INTRA-HOUSEHOLD WELFARE

By

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Abstract

In this paper we develop an approach to measuring inequality and poverty that recognizes the fact that individuals within households may have both different preferences and differential access to resources. We argue that a measure based on estimates of the sharing rule is inadequate as an approach that seeks to understand how welfare is distributed in the population because it ignores public good and the allocation of time to market work, leisure and household production. We develop a money metric measure of welfare that accounts for public goods (by using personalized prices) household production and for the allocation of time.

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1 Introduction: individual and household welfare

When dealing with households, the applied welfare literature is faced with an interesting conundrum. On the one hand, what we are (or should be) ultimately interested in is individual welfare. 'Household welfare', if this notion has any sense, cannot be defined without considering the welfare of each member. On the other hand, most empirical measures of welfare stop at the household level. That could have been acceptable if the two approaches were equivalent - say, if there existed a stable, monotonic, one-to-one relationship between household welfare, as measured by the standard approaches, and the welfare of each individual composing the household, so that any reform improving total welfare would automatically improve that of each member in similar proportion. However, everything we know about household behavior strongly suggests that such an assumption would be plain wrong. From a theoretical perspective, it would imply that 'power' is either distributed across household members in a totally inflexible manner, regardless of individual situations, or is irrelevant to intrahousehold allocation of welfare. While both arguments can be found in the literature (the first is reminiscent of Samuelson's household welfare index, whereas the second relates to Becker's rotten kid theorem), advances in family economics over the last two decades have essentially been build upon the opposite view - i.e., that intrahousehold allocation of power is crucial for individual welfare, and responds to changes in the environment. From an empirical perspective, moreover, the verdict is clear. Income pooling - a central prediction of the previous approaches - has been systematically rejected; there is ample evidence that reforms which alter the balance of power within the household (e.g., by paying a benefit to the wife instead of the husband) do impact household behavior and individual well-being.

Analyzing welfare at the intrahousehold level, however, raises a host of specific problems. An obvious difficulty is observability. While many data sets report aggregate consumption at the household level, individual consumptions are typically not recorded, at least for most commodities; they have to be recovered. But conceptual problems at least as challenging. A large fraction of household expenditures relate to public commodities - i.e., goods that are jointly consumed by the household, without anyone being excluded; moreover, in many cases these public commodities are internally produced within the household. Spouses may have different preferences regarding public goods; therefore, the fraction of household expenditures devoted to public consumption has a potentially important (and differentiated) impact on individual welfare that cannot be ignored. Similar questions arise for intrahousehold production, with the additional twist that time spent by each spouse should also be taken into account. How should such public productions and consumptions be considered? Can one define a money-metric measure of individual welfare that accounts for the public nature of several consumption goods (and their potentially differentiated impact of the welfare of each individual)? And when would such a measure be empirically identifiable from standard data on household behavior?

The aim of the present article is to provide a new answer to these questions. Obviously, this task first requires an explicit model of household decision making that recognizes the existence of (potentially different) individual preferences and clarifies the notion of 'power' within the household. Furthermore, these goals should be achieved in an empirically tractable way. An acceptable approach must fulfill a double requirement: testability (i.e., it should generate a set of empirically testable restrictions that fully characterize the model, in the sense that any given behavior is compatible with the model if and only if these conditions are satisfied) and identifiability (it should be feasible, possibly under additional assumption, to recover the structure of the model – in our case, individual preferences and welfare) from the sole observation of household behavior. The main candidate, in this respect, is the collective approach.[1] While other (non-unitary) perspectives have been adopted in the literature, none of the alternatives has (so far) convincingly addressed the double requirement of testability and identifiability just evoked.

The basic axiom of the collective approach is Pareto efficiency: whatever decision the household is making, no alternative choice would have been preferred by all members. While this assumption is undoubtedly restrictive, its scope remains quite large. It encompasses as particular cases many models that have been proposed in the literature, including:

- 'unitary' models, which posit that the household behaves like a single decision maker; this includes simple dictatorship (possibly by a 'benevolent patriarch', as in Becker, 1974) to the existence of some household welfare function (as in Samuelson 1956),
- models based on cooperative game theory, and particularly bargaining theory (at least in a context of symmetric information), as pioneered by Manser and Brown (1980) and McElroy and Horney (1981),

[1] For a more detailed presentation, the reader is referred to Browning, Chiappori and Weiss (2013)

- model based on market equilibrium, as analyzed by Grossbard-Shechtman (1993), Gersbach and Haller (2001), Edlund, and Korn (2002) and others.
- more specific models, such as Lundberg and Pollak's 'separate spheres' framework.[2]

Over the last decades, the collective model has been fully characterized. We now have a set of necessary and sufficient conditions for a demand function to stem from a collective framework (Chiappori, Ekeland 2006); and exclusion restrictions have been derived under which individual preferences and the decision process (as summarized by the Pareto weights) can be recovered from the sole observation of household behavior (Chiappori, Ekeland 2009a). To the best of our knowledge, this is the only model of the household for which such results have been derived.[3]

The next section describes the basic model. We then discuss the conceptual issues linked with intrahousehold inequality, first in the case where all commodities are privately consumed, then in the presence of public goods. In the following section, we consider extensions of the model to encompass individual-specific prices and domestic production. Finally, we discuss issues related to identification.

[2] On the other hand, the collective framework excludes models based on non cooperative game theory (at least in the presence of public good), such as those considered by Ulph (2006), Lechene and Preston (2009), Browning, Chiappori and Lechene (2009) and many others, as well as models of inefficient bargaining a la Basu (2006).

[3] Browning, Chiappori and Lechene (2009) and Lechene and Preston (2009) provide a set of necessary conditions for non cooperative models. However, whether these conditions are sufficient is not known; moreover, no general identification result has been derived so far.

2 Concepts, definitions, axioms

In what follows, we consider a K-person household that can consume several commodities; these include standard consumption goods and services, but also leisure, future or contingent goods, etc. Formally, N of these commodities are publicly consumed within the houshold. The market purchase of public good j is denoted Q_j; the N-vector of public goods is given by Q. Similarly, private goods are denoted q_i with the n-vector q. Each private goods bought is divided between the members so that member a $(a = 1, ..., K)$ receives q_i^a of good i, with $\sum_a q_i^a = q_i$. The vector of private goods that a receives is q^a, with $\sum_a q^a = q$. An allocation is a $N + Kn$-vector $\left(Q, q^1, ..., q^K\right)$. The associated market prices are given by the N-vector P and the n-vector p for public and private goods respectively.

We assume that each married person has her or his own preferences over the allocation of family resources. The most general version of the model would consider utilities of the form $U^a\left(Q, q^1, ..., q^K\right)$, implying that a is concerned directly with all members' consumptions. Here, however, tractability requires additional structure. In what follows, we therefore assume that preferences are of the caring type. That is, each individual a has a felicity function $u^a(Q, q^a)$; and a's utlity takes the form:

$$U^a\left(Q, q^1, ..., q^K\right) = W^a\left(u^1\left(Q, q^1\right), ..., u^K\left(Q, q^K\right)\right), \tag{1}$$

where $W^a(., .)$ is an increasing function. The weak separability of these 'social' preferences represents an important moral principle; a is indifferent between bundles $\left(q^b, Q\right)$ that b consumes whenever b is indifferent. In this sense caring is distinguished from paternalism. Caring rules out direct externalities between members because a's evaluation of her private consumption q^a does not depend directly on the private goods that b consumes.

Lastly, a particular but widely used version of caring is egotistic preferences, whereby members only care about their own (private and public) consumption; then individual preferences can be represented by felicities (i.e., utilities of the form $u^a(Q, q^a)$).[4] Note that such egotistic preferences for consumption do not exclude non economic aspects, such as love, companionship or others. That is, a person's utility may be affected by the presence of other persons, but not by their consumption. Technically, the 'true' preferences are of the form $F^a(u^a(Q, q^a))$, where F^a may depend on marital status and on the spouse's characteristics. Note that the F^as will typically play a crucial role in the decision to marry and in the choice of a partner. However, it is irrelevant for the characterization of individual preferences over consumption bundles.

Efficiency has a simple translation - namely, the household behaves as if it was maximizing a weighted sum of utilities of its members. Technically, the program is thus (assuming egotistic preferences):

$$\max_{(Q, q^1, \ldots, q^K)} \sum_a \mu^a u^a(Q, q^a) \tag{(P)}$$

under the budget constraint:

$$\sum_i P_i Q_i + \sum_j p_j \left(q_j^1 + \ldots + q_j^K\right) = y^1 + \ldots + y^K = y$$

where y^a denotes a's (non labor) income. Here, μ^a is the Pareto weight of member a; one may, for instance, adopt the normalization $\sum_a \mu^a = 1$. In the particular case where μ^a is constant, the program above describes a unitary model, since household behavior is described by the maximization of some

[4] Throughout the chapter, we assume, for convenience, that utility functions $U^s(.)$, $s = a, b$ are continuously differentiable and strictly quasi-concave.

(price independent) utility. In general, however, μ^a may vary with prices and individual incomes; the maximand in (P) is therefore price-dependent, and we are not in a unitary framework in general.

This program can readily be extended to caring preferences - one must simply replace $u^a(Q, q^a)$ with $W^a\left(u^1\left(Q, q^1\right), ..., u^K\left(Q, q^K\right)\right)$ in (P). In what follows, however, (P) plays a very special role, mostly because of the following result:

Proposition 1 *Assume that some allocation is Pareto-efficient for the caring utilities $W^1, ..., W^K$. Then it solves (P) for some $\left(\mu^1, ..., \mu^K\right)$.*

Proof. *Assume not, then there exists an alternative allocation that gives a larger value to u^a for all $a = 1, ..., K$. But then that allocation also gives a higher value to all W^as, a contradiction.* ■

In words: any allocation that is efficient for caring preferences must be efficient for the underlying, egotistic felicities. The converse is not true, because a very unequal solution to (P) may fail to be Pareto efficient for caring preferences: transfering resources from well endowed but caring individuals to poorly endowed ones may be Pareto improving. We conclude that any property of the solutions to a program of the form (P) must be satisfied by any Pareto-efficient allocation with caring preferences.

A major advantage of the formulation (P) is that the Pareto weights have a natural interpretation in terms of respective decision powers. The notion of 'power' in households may be difficult to define formally, even in a simplified framework like ours. Still, it seems natural to expect that when two people bargain, a person's gain increases with the person's power. This somewhat hazy notion is captured very effectively by the Pareto weights. Clearly, if μ^a in (P) is zero then a has no say on the final allocation, while if μ^a is large (close to 1 in our normalization) then a effectively gets her way. A key property of

(P) is precisely that increasing μ will result in a move along the Pareto set, in the direction of higher utility for a. If we restrict ourselves to economic considerations, we may thus consider that the Pareto weight μ^a 'reflects' a's power, in the sense that a larger μ^a corresponds to more power (and better outcomes) being enjoyed by a.

If $\left(\bar{Q}(p,P,y), \bar{q}^1(p,P,y), ..., \bar{q}^K(p,P,y)\right)$ denotes the solution to (P), we define the collective indirect utlity of a as the utility reached by a at the end of the decision process; formally:

$$V^a(p,P,y) = u^a\left(\bar{Q}(p,P,y), \bar{q}^a(p,P,y)\right)$$

Note that, unlike the unitary setting, in the collective framework a member's collective indirect utility depends not only on the member's preferences but also on the decision process (hence the adjective 'collective'). This notion is crucial for welfare analysis, as we shall see below.

Finally, an important concept is the notion of distribution factors. A distribution factor is any variable that (i) does not affect preferences or the budget constraint, but (ii) may influence the decision process, therefore the Pareto weights. Think, for instance, of a bargaining model in which the agents' respective threat points may vary. A change in the threat point of one member will typically influence the outcome of the bargaining process, even if the household's budget constraint is unaffected. In particular, several works use individual (non labor) incomes as distribution factors. If $\left(y^1, ..., y^K\right)$ is the vector of individual incomes and $y = \sum_a y^a$, while total income y is not a distribution factor (it enters the budget constraints), the $(K-1)$ ratios $y^1/y, ..., y^{K-1}/y$ are.[5]

[5] In practice, distribution factors must be *uncorrelated* with preferences, which, in the case of individual incomes, can generate subtle exogeneity problems. See Browning, Chiappori and

In what follows, the vector of distribution factors will be denoted $z = (z_1, ..., z_S)$; Pareto weights and collective indirect utilities, therefore, have the general form $\mu^a(p, P, y, z)$ and $V^a(p, P, y, z)$.

3 Intrahousehold welfare: basic issues

We now consider individual welfare issues. We first consider a special case in which all commodities are privately consumed, then move to the general case.

3.1 The case of private goods

When all commodities are privately consumed, the household can be considered as a small economy without externalities or public goods. From the second welfare theorem, any Pareto efficient allocation can be decentralized by adequate transfers. Formally, we have the following result:

Proposition 2 *Assume an allocation $\left(\bar{q}^1, ..., \bar{q}^K\right)$ is Pareto efficient. Then there exists K non-negative functions $\left(\rho^1, ..., \rho^K\right)$ of prices, total income and distribution factors, with $\sum_k \rho^k(p, y, z) = y$, such that agent a solves*

$$\max_{q^a} u^a(q^a) \tag{D}$$

under the budget constraint

$$\sum_{i=1}^{n} p_i q_i^a = \rho^a$$

Conversely, for any non-negative functions $\left(\rho^1, ..., \rho^K\right)$ such that $\sum_k \rho_k(p, y, z) = y$, an allocation that solves (D) for all a is Pareto-efficient.

In words: in a private goods setting, any efficient decision can be described as (or as if) a two-stage process. In the first stage, agents jointly decide on the

Weiss (2013) for a detailed discussion.

allocation of household aggregate income y between agents (and agent a gets ρ^a); in stage two, agents freely spend the share they have received. The decision process (bargaining, for instance) takes place in the first stage; its outcome is given by the functions $\left(\rho^1, ..., \rho^K\right)$, which are called the sharing rule of the household.

From a welfare perspective, the crucial point is that there exists a one-to-one, increasing corespondance between Pareto weights and the sharing rule, at least when the Pareto set is strictly convex. When prices and incomes are constant, increasing the weight of one individual (reducing the other weights proportionally in order to maintain the normalization) always results in a larger share for that individual and conversely. The collective, indirect utility of agent a takes a simple form, namely:

$$V^a\left(p, y\right) = v^a\left(p, \rho^a\left(p, y\right)\right)$$

where v^a is the standard, indirect utility of agent a. In particular, we have the following result:

Proposition 3 *When all commodities are privately consumed, then for any given price vector there exists a one-to-one correspondence between the sharing rule and the indirect utility*

This result has two consequences. First, given each person's preferences, the sharing rule is a sufficient statistic for the entire decision process. Indeed, since all agents face the same prices, the sharing rule fully summarizes intrahousehold allocation of resources. As such, it is directly relevant for intrahousehold inequality. Second, and more importantly for our present purpose, the sharing rule is a money metric measure of individual utility. For given prices, ρ^a is an increasing transform of the collective indirect utility of person a; moreover, and unlike V^a, it is measured in dollars.

3.2 Public and private commodities

Convenient as the previous notions may be, they still rely on a strong assumption - namely that all commodities are privately consumed. Relaxing this assumption is obviously necessary, if only because the existence of public consumption is one of the motives of household formation. We shall successively consider three possible extensions of the previous notion to the case of public goods.

3.2.1 Conditional sharing rule

A first generalization of the notion of sharing rule, the conditional sharing rule, is based on the following result:

Proposition 4 *Assume an allocation $\left(\bar{Q}, \bar{q}^1, ..., \bar{q}^K\right)$ is Pareto efficient. Then there exists K non-negative functions $\left(\tilde{\rho}^1, ..., \tilde{\rho}^K\right)$ of prices, total income and distribution factors, with $\sum_k \tilde{\rho}^k\left(p, P, y, z\right) = y - \sum_j P_j \bar{Q}_j$, such that for all a the vector of private consumptions $\bar{q}^a$ solves:*

$$\max_{q^a} u^a\left(\bar{Q}, q^a\right)$$

under the budget constraint

$$\sum_{i=1}^{n} p_i q_i^a = \rho^a$$

Proof. *Assume not, then there exists $\hat{q}^a$ such that $u^a\left(\bar{Q}, \hat{q}^a\right) > u^a\left(\bar{Q}, q^a\right)$ while $\sum_{i=1}^n p_i \hat{q}_i^a = \rho^a$. But then $\left(\bar{Q}, \bar{q}^1, ..., \hat{q}^a, ..., \bar{q}^K\right)$ is feasible and Pareto dominates $\left(\bar{Q}, \bar{q}^1, ..., \bar{q}^K\right)$, a contradiction.* ■

The function $\tilde{\rho} = \left(\tilde{\rho}^1, ..., \tilde{\rho}^K\right)$ constitute the conditional sharing rule of the household. The interpretation, again, is in terms of a two-stage process. In stage one, the household decides the consumption of public goods and the distribution of remaining income between members; in stage two, members all spend their alloted amount on private consumption, so as to maximize individual utility conditional on the level of public consumption decided in stage 1. The conditional indirect utility is thus:

$$\tilde{V}^a(p, Q, \rho) = \max_{q^a} \{u^a(Q, q^a) \quad \text{s.t.} \quad p.q^a = \rho\}$$

While the conditional sharing rule (CSR) is indeed a generalization of the sharing rule, three points must be noted. First, the existence of a conditional sharing rule is a necessary but not sufficient condition for efficiency; that is, for any given level of public consumption, it is in general the case that almost all conditional sharing rules lead to inefficient allocations. Specifically, a conditional sharing rule is compatible with efficiency if and only if the standard, Bowen-Lindahl-Samuelson conditions, which express the optimality of Q for these preferences, are satisfied:

$$\sum_a \frac{\partial \tilde{V}^a(p, Q, \rho^a) / \partial Q_j}{\partial \tilde{V}^a(p, Q, \rho^a) / \partial \rho^a} = P_j, \ j = 1, ..., N$$

Second, the monotonic relationship between sharing rule and Pareto weights is lost. In particular, increasing a's weight does not necessarily result in a larger value for ρ^a. The intuition, here, is that giving more weight to one agent may result in a different allocation of public expenditures, which may or may not result in an increase in the agent's private consumption. In that sense, the generalization is only partial.

Third, and more importantly for our purpose, the conditional sharing rule may give a biased estimate of intrahousehold welfare allocation, because it simply disregards public consumption. That this pattern could be problematic is easy to see. Assume that one spouse (say the wife) cares a lot for a public good, while her husband cares very little. If the structure of household demand entails a significant fraction of expenditures being devoted to that public good, one can expect this pattern to have an impact on any welfare measure within the household. Disregarding public consumption altogether is therefore not an adequate approach.

3.2.2 Public goods and Lindahl prices

An alternative approach to public consumption relies on the notion of Lindahl prices. An old result in public economics states that, in the presence of public goods, Pareto efficient allocations can be decentralized using personal prices that add up to the market price of the commodity. Formally, we have the following result:

Proposition 5 *Assume an allocation* $\left(\bar{Q}, \bar{q}^1, ..., \bar{q}^K\right)$ *is Pareto efficient. Then there exists* K *non-negative functions* $\left(\rho^{*1}, ..., \rho^{*K}\right)$*, with* $\sum_k \rho^{*k} = y$*, and* N *non-negative functions* $\left(P_j^a\right), a = 1, ..., K, j = 1, ..., N$ *(where* P^a *is a's vector of personal prices), with* $\sum_a P_j^a = P_j$ *for all* j*, such that for all* a *the vector* $\left(\bar{Q}, \bar{q}^a\right)$ *solves:*

$$\max_{q^a} u^a\left(Q, q^a\right) \tag{DP}$$

under the budget constraint

$$\sum_{i=1}^{n} p_i q_i^a + \sum_{j=1}^{N} P_j^a Q_j^a = \rho^{*a}$$

Conversely, for any non-negative functions $\left(\rho^1, ..., \rho^K\right)$ *such that* $\sum_a \rho^a = y$ *and* $\left(P_j^a\right)$ *such that* $\sum_a P_j^a = P_j$ *for all* j*, an allocation that solves (DP) for all* a *is Pareto-efficient.*

The vector $\rho^* = \left(\rho^{*1}, ..., \rho^{*K}\right)$ defines a generalized sharing rule (GSR). From an inequality perspective, this notion raises interesting issues. One could choose to adopt ρ^* as a description of intrahousehold welfare allocation; indeed, agents now maximize utility under a budget constraint in which ρ^* describes available income. In particular, ρ^* is a much better indicator of the distribution of resources than the conditional sharing rule $\tilde{\rho}$, because it takes into account both private and public consumptions.

However, the welfare of agent a is not fully described by ρ^{*a}; one also needs to know the vector P^a of a's personal prices. Technically, the collective indirect utility of a is:

$$V^a(p, P, y, z) = v^a(p, P^a, \rho^{*a}(p, P, y, z))$$

which depends on both ρ^{*a} and P^a. This implies that the sole knowledge of the GSR is not sufficient to recover the welfare level reached by a given agent, even if her preferences are known; indeed, one also needs to know the prices, which depend on all preferences.

In particular, welfare within the household cannot be analyzed from the sole knowledge of the generalized sharing rule. Agents now face different personal prices, and this should be taken into account. Of course, this conclusion was expected; it simply reflects a basic but crucial insight - namely that if agents 'care differently' about the public goods (as indicated by personal prices, which reflect individual marginal willingnesses to pay), then variations in the quantity of these public goods have an impact on intrahousehold inequality.

3.2.3 The Money Metric Welfare Index

This leads us to the basic concept of Money Metric Welfare Index (MMWI) of agent a. Formally:

Definition 6 *The Money Metric Welfare Index (MMWI) of agent a, $m^a(p, P, y, z)$,* *is defined by:*

$$v^a\left(p,P,m^a\left(p,P,y,z\right)\right)=V^a\left(p,P,y,z\right) \tag{2}$$

Equivalently, if c^a *denotes the expenditure function of agent* a*,then:*

$$m^a\left(p,P,y,z\right)=c^a\left(p,P,V^a\left(p,P,y,z\right)\right) \tag{3}$$

In words, m^a is the monetary amount that agent a would need to reach the utility level $V^a\left(p,P,y\right)$, if she was to pay the full price of each public good (i.e., if she faced the price vector P instead of the personalized prices P^a). The basic intuition is simple enough. The index is defined as the monetary amount that would be needed to reach the same utility level, at some reference prices; a natural benchmark is to use the current market price for all goods, private and public. Unlike the GSR, the Money Metric Welfare Index fully characterizes the utility level reached by the agent. That is, knowing an agent's preferences, there is a one-to-one relationship between her utility and her MMWI, and this relationship does not depend on the partner's characteristics.

Three remarks can be made at this point. First, in the absence of public goods, the MMWI coincides with the sharing rule. In other words, the MMWI is a fully general measure of individual welfare, which coincides with the natural concept (i.e. the sharing rule) in the (largely explored) case of private consumptions, and extends it to allow for public expenditures within the household.

A second remark is that in the presence of public goods, the MMWI depends on the price vector for public goods used as a reference. While using the market price as a benchmark is a natural solution, it is by no means the only one. Even more striking is the fact that even the direction of intrahousehold inequality may be affected by this choice; i.e., one can easily construct examples in which the MMWI of member A is larger than B's for some prices but smaller for others

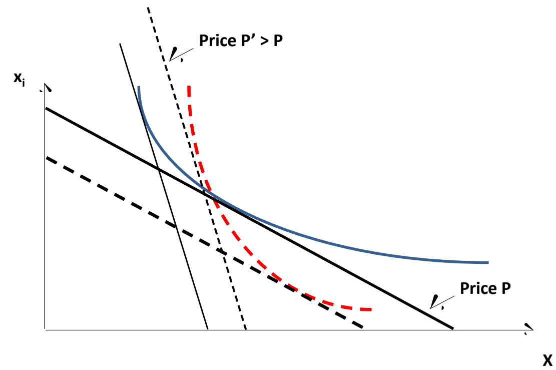

Figure 1: Fig 1: MMWIs for different reference prices

(see Figure 1).[6]

Lastly, there is a direct relationship between the MMWI and the standard notion of *equivalent income*.[7] Both approaches rely on the notion that refering to a common price vector can facilitate interpersonal comparisons of welfare. However, to the best of our knowledge, equivalent income has exclusively be applied so far to private goods. Our point, here, is that using the concept of Lindahl prices allows to extend it to the case of public comsumption, thus providing a natural solution to a recurrent and somewhat difficult problem.

3.3 An example

The previous concepts can be illustrated on a very simple example. Assume two agents a and b, two commodities - one private q, one public Q - and Cobb-

[6] We thanks Frederic Vermeulen for suggesting this example.

[7] See f.i. Fleurbaey (forthcoming) for a recent survey.

Douglas preferences:

$$\begin{aligned} u^a &= \frac{1}{1+\alpha}\log q^a + \frac{\alpha}{1+\alpha}\log Q \\ u^b &= \frac{1}{1+\beta}\log q^b + \frac{\beta}{1+\beta}\log Q \end{aligned}$$

corresponding to the indirect utilities:

$$\begin{aligned} v^a &= \log y - \frac{\alpha}{1+\alpha}\log P - \log(1+\alpha) + \frac{\alpha}{1+\alpha}\log\alpha \\ v^b &= \log y - \frac{\beta}{1+\beta}\log P - \log(1+\beta) + \frac{\beta}{1+\beta}\log\beta \end{aligned}$$

Let μ be b's Pareto weight; then the couple's consumption is given by:

$$\begin{aligned} q^a &= \frac{1}{(1+\alpha)(1+\mu)}y, q^b = \frac{\mu}{(1+\beta)(1+\mu)}y \\ \text{and } Q &= \frac{\alpha(1+\beta)+\mu\beta(1+\alpha)}{(1+\alpha)(1+\beta)(1+\mu)}\frac{y}{P} \end{aligned}$$

generating utilities equal to:

$$\begin{aligned} V^a &= \log y - \frac{\alpha}{1+\alpha}\log P - \log((1+\alpha)(1+\mu)) + \frac{\alpha}{1+\alpha}\log\left(\frac{\alpha(1+\beta)+\mu\beta(1+\alpha)}{1+\beta}\right) \\ V^b &= \log y - \frac{\beta}{1+\beta}\log P - \log(1+\beta)(1+\mu) + \frac{1}{1+\beta}\log\mu + \frac{\beta}{1+\beta}\log\left(\frac{\alpha(1+\beta)+\mu\beta(1+\alpha)}{1+\alpha}\right) \end{aligned}$$

In this context, straightforward calculations allow to see that:

1. The conditional sharing rule coincides with private consumption:

$$\tilde{\rho}^a = \frac{1}{(1+\alpha)(1+\mu)}y, \tilde{\rho}^b = \frac{\mu}{(1+\beta)(1+\mu)}y$$

2. Lindahl prices are

$$\begin{aligned} P^a &= \frac{\alpha(1+\beta)}{\alpha(1+\beta)+\mu\beta(1+\alpha)}P \\ P^b &= \frac{\mu\beta(1+\alpha)}{\alpha(1+\beta)+\mu\beta(1+\alpha)}P \end{aligned}$$

and the generalized sharing rule is

$$\rho^{*a} = \frac{y}{1+\mu}$$
$$\rho^{*b} = \frac{\mu y}{1+\mu}$$

3. The two MMWIs are given by:

$$m^a = \left(\frac{\alpha(1+\beta)+\mu\beta(1+\alpha)}{\alpha(1+\beta)}\right)^{\frac{\alpha}{1+\alpha}} \frac{y}{1+\mu} = \left(\frac{\alpha(1+\beta)+\mu\beta(1+\alpha)}{\alpha(1+\beta)}\right)^{\frac{\alpha}{1+\alpha}} \rho^{*a}$$
$$m^b = \left(\frac{\alpha(1+\beta)+\mu\beta(1+\alpha)}{\mu\beta(1+\alpha)}\right)^{\frac{\beta}{1+\beta}} \frac{\mu y}{1+\mu} = \left(\frac{\alpha(1+\beta)+\mu\beta(1+\alpha)}{\mu\beta(1+\alpha)}\right)^{\frac{\beta}{1+\beta}} \rho^{*b}$$

Assume, now, that $\mu = 1$ but agents have different preferences for the public good - say, $\alpha = 2$ while $\beta = .5$; and let us analyze intrahousehold welfare using three possible indicators.

1. If we concentrate on private consumption, we find that

$$\tilde{\rho}^a = \frac{1}{6}y, \quad \tilde{\rho}^b = \frac{1}{3}y$$

   and we conclude that member b is much better off than a.

2. This conclusion is clearly unsatisfactory, because it disregards the fact that half the budget is spent on the public good, which benefits a more than b. Indeed, the GSR is

$$\rho^{*a} = \frac{y}{2} = \rho^{*b}$$

   and we conclude that for this indicator, the household is perfectly equal: the benefits of public expenditures exactly compensate differences in private consumptions.

3. The later conclusion is however too optimistic, since it omits the fact that a 'pays' twice as much for the public good than b does (here, $P^a = \frac{2}{3}P$

while $P^b = \frac{1}{3}P$). Taking this last aspect into account, the respective MMWIs are:

$$m^a = .655y, \quad m^b = .72y$$

Again, b is better off than a (although by much less than with the first measure). In addition, one may note that

$$m^a + m^b = 1.375y$$

Individual MMWIs add up to more than total income, reflecting the gain generated by the publicness of one commodity.

4 Extensions

We now consider a few extensions of the model

4.1 Private goods with individual-specific prices

Interesting issues arise when, within the same household, individuals face different prices for some good. A typical example is leisure: its (opportunity) price is the wage, which is individual-specific. The previous approach applies in that case as well. Specifically, consider a standard, collective model of labor supply with private consumption, as in Chiappori (1992). Individual utilities are of the form $u^a(q^a, L^a)$, where L denotes leisure and q is the consumption of some Hicksian aggregate good. Let w^a denote member a's wage, y the household's (total) non labor income, and define Y to be the household total (or potential) income:

$$Y = y + \sum_a w^a T$$

where T denotes total time available.

Efficiency, in this context, is equivalent to a two stage process, in which total income Y is split between members at the first stage (so that member a gets ρ^a, with $\sum_a \rho^a = Y$), and members each independently choose their consumption and leisure bundle in a second stage, by maximizing u^a under the budget constraint:

$$pq^a + w^a L^a = \rho^a$$

Here as above, a natural measure of individual welfare is provided by the sharing rule ρ^a. Unlike standard measures, which are based on consumption, the sharing rule also considers leisure, the value of which is, as usual, estimated at the person's current wage. This approach directly extends to non participation by one spouse (or both). If member a does not work, then his/her leisure equals total time available T, and is valued at its opportunity cost $w^a T$, where w^a is member a's potential wage. Clearly, the notion thus defined requires the (actual or potential) wage to be observable; for non working spouses, one may have to estimate a potential wage, as a function of observable characteristics (age, education,...) and correcting for possible selection biases.

While the practical implementation may raise specific difficulties, the conceptual background is largely straightforward. Welfare measures should be based on total consumption, which includes consumption of leisure; and if the opportunity cost of leisure differs across members, this should be reflected in the assessment. Note, however, that this logic may have surprising implications. Consider a couple in which husband and wife have identical levels of leisure and commodity consumption but different wages (say, his wage is higher). Then our criterion concludes that the intrahousehold allocation is unequal in the husband's favor, because, although the number of hours of leisure is the same, the value of his consumption of leisure is larger. This conclusion is, in a sense, unavoidable if one wants to consider a 'general' measure of consumption that also includes leisure. Aggregating various consumptions requires relative prices, and there is no compelling reason for not using market prices. But then the value of one hour of leisure equals the person's wage; there is little justification for departing from this benchmark.

It should however be noted that this approach may be seen as contradicting the notion of equivalent income - which would require using the same 'price' (here wage) as a common benchmark. The contradiction, however, is largely superficial. Using the same reference wage for the husband and the wife is needed only to the extent one considers male and female leisure as the same commodity (which happens to be priced differently depending on gender). While this assumption may sometimes be acceptable (say, if both spouses have exactly the same human capital and exert exactly the same task with the same productivity, so that the wage difference is exclusively due to gender discrimination), one would expect such cases to be the exception. Most of the time, husband and wife have different jobs, and there would be little rationale to imposing these jobs to be priced equally.

Finally, it is clear that the measure of welfare thus defined will be sensitive to the definition of leisure. This raises two specific problems. One is the choice of total available time T: a larger value of T inflates the evaluation of time spent on leisure, which increases total consumption of all members, but increases more that of higher wage individuals. Second, and more important, is the issue of domestic production. If, as seems natural, we include leisure in our assessment of total consumption, then the distinction between 'true' leisure and other uses of available time (including chores and other forms of household production) becomes crucial. This issue is considered below.

4.2 Changes in marital status

One of the main advantages of the collective approach, as opposed to unitary models, is that it allows to model member's preferences both within and outside the relationship (say, before marriage or after divorce) within the same basic framework. Still, an important question is the relationship between the two sets of preferences. Various models make different assumptions on this issue. One extreme version does not postulate any link between utilities when married and single; hence, knowing an individual preferences when single brings no information about her tastes whithin the household. On the other extreme, some models assume that preferences are unaffected by marital status, at least ordinally. This means that if $u_S^a(Q, q^a)$ denotes a's utility when single, then her utility when married takes the form:

$$u^a(Q, q^a) = F(u_S^a(Q, q^a))$$

where F is an increasing transform. Thus marriage can directly affect a person's utility level, but not the person's marginal rates of substitution between various commodities. Note that if we assume preferences are unaffected by marital status, then the MMWI defined above has a natural interpretation; namely, it is the level of income that would be needed by the individual, if single, to reach the same utility level as what she currently gets within marriage. It must however be stressed that the assumption of constant preferences across marital status is not needed for the definition of the index, but only for this particular interpretation.

An intermediate approach, that relies on the notion of domestic production, has recently been proposed by Browning, Chiappori and Lewbel (2003). It posits that agents, when they get married, keep the same preferences but can access a different (and generally more productive) technology. That is, while the basic rates of substitution between consumed commodities remains unaffected by marriage (or cohabitation), the relationship between purchases and consumptions is not; therefore, the structure of demand, including for exclusive commodities (consumed only by one member) is different from what it would be for singles. More generally, one can, following Dunbar, Lewbel and Pendakur (), only assume that preferences are unaffected by family composition; e.g., that parents' preferences regarding their own consumption does not depend on the number of children. These approaches are described in the next subsection.

4.3 Domestic production

The general notion of domestic production covers a host of different situations. Rural households typically have an explicit production activity, the outcomes of which can be self consumed or sold on a market; in low income countries, a large fraction of GDP consists of agricultural commodities produced at the household (or the village) level. Even in high income economies, a significant fraction of individual available time is spent on household production. This entails immediate tasks (cleaning, cooking, etc.) but also long term investments in health, education and others. In a more abstract way, some authors, starting with Becker's (1965) seminal contributions, have argued that most intrahousehold activities, including consumption, can be modeled as entailing a production component; even such 'commodities' as love, affection or mutual care are 'produced' (and consumed) at the household level. In Becker's model, actually, the only commodities that are ultimately consumed by individuals are those produced at the household level; goods purchased in the market are seen as inputs in a production system that transforms these purchased goods into final commodities that are actually consumed (and enter individual utilities). These home produced goods can be public or private. In what follow, we respectively denoted by Q_j and $q_i^a, a = 1, ..., K, j = 1, ..., n$ the household's consumption of public good j and private good i by agent a.

The technology is described by a production function that gives the possible vector of outputs (q, Q) that can be produced given a vector of market purchases x (and possibly the time $\tau = (\tau^a, a = 1, K)$ spent in household production by each of the members). It takes the general form:

$$(q, Q) = f(x, \tau) \tag{4}$$

while individual utilities are now $U^a(q^a, Q)$ for $a = 1, ..., K$.[8]

For clarity purposes, it is useful to start with case when all produced goods are privately consumed within the household, then move to the general case.

4.3.1 Private goods only

We start with the case $N = 0$; moreover, we first disregard the time spent by each member on domestic production. This setting is thus identical to the general model of household production of Browning, Chiappori and Lewbel (2003).[9] Pareto efficiency translates into the program:

[8] The setting just described is identical to the general model of household production of Browning, Chiappori and Lewbel (2003). For empirical applications, these authors use a linear technology a la Barten.

[9] For empirical applications, these authors use a linear technology a la Barten.

$$\max \sum \mu^a u^a (q^a)$$

$$\begin{aligned}
\sum_a q_i^a &= f_i \left(x^i\right), \\
p' \left(\sum_i x^i \right) &= y
\end{aligned}$$

where

$$\begin{aligned}
q^a &= \left(q_i^a\right), i = 1, n \\
x^i &= \left(x_j^i\right), j = 1, k,
\end{aligned}$$

As before, this program can be decentralized, although decentralization now requires specific (shadow) prices for the produced goods. Specifically, let η_i, λ be the respective Lagrange multipliers of the production constraints in this program, and define

$$\pi_i = \frac{\eta_i}{\lambda}$$

Let $((q^{a*}), a = 1, ..., K, x^*)$ denote the solutions, and define the sharing rule by

$$\rho^a = \pi' q^{a*}$$

Then the program is equivalent to a two stage process, in which q^{a*} solves

$$\max u^a (q^a)$$

under the budget constraint

$$\pi' q^a = \rho^a$$

and x^* solves the profit maximization problem:

$$\max \sum_i \pi_i f_i \left(x^i\right) - \sum_{i,j} p_j x_j^i$$

or equivalently the cost minimization one:

$$\min p'x$$

$$f(x) = \sum_a q^{a*}$$

In that case, again, individual welfare is adequately measured by the sharing rule.

Extending this model to domestic labor supply is straightforward. The Pareto program is now:

$$\max \sum \mu^a u^a \left(q^a, L^a\right)$$

$$\begin{aligned} \sum_a q_i^a &= f_i\left(x^i, \tau_i\right) \\ p'\left(\sum_i x^i\right) + \sum_a w_a\left(L^a + \sum_i \tau_i^a\right) &= y + \sum_a w_a T = Y \end{aligned}$$

where

$$\tau_i = \left(\tau_i^a\right), a = 1, K$$

Prices for internally produced goods are defined as before; the sharing rule is now:

$$\rho^a = \pi' q^{a*} + w_a L^{a*}, a = 1, K$$

where L^{a*} denotes a's optimal leisure. The program can be decentralized as follows: for each a, (q^{a*}, L^{a*}) solve

$$\max u^a\left(q^a, L^a\right)$$

$$\pi' q^a + w_a L^a = \rho^a$$

and x^*, τ^{a*} solves

$$\max \sum_i \pi_i f_i\left(x^i, \tau_i\right) - \sum_{i,j} p_j x_j^i - \sum_{i,a} w_a \tau_i^a$$

or equivalently:

$$\min \sum_{i,j} p_j x_j^i + \sum_{i,a} w_a \tau_i^a$$

under

$$f_i\left(x^i, \tau_i^a\right) = \sum_a q_i^{a*}, i = 1, n$$

4.3.2 Private and public goods

We now consider the general case where produced goods can be private or public. With the same notations as above, the program is now:

$$\max \sum \mu^a u^a\left(q^a, Q\right)$$

$$\begin{aligned} q_i &= f_i\left(x^i\right) \\ Q_j &= F_j\left(X^j\right) \\ p'\left(\sum_i x^i + \sum_j X^j\right) &= y \end{aligned}$$

As before, we may define the shadow price of a produced good as the ratio of the Lagrange multiplier of the corresponding production constraint to the Lagrange multiplier of the budget constraint. But decentralization now involves Lindahl prices for the public goods; i.e., person a's program is now:

$$\max u^a\left(q^a, Q\right)$$

under

$$\sum_i \pi_i q_i^a + \sum_j \Pi_j^a Q_j = \rho^{*a}$$

Here, ρ^{*a} is the Generalized Sharing Rule, and Π_j^a is a's personal price for public good j; these may satisfy

$$\sum_a \Pi_j^a = \Pi_j$$

where Π_j is the shadow price of public good j. Lastly, the MMWIs can be defined as above; the definition (3) must simply be replaced with:

$$m^a(p, P, y, z) = c^a(\pi, \Pi, V^a(\pi, \Pi, y, z)) \quad (5)$$

Extending this formula to domestic time is straightforward.

5 Identification: some remarks

While the conceptual tools just presented help clarifying some of the issues involved, their empirical content must be carefully considered: these is no point putting much emphasis on a concept that cannot possibly be identified form existing data. In fact, much progress has recently been made on these issues. In this section, we briefly summarize some of the main results. For a detailed presentation, the reader is referred to Chiappori and Ekeland (2009b) and Browning, Chiappori and Weiss (2014).

We start with the 'pure' identification problem. Assume that the entire demand function of a household can be observed; what can be recovered from such data (and such data only)? A first result, due to Chiappori and Ekeland (2009a), is that under mild regularity conditions, one exclusion restriction per agent is sufficient to fully identify the collective, indirect utilities. The exclusion restriction, here, requires that for each agent there exists a least one commodity that is not consumed by this agent. The result is local; in particular, it does not require global constraints (such as non negativity restrictions). Moreover, the presence of distribution factors would allow a stronger identification result. Specifically, the exclusion requirement can then be relaxed; one only need the presence of an assignable commodity.[10]

[10] A good is assignable when it is consumed by all members and the consumption of each

A crucial remark is that what is identified (up to an increasing transform) is the indirect collective utility of each member. From a welfare perspective, this is the only relevant concept, since it fully characterizes the utility reached by each agent. However, its implications for the previous discussion must be carefully considered. Paradoxically, the public good case is the easiest. Indeed, Chiappori and Ekeland (2009a) show that when all commodities are publicly consumed, recovering a person's indirect collective utility is equivalent to recovering their direct utility. It follows that all the concepts previously defined (in particular the MMWI) are exactly identified under either the exclusion condition or the assignable and distribution factor case.

Private goods, however, raise specific difficulties. Remember that, in that case, the various concepts (conditional sharing rule, generalized sharing rule, money metric welfare index) coincide with the sharing rule, and the collective indirect utility takes the form:

$$V^a (p, y) = v^a (p, \rho^a (p, y))$$

where, as above, v^a is a's indirect utility and ρ is the sharing rule. Under assumptions stated above, the function V^a is identified. The sharing rule, however, is not; identification only obtains up to an additive function of the prices of the non exclusive goods. The corresponding indetermination is not welfare relevant, since the different solutions correspond to the same collective indirect utilities for each agent. In that case, and somewhat paradoxically, one can identify intra-household welfare distribution (although only up to the usual restrictions: one can only identify individual utilities in an ordinal sense), but not income distribution.

member is independently observed.

It is crucial to remark, however, that this non identification result is only local. In particular, it disregards additional, global restrictions such as non negativity contraints. If these are added, then more precise identification obtains. For instance, adding a non negativity restriction exactly pins down the sharing rule in general. This result should be related to recent work on the estimation of the sharing rules based on a revealed preference approach (see for instance Cherchye et al 2012). Since the revealed preference approach is global by nature, it can generate bounds on the sharing rule, which can actually be quite narrow. In all cases, the global restrictions are generated at one end of the distribution of expenditures, so their use for identifying the sharing rule outside this range should be submitted to the usual caution. Still, they tend to considerably reduce the scope of the non identification conclusion.

Finally, additional assumptions may also help identification. The literature, here, has followed two main directions. On the one hand, one may assume that individual preferences remain (partly) unchanged after marriage. Then information can be recovered from observing the demand of single individuals, which allows full identification of the sharing rule even with private goods. This line has been followed, for instance, by Bargain et al (2006), Vermeulen et al (2006) and Lise and Seitz (2011) for labor supply, and by Browning, Chiappori and Lewbel (2013) for consumption. Recently, Dunbar, Lewbel and Pendakur (2012, 2014) have extended this approach by showing that, under additional conditions on either preferences or the sharing rule (the so-called 'independence of base', whereby the fraction of income going to each member does not depend on total income), the requirements can be relaxed; what is needed is simply that demand functions should be observed for families of different composition.

A second line of research adopts an equilibrium approach. There constraints on intrahousehold allocations are derived from the equilibrium conditions on the 'marriage market'. These approaches refer either to frictionless, matching models (Choo and Siow 2002; Chiappori, Iyigun and Weiss 2009; Chiappori, Salanie and Weiss 2013; Chiappori, Costa and Meghir 2014) or to a search framework (Jacquemet and Robin 2013; Goussé 2013). In all these cases, complete identification of the sharing rule obtains.

6 Conclusion

In the paper, we propose a systematic view of issues related to welfare within the household. We argue that any such analysis should be based on the notion of individual welfare; i.e., it should consider the well-being of each individual within the household. This raises conceptual and empirical difficulties. On the conceptual side, the main issue is to account for the public nature of some consumptions and for the presence of household production. We suggest that the concept of Money Metric Welfare Index (MMWI), which can be viewed as a generalization of the notion of equivalent income, is an adequate response to these concerns. On the empirical side, while some (and possibly most) individual consumptions are not observable, recent progress in the collective literature allows one to actually recover these concepts from data on household behavior under relatively mild conditions (typically exclusion restrictions for at least one commodity per agent). All in all, the tools exist for shifting our perspective from household to individual welfare. We expect future empirical work to follow this promising direction.

References

[1] Bargain, Olivier, Beblo, Miriam, Beninger, Denis, Blundell, Richard, Carrasco, Raquel, Chiuri, Maria-Concetta, Laisney, Francois, Lechene, Valérie, Moreau, Nicolas, Myck, Michal, Ruiz-Castillo, Javier, Javier and Vermeulen, Frederic, 'Does the Representation of Household Behavior Matter for Welfare Analysis of Tax-benefit Policies? An Introduction', Review of Economics of the Household, 4 (2006), 99-111.

[2] Basu K., 2006, "Gender and Say: A Model of Household Behavior with Endogenously-determined Balance of Power", Economic Journal, vol. 116, pp. 558-580.

[3] Browning M., P.A. Chiappori, and V. Lechene, 2008, "Distributional Effects in Household Models: Separate Spheres and Income Pooling", Economic Journal (forthcoming).

[4] Browning M., P.A. Chiappori, and Y. Weiss, 2013, Family Economics, Cambridge University Press.

[5] Chiappori, P.A., and I. Ekeland, 2006,"The Micro Economics of Group Behavior: General Characterization", Journal of Economic Theory, 130, 1-26.

[6] Chiappori, P.A., and I. Ekeland, 2009 a, "The Micro Economics of Efficient Group Behavior: Identification", Econometrica, 77 3, 763-99.

[7] Chiappori, P.A., and I. Ekeland, 2009b, The Economics and Mathematics of Aggregation, Foundations and Trends in Microeconomics, Now Publishers, Hanover, USA

[8] Cherchye, L. J. H.; Rock, B. de; Lewbel, A.; Vermeulen, F. M. P., "Sharing Rule Identification for General Collective Consumption Models", 2012, Tilburg University, Center for Economic Research, Discussion Paper: 2012-041

[9] Edlund, L., and E. Korn, 2002, “A Theory of Prostitution”, Journal of Political Economy, 2002, vol. 110, no. 1, 181-214.

[10] Fleurbaey, M., "Equivalent income", *Oxford Handbook of Well-Being and Public Policy,* Chapter 15, Oxford University Press (forthcoming).

[11] Gersbach H. and H. Haller, 2001, “Collective Decisions and Competitive Markets”, Review of Economic Studies, vol. 68, pp. 347–368.

[12] Grossbard-Shechtman Shoshana, On the Economics of Marriage: A Theory of Marriage, Labor, and Divorce, (Boulder: Westview Press, 1993).

[13] Lechene V. and I. Preston, 2000, “Noncooperative Household Demand”, Working Paper WP08/14, The Institute for Fiscal Studies.

[14] Manser, Marilyn, and Brown, Murray, ‘Marriage and Household Decision-Making: A Bargaining Analysis’, International Economic Review, 21 (1980), 31-44.

[15] Mcelroy, Marjorie B., Horney, Mary Jean, ‘Nash-Bargained Household Decisions: Toward a Generalization of the Theory of Demand’, International Economic Review, 22 (1981), 333-349.

[16] Ulph D., 2006, “Un modèle non-coopératif de Nash appliqué à l’étude du comportement de consommation du ménage”, Actualité économique: revue d’analyse économique, vol. 82, pp. 53-86.

[17] Vermeulen, Frederic, Bargain, Olivier, Beblo, Miriam, Beninger, Denis, Blundell, Richard, Carrasco, Raquel, Chiuri, Maria-Concetta, Laisney, Francois, Lechene, Valérie, Moreau, Nicolas and Michal Myck, 'Collective Models of Labor Supply with Nonconvex Budget Sets and Nonparticipation: A Calibration Approach', Review of Economics of the Household, 4 (2006), 113-127.