allocations as stationary points of a linear 'social welfare function' (more specifically, of a nonsymmetric utilitarian social welfare function) for some positive welfare weights for both individuals (see Dorfman, 1975, Panzar and Willig, 1976 and Mas-Colell et alii, 1995). That is, the household allocation problem (2.4) can be defined as the unique solution to the following maximization problem:

$$\max_{\mathbf{q}^A, \mathbf{q}^B, q_0^A, q_0^B, \mathbf{Q}} \mu(\mathbf{p}, \mathbf{w}, \mathbf{y}) v^A(\mathbf{q}^A, \mathbf{q}^B, q_0^A, q_0^B, \mathbf{Q}) + [1 - \mu(\mathbf{p}, \mathbf{w}, \mathbf{y})] v^B(\mathbf{q}^A, \mathbf{q}^B, q_0^A, q_0^B, \mathbf{Q}) \quad (2.5)$$

subject to

$$\mathbf{p}'\mathbf{q} + w^A q_0^A + w^B q_0^B \leq y^S + (w^A + w^B)T,$$

where $\mathbf{w} = (w^A, w^B)'$ and $\mathbf{y} = (y^A, y^B, y^H)'$.⁵

In this social welfare context, welfare weights $\mu(\mathbf{p}, \mathbf{w}, \mathbf{y})$ and $[1 - \mu(\mathbf{p}, \mathbf{w}, \mathbf{y})]$ are attached to both household members. In general, these (normalized) Lagrangian multipliers of the maximization problem (2.4) will depend on the exogenous variables \mathbf{p} , \mathbf{w} and \mathbf{y} . An interpretation of these welfare weights is that they represent the *bargaining power* of the household members in the intrahousehold allocation process. Changes in wages, nonlabour incomes or prices, may then shift bargaining power from one individual to the other. This, in turn, has consequences on observable household consumption and labour supply. A change in the nonlabour income of a household member, e.g., may not only affect household consumption and labour supply via the usual income effect, but also by means of a shift in bargaining power. Since changes in individual nonlabour incomes alter the bargaining position of the household members, the source of the nonlabour income may be important for the household allocation. This is an important implication of the collective household approach, since it no longer implies the income pooling hypothesis.

The same applies for changes in wages or prices. Apart from the usual substitution and income effects, shifts in the bargaining power of the household members can also be expected. These may invoke some additional effects on household consumption and labour supply. More specifically, *household preferences*, as captured by the linear social welfare function (2.5), thus depend on prices, wages and nonlabour incomes. Such preferences are a generalization of Kalman's (1968) and Pollak's (1977) price dependent preferences. They have shown that the usual 'Slutsky effects', defined as the sum of the 'standard' uncompensated price effect and the 'standard' income effect, are no longer symmetric.⁶ Moreover, the matrix consisting of these 'Slutsky effects' is not necessarily negative semidefinite. These are again very important and distinguishing implications of the collective household model.

Before we elaborate on this point, it is perhaps useful to give some intuition for it. Household preferences, as represented by the social welfare function (2.5), may be interpreted as being a sort of weighted average of individual preferences. Since the individuals' weights may alter following changes in the wages, prices or nonlabour incomes, household preferences are no longer constant in the normal sense. The probability of still obtaining a rational, i.e. complete and transitive, household preference ordering, is limited. Consequently, one cannot expect household consumption and labour supply to remain subject to the standard restrictions on demand, which are direct consequences of rational preference orderings in the unitary approach.

Given that the collective approach to household behaviour does not assume the existence of rational household preferences, is it possible at all to derive testable restrictions on the collective household model? Or can *any* observable house-

hold behaviour be placed in the rather loose jacket of the collective framework? Another important question is whether the collective approach makes it possible to draw any conclusions on the intrahousehold decision-making process and on individual preferences. It is well-known that in the unitary model, demand that satisfies the restrictions of adding up, homogeneity, symmetry and negative semidefiniteness of the Slutsky matrix is integrable to a rational preference ordering. This is quite a useful result, if one wants to evaluate changes in the economic environment on the welfare of households. Both questions and, of course, answers, will pop up here and there in the remainder of this paper. But first, it is demonstrated that the unitary model can be seen as a special case of the collective household model.

2.2.3. The unitary model as a special case of the general model

Under what circumstances does the collective household model, as defined by equation (2.5), reduce to the unitary model? Three possibilities can be distinguished.

A first possibility lies perhaps closest to the consumption theory that early contributors had in mind: household preferences are those of the ‘household planner’ or the ‘household leader’ (see, e.g., Kauder, 1965). This dictatorial solution is obtained if individual A ’s welfare weight $\mu(\mathbf{p}, \mathbf{w}, \mathbf{y})$ is fixed at either 1 or 0. In the first case, A would be the dictator; in the latter case, household member B . Note that this dictator can be a benevolent one, who positively values the consumption and leisure bundle of the other household member. In this case, the dictator’s utility function $v^I(\mathbf{q}^A, \mathbf{q}^B, q_0^A, q_0^B, \mathbf{Q})$ ($I = A$ or B) would be increasing in all its arguments (i.e., there would only be positive externalities). A special form of such utility function would occur if the benevolent dictator were nonpaternalistic in the sense that he only valued the welfare of the other household member, rather than the specific consumption and leisure bundle preferred by this individual. The utility function of this Beckerian (1974a, 1974b) benevolent head of the family is of the form $f^I(v^A(\mathbf{q}^A, q_0^A, \mathbf{Q}), v^B(\mathbf{q}^B, q_0^B, \mathbf{Q}))$ ($I = A$ or B), where f^I is some increasing function in its arguments.

A second possibility is when the welfare weights of the individuals are fixed somewhere between 0 and 1. In this case, the household utility function equals $\mu v^A(\mathbf{q}^A, \mathbf{q}^B, q_0^A, q_0^B, \mathbf{Q}) + (1 - \mu) v^B(\mathbf{q}^A, \mathbf{q}^B, q_0^A, q_0^B, \mathbf{Q})$, with $\mu \in]0, 1[$. Depending on the arguments in the individual utility functions, this possibility has some interesting specifications. If each individual utility function has at least one good (or leisure amount) as an exclusive argument, then the household behaves as if it were a single individual with latently separable preferences (see Blundell and Robin, 2000).⁷If there are no externalities in consumption and leisure and no pub-

lic consumption, then one obtains strongly separable household preferences that are closely connected to the rational preferences of Samuelson's (1956) imaginary individual.

Finally, the collective household model collapses to the unitary model if both household members have the same preferences over consumption and leisure bundles. In this case, the household utility function equals the common utility function of both individuals.

As was already stressed, observable household demand that is compatible with the unitary model satisfies the usual theoretical restrictions and the income pooling hypothesis. On the other hand, demand that stems from the collective household model is not put in such a strait-jacket. In the next paragraph, it is shown that even the loose framework of the collective approach implies an important restriction that is testable on observable household demand.

2.2.4. A generalization of Slutsky symmetry

To reach a testable implication of the collective household model, we will put some more structure into the household utility function (2.5). More specifically, it will be assumed that the function $\mu(\mathbf{p}, \mathbf{w}, \mathbf{y})$ is continuously differentiable and homogeneous of degree zero in its arguments. This will guarantee that the unique solution to the maximization of the household utility function, subject to the budget constraint, will be a set of demand functions that are continuously differentiable and homogeneous of degree zero. Note that this assumption implies the usual absence of money illusion: the unit in which prices, wages and income are expressed does not affect the household allocation process. A second assumption is that only *total household consumption* is observable (apart from the observable individual leisure amounts q_0^A and q_0^B). That is, we can only observe $\mathbf{q} = \mathbf{q}^A + \mathbf{q}^B + \mathbf{Q}$ and not the individual components of \mathbf{q} . This is a very useful generalization, since most household budget surveys do not allow to distinguish the final consumer of the greater part of the household consumption bundle.

Let us again use the notation associated with the unitary model. The household consumption and leisure bundle is denoted by $\tilde{\mathbf{q}} = (\mathbf{q}', q_0^A, q_0^B)'$, while the price vector, augmented with the two wages, is denoted by $\tilde{\mathbf{p}} = (\mathbf{p}', w^A, w^B)'$. The (Pareto efficient) solution of the household allocation problem (2.5) now equals the following set of $n + 2$ demand equations:

$$\tilde{\mathbf{q}} = \mathbf{g}(y^S + w^A T + w^B T, \tilde{\mathbf{p}}), \quad (2.6)$$

where for all commodities in the vector $\tilde{\mathbf{q}}$, $\tilde{q}_i = q_i^A + q_i^B + Q_i$. Moreover, given the assumptions we made, these demand functions are continuously differentiable,

homogeneous of degree zero and add up to full income $y^S + w^AT + w^BT$. By means of these observable demand functions, we can again define a ‘Slutsky’ matrix:

$$\mathbf{S} = \frac{\partial \mathbf{g}}{\partial \tilde{\mathbf{p}}'} + \frac{\partial \mathbf{g}}{\partial (y^S + w^AT + w^BT)} \tilde{\mathbf{q}}'. \quad (2.7)$$

Following Browning and Chiappori (1998), we call this the *pseudo-Slutsky matrix*. The reason for this change of name is that the elements of \mathbf{S} can no longer be considered as the price effects on demand with the household utility level held constant. In the unitary model, Slutsky effects capture the move along an indifference surface due to a marginal price or wage change. The pseudo-Slutsky effects as defined in equation (2.7), however, not only encompass the move along an indifference surface, but also a move of the indifference surface itself.

This is easily seen, if we look at the main result of Browning and Chiappori (1998). They showed that household demand, which is compatible with the collective household model, satisfies the following restriction:

$$\mathbf{S} = \mathbf{\Sigma} + \mathbf{u}\mathbf{v}', \quad (2.8)$$

where $\mathbf{\Sigma}$ is a symmetric negative semidefinite matrix and \mathbf{u} and \mathbf{v} are two $(n + 2)$ vectors. Note that the matrix $\mathbf{R} = \mathbf{u}\mathbf{v}'$ has at most rank 1.

This result can be interpreted as follows. The pseudo-Slutsky effect $s_{ij} = \frac{\partial q_i}{\partial p_j} + \frac{\partial q_i}{\partial (y^S + w^AT + w^BT)} q_j$ is the effect on commodity i of a marginal increase in the price of commodity j , whereby the household is compensated by an increase in the full income. Browning and Chiappori’s “symmetry + rank 1” (SR1) condition shows that these pseudo-Slutsky effects can be decomposed into two parts: a pure substitution effect and an extra price effect. The *pure substitution effect* corresponds to the usual compensated (Slutsky) price and wage effects, whereby the household utility and the welfare weights μ and $(1 - \mu)$ are held constant (i.e., the move *along* an indifference curve). The *extra price effect*, in turn, comes from the change in bargaining power functions μ and $(1 - \mu)$ as a consequence of the marginal price change (i.e., the move *of* the indifference curve). Note that in the unitary model, this latter effect equals zero ($\mathbf{R} = \mathbf{0}$). In this case, the pseudo-Slutsky matrix \mathbf{S} reduces to the usual Slutsky matrix $\mathbf{\Sigma}$ that is symmetric and negative semidefinite. Browning and Chiappori (1998) also showed that to test the SR1 condition, one needs at least five commodities, leisure amounts included. This is quite an important restriction, since it rules out testing the SR1 property on datasets that only contain labour supply information (i.e., hours and wages of the two household members), and no information on how expenditures are allocated to different goods and services with price variation.

Browning and Chiappori (1998) put data on Canadian childless households to the SR1 test. Their main results are that the unitary model could not be rejected

for singles, while it could be rejected for couples. The SR1 property, on the other hand, could not be rejected for couples. Observed household behaviour thus seems to be consistent with the collective household model on the basis of this dataset.

2.2.5. Expanding the general model with distribution factors

Earlier, it was stressed that the household utility function's welfare weights μ and $(1 - \mu)$, which represent the bargaining power of the household members, may depend on prices, wages and nonlabour incomes. In the derivation of Browning and Chiappori's (1998) SR1 property, e.g., prices and wages played an explicit role in the household allocation process. However, other factors may also affect this allocation process. The most obvious examples are the individual nonlabour incomes y^A and y^B . An increase in an individual's nonlabour income may shift bargaining power from one individual to the other, which has consequences on the allocation of household consumption and labour supply. Less obvious, but not necessarily less important are the so-called extrahousehold environmental parameters (see McElroy, 1990). Examples are laws on alimony and child benefits, tax laws that differ according to marital status and divorce law. Changes in these variables may affect outside opportunities of the household members and may thus have consequences on their bargaining power. Following Bourguignon, Browning and Chiappori (1994), such factors can be termed distribution factors. More precisely, *distribution factors* are defined as variables that affect the bargaining power function μ , but that do not have any direct influence on the individuals' preferences and the household budget constraint. Individual nonlabour incomes, e.g., may be assumed to affect the bargaining power of the household members, but not their preferences. Moreover, the effect on the budget constraint runs through a change in total household nonlabour income. Even laws on alimony or divorce laws do not have such an indirect effect on the household budget constraint.

An interesting additional test of the general collective household model can be derived if there is only one distribution factor z .⁸In this case, Browning and Chiappori (1998) showed that the pseudo-Slutsky matrix takes the form:

$$\mathbf{S} = \mathbf{\Sigma} + \frac{\partial \mathbf{g}}{\partial z} \mathbf{v}', \quad (2.9)$$

where $\mathbf{\Sigma}$ is again a symmetric negative semidefinite matrix and \mathbf{v} an $(n + 2)$ vector. The change in demand due to a marginal change in the distribution factor z is thus directly related to the pseudo-Slutsky matrix \mathbf{S} and the usual Slutsky matrix $\mathbf{\Sigma}$. Such a result would be quite remarkable outside the collective household framework, but easily explainable within.

If there is a vector of distribution factors $\mathbf{z} = (z_1, \dots, z_m)'$, another result can be proven, providing an extra test of the collective household model (see Bourguignon

et alii, 1993). Demand compatible with the collective household model must satisfy the following proportionality result:

$$\frac{\partial \mathbf{g}}{\partial z_i} = \theta_i \frac{\partial \mathbf{g}}{\partial z_1}, \text{ for all } i \geq 2 \text{ and } \theta_i \in \mathbb{R}. \quad (2.10)$$

Both tests (2.9) and (2.10) were applied by Browning and Chiappori (1998). After a careful selection of distribution factors (concretely, variables that did not affect the demand of singles), they could not reject the collective household model. Together with the results of the SR1 test, these results give rather strong evidence in favour of the collective approach to household behaviour.

3. Restrictions on the general collective household model

In the former section, we considered a very general collective household model. There were no restrictions on individual preferences. Both externalities and public goods were allowed to enter the individual utility functions. Moreover, almost all testable implications of the general model were defined in a context with explicit price variation (cf. the SR1 property). In this section, we will restrict the general collective household model in several ways. Firstly, individual preferences can be restricted in some useful directions. As will be shown further on, this will allow for a nice interpretation of the collective approach. These restrictions will also permit to derive some important identification results on individual preferences and the intrahousehold allocation process. Apart from restrictions on preferences, available datasets may bring about additional restrictions on the general model. Many household labour supply datasets, e.g., do not contain information on the allocation of total expenditures to different consumption goods. Household budget surveys, on the other hand, do not always capture individual wages or hours worked. This section discusses some collective household models that arise from these particular restrictions.

3.1. Restrictions on preferences: the sharing rule result

3.1.1. Egoistic and caring preferences

Up to now, individual preferences were assumed to be representable by the utility function $v^I(\mathbf{q}^A, \mathbf{q}^B, q_0^A, q_0^B, \mathbf{Q})$, for $I = A, B$. Both positive and negative externalities in consumption and leisure could occur. There was also room for public goods in the household allocation problem. We will now restrict these general preferences somewhat. Two particularly useful types of preferences are egoistic and caring preferences.

Household members have *egoistic preferences* if their preferences only depend on own consumption and own leisure. This amounts to preferences that can be represented by a utility function of the form:

$$u^I = v^I(\mathbf{q}^I, q_0^I), \quad I = A, B.$$

In this case, household members derive utility only from own consumption and leisure. Changes in the commodity bundle of the other household member do not have any effect on one's own welfare.

Beckerian *caring preferences* (Becker, 1974a, 1974b) are a generalization of these rather restrictive egoistic preferences. This type of preferences can be represented by utility functions of the form:

$$u^I = f^I(v^A(\mathbf{q}^A, q_0^A), v^B(\mathbf{q}^B, q_0^B)), \quad I = A, B,$$

where f^I is some increasing function in its arguments. Caring preferences thus boil down to household members who positively value increases in the welfare of the others, but who are not primarily interested in how this welfare is obtained.

3.1.2. The sharing rule result

Both egoistic and caring preferences make a nice interpretation of the collective household model possible. If preferences are egoistic or caring, then the Pareto efficient household allocation program (2.5) can be shown to be equivalent to the existence of a function $\phi(\mathbf{p}, \mathbf{w}, \mathbf{y})$ such that the individuals' leisure amounts q_0^A and q_0^B and consumption bundles \mathbf{q}^A and \mathbf{q}^B , with $\mathbf{q} = \mathbf{q}^A + \mathbf{q}^B$, are solutions to the maximization programs ($I = A, B$):

$$\max_{\mathbf{q}^I, q_0^I} v^I(\mathbf{q}^I, q_0^I), \tag{3.1}$$

subject to

$$\mathbf{p}'\mathbf{q}^I + w^I q_0^I \leq \phi^I(\mathbf{p}, \mathbf{w}, \mathbf{y}) + w^I T,$$

where $\phi^A(\mathbf{p}, \mathbf{w}, \mathbf{y}) = \phi(\mathbf{p}, \mathbf{w}, \mathbf{y})$ and $\phi^B(\mathbf{p}, \mathbf{w}, \mathbf{y}) = y^S - \phi(\mathbf{p}, \mathbf{w}, \mathbf{y})$.⁹ Under the given assumptions, the household allocation problem is reduced to a sort of two-stage budgeting process. Firstly, both household members divide total household nonlabour income y^S among each other according to the *sharing rule* ϕ , which in general depends on exogenous prices, wages and nonlabour incomes. In the second stage, the individuals independently allocate their share of full income to own consumption and leisure in a way that maximizes their individual welfare. This sharing rule interpretation of Pareto efficient household behaviour is nothing more than an application of the second fundamental theorem of welfare economics.

The Pareto optimal allocation $(\mathbf{q}^{A'}, \mathbf{q}^{B'}, q_0^A, q_0^B)'$ can in this sense be considered as a competitive market equilibrium with lump-sum transfers between household members (see, e.g., Mas-Colell et alii, 1995).¹⁰

This sharing rule result will prove useful in the identification of individual preferences and the intrahousehold allocation process. To illustrate this, we will focus attention on household labour supply models.

3.2. Collective labour supply models

3.2.1. Collective labour supply with observable distribution factors

Many datasets that contain labour supply data (wages and hours worked) do not embrace information on the household consumption bundle under different price regimes. The only ‘price’ variation in most cross-sections with microdata is the wage variation between individuals. Of course, one must cut one’s coat according to one’s cloth, if one wants to apply standard microeconomic theory to labour supply behaviour. This cloth is not even that poor a quality. Since it is assumed that there is no relative price variation for consumption goods in cross-sections, one can safely resort to Hicks’ composite commodity theorem. This theorem asserts that if a group of prices move in parallel, then the corresponding group of consumption goods can be treated as a single commodity; the so-called *Hicksian aggregate commodity* (see Deaton and Muellbauer, 1980). More specifically, the theorem implies that, under the given condition, a new preference ordering can be defined over a Hicksian aggregate commodity (in this case, total expenditures on consumption goods) and leisure that leads to the same consumption and leisure bundle as the original preference ordering.¹¹ This way out has important consequences on the testability of the collective model by means of the pseudo-Slutsky matrix. As proven by Browning and Chiappori (1998), the SR1 property can only be tested if there are at least five commodities (cf. supra). We have only three different commodities (two leisure amounts and one observable Hicksian aggregate commodity), which renders the SR1 property untestable in the given context. However, the particular set-up we will focus on allows to derive other testable restrictions. Moreover, this set-up implies some important identification results.

In what follows, we will assume that there are only two sources of relative price variation. These are the wages of both household members. A second assumption is that individual preferences are egoistic.¹² The set-up is fully defined with the third assumption of at least one observable distribution factor z that differs from individual nonlabour incomes (i.e., a variable that affects the bargaining power of the household members, but which has no direct influence on their preferences and the household budget constraint). In this setting, the general collective household

allocation problem (2.5) reduces to the following maximization problem:

$$\max_{c^A, c^B, q_0^A, q_0^B} \mu(\mathbf{w}, \mathbf{y}, z) v^A(c^A, q_0^A) + [1 - \mu(\mathbf{w}, \mathbf{y}, z)] v^B(c^B, q_0^B) \quad (3.2)$$

subject to

$$c^A + c^B + w^A q_0^A + w^B q_0^B \leq y^S + (w^A + w^B) T,$$

where c^I is member I 's unobserved consumption of the Hicksian aggregate commodity ($I = A, B$) and z is the distribution factor that only affects the functions μ and $(1 - \mu)$. Note that, without losing generality, the price of the Hicksian commodity has been set equal to 1. Under the usual regularity conditions, the solution to this maximization problem is the set of differentiable Marshallian labour supply equations (with $\ell^I = T - q_0^I$ for $I = A, B$):

$$\ell^I = h^I(y^S, \mathbf{w}, z), \quad (3.3)$$

which are dependent on nonlabour income, wages and the distribution factor. Since preferences are assumed to be egoistic, the observed labour supplies ℓ^A and ℓ^B can be considered as derived from the maximization programs (3.1), redefined in a cross-section context and completed with the distribution factor z . Consequently, labour supply equations can be written as follows:

$$\begin{aligned} \ell^A &= l^A(\phi(\mathbf{w}, \mathbf{y}, z), w^A), \\ \ell^B &= l^B(y^S - \phi(\mathbf{w}, \mathbf{y}, z), w^B), \end{aligned} \quad (3.4)$$

where the sharing rule ϕ , that defines the intrahousehold allocation process, is assumed to be twice continuously differentiable.

Chiappori, Fortin and Lacroix (forthcoming) proved that this set-up implies testable restrictions of the collective model on observed labour supply behaviour. Instead of enumerating these restrictions, we will focus on the intuition behind the derivation of these. The obtained results are entirely driven by the applicability of the sharing rule result. Firstly, as is clear from equation (3.4), marginal changes in the distribution factor z only affect individual labour supplies ℓ^A and ℓ^B via the sharing rule ϕ . Secondly, a marginal change of a household member's wage has only an income effect on the other's labour supply. This income effect runs through the individuals' shares of nonlabour income. Finally, marginal changes in nonlabour incomes $\mathbf{y} = (y^A, y^B, y^H)'$ have an indirect effect on labour supplies via the shares of nonlabour income of both household members.¹³ Taken together, these results allow to derive the marginal rates of substitution, between each couple of variables of the set $\{w^A, w^B, y^A, y^B, y^H, z\}$, of the sharing rule ϕ in terms of observable labour supplies ℓ^A and ℓ^B .¹⁴ By means of this set of marginal

substitution rates, the partial derivatives of the sharing rule ϕ (i.e., $\frac{\partial\phi}{\partial w^A}$, $\frac{\partial\phi}{\partial w^B}$, $\frac{\partial\phi}{\partial y^A}$, $\frac{\partial\phi}{\partial y^B}$, $\frac{\partial\phi}{\partial y^H}$, $\frac{\partial\phi}{\partial z}$) can be derived. In order to make this set of partial differential equations integrable to ϕ , a set of cross-equation restrictions has to be satisfied (e.g., $\partial\left(\frac{\partial\phi}{\partial y^A}\right)/\partial z = \partial\left(\frac{\partial\phi}{\partial z}\right)/\partial y^A$). Since leisure $q_0^I = T - \ell^I$ can also be considered as resulting from the maximization of the individual utility function v^I subject to an individual budget constraint (cf. equation (3.1)), the usual integrability conditions of symmetry and negativity of the associated Slutsky matrix have to be satisfied.¹⁵

The main result of Chiappori, Fortin and Lacroix (forthcoming) now is, that if all these conditions are satisfied, the sharing rule ϕ is identified up to an additive constant. It can be shown that individual consumptions of the Hicksian aggregate commodity c^A and c^B are also identified up to the same additive constant. Moreover, keeping in mind the sharing rule result, individual indirect utility functions can also be defined, for a given additive constant, via observable labour supply behaviour. As for the sharing rule, this implies that it will in general be impossible to predict that, say, 60% of total household nonlabour income will be allocated to individual A and 40% to individual B in a certain wage and nonlabour income regime. On the other hand, the given set-up allows statements like “a one percent increase of individual A ’s wage will change his share in nonlabour income by x percent”. These are important identification results, since next to a restriction on individual preferences, only Pareto efficiency of household behaviour is assumed. In particular, the collective approach allows to analyse the effects of policy reforms upon individual household members, both in terms of individual welfare and in terms of derived individual consumption. Note that such identification results will, in general, not exist in the unitary model. Consequently, with regard to normative welfare analyses, the collective model has a decisive advantage over the unitary one.

Chiappori, Fortin and Lacroix (forthcoming) tested the above collective household model on a sample of couples where both spouses have a positive labour supply. They considered the sex ratio, defined as the number of males over the number of males and females for several sociological groups, and variables capturing divorce legislation as distribution factors. The restrictions of the collective model could not be rejected on the base of their results. As for the sharing rule, they found a significant positive relationship between the sex ratio and the wife’s share in nonlabour income. Also the passing of divorce laws that are favourable to women significantly increases their share in nonlabour income.

3.2.2. Collective labour supply without observable distribution factors

In what follows, we will put more information constraints on available data. Contrary to the previous section, we will assume that only individual wages of both household members and *total* household nonlabour income are observed. This is the set-up assumed by Chiappori (1988a, 1992) in his initial contributions to the collective approach.

Under these assumptions, the general collective household model of equation (2.5) reduces to the following maximization problem:

$$\max_{c^A, c^B, q_0^A, q_0^B} \mu(\mathbf{w}, y^S) v^A(c^A, q_0^A) + [1 - \mu(\mathbf{w}, y^S)] v^B(c^B, q_0^B) \quad (3.5)$$

subject to

$$c^A + c^B + w^A q_0^A + w^B q_0^B \leq y^S + (w^A + w^B) T,$$

where y^S denotes observable total household nonlabour income. This maximization problem will result in a set of labour supply functions, with nonlabour income and wages as the only arguments. Given that egoistic (or caring) preferences are assumed, the individual labour supply can again be written as a function of the share in nonlabour income and the own wage rate.

The problem with this set-up without observable distribution factors, is that the simple derivation of the partials of the sharing rule ϕ , in terms of first-order derivatives of labour supply functions, is no longer possible. In Chiappori (1988a), a set of testable restrictions of the collective approach on observable labour supply is derived. These restrictions make use of second-order and third-order derivatives of observable labour supply. Consequently, results may be less robust than those derived in a context with observable distribution factors. If the restrictions are satisfied, the sharing rule ϕ and individual consumption of the Hicksian aggregate commodity c^A and c^B can be identified up to an additive constant. For a particular choice of this additive constant, the individual utility functions v^A and v^B are uniquely defined. Again, these results are driven by the sharing rule result that is applicable under egoistic and caring preferences. Chiappori (1988a) also derived some restrictions on observed labour supply under the general individual preferences $v^I(c^A, c^B, q_0^A, q_0^B)$ for $I = A, B$. It turned out that only nonparametric restrictions (i.e., conditions based on revealed preferences, see, e.g., Varian, 1982) could be derived with such preferences.

Restrictions of this collective labour supply model have been tested by Fortin and Lacroix (1997). While the restrictions of the unitary model (Slutsky symmetry and income pooling hypothesis) were strongly rejected, the implications of the collective model could not be rejected for a sample of households without pre-school children.

3.3. Consumption behaviour without price variation

In the former paragraphs, we concentrated on collective labour supply models in a cross-section context. There it was assumed that only labour supply information was captured by a given dataset. Consequently, information on consumption was restricted to the consumption of a Hicksian aggregate commodity. Now we will turn the tables. In many household budget surveys, detailed information is available on households' allocations of expenditures to different commodities. However, individual wages and labour supply are lacking in many cases.

The set-up of the current collective household model will therefore be as follows. Firstly, we will assume that labour supply is fixed. In other words, both household members work a fixed amount of hours (that may be zero), thus generating an exogenous income. This labour income may be augmented by individual and household nonlabour incomes. Secondly, as is usual in many household budget surveys, no relative price variation is observable. A third assumption is that individual preferences over consumption goods are of the egoistic or caring type. This again allows to make use of the sharing rule result to derive testable implications of this collective model and to provide some identification results. Fourthly, we will assume that there is at least one commodity of which individual demands are observable. Clothing would be a good example if one of the household members only wore men's clothing, while the other only women's clothing. Note that this commodity plays the same role in the current model as individual labour supplies in the collective labour supply models. Finally, it is assumed that there is at least one distribution factor observable.

These assumptions can be translated in a new maximization problem, which results in a Pareto efficient allocation of expenditures on private goods to individual demands. The general model (2.5) is now reduced to the following problem:

$$\max_{\mathbf{q}^A, \mathbf{q}^B} \mu(x, z) v^A(\mathbf{q}^A) + [1 - \mu(x, z)] v^B(\mathbf{q}^B), \quad (3.6)$$

subject to

$$\boldsymbol{\iota}'(\mathbf{q}^A + \mathbf{q}^B) \leq x,$$

where $\mathbf{q}^I = (q_1^I, \dots, q_n^I)'$, for $I = A, B$, is individual I 's consumption vector, $\boldsymbol{\iota}$ is a vector that contains a column of 1's, z is an observed distribution factor and x are total household expenditures. Note that, without losing generality, all commodity prices are set equal to one. Also note that the individuals' bargaining weights μ and $(1 - \mu)$ will in general depend on x , as the exogenous variable of the above maximization problem. Let us now assume that the individual demands for commodity 1, q_1^A and q_1^B , are observable. The maximization problem then results

in the following set of $n + 1$ observable Engel curves:

$$\begin{aligned} q_1^A &= g_1^A(x, z), \\ q_1^B &= g_1^B(x, z), \\ \tilde{\mathbf{q}} &= \tilde{\mathbf{g}}(x, z), \end{aligned} \tag{3.7}$$

where $\tilde{\mathbf{q}} = (q_2^A + q_2^B, \dots, q_n^A + q_n^B)'$ is the observed household demand on the consumption goods of which individual consumption cannot be distinguished. The equations of interest are those associated with q_1^A and q_1^B . Since individual preferences are assumed to be of the egoistic or caring type, we can again make use of the sharing rule result (see Bourguignon et alii, 1993 and Browning et alii, 1994). Denoting $\phi(x, z)$ and $x - \phi(x, z)$ as the respective shares in total household expenditures of individuals A and B , we can rewrite the Engel curves of observable individual consumption of commodity 1 as follows:

$$\begin{aligned} q_1^A &= f_1^A(\phi(x, z)), \\ q_1^B &= f_1^B(x - \phi(x, z)). \end{aligned} \tag{3.8}$$

Via the four partial derivatives of these equations, a set of two marginal rates of substitution of ϕ can be derived. By means of these marginal rates of substitution, the partial derivatives of the sharing rule can be obtained. This set of partial differential equations is integrable to the twice continuously differentiable sharing rule ϕ if the cross-equation restriction $\frac{\partial^2 \phi}{\partial x \partial z} = \frac{\partial^2 \phi}{\partial z \partial x}$ is satisfied, which is a testable restriction of the collective model.

In line with the results outlined in the former paragraph, this model allows for some identification results if the restrictions, implied by the collective approach, are satisfied. Firstly, the sharing rule can be identified up to an additive constant. Secondly, following the sharing rule identification, the individual shares in expenditures on private commodities are identifiable up to the same additive constant.

Browning et alii (1994) applied the above model to Canadian household budget data. Clothing was chosen as the commodity for which individual consumption (in this case men's and women's clothing) is observable. They could not reject the restrictions of the collective household model. Differences in ages and incomes of both household members, and total household expenditures had a highly significant impact on the sharing rule. Further results on the collective approach to household behaviour in a cross-section context can be found in Bourguignon, Browning and Chiappori (1994) and Dauphin and Fortin (2001).

3.4. Other applications of the collective approach

The above contributions to the collective approach, as defined by Chiappori (1988a), were primarily focused on the derivation of testable implications and identification results. The collective approach is gradually getting more and more refined. Moreover, many microeconomic models, based on the unitary approach, are translated in terms of collective household models. In this paragraph, a few examples are given of these refinements and new research tracks.

The analysis of household labour supply has been very rudimentary thus far. We assumed that wages were observable and fixed for both household members, which gave rise to simple linear budget constraints. In Blundell et alii (2001), a more realistic collective labour supply model is developed. It allows both nonparticipation and unobserved preference heterogeneity, which is common nowadays in unitary labour supply models (see Blundell and MaCurdy, 1999). Concretely, Blundell et alii (2001) consider the possibility of corner solutions in female employment and a discrete choice framework (working versus not working) for men with no variability in labour supply. Firstly, under the assumption of egoistic or caring preferences and some regularity conditions, they show that this collective household model leads to testable implications on observed household behaviour. In addition, individual preferences and the sharing rule can be recovered up to an additive constant. Secondly, they generalize the model in order to take account of preference heterogeneity and unobserved wages for nonparticipants in the labour market. For the case of linear labour supply functions and sharing rules, further identification results are derived. The model was applied to the UK Family Expenditure Survey, with a focus on married couples without children. The restrictions of the collective household model could not be rejected on the base of their results. In Donni (forthcoming), the collective labour supply model is extended with nonparticipation and nonlinear budget constraints (e.g., due to income taxation). Donni (2001) gives a collective labour supply model that allows for rationing. For both generalizations, testable implications and identification results are derived.

The household production theory provides an important reinterpretation of household behaviour. This approach assumes that households derive welfare from certain nonmarket goods that are produced within the household by means of goods bought in the market and leisure time (see, e.g., Deaton and Muellbauer, 1980). Apps and Rees (1996, 1997) make a plea for the introduction of household production in the collective approach, since its absence is not entirely innocuous if welfare issues are considered. In the models discussed above, all time not spent in labour supply is interpreted as leisure. However, it may be the case that some of this leisure time is an input in the household production process of nonmarket goods. In Chiappori (1997), some identification results are derived for

a collective household model that allows for household production. If the domestically produced commodity is marketable and preferences are egoistic or caring, then the collective approach implies some testable conditions on observed labour supply behaviour. In this set-up, the sharing rule can be identified up to an additive constant. In the case of a nonmarketable domestically produced good, more assumptions on the intrahousehold decision process are needed to identify the sharing rule.

In Bourguignon (1999), the collective consumption model of Browning et alii (1994) is extended to the case where children are considered as a public consumption good to the adult household members. This approach exploits certain ways of estimating the cost of children (see, e.g., Van Praag and Warnaar, 1997). If preferences are of the caring type, then the sharing rule can be identified up to a constant. Consequently, this allows for an analysis of how individual budgets (including what is spent on children) change if the household budget constraint changes. Contrary to other methods for estimating the cost of children, identification does not rely on the comparison of consumption behaviour across different demographic groups of households. The other side of the coin, however, is that the sharing rule is only identified up to a constant. This implies that the actual allocation of the household budget to the individual members cannot be recovered without additional assumptions.

Dercon and Krishnan (2000) link the collective household model to the literature on consumption smoothing and risk-sharing. This literature mainly focuses on the ability of the household to smooth consumption over time. In Dercon and Krishnan (2000), Ethiopian panel data are used to test whether individual household members keep consumption smooth over time. Apart from that, they investigate whether households do engage in risk-sharing. They show that, under uncertainty, the assumption of Pareto efficiency of household allocations requires income shock pooling. This implies that specific income shocks to individuals in the household are insured by the other members of the household. More specifically, if the household is a risk-sharing institution, then individual specific shocks should only have an effect on the household's allocation of consumption via the household budget constraint. A test of the collective household model under uncertainty then consists of testing for risk-sharing. Perhaps dissonant from earlier results in this text, Dercon and Krishnan (2000) rejected the risk sharing assumption. This, in turn, implies the absence of Pareto efficient household allocations.

4. Introducing extra bargaining axioms

Hitherto, we assumed only Pareto efficiency of intrahousehold allocations in the different collective household models. The boundary of the utility possibility

set, however, contains an infinity of Pareto efficient allocations (cf. equation (2.4)). If one is ready to adopt some more axioms, besides Pareto efficiency, more specific results on household behaviour can be obtained. This is exactly what has been done in early contributions to the approach of multiple decision-makers in a household. Manser and Brown (1980), e.g., derived empirical implications on demand for axiomatic bargaining solutions like the dictatorial, the Nash and the Kalai-Smorodinsky rules. McElroy and Horney (1981) proceeded with the Nash solution and derived a generalization of Slutsky symmetry.

The Nash solution, e.g., is obtained if the axiom of Pareto efficiency is supplemented by three other axioms: symmetry, independence of utility origins and units, and contraction independence (see Thomson, 1994). The axiom of symmetry implies that if household members are identical, then the gains from cooperation are divided equally. Independence of utility origins and units requires that the axiomatic bargaining solution is invariant to positive affine transformations of the utilities of the household members. More specifically, although the Nash solution is driven by cardinal information, there is no need for interpersonal comparability of utilities. Finally, the axiom of contraction independence implies that if an allocation is the bargaining outcome for a given utility possibility set, then this allocation remains the bargaining outcome for a contracted utility possibility set that still includes this original allocation. Consequently, household behaviour that satisfies these axioms is derived from the following maximization problem (in the notation of equation (2.5)):

$$\max_{\mathbf{q}^A, \mathbf{q}^B, q_0^A, q_0^B, \mathbf{Q}} \left[v^A \left(\mathbf{q}^A, \mathbf{q}^B, q_0^A, q_0^B, \mathbf{Q} \right) - \tilde{v}^A \right] \left[v^B \left(\mathbf{q}^A, \mathbf{q}^B, q_0^A, q_0^B, \mathbf{Q} \right) - \tilde{v}^B \right] \quad (4.1)$$

subject to

$$\mathbf{p}'\mathbf{q} + w^A q_0^A + w^B q_0^B \leq y^S + (w^A + w^B) T,$$

where \tilde{v}^I ($I = A, B$) is individual I 's threat point or disagreement point. This is the outcome that results if no collective agreement is reached. The Nash solution is thus the outcome that maximizes the product of the gains to cooperation under the household budget constraint.

A few remarks need discussing. Firstly, in order to be able to apply Nash bargaining (or several other bargaining rules), the threat points have to be properly defined. The problem is that it is not very clear which disagreement points should be chosen. Are the utility levels associated with non-cooperative household behaviour appropriate, or should one choose the utility levels when divorced (living alone)? The first approach was followed by, e.g., Lundberg and Pollak (1993), Konrad and Lommerud (2000), and Chen and Woolley (2001), while the second is advocated by McElroy (1990). Even if one agrees on which threat points are to be

chosen, not all problems have been solved. McElroy (1990) and McElroy and Horney (1990), propose to estimate the threat points by means of consumption and labour supply data on individuals who are divorced. Consumption and labour supply data on multi-person households is then to be completed with the estimated threat points. However, this approach requires the independent estimation of both preferences of individuals living alone and preferences of individuals living in a multi-person household. Since the Nash bargaining solution requires a cardinal representation of preferences, estimation of the above model from independent data appears impossible (Chiappori, 1988b, 1991).

A second remark on the use of a particular bargaining rule is the following. As shown by McElroy and Horney (1981), household behaviour that is assumed to be the result of Nash bargaining, should satisfy some theoretical restrictions. If these are empirically rejected, however, it is impossible to attribute this failure to the collective setting as such or to the particular bargaining concept chosen (see Chiappori, 1988a). Therefore, Chiappori (1988a) pleads in favour of a minimum of assumptions on the intrahousehold decision process. Since most bargaining solutions lead to a Pareto efficient outcome, the axiom of Pareto efficiency can be defended as the (sole) starting-point of an analysis of intrahousehold decision-making. This is exactly what is done in the models described in the former sections. Moreover, if only the total household consumption bundle $\mathbf{q} = \mathbf{q}^A + \mathbf{q}^B + \mathbf{Q}$ (or alternatively, total consumption on a Hicksian aggregate commodity) is observable, then the Nash bargaining rule is unable to empirically identify the whole intrahousehold allocation process. Note that this is the case even if the threat points can be adequately estimated and preferences are egoistic or caring. The question remains as to whether the assumption of Nash bargaining fleshes out the collective approach in this context.

To conclude the section, it is useful to stress the importance of the fundamental insight made explicit in bargaining rules. In a simple unitary model, prices and income are the only explanatory variables. The bargaining approach now extends the set of explanatory variables in a very useful way. Every variable that can be expected to affect the threat points of the individuals can be taken up in the analysis. This idea is captured by the concept of distribution factors in the collective household model (cf. *supra*). These variables also affect the bargaining power of individuals, which has consequences on the chosen Pareto efficient allocation.

5. A browse through some non-cooperative household models

One class of household models that explicitly takes account of multiple decision-makers, is based on non-cooperative game theory. In these non-cooperative mod-

els, it is assumed that household members maximize their utility, subject to an individual budget constraint and taking the other individual's behaviour as given. A distinguishing characteristic with respect to the models described above, is that they do not necessarily result in Pareto efficient intrahousehold allocations. This depends on the assumptions made with regard to how individuals in the household are interdependent (e.g., via public goods).

Seminal papers on the non-cooperative approach are Leuthold (1968) and Ashworth and Ulph (1981). In these labour supply models, individuals allocate their full income to own leisure and a Hicksian consumption good, which is assumed to be a public good. The model of Ashworth and Ulph (1981) also allows for external effects with regard to the other individual's leisure. It can be shown that both models imply other behavioural restrictions than the standard unitary model. What is important for these models, is that they do not imply Pareto efficient intrahousehold allocations (see, e.g., Kooreman and Kapteyn, 1990 and Konrad and Lommerud, 1995).

This is also made clear in non-cooperative consumption models. Examples are Chen and Woolley (2001) and Browning and Lechene (2001). Household consumption behaviour is modelled here as a voluntary contributions game with public goods. In other words, each household member allocates an individual budget to private consumption and to a contribution for household public goods. The contribution of the other individual is taken as given. In general, these models obtain inefficient intrahousehold allocations. All household members would be better off if they would simultaneously increase their contribution for public goods. This result parallels standard results in welfare economic models focusing on the private provision of public goods (see, e.g., Myles, 1995). It is perhaps interesting to note that other remarkable results of welfare economic models are transferred to these non-cooperative consumption models. With regard to the empirical testing of the income pooling hypothesis (cf. *supra*), it is important that the intrahousehold income distribution does not always have an effect on the allocation of consumption within the household. A similar result is obtained in models that analyse the private provision of public goods in economies with several households. The total provision of the public good can be shown to be independent of the income distribution when certain conditions are satisfied (see, e.g., Warr, 1983 and Bergstrom et alii, 1986). Another invariance result with respect to the income distribution within the household occurs when preferences are of the Beckerian caring type, with public goods as an argument in the subutility functions (cf. *supra*). Here it can be shown that small income distributions at the extremes of the intrahousehold income distribution do not have any effect on the intrahousehold allocation. This result is a version of Becker's (1974b) rotten kid theorem. This states that if the high income household member cares enough

about the other individual that transfers are made to the latter, then small redistributions of income do not affect the consumption of the household members (see Bergstrom, 1989).

Although Pareto inefficient allocations are a characteristic of many non-cooperative household models, this is not always the case. Browning (2000), for example, analyses saving behaviour and portfolio choice of non-cooperative households. Household members derive utility from the current and future consumption of a household public good. The Nash equilibrium in this model can be shown to be Pareto efficient. The reason for this result is that all consumption is public. As soon as private consumption or leisure are taken up in the analysis, inefficient outcomes once again become possible.

6. Conclusion: is the game worth the candle?

The collective approach to household behaviour seems to be a valuable alternative to the unitary model. In the unitary model, it is assumed that households behave as if they were single decision-making units. Contrary to this, the collective approach explicitly takes account of the fact that multi-person households consist of several members who may have different preferences. An intrahousehold bargaining process is assumed to take place among these household members. This bargaining process can take many forms. The collective model, as defined by Chiappori (1988a), only assumes that the bargaining within a household results in Pareto efficient allocations of household resources.

The collective approach has some important advantages over the unitary model. Since the former assigns individual preferences to the different household members, it meets the principle of methodological individualism. Although this Popperian principle is essentially normative in nature, it can be argued to be a fertile starting point for social theories.

Perhaps more important than the compatibility with methodological individualism, is the fact that the collective approach does not subject observable household behaviour to the empirical strait-jacket of the unitary model. This does not imply, however, that any observable household behaviour can be considered as coming from a collective model. The assumption of Pareto efficiency of household decisions engenders testable, and thus rejectable, restrictions on observed household allocations. These restrictions are weaker than the theoretical implications of the unitary model, which is nested in the collective model. Since the same behaviour is explained by means of fewer hypotheses, the principle of Ockham's razor would favour the collective model as opposed to the unitary one.

A third advantage of the collective approach is that it is able to say more on the *intra*household distribution of resources. This is entirely missing in the unitary

model, which can only provide the base for models focusing on *inter*household inequality.

The collective approach comes at a cost, however. It is well-known that preferences can be recovered by means of observable demand and labour supply, if the latter satisfy the theoretical restrictions of the unitary model. This is an important result for welfare economic issues. In general, the collective approach does not allow such a strong identification result for individual preferences and the intrahousehold decision process. Nonetheless, a great deal of this process and of individual preferences can be identified by means of a collective model and some additional weak assumptions. This allows for an evaluation of the *changes* in the household members' shares of total resources coming from changes in the economic environment. Relative shares of the initial situation, on the other hand, cannot be identified.

It should be clear, however, that one must not throw out the baby with the bath-water. It can be argued that an evaluation of policy reforms is primarily interested in the change of a welfare measure, rather than in the welfare level itself. The possibility of stating that a certain policy proposal will increase the resources going to women or children in households by x dollar, or euro, provides the collective approach with a comparative advantage that should not be underestimated. Therefore, it should be clear that the answer to the question in the title of this section is unambiguously *yes*.

Acknowledgements

I would like to thank the Editor and an anonymous referee for useful suggestions. I am also grateful to Bart Capéau, André Decoster, Stefan Dercon and Erwin Ooghe for valuable comments. Olivier Donni and Bernard Fortin are thanked for pointing out some papers I had not previously seen. All remaining errors are mine of course. Financial support of this research by the research fund of the Katholieke Universiteit Leuven (project OT 98/03) is gratefully acknowledged.

Notes

1. This hypothesis may also find some support in the sociological literature on money management in households. Pahl (1989), e.g., distinguishes between four patterns of money management. One of these types is the so-called 'whole wage system', where one partner is responsible for almost all household expenditures. That partner, usually the wife, solely allocates the means of the household, taking into account the needs of all household members.

This system was widespread until the beginning of the twentieth century, especially in the labour class.

2. Perhaps this can be viewed as a (small) concession to the “hardy souls [who] will pursue the will-o’-the-wisp of sovereignty within the family so as to reduce even these collective indifference curves to an individualistic basis” (Samuelson, 1947, p. 224).
3. *Rational preferences* are defined as a preference ordering that is both complete and transitive. *Completeness* says that the consumer has a well-defined preference between any two bundles in the consumption and leisure set. *Transitivity* (or consistency) excludes cyclical preferences in sequences of pairwise choices between bundles.
4. Note that $\frac{\partial \mathbf{g}}{\partial \mathbf{p}^I}$ denotes the matrix of effects on demand due to a marginal change in the prices, with *full* income $(y^S + w^A T + w^B T)$ kept constant. Of course, for price changes of the consumption goods \mathbf{q} there is nothing new under the sun. As regards marginal changes in the wage rates, however, one should remember that this induces, apart from the usual price and income effects, an additional income effect coming from a change in full income. That is, $\frac{\partial \mathbf{g}}{\partial w^I} = \frac{\partial \mathbf{g}}{\partial w^I} \Big|_{y^S} - T \frac{\partial \mathbf{g}}{\partial (y^S + w^A T + w^B T)}$, $I = A, B$.
5. To see this, note that the Lagrangian function of the maximization problem (2.4) equals: $v^A(\mathbf{q}^A, \mathbf{q}^B, q_0^A, q_0^B, \mathbf{Q}) + \delta [v^B(\mathbf{q}^A, \mathbf{q}^B, q_0^A, q_0^B, \mathbf{Q}) - \bar{u}^B] + \lambda [y^S + (w^A + w^B)T - \mathbf{p}'\mathbf{q} - w^A q_0^A - w^B q_0^B]$. Multiplying this Lagrangian function by $\frac{1}{1+\delta}$, results in $\mu v^A(\mathbf{q}^A, \mathbf{q}^B, q_0^A, q_0^B, \mathbf{Q}) + (1 - \mu) v^B(\mathbf{q}^A, \mathbf{q}^B, q_0^A, q_0^B, \mathbf{Q}) + \rho [y^S + (w^A + w^B)T - \mathbf{p}'\mathbf{q} - w^A q_0^A - w^B q_0^B]$ where $\mu = \frac{1}{1+\delta}$ and $\rho = \frac{\lambda}{1+\delta}$ and where the unimportant constant \bar{u}^B for the maximization problem has been eliminated.
6. Take, for example, the Stone-Geary utility function, which gives rise to the linear expenditure system, in a consumption context (allocation of budget x to commodities \mathbf{q} , given prices \mathbf{p}) and without referring to collective household models. Let us assume that for one reason or another (e.g., presence of ‘snob’ or Veblen goods), prices and expenditures affect preferences as follows: $u = \sum_i (\beta_{0i} + \beta_{1i} p_i + \beta_{1i} x) \ln(q_i - \gamma_i)$, where the β ’s and the γ ’s are parameters subject to the usual restrictions. Deriving demand and the ‘Slutsky effects’ by means of observable demand will show that $s_{ij} = \frac{\partial q_i}{\partial p_j} + \frac{\partial q_i}{\partial x} q_j \neq \frac{\partial q_i}{\partial p_i} + \frac{\partial q_i}{\partial x} q_i = s_{ji}$.

7. Latent separability is a generalization of weak separability, which allows some goods to enter in more than one commodity group.
8. E.g., it may be assumed that only relative nonlabour incomes affect the bargaining power of the individuals. The single distribution factor z would then equal $\frac{y^A}{y^B}$. Remark that this implies an extra effect on the function μ , in comparison with the previous paragraph. There, a marginal change in, say, y^A only affected μ via the full household income: $\frac{\partial \mu}{\partial y^A} = \frac{\partial \mu}{\partial (y^S + w^A T + w^B T)}$. Now we have $\frac{\partial \mu}{\partial y^A} = \frac{\partial \mu}{\partial (y^S + w^A T + w^B T)} + \frac{\partial \mu}{\partial y^A} \Big|_{y^S}$.
9. This is easily seen if one derives the first-order conditions and marginal substitution rates between commodities of this allocation problem and compares them with those obtained from the maximization problem (2.5).
10. As regards the applicability of this result to caring preferences, it is perhaps worthwhile to note that the externalities embodied in this kind of preferences are Pareto irrelevant, in the sense that a competitive equilibrium remains Pareto efficient in the presence of externalities (see Parks, 1991). Also note that we did not take into account public consumption to state the alternative interpretation of the collective household model. A comparable result can be derived by means of individual utility functions with public consumption as an argument. The first stage of the two-stage budgeting process then amounts to the allocation of full income to expenditures on public goods and to the individuals' shares of full income. In the second stage, both household members allocate their share to own consumption and leisure, conditionally on public consumption (or unconditionally if public consumption is weakly separable from private consumption).
11. Frequently, one implicitly appeals to Hicks' composite commodity theorem, if one applies the unitary model. As already mentioned, in many budget surveys, one cannot distinguish the final consumer of, say, bread or soft drinks. Since it can be assumed that both individuals buy these commodities at the same prices, Hicksian aggregate commodities can be composed. A new preference ordering can then be defined on these Hicksian aggregates (in this case, household expenditures on the different commodities).
12. The same results can be obtained with caring preferences. To save on notation, however, we have opted for an analysis under egoistic preferences. Also note that we will not focus on public goods. This does not change the main results.
13. Note that this is a slight generalization of the results of Chiappori, Fortin and Lacroix (forthcoming), who assume that only total household nonlabour

income y^S is observable. We have opted for the generalization to keep notation as close as possible to that of previous results. In the next paragraph, we will also assume that only y^S is observed.

14. To give an example: $\frac{\frac{\partial \ell^A}{\partial w^B}}{\frac{\partial \ell^A}{\partial y^A}} = \frac{\frac{\partial \phi}{\partial w^B}}{\frac{\partial \phi}{\partial y^A}}$.
15. In the given set-up, with only two commodities as arguments in the individual utility functions and one of the prices set equal to one, a negative effect of a compensated change in w^I on leisure q_0^I is all that is required.

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