Inefficient Collective Households: Cooperation and Consumption

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Abstract

We propose a model of consumption inefficiency in collective households. Inefficiency depends on a "cooperation factor", which can also affect both the allocation of resources within a household and the utility of household members. Households are conditionally efficient, conditioning on the value of the cooperation factor. This lets us exploit convenient modeling features of efficient households (like not needing to specify the bargaining process), while still accounting for, and measuring the dollar cost of, inefficient levels of cooperation.

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1 Introduction

Collective household models of consumption often assume that the allocation and use of household resources is Pareto efficient. As observed by Becker (1981), Chiappori (1988, 1992) and many later authors, the efficiency assumption greatly simplifies analysis, construction, and estimation of such models. In particular, efficiency allows models to be estimated without specifying and solving for the specific bargaining process that is used by household members to allocate resources. Efficiency also means that households automatically satisfy decentralization rules analogous to the first and second welfare theorems, in which the consumption behavior of the household as a whole is equivalent to each household member maximizing their own utility function, subject to a shadow budget constraint. The shadow prices in this constraint embody scale economies associated with the sharing and joint consumption of goods, while the shadow budget incorporates the allocation of resources to each member. This decentralization leads to many modeling simplifications.

However, a common objection to the use of these efficient household models in the development literature is that very prominent examples exist of inefficient household behavior. An example is household members concealing money from each other, even to the point of paying outside money holders, or using low- (or negative) return savings instruments (e.g. Schaner 2015, 2017). Another example is actual or threatened domestic violence, which is widespread in some cultures and countries (e.g., Bloch and Rao 2002, Koç and Erkin 2011, Ramos 2016, Hughes, et. al. 2015, and Hidrobo, et. al. 2016).

We propose a collective household model that allows for the presence of some types of inefficiencies, but still maintains all the modeling properties and simplifications, such as decentralization theorems, that are associated with efficient household models. Specifically, we generalize the efficient collective household model of Browning, Chiappori, and Lewbel (2013, hereafter denoted BCL) to allow for inefficiency. Our model identifies all of the features of collective household models identified by BCL, including resource shares of each household member (defined as the fraction of the overall household budget consumed by that member) and the economies of scale of consumption (i.e., the cost savings associated with joint consumption). In addition, for inefficient households, we identify the costs to the household attributable to their inefficient use of resources.

How can models that assume efficient allocations be applied to inefficient households? The intuition comes from the following analogy. Consider two different perfectly competitive economies, one of which has access to a superior production technology. Each economy can be *conditionally* Pareto efficient, conditioning on the technology they have access to, even though the one with inferior technology is *unconditionally* inefficient relative to the superior economy. Both economies, being conditionally efficient, satisfy all the modeling properties and simplifications (such as decentralization) that go with efficient economies. The same will be true of our households.

We start with the BCL collective household model, which includes what BCL call a "consumption technology function"that summarizes a household's ability to share and jointly consume goods, or more generally to cooperate and thereby attain economies of scale in consumption. A household that has an inferior consumption technology is a household that has lower economies of scale to consumption, and as a result cannot attain as high a level of utility from goods for each of its members as could a household with a superior consumption technology. Nevertheless, households with each technology efficiently use the consumption technology they have, and so models of efficient household behavior can be applied to each.

We first derive this conditional efficiency result in the context of the BCL model. We then extend this model to allow for unconditional inefficiency, where a given household has access to the superior consumption technology but could still choose an inefficient level of sharing. An example could be where a husband shirks responsibility for household activities to increase his own utility, even if that results in inefficiency in the household's consumption of goods.

We define the notion of a *cooperation factor* which, like a distribution factor (see Browning and Chiappori 1998), affects how resources are divided amongst household members and does not affect each member's indifference curves over goods. But unlike distribution factors, cooperation factors may also directly affect the household's consumption technology, and may affect the utility levels of individual household members.

Examples of cooperation factors could be direct indicators cooperation, e.g., measures of time spent together on household chores, or joint decision-making on how a couple's money is spent. More generally, cooperation factors could be behaviors that correlate with cooperation or failures to cooperate, such as money hiding or domestic abuse. Many variables that the previous literature considered to be distribution factors might also be cooperation factors.

Most models in the collective household literature assume all goods are either purely private or purely public within the household (i.e., are either not shared at all, or are completely shared). Such models cannot capture our notion of efficiency, or the concept of a cooperation factor, because the definition of goods as purely private or purely public rules out any variation in how much any particular type of good is shared. This is why we start from the BCL model; it is general enough to allow for variation in sharing both between and within goods, and hence it allows for variation in consumption efficiency across households.

1.1 Literature Review

A key component of collective household models are *resource shares*. Resource shares are defined as the fraction of a household's total resources or budget (spent on consumption goods) that are allocated to each household member. Resource shares are useful for several reasons. First, they are closely related to Pareto weights, and so are often interpreted as measures of the bargaining power of each household member. Second, they provide a measure of consumption inequality within households: if one member has a larger resource share than another member, then they have more consumption. Third, multiplying the resource share by the household budget gives each person's shadow budget. When this shadow budget is appropriately scaled to reflect scale economies, we can compare it to a poverty line and assess whether or not any (or all) household members are poor.

Our primary goal is identification of resource shares, and household's economies of scale to consumption, allowing for inefficiency, and on measuring the economic costs of inefficiency. Resource shares and economies of scale are in general difficult to identify, because consumption is typically measured at the household level, and many goods are jointly consumed and/or shareable. Even the rare surveys that carefully record what each household member consumes face difficulty appropriately allocating the consumption of goods that are sometimes or mostly jointly consumed, like heat, shelter and transportation. Models are therefore generally required.

The earlier literature on collective household models, which assumes that households reach a Pareto efficient allocation of resources, includes Becker (1965, 1981), Chiappori (1988, 1992), Browning, Bourguignon, Chiappori, and Lechene (1994), Browning and Chiappori (1998), Vermeulen (2002), and Chiappori and Ekeland (2009). This literature showed that, even if one knew the entire demand vector-function of a household (that is, how much the household buys of every good and service as a function of prices, income, and other observed covariates), one still could not identify the level of each household member's resource share.

A number of previous approaches exist to address the fundamental nonidentification of resource share levels just from household demand data. One direct approach, taken e.g. by Menon, Perali and Pendakur (2012) and Cherchye, De Rock and Vermeulen (2012), is to collect as much detailed data as possible on the separate consumption of each household member, rather than just observing household-level consumption. A second approach is taken by Cherchye, De Rock and Vermeulen (2011). While the levels of resource shares cannot be identified without additional assumptions, these authors show that it is possible to obtain bounds on resource shares, using revealed preference inequalities. A third method is to point-identify the level of resource shares from household level data by imposing additional restrictions either on preferences, or on the household's allocation process, or both. Papers that use these methods include Lewbel (2003), Lewbel and Pendakur (2008), Couprie, Peluso and Trannoy (2010), Bargain and Donni (2009, 2012), Lise and Seitz (2011), BCL, and

Dunbar, Lewbel, and Pendakur (2013, 2019).

One feature that all of the above cited works have in common is that they assume the household is efficient, in that it reaches the Pareto frontier. While many of the above papers cite evidence supporting these efficient collective models (see, e.g., Bobonis 2009), other papers reject Pareto efficiency within the household, including Udry (1996), Dercon and Krishnan (2003), Walther (2018), and the laboratory experimental evidence in Jakiela and Ozier (2016). We identify the level of resource shares in a model with possible inefficiency.

A number of models of noncooperative household behavior exist. Gutierrez (2018) proposes a model that nests both cooperative and noncooperative behavior. Castilla and Walker (2013) provide a model and associated empirical evidence of inefficiency based on information asymmetry, that is, hiding income. Other evidence of income hiding includes Vogley and Pahl (1994) and Ashraf (2009). Ramos (2016) has exogenously determined domestic violence that affects the efficiency of home production. Other noncooperative models include Basu (2006) and Iyigun and Walsh (2007).

One can think of our framework as a two period game, or a two step program: first choosing the cooperation factor, and then, conditional on that choice, optimizing consumption. However, dynamic considerations like these raise a host of issues associated with uncertainty about future incomes, prices, and power, as well as potentially limited commitment. We abstract from these complications by treating our model as static, where both steps occur sequentially, but in a single time period. Nevertheless, our framework is related to models that have static efficiency but may be intertemporally inefficient, or have limited commitment. Examples include Mazzocco (2007), Abraham and Laczo (2017), Chiappori and Mazzocco (2017), and Lise and Yamada (2019). This is also related to Lundberg and Pollak (2003), who consider the case where a one-off decision in one period affects future bargaining power, and to Eswaran and Malhotra (2011), who model domestic abuse as a vehicle for enhancing future bargaining power.

We allow the household's objective function determining the cooperation factor to differ from its objective in determining consumption. This difference makes general inefficiency possible. Other models with analogous stages are Lundberg and Pollak (1993), Gobbi (2018), and Doepke and Kindermann (2019).

2 Inefficient Collective Household Models

In this section we first summarize the BCL model, and generalize it to allow for household inefficiency. We then further generalize the model by allowing the source of inefficiency, the cooperation factor, to be endogenous. For ease of exposition, derivations here are presented somewhat informally (The appendices of earlier, working paper versions of this paper contain more formal derivations).

2.1 Collective Households with Varying Consumption Technologies

For simplicity, start with a household consisting of just two members, a husband and a wife, indexed by $j = 1, 2$. Let g denote the vector of continuous quantities of goods purchased by the household. Let $\boldsymbol{p}$ denote the vector of market prices of the goods in $\boldsymbol{g}$. Let y be the household's budget, that is, total expenditures, which is the total amount of money the household spends on goods. We begin with a simplified version of the BCL model. Given prices $\boldsymbol{p}$ and a budget y, the purchased quantity vector g is determined by

$$\max_{\boldsymbol{g}_1, \boldsymbol{g}_2} U_1 (\boldsymbol{g}_1) \, \omega_1 (\boldsymbol{p}, y) + U_2 (\boldsymbol{g}_2) \, \omega_2 (\boldsymbol{p}, y) \tag{1}$$

$$\text{such that} \quad \boldsymbol{p}'\boldsymbol{g} = y, \qquad \boldsymbol{g} = A (\boldsymbol{g}_1 + \boldsymbol{g}_2)$$

Here $\boldsymbol{p}'\boldsymbol{g} = y$ is the usual linear budget constraint, $\boldsymbol{g}_1$ and $\boldsymbol{g}_2$ are private good equivalents (described below) for person 1 and 2, and $\boldsymbol{A}$ is a matrix. The functions U_1 and U_2 are the utility functions of members 1 and 2, respectively, while ω_1 and ω_2 are the so-called "Pareto Weights" of each member. Each member's Pareto weight summarizes that member's relative bargaining power in a bargaining model, or the relative weight of their utility function in a household social welfare function. The fact that these weight functions can depend on prices $\boldsymbol{p}$ and the budget y is what makes the collective household model more general than a unitary model[1].

Each utility function $U_j\left(\boldsymbol{g}_j\right)$ depends on a quantity vector of goods $\boldsymbol{g}_j$ that member j consumes. Goods can be partly shared, and so are not constrained to be purely privately consumed or purely publicly consumed within the household. In equation (1), $\boldsymbol{g} = \boldsymbol{A}\left(\boldsymbol{g}_1 + \boldsymbol{g}_2\right)$ is the "consumption technology function", which describes the extent to which each good is shared by the household members. Each household member j consumes (and gets utility from) the quantity vector $\boldsymbol{g}_j$, which BCL call "private good equivalents."

The square matrix A summarizes how much goods are shared. Suppose A were diagonal (it need not be, but this case is useful for understanding sharing). The extent to which each element of $\boldsymbol{g}_1 + \boldsymbol{g}_2$ exceeds the corresponding element of $\boldsymbol{g}$ is the extent to which that good is shared by household members. For example, suppose that g^1, the first element of $\boldsymbol{g}$, was the quantity of gasoline consumed by a couple. If both household members shared their car (riding together) 1/2 of the time, then, in terms of the total distance traveled by each member, it is as if member 1 consumed a quantity g_1^1 of gasoline and member 2 consumed a quantity g_2^1 where $g^1 = (3/4)(g_1^1 + g_2^1)$. For example, Person 1 drives 100km and person 2 drives 100km, but because 50km are driven together, the vehicle only drives 150km. Here, the upper left corner of the matrix $\boldsymbol{A}$ would be 3/4 (which summarizes the extent to which gasoline is shared).

Non-zero off-diagonal elements of $\boldsymbol{A}$ allow the sharing of one good to depend on the purchases of other goods, e.g., more gasoline might be shared by households that purchase less public transportation. As a result, the model is also equivalent to some restricted forms of home production, e.g., a household that wastes less food by cooperating and coordinating on the production of meals could be represented by having a lower value of the k'th element on the diagonal of the matrix $\boldsymbol{A}$, where g^k is the quantity of purchased food.

[1]A unitary model is one that is observationally equivalent to the behavior of a single utility maximizing individual. See, e.g., Chiappori (1988, 1992)

Because the structure given in (1) optimizes a weighted average of utilities, it yields an efficient allocation and may have a decentralized representation. Given some regularity conditions, there exist resource share functions $\eta_j(\boldsymbol{p}, y)$ such that the household's behavior is equivalent to each member j solving the program

$$\max_{\boldsymbol{g}_j} U_j(\boldsymbol{g}_j) \qquad \text{such that} \;\; \boldsymbol{p}'\boldsymbol{A}\boldsymbol{g}_j = \eta_j(\boldsymbol{p}, y)\, y \tag{2}$$

Each η_j is the fraction of the household's total resources y that are claimed by member j. Resource shares sum to one, so that with two household members we have $\eta_1 + \eta_2 = 1$. Equation (2) is the key decentralization result: the couple's behavior is observationally equivalent to a model where each member j chooses a consumption vector $\boldsymbol{g}_j$ to maximize their own utility function, subject to their own personal budget constraint, which has shadow price vector $\boldsymbol{A}'\boldsymbol{p}$ and shadow budget $\eta_j(\boldsymbol{p}, y)\, y$.

Let $\boldsymbol{g}_j = \boldsymbol{h}_j(\boldsymbol{p}, y)$ be the demand equations that would be obtained from maximizing the utility function $U_j(\boldsymbol{g}_j)$ under the linear budget constraint $\boldsymbol{p}'\boldsymbol{g}_j = y$. Each member j faces the constraint in equation (2), so

$$\boldsymbol{g}_j = \boldsymbol{h}_j(\boldsymbol{p}'\boldsymbol{A}, \eta_j(\boldsymbol{p}, y)\, y) \tag{3}$$

and $\boldsymbol{g} = \boldsymbol{A}(\boldsymbol{g}_1 + \boldsymbol{g}_2)$ so the household's demand equations are

$$\boldsymbol{g} = \boldsymbol{A}\left(\boldsymbol{h}_1(\boldsymbol{p}'\boldsymbol{A}, \eta_1(\boldsymbol{p}, y)\, y) + \boldsymbol{h}_2(\boldsymbol{p}'\boldsymbol{A}, \eta_2(\boldsymbol{p}, y)\, y)\right). \tag{4}$$

BCL show that if the demand functions $\boldsymbol{h}_j$ are known, then the consumption technology matrix $\boldsymbol{A}$ and the resource share functions $\eta_j(\boldsymbol{p}, y)$ are generically identified from household demand data. They suggest that the $\boldsymbol{h}_j$ demand functions could be identified from observing the demands of people living alone.

A feature of this model is that, the more that goods are jointly consumed, the lower is the shadow price vector $\boldsymbol{A}'\boldsymbol{p}$ relative to market prices $\boldsymbol{p}$, reflecting the greater efficiency associated with increased sharing. In the gasoline example above, the shadow price of gasoline is $3/4$ that of the market price. This means that the household's actual expenditures on gasoline, $g^1 p^1$, is equal to the cost of buying the sum of what the couple consumed, $g_1^1 + g_2^1$, at the shadow price of $(3/4)p^1$. If the couple had consumed the total quantity of gasoline $g_1^1 + g_2^1$ without any sharing, it would have cost $\left(g_1^1 + g_2^1\right) p_1$ dollars instead of what they actually spent, $g^1 p^1 = (3/4)(g_1^1 + g_2^1)p_1$. The difference between these two is the dollar savings they obtained by sharing gasoline.

Analogous gains are obtained with each good that is shared to some extent. The more efficient the household is, (i.e., the more they share consumption), the greater is the difference between what they would have had to spend on all goods if they hadn't shared, which is $\boldsymbol{p}'(\boldsymbol{g}_1 + \boldsymbol{g}_2) = \boldsymbol{p}'\boldsymbol{A}^{-1}\boldsymbol{g}$, relative to what they actually spent, which is $y = \boldsymbol{p}'\boldsymbol{g}$. Thus, the matrix $\boldsymbol{A}$ embodies the scale economies due to sharing that are available to the household. Note that sharing and jointly consuming goods requires cooperation and coordination among household members.

Now consider two couples that differ in how much they are able to (or how much they choose to) cooperate and coordinate consumption. Then these two couples will differ in how much they share or jointly consume goods, and so will have different consumption technology matrices $\boldsymbol{A}_0$ and $\boldsymbol{A}_1$. Suppose the couple with $\boldsymbol{A}_1$ is more efficient in their consumption, meaning that they share more. Then, even if both couples bought the same market quantity of goods $\boldsymbol{g}$, the couple with $\boldsymbol{A}_1$ would have higher consumption of private good equivalents, and so be able to obtain higher utility for its members. By the above logic, this increased efficiency in dollar terms equals the difference between $\boldsymbol{p}'\boldsymbol{A}_0^{-1}\boldsymbol{g}$ and $\boldsymbol{p}'\boldsymbol{A}_1^{-1}\boldsymbol{g}$.

Note that it is possible for the couple with $\boldsymbol{A}_0$ to share more of some goods, and less of others, than the couple with $\boldsymbol{A}_1$. What makes the couple with $\boldsymbol{A}_0$ less efficient is that, at their given $\boldsymbol{p}$ and y, their shadow budget $\boldsymbol{p}'\boldsymbol{A}_0^{-1}\boldsymbol{g}$ is less than the corresponding shadow budget of the couple with $\boldsymbol{A}_1$.

Even though the couple with $\boldsymbol{A}_0$ is inefficient relative to the couple with $\boldsymbol{A}_1$, each is conditionally efficient, conditioning on each couple's ability or willingness to share and cooperate. Equivalently, each is conditionally efficient, conditioning on the consumption technology matrix that they possess (either $\boldsymbol{A}_0$ or $\boldsymbol{A}_1$). And because each is conditionally efficient, each household's decision problem can be represented by the decentralized program (2).

Now suppose we have two sets of households. One set has consumption technology matrix $\boldsymbol{A}_0$ and the other set has $\boldsymbol{A}_1$. Even though the former households are inefficient, we can still apply and estimate the collective household model for each set of households separately. In particular, we can treat inefficient households as if they were Pareto efficient, satisfying decentralization and other properties of efficiency, because they are conditionally efficient, conditioning on their particular consumption technology matrix $\boldsymbol{A}_0$.

In all of this discussion, we have for simplicity spoken as if $\boldsymbol{A}_1$ is always superior to $\boldsymbol{A}_0$, but the reality could be more complicated. For example, $\boldsymbol{A}_1$ could imply more sharing of some goods and less sharing of others. In that case, it would depend on the household's particular demand functions, prices, and budgets which one is actually more efficient.

2.2 Collective Households With Endogenous Inefficiency

In the previous subsection, each household possessed an ability to cooperate (in terms of sharing consumption) given by a matrix $\boldsymbol{A}_f$. We call the f index a "cooperation factor". A cooperation factor is an observable behavior f that affects the household's level of cooperation and hence their level of sharing. As noted earlier, examples of cooperation factors could be direct indicators of cooperation (like the degree to which consumption decisions are made jointly), or behaviors associated with likely cooperation or failures to cooperate, such as money hiding or domestic abuse. We will now let f be an endogenous choice. Again derivations here are presented informally for ease of exposition.

Here we generalize the model of the previous section. First, we allow for an arbitrary number of household members instead of two. Second, we incorporate f into the model, reflecting all of its potential impacts on the household. Third, we let f be a choice variable.

The resulting model of the household is now

$$\max_{\boldsymbol{g}_1,\boldsymbol{g}_2,\cdots\boldsymbol{g}_J} \sum\nolimits_{j=1}^{J} \left(U_j\left(\boldsymbol{g}_j\right)+u_j\left(f,v\right)\right)\omega_j\left(\boldsymbol{p},y,f\right) \tag{5}$$

$$\text{such that } \boldsymbol{p}'\boldsymbol{g}=y, \quad g=\boldsymbol{A}_f\sum\nolimits_{j=1}^{J}\boldsymbol{g}_j$$

The new variable v is discussed below. As before, assume the most efficient value for $\boldsymbol{A}$ is $\boldsymbol{A}_1$. The factor f appears in three places in this model. First, f affects sharing through $\boldsymbol{A}_f$. Second, f appears in the Pareto weight functions ω_j, showing its potential impact on relative power, and the associated allocation of resources, among household members. Third, member utility levels have a consumption component $U_j\left(\boldsymbol{g}_j\right)$ a non-consumption component $u_j\left(f,v\right)$, and f directly affects member utilities through the u_j functions.

The term $u_j\left(f,v\right)$ is the utility member j directly experiences (not including his or her utility over goods) from living in a household with a cooperation level given by f. The variable v is any observed covariate (or vector of covariates) that affects any household member's utility associated with f, but does not affect the rest of the model. The role of the variable v for identification and estimation is discussed below.

To illustrate, if cooperating and coordinating consumption at the level $\boldsymbol{A}_1$ instead of $\boldsymbol{A}_0$ requires more effort, $u_j\left(1,v\right)-u_j\left(0,v\right)$ may be negative, reflecting member j's disutility from expending that extra effort. Alternatively, $u_j\left(1,v\right)-u_j\left(0,v\right)$ may be positive if member j experiences direct joy or satisfaction from cooperating that more than compensates for the extra effort that is involved.

Generalizing the model to equation (5) means that the resource share functions η_j now depend on f, and the demand equations (3) and (4) become

$$\boldsymbol{g}_j=\boldsymbol{h}_j\left(\boldsymbol{p}'\boldsymbol{A}_f,\eta_j\left(\boldsymbol{p},y,f\right)y\right) \tag{6}$$

and

$$\boldsymbol{g} = \boldsymbol{A}_f \sum_{j=1}^{J} \boldsymbol{h}_j \left(\boldsymbol{p}' \boldsymbol{A}_f, \eta_j \left(\boldsymbol{p}, y, f \right) y \right) \tag{7}$$

Substituting in equations (6), the level of utility attained by member j, call it R_j, is therefore given by

$$R_j \left(\boldsymbol{p}, y, f, v \right) = U_j \left(\boldsymbol{h}_j \left(\boldsymbol{p}' \boldsymbol{A}_f, \eta_j \left(\boldsymbol{p}, y, f \right) y \right) \right) + u_j \left(f, v \right) \tag{8}$$

Now consider what happens to this model when f becomes a choice variable. First, as discussed in the previous section, the household remains conditionally efficient, conditioning on the chosen level of f, so equations (6), (7) and (8) continue to hold. Second, we must consider how f is chosen. We assume that the household chooses f to maximize some function of the utilities of the household members, that is,

$$f = \arg\max \Psi \left(R_1 \left(\boldsymbol{p}, y, f, v \right), ... R_J \left(\boldsymbol{p}, y, f, v \right) \right). \tag{9}$$

for some function Ψ, and where $\boldsymbol{g}_1, \boldsymbol{g}_2, ... \boldsymbol{g}_J$ are given by equations (6). The function Ψ could be exactly the Pareto weighted average of utility functions given by equation (5), meaning that the household uses the same criterion to choose f as it uses to choose consumption. At the other extreme, just one member of the household, say the husband $j = 1$, might unilaterally choose f, so Ψ just equals $R_1 \left(\boldsymbol{p}, y, f, v \right)$. Or if the parents are choosing the level of f, then Ψ might only contain the parent's utility functions. However, if household members have caring preferences, then even members who are not party to choosing f could have their utility functions included in Ψ, so e.g. parents deciding f could put some weight on children's utility functions in Ψ.

Relative to $f = 0$, choosing $f = 1$ has three effects on household members. First, $f = 1$ lowers shadow prices $\boldsymbol{p}' \boldsymbol{A}_f$, reflecting that fact that, by increasing cooperation, the total effective quantities for consumption by the household, $\sum_{j=1}^{J} \boldsymbol{g}_j$, are increased. This means that one or more members will have their utility over goods increase relative to $f = 0$. Second, $f = 1$ could raise or lower each $u_j \left(f, v \right)$, depending on whether each member j gets direct utility or disutility from cooperating. For example, a household might choose $f = 0$, foregoing the gains in consumption from cooperating, if some or all members experience substantial disutility from the effort required to coordinate and cooperate. Third, choosing $f = 1$ could change each member's resource share η_j. So, e.g., if member 1 is choosing f by himself, he might inefficiently choose $f = 0$, even if he doesn't mind cooperating, if choosing $f = 0$ increased his own resource share more than enough to compensate for the loss associated with a higher shadow price for goods.

We will *not* need to actually specify or estimate equation (9), which determines the choice of f. This is important because we may know very little both about which members of the household are making the f decision, and little about the functions u_1,...u_J.

However, the presence of the u_j functions complicates the definition of efficiency. In particular, $f = 0$ might maximize equation (5), and so is efficient in the sense of being on the household's Pareto frontier of member's total utilities $(U_j\left(\boldsymbol{g}_j\right) + u_j\left(f, v\right)$ for $j = 1, ..., J)$. But at the same time $f = 0$ could be inefficient in terms of consumption, i.e., leading to a lower shadow budget $\boldsymbol{p}'\boldsymbol{A}_0^{-1}\boldsymbol{g}$, or equivalently, not being on the household's Pareto frontier in terms of utilities of consumption $(U_j\left(\boldsymbol{g}_j\right)$ for $j = 1, ..., J)$. To distinguish between these efficiency concepts, we define the latter as *consumption efficiency* and the former as *total efficiency*.

If Ψ equals equation (5), so the household maximizes the same objective function in both stages, then the household's choice of f is by construction totally efficient, but it could still be consumption inefficient. In contrast, if Ψ does not equal equation (5) (e.g., if only a subset of household members choose f), then f could be inefficient by both definitions.[2] We will for convenience just to refer to $f = 0$ as inefficient, both because we don't know Ψ, and because, regardless of Ψ, $f = 0$ means the household is consumption inefficient. One of the objects we'll estimate is the dollar cost of this consumption inefficiency.

[2]We do not address the question of when f might be consumption efficient even if Ψ does not equal equation (5), but note that the question is closely related to Becker's Rotten Kid theorem (see, e.g. Becker 1974 and Bergstrom 1989).

One argument for why households should behave efficiently is that these consumption and cooperation decisions are, in reality, a repeated game, giving households opportunities to learn efficient behavior. This could be an argument for assuming Ψ equals equation (5), but our model is agnostic on this point. We do not take a stand on whether the household choses Ψ in a way that promotes either total or consumption efficiency.

Note, however, that when the household chooses $f = 0$, there could be an incentive for side payments. For example, if only member 1 gets to choose f, and very much dislikes cooperating, then other members could find it utility-improving to bribe him into choosing $f = 1$ instead of $f = 0$. The model implicitly incorporates side payments, by letting the resource shares depend on f. Increasing member 1's resource share at the expense of other members is equivalent to a side payment from other members to member 1. In this example, member 1 would have a higher resource share with $f = 1$ than $f = 0$, reflecting the redistribution needed to induce member 1 to choose $f = 1$.

Given sufficient data, the household's demand equations (7) could be estimated as described by BCL or by Lewbel and Lin (2021). BCL show identification of the model on the basis of observing both household demand functions for all goods and individual demand functions for all goods. The latter may be observed via observing the demand functions of single individuals. Thus, without further assumptions, BCL does not identify the resource shares of children (who do not live alone as singles). However, Lewbel and Lin (2021) provide examples of additional assumptions that allow the BCL to be identified and estimated for children as well as adults. Primary among these additional assumptions is the presence of private, assignable goods, which are also used by Dunbar, Lewbel and Pendakur (2013) in their cross section, Engel curve identification arguments.

The main additional complication here is that f would be an endogenous regressor. However, this is where the role of the covariate v comes in. As can be seen in equation (9), the variable v affects the choice of f, (through the $u_j(f, v)$ functions), and so correlates with the household's choice of f. However, by equations (6) and (7), v does not otherwise affect the household's demand functions for goods. This is because v only affects the u_j functions, not utility from goods consumption U_j or Pareto weights ω_j. This means that v is a valid instrument for the endogenous f in the demand equations.

An important feature of our model is that we do *not* need to actually specify or estimate equation (9). To deal with endogeneity of f, all we need is to observe some variable v, i.e., a variable that affects members' propensity to cooperate, without otherwise impacting utility over consumption goods. For example, using data from developing countries, one might take v to be the average value of f in the household's village, which is a measure of the prevalence or norms regarding intrahousehold cooperation in the village. As long as v affects household members' propensity to cooperate, without directly affecting utility functions over consumption goods, then it can be used as an instrument. This means that v does not need to be randomly assigned to be valid as an instrument for our model.

Given estimates of the model, particularly of $\boldsymbol{A}_f$, we could calculate dollar costs of inefficiency on consumption, such as the difference between $\boldsymbol{p}'\boldsymbol{A}_0^{-1}$ and $\boldsymbol{p}'\boldsymbol{A}_1^{-1}$. However, we will not be able to identify or estimate the functions $u_j(f, v)$, e.g., we can't estimate how much individual members like or dislike cooperating.

BCL and Lewbel and Lin (2021) give alternative conditions under which the demand functions, resource share functions, and A matrix in BCL are nonparametrically either point identified or generically identified (see also Chiappori and Ekeland 2009).[3]

A similar argument to theirs shows identification of our general model above. In particular, suppose we impose the minimal regularity needed to guarantee that equation (9) is maximized by only one value of f, which depends on v. For example, if f is discrete then we only need to rule out knife edge cases where multiple values of f yield the exact same value for the function Ψ regardless of the values of the other covariates. Then, conditional on any given value of v and hence of f, our general model reduces to BCL, and so the demand

[3]Informally, features of a model are said to be " generically identified" if there are only rare exceptional cases in which they are not identified. More formally, generic identification means that the subset of all possible data generating processes consistent with the model for which the features are not identified has measure zero. See, e.g., McManus (1992) and Lewbel (2019).

functions, resource share functions, and A matrix in our model can also be identified, using the arguments in BCL and Lewbel and Lin (2021).

3 Conclusions

We provide a general framework for analyzing the effects of what we call "cooperation factors" on collective household behavior. A cooperation factor is any variable that can: induce inefficiency in consumption by reducing cooperation and sharing; affect resource shares like a distribution factor; and/or, directly affect the utility of household members (additively separably from consumption). Examples of cooperation factors could be family reports of coordination and cooperation on consumption, such as family member self reports of joint consumption decision making. Other possible cooperation factors might be behaviors that correlate with cooperation, or with failures to cooperate.

A common objection to the application of collective household models, particularly in developing countries, is that most such models assume households are Pareto efficient, while behaviors like domestic abuse or money holding provide evidence of inefficiency. A convenient feature of cooperation factors is that they allow for inefficiency while still maintaining the modeling advantages of efficient collectives.

One limitation of our proposed model is that it, like the BCL model it is based on requires observing households under many different price regimes. In a companion paper to this one (Lewbel and Pendakur 2021), we bring this model to data, making use of a range of simplifying assumptions to simplify the model and reduce its data requirements. Another limitation of the model is that the only form of inefficiency it includes is failure to fully cooperate in joint consumption. Other forms of inefficiency could also be important in practice, such as potentially inefficient home production (in, e.g., meal preparation or household businesses like farming). Our consumption technology can be interpreted as a restricted form of home production, but it would be useful to further generalize that side of the model.

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