Ine□cient Collective Households: Cooperation and Consumption

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

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

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 e□cient, in that it reaches the Pareto frontier. While many of the above papers cite evidence supporting these e□cient collective models (see, e.g., Bobonis 2009), other papers reject Pareto e□ciency 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 ine□ciency.

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 ine□ciency 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 a□ects the e□ciency 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 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 p denote the vector of market prices of the goods in g. Let y be 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 $U_j \;\; \boldsymbol{g}_j$ 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), $\boldsymbol{g} = A\,(\boldsymbol{g}_1 + \boldsymbol{g}_2)$ 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 A would be 3/4 (which summarizes the extent to which gasoline is shared).

Non-zero off-diagonal elements of 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 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 $\ _j(p;y)$ such that the household's behavior is equivalent to each member j solving the program

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

Each $\ _j$ 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 $\ _1 + \ _2 = 1$. 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 $A^{\prime}\boldsymbol{p}$ and shadow budget $\ _j(\boldsymbol{p};y)\, y$.

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

$$\boldsymbol{g}_j = \boldsymbol{h}_j(\boldsymbol{p}^{\prime}A; \ _j(\boldsymbol{p};y)\, y) \tag{3}$$

and $\boldsymbol{g}$

sociated 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^1p^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 $(g_1^1 + g_2^1)\,p_1$ dollars instead of what they actually spent, $g^1p^1 = (3{=}4)(g_1^1 + g_2^1)p_1$. 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 $p'(g_1 + g_2) = p'A\ ^1g$, relative to what they actually spent, which is $y = p'g$. Thus, the matrix A embodies the scale economies due to sharing that are available to the household.

tionally 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 A_0 or 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 A_0 and the other set has 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 A_0.

In all of this discussion, we have for simplicity spoken as if A_1 is always superior to A_0, but the reality could be more complicated. For example, 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 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

$$\max_{g_1, g_2, \ldots, g_J} \sum_{j=1}^{J} \left[U_j \left(g_j \right) + u_j(f; v) \right] \omega_j(p; y; f) \tag{5}$$

$$\text{such that } p' g = y, \quad g = A_f \sum_{j=1}^{J} g_j$$

The new variable v

and

$$g = A_f \sum_{j=1}^{J} h_j \left(p' A_f ; \;\; _j (p; y; f)\, y\right) \tag{7}$$

Substituting in equations (6), the level of utility attained by member j

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 $_j$. 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 ($U_j \; g_j \; + u_j(f;v)$ 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 $p^{0}A_0{}^{1}g$, or equivalently, not being on the household's Pareto frontier in terms of utilities of consumption ($U_j \; g_j$ for $j = 1;:::;J$). To distinguish between these efficiency concepts, we define the latter as *consumption efficiency* and the former as *total efficiency*.

If 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 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 , and because, regardless of , $f = 0$ 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 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).

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* 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

4 References

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