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Collective Household Consumption Behavior: Revealed Preference Analysis

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Abstract

We review a nonparametric "revealed preference" methodology for analyzing collective consumption behavior in practical applications. The methodology allows for accounting for externalities, public consumption, and the use of assignable quantity information in the consumption analysis. This provides a framework for empirically assessing welfare-related questions that are specific to the collective model of household consumption. As a first step, we discuss the testable necessary and sufficient conditions for data consistency with special cases of

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the collective model (e.g., the case with all goods publicly consumed, and the case with all goods privately consumed without externalities); these conditions can be checked by means of mixed integer (linear) programming (MIP) solution algorithms. Next, we focus on a testable necessary condition for the most general model in our setting (i.e., the case in which any good can be publicly consumed as well as privately consumed, possibly with externalities); again, this condition can be checked by means of MIP solution algorithms. Even though this general model imposes minimal structure *a priori*, we show that the MIP characterization allows for deriving bounds on the feasible income shares. Finally, we illustrate our methods by some empirical applications to data drawn from the Russian Longitudinal Monitoring Survey.

Keywords: Household consumption, collective model, revealed preferences, nonparametric recovery, integer programming.

JEL Codes: D11, D12, D13, C14

Contents

1

Introduction

We present a nonparametric "revealed preference" methodology for analyzing collective consumption behavior in practical applications, while possibly accounting for externalities, public consumption, and the use of assignable quantity information. This methodology allows for empirically assessing welfare-related questions that are specific to the collective model of household consumption. This introductory section articulates the main results and relates our findings to the existing literature.

The collective model and welfare analysis. The collective model explicitly recognizes that household consumption is the outcome of multi-person decision making, with each household member characterized by her or his own rational preferences. Following Chiappori (1988, 1992), it regards rational household consumption as the Pareto efficient outcome of a within-household bargaining process; see also Apps and Rees (1988) for a closely related model. This collective approach contrasts with the more standard unitary approach,

which models households as if they were single decision makers. See Vermeulen (2002) and Donni (2008) for a general discussion of collective models.

An alternative approach to model household consumption under the assumption of Pareto efficiency (or cooperation) focuses on specific axiomatic bargaining solutions like the Nash bargaining solution. Examples of this approach are Manser and Brown (1980), McElroy and Horney (1981), and more recently, Chiappori et al. (2011). Another class of models leaves the assumption of Pareto efficiency by modeling household decisions in a noncooperative framework. See, for example, Lundberg and Pollak (1993), Chen and Woolley (2001), Browning et al. (2010), Lechene and Preston (2011), and Cherchye et al. (2011b,c). For studies focusing on testing cooperative versus noncooperative consumption models, see Del Boca and Flinn (2011a,b). For the sake of brevity, we will only focus on collective models.

The fact that the collective approach starts from individual preferences (and not household preferences) makes it particularly useful for addressing welfare-related questions that specifically focus on the within-household distribution of the household income. For example, the "targeting view" of Blundell et al. (2005) takes as a starting point that the effectiveness of a specific benefit or tax also depends on the particular household member to whom it has been targeted; and these authors argue that a unitary set-up, which implicitly assumes income pooling at the aggregate household level, fails to adequately deal with such targeting considerations. In addition, the collective model allows for analyzing welfare at the individual level rather than at the aggregate household level; for example, Browning et al. (2006) and Lewbel and Pendakur (2008) suggest a collective approach for comparing the cost-of-living of individuals living alone with that of the same individuals living in a multi-member household. Finally, a concept that is intrinsically related to the collective approach is the so-called "sharing rule," which divides the aggregate household income over the individual members. Recovering this sharing rule, and subsequently explaining its variation in terms of household characteristics, can yield useful insights into the distribution of the within-household bargaining power across the individual household members; see, for example, Browning et al.

(1994), Browning and Chiappori (1998) and Chiappori and Ekeland (2006).[1]

Revealed preference characterizations for the collective approach. In the household consumption literature, empirical studies usually build on a differential characterization (rather than a revealed preference characterization) of household consumption models. The specific feature of this differential approach is that it focuses on properties of functions representing household consumption behavior (e.g., cost, indirect utility, and demand functions).[2] In contrast, the revealed preference approach starts directly from a finite number of price-quantity combinations to characterize the model under study. See, for example, Samuelson (1938), Houthakker (1950), Afriat (1967), Diewert (1973), and Varian (1982) for seminal contributions and Blundell et al. (2003, 2008) for recent advances of the revealed preference analysis of the unitary consumption model.

The revealed preference approach has a number of attractive features for applying it to collective models. Firstly, our characterizations are global, while a differential characterization is typically local in nature. We get global conditions that enable checking consistency of a given data set with a particular consumption model; in the spirit of Varian (1982), we refer to this as "testing" data consistency with the model under study.[3] Secondly, we are able to verify this condition while keeping its inherent nonparametric nature, that is, the associated tests do not require an *a priori* (typically non-verifiable) parametric specification of the intrahousehold decision process (e.g., individual preferences). By contrast, the differential approach usually maintains additional assumptions concerning the functional form for the demand function (and thus individual preferences) when verifying

[1] This sharing of the household budget is not only relevant for the collective approach. See, e.g., Browning and Lechene (2001) for a discussion of income sharing for several non-unitary consumption models.

[2] The term "differential" refers to the fact that the characterization is obtained by integrating and/or differentiating the functional specifications of the fundamentals of the model (e.g., the individual preferences of the household members).

[3] As is standard in the revealed preference literature, the type of tests that we consider here are "sharp" tests; either a data set satisfies the data consistency conditions or it does not.

the empirical restrictions implied by the collective model (e.g., Browning and Chiappori (1998) start from a quadratic almost ideal demand system in their empirical analysis). Finally, the revealed preference approach has been successfully applied for empirical analysis and comparison of non-unitary consumption models; see Cherchye et al. (2009, 2011a) for the collective model and Cherchye et al. (2011b,c) for non-unitary consumption models that assume noncooperative interaction in the household (which does not necessarily imply Pareto optimality).

In this study, we will consider two types of collective models. The *general collective model* considers general preferences of the individual household members, which allow for externalities and public consumption within the household.[4] Cherchye et al. (2007) established a "revealed preference" characterization of this general collective model. They also introduced a testable necessary condition and a testable sufficient condition for data consistency with the collective model that only require price and quantity data pertaining to the aggregate household level. We will focus on this necessary condition since, as we will argue below, it forms the natural starting point for our nonparametric analysis. To do so we start from Cherchye et al. (2008), which presents an "Mixed Integer (linear) Programming" (MIP) characterization of this necessary condition. We will recapture this MIP characterization and extend it to settings with M members.

The second type of collective models are the *special collective models* that do not allow for consumption externalities. Moreover, it is assumed that each good is either entirely privately consumed or publicly consumed. We refer to Section 3 for a more detailed discussion. Cherchye et al. (2011a) presents the revealed preference characterization of these special collective models. This characterization allows for including the use of assignable quantity information. As a matter of fact, such assignable quantity information becomes increasingly available in budget surveys and is often used in empirical applications of collective models; see, for example, Browning et al. (1994), Bonke and Browning (2009), and Cherchye et al. (2012). Below we recapture the

[4] Browning and Chiappori (1998) originally suggested this collective model, and established its differential characterization; see Chiappori and Ekeland (2006) for additional discussion.

characterizations of these special collective models and present the corresponding MIP constraints. These conditions, as well as the ones for the general collective model, enable checking consistency of a given data set with particular collective models. Given our MIP characterization, such testing boils down to verifying non-emptiness of the feasible region of specific MIP problems.

Recovery on the basis of revealed preferences. The empirical analysis of the welfare-related questions listed above requires *recovery* of the decision structure underlying the observed (aggregate) household behavior. More specifically, it requires recovering the structural collective model (i.e., individual preferences, individual consumption and the sharing rule) on the basis of observed household behavior alone (i.e., aggregate quantities and prices). These recovery questions are essentially the nonparametric "revealed preference" counterparts of the so-called "identifiability" questions in the parametric (or differential) literature; see Chiappori and Ekeland (2009) for a general discussion of identifiability for the collective model. Our central argument is that our MIP characterizations of collective rationality naturally allow for addressing such recovery questions.

At this point, it is worth emphasizing that nonparametric "revealed preference" recovery typically aims at identifying the *set* of structural models that are consistent with a given set of observations. To illustrate this, let us consider the unitary model. For that model, standard identifiability aims at recovering the household preferences (the structural model) from a known (or estimated) set of demand equations (the reduced form) that give the quantities demanded by the household for all price and income combinations in the domain. By contrast, from a revealed preference perspective, there usually are *many* types of preferences that are consistent with the same set of data satisfying the conditions associated with the unitary model (see the next section for more details concerning these revealed preference conditions). Therefore, the nonparametric revealed preference recovery of the unitary model focuses on identifying the *set* of preferences that are consistent with a given data set; see, for example, Afriat (1967) and Varian (1982, 2006). This study reviews similar "set identification" results for the

collective model. In fact, given that this collective model includes the unitary model as a special case (i.e., when there is a single household member/decision maker), we also complement the existing literature on nonparametric recovery within the context of the unitary model. To be precise, our recovery methodology focuses on set identification (and correspondingly, "bounds" recovery) in the sense of Blundell et al. (2008), who focus on similar (revealed preference) recovery questions in the context of the unitary model. These authors also discuss the relationship between their analysis and the literature on partial identification (see, e.g., Manski (2003), and Chernozhukov et al. (2007)).

Empirical results. We illustrate our revealed preference characterizations by empirical tests of the different consumption models under study applied to data drawn from the Russian Longitudinal Monitoring Survey (RLMS). Here, a first observation will be that the unitary model does not fit the data of couples very well, while the general collective model does seem to provide an adequate description of their consumption behavior. Given that this first conclusion may be explained by the fact that the theoretical explanations of the general collective model are simply too generous to be rejectable, we next focus on restricted versions of this general model. Now, we find that most of the couples' data are consistent with the following three special collective models: the model that assumes all goods are public, the model with all goods private and no externalities, and a final (intermediate) model with some goods private (without externalities) and some goods public. For these three model specifications, we will also investigate the impact of assignable quantity information on the test and recovery results. This will demonstrate that including this extra information in our tests significantly enhances the power of the tests and the corresponding recovery results.

Structure. Section 2 sets the stage by introducing the revealed preference characterizations of the unitary model. In Section 3 we present a collective model that allows for general individual preferences and we discuss its revealed preference characterization. In Sections 4 and 5 we show how to bring this theoretical characterization to observational

data. More specifically, in Section 4 we introduce the MIP characterizations for special collective models that impose restrictions on the household members' preferences. In Section 5 we do the same for the general collective model. Throughout Sections 2 to 5, we illustrate the most relevant concepts by means of numerical examples. In Section 6 we subsequently illustrate our main results for data drawn from the RLMS. The final Section 7 concludes.

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