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Household Economic Behaviors

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Introduction

The study of household economic behaviours has traditionally begun with the assumption that the household is identified as an individual structure, in such a way that the preferences of the collective unit have been represented by only one behaviour function. This initial assumption constitutes the foundation of the traditional or unitary approach to the micro-economics of the individual, that is to say, the preferences of the household are represented by an individual utility function. This unitary approach has received a number of methodological, empirical and welfare critiques. In methodological terms, the traditional assumption does not conform to the habitual structure of a household composed, as it is, of a number of individuals with different preferences, among whom there operates an intra-household decision process. However, when assuming that a household constitutes a micro-society, composed of individuals with their own rational preferences, the unitary approach imposes a number of restrictions on the observed behaviour. Among these restrictions, we emphasise the notion that individual non-labour incomes are aggregated in only one household, in such a way that the source of this exogenous income plays no role in the intra-household allocation of consumption of goods and of labour supply, and thus it is not possible to determine the intra-household allocation of welfare among the household members.

On the basis of the recent literature on household economics, which has been singled out by the above critiques of the unitary models of household decision-making, Professors Chiappori and Donni begin this book by addressing the non-unitary models of household behaviour, which suppose explicitly that households consist of a number of different members with preferences that are different from each other. According to these authors, such models can be divided into two principal categories: cooperative or collective models, in which the allocations are supposed to be Pareto efficient; and non-cooperative or strategic models, which are based on the concept of the Cournot–Nash equilibrium. The demand functions that describe household behaviour in these models are subject to constraints that differ from the traditional Slutsky conditions. In addition, in a certain number of specific cases, the preferences of individual household members can be identified from observable behaviour.

In the following chapter, Professor Grossbard discusses another alternative to cooperative or consensual models and strategic or bargaining models, that is to say, independent individual models of decision-making that make no specific assumptions of jointness of decision-making in households. Unitary models are typically associated with Gary Becker, even though most of Becker's own analyses of the family did not use his unitary model. This is especially the case with the specifically independent individual models presented in his theory of marriage. Decision-making models assuming independent individual household members in the Becker tradition are reminiscent of models of labour markets in which firms and workers are independent decision-makers. As a basis for econometric estimations, the author argues that such models may be preferable to models imposing the structure of a game or a household welfare function.

After these two excellent reviews of the non-unitary models of household behaviour, the third chapter addresses, in this context of non-unitary models, the topic of the measurement of inequality in the household. The fact that individual wellbeing is determined by the way in which the household, consisting of at least two adults with or without children, allocates its resources, has of course been recognised in this literature for some time. Recently, a number of papers have attempted to deal with this issue empirically and, although this new research is welcome, it suffers from the limitation that it continues effectively to assume that households have only two uses of their time, market labour supply and leisure, and hence ignores the existence of household production and intra-family exchange of domestic output for market output. Professors Apps and Rees develop this point, both theoretically and empirically, and go on to discuss its policy implications.

Chapter 4, by Professors Cherchye, De Rock, Vermeulen and Verriest, changes the approach to household economic behaviours, and presents a state-of-the-art discussion of revealed preference tests for consistency of observed household behaviour with Pareto efficiency. These tests are entirely non-parametric, since they do not require any assumptions regarding the parametric form of individual preferences, or the intra-household bargaining process. The authors begin with a discussion of certain tests based on Chiappori's seminal labour supply model, with egoistic preferences and observed individual leisure, and they then present revealed preference conditions for Browning and Chiappori's collective consumption model with general individual preferences, including public goods and externalities, with only aggregate household consumption being observed.

Professors Van Klaveren, Van Praag and Maassen Van den Brink, in Chap.5, address certain aspects of an important behaviour in the household, that is to say, the time allocation decision. In particular, and after checking that research on household labour supply decisions tends to neglect the household labour supply decision process of immigrants, the authors examine the time allocation decisions of immigrant households in the Netherlands. By assuming endogenous labour supply for men and women, and by considering housework and household production, the authors make use of the collective household model in order to examine individual preferences and the intra-household bargaining process between the household members, so that differences in ethnic background may reveal interesting variations in behaviours between native and immigrant households.

On this same topic of the allocation decisions within the household, Professors Moreau and El Lahga, in Chap.6, address another important issue of the link between marital status and family outcomes, that is to say, the authors analyse how married and unmarried couples, who face different legal status, balance home versus market work. More specifically, they examine whether the shift from cohabitation to marriage, in Germany, is associated with a significant change in household market and non-market labour supply, and thus whether the transition from cohabitation to marriage reinforces the degree of specialisation among couples. The results show that marriage increases female specialisation in home-based activities.

In the context of the household, the widely held view that separation has adverse effects on children has long been the basis of important policy interventions, although there are no studies that have attempted to separate out the effects of one parent, mostly the father, leaving, from the effects of that parent's money leaving, on the outcomes for the child. Thus, in Chap.7, Professors Walker and Zhu are concerned with early school leaving and educational attainment, and how these are related to parental separation and parental incomes. While the authors find that parental separation has strong effects on these outcomes, this result seems not to be robust to adding additional control variables. Thus, when including income, results indicate that the father's departure appears to be unimportant for early school leaving and academic achievement, while income is significant, suggesting that income may have been an important unobservable variable, correlated with separation and the outcome variables, in earlier research.

Our final chapter (Chap.8) addresses another relevant topic in household economic behaviours, that is to say, intra-household transfers. Specifically, previous literature has examined whether monetary transfers among family members react to adverse economic shocks of any of the parties involved, with the perfect family insurance predicting that the distribution of consumption of all households belonging to the same family remains unaffected by changes in the distribution of income within the family. Today, it is well understood that there are many reasons why, even in the case where households are altruistically linked, this may lead to failed predictions and, in consequence, Professor Villanueva takes a step back in this chapter and claims that any model imperfect of consumption insurance within households that belong to the same extended family predicts that, whenever a member of the extended family experiences an income drop, the consumption of the other members should fall. The author's US results support the notion that food consumption in the household falls when the head of the household where his or her child lives experiences an involuntary job loss.

Throughout this volume, we have demonstrated the importance of household economic behaviours as a topic of interest for economists and policy makers. In presenting a broad range of thought from a distinguished panel of authors, our goal has been to acknowledge the invaluable work contained in the existing literature, while addressing more recent concerns regarding the inherent anomalies of a unitary approach, and to point the way to a more comprehensive analysis. In this, we hope we have been successful.

Contents

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Chapter 1
Nonunitary Models of Household Behavior: A Survey of the Literature*

Olivier Donni and Pierre-André Chiappori

Abstract This chapter considers nonunitary models of household behavior. These models suppose explicitly that households consist of a number of different members with preferences that are different from each other. They can be split up into two principal categories: cooperative (or collective) models, in which the allocations are supposed to be Pareto efficient, and noncooperative (or strategic) models, which are based on the concept of Cournot–Nash equilibrium. The demand functions that describe household behavior in these models are subject to constraints that differ from the traditional Slutsky conditions. In addition, in a certain number of specific cases, the preferences of the different household members can be identified from observable behavior.

Keywords Households • Collective model • Strategic model • Testability • Identification

JEL Codes D11 • D13 • J22

> *Men are not, when brought together, converted into another kind of substance, with different properties.*
>
> John Stuart Mills (1965 [1843]), Collected Works, vol. 8, p. 879.

*This paper is an updated translation of our paper "Les modèles non unitaires de comportement des ménages: un survol de la littérature," Actualité économique: revue d'analyse économique, vol. 82, pp. 9–52 (2006). We are conscious that this survey does not justice to the literature that has appeared in the intervening 5 years.

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1 Introduction[1]

1.1 The Current State of Play

In Microeconomic textbooks, household behavior, even if this household consists of several different members, is almost always analyzed using a single household utility function, which is maximized subject to a budget constraint. This "unitary" approach, whereby individual preferences are aggregated up to some kind of social preference function, has the advantage of producing testable restrictions on household behavior, and thus to allow the rigorous empirical testing of the underlying hypotheses. For example, in the context of consumer theory, the demands for goods have to be homogeneous of degree zero, and the associated Slutsky matrix should be symmetric and negative semi-definite; moreover, demand should satisfy an "income pooling" property, according to which only the sum of exogenous income matters for the explanation of household behavior (and not its distribution between the different household members). Moreover, if these restrictions are found to hold, household preferences can be identified via information on the complete system of household demands. Econometricians can thus analyze the effect of economic policy on the behavior and the welfare of the household. This explains to a large extent the success that the unitary model has experienced in the literature for a number of decades.

However, an analytical approach that does not take into account the multiplicity of decision makers in the household cannot be entirely satisfactory. From a methodological point of view, the neoclassical theory of utility was developed to describe the choices made by individuals, and not those undertaken by groups such as households. Samuelson (1956) showed that a household will act like an individual if the household members choose to maximize a social welfare function, but this result relies on several, particularly restrictive hypotheses; for instance, the presence of bargaining between members is either ruled away or submitted to the condition that individual threat points or bargaining powers cannot depend on wages or individual incomes. Becker's (1974, 1991) Rotten Kid Theorem yields a conclusion similar to that of Samuelson, in the case where the household consists of one altruistic "patriarch" and one (or more) egotistical "kids." This result does, however, also pose a number of problems; for instance, Bergstrom (1989) showed that preferences have to satisfy some very restrictive properties for the Rotten Kid Theorem to apply.[2] From an empirical point of view, the symmetry of the Slutsky matrix has regularly been tested in this literature, either on consumption or on labor

[1] The only bibliographic references presented in Sect. 1 are those which do not appear in the remainder of the text.

[2] Another essential condition for this theorem to hold is that the altruistic household member has to have sufficient resources available to be able to modify her transfers as a function of the decisions taken by other household members.

supply, and almost always rejected; furthermore, the income pooling property has equally been rejected on many occasions. Last, in addition to these fundamental criticisms, the unitary model has shown itself to be too restrictive for the analysis of a certain number of questions, such as intra-household inequality, economic policies which target certain household members only, or the formation and dissolution of households.

Given both the scarcity of convincing empirical support for the unitary model and its relative lack of theoretical foundations, a number of researchers have developed models that are based on a nonunitary description of household decision making.[3] All these models share a basic theoretical trait: each individual in the household has their own individual preferences. On the contrary, a variety of different mechanisms are appealed to explain how decisions are actually taken within the household. On one hand, noncooperative (strategic) models use the Cournot–Nash equilibrium concept. Here, each individual within a household is considered to maximize their own utility, relative to their own budget constraints, taking the actions of other household members as given. One drawback of these models is that, as game theory tells us, the equilibrium outcomes are typically not Pareto efficient. As such, it is generally possible, starting from this equilibrium, to increase the welfare of one household member without reducing the welfare of any other member. On the other hand, cooperative (or collective) models are based on the hypothesis that the decision process within the household, whatever that may turn out to be, produces Pareto-efficient outcomes. This category includes, in particular, models of household behavior based on the axiomatic theory of bargaining with symmetric information (e.g., the Nash and Kalai–Smorodinsky solutions).

The aim of this survey is to summarize research carried out on nonunitary models in recent years, and to update the surveys provided by Bourguignon and Chiappori (1992), Chiappori (1997a), Chiuri (2000), and Vermeulen (2002).[4] In the following, we will mainly concentrate on cooperative models, insisting on their empirical content, as it is with respect to these models that the most significant theoretical advances have taken place. We will, however, not ignore other types of models.[5] Section 2 introduces the concept of distribution factors and characterizes the demand

[3] Alderman et al. (1995) emphasize the importance of the question of the distribution of resources within the household in the context of developing countries, and call for the development of models which allow such questions to be taken into account.

[4] Lundberg and Pollak (1996) and Strauss et al. (2000) also consider nonunitary models in their literature surveys, but are more particularly interested in the question of the intra-household distribution of resources.

[5] Nonetheless, we will not present here the approaches inspired by Feminist Economics (Folbre, 1986) or Institutional Economics (Pollak, 1985). These insist on the conflicts that can occur within the household, but in a relatively nonformalized way, and even if it is difficult to deny the interest of their subject matter, the empirical content of the models is fairly limited. We will also not consider the applications of nonunitary models to general equilibrium (Gersbach and Haller, 2001), optimal taxation (Apps and Rees, 1988, 2009; Brett, 1998), and couple formation (Becker and Murphy, 2000).

functions that result from cooperative models under the most general hypotheses. Section 3 introduces the question of the identification of the structural components of the model. The question is as follows: what can we say about individual preferences and the decision process within the household when we only observe household-level demands? Section 4 presents more specific cooperative models, namely those relating to labor supply and intertemporal choice under uncertainty. This section also considers households consisting of more than two decision makers, and the specification of threat points in bargaining models. Section 5 then considers a certain number of results from noncooperative models, focussing in particular on their links with cooperative models. A summary table of empirical estimates of these different models is provided in the Appendix.

1.2 Notation and Definitions

We consider a household consisting of two individuals, A and B. These individuals both have distinct preferences over a set of K consumption goods. In the most general models that we will present, the goods that are purchased serve one of the three different uses: private consumption by A, private consumption by B, and public consumption. These different uses are denoted respectively by the following vectors:

$$\boldsymbol{q}_A = \begin{pmatrix} q_A^1 \\ \vdots \\ q_A^K \end{pmatrix}, \quad \boldsymbol{q}_B = \begin{pmatrix} q_B^1 \\ \vdots \\ q_B^K \end{pmatrix}, \quad \boldsymbol{Q} = \begin{pmatrix} Q^1 \\ \vdots \\ Q^K \end{pmatrix},$$

and we have that:

$$\xi = \boldsymbol{q}_A + \boldsymbol{q}_B + \boldsymbol{Q},$$

where the vector $\boldsymbol{\xi} = (\xi^1, \ldots, \xi^K)'$ designates the goods purchased by the household. The household budget constraint is linear and is given by

$$\boldsymbol{\pi}' \cdot \boldsymbol{\xi} = y, \tag{1.1}$$

where y refers to total household spending (including when appropriate spending on leisure) and $\boldsymbol{\pi} = (\pi^1, \ldots, \pi^K)'$ is the price vector corresponding to $\boldsymbol{\xi}$.

A number of remarks can usefully be made at this point. First, some goods may combine aspects of private and public consumption. For example, "telephone services" consist of the (public) subscription and the minutes of conversation or other services that are used (privately) by each individual. Next, in the context of a labor-supply model, the vector $\boldsymbol{\xi}$ may include the leisure of household members.

This latter is typically analyzed as a private consumption, but may also include externality aspects on the well-being of the individual's partner. Last, the econometrician does not observe in general the use that is made of the different goods that households purchase, and only has information on the total demand vector $\boldsymbol{\xi}$. As such, any theory of household behavior, if it is to be of use to econometricians, should predict behavior based only on the observation of this vector.[6]

In the most general case, we imagine that an individual's preferences depend not only on their own consumption, but also on that of their partner. This situation includes certain very general forms of altruism, but also externalities in consumption. In this case, the utility functions of household members have the following form[7]:

$$U_i(\boldsymbol{q}_A, \boldsymbol{q}_B, \boldsymbol{Q}), \tag{1.2}$$

where U_i $(\cdot)$ has the usual properties of continuity, positive monotonicity and concavity. Under this hypothesis, any distinction between public and private consumption is purely artificial. For some applications, however, it will be necessary to introduce stronger hypotheses regarding preferences. For example, if agents are egotistical, and in the absence of externalities, individual preferences can be written as follows:

$$U_i(\boldsymbol{q}_i, \boldsymbol{Q}). \tag{1.3}$$

An intermediary situation between the types described by (2) and (3) comes from altruistic (*caring*) agents, in Becker's sense, in an environment without externalities. Preferences can then be written as follows:

$$U_i(u_A(\boldsymbol{q}_A, \boldsymbol{Q}), u_B(\boldsymbol{q}_B, \boldsymbol{Q})). \tag{1.4}$$

This definition is close to the notion of pure altruism that is found in the economic literature on the subject.

A number of the distinctions that we can make refer to the nature of the goods rather than to individuals' preferences. Consider, for example, some good k. In the case without externalities, we can imagine the following situations:

(a) Good k is (purely) private if $Q^k = 0$.
(b) Good k is (purely) public if $(q_A^k + q_B^k) = 0$.

[6] The econometrician may sometimes be able to obtain information on the private and public components of a good. If information is also available, with respect to the private component of the good, which part is consumed by A and which by B, the good is called "assignable." This situation is, however, exceptional.

[7] In the remainder of the text, the index i will refer indiscriminately to agent A or B.

In what follows, we will sometimes consider the specific cases where all goods are either private or public.[8] We will also examine the case where each good is either purely private or purely public. If we let $\boldsymbol{q} = \boldsymbol{q}_A + \boldsymbol{q}_B$ denote the household's demand for private goods, then this formally means that

$$Q \odot q = \mathbf{0},$$

where $\odot$ is the Hadamard product (i.e., the element-by-element product). In this case, we say that the public and private goods are disjoint, and we designate the prices of private and public goods, respectively, by the vectors $\boldsymbol{p}$ and $\boldsymbol{P}$. For reasons which will become clear below, the vector $\boldsymbol{p}$ is of dimension K and contains zeros instead of prices for public goods. The vector $\boldsymbol{P}$ is defined similarly, so that we have $\boldsymbol{\pi} = \boldsymbol{p} + \boldsymbol{P}$.

If some good is consumed by one person only in the household, the distinction between public and private good loses its meaning, and, in this case, we prefer to talk about exclusive goods. Note that this property of exclusivity is more a characteristic of preferences than of the good itself. For example, cigarettes are generally considered as a private good (if we exclude any resulting externalities), but if one of the household members does not smoke, then cigarettes will be classified as an exclusive good. These types of goods are often encountered by the econometrician in household survey data on consumption. A typical example, which is often given, is that of clothing when this is sexually differentiated. Another example, which is more debatable, is that of the leisure of different household members.

The presence of exclusive goods in the household is often necessary for us to be able to understand the mechanisms that determine the allocation of resources. This aspect will be made clearer in the remainder of the chapter, but we can note at this preliminary stage that the quantity of an exclusive good consumed by an individual is a guide as to the distribution of decision power in the household. The intuition, if exclusive goods are superior, is that their consumption will be greater as the decision power of the person to whom that good is associated is larger.

2 Cooperative Models: General Theory

2.1 The Demand for Goods

As we noted in Sect. 1, cooperative models are based on the sole hypothesis that the household decision process leads to Pareto-efficient outcomes. However, the actual process that determines the household's equilibrium outcome on the efficiency frontier is not necessarily specified. In principle, this process could be a function of any kind of variable that reflects the household environment. Some of these variables, called "distribution factors," play a particularly important role

[8] Note that, if all goods are public, the distinction between altruistic and egotistical agents disappears.

as they will affect the decision process within the household without affecting preferences or the budget constraint.[9] Numerous examples of such variables can be found in Household Economics and Development Economics. For example, Lundberg et al. (1997) analyze the effects on the structure of consumption of a change, in the UK in the 1970s, in the beneficiary of child support. They notably demonstrate that this change in recipient had an effect on the demand for children's clothing.[10] Along the same lines, Thomas et al. (2004) appeal to Indonesian data to underline that the distribution of income at the time of marriage has an impact on the subsequent health of the children. In addition, Rubalcava and Thomas (2005) show that changes in the amount of support to *single women* with children (AFDC) in the USA has an effect on the consumption and labor supply of couples with children. Duflo (2000) has derived related conclusions from a careful analysis of a reform of the South African social pension program that extended the benefits to a large, previously not covered black population. She finds that the recipient's gender – a typical distribution factor – is of considerable importance for the consequences of the transfers on children's health. The analysis in Chiappori et al. (2002), inspired by the work of Becker (1991), considers marriage market indicators and marriage legislation in the USA. They find that these variables influence the labor supply of American households.[11] Equally, Oreffice (2007) analyzes the effect of the legalization of abortion on the labor supply of American households. Last, Folbre (1997) provides numerous additional examples based on certain legislative aspects (the right of women to possess land, to participate in the labor market, to be protected against domestic violence, etc.).

Suppose that agents' preferences have the general form (2) and that the J distribution factors which are pertinent for the problem at hand are designated by $s = (s_1, \ldots, s_J)'$. In an attractive representation, the Pareto-efficient solution can be obtained from the maximization of a utilitarian social welfare function with appropriate weights.[12] This thus implies that there exists a function

[9] Distribution factors are similar to the extra-environmental parameters (EEPs) in the terminology of McElroy (1990, 1997).

[10] A number of other contributions have confirmed this type of result by showing, in the context of testing the income-pooling condition, that the share of each individual in total exogenous income affects households' decisions. A nonexhaustive list of this kind of work includes Behrman (1988), Thomas (1990, 1992, 1994), Schultz (1990), Phipps and Burton (1992), Haddad and Hoddinott (1994), Duflo (2000), Kooreman (2000), and Lechene and Attanasio (2002). In particular, Altonji et al. (1992) consider the cadre of the extended family, while Klassen (1998) and Moehling (2005) appeal to historical data.

[11] Similar conclusions are reached with different data by Gray (1998), Moreau and Donni (2002), and Grossbard-Schechtman and Neuman (2003).

[12] More generally, any Pareto efficient solution can be obtained as the solution of an optimization problem such as

$$\max_{\boldsymbol{q}_A, \boldsymbol{q}_B, \boldsymbol{Q}} W[U_A(\boldsymbol{q}_A, \boldsymbol{q}_B, \boldsymbol{Q}), U_B(\boldsymbol{q}_A, \boldsymbol{q}_B, \boldsymbol{Q}), y, \boldsymbol{\pi}, s]$$

subject to constraint (1), where $W(\cdot)$ is a function increasing in its first two arguments.

$\mu(y, \boldsymbol{\pi}, s) \in [0, 1]$ such that the household choice is described by the programme below:

$$\max_{\boldsymbol{q}_A, \boldsymbol{q}_B, \boldsymbol{Q}} \mu(y, \boldsymbol{\pi}, s) \cdot U_A(\boldsymbol{q}_A, \boldsymbol{q}_B, \boldsymbol{Q}) + (1 - \mu(y, \boldsymbol{\pi}, s)) \cdot U_B(\boldsymbol{q}_A, \boldsymbol{q}_B, \boldsymbol{Q}) \quad (1.5)$$

subject to constraint (1). The function $\mu(y, \boldsymbol{\pi}, s)$ can be interpreted as an index of the distribution of power within the household. If $\mu = 0$, the preferences of B are imposed dictatorially in the household, and A has no decision-making power. If, on the contrary, $\mu = 1$, it is A's preferences which are imposed. We imagine that in general $\mu(y, \boldsymbol{\pi}, s)$ is a continuous function (and differentiable to boot) and homogeneous of degree zero in y and $\boldsymbol{\pi}$.

As we can see, the cooperative approach is characterized by the maximization of a function. Even so, and contrary to the unitary case, this function cannot be interpreted as a traditional utility function as it depends on income, prices, and the distribution factors.[13] The demands that result from the programme (5) will not in general exhibit the habitual properties of Marshallian demand functions (Pollak 1977). However, it can be noted that if the function μ is fixed, then programme (5) boils down to the maximization of a utility function. This implies, in other words, that household demands can be written as follows:

$$\boldsymbol{q}_i = \boldsymbol{q}_i(\boldsymbol{\pi}, y, \mu(y, \boldsymbol{\pi}, s)),$$
$$\boldsymbol{Q} = \boldsymbol{Q}(\boldsymbol{\pi}, y, \mu(y, \boldsymbol{\pi}, s)),$$

where the $\boldsymbol{q}_i$ $(\cdot)$, μ and $\boldsymbol{Q}$ $(\cdot)$, μ functions satisfy the Slutsky conditions for a fixed level of μ. In addition, in accordance with Hicks' aggregation theorem, the aggregated demands, defined by

$$\begin{aligned} \boldsymbol{\xi} &= \sum_{i=A,B} \boldsymbol{q}_i(\boldsymbol{\pi}, y, \mu(y, \boldsymbol{\pi}, s)) + \boldsymbol{Q}(\boldsymbol{\pi}, y, \mu(y, \boldsymbol{\pi}, s)) \\ &= \boldsymbol{\xi}(\boldsymbol{\pi}, y, \mu(y, \boldsymbol{\pi}, s)), \end{aligned} \quad (1.6)$$

will also satisfy the Slutsky conditions for a fixed value of μ. Last, note that the distribution factors s influence household choices uniquely via the μ function.

Household demands thus naturally exhibit certain characteristic properties. In addition to the trivial property of homogeneity of degree zero, we can also single out the conditions of SR(1), linearity and proportionality. Further, under additional hypotheses over preferences or goods, household demands will also satisfy more restrictive conditions.

[13] See Browning et al. 2006a for a detailed discussion.

2.2 *The Characterization of Household Demands*[14]

2.2.1 The Symmetric Negative Plus Rank 1 or SNR(1) Condition

We define, analogously to the model of the consumer in the unitary case, the Pseudo–Slutsky matrix as follows:

$$\mathbf{S} = \frac{\partial \boldsymbol{\xi}}{\partial \boldsymbol{\pi}'} + \frac{\partial \boldsymbol{\xi}}{\partial y} \cdot \boldsymbol{\xi}'.$$

Browning and Chiappori (1998) then show that the household demands that are compatible with problem (5) have to satisfy the following restriction:

$$\mathbf{S} = \Sigma + \mathbf{R}, \tag{1.7}$$

where $\boldsymbol{\Sigma}$ is a negative symmetric semi-definite matrix and $\mathbf{R}$ is a matrix of rank 1. This equation can be interpreted geometrically if we note that, for any pair of utility functions: (a) the budget constraint determines the Pareto frontier, as a function of prices and income; and (b) the value of μ determines the location of the point that will be chosen by the household along that frontier. Consequently, any change in prices or income will displace the Pareto frontier. This displacement will lead to a change in household demands in the way described by $\boldsymbol{\Sigma}$. However, the value of μ will change at the same time. This second effect, which is restricted to movements along the Pareto frontier, is defined by the matrix $\mathbf{R}$. In fact, the SNR(1) condition is restrictive for household demands that satisfy the homogeneity and adding-up conditions as long as the number of goods K is greater or equal to 3.[15] Chiappori and Ekeland (2006) show, in the case where there are no distribution factors, that this condition is also *locally sufficient*. In other words, for any system of demands which satisfies the condition (7) in the neighborhood of some vector $(\boldsymbol{\pi}'_*, y_*)$, there exists at least one pair of utility functions and a function μ such that the demand system is the solution to programme (5) in the neighborhood under consideration.[16]

A specific procedure needs to be followed for empirical tests to be carried out. The principle of this procedure is based on the fact that the matrix $\mathbf{S}$ will be SNR(1) if and only if the antisymmetric matrix $(\mathbf{S} - \mathbf{S}')$ is of rank 2 at most. The procedure is then to estimate a system of demands, to calculate the matrix $(\mathbf{S} - \mathbf{S}')$, and to test the

[14] In what follows, we only consider local restrictions. The reader is referred to Cherchye et al. (2007) and Cherchye and Vermeulen (2008) for global analysis.

[15] Three goods are sufficient for negativeness to be restrictive, while five are needed for symmetry.

[16] Chiappori and Ekeland (2006) also consider the implications of more restrictive hypotheses over goods, such as goods being only private, only public, or where all goods are disjoint. They show, perhaps surprisingly, that the SR(1) condition remains sufficient.

rank of this matrix by appealing to existing techniques; see Robin and Smith (2000) for example. This test was carried out on Canadian data by Browning and Chiappori (1998). A system of demands for seven goods was estimated on a sample of couples without children, to show that the traditional condition of symmetry is rejected, while that of SR1 is not. Moreover, as the condition of symmetry is not rejected for single people, it would seem that not taking the multiplicity of decision makers into account in the household could explain the empirical rejection of unitary models.

2.2.2 The Conditions of Colinearity and Proportionality

Additional restrictions come into play as soon as we introduce distribution factors. In the first instance, consider that there is only one distribution factor, s. Browning and Chiappori (1998) then show that there exists a vector $\mathbf{u}$ such that:

$$\frac{\partial \boldsymbol{\xi}}{\partial s} = (\mathbf{S} - \mathbf{S}') \cdot \mathbf{u}.$$

This is a restrictive condition due to the fact that, as discussed above, the matrix $\mathbf{S} - \mathbf{S}'$ is of rank 2 at most. We thus obtain a surprising result, where the effect of a distribution factor on demand is colinear to the effect of prices.

When there are at least two distribution factors, the demands have to satisfy an additional property that is particularly useful as it can be tested using cross-section data and does not require price effects to be evaluated. This property reflects the fact that distribution factors influence the demand for goods only via the function μ. More precisely,

$$\frac{\partial \boldsymbol{\xi}}{\partial s_j} = \theta_j \cdot \frac{\partial \boldsymbol{\xi}}{\partial s_1} \quad \text{for all } j \ ,$$

where $\theta_j = (\partial\mu/\partial s_1)/\left(\partial\mu/\partial s_j\right)$ is a scalar. In other words, the vectors of response of demands to a change in the various distribution factors are colinear. Equivalently, we must have that:

$$\frac{\partial \boldsymbol{\xi}_i/\partial s_j}{\partial \boldsymbol{\xi}_i/\partial s_k} = \frac{\partial \boldsymbol{\xi}_{i'}/\partial s_j}{\partial \boldsymbol{\xi}_{i'}/\partial s_k} \quad \text{for all } \boldsymbol{i}, \boldsymbol{i}'.$$

This proportionality condition has now been tested in a wide variety of settings. We present only two examples. Bourguignon et al. (1993) estimate a system of six demand equations using French data, retaining the share of female and male labor earnings in total household income as distribution factors. Thomas and Chen (1994) appeal to the same distribution factors in their estimation of a system of ten demand equations in Taiwanese data. In both of these pieces of work, and more remarkably in the majority of empirical work, the proportionality condition is not rejected.

2.2.3 Particular Conditions

The restrictions discussed above are general in the sense that they result only from the hypothesis of Pareto efficiency. However, more restrictive conditions result from the adoption of particular hypotheses regarding goods or preferences.

For reasons that will become clear in the following section, the cases of preferences that are given by a utility function such as (3) and where the goods, public or private, are disjoint has been the subject of particular interest in the profession. Under these hypotheses, Chiappori (1992), and numerous other authors since, showed that the household decision process can be composed into two stages. First, the household members agree on the consumption of public goods and on the sharing of the sum to be spent on private goods. They then each maximize independently their utilities taking into account the level of public goods and their own personal budget constraint. Formally, this implies that there exist a pair of functions, ρ_A and ρ_B, such that $\rho_A + \rho_B = y^*$, where $y^* = y - P'\boldsymbol{Q}$ is household spending on private goods, such that the demand for private goods of individual i, q_i, is given by the solution to

$$\max_{\boldsymbol{q}_i} U_i(\boldsymbol{q}_i, \boldsymbol{Q}) \text{ such that } \boldsymbol{p}'\boldsymbol{q}_i = \rho_i.$$

The functions, ρ_A and ρ_B, describe the distribution of power in the household (for a given level of public goods) and depend on the variables y, p, Q and s. Consequently, the demands for private goods can be written as follows:

$$\boldsymbol{q} = \boldsymbol{q}_A(\boldsymbol{p}, \boldsymbol{Q}, \rho(y, \boldsymbol{p}, \boldsymbol{Q}, s)) + \boldsymbol{q}_B(\boldsymbol{p}, \boldsymbol{Q}, y^* - \rho(y, \boldsymbol{p}, \boldsymbol{Q}, s)), \tag{1.8}$$

where $\rho = \rho_A$ and $y^* - \rho = \rho_B$, and where the functions $\boldsymbol{q}_A(\cdot)$ and $q_B(\cdot)$ are Marshallian demands conditional on $\boldsymbol{Q}$ in the sense of Pollak (1969) or Browning and Meghir (1991). This structure produces particular restrictions on household behavior as the same function ρ appears in all of the demands. Compared to (6), the distribution factors now have an income effect through the sharing rule. In addition, Bourguignon et al. (2009) derive particular constraints, in the form of partial differential equations, which private demands need to satisfy in the particular case where prices are constant. They also show that a minimum of three separate demands are in general necessary for household behavior to be constrained.

The question of the allocation of public goods has only been treated more recently in the literature.[17] In particular, Donni (2009) shows that the (inverse) demands for public goods have to have a fairly comparable structure to those for private goods. The demands for public goods are thus implicitly defined as follows:

$$\boldsymbol{P} = \boldsymbol{P}_A(\boldsymbol{p}, \boldsymbol{Q}, \rho(y, \boldsymbol{p}, \boldsymbol{Q}, s)) + \boldsymbol{P}_B(\boldsymbol{p}, \boldsymbol{Q}, y^* - \rho(y, \boldsymbol{p}, \boldsymbol{Q}, s)), \tag{1.9}$$

[17] A preliminary analysis of the constraints due to the presence of public goods was carried out by Chiuri and Simmons (1997).

where the functions $\boldsymbol{P}_A(\cdot)$ and $\boldsymbol{P}_B(\cdot)$ denote the individual prices (i.e., the Lindahl prices) at which the household members value the public goods, and ρ as previously.

To conclude, the demands for exclusive goods can be written in an analogous manner whether the good be public or private. Imagine that good 1, for example, is exclusively consumed by household member i. If the econometrician considers that this is an exclusive public good, its inverse demand can be written as follows:

$$P^1 = P_i^1(\boldsymbol{p}, \boldsymbol{Q}, \rho_i(y, \boldsymbol{p}, \boldsymbol{Q}, s)), \tag{1.10}$$

where $p^1 = 0$ and ρ_i do not include expenditure on good 1 (as good 1 is a public good). However, the exclusive good is most often considered to be private, for simplicity's sake. Then, the demand for this good is written as follows:

$$q^1 = q_i^1(\boldsymbol{p}, \boldsymbol{Q}, \rho_i(y, \boldsymbol{p}, \boldsymbol{Q}, s)), \tag{1.11}$$

where $Q^1 = 0$ and ρ_i now include the expenditure on good 1 (as good 1 is a private good). The most important point here is that the demands for public and private goods by one household member do not depend on the price of the exclusive goods consumed by his or her partner – except via the sharing rule. We can thus show that the presence of these goods produces greater restrictions, which are formally derived in a series of theoretical contributions including, among others, Chiappori (1988, 1992), Bourguignon et al. (2009), Donni (2007), and Chiappori et al. (2002).

2.3 Conditional Demands

In the context of collective models, one type of conditional demand is of particular interest. Consider, for example, the demand for good k, denoted by ξ^k, and suppose that this demand can be locally inverted with respect to a distribution factor (say s_1). We then have:

$$s_1 = s_1^k(y, \xi^k, \boldsymbol{\pi}, s_{-1}),$$

where s_{-1} is the vector of distribution factors with the first element removed. The substitution of this function into the demands for the goods $k' \neq k$ yields the following conditional demand:

$$\xi^{k\prime} = \xi_c^{k'}(y, \xi^k, \boldsymbol{\pi}, s_{-1}).$$

These demands, known as "s-conditional demands," turn out to be very useful as a way of expressing the different constraints due to Pareto efficiency.

For example, Bourguignon et al. (2009) show that the proportionality condition can be transposed very simply as follows:

$$\frac{\partial \xi_c^{k'}}{\partial s'_{-1}} = 0.$$

In what follows, we will refer to "implicit proportionality" to make clear that this condition applies to the conditional demands. Donni (2006a) equally derives an implicit transposition of the SR1 condition with a set of additional hypotheses over preferences and goods, while Donni and Moreau (2007) adapt s-conditional demands to the question of labor supply.

There are other ways in which demands can be usefully expressed in the collective framework. Donni (2009), as does Mazzocco (2004) in a somewhat different context, considers a form of demands where the good under consideration is a function of the demands for two goods. These represent the distribution factors s and income y. These demands, known as "cm-demands," are valuable for the analysis of cooperative models, in particular if we suppose that agents are egotistical and that the conditioning goods are exclusive.

3 Cooperative Models: Identification

This section asks the following question: given that household demands are observed, what can we say about the structural components of the decision process that led to them, that is, the utility functions and the function μ? This question has been answered in a number of different ways in the recent literature. Indeed, rather than a general theory of identification, the literature has provided a scattered set of results based on particular hypotheses. In the following, we will attempt to present the most important of these results.

As a preliminary, we should note that in a general model where the preferences are given by (2), it is simply not possible to identify the decision process.[18] Additional hypotheses over goods or preferences are necessary for identification to be feasible. In the following, we thus imagine that preferences are as given in (3) and that public and private goods are disjoint. We consider first of all the case where all goods are private, and then later all of the other cases.

[18] A formal proof of this statement is provided in Chiappori and Ekeland (2009).

3.1 The Case of Private Goods Only

As noted above, under the preceding hypotheses, Pareto efficiency has one attractive consequence: that of being able to split the decision process up into two stages. Without public goods, the demands for private goods can then be written as follows:

$$\boldsymbol{q} = \boldsymbol{q}_A(\boldsymbol{p}, \rho(y, \boldsymbol{p}, s)) + \boldsymbol{q}_B(\boldsymbol{p}, y - \rho(y, \boldsymbol{p}, s)). \tag{1.12}$$

When all goods are private, the decentralization of the decision-making process can be seen as a simple corollary of the Second Fundamental Theorem of Welfare Economics. Moreover, the relationship between the functions $\mu(y, \boldsymbol{p}, s)$ and $\rho(y, \boldsymbol{p}, s)$ is bijective, so that these functions are equivalent representations of the distribution of power within the household. Even so, the representation in terms of the sharing rule is often preferable, as it is invariant to a positive monotonic transformation of the utility functions. Nonetheless, the sharing rule no longer constitutes an adequate measure of the distribution of power as soon as some of the goods are public – even though it still exists in this case, as we saw in the preceding section.

When all goods are private, Bourguignon et al. (2009) show that some derivatives of the sharing rule can be identified from observed behavior. More precisely[19]:

Proposition 1. *If a set of three demands for three goods is observed, and if $K \geqslant 4$ and $J \geqslant 1$, the sharing rule ρ is identified up to a function $k(p)$; this function is homogeneous of degree 1 in* $\boldsymbol{p}$.

In other words, if the sharing rule $\rho^*(y, p, s)$ is compatible with a set of three private goods demands, then any other rule $\rho(y, p, s)$ which is compatible with the same set of demands will necessarily have the following form:

$$\rho(y, \boldsymbol{p}, s) = \rho^*(y, \boldsymbol{p}, s) + k(\boldsymbol{p}),$$

where $k(p)$ is a linear homogeneous function. In particular, if prices do not change, which will in principle be the case in cross-section data, this indetermination then boils down to a constant. Note that the identification of the derivatives of the sharing rule does not require the observation of demands at the individual level. The mechanism of resource-sharing within the household can be analyzed via the estimation of a system of demands.

In certain situations, it is possible to reduce this indetermination regarding the function $k(\cdot)$. To this end, the econometrician needs information on one or

[19] Our objective in the following propositions is to set out a number of the main identification results. However, all of these results require regularity conditions, sometimes very complex, that it would be too tedious to list here. Information on these is available in the cited articles.

more exclusive goods. Suppose that good 1 (resp. 2) is exclusively consumed by member A (resp. B). From (11), we know that the demands for exclusive goods can be written as follows:

$$q^1 = q_A^1(p_1, \boldsymbol{p}_{-2}, \rho(y, \boldsymbol{p}, s)), \tag{1.13}$$

$$q^2 = q_B^2(p_2, \boldsymbol{p}_{-2}, y - \rho(y, \boldsymbol{p}, s)), \tag{1.14}$$

where $\boldsymbol{p}_{-2}$ denotes the vector of prices p with its first two elements removed. Some simple manipulations of these equations show that the indifference curves of the sharing rule can be recovered. If we consider (13), for example, we can identify the slopes of these curves:

$$\frac{\partial \rho}{\partial s_l} \Big/ \frac{\partial \rho}{\partial y} = \frac{\partial q^1}{\partial s_l} \Big/ \frac{\partial q^1}{\partial y} \text{ and } \frac{\partial \rho}{\partial p_2} \Big/ \frac{\partial \rho}{\partial y} = \frac{\partial q^1}{\partial p_2} \Big/ \frac{\partial q^1}{\partial y},$$

where the terms on the right-hand side are observable; we can carry out an analogous procedure in the case of (14). This information on the sharing rule is invaluable, and as a result the identification of the sharing rule from exclusive goods is in general more robust.

In more detail, Chiappori and Ekeland (2009) and Chiappori et al. (2002) prove the following result:

Proposition 2. *If the demands for goods 1 and 2 are observed, and good 1 (resp. 2) is exclusively consumed by member A (resp. B), and if $J \geq 1$, the sharing rule ρ is identified up to a function $\boldsymbol{p}_{-2}$; this function is homogeneous of degree 1 in $\boldsymbol{p}_{-2}$.*

In other words, the derivative of the sharing rule with respect to the price of exclusive goods can be identified. Furthermore, we only need to observe the demands for two goods, as opposed to three in the preceding case. Chiappori (1988, 1992) shows that distribution factors are not totally indispensable for identification. These do, however, produce more robust identification and are necessary if we consider the price of exclusive goods to be constant.

These theoretical results have inspired a substantial empirical literature. For example, Browning et al. (1994) consider a theoretical framework where prices are constant, and estimate the sharing rule on Canadian data under the hypothesis that male and female clothing are exclusive goods. They show that the sharing of household resources is a function of the labour earnings of husband and wife. Other authors, whose work will be described in more detail below, use these theoretical results in the context of labor supply, where leisure is considered to be an exclusive good. Finally, Bourguignon et al. (2009) and Donni (2006a) consider the theoretical case where the econometrician only observes one exclusive good, and an aggregated good, and reach similar conclusions to those in Propositions 1 and 2.

3.2 The Case of Public Goods Only

The literature on the possibility of identifying the structural elements of household behavior when consumption is public is only recent. When the econometrician observes demands for two exclusive goods, Chiappori and Ekeland (2009), and Donni (2009) with another proof technique, prove the following powerful result.

Proposition 3. *If a complete system of demands is observed and good 1 (resp. 2) is exclusively consumed by member A (resp. B), the utility functions are identified up to a monotone transformation. For any choice of cardinalization, the μ function is exactly identified.*

As such, all the structural components of the model are identifiable, and this identification is not conditional on an unknown constant. This result does not depend on distribution factors. On the contrary, we do need to observe the complete system of demands to recuperate the utility functions, but this is also the case in the unitary model.

3.3 The General Case of Private and Public Goods

If some goods are private and others public, the identification question becomes much more complicated and there is no general solution to the problem at the time of writing. Some important components of the structural model can, however, be identified. To show this, we define the "collective" indirect utility functions v_i^* $(y, \boldsymbol{p}, \boldsymbol{P}, s)$ by substituting demand functions for private and public goods into the direct utility functions. This yields:

$$v_i^*(y, \boldsymbol{p}, \boldsymbol{P}, s) = u_i(q(y, \boldsymbol{p}, \boldsymbol{P}, s), \boldsymbol{Q}(y, \boldsymbol{p}, \boldsymbol{P}, s)).$$

This expression describes the level of welfare that member i attains in the household when he or she faces the price-income bundle $\boldsymbol{p}$, $\boldsymbol{P}$, y and a set of distribution factors s. This representation of utility differs from the "unitary" indirect utility function in which it implicitly includes an outcome of the collective decision process. In the case where certain private goods are consumed exclusively by one or the other of the household members, Chiappori and Ekeland (2009) proves the following result:

Proposition 4. *If a complete system of demands for goods is observed, and private good 1 (resp. 2) is exclusively consumed by member A (resp. B), the indirect collective utility functions are identified up to a monotonic transformation. For any choice of cardinalization, the μ function is exactly identified.*

This result is important because it gives us the opportunity to carry out well-being analysis, not at the household but at the individual level. Blundell et al. (2005)

propose a similar analysis with respect to labor supply (see below). Donni (2006a) shows that the indirect collective utility function can be identified, using the observation of only one exclusive good, in the case where all goods are private.

3.4 *Single People's Preferences and the Behavior of Married Couples*

In the work described above, one of the principal difficulties comes from the fact that individual preferences are unknown, and have to be estimated from behavior (at the same time as the Pareto weights). One possible solution is to appeal to other sources of information to estimate preferences. In practice, this most often consists in the use of data on single people to estimate individual preferences, and then to use the results of these estimations in the analysis of couple behavior, which allows us in general to identify exactly the decision process. A general presentation of this procedure is contained in Laisney (2006).

The identification of household decision making from the behavior of single people does of course raise a number of particular problems. In the first instance, there is obviously the danger of selection bias, in the sense that the marriage decision will likely depend on preferences. To avoid this stumbling block, it is useful to have panel data available in which the same individuals are followed over time and are observed at different periods both as single or divorced, and married. Recent work by Couprie (2007) appeals to this idea to analyze labor supply in the context of domestic production, which we will return to below.

Even if the correction bias is corrected, other problems remain. We know, for example, that the consumption structure of couples is qualitatively different from that of singles ("one and one don't make two," to cite the title of an article by Vermeulen and Watteyne, 2006). Browning et al. (2006b) propose a solution which avoids supposing that preferences change (in good methodological practice, changes in preferences are only invoked as a last resort). It is supposed that individual preferences remain the same whatever the marital status, but introduce the Beckerian idea of a domestic production technology which is particular to couples – either because the consumption of certain goods is associated with economies of scale, or more generally because the complementarity or substitutability between goods might be different for couples. They show that for a general linear technology, it is possible to identify all of the structural elements of the model (both the decision-making process and the production technology) when estimating the demands of the single and couples. These methods have the additional advantage of supplying a new and probably more operational definition of the concept of an equivalence scale.[20]

[20] See also Lewbel and Pendakur (2008) on this.

4 Cooperative Models: Applications and Extensions

4.1 Labor Supply Models

Labor supply models are among the oldest to have appealed to the cooperative approach, having started at the beginning of the 1980s.[21] In these models, the leisure of household members is typically considered as an exclusive good, while the other goods, which are of only secondary importance, are aggregated into a Hicksian good with a price that is supposed equal to one.[22]

Labor supply models are distinctive in the first instance by the hypotheses that are made with respect to the nature of the goods and the form of preferences. If consumption is private, and if agents are egotistical, the utility functions can be written as follows:

$$U_i(T - h_i, q_i),$$

where h_i denotes the labor supply of member i, q_i their private consumption, and T total available time. The price of leisure of member i, in other words their hourly wage, is denoted by w_i. As we saw above, the decision process can be decentralized. In the first stage, household members receive an equal allocation of ρ_i, with $\rho_A + \rho_B = y$, where y designates the net spending of the household (i.e., total spending, including spending on leisure, from which the value of the time endowment, $Tw_A + Tw_B$, is subtracted). In the second stage, each individual maximizes their utility without taking their partner's behavior into account. In this case, labor supplies are of the following form:

$$h_i = h_i(w_i, \rho_i(y, w_A, w_B, s)). \tag{1.15}$$

It is to be noted here that the labor supply of individual i depends only on her own wage and her endowment, in particular, the wage and endowment of her partner play a part only via the sharing rule.

The identification results presented above can be readily applied here. It is clear, from Proposition 2, that the sharing rule can be identified up to *a constant* (as the price of the aggregate good is constant). Moreover, Proposition 4 implies that the collective indirect utility function can be retrieved as well. This gives us the opportunity to carry out well-being analysis, not at the household but at the individual level. Last, note that the identification of the sharing rule does not

[21] The first contributions to the cooperative theory of labor supply include, among others, Apps (1981, 1982), Apps and Jones (1986), and Apps and Rees (1988). This research was in general based on less general hypotheses than those used in later work.

[22] This last seems like a natural hypothesis as, in labor-supply models, the consumption price is generally considered to be constant.

require any distribution factors here; the presence of these latter will nonetheless produce more robust estimation results.

The theory of cooperative models of labor supply is extended by Donni (2003) to include the treatment of corner solutions and nonlinear budget constraints. In addition, Blundell et al. (2007) consider the situation where female labor supply is continuous whereas male labor supply is discrete, and show that the sharing rule can equally be recovered in this case. Last, a great number of empirical applications have appealed to the theoretical framework developed above. Fortin and Lacroix (1997) use Canadian data to test the constraints of the model: the results show that these are rejected for a sample of couples without children. They also estimate the parameters of the sharing rule, but these are not estimated particularly precisely. Chiappori et al. (2002) appeal to data from the Panel Study of Income Dynamics and obtain much more precise estimates of the structural parameters. One of the reasons for this greater precision is their introduction of appropriate distribution factors into the analysis, in this case variables relating to the marriage market and the legislation of marriage. Moreau and Donni (2002) also introduce distribution factors, applied to French data, and take into account the nonlinearity of taxation. Other empirical analyses in the same vein include Bloemen (2010), Clark et al. (2004), and Vermeulen (2005) on Dutch, British and Belgian data, respectively.

The hypothesis on the private nature of consumption can easily be relaxed. For example, Donni (2007) considers egotistical individuals with the following preferences:

$$U_i(T - h_i, Q),$$

where Q is a Hicksian good which represents public consumption. Under this hypothesis, and taking into account the property of homogeneity, labor supplies can be written as follows:

$$h_i = h_i\left(\frac{w_i}{\pi_i(y, w_A, w_B, s)}, \frac{\rho_i(y, w_A, w_B, s)}{\pi_i(y, w_A, w_B, s)}\right),$$

where

$$\pi_i(y, w_A, w_B, s) = \frac{h_i w_i + \rho_i(y, w_A, w_B, s)}{y + h_A w_A + h_B w_B}$$

denotes member i's Lindahl price for the public good. Proposition 3, adapted to the case of labor supply, implies that the utility functions are identified up to a positive transformation.

A wide variety of other models of labor supply have recently been proposed.[23] Blundell et al. (2005) have developed a model where consumption consists

[23] We do not discuss below those which are inspired by the theory of revealed preferences; see Chiappori (1988) and Seaton (1997, 2001) on this subject.

of a public good and a private good. The utility functions then are of the following form:

$$U_i(l_i, q_i, Q).$$

Blundell, Chiappori and Meghir then advance that the collective indirect utility functions can be identified up to a positive transformation. This result is a variation of Proposition 4. However, to facilitate identification, they use a distribution factor.

In addition, Fong and Zhang (2001) question the idea that leisure is an exclusive good and adopt a novel approach to the problem. They imagine that leisure can be decomposed into private leisure (that agents use independently from each other) and public leisure (that agents enjoy together). Preferences have a separable structure and are written as follows:

$$U_i(u_i(l_i, q_i), L),$$

where L denotes public leisure and l_i private leisure. The important point in their analysis is that, in general, the econometrician only observes the total leisure of each member, that is $\ell_i = l_i + L$. It can then be shown that, with the help of exclusive goods and distribution factors, the two components of leisure can be identified. This result is of particular interest as it shows how the identification question can be treated in the case where public and private goods are not disjoint.

4.2 Domestic Production

One natural generalization of the above models is to include domestic production. Apps and Rees (1997), Chiappori (1997b), and then Donni (2008), all suppose that preferences also cover the consumption of a good which is produced within the household. The utility functions then have the following form:

$$U_i(l_i, q_i, z_i),$$

where z_i is produced with the technology:

$$z_A + z_B = F(t_A, t_B),$$

where F is a constant – or decreasing – returns to scale production function, and t_i is the time devoted by household member i to domestic production. If domestic labor supplies, as well as market labor supplies, are observed, and the domestic good is tradeable, then identification of preferences and the sharing rule does not pose any particular problem. However, if the domestic good is not tradeable, so that its price is endogenous to the household decisions, identification raises problems which have not yet been entirely solved.

This model, and variants of it, have been empirically analyzed in a number of contributions. For example, Apps and Rees (1996), Rapoport et al. (2011) estimate the canonical model with Australian and French data, respectively. Couprie (2007) and van Klaveren et al. (2008) consider a model where the domestic good is public, and present empirical results from British and Dutch data, respectively. Udry (1996) takes a radically different approach to test efficiency in a sample of rural households where agricultural production is carried out using different plots of land. Productive efficiency here requires that domestic labor supplies are determined such that average productivity is the same for all of the plots of land that the household cultivates, independently of the identity of the individual who owns the plot. This condition is tested and rejected using data from Burkina Faso.

4.3 Choice Under Uncertainty

Once we accept that households need to be analyzed as a group of individuals, rather than as a single decision-making center, any situation involving uncertainty should be considered in the framework of risk sharing within the household. This type of analysis raises a number of interesting problems. First, we can consider the conditions under which a household will behave, as seen from the outside, like a single decision maker. The work of Wilson (1968), extended by Mazzocco (2005), shows that an exact aggregation of this type is only possible under restrictive conditions: technically, risk aversion has to be of the "harmonic risk-aversion" (HARA) type, with in addition the same coefficient for all of the household members (ISHARA).[24] If this is not the case, then the analysis of the sharing of risk within the household is complex. Mazzocco shows that an increase in the risk aversion of one individual can reduce the risk aversion exhibited by the group.

[24] The utility function u_i of individual i has to be such that :

$$-\frac{u_i''(q_i)}{u_i'(q_i)} = \frac{1}{a_i + bq_i},$$

where the coefficient b is identical for all of the individuals. Utility functions are therefore of the form

$$u_i(q_i) = \frac{1}{b-1}(a_i + bq_i)^{1-\frac{1}{b}}.$$

We may, in addition, try to measure the extent of risk sharing within the household. This was the subject of a great deal of research in the past (see Hayashi et al. 1996, for example), and the principal implication of efficiency in this context is well known: when exogenous income is subject to random fluctuations, the consumption of any one individual should not be affected by their own individual risk, but only by the aggregate risk. This "mutuality principle" has been applied on a number of occasions to the problem of risk sharing in rural villages in developing countries, starting with the contribution of Townsend (1994). To apply these results at the household level, however, requires that we face the traditional problem of the nonobservation of individual consumption levels. Chiappori (1999) tackles this problem by extending the existing results to the situation where agents are able to adjust their labor supply in response to random shocks. He then shows that labor supplies should then depend only on total exogenous household income, and not on variations in its components due to random shocks. In other words, the income aggregation condition holds in a collective model with uncertainty. In addition, the sharing rule that results from the sharing of risk between household members has to satisfy a restriction which takes the form of a partial differential equation. This model has not to date been estimated empirically. However, Dercon and Krishnan (2000) are also on the subject of risk sharing and present results from Ethiopian data. The underlying idea in this chapter is to use a measure of health, which is observed at the individual level, to pick up the effect of shocks on incomes.

4.4 Intertemporal Choice

These difficulties are also found in collective models of intertemporal consumption,[25] but we have in addition a more fundamental problem: a potential challenge to the paradigm of Pareto efficiency, at least in its strongest sense. This latter supposes that household members are able to commit to long-term engagements; technically, the Pareto weights are invariant over time and independent of any shocks which hit the household. This is a strong hypothesis, particularly in a context where divorce is possible (and agents cannot commit not to divorce). Recent work has, however, suggested first a way of empirically testing the validity of this hypothesis, and second a more general formulation of the problem which allows this hypothesis to be relaxed.

[25] Browning (1996, 2000) was among the first contributions to analyze intertemporal choice in the context of a collective model. He also emphasizes the different problems that are encountered in such estimations.

Technically, if risk sharing is efficient, and if utility functions are intertemporally additive, the problem facing the household in period 0 is the following:

$$\max_{\substack{q_A^t,\, q_B^t \\ \forall t,\omega}} \mu(\boldsymbol{\theta}) \cdot E_0\left(\sum_{t=0}^{T} \frac{u_A(q_A^t(\omega))}{(1+\delta)^t}\right) + (1-\mu(\boldsymbol{\theta})) \cdot E_0\left(\sum_{t=0}^{T} \frac{u_B(q_B^t(\omega))}{(1+\delta)^t}\right),$$

under a stochastic intertemporal budget constraint, where ω is the state of nature, δ is the discount rate, and $q_i^t(\omega)$ is the consumption of household member i in period t in state ω. The strongest form of efficiency (*full-commitment efficiency*) implies that no renegotiation of a preexisting agreement take place. The function μ is then fixed at the beginning of the planning horizon, taking into account the full set of characteristics of the distribution of prices and incomes (represented by the parameter vector $\boldsymbol{\theta}$), and remains constant over the entire life cycle. A weaker form of efficiency (*limited-commitment efficiency*) consists of supposing that participation constraints are satisfied at each time period and for each state of nature. Formally, this yields a series of additional constraints such that:

$$E_\tau\left(\sum_{t=0}^{T-\tau} \frac{u_i(q_i^{t+\tau}(\omega))}{(1+\delta)^t}\right) \geqslant \bar{U}_i^{t+\tau}(\boldsymbol{\theta},\omega),$$

for all $\tau > 0$ and all ω, where $\bar{U}_i^{t+\tau}(\boldsymbol{\theta},\omega)$ are utility thresholds.[26]

Recent work has looked at the theoretical properties of this model. Mazzocco (2005) considers the allocation of consumption over two periods, and notably produces a paradoxical result: everything else equal, risk sharing within the household may produce a higher level of saving, even when the individual utility function have all of the standard properties (prudence, etc.). Again, this paradox only disappears if preferences are of the "ISHARA" type. Mazzocco (2007) shows that, in households with more than one individual, the Euler equation, which describes the intertemporal allocation of consumption, will in general depend on the distribution of bargaining power, that is of the Pareto weights.[27]

[26] Basu (2006) considers a different type of inefficiency in the intertemporal context, due to current actions affecting future bargaining power; this endogenization of the Pareto weights may provide an incentive for certain households not to exploit all of the potential efficiency gains. Lundberg and Pollak (2003) continue with this idea, with an example based on the location choice of the couple, and insist on the role of particular decisions which may change the stationary character of the household's environment. These inefficiencies disappear once we allow household members to commit contractually. Further contributions in the same vein are Konrad and Lommerud (2000) and Lundberg (2002).

[27] Lich-Tyler (2001, 2003) also considers Euler equations in the framework of an intertemporal model, and reaches similar conclusions.

Here again, household behavior can be described by a traditional Euler equation (corresponding to a unitary utility function $U(q_A^t + q_B^t)$) only if preferences are ISHARA. When this is not the case, any parameter which affects the Pareto weights will also have an impact on the Euler equations, even if all of the other properties of the model (perfect financial markets, rational expectations, etc.) are satisfied. As a result, the classic test of intertemporal behavior, that the marginal expected utility of future consumption depends only on current marginal utility (and not on the current values of other variables, such as incomes) will be in general inappropriate in the case of household data, at least in the case, which is likely true, that preferences are not ISHARA and current incomes are correlated with the Pareto weights. Mazzocco (2003) carries out empirical tests of these ideas on American data and finds that the classic conditions hold for singles, but not for couples.

If we imagine that bargaining power may change over time (in the absence of full-commitment efficiency), and that preferences are ISHARA, the traditional Euler equation is replaced by a super-martingale condition:

$$\frac{\partial U(q^t)}{\partial q^t} > E_t\left(\frac{1 + r_{t+1}}{1 + \delta} \cdot \frac{\partial U(q^{t+1})}{\partial q^{t+1}}\right),$$

where $q^t = q_A^t + q_B^t$, and r_t is the interest rate in period t. The intuition behind this result is that agents decide to save more when they are faced with a new kind of risk (due to fluctuations in bargaining power).[28] Mazzocco (2007) uses these properties to test model of efficiency with commitment, which is rejected in favor of a weaker version of efficiency.

One drawback is that the model does not produce any specific predictions regarding the constraints on behavior if preferences are not ISHARA. This comes from the fact that individual consumptions are not observed. However, consider the case of the following utility function:

$$E_0\left(\sum_{t=0}^{T} \frac{u_i(l_i^t, q_i^t)}{(1 + \delta)^t}\right),$$

where l_i^t is the leisure of household member i in the period t. This latter can be interpreted as an exclusive good. Appealing to a type of cm-demands, Mazzocco (2004) then shows that, in this case, the individual Euler equations can be recovered, and that the model can be tested.

Further empirical work has considered less general questions. Lundberg et al. (2003) develop a model of the intertemporal allocation of consumption that is particularly aimed at explaining why consumption drops sharply at the time of retirement. Seitz (2009) builds and estimates a dynamic model of

[28] Aura (2004) obtains a similar result with a less general model.

marriage-market equilibrium to establish the link between the characteristics of this market and the observed behavioral differences between Blacks and Whites in terms of marriage, divorce, and employment.

4.5 More Than Two People in the Household

It is fairly simple to generalize the preceding models to greater numbers of decision makers. Consider then that the household consists of $N \geq 2$ individuals, and that the members of this household have utility functions as given by (1.2). Chiappori and Ekeland (2006) then show that the Pseudo–Slutsky matrix **S** has to satisfy the following SNR(N-1) condition:

$$\mathbf{S} = \Sigma + \mathbf{R}(N-1),$$

where $\boldsymbol{\Sigma}$ is a negative semi-definite matrix, and $\mathbf{R}(N-1)$ is a matrix of rank $N-1$. This condition is restrictive if the number of goods is sufficiently high. Both Dauphin and Fortin (2001) and Chiappori and Ekeland (2006) analyze the implications of distribution factors on household demands. They show that

$$\text{rang}\left(\frac{\partial \boldsymbol{\xi}}{\partial \mathbf{s}'}\right) \leqslant N.$$

This condition is obviously only restrictive if the number of distribution factors is greater than N. The condition is tested by Dauphin and Fortin (2001) and Dauphin (2003) on a sample from Burkina Faso including bigamous households, and by Kapan (2009) on Turkish data.

To conclude, Bourguignon (1999) proposes a model of consumption, without price effects, in a three-person household. His main objective is to analyze the conditions under which the mechanism of resource allocation between household members can be recovered. Individual preferences are imagined to be as in (3), and all goods are considered to be private.[29] The decision-making process, as in traditional models, can be decomposed into two stages. Household members first agree on a split of the household's resources between themselves, and then maximize their utilities. In this case, and under a certain number of conditions (notably that there are both exclusive goods and distribution factors), the derivatives of the sharing rule can be recovered.

[29] In fact, Bourguignon (1999) analyzes a household with two parents and one child. He imagines that the parents hold all of the bargaining power and are altruistic. The utility functions are as in (4), and include as arguments, the utilities of each of the parents and of the child. However, the analysis requires that each household member has a different Pareto weight. Our presentation in terms of three symmetrical individuals is thus more appropriate.

4.6 Bargaining and Threat Points

The cooperative models that we have discussed above are in fact generalizations of more specific models based on the axiomatic theory of bargaining. These latter are typically built up from the idea that household decisions can be represented by Nash (or Kalai–Smorodinsky) bargaining. In its most general form, agents' behavior is then described by the programme below:

$$\max_{\boldsymbol{q}_A, \boldsymbol{q}_B, \boldsymbol{Q}} (U_A(\boldsymbol{q}_A, \boldsymbol{q}_B, \boldsymbol{Q}) - V_A) \times (U_B(\boldsymbol{q}_A, \boldsymbol{q}_B, \boldsymbol{Q}) - V_B) \tag{1.16}$$

subject to the budget constraint (1), where V_i is the threat point of member i, that is, the utility that this member would enjoy if there is no bargaining agreement. This threat point depends in general on a variety of variables, including the distribution factors.

The distinction between the different bargaining models boils down to the choice of threat point.[30] Manser and Brown (1980) and McElroy and Horney (1981) imagine that this latter is represented by the individual's utility in the case of divorce.[31] For example, the threat points could be written as follows:

$$V_i(y_i, w_i, c_i, m_i), \tag{1.17}$$

where y_i represents the income of member i after divorce, w_i the wage rate, c_i the share of divorce costs that i would have to pay, and m_i is an indicator related to the marriage market which reflects remarriage opportunities. However, imagining that the principal threat in a household is that of divorce may seem rather excessive. Lundberg and Pollak (1993) therefore developed a model where the threat point is determined by the solution to a noncooperative game.[32] In this model, certain types of spending belong to the masculine sphere, and others to the feminine sphere. If the couple decides not to cooperate, each household member will carry out the spending in their own sphere, subject to their own budget constraint. Bergstrom (1996) attempts to unite this literature by building a model, inspired by the foundations of noncooperative bargaining theory (as in Rubinstein and Binmore), where divorce is only the ultimate threat,

[30] Ligon (2002) proposes a different type of model, where the Nash solution is generalized to an intertemporal framework (and the hypothesis of efficiency is relaxed).

[31] Ott (1992) presents a certain number of extensions of this model.

[32] Chen and Woolley (2000) also propose a bargaining model where the threat points are given by the level of utility that would be obtained in a noncooperative game. However, their model, perhaps surprisingly, does not yield Pareto-efficient outcomes. It is therefore difficult to classify this model in the cooperative group.

in the sense that the level of utility cannot fall below that which would pertain in the case of divorce.[33]

The question of the empirical content of bargaining models was the subject of hot debate a number of years ago, and the following conclusions seem to have been drawn (see Chiappori (1988b, 1990), McElroy (1990) and McElroy (1990)). In the first instance, the demands resulting from the programme in (16) naturally have to satisfy the conditions derived in Sect. 2 as these bargaining models with symmetric information lead to efficient allocations. The problem is then the following: does the hypothesis that individual behavior is described by Nash bargaining lead to any additional constraints? This point is complicated by the fact that neither individual preferences nor the threat points are observed by the econometrician, and it is not even possible to estimate them on a sample of single or divorced individuals as the concepts of utility that appear in (16) have a cardinal dimension. However, one possible response to this question has recently been proposed. Chiappori et al. (2011) show that if we have no a priori information on the threat points, then bargaining models produce no new predictions that can be tested empirically. The underlying idea is that any point along the Pareto frontier can be achieved by the judicious choice of the threat points. Even so, bargaining models will yield additional empirical content as long as preferences and threat points satisfy a particular separability property. This is in particular the case when agents are egotistical, when there are no externalities, and when the threat points are of the type given by (17). Furthermore, under certain additional hypotheses, it is even possible to identify the *cardinal utility functions*.

5 Noncooperative Models

Noncooperative models are based on game theory and more specifically on Cournot–Nash equilibria. The principle here is that household members act to maximize their own utility subject to their own budget constraint, while taking the decisions of their partner into account. First, suppose that household income y is divided up between the household members according to some rule, and that as a result member A receives ρ_A and member B ρ_B. When preferences are as (3), and public and private goods are disjoint, the demands resulting from the Cournot–Nash equilibrium are given by[34]

$$\max_{\boldsymbol{q}_i, \boldsymbol{Q}_i} U_i(\boldsymbol{q}_A, \boldsymbol{Q}_A + \boldsymbol{Q}_B) \text{ subject to } \boldsymbol{p}'\boldsymbol{q}_i + P'Q_i = \rho_i(y, \boldsymbol{p}, \boldsymbol{P}, s), \quad (1.18)$$

[33] Kanbur and Haddad (1994) and Haddad and Kanbur (1992a, b) appeal to bargaining models to consider the relationship between economic growth and within-household inequality.

[34] This specification is reminiscent of that in Carter and Katz (1997) where, before the game starts, agents divide household income up according to what the authors call a "conjugal contract."

where $\boldsymbol{Q}_i$ denotes the contribution of member i to the provision of public goods. This presentation of the problem is similar to the decentralization of the allocation of private goods in cooperative models. There is nonetheless an essential difference here, in which *the decentralization here simultaneously covers both private and public goods*. Consequently, the allocation of goods that results will be inefficient.[35] It should be noted, however, that cooperative and noncooperative models will produce the same outcomes if all goods are private and there are no externalities.

The solution of the program (18) produces reaction functions and solving them with respect to $(\boldsymbol{q}_i, \boldsymbol{Q}_i)$ gives the Cournot–Nash equilibrium. Browning et al. (2010) and Ulph (2006) analyze the existence conditions of this equilibrium and the properties of the resulting demand functions. The former authors show that, in general, household members will contribute to the provision of no more than one public good. One remarkable result, in the very case where the provision of one public good is made by both household members, is that the demands for goods do not depend on the initial division of exogenous income. In other words, if we analyze the couple's demands, at a given total level of income, as a function of the initial split of this income, we will obtain a "plateau" on which these demands are independent of this split; in particular, the income pooling condition is satisfied. However, for a very unequal distribution of income, one of the members will stop contributing to the public good, and we will return to the case where demands are indeed a function of the initial distribution of income. This is a generalization of a well-known result in Public Economics due to Warr (1983), Kemp (1984), and Bergstrom et al. (1986). This conclusion also applies, mutatis mutandis, to cooperative models in which the noncooperative outcome acts as the threat point.

While one of the conditions that characterizes the unitary model, that is the aggregation of income, is satisfied by the goods demands that result from the noncooperative model, the symmetry condition in general is not. Considering the special case where $\rho_i(y, \boldsymbol{p}, \boldsymbol{P}, s) = y_i$, where y_i is the income of member i, Ulph (2006) has shown that the Pseudo–Slutsky matrix will be symmetric in the special case where preferences depend only on public goods or the endowment of household members is very unequal. Lechene and Preston (2000) show that, in general, if the number of public goods is equal to M and the number of private goods is sufficiently large, the Pseudo–Slutsky matrix $\mathbf{S}$ satisfies the following condition:

$$\mathbf{S} = \Sigma + \mathbf{R}(M + 1),$$

where $\mathbf{R}(M + 1)$ is a matrix of rank $M + 1$. As such, the price effects have to satisfy a certain restriction, but this latter is weaker than that which pertains in cooperative models.

[35] A decentralized decision-making process will lead to Pareto-efficient allocations if personal prices, that is the Lindahl prices, are defined in a first stage. This point was briefly mentioned in Sect. 4.

The noncooperative framework has also been applied to labor supply. Donni (2006b) considers a fairly general form of preferences, which are as follows:

$$U_i(l_A, l_B, q_A, q_B), \tag{1.19}$$

where l_i denotes the leisure of member i and q_i their consumption; these variables create an externality on the well-being of the individual's partner. In this general model, as there are no public goods, strictly speaking, the distribution factors may affect household behavior. However, if stronger hypotheses on preferences are adopted, then the empirical content of the model is considerably richer. For example, Ashworth and Ulph (1981) and Kooreman and Kapteyn (1990) estimate the labor supplies which result from preferences of the following type:

$$U_i(l_A, l_B, Q_A + Q_B).$$

In this case, the presence of public consumption implies that the aggregation condition of income is satisfied, and the initial division of income will have no effect on outcomes. Some elements of individual preferences can equally be recovered. More precisely, the general solution for the preferences of member i, as a function of the labor supplies, is given by:

$$F(U_i(l_A, l_B, Q), l_i),$$

where $U_i(l_A, l_B, q)$ is a particular solution and $F(\cdot)$ is a positive function of U_i. Leuthold (1968), in what is very likely the first article on "formal" nonunitary models, considers another special case and supposes that preferences are given by:

$$U_i(l_i, Q_A + Q_B).$$

The drawback of this specification is that it is not possible to take into account any complementarity or substitutability between the leisure of different household members. Other labor supply models where consumption is partly public and partly private are proposed by Bourguignon (1984).

To conclude, it should be noted that many household decisions are analyzed in a noncooperative framework. Bjorn and Vuong (1985, 1997) and Kooreman (1994) adapt noncooperative models of labor supply to discrete choices,[36] while Konrad and Lommerud (1995) and Carter and Katz (1997) concentrate on domestic production. Konrad and Lommerud (2000) analyze over-investment in human capital in both cooperative and noncooperative models. This list is far from being exhaustive.

[36] They also consider models based on Stackelberg equilibria.

6 Conclusion

In this chapter, we have seen that nonunitary models of household behavior can be split up into two broad categories. The first includes noncooperative (or strategic) models, which are based on Cournot–Nash equilibria, and the second cooperative (or collective) models which only posit the Pareto efficiency of allocations. Recent research appears to have shown, nonetheless, that the interactions between these two categories of model are increasingly important. As we have seen, cooperative models which are based on bargaining theory sometimes use the utility levels that would prevail under a noncooperative game between household members as threat points. Further, the analysis of intertemporal choice models has often led to the abandon of the hypothesis of Pareto efficiency. On one hand, Lundberg and Pollak (1994) have become the advocates of a more general model, based on repeated games and which often exhibits a number of different Cournot–Nash equilibria. Some of these equilibria are efficient, but others are not, and the choice between the different equilibria is determined by cultural factors. On the other hand, Kaushik Basu, Ethan Legon, Stephen Lich-Tyler, and Maurizio Mazzoco, in addition to a number of other authors, whose work was discussed in Sects. 4.3–4.4, emphasize that Pareto efficiency is more difficult to justify in an intertemporal context. If household members are not able to precommit contractually, changes in the opportunities that become open to them over time will yield changes in negotiating power, and thus inefficiency. The analysis of household behavior in this framework constitutes vast research program.

Recent work has also moved toward the use of collective models in economic policy. For example, Lise and Seitz (2008) consider the distribution of income, both between and within households. Laisney (2006) discusses an ambitious research project the objective of which is to analyze the effects of fiscal reform on labor supply. On this score, empirical models which are based only on Pareto efficiency raise a certain number of problems: as they do not explicitly specify the threat points of household members, nor the type of bargain which underlies outcomes, they are not strictly speaking structural models. In other words, the form of the sharing rule cannot be explained by these models. A substantial degree of caution is therefore required if we wish to use the results of this analysis to simulate the effects of economic policy. An example may help to make this point clearer. As we saw above, Marjorie McElroy and Mary-Jane Horney choose the level of utility that household members would obtain when divorced as the threat point. One implication of this hypothesis is that any change in the identity of the beneficiary of family support will have no effect on household behavior (as family support automatically goes to the individual who keeps the children in the case of divorce). Alternatively, Shelly Lundberg and Robert A. Pollak suppose that the threat point is determined by the levels of utility that each household member would obtain if they were to carry out the tasks that are traditionally assigned to their gender. In this case, a change in the beneficiary of family support will likely affect the distribution of resources within the household. In other words, empirical analysis based on Pareto efficiency can yield diverse predictions with respect to behavior, because there is no theory to determine the sharing rule. The solution to this problem is likely found in the use of richer data in which we are able to observe exogenous changes in both the amount of child benefits and other family support and the way in which these are allocated within the family, or in the development of more restrictive theoretical models which also explain the distribution of resources within the household. This constitutes one of the main challenges facing researchers in the area of the Economics of the Household.

Appendix
Empirical Applications of Non-unitary Models

Authors	Models	Data	Tests and identification
Non-cooperative models			
Ashworth and Ulph (1981)	Labor supply equations; public consumption and externalities	Survey of Social Science Research Counsil, 1971 (United Kingdom)	———
Bjorn and Vuong (1985)	Participation equations	PSID, 1982 (United States)	———
Bjorn and Vuong (1997)	Participation equations	PSID, 1982 (United States)	———
Donni (2006b)	Labor supply equations; private and public consumption, and externalities	PSID, 1990 (United States)	Tests of negativity and particular tests
Leuthold (1968)	Labor supply equations; public consumption; linear expenditure system	Survey of Survey Research Center of the University of Michigan, 1959 (United States)	———
Kooreman (1994)	Participation equations	Dutch Labor Mobility Survey, 1985 (Netherlands)	Tests of various models (Nash and Stackelberg)
Kooreman and Kapteyn (1990)	Labor supply equations; public consumption and externalities; linear expenditure system	Dutch Labor Mobility Survey, 1982 (Netherlands)	———
Cooperative models of consumption and labor supply in a static environment			
Apps and Rees (1996)	Labor supply equations and leisure demand equations; domestic cost function	ABS Income Distribution Survey, 1985-86; ABS Time Use Pilot Survey, 1987 (Australia)	———

(continued)

Appendix (continued)

Authors	Models	Data	Tests and identification
Aronsson, Daunfeldt and Wikstrom (2001)	Market labor supply equations and one domestic labor supply equation	Survey of Household Market and Nonmarket Activities, 1984 et 1993 (Sweden)	———
Basu and Ray (2008)	Children's labor supply equations	Nepal Living Standards Survey, 1995	Tests of the link between labor supply and bargaining power
Bloemen (2010)	Labor supply equations; participation decisions	Socio-Economic Panel (Netherlands), 1990-2001.	Estimation of the sharing rule
Blundell, Chiappori, Magnac and Meghir (2007)	Women's labor supply equation and men's participatin equation	Family Expenditure Survey, 1978-1993 (United Kingdom)	Particular tests; estimation of the sharing rule
Bourguignon, Chiappori, Browning and Lechene (1993)	Demand equations for private goods	Budget des familles, 1984-85 (France)	Proportionality tests
Browning and Chiappori (1998)	Demand equations for impure goods	Family Expenditure Survey, 1974-1992 (Canada)	SR1, linearity and proportionality tests
Browning, Bourguignon, Chiappori and Lechene (1994)	Demand equations for exclusive goods	Family Expenditure Survey, 1974-1992 (Canada)	Particular tests; estimation of the sharing rule
Carrasco and Zamora (2007)	Demand equations for impure goods; regime switchings as a function of the women's participation decisions	Encuesta de Presupuestos Familiares, 1990-91 (Spain)	———
Chiappori, Fortin and Lacroix (2002)	Market labor supply equations; distribution factors: sex ratio and dummies for marriage/divorce laws	PSID, 1988 (United States)	Proportionality tests and particular tests; estimation of the sharing rule
Clark, Couprie and Sofer (2004)	Labor supply equations	British Household Panel Survey, 1997 (United Kingdom)	Particular tests, estimation of the sharing rule
Couprie (2007)	Market and domestic labor supply equations	British Household Panel Survey, 1992-2000 (United Kingdom)	Estimation of the sharing rule

(continued)

Appendix (continued)

Authors	Models	Data	Tests and identification
Dauphin (2003)	Demand equations for impure goods; household with more that two decision-makers	Survey of CRDI, 2002 (Burkina Faso)	Proportionality tests
Donni (2007a)	Women's labor supply equation and demand equations for private goods	Budget des familles, 1984-85 (France)	Particular tests; estimation of the sharing rule
Donni (2009)	Demand equations for private and public goods; cm-demands; conditioning goods: male and female clothing	Consumer Expenditure Survey, 1980-99 (United States)	Tests of (implicit) proportionality and SR1; particular tests
Fortin and Lacroix (1997)	Labor supply equations	Census of Population and Housing, 1986 (Canada)	Particular tests and proportionality tests; estimation of the sharing rule
Browning, Chiappori and Lewbel (2006)	Demand equations for goods and production technology	Family Expenditure Survey, 1974-1992 (Canada)	Estimation of the sharing rule, and of the production technology; various tests
Luo (2002)	Demand equations for impure goods	Family Expenditure Survey, 1978-1986 (Canada)	SR1, linearity and proportionality tests
Moreau and Donni (2002)	Labor supply equations; distribution factor: sex ratio	Panel INSEE, 1994 (France)	Particular tests; estimation of the sharing rule
Rapallini (2004)	Demand equations for exclusive goods	Consumption Survey ISTAT, 1999 (Italy)	Particular tests, estimation of the sharing rule
Seaton (2001)	———	Family Expenditure Survey, 1984 (United-Kingdom)	Non-parametric tests
Thomas and Chen (1994)	Demand equations for private goods	Personal Survey of Income Distribution, 1980 (Taiwan)	Proportionality tests
Vermeulen (2005)	Market labor supply equations	Belgian Socio-Economic Panel, 1992 and 1997 (Belgium)	Particular tests; and estimation of the sharing rule
Vermeulen (2006)	Single end married women labor supply equations	Belgian Socio-Economic Panel, 1992 and 1997 (Belgium)	Particular tests; estimation of the sharing rule

(continued)

Appendix (continued)

Authors	Models	Data	Tests and identification
Zamora (2011)	Demand equations for exclusive goods; regime switchings as a function of the women's participation decisions	Encuesta de Presupuestos Familiares, 1990-91 (Spain)	Particular tests; estimation of the sharing rule
Other cooperative models			
Dercon and Krishnan (2000)	Equations of nutritional statute	Ethiopian Rural Household Survey, 1994-1995 (Ethiopia)	Tests of efficient risk sharing
Lundberg, Startz, and Stillman (2003)	Demand equation for intertemporal consumption	PSID, 1979-86 and 1989-92 (United States)	Tests of consumption smoothing (after retirement)
Mazzocco (2003)	Euler equations	PSID, 1975-1987; Consumer Expenditure Survey, 1980-95 (United States)	Tests of Euler equations on singles and couples
Mazzocco (2004)	Demand equation for intertemporal consumption; cm-demands; conditioning good: leisure	Consumer Expenditure Survey, 1982-1998 (Unitd States)	Tests of Euler equations; particular tests
Udry (1996)	Equations of productivity	Survey of International Crops Research Institute for the Semi-Arid Tropics, 1981-1983 (Burkina Faso)	Tests of productive efficiency

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Chapter 2
Independent Individual Decision-Makers in Household Models and the New Home Economics

Shoshana Grossbard

Abstract Much of the recent literature in household economics has been critical of unitary models of household decision-making. Most alternative models currently used are bargaining models and consensual models, including collective models. This paper discusses another alternative: independent individual models of decision-making that do not make any specific assumptions of jointness of decision-making in households. Unitary models are typically associated with Gary Becker, even though most of Becker's own analyses of the family did not use his unitary model. This is especially the case with the specifically independent individual models presented in his theory of marriage. Decision-making models assuming independent individual household members in the Becker tradition are reminiscent of models of labor markets in which firms and workers are independent decision-makers. As basis for econometric estimations, such models may be preferable to models imposing the structure of a game or a household welfare function.

Keywords Unitary model • Household model • Gary Becker • Marriage

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1 Introduction

Much of the recent literature in household economics has been critical of unitary models in which households act as monolithic blocs possibly led by a male benevolent dictator.[1] Gary Becker authored a well-known unitary model assuming a benevolent altruist (Becker 1976), with which he is often associated.[2] This unitary model has also been associated with the New Home Economics (NHE) pioneered by Becker and Jacob Mincer in the 1960s.[3] For instance, Elizabeth Katz (1997) wrote: "Becker's model of the household (alternatively referred to as the common preference model, the unitary approach or the New Home Economics). . ."

Critics of unitary models have proposed to replace these models with models assuming that in multiperson households decisions are made by individuals who have their own preferences and their own constraints. The alternative models proposed by the critics include bargaining models and consensual models. Bargaining models assume that households play games of a cooperative (e.g., McElroy and Horney 1981) or a noncooperative (e.g., Konrad and Lommerud 1995) nature. Nonbargaining models, such as Chiappori (1988) or Apps and Rees' (1988) model, follow Samuelson's (1956) consensual approach and assume that households have a social welfare function (SWF).

These alternatives to the unitary models impose a structure of jointness in the decision-making by individual household members, either in the form of a game that is supposedly played or a SWF that the household adheres to. There is another alternative to unitary models: independent individual models of decision-making that do not make any specific assumptions of jointness of decision-making in households. Such models can be as useful for framing econometric estimations as the bargaining or SWF models while not entailing restrictions following from jointness assumptions.

Some of the most influential models in household economics authored by Becker can be interpreted as "independent individual" models. They first appeared while he was working with Jacob Mincer at Columbia in the 1960s, when together they started the NHE, before his specifically unitary models that appeared in the 1970s and 1980s. What the recent literature seems to overlook is that Becker has offered a palette of models, the equivalent of an artist's palette of colors. In most of his own

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[1] The term "unitary" was coined by Browning et al. (1994).

[2] References to Becker's unitary model can be found in articles on a diverse range of applications of household economics, ranging from labor supply – such as Chiappori (1988), Chiappori et al. (2002), Chau et al. (2007) – to fertility (including Tiefenthaler 1999; Klawon and Tiefenthaler 2001), care work (e.g., Bergeron 2009), child labor and school attendance – such as Emerson and Souza (2007) – and demand for pets (see Schwarz et al. 2007).

[3] The NHE was called "New" to distinguish applications of household economics based on economic analysis from "Home Economics", an academic discipline that was then very popular in USA and focused on the training of high school students in practical home management skills, including sewing and woodwork.

empirical work on the family, Becker refrained from referring to an explicitly unitary framework. Some of the work of others in the NHE tradition, including Mincer, can also be interpreted with independent individual decision-making models. The NHE has many models that are consistent with the assumption that individual members of a household are independent decision-makers. More generally, whether associated with the NHE or not, few researchers have adopted the altruistic dictator model or other explicitly unitary models as the basis for their empirical models analyzing household outcomes.

This chapter first examines what is wrong with unitary models. Section 3 defines household economics and opens the door to independent individual household models, including models of decision-making by single households. The tradition of independent individual models goes back at least to Robbins' (1930) individual labor supply model, which is presented and discussed in Sect. 4. Section 5 is about Becker's allocation of time model, Becker's (1965) standard independent individual decision-making model. The 1965 model antedates the bargaining models (such as Manser and Brown 1980; McElroy and Horney 1981) and "individual" models that are specific about individual members of a household making decisions independently, such as parts of Becker (1973). Section 6 places Becker (1965) in the context of Becker's contributions to economics of the family and that of independent individual models in the tradition of the NHE. Section 7 discusses unitary models from the perspective of Becker students at Chicago in the 1970s. Conclusions are found in Sect. 8.

Independent individual decision-making models in the NHE tradition, developed by Becker and his students, tend to be overlooked in recent studies of couples and families. This chapter aims at rectifying this oversight and help correct misperceptions regarding the place of unitary models in the NHE and the economics of the family.

2 Righting the Wrongs of Unitary Models

Models assuming that multiperson households act as if they were one unit are problematic. First, as has been mentioned by all critics of unitary models, such models imply that it does not matter who within the household earned a particular income. Apps and Rees (2009) call this the anonymity implication. As is well documented in Woolley (2003), this implication of anonymity does not hold based on numerous studies of consumption and personal finance. By contrast, the models proposed by the critics of the unitary model recognize that it matters who earns income in a household.

Second, it follows from unitary models that factors affecting the remarriage prospects of individual members of a couple – such as sex ratios in marriage markets – will have no effect on the consumption or labor supply of these individual members. This is a problem that critics of the unitary model have addressed: they proposed that factors such as sex ratios be included as explanatory variables in studies of labor supply or consumption (see Grossbard-Shechtman 1993). McElroy (1990) coined these factors "EEP" and Browning et al. (1994) "distribution factors."

Third, the assumptions behind unitary models are often unappealing. For example, consider Becker's often-cited unitary Rotten Kid model of an altruistic dictator making decisions for household members he cares about (Becker 1976 and Chap. 8 in Becker 1981).[4] The assumptions behind this model are offensive to the sensitivity of women if the dictator is a man, as is the case of all of the examples Becker used in print [see Barbara Bergmann's (1995) critique in the first issue of *Feminist Economics*]. Orally, Becker has accepted that the dictator could be a woman.[5] It would also be highly unrealistic and offensive to men if models assumed that women dictate their will on their husband and children. The critics of Becker's unitary model (Becker 1976) have avoided all these problems by not relying on the existence of a benevolent dictator making decisions in the household.

One does not need to impose so much structure on couples or other multiperson households to make right the wrongs of unitary models. Instead, one could use independent individual models. In such models, the same factors that are sometimes called EEP or distribution factors also matter, and these models do not assume that households are run by anyone, let alone a benevolent dictator. These models have the advantage of not requiring the strong assumptions needed by bargaining or SWF models.

Before taking a closer look at the range of models that are available for modeling behavior of household members we need to define household economics.

3 Defining Models of Decision-Making in Households

Central components of this definition are the scope of the models, the nature of the decision-making agent, and assumptions regarding jointness of decision-making in multiperson households.

Scope. The scope of household decisions encompasses any outcome that originates on the "household" side of the circular flow and possibly requires a decision by a household or any of its members. The circular flow is typically limited to conventional outcomes, such as consumption, labor supply, or the supply of loanable funds. As defined here, household decision-making models also address outcomes that became part of the territory of economics after its expansion into new areas of inquiry. In that sense, this article defines household economics in the spirit of the New Home Economics started by Becker and Mincer in the 1960s. It is then that economists started to apply utility maximizing models to frame decision-making

[4] Note that Becker (1991) is identical to Becker (1981) except for a new introduction.

[5] Personal recollection of the author while attending Becker's workshop in the years 1974–1976.

about outcomes of great interest to households but traditionally not researched by economists, such as fertility, health production at home, well-being, number of wives, and type of marriage contract. In sum, the scope of the models surveyed here includes any outcome that possibly involves decision-making by a household or one of its members. From here onward, I use the term "household model" to describe a model that frames decisions by households regarding any possible outcome.

The scope of the definition used here is wider than that of Samuelson's (1956) theoretical treatment of household decisions. Of central interest to Samuelson was the question of whether the body of standard propositions in economics – such as the law of demand – is compatible with the realization that households often consist of a number of people. Authors of economic models of the household who have followed Samuelson's tendency to focus on standard applications of economics such as consumption, savings, and labor supply include Apps, Bourguignon, Rees, and Woolley, and until recently, Browning and Chiappori.

Individual vs. multiperson households. Some households consist of single individuals. The most individualistic household model involves a single individual with an individual utility function that does not include any terms reflecting others' well-being in the utility function and limited by constraints that solely involve personally owned resources. In some economic models, such individual agents interact with others via voluntary exchanges possibly involving prices. The household models I consider include such completely individualistic models. They span the whole *individualistic–collectivistic spectrum*: from these most individualistic models to models that involve symbiotic relationships between two partners in line with the ideal of romantic love. At this other extreme there is no distinction between his and her consumption and the couple has one blended utility function and completely pooled resources. Most household models fall in between these two extremes and are often vague as to the exact nature of the interdependence between household members.

Most others use a more restrictive definition of household model and have limited their interest to households including more than one decision-maker. Such is the case of those who apply bargaining or SWF models, for these models only make sense if there are at least two members in a household. By contrast, the definition used here encompasses single households into the definition of household.

Jointness of decision-making by multiperson households. SWF models such as Chiappori (1988) and Apps and Rees (1988) assume that in multiperson households there is some "joint decision taking." Bargaining models assume that individuals in households play either cooperative or noncooperative games. By contrast, the definition used here does not limit household models to models assuming that multiperson households necessarily make joint decisions or react to each other in certain ways. The definition used here allows for the cohabitation of family members who are independent decision-makers. Not only do household members not necessarily cooperate, as is assumed in cooperative models of household decision-making, but they may also not behave according to noncooperative models of decision-making either, in the sense that such models view a need to establish equilibrium allocations for the household. Household models include the separate sphere model of Lundberg and Pollak (1993) in which household members are joint decision-makers regarding some outcomes and they maintain separate spheres regarding other outcomes. They also include independent individual models of decision-making in which individual members act in separate spheres all the time, and there is no attempt to establish equilibrium allocations for the household (as is the case in Grossbard-Shechtman 1984).

The definition of household models used here is more general than that used by most authors, including the classification of household models by Apps and Rees (2009), in the sense that it does the following:

1. Applies to unconventional applications of economics, such as the economics of marriage, health, and fertility.
2. Includes single households.
3. Includes models that do not assume jointness in decision-making by members of multiperson households.

An example of a very popular and well-known model of decision-making by individuals in households is the standard model of labor supply. This model, presented in the next section, is often interpreted as an independent individual model of decision-making by members of multiperson households.

4 The Individual Household Model of Labor Supply

The classic work on Lionel Robbins (1930) on the leisure/goods trade-off continues to be very influential in labor economics. This quintessentially individualistic model consists of the following maximization problem:

$$\begin{aligned}&\text{Max}\, U(x,\, s)\\&\text{s. t. a budget constraint: } I + wl = px\\&\text{and a time constraint: } T = l + s,\end{aligned} \tag{2.1}$$

where x are commercial goods, s is leisure, I is nonlabor income, p are prices and x is a composite commercial good.

The popularity of this model is evident from the prominent place it takes in introductory labor economics such as (Borjas 2009) and Ehrenberg and Smith (2009) and in the “labor economics” entry on Wikipedia (May 16, 2010). One of the reasons this model is so popular in textbooks is that it is widely used in empirical research on labor supply, even in research analyzing allocation of time by individuals who are part of a couple. Researchers typically include other household members’ income, and possibly other characteristics of these other members, as parameters influencing an individual’s choice between leisure and goods.

Given that labor supply studies may be one of the most important sub-fields of household economics as defined here, the prominence of independent individual models in that area is revealing. Labor economics tends to be a field focused on applied economics and not on theory, so this prominence indicates that from a pragmatic point of view, despite the proliferation of bargaining and consensual household models, empirical researchers often prefer to stick to the simpler models of individual behavior that do not impose restrictive assumptions as to how the members of a household deal with each other and that are generally as useful for framing an empirical model as the bargaining or SWF models.

What contributes to the model's usefulness for framing empirical work on labor supply and time use is that the model is applicable both to single households and to multiperson households such as couples. Most economists who use the model in the context of a multiperson household assume that each agent is acting independently, while taking account of the other household members' resources such as their income.

It is also interesting to examine this model that dominates in labor economics in order to extract its underlying assumptions about relationships between workers and firms and establish the relevance of these assumptions to analyses of household behavior. Standard models of labor supply and demand at the basis of much of the empirical literature, such as the literature on wage differentials, assume competitive labor markets and view firms and workers as independent decision-makers. They typically ignore the fact that firms are actually composed of individual agents, including workers, firm managers and firm owners. The use of bargaining models taking account of monopoly or monopsony power is limited in much of the empirical research in labor economics.

Why would households be so different from firms in that respect? The forces of competition before and after couple formation are likely to reduce the monopoly power of individual agents whether they are workers and firms, in the labor market context, or spouses – in the household and marriage market context.

There is some use of bargaining models among workers and firms, including collective bargaining, especially in the Industrial Organization literature less interested in labor supply and wage differentials. But what is really hard to find in labor economics are consensual models assuming that workers and the firm they work for have a shared SWF. It would not occur to most labor economists to assume that a firm and its workers need a consensually established rule for distribution of the surplus that the firm generates. It is too obvious that there are exogenously established prices guiding the firm and its workers and that all the agents involved are independent decision-makers with separate utility functions and no comprehensive SWF inducing them to reach distribution rules by consensus. I do not see any good reason to assume that the small nonprofit firms we call "households" that produce goods and services at home are fundamentally different from firms producing goods and services using hired labor.

This basic model of labor supply had a strong influence on Becker's model of allocation of time, a very influential model that is a central part of the NHE tradition.

5 Becker's Model of Allocation of Time in the Context of His Economics of the Family

Becker (1965) published a theoretical model of decision-making that incorporated choice between labor and an alternative activity including both leisure and household production. The model has a single household utility function, a function of commodities Z that can either be bought or produced at home. If we translate Becker's home-produced Zs into the factors of production used to produce them at home, the Becker model of allocation of time looks similar to the basic problem of labor supply presented above. The Becker (1965) model looks as follows:

$$\begin{aligned}&\text{Max}\, U(x,\ s)\\&\text{s. t. a budget constraint: } I + wl = px\\&\text{and time constraint: } T = l + s\end{aligned} \tag{2.2}$$

These two constraints can be combined into a full income constraint:

$$\text{FI} = (I + wT) = ws + px,$$

where ws is the time cost of home-produced goods, assuming the individual participates in the labor force and earns a wage w, and FI is full income.

Becker's (1965) model of allocation of time is consistent with his altruist model in which the household acts as one unit led by a benevolent dictator. However, it is also consistent with completely different assumptions, including the assumption that two individuals live independently under the same roof, each having his or her own utility function and production function. This model can be understood as a model of behavior of single individuals, which is how it was presented in the first chapter in Becker's (1981) *Treatise on the Family*. Alternatively, the model can be interpreted for individuals in a two-person household, typically either a husband or a wife, who act independently and take the other's income into account in their nonlabor(own) income I. This is how many empirical models of labor supply frame the labor supply equation or earnings equation of a married man or woman (see for instance Bloemen and Stancanelli 2008). The partner's income is then considered nonlabor income of the individual in focus.

With the relatively recent availability of time use data there has been much recent growth in economic research on allocation of time to household production. This research often uses Becker's individual model of allocation of time. Again, as in the case of labor supply studies, this is for pragmatic reasons. The model can be interpreted in terms of independent decision-making by individuals living in couples. Some recent econometric studies frame their analyses of time use in a manner that is consistent with the assumption of independent decision-making (see for instance Connelly and Kimmel 2010). Most empirical specifications related to time use include variables such as spouse's income and other characteristics without referring to a particular type of game or assumption about a couple's SWF.

If the Becker (1965) model is so influential and it does not require the assumption of a household unified by an altruistic head, why then are so many scholars associating Becker with the unitary model? Becker may have favored this interpretation. For instance, in section (e) Becker (1965) writes: "multi-person households also allocate the time of different members", which implies that the household rather than the individuals make decisions. More importantly, in his *Treatise on the Family* (1981, 1991) Becker creates the impression that he has a unified theory of the family. It could be that scholars trained after 1980, who mostly studied Becker's economics of the family from his *Treatise*, therefore concluded that one cannot pick and chose some of Becker's models of the household but not others. The title of the book suggests the following: Were it a unified theory, it would follow that the chapter on altruism in the family needs to be tied to chapters analyzing various household outcomes, such as fertility and consumption. It would also follow that Becker's own empirical research on household outcomes would be based on the assumption that families are run by men acting as benevolent dictators. This is far from being the case.

Becker's total set of economic analyses of the family – including the *Treatise* and all the published articles – does not consist of a unified theory but offers a smorgasbord of models. Of these models, Becker (1965) is a central building block of the NHE, and more so than Becker's unitary model (Becker 1976). Many of the models, including the 1965 model of allocation of time, are compatible with the assumption that individuals in multiperson households make decisions independently as well as with the assumption that households have a benevolent dictator making decisions for all household members. This is especially true of models with testable implications. This holds not only for Becker but also for others in the NHE tradition.

6 Independent Individual Decision-Making Models in the NHE

Jacob Mincer is the other founder of the NHE.[6] The first NHE publications were Becker (1960) on fertility and Mincer (1962) on women's labor supply, articles that recognized the importance of household production. The NHE developed principally in the 1960s at the labor workshop at Columbia University that was directed by both Becker and Jacob Mincer. Here are two statements about the importance of the Becker/Mincer cooperation on the NHE. The first is by Becker: "The decade Jacob and I spent working together was surely one of the most, if not the most exciting and fruitful in my life" (Becker 2006, p. 23). The second statement is by Michael Grossman, who was a student of Becker and Mincer: "Although they never published research together, their interaction with each other and with students at

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[6] See Grossbard-Shechtman (2001) for more on the history of the NHE.

the workshop and the publications that emerged from those interactions (...) resulted in the NHE" (Grossman 2006, p. 162).

It is hard to see an impact of Becker's altruism model – published in 1976, 7 years after Becker had left Columbia – on Mincer's contributions to the NHE. Mincer's first articles centered on the concept of household production (Mincer 1962, 1963) include econometric models that can also be derived from independent individual decision-making models, such as Mincer's (1963) equations of women's labor supply and demand for paid domestic services as functions of husband's income and wife's wage. However, Mincer specifically writes that he uses "total family income" (Mincer 1963) and that "the household, or family, in which income is pooled, is specified as the appropriate decision unit" (Mincer 1993, p. x). As a result, he overlooks part of the wife's wage's income effect on her hours of work in the labor force.

After he moved to Chicago in 1969, Becker developed models that are by no means unitary. His marriage models stand out in that respect. Becker's "theory" of marriage contains at least three separate models (Becker 1973 and Chaps. 2 and 3 in Becker 1981),[7] and these models all assume that individuals are the decision-makers, not multiperson households.

At least one prediction out of this work has had repercussions in the more recent bargaining and SWF literature: Becker's (1973, 1981, Chap. 2) prediction that sex ratios will affect individual consumption of wives and husbands. Becker's work on divorce (Becker et al. 1977, Chaps. 10 and 11 in Becker 1981) is also mostly consistent with independent individual decision-making assumptions.

Other Beckerian household decision-making models, such as Becker's fertility models (including Becker 1960; Becker and Gregg Lewis 1973) have household utility functions but they are vague as to the structures binding households. Generally, there is no reference to the benevolent altruist in most of Becker's empirical research on outcomes of household decisions, including most family behaviors singled out by the Nobel committee. This applies to his work on marriage, fertility, and divorce. In his empirical articles, I would describe Becker's approach to household decision-making as pragmatic in that it does not impose any structure on whether households make their decisions jointly or separately. In all of his work on marriage and divorce, he recognizes individuals as separate and often independent decision-makers.

Michael Grossman has become a world-renown health economist. His dissertation at Columbia, written under the guidance of Becker and Mincer, included a model of health production in the household and was eventually published as Grossman (1976). Again, this model is of a pragmatic nature, making no assumptions as to the distribution of health produced in a household or whether men and women play any cooperative or noncooperative games when investing in the human capital that helps them fight illness. He tested how his and her

[7] More on these separate models of marriage is found in Grossbard (2010).

resources – including each partner's education levels – affected both his and her health. This is not an empirical approach based on a unitary model. Until this day, Grossman's independent individual model of the production of health at home is widely cited in the literature in health economics but often misnamed the Human Capital model (rather than the home production or NHE model, see Anderson and Grossman 2009). Another student writing his dissertation under Becker and Mincer, Robert T. Michael, analyzed productivity in household production (see Michael 1973), with a focus on the effect of education on that productivity.

Becker's economic analyses of marriage inspired a number of students writing their dissertations on marriage under his guidance at Chicago in the 1970s, including Alan Freiden (see Freiden 1974), Michael Keeley (see Keeley 1977), and myself. In my dissertation on the economics of polygamy in Nigeria, I developed a model of household decision-making that considers spouses as independent decision-makers supplying or demanding work in household production. It is closely related to Becker's Demand and Supply models of marriage as well as to traditional labor economics models. This Demand and Supply analysis of women's household production work for the benefit of husbands included the concept of wife-wage (called "quasi-wage" in gender-neutral later writings; see Grossbard 1976). I developed this model into a general equilibrium model of individual allocation of time in multiple markets for labor and marriage in Grossbard-Shechtman (1984).

Based on Becker's Demand and Supply models of marriage, Grossbard-Shechtman (1984) assumes that individuals remain independent decision-makers after marriage as far as their supply of labor and their demand for goods are concerned. This article includes predictions that there will be compensating differentials in marriage and that sex ratios will affect individual labor supply. Later, the bargaining/SWF literature also obtained Becker's prediction regarding sex ratio effects on consumption (see McElroy 1990) and my prediction regarding sex ratio effects on labor supply (see Chiappori et al. 2002). The concept of compensating differentials in marriage developed in my model assuming independent individual decision-makers (Grossbard-Shechtman 1984) has been derived by Chiappori based on his SWF approach and has recently been analyzed empirically by Chiappori et al. (2010).

7 Becker's Models and His Students at Chicago in the 1970s

Even though they were published around the same time as his independent individual models of marriage – in the period 1965–1976 – Becker's unitary model of a benevolent altruist (Becker 1974, 1981, Chap. 8) did not have much success among students. The same holds for his sociobiological model (Becker 1974, 1981, Chap. 8), justifying gender differences based on biological factors, published around the same time. Students interested in economics of the family at Chicago in the 1970s realized the coexistence of Becker's many models of household decision-making. As first-year students we got to know Becker in his price theory course packed with a variety of maximization models and aimed at getting us to practice his specialty: applying calculus to everything. The message was as follows: "Identify a utility function and some constraints and do some calculus." A few of us also learned Beckerian household models in Gregg Lewis' labor supply courses he taught in 1974, some of which were developed by Gregg Lewis but never published.[8] Gregg Lewis also mentioned Glen Cain's research in which he estimated income's effect of husband on wife's labor supply separately from the effect of nonlabor income in the household (see Cain and Dooley 1976). We also learned about Cain's earlier empirical research on labor supply (Cain 1966). Such an independent individual model appeared to be in the tradition of the NHE even though Cain had not studied or worked with Becker or Mincer. We also got to learn some NHE models of the household from Jacob Mincer, who was a visiting professor at Chicago during the period 1974–1975.

Becker offered his course on the economics of the family for the first time in 1975–1976, while he worked on his *Treatise on the Family*, which eventually got published in 1981. Again, Becker showered students with what seemed like an endless stream of optimization models, but this time they all addressed issues related to household economics. One of the models was the benevolent dictator model. It was applied in the context of intra-household transfers.

Students interested in economics of the family also participated in Becker's workshop on Applications of Economics. I did so in the years 1974–1976. That Becker's various models coexisted and did not have to be integrated into one whole was obvious from some of the discussions that went on in Becker's workshop during this period, including a discussion on Becker's various models of marriage in which Ed Lazear also participated.

In his workshop, Becker gave a voice to the proponents of nascent game theories of marriage. Louis Wilde, a student at Rochester, presented a paper on marriage using Nash equilibrium in Becker's workshop in 1975. Marjorie McElroy did a postdoc at Chicago, invited by Becker, around 1977. During this time, she worked on her influential bargaining theory of marriage (McElroy and Horney 1981).[9]

Overall, the approach at Chicago in the 1970s was pragmatic: if a model helps develop interesting testable implications, it is worth keeping. All theoretical models are welcome, as long as they "work." There was no sense that Becker has a unified theory of decision-making in households. We as students got the impression that Becker is a virtuoso, a brilliant performer on the academic stage, able to produce a variety of thought-provoking models. The messages were: "It is OK to choose the model most appropriate for studying the issues you are researching" and "*Good economists* can pick and choose their models, depending on what works best." We were not expected to integrate Becker's various models. There was

[8] See Grossbard-Shechtman (2003) for models based on that course.

[9] More on this topic in Grossbard (2010, forthcoming).

no pressure on students to accept Becker's argument that there are good biological reasons why women should do more of the household production than men (see Suzanne Bergeron's (2009) critique on Becker's model that assumes a male breadwinner/female care worker division of labor, a model found for example in the *Treatise*). Nor was there pressure to adopt the unitary model of an altruistic household head. Personally, I was eager to dissociate myself from the sexist assumptions of Becker's sociobiological theories and the assumptions of the Rotten Kid theorem, which bothered me both as a feminist and as a strong advocate of family democracy. At the same time, I enthusiastically endorsed Becker's individual models of marriage and used them as the basis for my own modeling. Woolley (1996) also recognizes that it is possible to separate Becker's various models and adopt some but not all.

Those who learned about Becker's models of decision-making in households after 1980, even if they studied at Chicago, have probably received a different perception regarding the possibility of including independent individual models in analyses in the NHE tradition. By then, Becker had published his *Treatise*, in which he tried to convey a sense that he has a unified theory; Gregg Lewis, who had taught Beckerian models with an independent individual approach and with heavy emphasis on parallels between households and firms, had left Chicago; and Mincer – having rejected Chicago's offer to join the economics department as a full professor – did not teach at Chicago. Unitary models of Becker may have been perceived as even more central to his opus on the family from the perspective of scholars trained outside Chicago after 1980.

8 Conclusions

Other than Becker's, the most widely cited theoretical models of decision-making in households are mostly bargaining models and consensual models. These models avoid flaws of unitary models, such as the anonymity implication and the lack of concern for external factors such as marriage market conditions measured by sex ratios. These models often place themselves in contradistinction with Becker's unitary models and the NHE tradition that Becker cofounded with Jacob Mincer.

It has been argued in this chapter that most of Becker's own analyses of the family did not use his unitary model. Many of the models by Becker, Mincer, and other researchers in the NHE tradition are consistent with the assumption that individuals in families act independently, although their decisions may depend on resources and prior decisions by their spouses or other household comembers. Becker's marriage models include specifically independent individual models. Decision-making models assuming independent individual household members in the Becker tradition, such as Grossbard-Shechtman (1984), are reminiscent of models of labor markets in which firms and workers are independent decision-makers. As basis for econometric estimations, such models may be preferable to models imposing the structure of a game or a household welfare function.

Given the low profile of unitary models in the work of Becker and Mincer – the founders of the NHE – their students and other NHE contributors, and the fact that important parts of the NHE consist of models that are either explicitly assuming independent individual models of household decision-making or compatible with that assumption, it is time to dissociate the NHE and unitary models. It is time to give the NHE tradition more credit for its decades of wide-ranging productive research on labor supply, consumption, marriage, and divorce and to take more seriously early models developed prior to the publication of bargaining and SWF models.

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Chapter 3
Household Time Use, Inequality and Taxation

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Abstract This paper explores the implications for inequality measurement, and its applications to problems of tax/transfer policy, of the empirical patterns of household time use, in particular the existence of household production and child care.

Keywords Inequality • Income • Welfare • Policy

1 Introduction

A basic dilemma underlying the vast literature on the measurement of inequality is that, conceptually, we are concerned about inequality among *individuals* but empirically, we measure the inequality of the distribution of *household* income and consumption. The fact that individual well-being is determined by the way in which the household, consisting of at least two adults with or without children,[1] allocates its resources has of course been recognized in this literature for some time.[2] Recently, a number of papers, in particular Browning and Bonke (2009a, b), Browning and Gortz (2006) and Lise and Seitz (2010), have attempted to deal with this issue empirically. The papers by Martin Browning and his co-authors use newly available datasets giving information on the allocation of consumption among

[1] Throughout this chapter, whenever we refer to the word "household", we mean it in this sense; otherwise, we qualify it with "single-person".

[2] See in particular Haddad and Kanbur (1990), who provide a thorough analysis of the statistical aspects of this issue.

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household members to estimate household sharing rules, which show that on average consumption shares of the adults are roughly equal, though there is quite a high degree of (as yet largely unexplained) variation across households in these shares. Lise and Seitz use an explicit household welfare function[3] as a basis for estimating "the" household sharing rule, modelled essentially as a function of the relative wage rates of the two adults in the household. On the basis of this, they argue that the conventional equivalence scale approach understates the degree of inequality within households, because it does not take account of the gender wage gap, but it also fails to capture the extent to which this inequality has fallen over the past few decades, because of the narrowing of this gap.

Though this new research is welcome, it suffers from the limitation that it continues effectively to assume that households have only two uses of their time, market labour supply and leisure, and so ignores the existence of household production and intra-family exchange of domestic for market output. This cannot be excused on the grounds of data availability, since a large body of data on intra-household time use now exists, and a large and growing literature is concerned with analyzing it.[4]

These data reveal two important facts. First, they show that the allocation of time to household production, especially by the female partner, is a very significant form of time use, above all when children are present in the household, and that there is a high degree of substitution between market work and work at home, especially child care. It is this substitution which drives the observed much higher labour supply elasticities of women relative to men.

Second, the data reveal a high degree of (as yet largely unexplained) heterogeneity in time use allocations of the female partner, as the second earner, across households with similar demographic profiles and wage rates. In a household model which ignores domestic production, this can only be explained by differences in preferences for leisure, with high leisure consumption of one partner being financed by transfers from the earned income of the other (as well as possibly from the state). In the absence of such preference heterogeneity, household income in this model is a perfect indicator of household utility possibilities so that in carrying out across-household comparisons of well-being, the conventional approach of the inequality measurement literature appears to be quite appropriate. But then, it provides no explanation of female labour supply heterogeneity.

The recognition of the significance of household production as a form of time use upsets this approach to the household profoundly, and implies a limitation of conventional inequality measurement that is, in our view, of greater concern than that arising out of the recognition of the potential for intra-family inequality.

[3] This is a function, analogous to a social welfare function, which represents the household's preferences over utility profiles of its members. Its use goes back to a proposal by Samuelson (1956). For further discussion, see Apps and Rees (2009).

[4] See for example Gronau and Hammermesh (2006).

It implies that household labour income is no longer an unambiguous measure of household utility possibilities, and this has deep implications for the interpretation of inequality measures based on household income. In this chapter, we develop this point at some length, both theoretically and empirically, and go on to discuss its policy implications.

The chapter is organized as follows. In the next section, we analyze a formal model from which we draw our conclusions on the significant implications of the existence of household production for inequality measurement, both within and across households. In Sect. 3, we present empirical evidence to substantiate the modelling approach and its conclusions, and go on to apply the discussion to tax/transfer policy. Section 4 concludes.

2 Household Production and Inequality

2.1 The Model

A good way of thinking about a multi-person household with household production is as a small economy. It trades labour for market goods at exogenously given prices, and uses labour and capital to produce non-traded goods consumed within the household. Individuals specialize at least to some extent, for example in working at home *vs* in the market, and exchange domestic and market goods.[5] From this point of view, identifying household utility possibilities with labour market income is analogous to comparing welfare across countries on the basis of the values of their exports.[6]

Obviously, in the absence of production of non-traded goods the household's utility possibilities are entirely determined by its budget constraint, which, with the price of the composite market consumption good normalized at unity, depends entirely on its wage rates and non-wage income. Introducing "leisure" as a consumption good does not change this, as long as it is assumed that across all households, preferences are identical, one unit of time "produces" one unit of leisure, and the opportunity cost of an individual's time in each household is equal to her market wage. In this case, a ranking of households according to labour income and a ranking according to full income[7] (plus non-wage income in each case) would be identical and would be a perfect indicator of the height of a household's utility possibility frontier. It would be correct then only to worry about the problem of the within-household income distribution. This breaks down

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[5] For earlier formal models, see Apps (1981) and Apps and Rees (1988).

[6] This suggests giving the label "mercantilist" to the traditional approach to inequality measurement, which, however, is unlikely to be very much appreciated.

[7] The sum of the values of the products of market wage rates and total time endowments.

Table 3.1 Life cycle time use and earnings

	Male hours pa			Female hours pa			Earnings $pa	
Phase	Market	Domestic	Child care	Market	Domestic	Child care	Male	Female
1	2,226	731	–	1,845	984	–	48,955	34,217
2	2,249	786	993	846	1,641	2,520	46,457	16,480
3	2,260	778	340	1,255	1,839	795	49,045	22,360
4	2,072	854	–	1,273	1,794	–	41,392	22,168
5	454	1,258	–	253	1,723	–	7,032	3,839

if preferences differ, since then a household whose members have a high preference for leisure could have a higher full income but a lower labour income than another. In modern analyses of public policy, however, especially optimal taxation and tax reform, individuals are assumed to have identical preferences so that this problem does not arise.

If we introduce household production, this picture may change in two important respects. First, productivities in household production may vary across households, for example because of differences in human and physical capital. Second, market goods are used as inputs into household production and their prices may well vary across households.[8] In the absence of specific assumptions about the relationship between the relevant productivities or prices and wage rates, as well as on household preferences, it is then not possible to determine the direction and strength of the relationship between a household's labour income and its utility possibilities. This has important implications for public policy. We now make these points more precise in a formal model. Because of its importance as a form of time use (see Table 3.1), we take child care as our prototypical household good.

Assume that there are two household types, indexed $h = 1,2$, each consisting of two adults, a primary and a second earner, and a child, labelled $i = 1,2,k$ respectively. They each consume a market good x and the child consumes child care y, which is produced by combining parental time inputs t_i, $i = 1,2$ with a bought in market child care input z. We can think of the child care variable as a real number measuring the quality of child outcomes. The production function, assumed linear homogenous and strictly quasiconcave, is as follows:

$$y_h = \phi^h(t_{1h}, t_{2h}, z_h), \quad h = 1,2 \tag{3.1}$$

[8] In a model without household production, the idea that households may face different prices for the composite consumption commodity can be handled simply by defining their real wage rates as the ratio of the nominal wage rate to the consumption good price they face. In empirical studies it is usually, unrealistically, assumed that consumers always face the same market prices. In the present context, however, non-parental child care is a good example of a good whose cost varies, ranging from the opportunity cost of a grandmother's time, through the fees for a pre-school playgroup or creche, to the wage of a highly trained nanny. These differences may not reflect simply differences in quality, but rather random differences in availability.

where $\phi^h(\cdot)$ may differ across households, reflecting differences in productivities. Minimizing the cost $\sum_{i=1,2} w_{ih}t_{ih} + q_h z_h$ of producing one unit of y_h yields the implicit price of child care:

$$p_h = \gamma^h(w_{1h}, w_{2h}, q_h) = \sum_{i=1,2} w_{ih}t^0_{ih} + q_h z^0_h \tag{3.2}$$

where w denotes a wage rate, q_h the price of the market child care good, which may vary with $\gamma^h(\cdot)$ is a unit cost function independent of the output of child care, strictly increasing in its arguments, and t^0_{ih}, z^0_h are the quantities of the respective inputs that minimize the cost of producing one unit of y_h at $w_{ih}, q_h, \quad i = 1, 2$.

Adult utility functions are $u^i(x_{ih}, l_{ih}),\ i = 1, 2,$ where l_{ih} is leisure, and that of the child[9] is $u^k(x_{kh}, y_h),$ where we assume identical preferences across households. Using (1) and the household budget and individual time constraints, which require that time spent in leisure, child care and market work must sum to total time available, normalized at 1, we derive the *household full income constraint*:

$$\sum_{i=1,2,k} (x_{ih} + w_{ih}l_{ih}) + p_h y_h \leq \sum_{i=1,2} w_{ih} \equiv W_h \tag{3.3}$$

where W_h is the household's full income and for simplicity we have assumed no non-wage income.

The household is assumed to choose its resource allocation, values of the variables $x_{ih}, y_h, l_{ih},$ and $t_{ih},$ by solving problem:

$$\max_{x_{ih}, l_{ih}, y_h} H = H(u^f(\cdot), u^m(\cdot), u^k(\cdot); w_{1h}, w_{2h}) \quad \text{s.t.}(3.3) \tag{3.4}$$

where H is a household welfare function (HWF) which embodies the household's ordering of utility profiles of its members.[10] This is assumed to be quasiconcave and strictly increasing in utilities and an identical function across households. The inclusion of the wage rates, which are exogenous to the household, expresses the idea that the household's ordering over utility profiles depends on individual wage rates.[11] For example, if $H(\cdot)$ were a standard Nash bargaining function, inclusion of the wage rates expresses the dependence of the outcome on the individual threat points.

[9] We assume that all of the child's time is spent as leisure. This utility function could be that imputed to the child by its parents.

[10] This, rather than the individual utility functions defined only on own consumptions, expresses the love, care and concern that household members may have for each other.

[11] For further discussion of this function see Apps and Rees (2009), Chap. 3. We could also include additional exogenous variables, or "exogenous environmental parameter" in the terminology of McElroy (1990).

The value function of the problem in (3.4) is $V^h = V(p_h, w_{1h}, w_{2h}, W_h),$ which, because of the assumption of identical preferences and HWFs, is also identical across households. This can be called the household's indirect welfare function (IWF) and is a complete representation of the aggregate utility possibilities of the household. At a given set of wages and prices, household 1 can be said to be "better off" than household 2, regardless of the precise distribution of utilities and choices of resource allocation, if and only if $V^1 > V^2$. It is in this sense that we say that household 1 has higher utility possibilities than household 2: The set of utility profiles available to household 1 (through lump sum redistribution) lies everywhere above that available to 2, at the given wages and prices.[12] We should, however, not lose sight of the fact that wage rates affect household resource allocations through *four* channels: the value of full income; the prices of individual leisure consumptions; the price of child care; and the distribution of utilities.

Thus a household's utility possibilities depend on its wage rates and the price of non-parental child care. If wage rates are observable, then so are full income and the prices of leisure. However, p_h depends not only on wage rates and the price of the market child care good but also on the household's productivity in producing child care, as summarized in the function $\phi^h(\cdot),$ which would, therefore, have to be known to be able to construct a ranking of the household types in terms of their utility possibilities. We now consider how this ranking can be expected to relate to a ranking of the households on the basis of labour market income.

2.2 Household Income and Utility Possibilities

We assume in this subsection that households face identical wage rates, and so we write these now as w_i, $i = 1,2$. Moreover, since variations in productivity have qualitatively strictly opposite effects on p_h as variations in q_h, we focus on the latter and assume that the functions $\phi^h(\cdot)$ and, therefore, $\gamma^h(\cdot)$ are identical.[13] Thus, we can write household welfare as a function of q_h, $V(q_h),$ and clearly $V'(q_h) < 0,$ so that, on the assumptions we have made up to now, the household facing the lower price of market child care is unambiguously better off.[14] Let $q_1 < q_2,$ so that household 1 is this household. Then, a ranking on household income will correspond to this welfare ranking if and only if $\sum_{i=1,2} w_i L_{i1} > \sum_{i=1,2} w_i L_{i2},$ where $L_{ih} = 1 - t_{ih} - l_{ih}$

[12] To see this, give 1 and 2 the same utility values in each household, and note that u^k can be higher in $h = 1$ if and only if $V^1 > V^2$.

[13] See Apps and Rees (2009), Chap. 3 for an explicit analysis of the effects of productivity variations across households.

[14] Note also that we assume for simplicity that q_h has no distributional effects within the household.

is market labour supply of individual i in household h. A sufficient condition for this is that both labour supplies are decreasing in q_h, i.e.:

$$\frac{\partial L_{ih}}{\partial q_h} = -y_h \frac{\partial t_{ih}^0}{\partial q_h} - t_{ih}^0 \frac{\partial y_h}{\partial p_h} \frac{\partial p_h}{\partial q_h} < 0 \quad i = 1, 2 \tag{3.5}$$

where[15] we have used the fact that $t_{ih} = t_{ih}^0 y_h$.

The first implication of this result is that it cannot be concluded that the household with the lower price of child care will have higher market labour supplies. The first term on the right hand side is indeed negative, since a change in the price of market child care will cause a change in the parental time-intensity of child care in the same direction. This follows simply from cost minimization and the technology of child care production. The second term, however, is positive: a change in the price of market child care changes the overall price of child care in the same direction (at the rate z_h^0), but this will in turn change the demand for child care in the opposite direction, assuming, as seems reasonable, that child care is a normal good.[16] The strength of the first effect depends on the elasticity of substitution between market and parental child care, that of the second on the price elasticity of the household's demand for child care and the values of t_{ih}^0 and z_h^0.

The value of t_{ih}^0 determines how strongly a given change in child care affects the demand for the time of a particular parent. That of z_h^0 determines how large is the impact of a change in the price of market child care on the unit cost of child care overall. To assume that market income provides an accurate ranking of household utility possibilities when households face differing prices of market child care is effectively to assume that, everything else equal, the first term in (5) dominates the second.

We now look at the relationship between household income and utility possibilities from a different perspective, relaxing as we do so the simplifying assumptions we have made up to now. Suppose we observe that the two household types have incomes satisfying:

$$\sum_{i=1,2} w_{i1} L_{i1} = \sum_{i=1,2} w_{i2} L_{i2}; w_{11} L_{11} > w_{12} L_{12} \tag{3.6}$$

with the primary earner in the first household earning more than the primary earner in the second. Since the empirical evidence suggests that primary earners work very similar hours (see the next section), we can assume equivalently that $w_{11} > w_{12}$, while then assortative matching would suggest that $w_{21} > w_{22}$ and so $L_{21} > L_{22}$. Thus,

[15] In the light of the analysis in the next subsection, it is clear that here we have assumed that the distributional term $(\partial l_{ih}/\partial s_{ih})/\partial s_{ih}/\partial q_h)$ is small enough to be ignored. Note that the derivatives $\partial s_{ih}/\partial q_h$, $i = 1, 2, k$ must sum to 0, since full income is unaffected by a change in q_h.

[16] We can, in the usual way, use a Slutsky equation to decompose this into income and substitution effects.

we have two households with the same total income, one having higher wage rates, the primary earners working much the same hours and the secondary earner in the higher wage household working fewer hours than her counterpart in the low wage household. Given our model, what assumptions would we have to make to be able to conclude that they have the same utility possibilities?

Recalling the IWF $V^h = V(p_h, w_{1h}, w_{2h}, W_h)$, note first that although the household with the higher wage rates will also have the higher costs of leisure and, *other things equal*, child care, nevertheless the net effect of higher wages on its utility possibilities must be positive as long as it has a positive market labour supply.[17] Thus, if $V^1 = V^2$ this can only be because p_1 is higher than would be suggested from a comparison of wage rates *alone*. In other words, either the first household has sufficiently lower productivity in child care, or the price of its bought-in market child care must be sufficiently higher, or both. In each case, the implicit assumption must be that second earner market labour supply decreases with the overall price of child care, and, if productivities are the same across households, that the derivative in (5) is negative for $i = 2$ – a higher price of bought-in child care leads to a lower second earner labour supply.

To illustrate: Suppose that each household has a market income of $100,000, but in household 1 this is earned by the primary earner alone, with his partner working only at providing child care, whereas in household 2 both earners work full time, with the primary earner contributing $60,000 and the secondary earner $40,000. For these households to be equally well off, it would have to be the case that the value of child care produced by "full time work" in the first household is less than that produced in the second household with a much lower parental time input, which requires implausibly large differences in productivity and/or a much lower price of bought-in child care.

The purpose of this discussion is to clarify what assumptions have to be made to support the claim that household utility possibilities increase with household market income in the presence of household production, since this claim implicitly underlies the structure of tax/transfer systems in many countries. We now consider the implications of the model for the within-household distribution of utility.

2.3 Within-Household Distribution

In this subsection, we explore the relationship between the household allocations to individuals and the exogenous variables – wage rates and price of the market child care input – implied by the model presented in Sect. 2.1. We do this using the sharing

[17] Just as an oil exporting country gains from a higher price of oil even though it may be a major oil consumer also.

rule approach introduced by Samuelson (1956). Thus consider the individual choice problems[18]:

$$\max_{x_i, l_i} u^i(x_i, l_i) \text{ s.t. } x_i + w_i l_i \leq s_i \quad i = 1, 2 \tag{3.7}$$

$$\max_{x_k, y} u^k(x_k, y) \text{ s.t. } x_k + py \leq s_k \tag{3.8}$$

where s denotes a share in full income assigned to an individual in the household. Solving these problems results in the indirect utility functions $v^i(w_i, s_i)$, $v^k(p, s_k)$ with the usual properties. We could then think of the household as choosing these income shares optimally by solving:

$$\max_{s_1, s_2, s_k} H\left(v^1(\cdot), v^2(\cdot), v^k(\cdot); w_1, w_2\right) \text{ s.t. } \sum_{i=1,2,k} s_i \leq \sum_{i=1,2} w_i \tag{3.9}$$

to produce the *sharing rule* functions $s^i(w_1, w_2, p)$, $i = 1, 2, k$. Samuelson then showed that inserting these functions in the problems in (7) and (8) and solving yields precisely the same set of allocations as is obtained by solving the problem (4) in Sect. 2.1. This is essentially an application of two-stage budgeting: the household can be modelled *as if* it first distributes its full income among its members and then leaves them to maximize their individual utilities. Thus, we can derive the individual leisure demands[19] $l_i\left(w_i, s^i(w_{1,} w_2, p)\right)$, $i = 1, 2,$ consumption demands $x_i(w_i, s^i(w_1, w_2, p))$, $i = 1, 2, k$ and the demand for child care $y\left(p, s^k(w_1, w_2, p)\right)$.

The "distribution of income" within the household is described by the set of functions $\{s^i(\cdot)\}$, $i = 1, 2, k$. The function $s^k(\cdot)$ could be thought of as yielding "child costs". Note that the market consumption quantities x_i give only a partial value of i's full income share. Also required for an adult member of the household is the value, at the individual's wage rate, of his/her leisure consumption.[20] The existence of household production implies that this requires time use data, since leisure consumption cannot be calculated simply by subtracting hours of market work from the total time endowment. For a child, we also require the value of child care, which, under constant returns to scale, is the value of the parental time inputs plus bought in child care inputs. Again, therefore, time use data, as well as more conventional expenditure data, will be required.

Assuming functional forms for $H(\cdot)$ and the indirect utility functions $v^i(\cdot)$, $i = 1, 2, k$ allows the $s^i(\cdot)$ to be derived from the problem in (9). These could then be taken to the data and estimated.[21] The main problem here is that

[18] Since we are concerned with a single household, we drop the subscript h.

[19] These explain the point made in footnote (15) above.

[20] In a more comprehensive and realistic model, in which there would also be domestically produced consumption goods, the values of individual shares in these would also be part of the sharing rule. See Apps and Rees (2001).

[21] See Apps and Rees (2001) for an approach to this. Note that the functional form of the sharing rule is implied by the forms assumed for the HWF and the individual indirect utility functions.

the price of child care is not observable as data, but rather has to be estimated from a household production model. The lack of data on which to do this is the main obstacle to empirical estimation of this model. Approaches to estimating household sharing rules which "solve" this problem by ignoring household production, as for example in the papers discussed earlier, suffer, therefore, from a serious omitted variable problem.

3 Life Cycle Profiles of Income, Consumption and Time Use

3.1 From Theory to Data

In the preceding section we emphasized that the data do not (yet) exist to enable complete estimation of even the relatively simple model of the multi-person household with household production presented there. Nevertheless, we believe that this model provides a useful framework for discussion of both theoretical and empirical aspects of the household, and is indispensable in the analysis of many important aspects of policy involving households, for example tax-transfer policy. In particular, it suggests a new approach to analyzing the decisions on time allocation and consumption over the life cycle, and the way in which policy influences these.

In the model we focussed on child care as the relevant form of household production. Over the life cycle of the household, the period when child care plays such a central role is only one in a sequence of phases, which together make up what we call the "family life cycle".[22] Nevertheless, the data show that this phase is pivotal, essentially because of the effects of the time allocation decisions taken in this phase on the labour supply of the second earner, typically female, throughout the remainder of her life cycle. Following the arrival of children, and while they are still young, the household has to decide on the extent to which the second earner will allocate her time to child care as opposed to market work. There is a great deal of heterogeneity in the choices households make in this respect. This is exactly the concern of the analysis of the preceding section. The key point is that there appears to be considerable persistence of the effects of this decision over the remainder of the life cycle. Second earners who choose to work part time in the market, or not at all, are less likely to resume full time work across the remainder of the life cycle,[23] and this has important policy implications.

[22] For a comprehensive discussion of how this model relates to the existing life cycle literature see Chap. 5 of Apps and Rees (2009).

[23] This is supported by panel data studies. See, for example, Shaw (1994).

In this section we present data to support this view of the household. We model the family life cycle as consisting of five phases:

- Phase 1: The couple are of child-bearing age but do not yet have children.
- Phase 2: There is at least one child aged under 5 years in the household.
- Phase 3: The still-dependent children are all aged over 5 years.
- Phase 4: The couple are of pre-retirement age and there are no longer dependent children present.
- Phase 5: The couple are of retirement age.

These phases seem to us to characterize appropriately what we think of as a family life cycle.

3.2 Data

Our analysis is based on data from the Australian Bureau of Statistics (ABS) 2005–2006 Time Use Survey (TUS) and the ABS 2003–2004 Household Expenditure Survey (HES). The TUS provides detailed information collected by diary, for two diary days, on the allocation of time to labour market activities and nine non-market activities: personal care, education, domestic activities, child care, purchasing goods and services, voluntary work and care, social and community interaction, active recreation and passive leisure. We aggregate non-market activities into three categories: domestic work, child care and leisure.[24] Domestic work includes the activity episodes classified as "domestic activities" and "purchasing goods and services". Total time allocated to domestic work and child care is referred to as "household production" and the sum of time allocations to all other activities as "leisure". The HES contains data collected by interview on consumption expenditure, labour supply, earnings and non-labour incomes and estimates of government direct and indirect taxes and benefits. Both surveys provide data on a common set of demographic, education and occupation variables.

We select couples from each survey excluding those records reporting negative incomes in the HES.[25] Using regression models estimated on the TUS data, we merge information on time use with income and consumption data for each record in the HES sample. To ensure that the time constraint is satisfied, we predict time use ratios. We estimate as functions of observed variables the ratios of leisure to non-market time and child care to household production time. The regressors include dummy variables for age of youngest child, interaction variables that capture the effect of

[24] For each activity episode, information is recorded for a "primary" and, if relevant, a "secondary" activity. Where primary and secondary activities are reported, the weighting used is 0.6:0.4.

[25] This gives samples containing 2,085 records from the TUS and 4,064 records from the HES. Less than 4% of records report negative incomes in the HES sample.

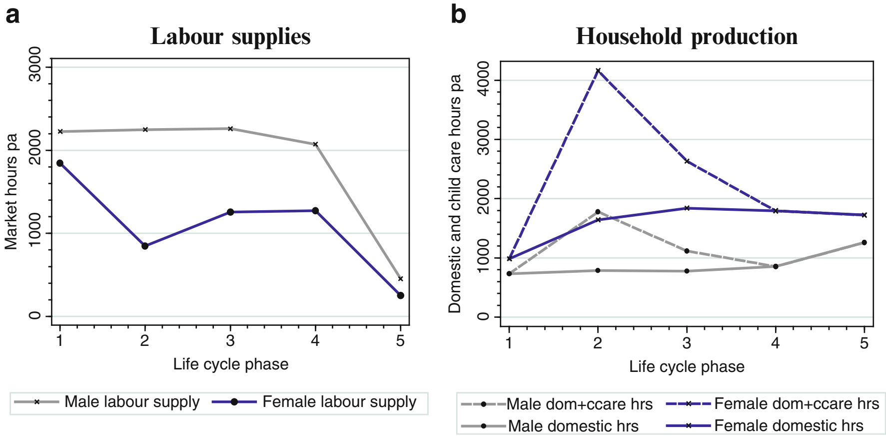

Fig. 3.1 Time use. (**a**) Labour supplies. (**b**) Household production

additional children at each age of youngest child, and the characteristics of the adults, including age and dummy variables for education and employment status.

In applying the "family life cycle" model discussed in the previous subsection, we adopt the following specification. Phase 1 couples are selected on the criteria that there are no dependent children present and the female partner is aged from 20 to 42 years. In phase 2, there is at least one child under 5 years present, and in phase 3 there is at least one dependent child but none under 5 years. The average number of children in phase 2 is 1.96 and in phase 3, 1.92. Phase 4 includes couples in which the male partner is under 60 years and there are no dependent children present. Because the central focus of the analysis is on time use choices, couples in which neither partner is employed or who have a household private income below \$15,000 in the prime aged phases are dropped from the sample. We also drop records in which either partner is a full time student. In phase 5, the male partner is aged from 60 to 79 years and there are no dependent children present. The final sample contains 3,547 records. The record numbers for phases 1–5 are: 462, 658, 951, 547 and 936, respectively.

3.3 Life Cycle Time Use and Incomes

When we organize time use data according to the five life cycle phases, the pivotal relationship between the demand for child care and female labour supply decisions becomes evident. Table 3.1 reports data means for the allocation of time to market work, domestic work and child care, and Fig. 3.1a, b presents the means across the life cycle phases. When the family enters phase 2 female labour supply falls by over 50%. This fall is more than matched by a rise in the allocation of time to household production, around 80% of which is child care. Because there are no children under 5 years in the household in phase 3, child care hours fall to a small

Table 3.2 Life cycle incomes and household production

Phase	H'hold	Male	Female	Net income	Hhp	Eq[a] net	Eq[a] net + hhp
1	89,428	53,730	35,698	68,676	23,315	34,338	45,996
2	71,529	52,513	19,016	60,353	79,226	21,972	33,663
3	83,405	57,362	26,043	66,632	49,310	24,264	36,702
4	73,739	47,712	26,026	57,335	35,201	28,667	46,268
5	26,361	17,002	9,358	33,175	39,139	16,587	36,156
Gini coefficients							
Phases 1–4	0.2903	0.4172		0.2327		0.2529	

Hhp = implicit expenditure on household production
[a]Equivalent adult

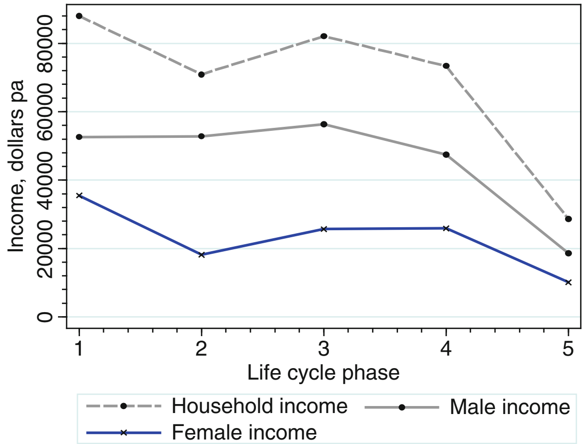

Fig. 3.2 Life cycle private incomes

fraction of their phase 2 level. Domestic hours rise only marginally, and similarly in phase 4. Nevertheless, average female labour supply remains well below its phase 1 level for the remainder of the life cycle. There is very little change in average male hours during the working age phases. The decline in phase 4, of around 200 hpa, in no way matches the drop in female hours in the younger phase 2 age category. The result is a large gender gap in hours across the life cycle. Overall, female market hours are only 53% of male hours. The data also show that the fall in female labour supply in phase 2 has an equally dramatic effect on female earnings and, in turn, on household income.

Table 3.2 reports data means for household private income and male and female private incomes. Figure 3.2 plots the life cycle profiles of these income variables to show graphically the way in which household income tracks female income and is, therefore, positively associated with female labour supply and negatively associated with household production.[26]

[26] Private income is defined by the ABS as all income from wages, investments, etc. Government benefits are not included.

The potential limit for downward bias in measures of inequality defined on money income that assume equality within the household is indicated by the Gini coefficients reported in the last row of the table. Since we are primarily interested in income variation due to heterogeneity in time use decisions in the working age phases, the coefficients are calculated on the data for households in phases 1–4 only. The results, 0.2903 for household private income and 0.4172 for individual private incomes, illustrate the effect of assuming that the total money income is divided equally between partners within each household, that is, of assuming on the one hand that an equal allocation of household private income is achieved by a lump sum transfer from the higher to the lower income partner, and on the other hand that no intra-household transfers are made. These, therefore, provide upper and lower bounds for the Gini coefficients corresponding to what may be thought of as the two extreme assumptions[27] regarding within-household income transfers: first, that they are such as to achieve complete equality of money incomes (and therefore, by implicit assumption, market consumption) within the household, and second, that no transfers take place at all, so that individual consumptions match individual incomes. Studies concerned with the possibility that such intra-family lump sum redistribution, though positive, does not lead to equality will typically yield a result that lies between the two coefficients. However, such studies omit household production. They, therefore, incorrectly assume that a partner working full time at home cannot make transfers to her partner (or to her children) if she has no money income.[28] Under this assumption, both Gini coefficients may be seriously biased when there is a high degree of unexplained heterogeneity in female labour supply.

Deflating household private income by an equivalence scale raises the Gini coefficient only marginally, because while the average household income of phase 2 is low, that of phase 3 is relatively high, and so there are offsetting effects. For example, if we apply an equivalence scale that sets a child's share to 0.4 of that of an adult, the Gini coefficient rises from 0.2903 to 0.3088.

Table 3.2 also reports household net income, obtained by subtracting government direct taxes and cash benefits from household private income. The data means for direct taxes net of cash transfers across phases 1–5 are as follows: $20,752; $11,176; $16,723; $16,404; and −$6,814, respectively. Overall, the system redistributes income from phases in which household income is high to those in which it is significantly lower. On average, direct taxes are at their highest level in phase 1, at $21,170, the phase which has the highest average household income because both partners in the vast majority of couples work full time in taxed market work, and with no dependents they receive little in cash benefits (an average of $418). By contrast, the average family in phase 2 pays only $16,207 in income taxes

[27] Of course, still more extreme would be that transfers are made from the lower to the higher income partner, or that the higher income partner transfers so much that the lower income partner ends up with higher income/consumption. We do not pursue these possibilities here, however.

[28] In Apps and Rees (1996) we refer to this model as the "transfer model" to distinguish it from our more plausible "exchange model".

and receives $5,031 under a joint income-tested family payment system. In phase 3, female labour supply rises and so income taxes rise and family payments fall. The government age pension accounts for the negative figure in the retirement phase. The Gini coefficient for net income, at 0.2327, is well below that for household private income. For equivalent adult net income, obtained by applying the same equivalence as above, we obtain a slightly higher coefficient of 0.2529.

Again, these results may change significantly when we introduce household production, since lower household incomes are systematically associated with higher implicit expenditures on home production. Table 3.2 reports an estimate of implicit expenditure on domestic work and child care based on valuing non-market time at the net wage.[29] Phase 2 has by far the highest implicit expenditure on home production, followed by phase 3, during the working age phases. However, much of the additional expenditure represents the cost of parental child care time.

From the data on parental child care it is clear that we cannot sensibly deflate expenditure on household production by the equivalence scale we applied to market income because almost all of the increase in non-market time in phase 2 is child care.[30] Expenditure on household production by the average couple in phase 1 is $23,315. Since there are no children present, this is the opportunity cost of time allocated entirely to domestic work. In phase 2, the implicit opportunity cost of domestic work rises to only $30,577. The remainder, $44,429, is the opportunity cost of child care.[31] Only the household's implicit expenditure on domestic work is unassigned. When we add this component to net income and apply the equivalence scale to the total, we obtain the result for equivalent adult "net + hhp" (net income plus expenditure on home production) reported in the last column of Table 3.2.[32] The life cycle distribution of this measure of income appears to be reasonably well correlated with equivalent adult net income. From the perspective of tax design by a government concerned to reduce inequality, this result might appear to suggest that omitting household production is a harmless simplification. However, the life cycle profiles of household income and home production in Table 3.2 represent averages for each phase and, therefore, conceal the very high degree of within-phase heterogeneity in female labour supply and household production decisions at given wage rates and demographic characteristics. It is this within-phase

[29] Gross wage rates are computed from hours and earnings data, and the predicted values are based on regression models estimated on data for workers, with the Heckman correction for selectivity applied in the estimation of the female wage equation.

[30] The same argument can be applied to the market income of the female partner (as second earner) in phase 2 because much of her net income will be spent on buying in child care.

[31] Apps and Rees (2001) show that when parental time cost of child care is included in the analysis of intrahousehold shares, the "cost" of a child is close to that of an adult.

[32] Note that adding the opportunity cost of leisure to net income and the cost of home production gives full income. In Apps and Rees (2009, Chap. 5), we obtain a U-shaped profile of full income. We attribute this to an imperfect capital market in which the borrowing rate is above the lending rate.

Table 3.3 Employment status by gender

	Males			Females		
Phase	FT	PT	SE/NE	FT	PT	SE/NE
1	92.4	6.7	0.9	72.6	20.5	6.9
2	91.3	6.9	1.8	21.7	40.1	38.2
3	91.8	6.0	2.2	36.2	43.1	20.7
4	83.2	10.2	6.6	38.5	35.9	25.6
5	16.5	7.4	76.1	6.7	11.2	82.1

heterogeneity that makes it essential to take account of household production in the measurement of inequality and in the construction of welfare rankings.

3.4 Heterogeneity

The high degree of within-phase heterogeneity in female labour supply following the first child is evident from employment status data. Table 3.3 reports the distributions of employment status across phases 1–4. "FT" refers to full-time employment (at least 35 h/week) and "PT" to part-time employment (between 1 and 34 h/week). "NE" denotes not in employment. Since the sample excludes households in which neither partner is out of employment in the working age phases, the presence of an NE partner defines a single-earner household in these phases. We, therefore, also apply the label "SE" to these households. The histograms in Fig. 3.3 show the high degree of heterogeneity in female employment that emerges in phase 2, and continues until the retirement phase. In phase 1 both partners in the large majority of couples work full time. Full time female employment then falls from 72.7 to 21.9%, and stays below 40% in subsequent phases. Over 20% remain out of employment. By contrast, male employment remains above 90% until the pre-retirement phase, where it drops to 82.2%.

Time use data show that married women employed full time within each of phases 2–4 allocate considerably less time to domestic work and child care than those employed part time or not in employment. To illustrate, Table 3.4 reports phase 2 data means for hours of market work, domestic work and child care, by female employment status. In the FT household, the female partner works a total of 5,227 h in the market and at home and in the PT household she works a total of 5,094 h per annum In the SE household total female hours of work are only fractionally lower, at 4,786 h per annum, even though market hours are 0. These diverse time use choices cannot be adequately explained by wage rates and demographics, as indicated by the data means in Table 3.5. There is little variation in predicted gross wage rates by employment status. The average numbers of dependent children, as well as the number under age five, also change very little with employment status. We can, therefore, infer that many families with the same demographic characteristics and earnings possibilities are making very different time use decisions. However, because the tax-transfer system is based heavily on

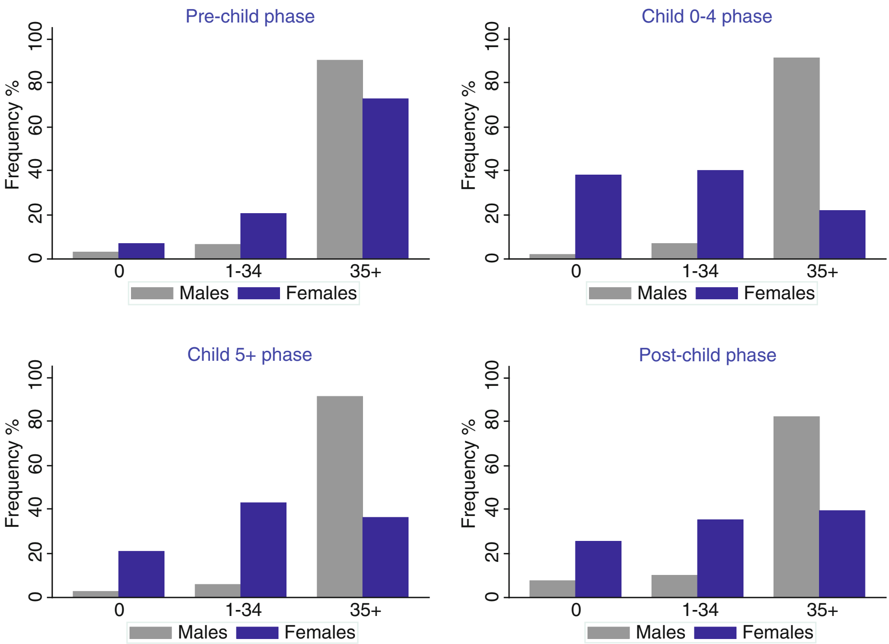

Fig. 3.3 Employment status by gender across phases 1–4

Table 3.4 Phase 2: Time use by female employment status

	Male hours pa				Female hours pa			
Female employment	Market	Domestic	C'care	Total	Market	Domestic	C'care	Total
FT	2,071	864	1,033	3,968	2,110	1,276	1,841	5,227
PT	2,320	787	1,034	4,141	959	1,602	2,533	5,094
SE	2,296	736	925	3,957	0	1,893	2,893	4,786

Table 3.5 Phase 2: Incomes, taxes, wage rates and demographics

Female employment	H'hold income	Net tax	Male wage	Female wage	Deps < 5 years	No. of deps
FT	91,199	19,007	20.79	19.54	1.20	1.71
PT	74,623	12,303	21.93	19.80	1.26	1.94
SE	57,132	5,555	21.05	18.93	1.37	2.12

household incomes, they can face very different levels of taxation. For example, the SE household has an annual private income of $57,132 and works a total of 2,296 h in the market. Net tax on income is $5,555. The FT household has additional income of $34,067, and works a total of 4,181 h. Net tax is $19,199, which gives an average tax rate on the additional income of 56.35%. Yet much of that additional income may be spent on buying in child care.

Table 3.6 Rankings by second earner employment status

Quintiles	1	2	3	4	5	All
Primary income $pa	24,962	38,282	47,652	59,288	105,723	55,301
SE%	48.3	42.0	38.1	34.2	37.1	40.0
PT	31.6	39.7	34.5	46.1	35.4	38.1
FT%	20.1	18.3	27.4	19.7	27.5	21.9
Household income $pa	30,177	47,002	62,174	80,631	137,670	71,076
NE%	70.7	61.3	30.8	16.4	20.4	40.0
PT	21.3	31.4	51.2	46.4	37.5	38.1
FT%	8.0	7.3	18.0	37.2	42.1	21.9

3.5 Household Income and Ranking Errors

We now investigate in further detail the potential for errors in a welfare ranking defined on household income, using the data for phase 2. Focusing on this specific phase, in which the demand for child care is at its highest, allows us to identify the effects of changes in female labour supply on earnings and, in turn, on household income, holding demographics approximately constant. Since the female partner has the higher earnings or higher private income in a non-trivial proportion of households, the analysis to follow is based on the income status of partners, primary or secondary, rather than on gender, as in the preceding sections. In phase 2, for example, the female partner has the higher income in around 15% of families, and this proportion is even higher in all other working age phases. This typically has the effect of increasing the degree of within-household inequality. From a policy perspective, a gender division of time use or income shares within households is especially questionable because selectivity in tax and welfare policies is normally defined on primary and second income status, and not on gender.[33]

The potential for ranking errors in an ordering defined on household income can be illustrated by comparing the ordering of single- and two-earner families defined on primary and household income. Table 3.6 presents this comparison for families in phase 2. Under the primary income ranking the position of a family does not change when it switches type from SE to PT or FT. Overall, 40% of families have a single earner, 22% have a full time second earner and the remaining 38% have a second earner in part time employment. The three types are distributed relatively evenly across primary income quintiles.

However, when we use household income as the welfare indicator, there is a very high degree of re-ranking. Two-earner families are much more strongly represented in the upper quintiles. In fact, a SE family in quintile 1 can be shifted to quintile 4 with the decision to switch to FT. To illustrate: the upper limit of quintile 1 is $39,364 and the lower limit of quintile 4 is $70,668. A single-earner family with an income of, say, $39,000 will be located in quintile 1. If the second

[33] In some countries, e.g. the USA, it is argued that this could be unconstitutional.

Table 3.7 Labour supplies and incomes by household type

Primary income quintiles	1	2	3	4	5	All
H1: Primary market hours pa	2,071	2,303	2,348	2,409	2,551	2,334
Second market hours pa	24	36	81	144	142	85
H2: Primary market hours pa	2,014	2,125	2,121	2,306	2,408	2,190
Second market hours pa	1,470	1,467	1,677	1,566	1,803	1,607
H1: Primary income $pa	26,437	38,179	46,985	58,603	111,337	56,298
Second income $pa	1,193	1,981	1,631	3,420	9,267	3,535
H2: Primary income $pa	23,247	38,377	48,026	59,450	102,114	55,061
Second income $pa	18,114	23,863	28,759	32,253	38,678	28,513

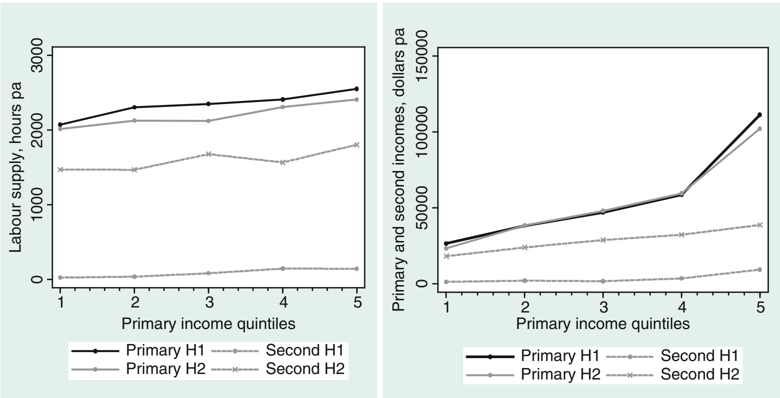

Fig. 3.4 Labour supplies and incomes by household type

earner decides to work full time for an income of $32,000, it will be re-ranked from quintile 1 to quintile 4.

The degree of re-ranking is due to heterogeneity in second earners' labour supplies, rather than to the shape of the distribution of the incomes of primary earners. To show this most clearly, we reclassify the households in each primary income quintile into two types, so as to obtain within each quintile equal numbers of households of each type:

Type H1. The second earner is working at or below the median second earner hours.

Type H2. The second earner is working above median second earner hours.

Table 3.7 and Fig. 3.4 present profiles of hours and incomes by quintiles of primary income for these two household types. The most important feature of the results is the relatively flat profile of primary income up to the 5th quintile, at which point it almost doubles. The increase is due almost entirely to an increase in the primary earner's wage, since average hours increase by less than 6%. In a distribution of primary income of this shape, the position of a family in a ranking defined on

Table 3.8 Second earner time use by primary income

Primary income quintiles	1	2	3	4	5	All
H1: Child care hours	2,797	2,902	2,812	2,950	2,941	2,878
Domestic hours	1,823	1,866	1,879	1,845	1,867	1,855
# Children under 5	1.28	1.37	1.28	1.49	1.46	1.38
H2: Child care hours	2,209	2,225	2,030	2,195	2,095	2,143
Domestic hours	1,410	1,440	1,403	1,454	1,400	1,419
# Children under 5	1.26	1.25	1.06	1.26	1.18	1.19

Table 3.9 Household type by household income

Household income quintiles	1	2	3	4	5	All
H1%	79.1	73.5	46.3	24.8	31.8	50.0
Primary income $pa	29,313	45,736	57,631	74,341	131,345	56,298
# Dependent children under 5	1.33	1.33	1.45	1.54	1.40	1.38
H2%	20.9	26.5	53.7	75.2	68.2	50.0
Primary income $pa	21,744	33,172	40,977	51,752	89,660	55,061
# Dependent children under 5	1.34	1.11	1.19	1.17	1.20	1.19

household income will be very sensitive to the labour supply of the second earner, because it will take only a small increase in her income to shift the family to a significantly higher point in the distribution, as illustrated by the numerical example given earlier.

In Table 3.8, the quintile data means for time use now show that the second earner's shift to market work tracks a large fall in the allocation of time to household production, and especially to child care, within each quintile of primary incomes. The table also reports the average number of children under 5 years in each quintile, to show that there is little variation in this across household types, especially in the lower quintiles. Thus, to justify the omission of household production from measures of household welfare it is necessary to argue either that bought-in child care is costless to the H2 household or that home child care makes little to no contribution to the welfare of the H1 household.

Table 3.9 presents a ranking by household income. The two household types are strongly polarized towards opposite ends of the distribution. The percentage of H2 households in quintile 1 falls to 21% and rises to 75 and 68% in phases 4 and 5, respectively. The average number of children under 5 years tends to be higher in the H1 household, apart from the first quintile. However, the differences are obviously not sufficient to drive the wide variation in time use choices.

The data means for primary incomes give an indication of the extent to which a household income ranking systematically places two-earner households with lower wage rates in the same percentile as a single-earner family on a significantly higher wage. The re-ranking could be justified on the basis of the assumption that the single earner has married a low wage partner, but this assumption is rejected by the evidence on assortative matching.

3.6 Family Tax/Transfer Policy

The analysis set out in this chapter so far provides the foundation for the argument that it is essential to measure inequality and evaluate tax reforms within the framework of a model that recognizes the multi-person household as a small economy engaged, to varying degrees, in production, particularly of child care, and intra-household exchange. This approach makes clear the importance of basing taxes on indicators of family welfare that take account of heterogeneity in the choice between home and market work following the arrival of children. Tax/transfer systems based on household income fail to do this.

Under a system of individual taxation, at any given level of primary income the two-earner family pays more tax than the single-earner household, because the second earner has chosen to work in the taxed market sector rather than in untaxed home production. A system of joint taxation with marginal rates increasing with household income imposes an additional penalty on the two-earner family by raising, at each given level of primary income, the marginal tax rate on both partners' incomes above the rate applying to the income of the single earner. The more progressive the marginal rate scale, the greater this effect. This can only be justified on equity grounds if the single-earner household is worse off than the two-earner household. In the preceding sections of this chapter we have suggested reasons for doubting that this is necessarily the case.

Many OECD countries still have systems of joint taxation, notably the USA and Germany. The UK moved to individual taxation in 1990 and Australia's income tax was always based on individual incomes. However, these two countries have recently moved to systems of partial joint taxation by introducing transfer payments that are withdrawn as a function of joint income. The USA has reinforced its system of joint taxation by introducing an Earned Income Tax Credit (EITC) programme under which the credit is withdrawn on joint income. Such systems raise marginal tax rates on joint income over the withdrawal range.

Under the tax systems of these countries, the second earner faces higher marginal and, therefore, higher average tax rates than the primary earner in the single-earner household, at a given level of primary income. If second earners have higher compensated labour supply elasticities than primary earners, this means that deadweight losses will be higher than under a system of individual taxation with the same total revenue requirement.

If we take the primary earner's labour supply to be fixed, the effect of such systems is to widen the average net of tax gender wage gap, given that the large majority of second earners are female. To the extent that outside opportunities determine within-family allocations, this can be expected to increase intra-family inequality. The systems also contribute to inequality across households, by imposing higher taxes on two-earner families than on single-earner households facing the same wage rates.

We illustrate the effects of joint taxation with the Australian family tax system, comprising the Personal Income Tax, Low Income Tax Offset and the system of

Table 3.10 Taxes by primary income

Primary income quintiles	1	2	3	4	5	All
H1 Tax $pa	−6,864	−1,856	2,636	8,340	33,780	7,363
Cash benefits $pa	10,621	8,579	7,098	5,169	2,758	6,850
ATR	−24.8	−4.6	5.4	13.3	28.5	12.3
H2 Tax $pa	971	9,492	13,630	18,439	38,563	16,029
Cash benefits $pa	5,218	3,874	2,156	1,644	941	2,710
ATR on additional income	2.3	15.3	17.8	20.1	27.4	19.2

joint income-tested family payments [Family Tax Benefits Part A (FTB-A) and Part B (FTB-B)]. As in the preceding section, we focus on households in phase 2 of the life cycle. Table 3.10 presents for these households the quintile distribution of taxes by quintiles of primary income and reports the average tax rate (ATR) on the primary income of the single-earner household and the effective rate on the additional income of the two-earner household.

The average income of the H1 household in quintile 1 is $26,437. This income attracts a negative tax of $6,864. If the household decides to switch type and earn additional income of $13,730 to raise its joint income to that of the H2 household, the family would pay $7,835 more in tax. The additional income is effectively taxed at an average rate of 57%. This very high rate is due primarily to the withdrawal of FTB-A on joint income and FTB-B on the income of the second earner. Both household types have very close to the same number of dependent children in total and under 5 years, yet the H2 household loses $5,405 pa in cash benefits – over 50% of the child payments received by the H1 household. The remainder of the additional tax, $2,432, is the tax on the second earner's income – the result of switching from untaxed home production to taxed market work.

By the 5th quintile, the ATR on the income of the H2 household is less than that on the H1 household because at around the 4th quintile the family payments are almost fully withdrawn, and the distributional impact of the progressive individual based income tax cuts in, with the result that at any given level of household income, a household with a higher primary income pays more tax. Thus, a progressive individual income tax has the effect of taxing home production indirectly, with the size of the tax rising with the degree of progressivity.

The introduction of a system of family payments withdrawn on joint income, which began in the 1980s and has been gradually expanded since then, can thus be seen as a reform that has replaced the progressive individual income tax and universal family payment system of the 1980s with a joint tax system with very high marginal rates on low and average second incomes at the lower end of the primary income ranking.

Under a system of full joint taxation the average tax rate on household incomes is the same across single- and two-earner households, since the rate scale is independent of the distribution of income between partners. The use of policy instruments, such as Australia's FTB system or the UK's Child Tax Credit and Working Tax Credit systems, tend to achieve close to joint taxation at the lower end and middle of the distribution of household income, but lose effect

Table 3.11 Taxes by household income

Household income quintiles	1	2	3	4	5	All
H1 Household income	30,215	46,694	61,497	79,268	147,370	59,832
Tax $pa	−5,706	1,386	7,907	18,532	44,128	7,363
ATR	−18.9	3.0	12.9	23.4	29.9	12.3
H2 Household income	30,035	47,853	62,759	81,080	133,190	83,574
Tax $pa	−2,575	3,218	8,046	14,140	35,435	16,029
ATR	−8.6	6.7	12.8	17.4	26.6	19.2

over the higher income ranges where the credits or payments have been fully withdrawn.

This is illustrated for the Australian case by the distribution of taxes by household income in Table 3.11. Both household types in the middle quintile have almost the same average tax rates, and so full joint taxation applies in this quintile. In the lower quintiles, the ATR on the income of the H2 types exceeds that of the H1 type. This is due to the withdrawal of FTB-B on the second income – at a given level of household income the two-earner family working longer hours and having to buy-in more child care pays more tax than the single-earner household. At higher income levels, the difference between average tax rates reverses because family payments are almost fully withdrawn and the progressive income tax takes effect. Thus, this type of tax system widens the net of tax wage gap between primary and second earners and increases inequality as between households with a single earner and those with two earners on lower wages.

4 Conclusions

In this chapter, we explore the implications for the measurement of inequality of taking account of household production as a significant form of economic activity. In relation to within-household inequality, this is important not only because the allocation of consumption of household goods as well as the allocation of market consumption must be taken into account, but also because it cannot be assumed that an individual's leisure consumption is given by subtracting time spent in market work from the total time endowment – we also need to subtract time spent in household production. The true intra-household distribution of full income,[34] which is the relevant concept for welfare analysis, may differ sharply from the distribution of consumption of market goods, just as in the overall economy, the distribution of national income will differ from the distribution of consumption of imports.

[34] Equal to the sum of consumptions of market goods, household goods and leisures.

At least as important, however, are the implications of household production for the measurement of across-household inequality. An important purpose in modelling within-household allocations in the presence of household production is to allow us to analyze rigorously the way in which female labour supply heterogeneity conditions the relationship between households' labour incomes and their utility possibilities. This analysis casts doubt on the idea of a simple monotonically increasing relationship between household income and welfare. A tacit belief in this relationship, however, seems to underlie much of public policy, especially tax-transfer policy, in many countries. Basing marginal tax rates on household income, either explicitly in the formal tax system, or implicitly, by withdrawing benefits as a function of household income, has the effect of shifting tax burdens on to low to middle-income households and in particular on to second earners, in a way which is both inequitable and inefficient. In widening the gap between net of tax wage rates of primary and second earners, it may also have regressive effects on the within-household allocation of full income.

Satisfactory empirical analysis of these issues requires better, more comprehensive datasets, particularly on measures of the inputs and outputs of household production, time use, and the within-household distribution of consumption. Resources will only be devoted to collection of these data when their importance for the formulation of policy is recognized. This chapter is intended to be a contribution to the process by which this recognition will be achieved.

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Chapter 4
Revealed Preference Tests for Collective Household Behavior

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Abstract This chapter contains a state of the art of revealed preference tests for consistency of observed household behavior with Pareto efficiency. These tests are entirely nonparametric, since they do not require any assumptions regarding the parametric form of individual preferences or the intrahousehold bargaining process. We start with a discussion of some tests that are based on Chiappori's (Econometrica, 56, 63–89, 1988) seminal labor supply model with egoistic preferences and observed individual leisure. We then present revealed preference conditions for Browning and Chiappori's (Econometrica, 66, 1241–1278, 1998) collective consumption model with general individual preferences (including public goods and externalities) and only aggregate household consumption observed. Finally, we deal with a test for special cases of the general model, one that is based on integer programming.

1 Introduction

The collective model explicitly recognizes that household consumption or labor supply behavior is the outcome of multiperson decision-making, with each individual decision-maker characterized by her or his own rational preferences. Following Chiappori (1988), it regards "rational" household behavior as the Pareto efficient outcome of an intrahousehold bargaining process. This collective approach contrasts with the conventional unitary approach, which models households as if they were single decision-makers. The collective model is quickly gaining in popularity. Part of this popularity may be explained by the fact that it, similar to the unitary

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model for singles, provides an attractive theoretical framework with clear testable implications. Still, testable implications of the collective model like the well-known SR1-condition (Browning and Chiappori 1998) or distribution factor proportionality (Bourguignon et al. 2009) are parametric in nature. Hence, they crucially depend on the functional form that is used for representing the individual preferences and the intrahousehold bargaining process. They do not only test the collective model as such but also an ad hoc functional specification; a rejection of the model may thus be due to misspecification.

In this chapter, we give an overview of recently proposed tests for consistency of observed household behavior with Pareto efficiency that do not require any assumptions regarding the parametric form of individual preferences or the intrahousehold bargaining process. More specifically, we focus on "revealed preference" tests in the tradition of, among others, Afriat (1967) and Varian (1982). This survey chapter first discusses the *Generalized Axiom of Revealed Preference* (*GARP*) test for the unitary model to introduce notation and to set the stage. The second part of the chapter is devoted to revealed preference tests for the collective model. We begin with early revealed preference tests based on Chiappori's (1988) standard labor supply model with egoistic preferences and observed individual leisure. These tests (explored by Snyder 2000; Cherchye and Vermeulen 2008) directly exploit the two-stage nature of the household decision process. We then discuss revealed preference conditions for Browning and Chiappori's (1998) collective consumption model with general individual preferences (including public goods and externalities) and only aggregate household consumption observed, which are based on Cherchye et al. (2007, 2008). Finally, we deal with a new approach, proposed by Cherchye et al. (2010b) to test special cases of the general model, one that makes use of integer programming.

2 Revealed Preference Tests for the Unitary Model

To make this chapter self-contained, we first consider the unitary model for rational household consumption behavior. Although the focus is on consumption in this section, we should remark that unitary labor supply behavior proceeds along the same lines.

The unitary model assumes that a household acts as if it were a single decision-maker. This implies that each observed household quantity bundle is assumed to maximize a single utility function subject to the corresponding household budget constraint.

Suppose that we observe a finite set of T price–quantity pairs. Let us denote the vectors of prices and quantities associated with observation t by $\mathbf{p}_t$ and $\mathbf{q}_t$, where $\mathbf{p}_t \in \mathbb{R}^N_{++}$ and $\mathbf{q}_t \in \mathbb{R}^L_{+}$. The dataset $S = \{(\mathbf{p}_t; \mathbf{q}_t),\ t = 1, \ldots, T\}$ represents the set of observations.

Let us now define (unitary) rationality. Rationality basically implies that the dataset under study could have been generated by a neoclassical utility maximizing consumer who is faced with a budget constraint:

Definition 1 (rationality). Let $S = \{(\mathbf{p}_t; \mathbf{q}_t),\ t = 1, \ldots, T\}$ *be a set of observations. A utility function U provides a rationalization of S if for each observation t we have* $U(\mathbf{q}_t) \geq U(\mathbf{q})$ *for all* $\mathbf{q}$ *with* $\mathbf{p}'_t\mathbf{q} \leq \mathbf{p}'_t\mathbf{q}_t$*.*

The only condition imposed on this utility function is that it is locally nonsatiated. As argued by Varian (1982), local nonsatiation avoids trivial rationalizations of the dataset: without this additional assumption, any observed household consumption behavior could be rationalized by a constant utility function.

A core result in the revealed preference approach to demand is that there exists a locally nonsatiated utility function that provides a rationalization of the set of observations S if and only if the data satisfy the *Generalized Axiom of Revealed Preference* (*GARP*).

Definition 2 (GARP). Let $S = \{(\mathbf{p}_t; \mathbf{q}_t),\ t = 1, \ldots, T\}$ *be a set of observations. The set S satisfies GARP if there exist relations* R_0, R *that meet:*

(i) If $\mathbf{p}'_s\mathbf{q}_s \geq \mathbf{p}'_s\mathbf{q}_t$ then $\mathbf{q}_s R_0 \mathbf{q}_t$
(ii) If $\mathbf{q}_s R_0 \mathbf{q}_u, \mathbf{q}_u R_0 \mathbf{q}_v, \ldots, \mathbf{q}_z R_0 \mathbf{q}_t$ for some (possibly empty) sequence $(u, v, \ldots, z)$ then $\mathbf{q}_s R \mathbf{q}_t$
(iii) If $\mathbf{q}_s R \mathbf{q}_t$ then $\mathbf{p}'_t\mathbf{q}_t \leq \mathbf{p}'_t\mathbf{q}_s$

In words, the bundle of quantities $\mathbf{q}_s$ is *directly revealed preferred* over the bundle $\mathbf{q}_t$ (i.e., $\mathbf{q}_s R_0 \mathbf{q}_t$) if $\mathbf{q}_s$ were chosen when $\mathbf{q}_t$ were equally attainable (i.e., $\mathbf{p}'_s\mathbf{q}_s \geq \mathbf{p}'_s\mathbf{q}_t$); see condition (i). Next, the *revealed preference* relation R exploits transitivity of preferences; see condition (ii). Finally, condition (iii) imposes that the bundle of quantities $\mathbf{q}_t$ cannot be more expensive than revealed preferred quantities $\mathbf{q}_s$.

As indicated above, any set S of price–quantity pairs can be rationalized by a locally nonsatiated utility function if and only if these price–quantity pairs satisfy *GARP*. This remarkable result is formalized and extended in the following theorem (Varian 1982, based on Afriat 1967).

Theorem 3 (Afriat theorem). *Let* $S = \{(\mathbf{p}_t; \mathbf{q}_t),\ t = 1, \ldots, T\}$ *be a set of observations. The following statements are equivalent:*

(i) *There exists a utility function U that satisfies local nonsatiation and that provides a rationalization of S.*
(ii) *The set S satisfies* GARP.
(iii) *For all* $t, r \in \{1, \ldots, T\}$, *there exist numbers* $U_t, \lambda_t \in \mathbb{R}_{++}$ *that meet the Afriat inequalities*

$$U_r - U_t \leq \lambda_t \mathbf{p}'_t(\mathbf{q}_r - \mathbf{q}_t).$$

(iv) *There exists a continuous, monotonically increasing, and concave utility function U that satisfies local nonsatiation and that provides a rationalization of S.*

In this result, condition (ii) implies that data consistency with *GARP* is necessary and sufficient for a rationalization of the data. Condition (iii) provides an equivalent characterization in terms of the so-called *Afriat inequalities*. These inequalities allow an explicit construction of the utility levels and the marginal utility of income associated with each observation t (i.e., utility level U_t and marginal utility of income λ_t for observed quantities $\mathbf{q}_t$). Finally, condition (iv) states that if there exists a utility function that provides a rationalization of the set S, then there exists a continuous, monotone, and concave utility function that provides such a rationalization. This also implies that continuity, monotonicity, and concavity of the data rationalizing utility function are nontestable for the basic model. In other words, if a utility function exists that rationalizes the dataset S, then the data can in fact also be rationalized by a utility function with the nice properties of continuity, monotonicity, and concavity.

Early applications of the revealed preference consistency test for the unitary model were applied to aggregate consumption time series data (see, e.g., Landsburg 1981; Varian 1982). Varian (1982) checked consistency with *GARP* of US aggregate consumption and found no violations of *GARP*. One problem with such (mainly post-war) datasets, though, is that they are characterized by relatively little relative price variation and big increases in income. This implies less room for potential *GARP*-violations: if budget sets do not cross, any (whatever irrational) behavior can be rationalized by means of the unitary model. A first application to microdata was conducted by Famulari (1995). She checked consistency with *GARP* on a series of cross-sections drawn from the Consumer Expenditure Survey. She divided her sample in 43 datasets on the basis of some observable household characteristics and checked consistency with *GARP* of each of these datasets. Although some of the datasets where consistent with *GARP*, most datasets could not be rationalized by means of the unitary model without accounting for measurement error.

The results discussed in Famulari's (1995) paper do not shed light on which types of households (e.g., singles versus couples) are closer to consistency with *GARP*. Such exercises have been conducted in a parametric framework (see, e.g., Fortin and Lacroix 1997; Browning and Chiappori 1998; Vermeulen 2005). The bottom line of these studies is that the unitary model seems to perform well when applied to singles, while the collective model outperforms the unitary model when focusing on couples. The next section presents revealed preference tests for the collective model and discusses some empirical evidence.

3 Revealed Preference Tests for the Collective Model

This section consists of two parts. The first part is devoted to early revealed preference tests of Chiappori's (1988) seminal collective labor supply model. These early tests have in common that they focus on collective labor supply models where the individual preferences of the household members are assumed to be egoistic.

Moreover, they have a partial nature. The second part of this section introduces some "modern" revealed preference tests of the collective model. In this part, the focus is on household consumption behavior. Interestingly, these models will be more general in the sense that there is room for public consumption and externalities inside the household. Contrary to the earlier tests, these tests can be considered as complete.

3.1 Early Tests

The collective approach essentially differs from the unitary approach in that each household member is characterized by own rational preferences, with household decisions resulting from a Pareto efficient bargaining process (Chiappori 1988, 1992). Although the individuals' preferences can be very general, we restrict attention to *egoistic* preferences in this section; preferences only depend on own (private) consumption and leisure. Empirically, the modeling of this collective approach is somewhat more involved than the unitary approach as the private consumption of each household member is usually not observed; labor supply datasets only reveal information on total household income (consumption).

We consider a two-member (1 and 2) household. Suppose that we observe a finite set of T observations. Each observation t contains both individuals' hours worked $\left(h_t^1, h_t^2\right)$ and wage rates $\left(w_t^1, w_t^2\right)$ and the household's aggregate income c_t. This aggregate income equals the sum of total labor income $(w_t^1 h_t^1 + w_t^2 h_t^2)$ and the household's aggregate nonlabor income y_t. Leisure is equal to the difference between the total time available x and hours worked h_t^i, and is denoted by l_t^i. The household's aggregate income is allocated to both individuals. The result of this allocation is not observed in general. Individual i's part of the consumption is denoted by c_t^i, where $c_t^1 + c_t^2 = c_t$. We further denote the vectors $\left(1, w_t^i\right)'$ and $(c_t^i, l_t^i)'$ by respectively $\mathbf{w}_t^i$ and $\mathbf{l}_t^i$. The observed dataset S is, in this labor supply setting, equal to $\{(c_t, l_t^1, l_t^2; w_t^1, w_t^2, y_t),\ \ t = 1, \ldots, T\}$.

Each individual's preferences are represented by a (nonsatiated) utility function that depends on individual consumption and leisure $v^i(c_t^i, l_t^i)$. The bargaining process within a household is captured by a sharing rule $\phi(w_t^1, w_t^2, y_t)$, which determines the distribution of the household's nonlabor income y_t over the household members. This sharing rule is formally defined as follows (see e.g., Chiappori 1988, 1992).

Definition 4 (sharing rule). A sharing rule ϕ *is a function which maps the vector* $(w_t^1, w_t^2, y_t)'$ *to* $\phi(w_t^1, w_t^2, y_t) = (y_t^1, y_t^2)$ *such that* $y_t^1 + y_t^2 = y_t$.

The sharing rule concept allows us to model household behavior as a two-stage budgeting process. After dividing the household's aggregate nonlabor income in the first stage, each individual faces a maximization problem that is formally similar to the unitary model's maximization program at the level of the household:

$$\max_{c_t^i, l_t^i} v^i\left(c_t^i, l_t^i\right) \text{ subject to } c_t^i + w_t^i l_t^i \leq y_t^i + w_t^i x$$

Chiappori (1992) demonstrated that the resulting household allocation is always Pareto efficient (and that each Pareto efficient allocation can be represented by such a two-stage budgeting process).

It turns out that this alternative interpretation of Pareto efficient household behavior is particularly convenient within the nonparametric context, as it entails the same kind of *GARP* tests as for the unitary model. Indeed, if we knew private consumption for each observation (c_t^1 and c_t^2), then we could immediately check consistency of the observed data by using the standard *GARP* tests at the level of the *household members*. In practice, however, we do *not* observe the intrahousehold allocation of total consumption, and, hence, we obtain the following condition for the collective model (see also Chiappori 1988):

Proposition 5. *Let* $S = \{(c_t, l_t^1, l_t^2; w_t^1, w_t^2, y_t),\ t = 1, \ldots, T\}$ *be a set of observations. The set S is consistent with a* collective rationalization with egoistic agents *if there exist T pairs of real numbers* $(c_t^1, c_t^2)'$ *such that for all* $t = 1, \ldots, T$:

$$\begin{aligned}&c_t^1 + c_t^2 = c_t\\&c_t^1, c_t^2 \geq 0\\&c_t^1 + c_t^2 + w_t^1 l_t^1 + w_t^2 l_t^2 \leq y_t + w_t^1 x + w_t^2 x\end{aligned}$$

and GARP *is satisfied* at the individual level $(i = 1, 2) : \forall t,\ s \in \{1, \ldots, T\}$, *if* $\mathbf{l}_t^i R \mathbf{l}_s^i$ *then* $\mathbf{w}_s^{i\prime} \mathbf{l}_s^i \leq \mathbf{w}_s^{i\prime} \mathbf{l}_t^i$.

This condition constitutes the natural counterpart to the unitary *GARP* test. Indeed, given that the intrahousehold consumption allocation is not observed, we only need that there exists at least one feasible allocation entailing individual labor supply data $\{(c_t^i, l_t^i; w_t^i, y_t^i = c_t^i - w_t^i h_t^i), t = 1, \ldots, T\}$ that are consistent with *GARP* for *both* individuals.

Snyder (2000) proposed a necessary and sufficient test for a collective rationalization with egoistic agents for datasets consisting of two observations. The test makes use of semialgebraic theory and only involves observable information (so, the test does not need knowledge about the unobservable individual consumption levels c_t^1 and c_t^2). Snyder starts from the observation that the above definition of collective rationality, applied to a dataset where $T = 2$, implies a finite set of polynomial inequalities defined over a finite set of observed and unobserved variables. She then derives a set of testable implications by means of quantifier elimination. More specifically, the quantified variables that are eliminated are the unobservable consumption levels c_t^1 and c_t^2. Once these quantified variables are eliminated, the following testable implications, in terms of only observables, are obtained for datasets with only two observations (see Snyder 2000, for more details).

Proposition 6. *Let* $S = \{(c_t, l_t^1, l_t^2; w_t^1, w_t^2, y_t), t = 1, 2\}$ *be a set of two observations. The set S is consistent with a* collective rationalization with egoistic agents *if and only if the following nonparametric restrictions are satisfied:*

$\forall t = 1, 2 : c_t = y_t + w_t^1 h_t^1 + w_t^2 h_t^2$ *and* $\exists t,\ s = 1, 2,\ t \neq s$ *such that*

$$(c_s + w_t^1 l_s^1 > w_t^1 l_t^1 \ \ \textit{and} \ \ c_t + w_s^2 l_t^2 > w_s^2 l_s^2)$$

or

$$(c_s + w_t^1 l_s^1 + w_t^2 l_s^2 > c_t + w_t^1 l_t^1 + w_t^2 l_t^2 \text{ and } c_s + w_t^1 l_s^1 > w_s^1 l_s^1 \text{ and } c_s + w_t^2 l_s^2 > w_t^2 l_t^2).$$

The above theorem thus implies that if the nonparametric restrictions are not satisfied for a dataset with two observations, then there does not exist a collective rationalization with egoistic agents for this dataset (necessity part). On the contrary, if the restrictions are satisfied, then the dataset can be collectively rationalized (sufficiency part).

Snyder (2000) applied her test to labor supply data drawn from the National Longitudinal Survey of Men. The test is applied to 243 working couples with no children coming from the 1969 and 1971 waves. Each household's data form a separate set S with two observations. About 98% of the couples satisfied *GARP*, while all couples satisfied the collective rationality restrictions. All in all, the unitary model performed rather well for this sample. This is probably not too surprising given that the different datasets contain only two observations.

One disadvantage of Snyder's (2000) test is that it is only necessary and sufficient for datasets with only two observations. Presumably, the quantifier elimination technique gets too involved when more observations (i.e., more revealed preference relations with more unobservables) are in the game. However, her test can still serve as a necessary condition for a collective rationalization with egoistic agents when applied for any subset of two observations of the bigger dataset. In this sense, the test can be seen as partial.

An alternative partial test has been proposed by Cherchye and Vermeulen (2008). Their starting point is that a collective rationalization with egoistic agents boils down to testing *GARP* conditional upon an intrahousehold consumption allocation (c_t^1 and c_t^2 corresponding to y_t^1 and y_t^2). Specifically, they impute (unobserved) individual consumption levels by exploiting a systematic finding in parametric studies of collective labor supply, namely the positive correlation between the male/female member's share of total nonlabor income and the corresponding individual wage (e.g., Chiappori et al. 2002; Vermeulen 2005).

Using this finding, their nonparametric testing exercise considers the following pair of distributions for the female consumption share s_t^1 ($= c_t^1/c_t$; the corresponding male share equals $s_t^2 = 1 - s_t^1$): the first distribution has mean 0.40 and a cumulative probability of 95% for the values between 0.35 and 0.45; the second distribution has mean 0.60 and a cumulative probability of 95% for the values between 0.55 and 0.65. From these distributions, they draw 1,000 combinations of s_t^1 values $(t = 1, \ldots, T):$ if $w_t^2 \geq w_t^1 (w_t^1 < w_t^2)$ then s_t^1 is drawn from the first (second) distribution. They subsequently select the combination of shares with the highest number of individual (male and female) household members passing *GARP*.

This approach does not guarantee the most favorable treatment of the collective model: to ensure computational tractability, their procedure restricts attention to a limited number of possible combinations of intrahousehold allocations; there may well exist other, noninvestigated, combinations that are associated with an even higher number of individuals consistent with *GARP*.

Cherchye and Vermeulen (2008) compared the empirical performance of both the unitary model and the collective model with egoistic agents based on data drawn from the DNB Household Survey (formerly known as the CentER Savings Survey). They focused on three subsamples: female singles (522 observations), male singles (888 observations) and couples without children (586 observations). Contrary to Snyder (2000), they assume homogeneous preferences of respectively men and women in different couples (similar assumptions were called upon by Famulari 1995). Their assessment of the theoretical models concentrated on two types of (nonparametric) empirical performance measures: *goodness-of-fit* measures and *power* measures. The goodness-of-fit measure focused on is the improved violation index (or efficiency index) proposed by Varian (1993). The index indicates the degree to which the data are "optimizing" in the sense of the evaluated behavioral model. More specifically, the index gives for each observation the minimal perturbation of the expenditure level that guarantees consistency of the observed set S with *GARP* at the household level (for the unitary model applied to couples) or *GARP* at the individual level (for the collective model and the unitary model applied to singles). See Varian (1993) and Cox (1997) for more discussion of this goodness-of-fit measure. Next to goodness-of-fit, some power measures for the different models were calculated. These measures were based on Bronars (1987; also Cox 1997). Both series of measures are complementary, since favorable goodness-of-fit results, indicating few violations of a model's behavioral restrictions, have little meaning if the behavioral implications have low power, i.e., optimizing behavior can hardly be rejected.

The main results of Cherchye and Vermeulen (2008) can be summarized as follows. Firstly, they found that the unitary model performed significantly worse when applied to couples than when applied to singles. As these results could not be attributed to power differences, one could conclude that they signal violations of the preference aggregation assumptions that underlie the unitary model; or that multiperson households do not behave as single decision-makers. Secondly, the collective model fitted observed couples' behavior much better than the unitary model. Again, this significant difference could not be explained by power differences. Their findings do not only indicate that the unitary approach is too restrictive for modeling the behavior of multiperson households but also that the collective model constitutes a more promising alternative. As such, this endorses the results obtained in the parametric literature by Fortin and Lacroix (1997), Browning and Chiappori (1998) and Vermeulen (2005).

3.2 Modern Tests

The collective labor supply model focused on above is characterized by two features. First, preferences of the household members were assumed to be egoistic: each member only derives utility from own leisure and own private consumption. Second, while an individual's private consumption in multiperson households is generally unobserved in standard labor supply data, individual leisure is. We next focus on more general collective consumption models. We first discuss the collective consumption model of Browning and Chiappori (1998). In addition, we focus on special cases of this general model, which are still more general than those discussed earlier.

3.2.1 A General Collective Consumption Model

The most general model in what follows has been presented by Browning and Chiappori (1998). This model allows for public goods inside the household and externalities with respect to privately consumed goods. Moreover, it is based on the assumption that the econometrician only observes the household's aggregate consumption of the modeled goods. Browning and Chiappori (1998) and Chiappori and Ekeland (2006, 2009) focused on the parametric characterization of this model, its testable implications, and its (lack of) identifiability. In this section, we consider the same issues from a nonparametric (revealed preference) angle.

We focus on the case with two household members (but all results can be generalized to households of any size). Like before, we consider a set of observations $S = \{(\mathbf{p}_t; \mathbf{q}_t),\ t = 1, \ldots, T\}$. To model externalities and public consumption, we consider *personalized quantities* $\hat{\mathbf{q}}_t = (\mathbf{q}_t^1, \mathbf{q}_t^2, \mathbf{q}_t^h)$. These personalized quantities decompose each (observed) aggregate quantity bundle $\mathbf{q}_t$ into quantities $\mathbf{q}_t^1$ and $\mathbf{q}_t^2 \in \mathbb{R}_+^N$ capturing the private consumption of each household member and quantities $\mathbf{q}_t^h \in \mathbb{R}_+^N$ representing public consumption. Of course, the different components of $\hat{\mathbf{q}}_t$ must add up to the aggregate quantity bundle for each observation t:

$$\mathbf{q}_t = \mathbf{q}_t^1 + \mathbf{q}_t^2 + \mathbf{q}_t^h. \tag{4.1}$$

Each member m has a nonsatiated utility function U^m that is nondecreasing in these personalized quantities, which effectively accounts for (positive) externalities and public consumption.

The collective model then regards the observed household consumption as the Pareto efficient outcome of a bargaining process between the two household members. This is formalized in the next definition:

Definition 7 (collective rationality). Let $S = \{(\mathbf{p}_t; \mathbf{q}_t),\ t = 1, \ldots, T\}$ be a set of observations. A pair of utility functions U^1 and U^2 provides a collective rationalization of S if for each observation t there exist feasible personalized quantities $\hat{\mathbf{q}}_t$ and $\mu_t \in \mathbb{R}_{++}$ such that:

$$U^1(\hat{\mathbf{q}}_t) + \mu_t U^2(\hat{\mathbf{q}}_t) \geq U^1(\hat{\mathbf{q}}) + \mu_t U^2(\hat{\mathbf{q}})$$

for all $\hat{\mathbf{q}} = (\mathbf{q}^1, \mathbf{q}^2, \mathbf{q}^h)$ with $(\mathbf{q}^1, \mathbf{q}^2, \mathbf{q}^h) \in \mathbb{R}_+^N$ and $\mathbf{p}'_t(\mathbf{q}^1 + \mathbf{q}^2 + \mathbf{q}^h) \leq \mathbf{p}'_t\mathbf{q}_t$.

The Pareto weight μ_t can be interpreted as the relative bargaining weight for the second household member; it represents the weight that is given to this member's utility in the intrahousehold optimization process. Contrary to the earlier discussed collective models (where a higher share in nonlabor income implies more private consumption and more leisure if it is a normal good), a higher Pareto weight does not necessarily imply more private consumption. This will depend on the relative valuation of the arguments in the utility function.

Cherchye et al. (2007), based on Chiappori (1988), established a nonparametric characterization for a collective rationalization of the dataset S. Let us first define *feasible personalized prices* $(\hat{\mathbf{p}}_t^1, \hat{\mathbf{p}}_t^2)$ for observed aggregate prices $\mathbf{p}_t$, as follows:

$$\begin{aligned}&\hat{\mathbf{p}}_t^1 = \left(\mathbf{p}_t^1, \mathbf{p}_t^2, \mathbf{p}_t^h\right) \quad \text{and} \quad \hat{\mathbf{p}}_t^2 = \left(\mathbf{p}_t - \mathbf{p}_t^1, \mathbf{p}_t - \mathbf{p}_t^2, \mathbf{p}_t - \mathbf{p}_t^h\right) \quad \text{with} \\ &\mathbf{p}_t^1, \mathbf{p}_t^2, \mathbf{p}_t^h \in \mathbb{R}_+^N \quad \text{and} \quad \mathbf{p}_t^c \leq \mathbf{p}_t (c = 1, 2, h).\end{aligned} \tag{4.2}$$

This concept complements the concept of feasible personalized quantities in (1): $\hat{\mathbf{p}}_t^1$ and $\hat{\mathbf{p}}_t^2$ capture the fraction of the price for the personalized quantities $\hat{\mathbf{q}}_t$ that is borne by, respectively, members 1 and 2; $\mathbf{p}_t^1$ and $\mathbf{p}_t^2$ pertain to private quantities and $\mathbf{p}_t^h$ to public quantities. Based on (1) and (2), we can define a *set of feasible personalized prices and quantities* as:

$$\hat{S} = \left\{\left(\hat{\mathbf{p}}_t^1, \hat{\mathbf{p}}_t^2; \hat{\mathbf{q}}_t\right),\ t = 1, \ldots, T\right\}. \tag{4.3}$$

We then have the following result.

Proposition 8. *Let $S = \{(\mathbf{p}_t; \mathbf{q}_t),\ t = 1, \ldots, T\}$ be a set of observations. The following conditions are equivalent:*

(i) *There exists a pair of concave and continuous utility functions U^1 and U^2 that provide a collective rationalization of S.*
(ii) *There exists a set of feasible personalized prices and quantities $\hat{S}$ such that the sets $\{(\hat{\mathbf{p}}_t^1; \hat{\mathbf{q}}_t);\ t = 1, \ldots, T\}$ and $\{(\hat{\mathbf{p}}_t^2; \hat{\mathbf{q}}_t);\ t = 1, \ldots, T\}$ both satisfy GARP.*
(iii) *There exists a set of feasible personalized prices and quantities $\hat{S}$, numbers $U_t^m > 0$ and $\lambda_t^m > 0$ $(m = 1, 2)$ such that for all $s, t \in \{1, \ldots, T\}$: $U_s^1 - U_t^1 \leq \lambda_t^1 (\hat{\mathbf{p}}_t^1)'(\hat{\mathbf{q}}_s - \hat{\mathbf{q}}_t)$ and $U_s^2 - U_t^2 \leq \lambda_t^2 (\hat{\mathbf{p}}_t^2)'(\hat{\mathbf{q}}_s - \hat{\mathbf{q}}_t)$.*

The nonparametric conditions (ii) and (iii) have a similar structure as for the unitary model; see Theorem 3. The essential difference is that the conditions for collective rationalization are expressed in terms of a set of feasible personalized prices and quantities $\hat{S}$. For a given specification of this set, Proposition 8 states nonparametric conditions *at the level of the household members 1 and 2* that are analogous to the unitary rationalization conditions *at the level of the aggregate household*. But contrary to the unitary case, the true personalized prices and quantities are unobserved. Therefore, it is only imposed that there must exist at least one $\hat{S}$ that satisfies the conditions.

The necessary and sufficient conditions for a collective rationalization in Proposition 8 can be difficult to use in practice, since they are nonlinear in terms of feasible personalized prices $(\hat{\mathbf{p}}_t^1, \hat{\mathbf{p}}_t^2)$ and quantities $\hat{\mathbf{q}}_t$. In the following section, we present testable conditions for collective rationality that solely use (observed) aggregate prices $\mathbf{p}_t$ and quantities $\mathbf{q}_t$.

The starting point of the revealed preference condition for collective rationality is that the "true" member-specific preference relations are not observed, because only the aggregate household quantities $(\mathbf{q}_t)$ are observed and not the "true" personalized quantities $(\mathbf{q}_t^1, \mathbf{q}_t^2$ and $\mathbf{q}_t^h)$. Given this, the condition focuses on so-called "hypothetical member-specific preference relations". These relations essentially represent feasible specifications of the true individual preference relations in terms of a number of collective rationality conditions [i.e., conditions (i)–(v) in Proposition 9 below] defined on the observed (aggregate household) quantities and prices. The revealed preference condition for collectively rational consumption behavior then requires that there must exist at least one specification of the hypothetical member-specific preference relations that simultaneously meets all these collective rationality conditions. The necessary condition for collective rationality is summarized in the following proposition[1]:

Proposition 9. *Suppose that there exists a pair of utility functions U^1 and U^2 that provide a collective rationalization of the set of observations $S = \{(\mathbf{p}_t; \mathbf{q}_t), t = 1, \ldots, T\}$. Then, there exist hypothetical relations H_0^m, H^m for each member $m \in (1, 2)$ such that:*

(i) *If* $\mathbf{p}'_s\mathbf{q}_s \geq \mathbf{p}'_s\mathbf{q}_t$, *then* $\mathbf{q}_s H_0^1 \mathbf{q}_t$ *or* $\mathbf{q}_s H_0^2 \mathbf{q}_t$.
(ii) *If* $\mathbf{q}_s H_0^m \mathbf{q}_k, \mathbf{q}_k H_0^m \mathbf{q}_l, \ldots, \mathbf{q}_z H_0^m \mathbf{q}_t$ *for some (possibly empty) sequence* $(k, l, \ldots, \mathrm{z})$, *then* $\mathbf{q}_s H^m \mathbf{q}_t$.
(iii) *If* $\mathbf{p}'_s\mathbf{q}_s \geq \mathbf{p}'_s\mathbf{q}_t$ *and* $\mathbf{q}_t H^m \mathbf{q}_s$, *then* $\mathbf{q}_s H_0^l \mathbf{q}_t$ (with $l \neq m$).
(iv) *If* $\mathbf{p}'_s\mathbf{q}_s \geq \mathbf{p}'_s(\mathbf{q}_{t_1} + \mathbf{q}_{t_2})$ *and* $\mathbf{q}_{t_1} H^m \mathbf{q}_s$, *then* $\mathbf{q}_s H_0^l \mathbf{q}_{t_2}$ (with $l \neq m$).
(v) (a) *If* $\mathbf{q}_s H^1 \mathbf{q}_t$ *and* $\mathbf{q}_s H^2 \mathbf{q}_t$, *then* $\mathbf{p}'_t\mathbf{q}_t \leq \mathbf{p}'_t\mathbf{q}_s$.
(b) *If* $\mathbf{q}_{s_1} H^1 \mathbf{q}_t$ *and* $\mathbf{q}_{s_2} H^2 \mathbf{q}_t$, *then* $\mathbf{p}'_t\mathbf{q}_t \leq \mathbf{p}'_t(\mathbf{q}_{s_1} + \mathbf{q}_{s_2})$.

Condition (i) applies to all situations with $\mathbf{p}'_s\mathbf{q}_s \geq \mathbf{p}'_s\mathbf{q}_t$. This means that the quantity bundle $\mathbf{q}_t$ was equally obtainable under the prices $\mathbf{p}_s$ and the outlay $\mathbf{p}'_s\mathbf{q}_s$ that correspond to the chosen bundle $\mathbf{q}_s$. In that case, Pareto efficiency requires that at least one household member must prefer the bundle $\mathbf{q}_s$ to the bundle $\mathbf{q}_t$. If we assume that member m prefers $\mathbf{q}_s$ to $\mathbf{q}_t$, then we specify $\mathbf{q}_s H_0^m \mathbf{q}_t$. To summarize, the inequality $\mathbf{p}'_s\mathbf{q}_s \geq \mathbf{p}'_s\mathbf{q}_t$ requires that we specify $\mathbf{q}_s H_0^m \mathbf{q}_t$ for at least one m. Condition (ii) uses that individual preferences are transitive.

The following conditions (iii)–(v) pertain to rationality across the household members. Condition (iii) expresses that, if member 1 prefers some $\mathbf{q}_t$ over $\mathbf{q}_s$, and the quantity bundle $\mathbf{q}_t$ is not more expensive than $\mathbf{q}_s$, then the choice of $\mathbf{q}_s$ can be

[1]As shown in Cherchye et al. (2010a), the necessary condition is also sufficient as soon as the individual preferences allow for nonconvexities (e.g., due to externalities).

rationalized only if member 2 prefers $\mathbf{q}_s$ over $\mathbf{q}_t$. Indeed, if this last condition were not satisfied, then the bundle $\mathbf{q}_t$ (under the given prices $\mathbf{p}_s$ and outlay $\mathbf{p}'_s\mathbf{q}_s$) would imply a Pareto improvement over the chosen bundle $\mathbf{q}_s$.

Similarly, condition (iv) states that, if the quantity bundle $\mathbf{q}_s$ is more expensive than the (newly defined) bundle $(\mathbf{q}_{t_1} + \mathbf{q}_{t_2})$, while member 1 prefers $\mathbf{q}_{t_1}$ over $\mathbf{q}_s$, then the only possibility for rationalizing the choice of $\mathbf{q}_s$ is that member 2 prefers $\mathbf{q}_s$ over the remaining bundle $\mathbf{q}_{t_2}$. The interpretation in terms of Pareto efficiency is directly similar to the one for condition (iii).

Finally, condition (v) complements conditions (iii) and (iv); it defines upper expenditure bounds for each observation t that depend on the specification of the relations H^m. Part (a) of condition (v) states that if both members prefer $\mathbf{q}_s$ over $\mathbf{q}_t$, then the choice of $\mathbf{q}_t$ can be rationalized only if it is not more expensive than $\mathbf{q}_s$. Indeed, if this last condition were not met, then for the given prices $\mathbf{p}_t$ and outlay $\mathbf{p}'_t\mathbf{q}_t$ all members would be better off by buying the bundle $\mathbf{q}_s$ rather than the chosen bundle $\mathbf{q}_t$, which of course conflicts with Pareto efficiency. Part (b) of condition (v) expresses a similar condition for the case where both members prefer a different quantity bundle $\mathbf{q}_{s_m}$ to $\mathbf{q}_t$. In that case, the choice of $\mathbf{q}_t$ can be rationalized only if it is not more expensive than the bundle $(\mathbf{q}_{s_1} + \mathbf{q}_{s_2})$.

Cherchye et al. (2007) also showed that the necessary condition is rejectable in a two-person setting as soon as there are three goods and three observations. An application of this condition can be found in Cherchye et al. (2009), who also discuss algorithms to test the condition in an efficient way.[2] They check data consistency with collective rationality of a sample of couples drawn from the Russia Longitudinal Monitoring Survey (RLMS). Interestingly, the panel structure of this data allows to nonparametrically test the collective consumption model without relying on preference homogeneity assumptions across similar individuals. In other words, the data allowed to run their revealed preference tests on each separate couple. This is a major advantage compared to earlier tests on cross-sectional data like in Famulari (1995) and Cherchye and Vermeulen (2008).

Cherchye et al. (2009) could not reject collective rationality on the basis of the necessary conditions discussed above. They also presented sufficient revealed preference conditions for collective rationality (more details can be found in their paper). Application of these tests showed that a multitude of collective consumption models is able to describe the couples' consumption behavior. They further checked data consistency with *GARP* of the same couples and male and female singles. Interestingly, while the unitary model fits the singles' observed behavior, this is not the case for couples. These results once again confirm earlier evidence of the relative performance of the unitary and the collective model when applied to different household types.

[2]Cherchye et al. (2008) present a characterization of the necessary condition for collective rationality in terms of integer programming constraints.

3.2.2 Collective Models with a Prior Specification of the Nature of the Goods

As demonstrated above, the goods in the general collective consumption model could be partly privately consumed (with or without externalities) and partly publicly consumed. In this subsection, we leave this level of generality somewhat by focusing on collective consumption models where the nature of the goods is known a priori: some goods are private (without externalities), while the other goods are publicly consumed. Two special cases here are collective models where all consumption is private and models where all consumption is public. These models are mostly used in the (mainly parametric) empirical literature (see also Chiappori and Ekeland 2009, for further discussion).

Owing to the assumption of a priori knowledge of which goods are private (without externalities) and which are public, the personalized quantities in $\hat{\mathbf{q}}_t = (\mathbf{q}_t^1, \mathbf{q}_t^2, \mathbf{q}_t^h)$ defined in (1) get a bit less involved. Let us denote the i'th good in the observed quantity vector $\mathbf{q}_t$ by $\mathbf{q}_{(i)t}$ (with a similar notation for the personalized quantity and price vectors). For a private good i, we have the following relation between observable and unobservable quantities:

$$\mathbf{q}_{(i)t} = \mathbf{q}^1_{(i)t} + \mathbf{q}^2_{(i)t}, \tag{4.4}$$

which implies that the observed quantities are entirely allocated to both members' unobserved private consumption.

For a public good i, we obtain that the observed quantity equals the public consumption of this good:

$$\mathbf{q}_{(i)t} = \mathbf{q}^h_{(i)t}. \tag{4.5}$$

Similar consequences can be drawn with respect to the feasible personalized prices $\hat{\mathbf{p}}_t^1$ and $\hat{\mathbf{p}}_t^2$. The personalized prices equal the observed price of good i for private goods[3]:

$$\hat{\mathbf{p}}^1_{(i)t} = \left(\mathbf{p}_{(i)t}, \mathbf{0}, \mathbf{p}_{(i)t}\right) \quad \text{and} \quad \hat{\mathbf{p}}^2_{(i)t} = \left(\mathbf{0}, \mathbf{p}_{(i)t}, \mathbf{0}\right),$$

while there are still unobservable (Lindahl) prices for a public good i:

$$\hat{\mathbf{p}}^1_{(i)t} = \left(\mathbf{p}_{(i)t}, \mathbf{p}_{(i)t}, \mathbf{p}^h_{(i)t}\right) \quad \text{and} \quad \hat{\mathbf{p}}^2_{(i)t} = \left(\mathbf{0}, \mathbf{0}, \mathbf{p}_{(i)t} - \mathbf{p}^h_{(i)t}\right).$$

[3] Note that the vector entries associated with the public (private) component(s) of a good that is privately (publicly) consumed can be chosen arbitrarily. This is because the associated quantities will be zero and will thus not influence the *GARP* conditions applied to personalized prices and quantities.

Thus, a priori knowledge about the character of the modeled goods (private versus private) implies that either personalized prices or personalized quantities are observed. To take this explicitly into account, let us introduce some new notation. The vector $\mathbf{q}_{\text{priv};t} \in \mathbb{R}_{+}^{L}$ contains the privately consumed goods in observation t, while the vector $\mathbf{q}_{pub;t} \in \mathbb{R}_{+}^{M}$ contains the publicly consumed goods. Let us denote the associated prices by, respectively, $\mathbf{p}_{priv;t} \in \mathbb{R}_{++}^{L}$ and $\mathbf{p}_{\text{pub};t} \in \mathbb{R}_{++}^{M}$. Note that $\mathbf{q}_{\text{priv};t} = \mathbf{q}_{\text{priv};t}^{1} + \mathbf{q}_{\text{priv};t}^{2}$, while $\mathbf{p}_{\text{pub};t} = \mathbf{p}_{\text{pub};t}^{1} + \mathbf{p}_{\text{pub};t}^{2}$.

Cherchye et al. (2010b) demonstrated that the important feature of observable prices (for private goods) and observable quantities (for public goods) allows to obtain nonparametric necessary and sufficient conditions for a collective rationalization. They also present an equivalent integer programming (IP) characterization of collectively rational consumption behavior when the nature of the goods is known. To obtain the IP formulation, they define the binary variables $x_{st}^{m} \in \{0,1\}$, with $x_{st}^{m} = 1$ interpreted as "$(\mathbf{q}_{\text{priv};s}^{m}, \mathbf{q}_{\text{pub};s}) R^{m} (\mathbf{q}_{\text{priv};t}^{m}, \mathbf{q}_{\text{pub};t})$" for a given specification of feasible personalized prices and quantities. A necessary and sufficient condition for a collective rationalization when the nature of the goods is known now equals.

Proposition 10. *Let S be a set of observations. There exists a combination of concave and continuous utility functions* U^1 *and* U^2 *that provide a collective rationalization of S if and only if there exist* $\mathbf{q}_{\text{priv};t}^{m} \in \mathbb{R}_{+}^{L}$ *and* $\mathbf{p}_{\text{pub};t}^{m} \in \mathbb{R}_{+}^{M}$ *and* $x_{st}^{m} \in \{0,1\}$, $m = 1,2$, *that satisfy:*

(i) $$\sum_{m=1}^{2} \mathbf{p}_{\text{pub};t}^{m} = \mathbf{p}_{\text{pub};t}$$

(ii) $$\sum_{m=1}^{2} \mathbf{q}_{\text{priv};t}^{m} = \mathbf{q}_{\text{priv};t}$$

(iii) $$\mathbf{p}'_{\text{priv};s}\mathbf{q}_{\text{priv};s}^{m} + \mathbf{p}_{\text{pub};s}^{m\prime}\mathbf{q}_{\text{pub};s} - \mathbf{p}'_{\text{priv};s}\mathbf{q}_{\text{priv};t}^{m} - \mathbf{p}_{\text{pub};s}^{m\prime}\mathbf{q}_{\text{pub};t} < \mathbf{p}'_{s}\mathbf{q}_{s}x_{st}^{m}$$

(iv) $$x_{su}^{m} + x_{ut}^{m} \leq 1 + x_{st}^{m}$$

(v) $$\mathbf{p}'_{\text{priv};t}\mathbf{q}_{\text{priv};t}^{m} + \mathbf{p}_{\text{pub};t}^{m\prime}\mathbf{q}_{\text{pub};t} - \mathbf{p}'_{\text{priv};t}\mathbf{q}_{priv;s}^{m} - \mathbf{p}_{\text{pub};t}^{m\prime}\mathbf{q}_{\text{pub};s} \leq \mathbf{p}'_{t}\mathbf{q}_{t}\left(1 - x_{st}^{m}\right)$$

The interpretation of the different constraints is the following. Constraints (i) and (ii) directly follow from the definitions of feasible personalized prices and quantities when it is known whether a good is (entirely) publicly or (entirely) privately consumed. The constraints (iii)–(v) correspond, for each member m, to the *GARP* conditions in Definition 2 applied to personalized quantities and prices. Specifically, constraint (iii) implies that, if $\mathbf{p}'_{\text{priv};s}\mathbf{q}_{\text{priv};s}^{m} + \mathbf{p}_{\text{pub};s}^{m\prime}\mathbf{q}_{\text{pub};s} \geq \mathbf{p}'_{\text{priv};s}\mathbf{q}_{\text{priv};t}^{m} + \mathbf{p}_{\text{pub};s}^{m\prime}\mathbf{q}_{\text{pub};t}$, then we must have $x_{st}^{m} = 1$ (which corresponds to $(\mathbf{q}_{\text{priv};s}^{m}, \mathbf{q}_{\text{pub};s}) R^{m} (\mathbf{q}_{\text{priv};t}^{m}, \mathbf{q}_{\text{pub};t})$). Next, constraint (iv) imposes transitivity, i.e., $x_{su}^{m} = 1$ $((\mathbf{q}_{\text{priv};s}^{m}, \mathbf{q}_{\text{pub};s}) R^{m} (\mathbf{q}_{\text{priv};u}^{m}, \mathbf{q}_{\text{pub};u}))$ and $x_{ut}^{m} = 1$ $((\mathbf{q}_{\text{priv};u}^{m}, \mathbf{q}_{\text{pub};u}) R^{m} (\mathbf{q}_{\text{priv};t}^{m}, \mathbf{q}_{\text{pub};t}))$ imply $x_{st}^{m} = 1$ $((\mathbf{q}_{\text{priv};s}^{m}, \mathbf{q}_{\text{pub};s}) R^{m} (\mathbf{q}_{\text{priv};t}^{m}, \mathbf{q}_{\text{pub};t}))$. Finally, constraint

(v) requires that, if $x_{st}^{m} = 1$ $((\mathbf{q}_{\text{priv};s}^{m}, \mathbf{q}_{\text{pub};s})R^{m}$ $(\mathbf{q}_{\text{priv};t}^{m}, \mathbf{q}_{\text{pub};t}))$, then $\mathbf{p}'_{\text{priv};t}\mathbf{q}_{\text{priv};t}^{m} + \mathbf{p}_{\text{pub};t}^{m\prime}\mathbf{q}_{\text{pub};t} \leq \mathbf{p}'_{\text{priv};t}\mathbf{q}_{\text{priv};s}^{m} + \mathbf{p}_{\text{pub};t}^{m\prime}\mathbf{q}_{\text{pub};s}$.

As such, Proposition 10 defines an operational necessary and sufficient test for collective rationality. If the IP constraints (i)–(v) characterize an empty feasible region for the given dataset, then a collective rationalization of the data is impossible. Conversely, if the IP constraints characterize a nonempty feasible region, then a collective rationalization of the data is certainly possible.

Proposition 10 can also be used for nonparametrically recovering feasible personalized prices, quantities and income shares that provide a collective rationalization of the set S. Specifically, for each member m it identifies feasible sets of personalized prices, quantities, and income shares as (nonempty) feasible sets of, respectively, $\mathbf{p}_{\text{pub};t}^{m}, \mathbf{q}_{\text{priv};t}^{m}$, $\eta_t^{\,m} = \mathbf{p}'_{\text{priv};t}\mathbf{q}_{\text{priv};t}^{m} + \mathbf{p}_{\text{pub};t}^{m\prime}\mathbf{q}_{\text{pub};t}$ characterized by the constraints (i)–(iii) in Proposition 10. See Cherchye et al. (2010b) for further discussion, examples, and an empirical application to observational data.

4 Conclusion

In this chapter, we give an overview of recently proposed revealed preference tests for consistency of observed household behavior with Pareto efficiency. These tests are entirely nonparametric, since they do not require any assumptions regarding the parametric form of individual preferences or the intrahousehold bargaining process. We start with a discussion of some tests that are based on Chiappori's (1988) seminal labor supply model with egoistic preferences and observed individual leisure. These tests directly exploit the two-stage nature of the household decision process via a sharing rule. We then discuss revealed preference conditions for Browning and Chiappori's (1998) collective consumption model with general individual preferences (including public goods and externalities) and only aggregate household consumption observed. Finally, we deal with a new approach to test special cases of the general model, one that is based on integer programming.

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Chapter 5
Collective Labor Supply of Native Dutch and Immigrant Households in the Netherlands

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Abstract We estimate a collective time allocation model, where Dutch, Surinamese/Antillean and Turkish households behave as if both spouses maximize a household utility function. We assume that paid labor and housework are the endogenous choice variables and furthermore consider household production. Surinamese/Antillean and Turkish women differ from Dutch women because they value (joint) household production more in their utility function. Surinamese/Antillean and Turkish men, on the other hand, value joint household production less then Dutch men. Turkish households are the more traditional households, in the sense that the woman is more oriented on household production, while the man is oriented on paid labor. It is often believed that the bargaining power of women in more traditional households is relatively low, but our estimation results do not support this idea. In general, the wage elasticities of Dutch, Turkish and Surinamese/Antillean households are comparable. Men and women replace housework hours by paid labor if their hourly wage rate increases but do the opposite when the hourly wage rate of the partner increases.

Keywords Collective model • Labor Supply • Household

1 Introduction

Like all Western countries, the Netherlands has a sizeable minority of immigrants. Nowadays, almost 10% of the Dutch population consists of non-Western (first- or second-generation) immigrants, and this number is expected to increase to over 20% in the year 2050 (Netherlands Statistics 2003a). In spite of the fact that immigrant households are a substantial and growing group within the total Dutch household

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population, they are usually undersampled or neglected in general surveys. Insofar as they participate in a survey, members of those subpopulations are usually lumped together with the main population of Dutch descent. As a consequence, research on household labor supply decisions in the Netherlands tends to neglect the household labor supply decision process of these immigrants.

In this chapter, we examine the time allocation decisions of Dutch, Turkish, and Surinamese/Antillean households. By assuming endogenous labor supply for men and women and by considering housework and household production, we aim to contribute to a better understanding of the household decision process for the household types we distinguish. Moreover, by making use of the collective household model, we are able to examine individual preferences and the intrahousehold bargaining process between the household members so that differences in ethnic background may reveal interesting differences between Dutch and immigrant households.

The four largest immigrant groups in the Netherlands are from Turkey, Morocco, Surinam, and the Dutch Antilles. During the 1950s, the Dutch decolonization process attracted immigrants from Indonesia. In the 1960s, inhabitants of Surinam and the Antilles received Dutch nationality, which gave them the right to work and live in the Netherlands (Cornelisse-Vermaat 2005). In the 1960s and 1970s, when the Dutch economy flourished, Surinamese, Antillean, and Turkish workers came to the Netherlands to find (low income) jobs. These immigrants were mostly men and although their initial intention was to stay in the Netherlands temporarily, they usually stayed permanently. Because we consider Surinamese/Antillean and Turkish households in this study, we shortly characterize these households.

The first group originates from the former Dutch colonies of Surinam and the Dutch Antilles. Surinamese/Antillean households are well integrated in the Dutch society; their mother tongue is frequently Dutch and they received an education that resembles that of the Dutch. Some of them have been in the Netherlands for 30 years or more, while others immigrated rather recently, in the last decade. The Turkish minority is one of the largest minorities in the Netherlands. Most of them came from relatively backward regions in Turkey; they are Muslims and frequently speak only Turkish within the family. Many Dutch Turks have double nationality, and a large part of them choose marriage partners from their homeland, who immigrate under the Law of Family Reunion. Their education level is relatively low compared with the Dutch. The integration problems for both groups are reflected by the high percentage of unemployed immigrants relative to the native Dutch (Netherlands Statistics 2003b; SCP 2002), the lower education levels of immigrants (SCP 2003), and, according to the (Dutch) Scientific Council for Government Policy (WRR), the lack of cohesion between immigrant groups and the native Dutch (WRR 2001).

This chapter proceeds as follows. In Sect. 2, we present the theoretical framework. In Sect. 3, we present the parametric specification of the model and the estimation method. In Sect. 4, we discuss the data and the estimation results are discussed in Sect. 5. In order to see how wage changes affect the time allocation choices of households, we derive the wage elasticities in Sect. 6. Section 7 concludes. The approach in this chapter is similar to that in van Klaveren et al. (2008).

2 Theory

We consider a two-earner household where the preferences of spouse i $(i = m,f)$ are represented by the following direct utility function:

$$U_i(C, H, le_i, wh_i, jh_i), \tag{5.1}$$

where $U_i(\cdot)$ is twice continuously differentiable and strictly concave. The individual utility functions depend on the household consumption, C, and the household production, H, and on the time that is spent on leisure (le_i), housework (wh_i) and paid work (jh_i). It is usually assumed that the working effort influences utility negatively through a corresponding loss of leisure hours. However, many studies on life satisfaction find that the experience of unemployment itself, rather than the loss of income through unemployment, reduces life satisfaction (Booth and van Ours 2007). A similar argument can be made for housework activities, and so men and women may derive positive or negative utility from the performance of housework.

Household expenditures on consumption goods are not observed in the data and, therefore, household consumption, C, is considered to be one Hicksian composite good, whose price is set to unity. The money value of this composite good is set equal to the total household income, Y. We have:

$$C = Y = w_m jh_m + w_f jh_f + y, \tag{5.2}$$

where w_m and w_f represent the wage rates of the spouses, and y stands for the net nonlabor income of the household. Household production is generally not observed in datasets either. We represent it by the household technology $h(wh_m, wh_f)$, that is a function of the hours that both spouses spend on housework, and we assume the following functional form:

$$H = h(wh_m, wh_f) = wh_m + \gamma wh_f, \tag{5.3}$$

where γ represents the marginal productivity of the woman relative to that of the man. With household production we mean the γ weighted sum of hours spent by both partners on what they call "household tasks." These tasks include cooking, cleaning, doing the laundry, and other such activities. Of course, the distinction between housework and leisure may be ambiguous, and therefore we leave the empirical definition to the respondents themselves in the empirical analysis.

Because the aggregated level of household income (that represents consumption) and the weighted sum of the individual hours spent on housework each represent one value for each household, it follows that household consumption and household production are treated as if they are public goods in the household. However, this does not imply that commodities that are bought out of the household income cannot be consumed by one of the two spouses, e.g., clothing, the barber, etc., but it does imply that, even then, a purchase by one of them needs the explicit or implicit approval of the other partner. It is an issue of bargaining between the two partners who in the end gets most of the pie. An immediate consequence of the public good assumption is, however, that it is not possible to examine how the various goods are distributed over the household members.

In the collective model, household decisions are assumed to be Pareto-efficient and under this assumption spouses behave as if an optimal bundle (le_m, wh_m, le_f, wh_f) is chosen that maximizes the following household utility function[1]:

$$U_h = \pi(w_m, w_f, \mathbf{d}) \cdot U_m(Y, H, le_m, wh_m, T - le_m - wh_m) \\ +(1 - \pi(w_m, w_f, \mathbf{d})) \cdot U_f(Y, H, le_f, wh_f, T - le_f - wh_f), \qquad (5.4)$$

subject to:

(1) $Y = w_m \cdot (T - le_m - wh_m) + w_f \cdot (T - le_f - wh_f) + y$
(2) $H = wh_m + \gamma wh_f$
(3) $0 < le_f; le_m; wh_f; wh_m \leq 1,$

where T is the total time endowment per week, and where job hours of spouse i is replaced by the individual time constraint $T - le_i - wh_i$. For identification purposes, each spouse's leisure is assumed to be a private good, i.e., the husband does not benefit from the wife's leisure, and conversely (Chiappori and Ekeland 2006).

The individual utility functions are weighted by the utility weight function $\pi(\cdot)$ and this function usually depends on wages, nonlabor income and on variables that do not enter the individual preferences directly but influence the utility weight distribution. Hereafter, we refer to the latter as distribution factors, d. An intuitive interpretation of the utility weight is that it represents the division of bargaining power between the spouses. The higher the value of $\pi(\cdot)$, the more the utility function of household member m is weighted in the household utility function. An increase in $\pi(\cdot)$ can, therefore, be interpreted as an improvement of the bargaining position of the male.

It is important that $\pi(\cdot)$ depends on the individual wage rates, because otherwise the marginal compensated wage changes of the spouses would have the same effect on each other's labor supply by definition (this is usually referred to as the Slutsky symmetry condition). The model would then collapse into a neoclassical unitary model, where individual preferences are not considered and where the intrahousehold allocation of welfare cannot be studied. For an elaborate discussion on the consequences when $\pi(\cdot)$ is misspecified, we refer to Browning et al. (2006). We note that the restrictions of the unitary model are often empirically tested and almost always rejected in the empirical literature (see, among others, Ashworth and Ulph 1981;

[1] For a discussion of the collective model of household behavior we refer to studies by Vermeulen (2002), Browning et al. (2006) and Donni (2008).

Kooreman and Kapteyn 1986; Thomas 1990; Browning and Costas 1991; Browning et al. 1994; Kawaguchi 1994; Fortin and Lacroix 1997; Lundberg et al. 1997; Browning and Chiappori 1998; Ward-Batts 2002).

The corresponding system of partial derivatives with respect to the man's and woman's leisure and housework are:

$$\begin{aligned}
\frac{\partial U_h}{\partial le_m} &= \pi \cdot \frac{\partial U_m}{\partial le_m} + (1-\pi) \cdot \frac{\partial U_f}{\partial le_m} \\
\frac{\partial U_h}{\partial wh_m} &= \pi \cdot \frac{\partial U_m}{\partial wh_m} + (1-\pi) \cdot \frac{\partial U_f}{\partial wh_m} \\
\frac{\partial U_h}{\partial le_f} &= \pi \cdot \frac{\partial U_m}{\partial le_f} + (1-\pi) \cdot \frac{\partial U_f}{\partial le_f} \\
\frac{\partial U_h}{\partial wh_f} &= \pi \cdot \frac{\partial U_m}{\partial wh_f} + (1-\pi) \cdot \frac{\partial U_f}{\partial wh_f}.
\end{aligned} \tag{5.5}$$

Let us focus on the first partial derivative with respect to male leisure that consists of two terms. The first term represents the male part of the collective utility function, while the second term represents the female part of the collective utility function. The leisure choice of the man influences the household utility through the utility of the man and the utility of the woman. In order to see how this happens, we can write the first FOC more extensively as follows:

$$\frac{\partial U_h}{\partial le_m} = \pi\left(\frac{\partial U_m}{\partial le_m} + \frac{\partial U_m}{\partial Y}\frac{\partial Y}{\partial le_m} + \frac{\partial U_m}{\partial jh_m}\frac{\partial jh_m}{\partial le_m}\right) + (1-\pi)\left(\frac{\partial U_f}{\partial Y}\frac{\partial Y}{\partial le_m}\right) \tag{5.6}$$

The first term between parenthesis on the right-hand side ($\partial U_m/\partial le_m$) indicates that the man's leisure influences the household utility directly through the utility function of the male. This is the consequence of the identifying assumption that individual leisure is a private good. Male leisure influences the household utility through consumption Y and through the man's job hours because we have replaced job hours by the individual time constraints. Because household consumption is considered as a public good, the household utility is influenced, through the utility function of both the man and the woman, by the leisure time of the man. As both utility functions are differently weighted in the household utility function, the sum of the individual partial effects is weighted by the utility weight π as well.

We do not repeat this exercise for the other partial derivatives, because the intuition is the same. Assuming that households are in equilibrium, i.e., assuming that the household utility derivatives are equal to 0, and solving the partial derivatives for the choice variables leisure and housework (and consequently job hours) gives the following system of demand functions:

$$\mathbf{z} = g(w_m, w_f, y, \mathbf{d}), \tag{5.7}$$

where we introduce the shorthand notation **z** that stands for the solution vector $z = (le_m, wh_m, le_f, wh_f)$. These "time" demand functions are functions of the wage rates, the unearned income, and the distribution factors that appear in the utility weight.

3 Parametric Specification and Estimation Method

3.1 Parametric Specification

According to the collective approach, household $n's$ behavior may be viewed as the outcome of maximizing a household utility function of the following type:

$$U_{n,h} = \pi_n U_{n,m} + (1 - \pi_n) U_{n,f} \tag{5.8}$$

subject to:

$$\begin{aligned} &Y = w_m \cdot (T - le_m - wh_m) + w_f \cdot (T - le_f - wh_f) + y \\ &H = wh_m + \gamma \cdot wh_f \\ &0 < le_f, le_m, wh_f, wh_m \leq 1, \end{aligned}$$

where we assume for the moment that π is a constant variable. The preferences of household member i are described by a log-additive utility function:

$$\begin{aligned} U_i = {} & \alpha_{i,1} \ln(le_i) + \alpha_{i,2} \ln(wh_i) + \alpha_{i,3} \ln(H) \\ & + \alpha_{i,4} \ln(fs + 1) \cdot \ln(H) + \alpha_{i,5} \ln(Y) + \alpha_{i,6} \ln(jh_i). \end{aligned} \tag{5.9}$$

Because 20 h of housework may influence utility differently for a two-person family than it does for a family with two children, we assume that the effect that H has on utility varies with family size (fs), and include an interaction term between H and family size. Assuming that men and women choose an optimal time allocation bundle, we have the following partial derivatives:

$$\begin{aligned} \frac{\partial U_h}{\partial le_m} &= \frac{\partial U_f}{\partial le_m} + \pi \left(\frac{\partial U_m}{\partial le_m} - \frac{\partial U_f}{\partial le_m} \right) \\ \frac{\partial U_h}{\partial wh_m} &= \frac{\partial U_f}{\partial wh_m} + \pi \left(\frac{\partial U_m}{\partial wh_m} - \frac{\partial U_f}{\partial wh_m} \right) \\ \frac{\partial U_h}{\partial le_f} &= \frac{\partial U_f}{\partial le_f} + \pi \left(\frac{\partial U_m}{\partial le_f} - \frac{\partial U_f}{\partial le_f} \right) \\ \frac{\partial U_h}{\partial wh_f} &= \frac{\partial U_f}{\partial wh_f} + \pi \left(\frac{\partial U_m}{\partial wh_f} - \frac{\partial U_f}{\partial wh_f} \right) \end{aligned}$$

When we focus on the first two partial derivatives, it holds that the first and the third term in each partial derivative refer to the partner's part of the collective utility function. This part exists because the individual utility of both partners is influenced through H by the partner's hours on housework and through Y by the partner's job hours. Given the chosen parametric specification, the derivative $\partial U_h/\partial le_m$ becomes as follows:

$$\frac{\partial U_h}{\partial le_m} = \pi \cdot \left[\frac{\alpha_{m,1}}{le_m} - \frac{\alpha_{m,5} \cdot w_m}{Y} - \frac{\alpha_{m,6}}{jh_m}\right] - (1-\pi) \cdot \left[\frac{\alpha_{f,5} \cdot w_m}{Y}\right].$$

This derivative is a linear expression in the utility parameters $(\alpha_m, \alpha_f) = \alpha$ of the man and the woman. The corresponding *coefficients* are nonlinear expressions in $le_m, le_f, wh_m, wh_f, w_m, w_f, fs,$ and y. The first *coefficient*, denoted by $x_{1,m,1}$ is, for example, $1/le_m$. Because $\alpha_{m,2}$ does not appear in the first partial derivative, we have $x_{1,m,2} = 0$. We may write the first partial derivative as:

$$x_f'\alpha_f + \pi\left(x'_{1m}\alpha_m - x'_{1f}\alpha_f\right). \tag{5.10}$$

The index 1 refers to the x-vector in the first partial derivative. This x-vector is a 6-vector function $x_{1,m}(le_m, le_f, wh_m, wh_f, w_m, w_f, fs, y)$. The other partial derivatives with respect to wh_m, le_f and wh_f can be obtained in a similar manner and the system of partial derivatives can be written as:

$$\begin{bmatrix} \pi \cdot x'_{1m} & (1-\pi) \cdot x'_{1f} \\ \pi \cdot x'_{2m} & (1-\pi) \cdot x'_{2f} \\ \pi \cdot x'_{3m} & (1-\pi) \cdot x'_{3f} \\ \pi \cdot x'_{4m} & (1-\pi) \cdot x'_{4f} \end{bmatrix} \alpha = \begin{bmatrix} \pi \cdot X'_m & (1-\pi) \cdot X'_f \end{bmatrix} \alpha, \tag{5.11}$$

where X_m' and X_f' are (4×6)-matrices; and α stands for a 12-vector of utility parameters. For household n we define the (4×12)-matrix $X'_{n,h} = \left[\pi_n X'_{n,m} \ (1-\pi_n)X'_{n,f}\right]$ so that the expression in (11) can be written as:

$$X'_{n,h}\alpha \tag{5.12}$$

Throughout this chapter, we use the shorthand notation $z = (le_m, wh_m, le_f, wh_f)$. The system in (11) and (12) is the gradient of the household utility function $U_h(z)$ and we shall write it sometimes as the 4-vector $U_h'(z)$ or, alternatively, as U_z. This system describes the equilibrium if the gradient vector equals the 0-vector. The (4×4)-matrix of second-order derivatives of $U_h''(z)$ is denoted by U_h'' or U_{zz}.

Up until now, in this section, we have assumed that π is a constant variable. However, as is mentioned by Browning et al. (2006), the collective model collapses into a standard unitary model if the utility weight does not depend on prices, or, in our model, wages. Moreover, the individual bargaining positions are likely to be affected by other factors as well, such as the number of children, the ages of the two partners and the net weekly nonlabor income.[2] More formally, we assume that π_n depends on characteristics v and define it as:

$$\pi_n(v) = N\left(\beta_1 \ln\left(w_{n,m}\right) + \beta_2 \ln\left(w_{n,f}\right) + \sum_{j=3}^{J} \beta_j \cdot v_{j,n}\right), \tag{5.13}$$

where $N(\cdot)$ stands for the standard normal distribution function. This functional specification is convenient because the arguments can take any value on the real axis, while π is automatically constrained in [0,1]. We note that the normal distribution function is used without any probabilistic connotation. For convenience we have listed the wage characteristics in (13) separately from the other characteristics that may influence the utility weight (represented by $\sum_{j=3}^{J} \beta_j \cdot v_{j,n}$). Consider the case where $\beta_3 = ... = \beta_J = 0,\ \beta_1 = -\beta_2$ and $w_m = w_f$. We then find that $\pi(v) = 1/2$ and this represents an equal division of bargaining power between men and women. In other words, the utility functions of men and women are equally weighted in the household utility function. The weight $\pi(v)$ increases in the man's wage and decreases in the woman's wage. If $\beta_3 = \cdots = \beta_J = 0$ and $\beta_1 \neq \beta_2,$ the weight is asymmetric, that is, even if $w_m = w_f,$ we may have $\pi(v) \neq 1/2$.

Adding a constant, say $\beta_0,$ to the argument in $N(\cdot)$ would allow for the fact that one of the individual utility functions is structurally overweighted. However, when we included β_0 in the empirical model, it was always estimated as being insignificant and hence we dropped it from the model.

3.2 Estimation Method

From the partial derivatives in (12) it follows that household n is in equilibrium if:

$$X_n' \alpha = 0, \tag{5.14}$$

where X_n is a linear function in π_n and α, and where the parameter vector (α, β) has to be estimated.[3] Normally, we would solve this system for the choice variables le_m, wh_m, le_f and wh_f for each $n,$ so that we obtain the optimal solution vector $z^* = (le_m^*, wh_m^*, le_f^*, wh_f^*)$. By comparing z_n^* with the observed z_n we can find the optimal parameter estimates that would minimize the difference between z_n^* and z_n. However, this solution vector z^* is highly nonlinear in the α and β parameters and so it is difficult to estimate the unknown parameters by a direct estimation method. We propose a more convenient indirect estimation method to estimate the unknown parameter vector (α, β) that is similar to the Wald-test criterion approach (see also Wales and Woodland 1983; Blundell and Robin 1999;

[2] We note that the fertility decision, and hence the presence of children, likely affects the time that is spent on labor, leisure and housework, simultaneously, through preferences and bargaining. However, modeling this decision of having children is beyond the scope of this study.

[3] For notational convenience we write π_n instead of $\pi_n(\beta; v_n)$ and leave out the subscript h.

van Klaveren et al. 2008). The estimation method is inspired by the fact that (14) is linear in the parameter vector α.

Because the matrix equality in (14) does not hold exactly, we add a stochastic component such that the estimation model becomes:

$$y_n = X_n^{'}\alpha + \varepsilon_n, \tag{5.15}$$

where y_n is a nuisance vector with $y_n = 0$ for all n, and where ε is a four-dimensional error vector, which we assume to be $\varepsilon \sim N(0, \Sigma_\varepsilon)$. It is likely that time allocation choices of spouses are not correlated between households and so $E(\varepsilon_n, \varepsilon_{n'}) = 0$ if $n \neq n'$. We do, however, allow the ε terms to be correlated within households, because such a correlation is probable.

The system in (15) can be estimated by an iterative two-step procedure. In the first step we set $\beta_1^{(1)} = \cdots = \beta_J^{(1)} = 1$, yielding the first round utility weight coefficients $\pi_n^{(1)}$. The superscript indicates the iteration round and we note that $\pi_n^{(1)}$ varies with the household characteristics. Conditional on $\pi_n^{(1)}$, we can estimate the α-parameters by the method of Seemingly Unrelated Least Squares (SUR). Estimation of this system under the constraints $\sum \alpha_m = 1$ and $\sum \alpha_f = 1$ is equivalent to minimizing $\sum_1^N \alpha' X_n \Sigma_\varepsilon^{-1} X_n' \alpha$ with respect to α under those constraints. By assuming, without loss of generality that $\sum \alpha_m = 1$ and $\sum \alpha_f = 1$, we exclude the "trivial" solution where all parameter estimates are 0. Because the utility functions can be interpreted as a net of indifference curves, the analysis is not affected by this normalization procedure.

In the second step we use the estimated α-parameters in the first iteration round, denoted by $\alpha^{(1)}$, and estimate $\beta_{1,\ldots,J}$ by means of a nonlinear maximum likelihood procedure. The estimated β-parameters in the second step are denoted by $\beta^{(2)}$ and we use them in the second iteration round to calculate $\pi_n^{(2)}$. Conditional on $\pi_n^{(2)}$, we re-estimate $\alpha^{(2)}$ and with the estimated $\alpha^{(2)}$-parameters we re-estimate $\beta^{(3)}$. These β's are then used in the third iteration round. We continue this iterative process until convergence is reached.

4 Data

The data were collected between September and November in 2001 by DESAN, a Dutch organization for market research. The aim was to create a balanced sample with as many Dutch households as Turkish and Surinamese/Antillean households. The Dutch subsample is randomly drawn from the total pool of phone numbers of the Royal Dutch Mail (KPN). The immigrant subsample is drawn from a register owned by DESAN.[4] In Table 5.1, we show the number of two-earner households differentiated according to ethnic background.

[4]Strictly speaking we cannot label households from the second generation as immigrant households. However, for convenience, we will refer to Turkish, Surinamese/Antillean households as immigrant households.

Table 5.1 Households by ethnicity

Ethnicity	Frequency	Percentage
Dutch	153	42.86
Surinamese/Antillean	113	31.65
Turkish	91	25.49
Total	357	100.00

The ethnicity of the spouses is defined as follows. For the respondent, we use the immigrant definition of the Netherlands Statistics, i.e., the respondent is considered to be an immigrant if at least one of the parents is born abroad (Netherlands Statistics 2000). However, for the respondent's partner we cannot use this definition because there is no information about the parental ethnicity of the partner. For the partner we, therefore, use a question that directly asks for the partner's ethnicity. The household is classified as Dutch, Surinamese/Antillean, or Turkish, if both the respondent and the partner have the same ethnicity.

In order to estimate the model, we need information on paid labor, leisure, and housework. Although this information is available for the respondent, there is no information available on housework for the partner. The hours spent on housework by the partner are therefore imputed, conditional on individual and household characteristics. We denote the amount of housework of the respondent as wh_r, and that of the partner as wh_p. The time endowment per week is 168 h, and so we should have $wh_p \in [0168]$. Therefore, we define the auxiliary variable θ for the respondents of the N available households as:

$$\theta_{n,r} = \log\left(\frac{wh_{n,r}}{168 - wh_{n,r}}\right). \tag{5.16}$$

The inverse of (16) equals $wh_r = 168/(1 + e^{-\theta_{n,r}})$ and it is easy to check that $wh_{n,r} \in [0168]$ for any real number of $\theta_{n,r}$.[5] Using the auxiliary variable, we estimate the following equation by means of ordinary least squares (OLS):

$$\theta_{n,r} = \delta_0 + \delta_1 \cdot s^h_{n,1} + \cdots + \delta_k \cdot s^h_{n,k} + \delta_{k+1} \cdot s^r_{n,k} + \cdots + \delta_K \cdot s^r_{n,K} + \varepsilon \tag{5.17}$$

where s^h_n are household characteristics; and s^r_n are individual characteristics of the respondents for the N available households. The explanatory variables that we use are gender, the hourly wage rate, age, education level, the number of children between certain age levels, having a computer at home and the ethnicity of the household, using Dutch households as the reference group. The education variable represents the highest education level that is attained and it is measured on an eight-point scale, where one stands for primary school as highest education level and eight stands for having a university degree. The estimation results are shown in Table 5.2.

[5] If $\theta = 0$, then $wh_r = 84$; if $\theta \to \infty$ then $wh_r \to 168$; and if $\theta \to -\infty$, then $wh_r \to 0$.

Table 5.2 Housework estimates for the respondents

Characteristics	Estimate	t-value
Male	−0.504***	−4.90
Hourly wage rate	0.003	0.40
Age	0.004	0.55
Highest education level	−0.030	−1.11
Log (#-children 0/3+1)	1.126***	7.31
Log (#-children 4/11+1)	0.583***	5.03
Log (#-children 12/15+1)	0.573***	3.86
Log (#-children 16/25+1)	0.393**	2.54
Surinamese/Antillean	−0.026	−0.22
Turkish	0.166	1.25
Computer at home	0.134*	1.82
Constant	−3.251***	−9.45
N	357	
Adjusted R^2	0.274	

*/**/***Statistically significant at the 10/5/1% level

From (16) it follows that a negative correlation between, for example, the male dummy and θ can be interpreted as a negative correlation between the male dummy and the hours spent on housework. As was to be expected, men spend less time on housework than women, and the presence of children increases the time that respondents devote to housework. The estimation results suggest that ethnicity is not correlated with the time devoted to housework, however the effect of household ethnicity is captured by the child variables.

By estimating (17) and obtaining $\hat{\delta}_0, \ldots, \hat{\delta}_K,$ we can impute the missing values $\hat{w}h_{n,p}$ by calculating $\hat{\theta}_{n,p}$:

$$\hat{\theta}_{n,p} = \hat{\delta}_0 + \hat{\delta}_1 \cdot s^h_{n,1} + \cdots + \hat{\delta}_j \cdot s^h_{n,k} + \hat{\delta}_{k+1} \cdot s^p_{n,k} + \cdots + \hat{\delta}_n \cdot s^p_{n,K}. \tag{5.18}$$

In (18) the respondent's characteristics are replaced by the characteristics of the partner whose housework hours wh_p are not observed. Using $\hat{\theta}_{n,p}$ and (16) we can obtain values for $\hat{w}h_{n,p}$ by inverting (16) as:

$$wh_{n,p} = \frac{168}{1 + e^{-\hat{\theta}_{n,p}}} \tag{5.19}$$

Table 5.3 displays the summary statistics, after imputation, for the different household types that we distinguish. The hours spent on paid work, housework and leisure are hours per week.

The values associated with Surinamese/Antillean households are always in between those of Dutch and Turkish households. This is not so surprising, because Surinamese and Antillean households are more similar to Dutch households than Turkish households. The descriptives statistics are in line with those usually found for the Netherlands (see Netherlands Statistics 2003). When we compare the men of the different household types with their partners we find that

Table 5.3 Descriptive statistics

	Dutch	Surinamese/ Antillean	Turkish
Male			
Time spent on paid work	39.97	37.58	39.37
Time spent on housework	8.24	11.33	14.74
Time spent on leisure	119.79	119.10	113.89
Education level	5.45	5.33	4.55
Age level	39.35	41.41	36.04
Hourly wage rate	10.00	9.65	8.19
Female			
Time spent on paid work	25.84	29.27	26.56
Time spent on housework	16.69	17.89	23.59
Time spent on leisure	125.48	120.84	117.85
Education level	5.22	4.81	3.67
Age level	37.33	38.07	32.76
Hourly wage rate	9.16	8.82	8.00
Household			
#-Children 0/3	0.29	0.27	0.27
#-Children 4/11	0.44	0.58	0.88
#-Children 12/15	0.23	0.38	0.35
#-Children 16/25	0.16	0.42	0.32
#-Children 25 plus	0.01	0.03	0.01
Family size	3.13	3.68	3.84
Household income per week	637.83	615.44	522.46
N	153	113	91

they are older, spend more hours on paid work, spend less hours on housework and earn a higher hourly wage. Furthermore, we find that Dutch (wo)men earn more per hour than immigrant (wo)men. The average family size is largest for Turkish households, followed by Surinamese/Antillean and Dutch households.

According to Netherlands Statistics, Surinamese/Antillean and Turkish men and women are lower educated than Dutch men and women (Netherlands Statistics 2003). This is also the case in our sample, except for Surinamese/Antillean men, who are about equally well educated as Dutch men. This means that well-educated Surinamese/Antillean men are overrepresented in our sample.

5 Estimation Results

We focus first on the estimated preference parameters (α_m, α_f) for Dutch, Surinamese/Antillean and Turkish households. The estimation results are displayed in Table 5.4. The table also displays γ that represents the marginal productivity of the woman relative to that of the man, and the utility weight $\overline{\pi}$, that represents how the individual utility functions are, on average, weighted in the household utility function.

Table 5.4 Estimated preference parameters

	Male		Female	
	Estimate	t-value	Estimate	t-value
Dutch				
Leisure	0.752	66.00	0.759	50.55
Housework	0.005	4.19	−0.003	−2.35
Household production (H)	−0.010	−0.59	0.066	3.15
H-interaction term	−0.001	−0.04	0.084	2.86
Household income	0.223	10.61	0.095	4.63
Job hours	0.031	3.44	−0.001	−0.15
Surinamese/Antillean				
Leisure	0.841	62.72	0.681	63.47
Housework	0.006	5.97	−0.014	−10.13
Household production (H)	−0.053	−0.56	0.133	1.37
H-interaction term	−0.140	−1.55	0.167	1.84
Household income	0.299	8.61	0.009	0.28
Job hours	0.048	3.85	0.024	3.50
Turkish				
Leisure	0.924	64.82	0.499	34.08
Housework	0.019	8.12	−0.009	−6.40
Household production (H)	−0.095	−1.78	0.205	3.11
H-interaction term	−0.107	−1.90	0.180	2.57
Household income	0.115	4.36	0.133	5.64
Job hours	0.144	13.69	−0.009	−3.79

	Dutch	Surinamese/Antillean	Turkish
$\overline{\pi}$	0.55	0.47	0.52
γ	0.98	1.35	0.80
N	153	113	91

Following the definition of household tasks, it is not assumed that household hours of male and female are perfect substitutes, i.e., $\gamma = 1$. If $\gamma > 1$, this means that the woman is marginally more productive in the household, and if $\gamma < 1$, this means that the man is marginally more productive in the household. To assess γ, we let it vary with a width of 0.025 and choose the γ estimate that yields the highest log likelihood of the linear parameters.

The relative marginal productivity is 0.98 for Dutch households, 0.8 for Turkish households, and 1.35 for Surinamese/Antillean. This means that the marginal housework hour of the Surinamese/Antillean woman is more valuable than that of her partner. The marginal housework hour of Dutch men is about equally productive as the marginal housework hour of Dutch women. The marginal housework hour of Turkish men is more productive than that of the Turkish women. Although γ may reflect the ratio of productivity, it may also reflect cultural backgrounds where different norms and values apply. It is well known that the roles of male coworkers in the household are very differently interpreted in the three ethnic communities considered. Hence, we should be careful when making a productivity statement based on the value of the γ parameter. The model is, nevertheless, more flexible by allowing for a rate of substitution that may be different from 1.

For Dutch men, the most important variables in their utility function are leisure and household income. For Dutch women, leisure seems to be the most important variable and household income less so. Dutch women do not derive utility from individual household chores, but they do find joint household production important. So, household tasks have to be done preferably not by themselves, but by the partner. The importance of joint household production increases the larger the size of the family.

Leisure and household income are the most important variables in the utility function of Surinamese/Antillean Men. For these men, also joint household production interacted with family size is important, although this variable enters the utility function negatively. The estimation results for Dutch and Surinamese/Antillean men are rather similar, which is not that surprising, given the similarities in background characteristics (see Table 5.3).

Surinamese/Antillean and Dutch women appear to have different preferences, although leisure is important for both groups. While joint household production and household production interacted with family size significantly enter the utility function of both Dutch and Surinamese/Antillean women, these variables are much more important for the latter group.

Turkish families appear to be different from Surinamese/Antillean and Dutch households. The most important variable for Turkish men is leisure. Other, but less important variables, are household income and job hours. Household production and household production interacted with family size appear negatively in the utility function of Turkish men. For Turkish women, on the contrary, household production and household production interacted with family size is very important, just as leisure is important to these women. While leisure is important, the coefficient of leisure is much smaller than the leisure coefficient of Surinamese/Antillean and Dutch women. An explanation for the preference differences between Turkish households and the other households that we distinguish is that these households are in general more traditional: men specialize on the labor market, and women specialize in household work.

In Table 5.4, we report the average utility weight, $\overline{\pi}$. When $\overline{\pi}$ is higher than 0.5, this means that the utility function of the male is more heavily weighted in the collective utility function. For Dutch households, $\overline{\pi}$ is slightly higher than 0.5, as is also the case for Turkish households. The latter result is interesting, because a more traditional household is usually associated with a situation where the bargaining position of the woman is relatively low. However, our results indicate that Turkish households are the more traditional households, but we do not find evidence that the bargaining position of women is relatively low. For Surinamese/Antillean households, we find that the value is slightly below 0.5. This means that the relative bargaining position of the two spouses in Surinamese/Antillean households differs from that in Dutch and Turkish households. An explanation for this result may be that the divorce rate in Surinamese/Antillean families is relatively high, so that it is more important to maintain a higher degree of independence.

The distributions of π_n for the three household types are shown in Fig. 5.1. The upper left graph shows the distribution of π_n for Dutch households and we find that it is approximately normally distributed around the mean of 0.55.

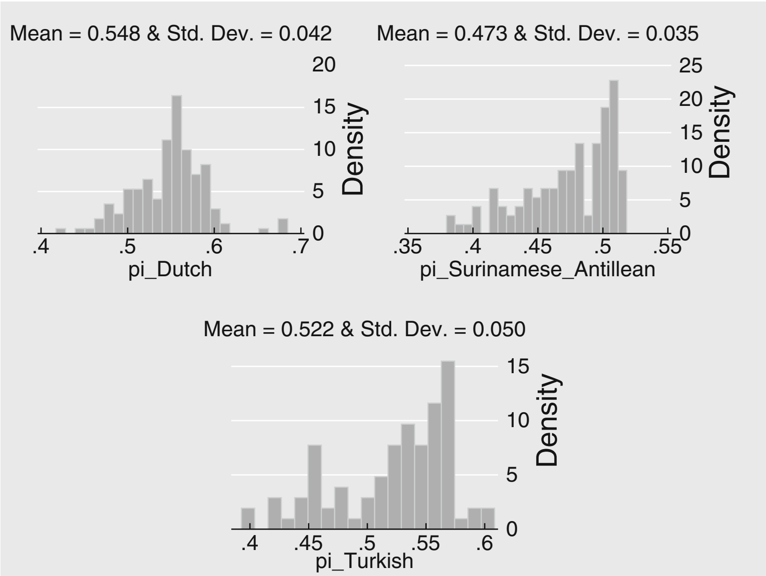

Fig. 5.1 Distribution graphs of utility weight function

For Surinamese/Antillean households (upper right graph) we find that the power distribution is skewed to the left and so the median value of π_n is smaller than the average value of π_n. A *t*-test shows that $\overline{\pi}$ is significantly smaller than 0.5 for Surinamese/Antillean households and this means that the utility weight that is assigned to the woman's utility function is frequently higher than the weight that is assigned to the man's utility function. For Turkish households (lower left graph) we find very different values for π_n, and that most values are above 0.5. A *t*-test indicates that $\overline{\pi}$ is significantly higher than 0.5, which means that the utility function of Turkish men gets, on average, more weight in the collective household utility function. More generally, Fig. 5.1 shows that there is substantial variation in the distribution of the utility weight between individual households.

Table 5.5 shows the estimation results concerning the utility weight, where the utility weight depends on wage rates, the number of children between certain age levels and age.[6] For Dutch households we find that age, the hourly wage rate, and the number of children aged between 0 and 3 influences the utility weight distribution. When partners are about the same age, the age effect will be small. However, if the age difference increases, the utility weight distribution shifts to the advantage of the older partner, mostly men. The bargaining power of the woman increases when there are children present in the household aged between 0 and 3. The wage rate effects are as expected: the power distribution will shift in the direction of the partner whose hourly wage rate increases.

[6]Because the education levels of men and women and the unearned income were not significant, we dropped these variables from the model.

Table 5.5 Estimated utility weight functions

	Dutch		Surinamese/Antillean	
	Estimate	t-value	Estimate	t-value
Log (w_{male})	0.174***	3.20	0.011	0.40
Log (w_{female})	−0.190***	−3.96	0.029	0.94
Log (#-children 0/3+1)	−0.185***	−3.87	−0.222***	−6.91
Log (#-children 4/11+1)	0.033	0.89	−0.089***	−4.43
Log (#-children 12/15+1)	0.001	0.02	−0.043**	−2.04
Log (#-children > 16+1)	−0.073	−1.22	0.030	1.36
Log (age$_{\text{male}}$)	0.445***	2.92	0.050	0.57
Log (age$_{\text{female}}$)	−0.402**	−2.62	−0.082	−0.89
N	153		113	

	Turkish	
	Estimate	t-value
Log (w_{male})	0.144***	4.20
Log (w_{female})	−0.100***	−3.88
Log (#-children 0/3+1)	−0.360***	−8.38
Log (#-children 4/11+1)	−0.007	−0.27
Log (#-children 12/16+1)	−0.064**	−2.06
Log (#-children > 16+1)	−0.099**	−2.95
Log (age$_{\text{male}}$)	−0.032	−0.42
Log (age$_{\text{female}}$)	0.041	0.55
N	91	

*/**/***Statistically significant at the 10/5/1% level

For Surinamese/Antillean households, the variation in the power distribution is entirely driven by the presence of children in the household. This is an interesting result. Apparently, the time allocation choices are not influenced by the individual wage rates and so a wage increase influences the time allocation choices of the partner only through the effect of the household income in the utility function and not through bargaining. Surinamese/Antillean women have more bargaining power if there are (more) children in the household, and the bargaining effect is more pronounced when the children are younger. Similar to Dutch households, we find a wage effect for Turkish households, although this effect is not as strong. Also, for Turkish households we find that the presence of children increases the bargaining power of the woman and that this effect is more pronounced when the children are between 0 and 3 years old.

6 Wage Effects

Time allocation choices depend on the wage rates of both partners, so it is interesting to examine how time allocation choices react to marginal wage changes. More formally, if the wage vector $(w_m, w_f) = w$ changes by $\Delta w,$ we are interested in the

Table 5.6 Wage elasticities

	Dutch		Surinamese/Antillean		Turkish	
	w_m	w_f	w_m	w_f	w_m	w_f
le_m	−0.15	0.15	−0.02	0.12	−0.02	0.06
wh_m	−4.41	4.11	−4.24	2.32	−1.46	1.26
jh_m	1.16	−1.10	1.08	−0.85	0.53	−0.57
le_f	0.17	−0.16	0.07	−0.14	0.23	−0.26
wh_f	2.63	−2.60	2.51	−1.24	0.38	−0.48
jh_f	−1.89	1.78	−1.88	1.54	−1.31	1.75

change in $z(w)$. Note that we use the shorthand notation $z = (le_m, wh_m, le_f, wh_f)$. The wage effect matrix can be written as[7]:

$$\frac{\partial z}{\partial w} = -(U_{zz})^{-1}\left[\underbrace{\pi U_{m,zw} + (1-\pi)U_{f,zw}}_{A} + \underbrace{\left[U_{m,z} - U_{f,z}\right]\left[\frac{\partial \pi}{\partial w}\right]'}_{B}\right], \tag{5.20}$$

and consists of two parts. Part A, represents the usual gross substitution effect and part B represents the *bargaining* effect. From the identity $jh + wh + le \equiv 24$, it follows that the wage effects on job hours of the man and the woman are:

$$\frac{\partial jh_m}{\partial w} = -\left(\frac{\partial wh_m}{\partial w} + \frac{\partial le_m}{\partial w}\right)$$

and

$$\frac{\partial jh_f}{\partial w} = -\left(\frac{\partial wh_f}{\partial w} + \frac{\partial le_f}{\partial w}\right).$$

The corresponding elasticities, $\frac{\partial z}{\partial w}.\frac{w}{z}$, can be obtained using (20). The elasticities are evaluated in the sample mean and are displayed in Table 5.6.

For all the three household types, we find a minor wage effect on the time that is allocated to leisure. It seems that men and women replace job hours for housework hours or vice versa. Men and women replace housework hours by paid labor if their hourly wage rate increases and that they do the opposite when the hourly wage rate of the partner increases. The labor supply wage elasticities in this study are in line with those usually found for the Netherlands, although they are more pronounced. eveymoo05 performed a meta-analysis and considered 239 wage elasticities from 32 empirical studies for different countries. For the Netherlands, they found that the labor supply wage elasticities for men and women are, on average, 0.1 and 0.5, while we find 1.16 and 1.78. The wage elasticities used

[7]In the Appendix we show how this wage effect matrix is constructed.

by Evers et al. (2005) are estimated on the basis of individual labor supply data, where the interaction between the household members and the time that is spent on housework are not considered, and this may explain why the wage elasticities are more pronounced in this study.

In Table 5.3, we found that the values of the descriptive statistics associated with Surinamese/Antillean households were in between those of Dutch and Turkish households and in Table 5.6 we find the same for the wage elasticities values, with the exception of the labor supply wage elasticity of women. The wage elasticities for Surinamese/Antillean households are not the result of bargaining between the household members, because the individual wage rates were not significant in the utility weight function. It follows that the wage elasticities for Surinamese/Antillean households purely represent the usual gross substitution effect, i.e., part A in (20). Based on our preference parameter and utility weight function estimates, we conclude that wage elasticity differences between Dutch and Surinamese/Antillean households are the result of bargaining between Dutch men and women and are, at the same time, the result of a preference difference with respect to the joint household production. This explains why the housework wage elasticity for Surinamese/Antillean women is smaller than that for Dutch women.

Although the wage elasticities for Turkish households are comparable to those of Dutch and Surinamese/Antillean households, they are less pronounced. This confirms the idea that Turkish households are the more traditional households, since time allocation choices are less responsive to wage changes. However, the labor supply wage elasticity for Turkish women is higher than that for Surinamese/Antillean women and comparable to that of Dutch women, and in that sense, Turkish households cannot be characterized as the more traditional households. The housework wage elasticity of Turkish men is lower than that of Dutch and Surinamese/Antillean men. An explanation for this result is that labor supply choices are to a large extent determined by gender roles. Turkish men, often, do not perform housework activities, such as cleaning, ironing, etc. Although Turkish households are, on average, more traditional, the housework wage elasticity for men can be caused by the less traditional Turkish households in the sample and this would also explain why the total housework wage elasticity is less pronounced.

Unfortunately, cross-elasticities for the Netherlands are (almost) never reported in empirical studies, and so it is not possible to relate our findings to those of other studies. That men and women work more labor hours if their hourly wage increases, but work less labor hours if the hourly wage rate of the partner increases, is an interesting result from a policy perspective. Let us focus, for example, on the wage elasticities of Dutch households that are remarkably symmetric.

The point of departure for current Dutch government policies is the idea that women supply more hours of paid labor if there wage rate is increased. This result is in line with the wage elasticities in Table 5.6. It is also in line with the observation that in young Dutch two-earner households both partners frequently have less than a full-time job. Policy makers often mention that increasing the labor supply of women is beneficial because it generates extra benefits through income taxes. However, usually they do not take into account the cross-elasticities. Thereby, they neglect the possibility that men in two-earner households, who generally pay higher marginal taxes than their partner, may supply less paid labor when the partner supplies more paid labor. As a consequence, the total benefits for the government may be smaller than expected, or may even be negative. Government tax policy should thus take these cross-effects into account when they estimate the prospective tax benefits of increasing female labor participation.

7 Conclusion

In this study, we examine the time allocation decisions of Dutch, Surinamese/Antillean, and Turkish households. We assume that labor supply for men and women are endogenous choice variables and also consider housework and household production. By using the theoretical framework of the collective household model, we can examine individual preferences and the intrahousehold bargaining process between the household members.

We find that leisure and household income are important utility variables for the household types we distinguish. Surinamese/Antillean and Turkish women differ from Dutch women because they value (joint) household production much more in their utility function. Surinamese/Antillean and Turkish men, on the contrary, value joint household production less then Dutch men. Turkish households are the more traditional households, in the sense that the woman is more oriented on household production, while the man is oriented on paid labor.

It is often believed that the bargaining power of women in more traditional households is relatively low, but our estimation results do not support this idea. For Dutch and Turkish households, we find that the man has slightly more bargaining power than his partner, and that the bargaining power varies in a similar way with individual and household characteristics. It increases with wage and the presence of young children increases the bargaining power of women. We conclude that the distribution of bargaining power within Turkish households is comparable with that of Dutch households, even though more traditional gender roles apply in Turkish household. For Surinamese/Antillean households we find that the distribution of bargaining power within the household is entirely driven by the presence of children. The bargaining power of the woman increases when there are (more) children in the household. It follows that time allocation choices of Surinamese/Antillean men and women are only influenced by the partner's wage through the household income and not through bargaining, since the individual bargaining position is not affected by the individual wage rates.

In general, the wage elasticities of Dutch, Turkish, and Surinamese/Antillean households are comparable, although those for Turkish households are less pronounced. Because the wage elasticities with respect to leisure are close to 0, we find that men and women replace housework hours by paid labor if their hourly wage rate increases and that they do the opposite when the hourly wage rate of the partner increases. The labor supply wage elasticities that we find are comparable with those usually found for the Netherlands, although they are more pronounced.

The less-pronounced wage elasticities of Turkish households may reflect that these are more traditional; however, at the same time we find that the labor supply wage elasticity of Turkish women resembles that of Dutch women, and in that sense we cannot refer to the Turkish households as being more traditional. The wage elasticity with respect to housework for Surinamese/Antillean women is smaller than that for Dutch women. This difference is the result of bargaining within Dutch households, and, at the same time, is the result of a preference difference with respect to the joint household production.

Cross-elasticities are (almost) never reported, and this is unfortunate because of its policy relevance. Based on our estimation results, and ignoring cross-elasticities, it is beneficial to increase the labor supply of women, as long as the costs are lower than the extra benefits that are received through income taxes. However, taking into account the cross-wage elasticities, we find that such an increase in the labor supply of women comes along with a decrease in the labor supply of men, who generally pay higher marginal taxes than their partner. Government tax policy should thus take these cross-effects into account when they estimate the prospective tax benefits of increasing female labor participation.

Appendix

In this appendix, we show how the wage effect matrix is constructed. Let us return to the system in (11) and assume that $w^{(0)}, z^{(0)}$ represents the situation *ex ante*, and that $w^{(1)}, z^{(1)}$ is the new equilibrium. The (4×12)-matrix X is a function of w and by differentiating the elements of the matrix X also with respect to w, we add two columns to the matrix U_{zz}, producing the (4×6)-matrix $(U_{zz} \quad U'_{zw})$. The matrix U'_{zw} is a (4×2)-matrix. Because $\frac{\partial U_h}{\partial z} = \pi \frac{\partial U_m}{\partial z} + (1-\pi)\frac{\partial U_f}{\partial z} = 0$, we have to take into account that π depends on the wage vector as well:

$$U_{zz} = \pi \cdot U_{m,zz} + (1-\pi) \cdot U_{f,zz}$$

$$U_{zw} = \pi \cdot U_{m,zw} + (1-\pi)U_{f,zw} + \left[U_{m,z} - U_{f,z}\right]\left[\frac{\partial \pi}{\partial w}\right]',$$

where the last element is the product of a (1×2)-matrix and a (4×1)-matrix, resulting in a (4×2)-matrix. Denoting $z^{(1)} - z^{(0)} = \Delta z$, the new equilibrium has to satisfy the equation:

$$U_{zz}\Delta z + U'_{zw}\Delta w = 0.$$

The wage effect matrix is, therefore:

$$\frac{\partial z}{\partial w} = -(U_{zz})^{-1}\left[\pi U_{m,zw} + (1-\pi)U_{f,zw} + \left[U_{m,z} - U_{f,z}\right]\left[\frac{\partial \pi}{\partial w}\right]'\right]$$

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Chapter 6
The Effects of Marriage on Couples' Allocation of Time Between Market and Nonmarket Hours

Nicolas Moreau and Abdel Rahmen El Lahga

1 Introduction

Living arrangements have undergone considerable change in recent decades. In most Western countries, marriage rates have fallen, divorce rates have risen, and fertility outside legal marriage has become commonplace (Lundberg and Pollak, 2007; Stevenson and Wolfers, 2007). Marriage is no longer the exclusive context of family formation. Cohabitation substitutes for marriage among many couples at younger ages and is a permanent alternative to marriage for a growing number of couples. For instance, in the USA, the percentage of marriages preceded by cohabitation has risen from about 10% in the period 1965–1974 to well over 50% for 1990–1994 (Bumpass and Lu, 2000). In the same way, the number of unmarried couples has nearly doubled in the 1990s. Cohabitation has also developed in Europe and has become very important in countries such as Germany, France, or Sweden (Stevenson and Wolfers, 2007).

The dissociation of domestic arrangements from legal marriage challenges the microeconomic literature in which couples living in consensual unions are implicitly assumed to act exactly as married couples. However, as outlined by Stevenson and Wolfers (2007, page 9), "these labels also have substantive economic content, determining the default allocation of property rights following separation, tax treatment of the couple, and the eligibility for both social programs and employment-related family benefits." Indeed, laws and institutions are important determinants of household behavior (see, for instance, Stevenson and Wolfers, 2006 or Stevenson, 2007). This raises the important issue of the link between marital status and family outcomes.

In this chapter, we shed some light on this question by analyzing how married and unmarried couples who face different legal status divide home versus market work.

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More specifically, we examine whether the shift from cohabitation to marriage is associated with a significant change in household market and nonmarket labor supply. We use a long German panel (GSOEP) to test whether the transition from cohabitation to marriage reinforces the degree of specialization among couples.[1] A crucial feature of the GSOEP is that it contains detailed information on marital status. This enables us to precisely spot those couples who transit from cohabitation to marriage. Taking advantage of the panel structure of our data, we control for unobserved household-specific differences that may influence self-selection into marriage.

We study the impact of marriage on the female-to-male relative levels of domestic and market work hours, to assess the specialization patterns within the household. Our results show that marriage increases female specialization in home-based activities.

We account for selection bias in the presence of endogenous regressors following the procedure advocated by Semykina and Wooldridge (2005), that we adapt to system GMM estimation. We also allow individual earnings, household nonlabor income, and possibly married life to be correlated with the idiosyncratic disturbances.

The chapter is structured as follows. Section 2 exposes the theoretical underpinning for the effects of marriage and cohabitation on market and nonmarket labor supply. Section 3 discusses the empirical specification. Section 4 exposes the econometric issues. The data are described in Sect. 5. The results are presented in Sects. 6 and 7 concludes.

2 Theoretical Background

The economic motivations that lie behind the existence of the household have been extensively discussed in the literature. At least since Becker (1973), it has been commonly argued that one of the reasons for household formation is that it allows household members to specialize efficiently on activities in which each has a comparative advantage. One partner can specialize in nonmarket household activities while the other specializes in market work. The distinction between legal marriage and consensual union is not formally stated, and the word "spouses" usually refers to two individuals living together. However, several arguments exist in the economic literature to predict that cohabitants specialize less than married couples.

First, cohabitants are often seen as playing noncooperatively (Nordblom, 2004 and references therein). Cohabitations are usually shorter lived than marriages (Brien et al. 2006; Bumpass and Sweet, 1995), and there is consensus to admit that cooperation is more likely to occur in stable couples, committed in a long-term relationship. Stratton (2005) also puts forward the hypothesis that specialization is closely related to perceived household stability. Using US data, she presents some

[1] The GSOEP is also used by Choi et al. (2005) to analyze the effects of marital life, children, and child gender on the work hours and earnings of West German men.

empirical evidence that the degree of specialization is greater within married couples compared to cohabitants. In contrast to cooperative settings, efficient specialization is less likely for couples playing strategically. For instance, Lundberg (2002) considers a bargaining model of intra-household allocation in a multi-period setting with limited commitment. That is, members are unable to make credible promises regarding future behavior.[2] She shows that inefficient levels of specialization and underprovision of household public goods are likely outcomes. Basu (2006) specifies a bargaining model with an endogenous balance of power between partners and no intertemporal commitment. He shows that strategic considerations can lead to inefficient outcomes.

Second, consensual unions offer less legal protection than marriage. Married spouses often have to care for each other and spousal maintenance is expected after divorce. Cohabitation provides individuals with less risk-sharing opportunities than marriage. That may prevent them from specializing in home-based activities and household production skills. Cohabitants are thus less likely to specialize in household-specific human capital. In this vein, Nordblom (2004) considers a model where married couples have legal restrictions on their relationship that force them to act cooperatively, while cohabitants with limited commitment act noncooperatively. This makes precautionary savings greater for cohabitants than for married couples.[3]

In Germany, the article 6 of the Constitution stipulates that the State must promote the institutions of marriage and the family through its legislation and prevent any situation which could disadvantage these institutions (Stintzing, 1999). Each spouse must support the other before the latter is entitled to subsidies from the State and this support is tax-deductible. This is not the case for cohabitants. In addition, the economic consequences of partnership dissolution are different for married couples and cohabiting couples. The German Constitution does not impose maintenance payments after nonmarital separation. However, child support payments are expected. In 1994, suggestions to extend the protection of marriage to any form of long-term cohabitation were not approved by Parliament.

Finally, income tax distorts the allocation of time between married and cohabiting couples whenever they are subjected to different income tax schedules. In the USA for instance, the federal tax system treats married couples as one unit and cohabiting couples as two units, which results in both marriage penalties and bonuses. For some married couples, especially those made up of two low-income workers, tax bills are much higher than if they were cohabiting. On the contrary, unmarried partners with very different earning levels might pay less tax if they were to marry. In Great Britain, married couples have certain advantages because they are given tax exemptions. In Germany, married couples can opt for the splitting system. Spouses' incomes are aggregated and halved, and the tax schedule is applied to this tax base. Married couples thus benefit from a more favorable taxation in the case of an asymmetric earnings situation between the spouses (Gustafsson, 1992). As a result,

[2] See also Wells and Maher (1998).

[3] Kotlikoff and Spivak (1981) and Anderberg (2003) also study risk sharing between spouses.

tax saving is maximized for one earner households, or if partners combine full-time/part-time employment. From a theoretical perspective, Wrede (2003) analyzes among others things the effect of joint taxation on specialization. Under the assumption that partners allocate their time efficiently between market and nonmarket activities through a Nash bargaining process, he shows that family members specialize more in reaction to joint taxation. Most importantly, only married couples can opt for the splitting system in Germany, while cohabitants face individual taxation. To the extent that this implies higher marginal tax rates on the first earner and lower marginal tax rates on the secondary earner, cohabitants have less incentives for specialization, ceteris paribus.

3 Empirical Specifications

We consider a household i consisting of a female (f) and a male (m) that makes decisions about market work, nonmarket work, marital status, and consumption. Let M be a dummy variable denoting the marital status of the couple, with $M=1$ if married and 0 if cohabiting. Each partner p ($p=m,f$) offers $l^p>0$ hours on the labor market at wage rate w^p and spends $h^p>0$ hours in domestic work.[4] Following Pollak and Wachter (1975) and Kooreman and Kapteyn (1987), we model the demand for consumption and the allocation of time by assuming that households or individuals maximize a utility function with goods (private and/or public) and time spent on market and nonmarket activities as arguments. The allocation of time among market and nonmarket activities is thus expressed as a function of prices, wage rates, and nonlabor incomes.

There are several ways of taking marital status into account in the utility function. Couprie (2007), Gray (1997), and Lundberg and Rose (2002), to name a few, treat marital status as a predetermined variable. Current shocks on labor supply do not influence current marital status. The utility function at time t is a function of current marital status but is maximized with respect to consumption goods and leisure only. Also, marital status can be seen as a preference variable that may vary over time. Couples may move from cohabitation to marriage and this change is likely to modify the allocation of time among market and nonmarket activities, but most previous literature assume that marital status is not a choice variable per se. However, it could be that marital status and the allocation of time are interrelated choices. Van der Klaauw (1996) explicitly studies their interdependence. In a life-cycle setting, he examines the interaction between female labor force participation (not

[4] Focusing the analysis on two earner couples may induce a selectivity bias. A more appealing approach, which is beyond the scope of this chapter, consists of explicitly modeling the household time allocation taking into account spouses' nonparticipation decisions regarding market and domestic labor. However, our econometric procedure tests and corrects for this potential selectivity bias.

hours) and marital decision (married or single). He shows, in particular, that ignoring the endogeneity of the marital status decision leads to an underestimation of own and husband's wage effect on female labor supply. Brien et al. (2006) estimate a model of nonmarital cohabitation, marriage, and divorce. They examine union formation and dissolution in the presence of uncertain match quality. They do not consider labor supply issues. However, their analysis shows that a significant cause of cohabitation is the need to learn about potential partners and to hedge against future bad shocks.

In this chapter, we estimate models with marriage assumed predetermined and models with endogenous marriage. We do not specify a structural model for the interaction between marital status and time use. However, we take this relation in reduced form via instrumental variables use in the market and nonmarket hours equations.

Also, we ignore the issue of union formation and dissolution.[5] Our estimates may then suffer from selection bias, but this problem is general to the household labor supply literature, where the analysis is usually done conditionally on household formation. We follow the bulk of the literature on this matter.[6] Our results must be interpreted conditionally on couple formation.

We now present our empirical model. To analyze the extent of specialization within households, we specify a two-equation system that relates female-to-male domestic and market work hours log ratios to marriage, relative earnings, and a set of preference factors.

3.1 The Domestic and Market Work Hours (Log) Ratios

Our specification is one that is often encountered in the literature. It was already used in a unitary framework (Kiker and Ng, 1990) as well as in a collective setting (Browning and Gørtz, 2006)[7] and explains the shares of domestic and market work:

$$\ln(r_{it}^h) = \alpha_h M_{it} + \beta_h \ln\left(\frac{w^f}{w^m}\right) + \gamma_h Y_{it} + \delta_h^{'} Z_{it} + \epsilon_{it}^h$$

$$\ln(r_{it}^l) = \alpha_l M_{it} + \beta_l \ln\left(\frac{w^f}{w^m}\right) + \gamma_l Y_{it} + \delta_l^{'} Z_{it} + \epsilon_{it}^l, \qquad (6.1)$$

where $r^h = h^f/h^m$ is the female-to-male domestic (home) work hours ratio, $r^l = l^f/l^m$ the female-to-male labor market work hours ratio, Y is the household nonlabor income, Z is a vector of household characteristics including the constant term,

[5] A recent paper that empirically addresses this issue is Lefgren and McIntyre (2006).

[6] See Blundell et al. (1998), Chiappori et al. (2002), and Pencavel (2006) among others.

[7] In the unitary framework, it is assumed that a household, irrespective of the number of household members, behaves as a single decision maker. The collective setting, introduced by Chiappori (1988), takes into account several decision makers and the bargaining process.

$\varepsilon = (\varepsilon^h, \varepsilon^l)$ is a vector of error terms, and α, β, γ, and δ are the parameters to be estimated. Subscripts i and t refer to the household and the time period, respectively.

Now we turn to the expected signs of the variables included in our empirical specification. As pointed out above, we expect a negative impact of marriage on women's relative hours on paid work (r^l) and a positive effect on women's relative hours on unpaid work (r^h). The overall effect on female relative leisure is a priori undetermined. Relative wages w^f/w^m are expected to be positively related to r^l and negatively to r^h. Again, the overall effect on relative leisure is undetermined. Nonlabor income has a positive effect on partners' leisure (if leisure is a normal good), but its impact on r^h and r^l is ambiguous.

We expect the specialization in home-based activities to increase with the duration of the relationship. To capture this effect, we include a series of dummy variables *Dur*2, *Dur*3, *Dur*4, and *Dur*5 indicating the relationship duration.[8] Also, the number and age of children are likely to influence the extent of specialization within the family. In line with the effect of children on female labor supply documented in the literature, we expect children to have a positive incidence on r^h and a negative impact on r^l. We include the number of children under 5 and the number of children older than 4 in our specification.

One may argue that time allocation within the household is sensitive to generational effects. More precisely, younger cohorts might exhibit a more equal division of domestic work and paid labor. To test this hypothesis, we include three cohort dummies in our model (individual born in 1931–1945, 1945–1955 and 1966–1979. The reference cohort is individuals born in 1956–1965). Other factors such as nationality, regional disparities, and religion may influence the intrafamily allocation of time. We thus include a set of dummy variables to control for these effects. The dummy variable German00 is defined as 1 for non-German couples and 0 otherwise, German10 takes on the value 1 for couples with a German male partner and a non-German female partner, whereas German01 = 1 for couples with a non-German male partner and a German female partner. Our control group is German couples. Included regions of residence are the southern and middle states of West Germany, Baden–Württenberg, Rheinland Pfalz, Saarland, and Bavaria. In contrast to the Protestant northern states, these regions include a majority of Catholics.[9]

4 Econometric Issues

In this section, we discuss econometric issues that arise with our specification and we present our estimation method. We draw upon Semykina and Wooldridge (2005). For the sake of expositional simplicity, we consider one equation of interest

[8] $Dur2 = \mathbf{1}[5, 10]$, $Dur3 = \mathbf{1}[10, 15]$, $Dur4 = \mathbf{1}[15, 20]$, and $Dur5 = \mathbf{1}[20, \infty]$, where $\mathbf{1}[\,.\,]$ denotes the indicator function of the corresponding event.

[9] Religious preferences are reported in the GSOEP but contain a lot of missing values.

to be estimated. All results can be easily generalized to a system of equations. We have:

$$y_{it} = x_{it}\beta + \epsilon_{it}, \quad (6.2)$$

where y_{it} is the dependent variable, x_{it} is a $1 \times K$ vector of explanatory variables, β is a $K \times 1$ vector of parameters to be estimated, and ε_{it} is the error term.

First, we control for a household-specific fixed effect c_i, which captures all unobserved time-constant household-specific heterogeneity in the labor supply. The error term is then expressed as $\epsilon_{it} = c_i + u_{it}$, where u_{it} is an idiosyncratic error.

We allow for arbitrary correlation between the unobserved fixed effect and the explanatory variables. In addition, we allow some elements of x_{it} to be endogenous (i.e., correlated with the idiosyncratic error, u_{it}). Let z_{it} a $1 \times L$ $(L \geq K)$ vector of instruments which are strictly exogenous conditional on c_i (i.e., $Eu_{is}z_{it}\ c_i = 0$ $\forall s, t = 1, \ldots, T$).

As previously mentioned, we focus our analysis on a sample of couples with strictly positive labor supply. Let s_{it} denote a binary selection rule that takes on the value 1 if the couple exhibits strictly positive market and nonmarket labor supply at period t, and 0 otherwise. Whether s_{it} equals 1 or 0, x_{it} and z_{it} are always observed.

Semykina and Wooldridge (2005) – SW hereafter – show that applying the usual fixed effect two-stage least squares (FE-2SLS) estimator to the selected sample yields consistent estimates if s_{it} is completely random – technically s_{it} is independent of (u_{it}, z_{it}, c_i) in all periods – or if s_{it} is a deterministic function of (z_i, c_i), where $z_i = (z_{i1}, \ldots, z_{iT})$. Thus, to obtain consistent estimates, one should carry out a formal test for sample selection and apply a correction method if necessary.

We now briefly sketch the procedure proposed by SW for linear fixed effects models.[10] The selection indicator s_{it} is generated by means of a latent variable s_{it}^* such that:

$$s_{it} = \mathbf{1}[s_{it}^* > 0] = \mathbf{1}[z_{it}\delta + a_i + \tau_{it} > 0],$$

where $\mathbf{1}[\,.\,]$ is the indicator function, a_i is an unobserved effect, and τ_{it} is an error term defined such that $\tau_{it}|z_i, a_i \sim N(0, 1)$, so that s_{it} follows an unobserved effect probit model. To allow a_i to be correlated with z_i, SW specify, following Mundlak (1978),

$$a_i = \eta + \xi\bar{z}_i + f_i, \quad (6.3)$$

where $\bar{z}_i$ is a vector of individual exogenous variables averaged across periods of time, and $f_i|z_i$ has a zero mean normal distribution. Hence, the selection indicator s_{it} is rewritten as:

$$s_{it} = \mathbf{1}[\eta + z_{it}\delta + \xi\bar{z}_i + v_{it} > 0], \quad (6.4)$$

where $v_{it} = (f_i + \tau_{it})$ has a zero mean normal distribution.

[10] Related papers are Gonzalez-Chapela (2004), Dustmann and Rochina-Barrachina (2000), and Kyriazidou (1997).

Now, suppose that (ε_{it}, v_i) is independent of (z_i), where $v_i = (v_{i1}, \ldots, v_{iT})'$, and $(\varepsilon_{it}, v_{it})$ is independent of $(v_{i1}, \ldots, v_{i,t-1}, v_{i,t+1}, \ldots, v_{iT})$. If $E(\varepsilon_{it}|v_{it})$ is linear, i.e., $E(\varepsilon_{it}|v_{it}) = \rho v_{it}$, then:

$$E(\epsilon_{it} \mid z_i, c_i, s_i) = \rho E(v_{it} \mid z_i, c_i, s_i) = \rho E(v_{it} \mid z_i, s_{it}). \tag{6.5}$$

Under the previous assumptions, we can write the level equation (2) as:

$$y_{it} = x_{it}\beta + c_i + \rho E(v_{it} \mid z_i, s_{it}) + e_{it}, \tag{6.6}$$

where e_{it} is an idiosyncratic error term verifying $E(e_{it}|z_i, c_i, s_i) = 0$ by construction.

As noted above, the FE-2SLS yields a consistent estimation of the parameters of interest if the expectation given by (5) is 0. Then, an immediate test for sample selection bias is obtained by testing $\mathbf{H}_0 : \rho = 0$ in (6), which can be estimated by FE-2SLS. For the selected sample (i.e., $s_{it} = 1$), we only need $E(v_{it}|z_i, s_{it} = 1)$, which can be obtained from the usual probit estimation:

$$E(v_{it} \mid z_i, s_{it} = 1) = \lambda(\eta + z_{it}\delta + \xi\bar{z}_i), \tag{6.7}$$

where $\lambda(.)$ denotes the normal hazard. Let $\widehat{\lambda}_{it}$ denote a consistent estimate. To test for selection, one simply has to estimate $P(s_{it} = 1 \mid z_i) = \Phi(\eta + z_{it}\delta + \xi\bar{z}_i)$ with a reduced-form probit at each period t, to plug $\widehat{\lambda}_{it}$ into equation of interest, to estimate the augmented level equation by FE-2SLS, and to test for $\mathbf{H}_0 : \rho = 0$ with a t-test, for example. To add more flexibility to the model, it is possible to interact $\widehat{\lambda}_{it}$ with time dummies to allow the coefficient ρ to be different across t. In this case, a Wald statistic can be used to test the joint significance of the T coefficients ρ_t. In our empirical specification, we use a FE-GMM estimator instead of the FE-2SLS and allow for different ρ_t.

SW offer a correction procedure for the sample selection problem when the null is rejected. It amounts to estimating (6) by Pooled 2SLS using a decomposition of the household-specific effect c_i that follows Mundlak (1978). Under the previous assumptions about the selection rule and the unobserved effects, the primary equation of interest (6.2) can be rewritten as follows:

$$y_{it} = \alpha + x_{it}\beta + \bar{z}_i\xi + \gamma_t E(v_{it} \mid z_i, s_{it}) + e_{it}. \tag{6.8}$$

SW show that applying the Pooled 2SLS estimator to (8) after replacing $E(v_{it}|z_i, s_{it})$ by the estimated normal hazard $\widehat{\lambda}_{it}$ yields a consistent estimator of the parameters.

We adapt the procedure presented in SW to system estimation and propose a GMM estimator (Pooled GMM hereafter).

Now, we address the question of the endogeneity of the regressors and the choice of the instruments. It is likely that hourly earnings and household nonlabor income are endogenously determined. Therefore, we have chosen to instrument the woman's wage rate, the man's wage rate, and the household nonlabor income.

One might also argue that the effect of marriage on labor supply cannot be distinguished from the effect of preschool children on parental time use. Indeed, the presence of children is more frequent among married couples in comparison with cohabitants who may enter marriage to begin childbearing or to legitimate the birth of a child. Child dependency on their mothers (breastfeeding, for example) coupled with the virtual absence of child-care facilities in West Germany for small children create a strong incentive for specialization in conjunction with motherhood.[11] To limit the extent of this problem, we focus on observations with no children under 2. We account for this potential endogenous selection rule in our estimation procedure but assume that older children can be regarded as strictly exogenous after conditioning on the unobserved effect. This approach is commonly used in the literature (see for instance Lundberg and Rose, 2002). Moreover, given that we ignore the issue of union formation and dissolution, we also consider the duration of the relationship to be strictly exogenous once we condition on the unobserved effect. Marital status will be considered either exogenous or endogenous depending on the estimations.

The set of excluded instruments that do not appear in the labor supply equations consists of the following variables: male and female years of schooling and their squares, male and female age and their squares, product of partners' age and education, and time dummies. Our intuition is that these variables have an impact on the various sources of household income.[12] Therefore, there are 26 excluded instruments from the labor supply equations.

Finally, it is important to have at least one instrument that affects only the selection equation, otherwise the parameters of the level equation are identified through the nonlinearity in the normal hazards. We use the female and male unemployment rates as exclusive regressors for the probit model.[13]

5 The Data

Our data are drawn from the first 21 waves of the German Socio–Economic Panel (GSOEP) for the years 1984–2004. We extract a sample of observations that corresponds to adult couples living in the former Federal Republic of Germany where both adults are between 25 and 55 years old, have finished their education, and are available for the labor market. Households where adults are retired or students

[11] In West Germany, full-day child-care is rare (Deutsches, 2002). Approximately 5% of children under age 3 are enrolled in formal child-care. Among 3–5 years old, 74.6% are enrolled in kindergarten (Gornick and Meyers, 2003).

[12] These are standard instruments in the literature. See for instance Chiappori et al. (2002) among others.

[13] These variables are constructed, by gender and 5-year age groups, from macroeconomic German statistics.

are excluded. We also exclude households where adults are self-employed. Excluded from the sample are also couples who gave incomplete or incoherent information. Finally, when an individual appears in more than one couple, we select the one with the longest duration in the data. Therefore, to each individual corresponds only one household. In all, these selection criteria lead to a sample of 4,762 couples resulting in 28,167 observations. On average, a couple appears six times over the 21 years period (the minimum and maximum are 2 and 21, respectively). Of the 4,762 couples in our sample, 3,796 (79.71%) are always married, 364 (7.64%) always cohabiting, and 602 (12.65%) make the transition from a cohabiting to a married couple. The couples who always live in a consensual union are observed for a shorter number of periods than the overall average. Their average number of waves is four within our observation window.

Also, to estimate the equation system (6.1), conditional on fixed effects, we need at least two observations for the same couple. Therefore, the data we use for estimating these equations use all couples without children under 2 who report, for both partners, a strictly positive amount of domestic work and market work in at least two periods. This leaves us with 12,925 observations from 2,762 households.

5.1 Measuring Time Use

Time spent on nonmarket work is computed as the sum of hours spent on housework (washing, cooking, and cleaning), childcare, gardening, and repairs in a typical weekday. Not all domestic work time is covered by this variable as weekend nonmarket work is not included.[14] However, we probably account for a larger set of activities than that captured when the question is only about time spent on housework (and not about childcare) in a normal week.

We measure time spent in market work as the annual work hours on all jobs divided by 365 (and by 366 for leap years). It corresponds to an average number of hours worked per day. It means that market work and nonmarket work have the same unit of time (i.e., a typical week day).

5.2 Measuring Earnings

Total labor earnings include wages and salaries from all jobs including overtime and secondary jobs. The wage rate is average hourly earnings defined by dividing total labor income over annual hours of work on all jobs. Nonlabor income includes

[14] Complete information on weekend domestic work is asked only with years 1993, 1995, 1997, 1999, 2001, and 2003.

income from assets, rent, private transfers, public transfers, etc. All these income variables are in euros adjusted for inflation with the price index provided by the GSOEP. Nonlabor income is in thousands of euros, also adjusted.

5.3 Measuring Marital Status

The couple's marital status is represented by the dummy variable M that takes on a value of 1 if the partners are legally married at the time of the interview, and 0 if they are cohabiting.

5.4 Measuring Duration of Conjugal Life

Duration of conjugal life can be computed from a retrospective data file on marital history that contains yearly information on marital status. The data include the beginning and the ending of each marital status spell.

Summary statistics for the whole sample that includes nonparticipation in the labor market and in the house are given in Table 6.1. Sample characteristics are classified by marital status. The average age is 41 years for men and 39 years for women. From the 28,167 observations, 34% are women who do not participate in the labor market and 13% are men who do not work in the house. Of the 4,762 females (males) in our sample, 47.84 (88.70)% always participate in the labor market, and 18.5 (1.83)% never do. Only 1.81% of the men never work in the house.

Women who live in a consensual union participate more in the labor market than married women. On average, cohabiting couples are younger and have fewer children than married couples. These findings could illustrate the transitional status of cohabitation but could also result from the composition of our sample. Cohabitation is indeed increasing over time.[15]

Table 6.2 reports statistics on the sample of households with no children under 2 and with both partners working in the labor market and in the house. The sample characteristics are reported separately by the number of children in the household and by marital status. On average, women work more hours in the house than men but less in the labor market. The variability of hours is lower for men: from the 12,925 observations, 77 (38)% are men (women) that work at most 3 h in the house per day and 75 (46)% are men (women) that work between 35 and 45 h per week in paid jobs.

The domestic workload increases with the number of children. Also, married women work more in the house than cohabiting women and less in the labor market. In all, the female share of "total" work (total work is market work together with

[15] About 4.32 (9.19)% of the households live in a consensual union in 1984 (2004). The highest proportion is observed for 1995 with 12.32% of cohabiting couples.

Table 6.1 Descriptive statistics for the whole sample

		Marital status		
	Total	AM	CM	AC
Age (f)	38.70	39.69	33.88	35.91
	(7.58)	(7.39)	(6.43)	(7.85)
Age (m)	41.21	42.33	35.98	37.35
	(7.77)	(7.53)	(6.53)	(7.74)
Market work participation (f)	0.66	0.62	0.80	0.88
	(0.47)	(0.48)	(0.40)	(0.33)
Market work participation (m)	0.95	0.95	0.96	0.92
	(0.22)	(0.22)	(0.20)	(0.27)
Nonmarket work participation (f)	0.99	0.99	0.99	0.98
	(0.08)	(0.07)	(0.11)	(0.14)
Nonmarket work participation (m)	0.87	0.87	0.90	0.85
	(0.34)	(0.34)	(0.30)	(0.35)
Number of children (f)	1.37	1.54	0.72	0.44
	(1.16)	(1.15)	(0.91)	(0.77)
Education level (f)	10.99	10.74	12.04	12.27
	(2.41)	(2.33)	(2.35)	(2.67)
Education level (m)	11.44	11.27	12.26	12.00
	(2.56)	(2.51)	(2.68)	(2.61)
Duration of conjugal life	16.98	18.96	10.26	7.44
	(9.03)	(8.61)	(5.63)	(5.79)
Number of observations	28,167	22,882	3,891	1,394

Notes: Sample standard deviations are in parentheses below sample means. "AM" refers to couples who are always married, "CM" to couples who transitfrom consensual union to marriage, and "AC" to couples who are always cohabiting. The duration of conjugal life is the maximum duration observed percouple. Its average is computed over the 4,762 couples, not over the 28,167 observations

domestic work) is slightly greater than 50% for married women and for couples with children. It seems that men do not fully compensate for the fewer hours of domestic work by working more in the market when they have children. Finally, women have a lower average wage rate than men.

6 Results

Conditioning the sample on households with working partners (i.e., $h^f > 0, l^f > 0$, $h^m > 0$ and $l^m > 0$) and no children under 2 years of age may induce a selectivity bias. To account for all these selection rules, we estimate 21 reduced-form participation equations and include the normal hazards into the market and nonmarket work equations, as explained in Sect. 4. The results, not reported here, show a significant effects of the unemployment rates (i.e., specific variables for the selection equations). Hence the parameters of the domestic work and the market work equations, which exclude the latter variables, are non-parametrically identified.

Table 6.2 Descriptive statistics for two-earner households where both partners do some housework

		No. of children				Marital status		
	Total	0	1	2	3	AM	CM	AC
Age (f)	39.15	37.02	40.19	40.13	40.53	40.52	34.27	35.53
	(7.39)	(8.84)	(6.97)	(5.75)	(5.38)	(6.96)	(6.62)	(7.66)
Age (m)	41.70	39.27	42.69	42.87	43.87	43.24	36.45	37.16
	(7.56)	(8.76)	(7.16)	(6.01)	(5.75)	(7.04)	(6.79)	(7.40)
Domestic hours (h^f)	5.21	2.67	5.91	6.84	7.24	5.57	4.44	2.91
	(3.41)	(1.63)	(3.16)	(3.50)	(3.28)	(3.31)	(3.73)	(2.46)
Domestic hours (h^m)	2.69	2.02	2.94	3.07	3.21	2.77	2.58	2.08
	(1.85)	(1.24)	(1.99)	(1.96)	(2.17)	(1.87)	(1.81)	(1.52)
Domestic hours	2.45	1.61	2.69	2.99	3.13	2.61	2.07	1.63
ratio ($r^h = \frac{h^f}{h^m}$)	(2.06)	(1.19)	(2.11)	(2.34)	(2.41)	(2.08)	(2.06)	(1.39)
Market hours (l^f)	4.31	5.29	4.03	3.66	3.62	4.15	4.73	5.22
	(1.65)	(1.28)	(1.56)	(1.59)	(1.61)	(1.63)	(1.63)	(1.44)
Market hours (l^m)	5.93	5.95	5.92	5.93	5.93	5.93	5.94	5.98
	(1.11)	(1.13)	(1.08)	(1.13)	(1.13)	(1.08)	(1.19)	(1.28)
Market hours	0.77	0.94	0.72	0.66	0.65	0.74	0.85	0.93
ratio ($r^l = \frac{l^f}{l^m}$)	(0.42)	(0.41)	(0.39)	(0.41)	(0.37)	(0.40)	(0.45)	(0.44)
Share of	0.52	0.50	0.52	0.53	0.54	0.52	0.51	0.50
total work (f)	(0.07)	(0.07)	(0.07)	(0.08)	(0.07)	(0.07)	(0.08)	(0.07)
Share of	0.64	0.56	0.66	0.68	0.69	0.65	0.59	0.55
domestic work (f)	(0.15)	(0.15)	(0.14)	(0.14)	(0.14)	(0.15)	(0.16)	(0.15)
Share of	0.41	0.47	0.39	0.37	0.37	0.40	0.43	0.46
market work (f)	(0.12)	(0.09)	(0.11)	(0.12)	(0.12)	(0.12)	(0.11)	(0.09)
Wage rate (w_f)	11.27	12.13	11.22	10.54	10.55	11.06	11.91	12.16
	(4.55)	(4.35)	(4.57)	(4.59)	(4.61)	(4.57)	(4.38)	(4.52)
Wage rate (w_m)	15.01	14.84	15.02	15.31	14.71	15.11	14.73	14.61
	(4.78)	(4.79)	(4.81)	(4.74)	(4.72)	(4.76)	(4.74)	(5.11)
Relative	0.81	0.88	0.80	0.74	0.77	0.78	0.88	0.90
wage rate ($\frac{w_f}{w_m}$)	(0.41)	(0.42)	(0.41)	(0.38)	(0.39)	(0.39)	(0.46)	(0.44)
Number of observations	12,925	4,325	3,821	3,642	1,137	9,914	2,184	827

Notes: Sample standard deviations are in parentheses below sample means. "AM" refers to couples who are always married, "CM" to couples who transitfrom consensual union to marriage and "AC" to couples who are always cohabiting

The estimates of the model (1) with exogenous marriage and using the fixed effect estimator FE-GMM are shown in Table 6.3. First, as can be shown from the reported statistic of Sargan test in the bottom of the table, we cannot reject the validity of our instruments. Second, we report a Wald statistic to test the overall significance of the 21 normal hazards added to test for selection bias.

At the 5% level, there is statistically significant evidence of selection bias for the log ratio of domestic hours but not for the log ratio of market hours. These results seem contradictory as our selection rule affects mainly couples with women who do not work in the labor market. Consequently, we decide to correct for contemporaneous selection in the equation related to domestic work but also in the equation

Table 6.3 FE-GMM estimates (Model 6.1)

	$r^h = \frac{h^f}{h^m}$	$r^l = \frac{l^f}{l^m}$
M	**0.112**	−**0.084**
	(0.055)	(0.032)
Log wage ratio	−**1.74**	**1.008**
	(0.432)	(0.291)
Nonlabor income	− 0.002	− 0.000
	(0.009)	(0.006)
Dur2[a]	0.019	−**0.072**
	(0.039)	(0.025)
Dur3	0.03	−**0.087**
	(0.06)	(0.039)
Dur4	0.048	−**0.116**
	(0.07)	(0.045)
Dur5	0.079	−**0.106**
	(0.078)	(0.05)
Children under 5	0.102	−**0.223**
	(0.064)	(0.044)
Children 5+	**0.069**	−**0.079**
	(0.029)	(0.019)
Wald test $\widehat{\lambda}_{it}$	35.337	9.46
P-value	0.026	0.985
Sargan test	31.896	
P-value	0.964	

[a]See footnote 8

Notes: Asymptotic standard errors are in parentheses. Coefficients in bold are significant at the 5% level

related to market work.[16] For this purpose, we use the Pooled GMM estimator that models the unobserved effect as a linear combination of the time averages of the exogenous variables. In comparison with the preceding estimation, we add eight time-constant regressors to explain the log ratios. Their effect could not be identified with the FE-GMM estimator.

The results are shown in Table 6.4. We present two Wald statistics to test the joint significance of the 13 coefficients related to the time averages of the exogenous variables and to test the joint significance of the 21 normal hazard.

Columns (1) and (2) in Table 6.4 report the estimates when marriage is assumed to be exogenous. At the 5% level, the time averages used to model the unobserved effect are jointly significant for both equations. Like the estimates obtained with the FE-GMM estimator, there is only evidence of sample selection for the log ratio of domestic hours. Also, the Sargan test does not reject the validity of the instruments and the overidentifying restrictions. We now turn to the parameters of main interest.

[16]We also estimate the model that accounts for selection bias only for the female relative domestic workload. The estimates are very similar.

Table 6.4 Pooled GMM estimates (Model 6.1)

	Marriage is exogenous		Marriage is endogenous	
	$r^h = \frac{h^f}{h^m}$	$r^l = \frac{l^f}{l^m}$	$r^h = \frac{h^f}{h^m}$	$r^l = \frac{l^f}{l^m}$
M	**0.153**	**−0.099**	**0.375**	**−0.436**
	(0.049)	(0.030)	(0.184)	(0.115)
Log Wage ratio	**−1.034**	**0.726**	**−1.067**	**0.632**
	(0.342)	(0.220)	(0.38)	(0.239)
Nonlabor income	**−0.020**	0.006	**−0.034**	0.012
	(0.010)	(0.006)	(0.013)	(0.007)
Dur2	− 0.002	**−0.066**		
	(0.033)	(0.020)		
Dur3	0.012	**−0.078**		
	(0.045)	(0.029)		
Dur4	0.006	**−0.098**		
	(0.059)	(0.038)		
Dur5	− 0.035	− 0.064		
	(0.068)	(0.043)		
Children under 5	**0.276**	**−0.280**	**0.287**	**−0.299**
	(0.049)	(0.033)	(0.053)	(0.034)
Children 5+	**0.129**	**−0.096**	**0.135**	**−0.108**
	(0.024)	(0.015)	(0.027)	(0.016)
Middle regions	**0.072**	0.009	**0.080**	− 0.004
	(0.032)	(0.022)	(0.035)	(0.023)
Southern regions	**0.087**	0.002	**0.097**	− 0.003
	(0.025)	(0.017)	(0.027)	(0.017)
German00	0.113	0.026	0.111	0.067
	(0.089)	(0.069)	(0.097)	(0.072)
German10	− 0.010	− 0.037	0.006	− 0.042
	(0.050)	(0.040)	(0.055)	(0.044)
German01	**0.123**	**−0.116**	**0.139**	**−0.111**
	(0.058)	(0.047)	(0.061)	(0.047)
Cohort 1931–1945	**0.159**	− 0.018	0.108	0.009
	(0.064)	(0.044)	(0.062)	(0.042)
Cohort 1946–1955	**0.089**	0.003	**0.073**	0.013
	(0.036)	(0.024)	(0.037)	(0.024)
Cohort 1966–1979	**−0.108**	0.012	− 0.076	− 0.014
	(0.039)	(0.024)	(0.043)	(0.026)
Intercept	0.473	**0.502**	0.323	**0.584**
	(0.370)	(0.253)	(0.411)	(0.264)
Wald test $\widehat{\lambda}_{it}$	34.624	24.857	36.598	29.598
P-value	0.031	0.253	0.019	0.100
Wald test $\bar{z}_{it}$	49.336	49.103	33.976	29.618
P-value	0.000	0.000	0.001	0.003
Sargan test	44.098		52.413	
P-value	0.633		0.381	

Notes: Asymptotic standard errors are in parentheses. Coefficients in bold aresignificant at the 5% level

The results indicate that marriage has a significant effect on both domestic and market work. When women are married, their domestic workload increases relative to men whereas the ratio of female-to-male market hours falls. All else being equal, married women are more likely to specialize in domestic work than cohabiting women.

Columns (3) and (4) in Table 6.4 report the estimates when married life is instrumented. The duration of the relationship is used as a supplementary excluded instrument.[17] The effects of marriage on the ratios of domestic work hours and market work hours are still significant when it is instrumented. However, the estimated coefficients of marriage exhibit a severe change in magnitude. It is possible that the effects of married life are seriously underestimated when marriage is supposed exogenous. On the other hand, such large variations in the estimated coefficients of marriage can denote a problem of weak instruments.[18] In such a case, and with no other relevant instruments for marriage, it may be better to just assume its exogeneity. Nevertheless, being married still raises the female relative domestic workload and decreases the female relative market workload, just as before.

The effects of the other explanatory variables are in line with those reported when marriage is supposed to be exogenous. Relative earnings have a negative effect on the ratio of nonmarket hours. A 1% rise in relative earnings leads roughly to a 1% decrease in the ratio of nonmarket hours. Women with a high relative wage are less likely to specialize in domestic activities. On the contrary, relative earnings have a positive impact on the log ratio of market hours. The division of market work between partners is more equal for high female relative wages. Also, nonlabor income has a significant and negative impact on the log ratio of unpaid hours. It could be that wealthy couples buy more market substitutes for home-based activities.

The presence of children in the household, especially of young children, raises women's domestic workload relative to men and decreases their share of market work. This is in accordance with the negative correlation between children and female market labor supply usually observed in empirical studies. Moreover, some regional disparities explain the division of domestic work between men and women. The female relative domestic workload is higher for households living in the southern states of West Germany. The ratio of female-to-male domestic hours is

[17]If we allow the duration of the relationship to appear in the labor supply equations, the estimates for M become very imprecise. We therefore maintain this exclusion restriction. Also, we test for the endogeneity of the duration of conjugal life whether marital status is assumed to be exogenous or endogenous. In both cases we do not reject the null (i.e., the exogeneity of the duration of conjugal life).

[18]We estimate the model with other instruments such as the female-to-male age and education ratios. It does not change the estimates. Also, as mentioned in Browning (1992), the usual practice of treating dummies as unbounded and continuous in the auxiliary equation may cause problems. We may be predicting values outside the (zero, one) interval that may in turn affect the estimates of the parameter of interest.

also higher for German-born women living with a non-German partner. Also, the results exhibit a cohort effect. Younger women are less likely to specialize in unpaid work than their elders.

6.1 Robustness Checks

6.1.1 Estimates on Alternative Samples

As previously mentioned, it could be difficult to disentangle the observed effect of marriage on labor supply from the effect of children. To give more robustness to our results, we re-estimate the model on the sample of couples with no children under 5 and on the sample of couples with no children under 11. This leaves us with $11,727$ observations from $2,579$ households if we include all observations with no children under 5 or with $8,657$ observations from $2,041$ couples if we include all observations with no children under 11.

Columns (1) and (2) of Table 6.5 are the estimates of the model (1) with no children under 5. Columns (3) and (4) are the estimates with no children under 11. Marriage is assumed to be exogenous. On the whole, the coefficients of the sample with no children under 11 are less precisely estimated.

The marital status coefficients exhibit a substantial fall in magnitude when we move from couples with preschool children to couples with no children under 11. It suggests that the effect of marriage on the parental allocation of time is higher for couples with young children. It is also possible that the marital status coefficients capture part of the effect of children on time use as married couples tend to have more children. However this may be, the effect of marriage is significant and has the expected sign. Married life increases women's specialization in home-based activities. This effect remains when marriage is instrumented, though with a large variation in the point estimates (see Table 6.7, in Appendix B).

For couples with no children under 5, relative earnings still have a significant and negative effect – though smaller in magnitude – on the ratio of nonmarket hours and a significant and positive impact on the ratio of market hours. The effect of relative earnings is insignificant for couples with no children under 11. Also, whatever the children's age, nonlabor income continues to have a significant and negative impact on the log ratio of domestic hours.

6.1.2 Does Marriage Cause This Outcome?

The observed effects of marriage may be due to selectivity if married couples exhibit systematic different characteristics than cohabitants. As a matter of fact, Lillard and Panis (1996) give evidence that healthier men tend to marry later and to postpone remarriage, while Lillard et al. (1995) show that individuals most prone to divorce are most likely to enter cohabitation. To check whether couples self-select

Table 6.5 Alternative samples: pooled GMM estimates, marriage is exogenous (Model 6.1)

	No. of children under 5		No. of children under 11	
	$r^h = \frac{h^f}{h^m}$	$r^l = \frac{l^f}{l^m}$	$r^h = \frac{h^f}{h^m}$	$r^l = \frac{l^f}{l^m}$
M	**0.126**	**−0.099**	**0.094**	**−0.078**
	(0.049)	(0.032)	(0.047)	(0.024)
Log wage ratio	**−0.893**	**0.757**	− 0.090	− 0.125
	(0.341)	(0.227)	(0.318)	(0.198)
Nonlabor income	− 0.019	0.010	− 0.025	0.000
	(0.011)	(0.007)	(0.013)	(0.008)
Dur2	− 0.016	**−0.057**	**−0.071**	− 0.005
	(0.034)	(0.022)	(0.036)	(0.02)
Dur3	0.039	**−0.079**	− 0.041	− 0.013
	(0.046)	(0.032)	(0.046)	(0.029)
Dur4	0.012	**−0.080**	0.102	**−0.158**
	(0.059)	(0.041)	(0.058)	(0.04)
Dur5	− 0.021	− 0.051	0.084	**−0.160**
	(0.070)	(0.047)	(0.072)	(0.049)
Children 5+	**0.140**	**−0.099**	**0.099**	**−0.065**
	(0.023)	(0.017)	(0.022)	(0.013)
Middle regions	**0.087**	− 0.002	**0.103**	− 0.019
	(0.031)	(0.022)	(0.031)	(0.026)
Southern regions	**0.107**	− 0.004	**0.105**	0.013
	(0.025)	(0.018)	(0.026)	(0.02)
German00	0.122	− 0.010	− 0.061	0.157
	(0.093)	(0.074)	(0.092)	(0.087)
German10	0.024	− 0.053	− 0.000	0.004
	(0.048)	(0.042)	(0.053)	(0.062)
German01	0.110	**−0.128**	0.017	− 0.081
	(0.059)	(0.050)	(0.059)	(0.051)
Cohort 1931–1945	**0.126**	− 0.023	0.007	0.01
	(0.064)	(0.045)	(0.066)	(0.052)
Cohort 1946–1955	**0.076**	− 0.002	0.003	0.023
	(0.035)	(0.026)	(0.038)	(0.03)
Cohort 1966–1979	**−0.098**	0.004	**−0.143**	0.022
	(0.041)	(0.027)	(0.046)	(0.027)
Intercept	0.629	0.343	**0.995**	− 0.063
	(0.366)	(0.264)	(0.382)	(0.274)
Wald test $\widehat{\lambda}_{it}$	32.629	28.658	19.158	34.855
P-value	0.050	0.122	0.575	0.029
Wald test $\overline{z}_{it}$	29.214	29.168	29.643	27.188
P-value	0.002	0.002	0.002	0.004
Sargan test	41.692		52.643	
P-value	0.728		0.299	

Notes: Asymptotic standard errors are in parentheses. Coefficients in bold are significant at the 5% level into marriage, we estimate the model (1) with a different marital status variable (*Change* hereafter) that takes on the value one for observations that correspond to married couples previously cohabiting. It is zero for couples who are either cohabiting or always married. This variable is for the permanent effect of the transition from cohabitation to marriage on time use. It does not capture intrinsic differences between married couples and cohabitants. Interestingly, its effect on domestic and market work hours is significant and very similar to those in Tables 6.4 and 6.5. For couples with no children under 2 for instance, the transition from cohabitation to married life, when assumed to be exogenous, increases the log ratio of domestic work hours by 0.150 and decreases the log ratio of market work hours by -0.099. We interpret this result as evidence of no significant selection into marriage. Table 6.6 in Appendix A reports the results.

6.1.3 Testing Exclusion Restrictions

We now consider whether education, age, and unemployment rates (which only appear in the selection equation) provide valid exclusion restrictions. Including these variables in the log ratios equations does not have significant effects on the original parameters estimates and their coefficients are insignificant. The effect of the duration of conjugal life on the log ratio of market work remains when age is a regressor. The *t*-values for the coefficients of the female education (age) are below 1.40 (1.33), whereas the *t*-values for the male education (age) are below 1.17 (1.33). We hence maintain these exclusion restrictions. We also test for interaction terms between marital status and wages and between marital status and the duration of conjugal life. Whatever the sample used, none of them is significant.[19]

7 Conclusion

In this chapter, we have estimated the effects of the transition from cohabitation to marriage on household market and nonmarket labor supply using a German sample of working couples. Our results indicate that marriage raises women's specialization in domestic work with a greater impact on couples with preschool children. We find that specialization in unpaid work is less likely for women with a high market wage.

Interestingly, we find that married women enjoy less leisure than cohabiting women. Marriage decreases women's market work and increases their domestic work so that the overall effect is a fall in their leisure. We also found evidence that married men enjoy less leisure than cohabiting men, but the effect of marriage on men's labor supply is less clear cut due to little variation in the male allocation of time.

[19] These figures and conclusions concern the estimation with marriage being exogenous. They still hold with endogenous marriage.

Finally, the magnitude of the estimated coefficients of marriage changes drastically and gives unrealistic results, when marital status is assumed to be endogenous, but the qualitative results remain the same. Marriage still increases women's specialization in unpaid work. It could also be that marriage influences the decision to participate in the labor market. In this case, the idea would be to estimate structural participation equations with marital status as an explanatory variable. This is a topic of future work.

8 Appendix A: The Permanent Effects of the Transition to Marriage on Domestic and Market Hours (Log) Ratios

Table 6.6 Pooled GMM estimates, permanent transition assumed exogenous (Model 6.1)

	No. of children under 2		No. of children under 5		No. of children under 11	
	$r^h = \frac{h^f}{h^m}$	$r^l = \frac{l^f}{l^m}$	$r^h = \frac{h^f}{h^m}$	$r^l = \frac{l^f}{l^m}$	$r^h = \frac{h^f}{h^m}$	$r^l = \frac{l^f}{l^m}$
Change	**0.150**	**−0.099**	**0.113**	**−0.091**	0.086	**−0.082**
	(0.049)	(0.029)	(0.049)	(0.030)	(0.048)	(0.025)
Log wage ratio	**−1.026**	**0.690**	**−0.946**	**0.633**	− 0.293	− 0.099
	(0.345)	(0.219)	(0.331)	(0.211)	(0.326)	(0.195)
Nonlabor income	− 0.021	0.005	− 0.017	0.005	− 0.028	− 0.005
	(0.011)	(0.006)	(0.011)	(0.007)	(0.015)	(0.009)
Dur2	0.006	**−0.075**	− 0.007	**−0.064**	− 0.062	− 0.008
	(0.033)	(0.020)	(0.034)	(0.021)	(0.037)	(0.02)
Dur3	0.025	**−0.090**	0.063	**−0.105**	− 0.036	− 0.014
	(0.046)	(0.030)	(0.047)	(0.030)	(0.046)	(0.029)
Dur4	0.024	**−0.114**	0.042	**−0.114**	0.101	**−0.164**
	(0.059)	(0.038)	(0.059)	(0.038)	(0.059)	(0.040)
Dur5	− 0.014	− 0.078	0.014	− 0.081	0.089	**−0.161**
	(0.068)	(0.042)	(0.069)	(0.043)	(0.073)	(0.050)
Children under 5	**0.263**	**−0.281**				
	(0.050)	(0.033)				
Children 5+	**0.128**	**−0.096**	**0.131**	**−0.093**	**0.096**	**−0.061**
	(0.024)	(0.015)	(0.023)	(0.016)	(0.022)	(0.013)
Middle regions	**0.072**	0.010	**0.088**	− 0.004	**0.101**	− 0.016
	(0.032)	(0.022)	(0.032)	(0.022)	(0.031)	(0.026)
Southern regions	**0.089**	0.005	**0.107**	0.002	**0.107**	0.019
	(0.025)	(0.016)	(0.025)	(0.017)	(0.027)	(0.020)
German00	0.116	0.031	0.136	0.021	− 0.023	0.166
	(0.090)	(0.069)	(0.093)	(0.071)	(0.093)	(0.086)
German10	− 0.009	− 0.039	0.016	− 0.046	− 0.001	0.024
	(0.051)	(0.041)	(0.049)	(0.042)	(0.052)	(0.062)
German01	**0.127**	**−0.111**	**0.117**	**−0.109**	0.036	− 0.076
	(0.059)	(0.046)	(0.060)	(0.047)	(0.059)	(0.051)
Cohort 1931–1945	**0.146**	− 0.017	0.107	− 0.018	− 0.011	0.0184
	(0.065)	(0.044)	(0.064)	(0.043)	(0.065)	(0.051)

(continued)

Table 6.6 (continued)

	No. of children under 2		No. of children under 5		No. of children under 11	
	$r^h = \frac{h^f}{h^m}$	$r^l = \frac{l^f}{l^m}$	$r^h = \frac{h^f}{h^m}$	$r^l = \frac{l^f}{l^m}$	$r^h = \frac{h^f}{h^m}$	$r^l = \frac{l^f}{l^m}$
Cohort 1946–1955	**0.081**	0.006	0.064	0.008	– 0.001	0.026
	(0.036)	(0.024)	(0.036)	(0.024)	(0.037)	(0.029)
Cohort 1966–1979	−**0.104**	0.012	−**0.091**	– 0.004	−**0.145**	0.026
	(0.039)	(0.024)	(0.041)	(0.025)	(0.046)	(0.026)
Intercept	0.513	0.438	0.685	0.208	**0.965**	– 0.135
	(0.378)	(0.256)	(0.372)	(0.259)	(0.382)	(0.273)
Sargan test	47.324		50.049		52.838	
P-value	0.500		0.392		0.293	

Notes: Asymptotic standard errors are in parentheses. Coefficients in bold are significant at the 5% level

9 Appendix B: Estimation Results with Endogenous Marriage

Table 6.7 Alternative samples: pooled GMM estimates, marriage is endogenous (Model 6.1)

	No. of children under 5		No. of children under 11	
	$r^h = \frac{h^f}{h^m}$	$r^l = \frac{l^f}{l^m}$	$r^h = \frac{h^f}{h^m}$	$r^l = \frac{l^f}{l^m}$
Married	**0.516**	−**0.506**	**0.382**	−**0.431**
	(0.172)	(0.113)	(0.155)	(0.096)
Log wage ratio	−**0.767**	**0.625**	– 0.254	– 0.105
	(0.357)	(0.23)	(0.327)	(0.214)
Nonlabor income	−**0.041**	**0.020**	−**0.039**	0.006
	(0.014)	(0.009)	(0.016)	(0.009)
Children 5+	**0.159**	−**0.111**	**0.108**	−**0.076**
	(0.026)	(0.018)	(0.024)	(0.013)
Middle regions	**0.106**	– 0.019	**0.112**	– 0.027
	(0.033)	(0.023)	(0.033)	(0.027)
Southern regions	**0.117**	– 0.010	**0.119**	0.004
	(0.027)	(0.019)	(0.029)	(0.021)
German00	0.089	0.051	– 0.032	**0.179**
	(0.098)	(0.076)	(0.097)	(0.089)
German10	0.053	– 0.052	0.023	0.011
	(0.052)	(0.046)	(0.056)	(0.063)
German01	0.115	−**0.120**	0.035	– 0.080
	(0.061)	(0.050)	(0.062)	(0.053)
Cohort 1931–1945	0.067	0.019	0.002	– 0.001
	(0.059)	(0.042)	(0.066)	(0.050)
Cohort 1946–1955	0.053	0.016	0.014	0.014
	(0.036)	(0.026)	(0.040)	(0.031)
Cohort 1966–1979	– 0.052	– 0.034	−**0.114**	– 0.010
	(0.044)	(0.029)	(0.051)	(0.032)
Intercept	0.488	0.408	0.800	0.039
	(0.412)	(0.283)	(0.425)	(0.296)

(continued)

Table 6.7 (continued)

	No. of children under 5		No. of children under 11	
	$r^h = \frac{h^f}{h^m}$	$r^l = \frac{l^f}{l^m}$	$r^h = \frac{h^f}{h^m}$	$r^l = \frac{l^f}{l^m}$
Wald test $\widehat{\lambda}_{it}$	36.461	31.775	20.602	39.982
P-value	0.019	0.062	0.483	0.007
Wald test $\overline{z}_{it}$	21.05	26.105	23.813	28.003
P-value	0.033	0.006	0.014	0.003
Sargan test	45.517		43.039	
P-value	0.654		0.747	

Notes: Asymptotic standard errors are in parentheses. Coefficients in bold are significant at the 5% level

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Chapter 7
Do Dads Matter? Or Is It Just Their Money that Matters? Unpicking the Effects of Separation on Educational Outcomes

Ian Walker and Yu Zhu

Abstract The widely held view that separation has adverse effects on children has been the basis of important policy interventions. While a small number of analyses have been concerned with selection into divorce, no studies have attempted to separate out the effects of one parent (mostly the father) leaving, from the effects of that parent's money leaving, on the outcomes for the child. This paper is concerned with early school leaving and educational attainment and their relationship to parental separation and parental incomes.

While we find that parental separation has strong effects on these outcomes, this result seems not to be robust to adding additional control variables. In particular, we find that when we include income our results then indicate that father's departure appears to be unimportant for early school leaving and academic achievement, while income is significant. This suggests that income may have been an important unobservable, that is correlated with separation and the outcome variables, in earlier research. Indeed, this finding also seems to be true in our instrumental variables analysis – although the effect of income is slightly weakened.

Keywords Parental separation • Parental incomes • Early school leaving • Educational attainment

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1 Introduction

It is widely thought that parental separation has adverse effects on children – social researchers have uncovered correlations between separation and many aspects of children's behaviours including early school leaving, low achievement, behavioural disorders, crime and poor health.[1] The falling cost of separation has resulted in large increases in separation rates in many countries in recent years. Consequently, many policy initiatives have been designed to foster reconciliation of fragile partnerships so as to reduce the separation rates of parents or, at least, reduce the impact of separation of parents on their children.[2] In some countries, tax policy is used to favour marriage which then implies higher separation costs than for cohabitation,[3] and in most countries there is a system of child support that raises the costs of separation for the non-custodial parent[4] and lowers it for the custodial parent.

However, relatively few studies have attempted to identify the causal impact of separation. Causality becomes questionable if there are omitted variables that are likely to be important for the outcomes and are correlated with separation. In particular, income has typically been omitted from previous analyses, and yet there are large negative income effects for the children that are associated with separation and there is considerable evidence that income does affect outcomes for children.[5] Yet, few studies have attempted to separate out the effects of one parent leaving (mostly the father) on the outcomes for the child(ren), from the effects of that parent's money leaving. That is, existing research fails to control adequately for income on outcomes. We are concerned that when fathers leave, not only does their time and influence go, but so too does their money. Thus, this paper is concerned with educational outcomes at age 16, and their relationship to parental separation, parental incomes, and parental repartnership.

Since child support is an important mechanism for ameliorating the loss in income associated with separation, it is of interest to try to unpick the way in which separation affects children.[6] If policy towards the children of separated

[1] See Amato and Keith (1991) who concluded that children with divorced parents, compared with children with continuously married parents, score significantly lower on measures of academic achievement, conduct, psychological adjustment, self-concept and social relations. Amato (2001) updated this analysis. Haveman and Wolfe (1995) identify divorce as a major contributing factor in their review of the determinants of child outcomes.

[2] In the UK attempts to implement compulsory mediation have not been successful. Mediation was a key element of the Family Law Act of 1996 and pilot project results showed that only 7% had attended voluntary mediation. In those pilot areas where mediation was compulsory, there was widespread use of exceptions granted to people fearing violence from former spouses.

[3] See Feenberg and Rosen (1995).

[4] See Cancian et al. (2003) for US evidence and González (2005) for evidence from across 16 countries.

[5] See Dahl and Lochner (2005) for example.

[6] Amato (2005) speculates as to why child outcomes are affected by separation.

parents is to be effective, we need to know the extent to which the living standards of children should be protected in the face of separation of their parents, whether parents should be discouraged from separating, say through the use of fiscal incentives,[7] and even whether couples who are likely to separate in the future should be discouraged from becoming parents?

Our empirical work here is based on a large panel dataset. The results suggest that living in a non-intact family has a large negative correlation with the risks of leaving school at the age of 16 and of low educational attainment. These findings are robust with respect to the successive addition of regressors that control for youth's own characteristics and the characteristics of the responsible parent. However, when we add total net family income to the specification, we find that living in a non-intact household has substantially smaller coefficients and they are no longer statistically significant.

The educational outcomes that we observe occur only once per child and therefore we cannot use fixed effect estimation methods even though the dataset is a panel. Besides, the dataset is too small to reliably exploit sibling difference based estimation methods. However, we do produce estimates based on matching by pre-separation observables in an attempt to control for selection on observables. Moreover, we attempt to control for selection by unobservables into separation (and into repartnership) by exploiting measures of mental-wellbeing of both parents in the data.

We also attempt to control for the endogeneity of parental incomes using instrumental variables exploiting the information on parental birth order.[8] Consistent with earlier results, our IV estimates suggest that there are important unobservables that are correlated with separation and our outcome variables as well as observable income.

We confine ourselves to educational outcomes in our analysis here. An analysis of subjective well-being is contained in Walker and Zhu (2006b).

2 Literature

The number of divorces of couples grew dramatically in many countries from the 1970s. Figure 7.1 shows the number of (married) couples with children (aged 0–16) in the UK who divorced each year from 1970. The divorce rate for parents with dependent children, as a percentage of existing marriages with dependent children

[7] In Walker and Zhu (2006a) we show that CS is an important disincentive to separate. Most parental separations are instigated by mothers and we interpret the lower rates of separation associated with higher levels of CS as better behaviour by fathers within marriage to reduce the probability of being ejected from the household.

[8] See Booth and Kee (2009) for evidence that supports an effect of birth order on income.

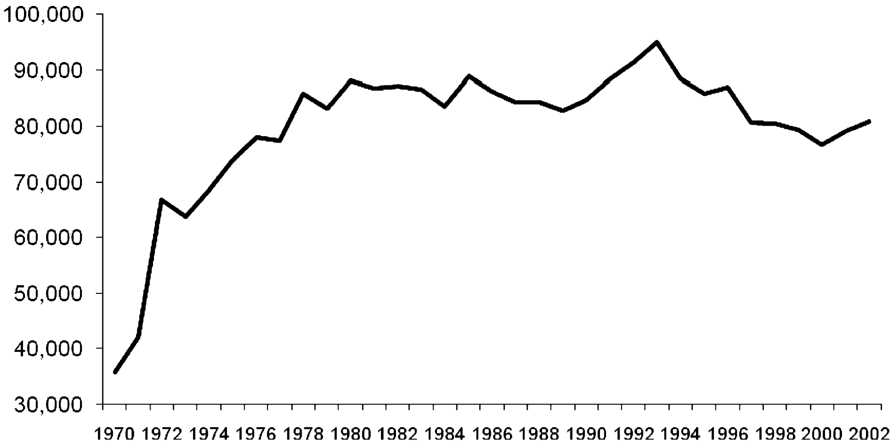

Fig. 7.1 Number of parents divorcing (child aged 0–16)

is now approximately 2.5% p.a. in the UK (2001). Many studies examine the correlations between separation and outcomes for children,[9] although few consider the issue of causality.[10]

Despite the wealth of evidence, an important limitation of most of the literature is that divorce is correlated with the unobservable determinants of child outcomes and this fact results in the adverse effects of separation being exaggerated in correlation studies. Gruber (2004) takes a novel approach. He uses 40 years of census data to capture the variation in divorce regulations across US states and over time and finds that unilateral divorce regulations have significantly increased the odds of an adult being divorced (by about 12%) and of a child living with a divorced parent (15% more likely to be living with a divorced mother and 11% more likely to be living with a divorced father, relative to the old laws). He then assesses the impact of easier divorce regimes on the higher education of children by comparing the adult circumstances of children who grew up in states where unilateral divorce was available, versus children who grew up in states where it was not available. He finds that children who grew up under laxer divorce laws were less likely to go to college and more likely to live in lower income households. His findings indicate that increased exposure to unilateral divorce regimes worsens child outcomes, but only up to about 8 years after the change in laws. After that, there is little additional harm from continuing exposure to the laxer laws. Gruber suggests that this implies that unilateral divorce rules may have only a short-run impact on the divorce rate. Finally, Gruber notes that making divorce easier may not only increase the odds that a child grows up in a divorced household but also change the bargaining power within intact households. For example, one parent

[9] See, for example, Kiernan (2004).

[10] See, however, Ní Bhrolcháin (2001) and Elliott and Richards (1991).

in a two-parent household may now feel more able to shift family spending away from child investment towards private consumption. Gruber's estimates are clearly the effects of divorce law changes and not divorce per se.

Piketty (2003) is in the same vein and shows that, controlling for observable parental characteristics, children with divorced or separated parents tend to perform less well at school than children living with their two parents. He pursues two identification strategies to address the potential selection problem. First, he notes that children whose parents eventually separate do as badly in school as children whose parents have already separated. Second, he, like Gruber, exploits the large increase in separation rates following the 1975 divorce law reform, together with the regional variations in divorce rates. He argues that his results imply that it is parental conflict, rather than separation, that is bad for children, and that the degree of conflict intensity between couples has been fairly stable over time.

Sanz de Galdeano and Vuri (2004) employ a difference-in-differences methodology that relies on comparing teenager's outcomes before and after divorce with those who did not experience divorce, to control for family specific effects. They conclude that parental divorce does not adversely affect teenagers' cognitive development, as had been suggested by cross-sectional evidence. However, this study only considers the impact up to 2 years after separation and does not consider the impact of repartnership.

Finally, Bjorklund and Sundstrom (2006) use a sibling difference approach in a very large Swedish dataset to show that selection accounts for the observed cross-section correlation. Sibling differences are, however, problematic in this context, since it seems likely that there are important peer effects between siblings arising from divorce. Our overall reading of the recent literature is that a substantial part of the observed correlation between separation and outcomes for children can be accounted for by selection.

The literature on the causal effects of parental *earnings* or *incomes* on educational outcomes for their children is not extensive. Random assignment experiments are potentially informative but uncommon. Blanden and Gregg (2004) review US and UK evidence on the effectiveness of policy experiments which largely focus on improving short-term family finances. These include initiatives such as the Moving to Opportunity (MTO) experiments in the USA which provide financial support associated with higher housing costs from moving to more affluent areas. MTO programmes are associated with noticeable improvements in child behaviour and test scores but whether these are caused by the financial gain or the environment, school and peer-group changes is unclear.[11] In the UK, the pilots of Educational Maintenance Allowances (EMAs) provided a sizeable means tested cash benefit conditional on participation in education and paid, depending on pilot scheme, either to the parents or directly to the child (UK Department for Education and Skills, 2002). Enrollments increased by up to

[11] Note that new work on MTO by Sanbonmatsu et al. (2006) suggests that MTO-driven neighbourhood effects on academic achievement were not significant.

6% in families eligible for full subsidies. However, this transfer was conditional on staying in school and so does not tell us about the effects of unconditional variations in income. In the absence of informative experimental evidence, instruments have been used to identify income effects. Shea (2000) uses union status (and occupation) as an instrument for parental income and therefore assumes that unionised fathers are not more "able" parents than non-union fathers with similar observable skills, while Mayer (1997) uses variation in family income caused by state welfare rules, income sources and income before and after the education period of the child, as well as changes in income inequality. While strong identification assumptions are used in both these studies, they both find that unanticipated changes in parental long-run income have modest and sometimes negligible effects on the human capital of the children.[12] Using UK data, Blanden and Gregg (2004) find the correlation between family income and children's educational attainment has actually risen between the 1970 birth cohort data and the later British Household Panel Survey data containing children reaching 16 in the late 1990s. They estimate the causal effect of family income in ordered probit models of educational attainment (from no qualifications up to degree level) based on sibling differences in the panel data. They also provide estimates of the probability of staying-on at school past the minimum age of 16. Throughout, income is assumed to be exogenous.

Recent evidence suggests that income has a strong role to play in outcomes for children. Dahl and Lochner (2005), Plug and Vijverberg (2003, 2005) and Chevalier et al. (2005) all suggest that income does have a causal impact on educational outcomes for children. However, none of these studies allow for an effect of separation. Similarly, many studies consider the impact of separation, but not income.[13] Indeed, to our knowledge, there are no studies that attempt to control for income as well as separation. This is an important omission because separation is usually accompanied by large reductions in the child's equivalent income. Indeed, it is the purpose of child support payments to counter this.

3 Data

This chapter is based on the first 13 waves of the British Household Panel Survey (BHPS) which is a nationally representative sample of some 5,500 households recruited in 1991, with about 10,000 original sample members (OSMs). These OSMs and their children, who also become sample members after reaching 16, are interviewed each year, together with all adult members of their families, even if the OSMs split off from their original households to form new families

[12] Acemoglu and Pischke (2001) use similar arguments to Mayer (1997) and exploit changes in the family income distribution between the 1970s and 1990s. They find that a 10% increase in family income is associated with a 1.4% increase in the probability of attending a 4-year college.

[13] See, for a recent example, Francesconi et al. (2005).

Table 7.1 Summary statistics by family types

Family type	Intact families	Lone mothers	Repartnered mothers	Total
% Cohabiting	0.6	–	28.8	3.5
Log total income	5.93	5.39	5.91	5.84
% Boys	48.9	53.4	55.0	50.3
% Only child	15.1	23.7	16.3	16.8
No. of kids <16	0.96	0.98	1.29	1.00
Youth's age	15.8	15.9	15.9	15.9
% Step-siblings	1.1	1.1	38.8	5.1
% New siblings	0.2	0.0	36.9	4.1
% Mother non-white	6.2	11.7	3.8	7.0
% Owning house	81.3	56.8	65.6	75.3
Age of mother	43.1	39.7	39.5	42.1
Age mother left school	17.3	17.2	17.2	17.3
% Leaving school at 16	19.0	27.8	26.3	21.3
% With 5+ GCSEs	58.3	45.1	41.9	54.2
Obs	1,070	266	160	1,496
%	71.5	17.8	10.7	100.0

and/or relocate to other areas (of the UK). This sampling design ensures that the sample remains representative of the UK population over time. The core questionnaire of BHPS collects information on household organisation, housing, employment, education, health and incomes in all waves. In wave 2, BHPS also collected lifetime histories of marriage, cohabitation, fertility and employment transitions, which allow us to construct spells in progress of the current relationship for all couples in our sample, despite the fact that we are unable to observe the partnerships from the time of their formation.

On average, 2% of partnerships with dependent children separate each year. Table 7.1 reports summary statistics by family types, where non-intact families are further divided into lone-mother and repartnered-mother households.

We concentrate on educational outcomes at the age of 16. There are 1496 distinct youths aged 16 in our sample, of which 71.5% are in intact families, 17.8% in lone-mother families, and 10.7% in repartnered families.[14] It is worth noting that there is not much difference in terms of household net income between intact and remarried families, which both average 50 log points higher than lone-mother families. Almost 40% of youths in repartnered-mothers households have step-siblings, almost all of which are the mothers' natural children with the new partner.

Intact parents have children with much lower early school leaving rates than lone mother households but repartnership seems to reduce some of the difference. However the much lower rate of achievement for children with lone mothers relative to intact parents still compares favourably with that of repartnered mothers.

[14] Families headed by custodial fathers constitute only a very small proportion of all non-intact families (less than 5%), and hence are dropped out of our sample.

4 Results

We pursue four strategies to allow for the potential endogeneity of non-intactness (and income). First, we explore sibling differences in the spirit of Sanz de Galdeano and Vuri (2004) but feel that, while our estimates of the impact of intactness are suggestive, our samples are too small to support parametric multivariate analysis and so we are unable to decompose the effect of separation into an income and a parental presence effect. Second, we examine how sensitive our multivariate parametric results on the levels data are to including additional control variables.[15] We find that the crucial control variable is income: non-intactness has large and precise coefficients until household income controls are added, whereupon the sizes of the coefficients are, at least, halved and become insignificant. Third, we use propensity score matching and find that, once we match we find no effects of separation on the separated and a negative effect on the untreated – significantly so in the case of achievement for boys and early leaving for girls. Finally, we use instrumental variable estimation and find that there are no causal effects of non-intactness.

4.1 *Non-parametric Sibling Differences*

Sibling comparisons are always problematic. Samples are likely to be small, and this is true here as Table 7.2 shows. Here, to identify the effect of separation we require that BOTH siblings be observed at age 16 in the sample and the elder is 16 prior

Table 7.2 Sibling differences in outcomes

	All youths	Intact to intact	Intact to non-intact	Non-intact to non-intact	Non-intact to intact
	1	2	3	4	5
Actual school leaving at 16					
Elder sibling	0.196	0.159	0.310	0.279	0.286
Younger sibling	0.249	0.230	0.276	0.305	0.238
Difference	**0.053**	**0.071**	−0.034	0.026	−0.048
Std error of mean difference	0.018	0.021	0.105	0.042	0.109
5+ Good GCSE grades					
Elder sibling	0.539	0.610	0.552	0.390	0.190
Younger sibling	0.527	0.572	0.517	0.396	0.476
Difference	−0.012	−0.029	−0.034	0.006	**0.286**
Std error of mean difference	0.021	0.026	0.093	0.041	0.140
N	683	479	29	154	21

[15] See Rhum (2004) who uses this idea in the context of the effects of maternal care.

to parental separation and the younger is 16 post-separation (column 3 in Table 7.2). Moreover, we need to compare this affected group with control groups where both children were 16 before any separation occurred (column 2) and/or where both were 16 after separation occurred (column 4). Indeed, in the latter case we restrict our attention to comparisons between children who are step-siblings. That is, both children are natural children of the mother but the eldest was the child of the first partnership which is no longer intact, while the second is the child of the new partnership. For completeness, we also present the data for those mothers who repartner between the point when the youngest child reaches 16 and when the older child reaches 16 (column 5) to capture a repartnership effect.

To reveal the effects of changes in circumstances, we take the difference in the sibling differences between columns 3 and 2. Thus, becoming separated *reduces* the probability of leaving at 16 by 0.105 (i.e. −0.034–0.071), but this is not significant; and the probability of attaining 5+ GCSEs is reduced by an insignificant 0.005 (i.e. −0.034 + 0.029). Similarly, the effect of becoming repartnered is revealed by the difference between the sibling differences amongst the repartnered group (column 5) and those that remain separated (column 4). The effect on the probability of leaving post 16 of repartnering is −0.074 (i.e. −0.048–0.026), while the effect on the achievement of 5+ GCSEs is 0.280 (i.e. 0.286–0.006), which is significant.

However, such sibling comparisons only capture the effects of a treatment (in this case separation or repartnership) if it is the case that only one child is affected and not the other. For example, if parents (and step-parents) take compensating actions to spread the costs and benefits across all siblings (and step-siblings) then these differences will underestimate the true effect of the change. Moreover, even if this were not a problem, these sibling differences do not help us to unpick the transmission mechanism whereby separation (or repartnership) affects children.

4.2 Parametric Analyses

Table 7.3 presents probit estimates for actual early school leaving. Column 1 is the raw correlation – the effect of non-intactness (when the child is 16) on the probability of staying on post 16. Column 2 adds repartnership, and column 3 adds log current net household (from all sources) when the child is 16. Column 4 adds controls for the child's characteristics including gender, while column 5 adds characteristics of the mother and time effects. Estimates for the pooled sample appear at the top of the table, followed by those for boys and girls separately. Having a lone mother as a parent at 16 seems to have a large effect, but simply adding household income is enough to drive that apparent effect to zero. Repartnership seems not to make any significant difference. The effect of income is large but is cut by about one third when we add maternal characteristics and this becomes significant at only the 10% level when maternal controls are included.

Table 7.3 Probit for actual school leaving at 16

	1	2	3	4	5
All					
Non-intact	0.273*** (0.079)	0.291*** (0.093)	0.064 (0.100)	0.059 (0.101)	0.034 (0.108)
Mother repartnered		−0.047 (0.135)	0.191 (0.140)	0.120 (0.161)	0.021 (0.172)
Log income			−0.385*** (0.053)	−0.394*** (0.053)	−0.286*** (0.057)
Boy				0.207*** (0.076)	0.237*** (0.080)
Youth characteristics				Yes	Yes
Family characteristics					Yes
Wave dummies					Yes
Region dummies					Yes
N	1,496	1,496	1,464	1,464	1,464
χ^2 (d.f.)	12.07 (1)	12.20 (2)	62.22 (3)	72.49 (7)	171.73 (27)
Log likelihood	−769.26	−769.20	−716.40	−711.43	−644.32
Boys					
Non-intact	0.185* (0.107)	0.215* (0.127)	−0.035 (0.135)	−0.027 (0.136)	−0.001 (0.148)
Mother repartnered		−0.082 (0.182)	0.175 (0.192)	0.072 (0.226)	−0.139 (0.245)
Log income			−0.513*** (0.081)	−0.518*** (0.081)	−0.464*** (0.088)
Youth characteristics				Yes	Yes
Family characteristics					Yes
Wave dummies					Yes

Region dummies					Yes
N	753	753	743	743	743
χ^2 (d.f.)	2.96 (1)	3.17 (2)	42.67 (3)	46.81 (6)	119.66 (26)
Log likelihood	−411.50	−411.39	−379.96	−379.06	−332.58
Girls					
Non-intact	0.364*** (0.116)	0.366*** (0.137)	0.159 (0.150)	0.171 (0.151)	0.127 (0.167)
Mother repartnered		−0.007 (0.200)	0.228 (0.208)	0.181 (0.232)	0.079 (0.249)
Log income			−0.271*** (0.071)	−0.273*** (0.071)	−0.134* (0.079)
Youth characteristics				Yes	Yes
Family characteristics					Yes
Wave dummies					Yes
Region dummies					Yes
N	743	743	721	721	721
χ^2 (d.f.)	9.86 (1)	9.87 (2)	21.75 (3)	24.07 (6)	89.14 (26)
Log likelihood	−354.69	−354.69	−329.41	−328.81	−292.77

Robust SE's in brackets. Youth characteristics include youth being an only child, number of children, and the presence of any step-siblings. Family characteristics include the presence of new child (of the natural mother and the stepfather), whether family owns house, mother's age, years of education and being non-white

*Significant at the 10% level; **significant at the 5% level; ***significant at the 1% level

Relative to girls, boys seem to be only half as sensitive to separation but are about twice as sensitive to income.

Table 7.4 presents data corresponding to the results for educational attainment – the probability of attaining 5+ GCSEs good passes. As in Table 7.3, separation and repartnership seems not to matter once income is included. Again, boys seem more sensitive to income and less to lone motherhood than girls, but these differences are not as pronounced as in Table 7.3. The scale of the income effects are broadly the same across these two outcomes.

Table 7.5 converts the results from the last columns in Tables 7.3 and 7.4 into marginal effects, and we break out some of the maternal and child characteristics. Younger mothers are associated with worse outcomes even controlling for maternal education, and more educated mothers generate better outcomes. If the child has a step-sibling, then there is a much larger chance of leaving early, even though repartnership itself does not matter. This effect is much larger for boys.

4.3 Extensions

The specifications presented in the previous subsection assumed that only current (net household) income matters. In fact, there is considerable evidence in the literature that suggests that permanent income matters most. Thus, in this section we construct a specification that allows us to identify the effect of transitory income (when the child is 16) from the effect of permanent income as perceived earlier in the child's life. Thus, we assume that the relevant income for determining outcomes for children is the log of the weighted sum of both parents' incomes – $\log\left(y^f + \beta y^m\right)$ so that $\beta > 1$ implies that more long run weight is attached to maternal income. If y^m/y^f is small then we can approximate this log weighted sum by $\log y^f + \beta\left(y^m/y^f\right)$. Thus, we estimate a log paternal income equation and we estimate a log of the ratio of maternal to paternal incomes and include the prediction of the former, evaluated when the child was 16, and the exponential of the prediction of the latter, again evaluated when the child was 16, into our specification. To capture the effects of shocks to household income, we compute the difference between log household income, when the child is 16, and subtract the predicted paternal income (if he is still in the household) by exponentiating his permanent income equation, and the predicted maternal income, by including his permanent income prediction into the log ratio of incomes equation and solving.

The results are presented in Tables 7.6 and 7.7. We find that the magnitude of log current income is reduced once we control for parents' permanent incomes, although it remains statistically significant. The effect of parents' permanent income, especially father's permanent income, appears to be larger than that of transitory income. This is consistent with the theory.

Table 7.4 Probit for passing 5 GCSEs

	1	2	3	4	5
All					
Non-intact	−0.364*** (0.072)	−0.333*** (0.086)	−0.058 (0.095)	−0.034 (0.095)	−0.012 (0.100)
Mother repartnered		−0.082 (0.126)	−0.380*** (0.133)	−0.417*** (0.150)	−0.271* (0.159)
Log income			0.410*** (0.056)	0.420*** (0.056)	0.271*** (0.054)
Boy				−0.237*** (0.067)	−0.247*** (0.070)
Youth characteristics				Yes	Yes
Family characteristics					Yes
Wave dummies					Yes
Region dummies					Yes
N	1,496	1,496	1,464	1,464	1,464
χ^2 (d.f.)	25.36 (1)	25.76 (2)	77.96 (3)	98.95 (7)	226.82 (27)
Log likelihood	−1018.89	−1018.68	−959.94	−950.86	−880.64
Boys					
Non-intact	−0.318*** (0.100)	−0.294** (0.119)	0.003 (0.130)	0.003 (0.130)	0.038 (0.137)
Mother repartnered		−0.064 (0.172)	−0.366** (0.184)	−0.284 (0.208)	−0.162 (0.222)
Log income			0.511*** (0.085)	0.513*** (0.084)	0.343*** (0.080)
Youth characteristics				Yes	Yes
Family characteristics					Yes
Wave dummies					Yes
Region dummies					Yes
N	753	753	743	743	743
χ^2 (d.f.)	10.14 (1)	10.28 (2)	45.50 (3)	53.98 (6)	118.33 (26)
Log likelihood	−516.84	−516.77	−484.78	−482.11	−445.85

(continued)

Table 7.4 (continued)

	1	2	3	4	5
Girls					
Non-intact	−0.396*** (0.105)	−0.360*** (0.125)	−0.082 (0.140)	−0.078 (0.140)	−0.090 (0.148)
Mother repartnered		−0.099 (0.186)	−0.418** (0.194)	−0.562*** (0.215)	−0.397* (0.238)
Log income			0.341*** (0.074)	0.344*** (0.074)	0.207*** (0.075)
Youth characteristics				Yes	Yes
Family characteristics					Yes
Wave dummies					Yes
Region dummies					Yes
N	743	743	721	721	657
χ^2 (d.f.)	14.23 (1)	14.50 (2)	35.28 (3)	39.41 (6)	118.21 (26)
Log likelihood	−497.30	−497.16	−467.21	−465.41	−420.76

Robust SE's in brackets. Youth characteristics include youth being an only child, number of children, and the presence of any step-siblings. Family characteristics include the presence of new child (of the natural mother and the stepfather), whether family owns house, mother's age, years of education and being non-white

*Significant at the 10% level; **significant at the 5% level; ***significant at the 1% level

Table 7.5 Marginal effects corresponding to Col 5 of previous tables

	Left school at 16 = 1			Attained 5+ GCSEs = 1		
	All	Boys	Girls	All	Boys	Girls
Non-intact	0.009 (0.027)	−0.002 (0.039)	0.029 (0.040)	−0.005 (0.040)	0.016 (0.055)	−0.035 (0.057)
Mother repartnered	0.005 (0.044)	−0.035 (0.059)	0.018 (0.060)	−0.108 (0.063)	−0.064 (0.088)	−0.156 (0.094)
Log income	−**0.072** (0.014)	−**0.123** (0.024)	−0.030 (0.018)	**0.107** (0.021)	**0.137** (0.032)	**0.080** (0.029)
Youth boy	**0.060** (0.020)	–	–	**–0.097** (0.027)	–	–
Youth only child	−0.018 (0.028)	−0.006 (0.044)	−0.019 (0.035)	−0.010 (0.040)	0.013 (0.057)	−0.021 (0.057)
Number of children	−**0.024** (0.011)	−0.032 (0.017)	−0.020 (0.015)	0.002 (0.015)	0.015 (0.022)	−0.002 (0.022)
Stepbrother/sister	**0.306** (0.138)	**0.468** (0.168)	**0.277** (0.168)	−0.114 (0.117)	−0.269 (0.157)	−0.030 (0.151)
New brother/sister	−0.136 (0.041)	−0.170 (0.042)	−0.121 (0.040)	0.155 (0.124)	0.211 (0.194)	0.198 (0.138)
Mother non-white	−**0.150** (0.020)	−**0.185** (0.024)	−**0.114** (0.030)	−0.018 (0.064)	−0.003 (0.082)	−0.071 (0.115)
Owns house	−**0.109** (0.028)	−0.047 (0.039)	−**0.161** (0.041)	**0.193** (0.035)	**0.219** (0.050)	**0.165** (0.050)
Mother age	−**0.010** (0.003)	−**0.018** (0.004)	−0.004 (0.003)	**0.013** (0.003)	**0.016** (0.005)	**0.012** (0.005)
Mother age left school	−**0.022** (0.005)	−**0.024** (0.007)	−**0.019** (0.005)	**0.031** (0.006)	**0.025** (0.008)	**0.038** (0.080)
N	1,464	743	721	1,464	743	721
χ^2 (d.f.)	171.73 (27)	119.66 (26)	89.14 (26)	226.82 (27)	118.33 (26)	118.21 (26)
Log likelihood	−644.32	−332.58	−292.77	−880.64	−445.85	−420.76

Robust SE's in brackets. Other regressors include wave and region dummies. Bold figures indicate statistical significance at the 5% level

Table 7.6 Probit for actual school leaving at 16, marginal effects

	Base	Add permanent income predictions	Add duration since separation	Add all
All				
Non-intact	0.009 (0.027)	−0.028 (0.039)	−0.036 (0.070)	−0.039 (0.069)
Mother repartnered	0.005 (0.044)	−0.024 (0.073)	−0.019 (0.075)	−0.024 (0.073)
Log income	−**0.072** (0.014)	−**0.053** (0.015)	−**0.060** (0.014)	−**0.053** (0.015)
Boy	**0.060** (0.020)	**0.065** (0.021)	**0.063** (0.021)	**0.065** (0.021)
Log perm income – Dad	–	−**0.200** (0.075)	–	−**0.200** (0.075)
Log perm income – Mum	–	−0.088 (0.160)	–	−0.089 (0.160)
Duration since separation	–	–	0.005 (0.050)	0.009 (0.049)
N	1,464	1,133	1,133	1,133
χ^2 (d.f.)	171.73 (27)	145.14 (28)	136.94 (27)	145.14 (29)
Log likelihood	−644.32	−456.05	−459.28	−456.04
Boys				
Non-intact	−0.002 (0.039)	−0.046 (0.052)	−0.082 (0.066)	−0.085 (0.064)
Mother repartnered	−0.035 (0.059)	−0.096 (0.070)	−0.095 (0.073)	−0.098 (0.068)
Log income	−**0.123** (0.024)	−**0.104** (0.025)	−**0.115** (0.024)	−**0.104** (0.025)
Log perm income – Dad	–	−0.223 (0.141)	–	−0.222 (0.141)

Log perm income – Mum	–	−0.157 (0.223)	–	−0.172 (0.226)
Duration since separation	–	–	0.034 (0.064)	0.041 (0.062)
N	743	561	561	561
χ^2 (d.f.)	119.66 (26)	100.93 (27)	98.87 (26)	101.78 (28)
Log likelihood	−332.58	−223.41	−224.81	–223.31
Girls				
Non-intact	0.029 (0.040)	0.019 (0.064)	0.054 (0.132)	0.050 (0.128)
Mother repartnered	0.018 (0.060)	0.041 (0.116)	0.062 (0.133)	0.053 (0.129)
Log income	−0.030 (0.018)	−0.009 (0.018)	−0.014 (0.018)	−0.009 (0.018)
Log perm income – Dad	–	−**0.168** (0.079)	–	−**0.167** (0.079)
Log perm income – Mum	–	−0.032 (0.180)	–	−0.036 (0.183)
Duration since separation	–	–	−0.027 (0.069)	−0.021 (0.069)
N	721	572	572	572
χ^2 (d.f.)	89.14 (26)	72.93 (27)	75.37 (26)	73.00 (28)
Log likelihood	−292.77	−212.13	−213.55	−212.10

Robust SE's in brackets. Bold figures indicate statistical significance at the 5% level. Baseline model same as in Table 7.5

Table 7.7 Probit for 5+ GCSEs, marginal effects

	Base	Add permanent income predictions	Add duration since separation	Add all
All				
Non-intact	−0.005 (0.040)	0.032 (0.069)	−0.093 (0.141)	−0.106 (0.143)
Mother repartnered	−0.108 (0.063)	0.050 (0.127)	0.024 (0.136)	0.017 (0.136)
Log income	**0.107** (0.021)	**0.089** (0.023)	**0.099** (0.022)	**0.088** (0.023)
Boy	−**0.097** (0.027)	−**0.101** (0.031)	−**0.101** (0.030)	−**0.101** (0.031)
Log perm income – Dad	–	**0.293** (0.119)	–	**0.292** (0.119)
Log perm income – Mum	–	0.460 (0.253)	–	0.465 (0.253)
Duration since separation	–	–	0.101 (0.090)	0.105 (0.091)
N	1,464	1,133	1,133	1,133
χ^2 (d.f.)	226.82 (27)	168.20 (29)	162.48 (28)	170.49 (30)
Log likelihood	−880.64	−676.70	−682.03	−675.98
Boys				
Non-intact	0.016 (0.055)	0.005 (0.102)	−0.010 (0.181)	−0.008 (0.188)
Mother repartnered	−0.064 (0.088)	0.172 (0.193)	0.144 (0.185)	0.171 (0.194)
Log income	**0.137** (0.032)	**0.132** (0.036)	**0.154** (0.035)	**0.132** (0.036)
Log perm income – Dad	–	0.248 (0.211)	–	0.248 (0.211)

Log perm income – Mum	–	**2.111** (0.625)	–	**2.111** (0.626)
Duration since separation	–	–	0.027 (0.118)	0.003 (0.123)
N	743	561	561	561
χ^2 (d.f.)	118.33 (26)	104.32 (27)	83.66 (26)	105.09 (28)
Log likelihood	−445.85	−332.63	−341.22	−332.63
Girls				
Non-intact	−0.035 (0.057)	0.034 (0.095)	−0.242 (0.217)	−0.259 (0.218)
Mother repartnered	−0.156 (0.094)	−0.033 (0.185)	−0.133 (0.217)	−0.143 (0.213)
Log income	**0.080** (0.029)	0.051 (0.030)	**0.058** (0.029)	0.049 (0.029)
Log perm income – Dad	–	**0.328** (0.141)	–	**0.317** (0.141)
Log perm income – Mum	–	0.143 (0.288)	–	0.194 (0.299)
Duration since separation	–	–	0.212 (0.143)	0.218 (0.145)
N	721	572	572	572
χ^2 (d.f.)	118.21 (26)	93.77 (27)	92.41 (27)	97.00 (28)
Log likelihood	−420.76	−325.58	−326.99	−324.44

Robust SE's in brackets. Bold figures indicate statistical significance at the 5% level. Baseline model same as in Table 7.5

Table 7.8 Propensity score matching estimates of impact of parental separation

	Boys		Girls	
	Mother and fathers age at Wave 1	Mother and fathers age at Wave 1 and GHQ12 residual at Wave 2	Mother and fathers age at Wave 1	Mother and fathers age at Wave 1 and GHQ12 residual at Wave 2
School leaving at 16				
Unmatched	0.046 (0.067)		0.100 (0.066)	
ATT	0.011 (0.069)	−0.023 (0.084)	0.077 (0.097)	0.070 (0.096)
ATU	−0.009 (0.068)	0.063 (0.093)	0.169 (0.107)	0.214 (0.127)
5+ GCSEs				
Unmatched	−0.071 (0.080)		−0.006 (0.088)	
ATT	−0.023 (0.096)	−0.018 (0.107)	−0.006 (0.097)	0.004 (0.103)
ATU	−0.016 (0.100)	−0.043 (0.110)	−0.071 (0.100)	−0.131 (0.132)
N	552	552	560	560

Standard error in parentheses bootstrapped with 200 repetitions. The treatment group (non-intact families) and the control group (intact families) are matched on mother and father's age at Wave1, plus mother and father's GHQ12 residual at Wave2, as well as contemporary measures of youth's gender and whether only child, number of children in the household, whether owns house, and mother's age, and education. Bold figures indicate statistical significance at the 5% level

4.4 Matching

A possible concern with the analysis above is that separated and intact households are quite different in their observable characteristics so that linear unweighted regression methods suffers from a lack of common support.

Thus, in Table 7.8, we present propensity score matching estimates of the impact of parental separation. Here, the treatment group (non-intact families) and the control group (intact families) are matched on the mothers' and fathers' ages (in columns 1 and 3) and (in columns 2 and 4) to the ages and estimated residual (evaluated in wave 2) from a regression of GHQ12 (a reliable measure of mental well-being) on mother's age, mother's job satisfaction, financial surprises, and contemporary measures of youth's gender and age, whether only child, number of dependent children in the household, whether house owner, and mother's education and ethnicity.[16] We have excluded any non-intact families who separated before wave 1 (which means all families in the matching analysis were intact at the beginning of the sample period).

[16] We match on the residual to insulate ourselves from the potential effect of the long run level of GHQ on the outcomes for the children.

The school leaving results show no significant effects on the treated suggesting that the unmatched results were heavily contaminated by selection on observables. In the last panel we show the treatment effects on GCSE passes. These are always similarly statistically insignificant for the treated, while there is typically a stronger, albeit still insignificant, negative effect on the untreated,[17] suggesting that separation would be damaging for those that we would not expect to separate. This provides a strong support for the results in Piketty (2003) and Bjorklund and Sundstrom (2006).

4.5 Instrumental Variable Estimates

Many authors have emphasised the importance of marital status endogeneity.[18] Here, we use the sample of youths whose parents stayed together at wave 1, and since we want to use instruments which are only observed in wave 13 (in particular, birth order index), we require that BOTH parents be observed at wave 13. The sample size is approximately halved. We consider the following variables to be potentially endogenous: log income and non-intact.[19] We use a variety of specifications. We begin by endogenising income assuming that separation is exogenous. We then endogenise separation but assume that income is exogenous. Finally we endogenise both variables. Our core instruments are: mother's and father's birth order index, number of siblings, dummy for only child, age at wave 1, and age of grandparents to exploit the discontinuity in grandparental education arising from the raising of the school leaving age reform that took place in 1947. In addition, we include an interaction between parents' birth orders and their grandparents' ages when the parents were born, which is observed for all adults in wave 13. We do this on the grounds that there is considerable evidence that early motherhood is associated with separation and this may transmit to the grandchildren who are themselves more likely to separate.[20]

Overall, there is some support in Table 7.9 for the idea that the earlier results are generated largely by selection by unobservables. In all cases our specification easily

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[17] Note that there is high correlation between early school leaving intentions and actual GCSE passes (the correlation coefficient in a bivariate probit model is estimated to be around −0.6). For those who intended to leave at 16, just over 10% managed to achieve the five good pass grades in their GCSE's taken at age 15 or 16, comparing to nearly 60% for those who intended to stay on.

[18] See Lundberg (2005).

[19] Here we have excluded the 115 mothers who have repartnered because of their small sample size. Our attempts to endogenise mother's education suggested that this made no difference to our estimates and we report only estimates where this is assumed to be exogenous.

[20] We also use an extended specification which includes additionally nineteen wave 1 characteristics: cohabiting, number of former marriages, age relationship started, log duration of relationship spell, same race, same religion, partner non-religious, youngest child under 5, number of dependent children, parents with different education levels, five dummies for age differences between parents, mother in employment, mother unemployed, father in employment, father unemployed.

Table 7.9 Second stage IV results

	Boys (N = 324)			Girls (N = 321)		
Endogenous variables	Only income	Only intact	Both income and intact	Only income	Only intact	Both income and intact
Leaving school at 16						
Log income	−**0.371** (0.149)	−**0.130** (0.065)	−**0.325** (0.154)	−0.166 (0.157)	−0.051 (0.040)	−0.174 (0.161)
Non-intact	−0.151 (0.129)	0.331 (0.394)	0.228 (0.416)	0.070 (0.131)	0.178 (0.269)	0.180 (0.290)
Maternal education	−0.004 (0.011)	−**0.020** (0.008)	−0.007 (0.012)	−0.008 (0.006)	−**0.011** (0.005)	−0.008 (0.006)
R^2	0.3602	0.3689	0.3414	0.1901	0.2141	0.1809
Hansen J stat χ^2 (d.f.)	17.540 (13)	16.352 (13)	13.563 (12)	8.503 (13)	9.050 (13)	8.372 (12)
P-value	0.1758	0.2306	0.3295	0.8093	0.7692	0.7554
5+ GCSEs						
Log income	**0.616** (0.228)	**0.163** (0.076)	**0.552** (0.230)	0.460 (0.236)	**0.204** (0.079)	0.439 (0.233)
Non-intact	0.227 (0.183)	−0.498 (0.486)	−0.293 (0.537)	0.162 (0.203)	0.427 (0.438)	0.424 (0.502)
Maternal education	−0.010 (0.017)	0.019 (0.011)	−0.006 (0.017)	0.012 (0.010)	0.018 (0.008)	0.012 (0.010)
R^2	0.6123	0.6510	0.6077	0.7014	0.7186	0.7005
Hansen J stat χ^2 (d.f.)	5.508 (13)	9.877 (13)	4.503 (12)	8.017 (13)	9.956 (13)	8.332 (12)
P-value	0.9623	0.7039	0.9726	0.8425	0.6976	0.7587

Robust SE's in brackets. First stage results reported in the Appendix. The IV sample includes both repartnered and lone mothers. Excluding repartnered mothers will give estimates of very similar magnitude and level of statistical significance (indeed log income will become significant at the 5% level in the girls GCSE equations). However, this will reduce the number of non-intact families by a third. Bold figures indicate statistical significance at the 5% level passes the overidentification tests yet none of the estimated intactness coefficients are significant. For boys, income seems to matter for leaving and for 5+ GCSEs. For girls, income seems not to matter for leaving, and there is a large estimated effect on achievement, but this is only significant at the 10% level.

5 Conclusions

A preliminary inspection of the raw data would suggest that parental separation has strong effects on childrens' education levels and achievements. The sibling difference data suggests that only the effect of separation on academic achievement is likely to be causal – but this does not control for income differences associated with separation. Our multivariate parametric results suggest that parental separation has strong effects on childrens' education, but this result seems not to be robust to adding additional control variables – in particular these results are not robust to including income. Moreover, the result carries over to our matching modelling, suggesting that there are important unobservables associated with separation for the separated that account for the apparent correlation.

Overall, our IV estimates suggest that there is some support for the idea that the simple results are generated largely by selection by unobservables. None of the estimated intactness coefficients are significant. For boys, income seems to matter for school leaving and for achieving 5+ GCSEs. For girls, income seems not to matter for school leaving and matters only marginally significantly so for achievement.

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Appendix (Table 7.10)

Table 7.10 First stage IV results

	Boys (N = 324)				Girls (N = 321)			
Endogenous variables	Only income	Only non-ntact	Both income and non-intact		Only income	Only intact	Both income and non-intact	
Log income	–	−**0.132** (0.034)	–	–	–	−**0.114** (0.031)	–	–
Non-intact	−**0.573** (0.113)	–	–	–	−**0.637** (0.158)	–	–	–
Mother's education	**0.057** (0.009)	**0.009** (0.005)	**0.055** (0.010)	0.002 (0.004)	**0.027** (0.010)	**0.008** (0.004)	**0.024** (0.010)	0.005 (0.004)
Father's birth index	−0.011 (0.075)	−0.031 (0.032)	0.008 (0.078)	−0.032 (0.034)	−0.008 (0.072)	−0.029 (0.035)	0.011 (0.073)	−0.031 (0.036)
Father's no. of sibs	−**0.041** (0.017)	−0.006 (0.007)	−**0.040** (0.018)	−0.001 (0.007)	−0.010 (0.018)	0.003 (0.006)	−0.013 (0.018)	0.005 (0.006)
Father only child	−0.128 (0.094)	0.047 (0.044)	−0.168 (0.103)	0.070 (0.050)	−0.147 (0.089)	0.038 (0.038)	−0.185 (0.094)	0.059 (0.040)
Father's age at W1	−0.012 (0.013)	−0.001 (0.006)	−0.013 (0.014)	0.001 (0.006)	−**0.008** (0.005)	−0.007 (0.002)	−0.004 (0.006)	−**0.006** (0.003)
Mother's birth index	−0.381 (0.345)	0.185 (0.217)	−0.527 (0.359)	0.254 (0.227)	−0.186 (0.357)	0.148 (0.184)	−0.302 (0.402)	0.182 (0.203)
Mother's no. of sibs	−0.030 (0.018)	0.020 (0.011)	−**0.045** (0.019)	**0.026** (0.011)	0.013 (0.015)	**0.016** (0.007)	−0.003 (0.021)	**0.016** (0.008)
Mother only child	−0.216 (0.134)	−0.027 (0.037)	−0.217 (0.137)	0.001 (0.035)	−0.106 (0.136)	−0.033 (0.030)	−0.091 (0.139)	−0.022 (0.029)
Mother's age at W1	**0.206** (0.105)	0.016 (0.055)	**0.213** (0.100)	−0.012 (0.054)	0.042 (0.132)	−0.037 (0.050)	0.071 (0.128)	−0.045 (0.048)
Grandfather RoSLA	0.034 (0.134)	0.143 (0.094)	−0.052 (0.149)	0.150 (0.101)	0.045 (0.146)	0.025 (0.066)	0.031 (0.152)	0.022 (0.069)
Grandmother RoSLA	−0.046 (0.136)	−0.096 (0.080)	−0.009 (0.144)	−0.097 (0.085)	−**0.297** (0.127)	−0.051 (0.063)	−**0.285** (0.126)	−0.019 (0.062)
Grandfather age when mum born	0.003 (0.020)	0.013 (0.008)	−0.004 (0.021)	0.013 (0.009)	0.011 (0.017)	**0.019** (0.009)	−0.001 (0.018)	**0.019** (0.009)
Grandmother age when mum born	−0.005 (0.022)	−0.012 (0.011)	0.002 (0.024)	−0.013 (0.012)	−0.022 (0.023)	−0.016 (0.009)	−0.013 (0.024)	−0.015 (0.009)
Grandfather age × mum's birth index	0.006 (0.018)	−0.011 (0.007)	0.013 (0.018)	−0.012 (0.008)	−0.000 (0.015)	−0.013 (0.008)	0.008 (0.016)	−0.014 (0.008)
Grandmother age × mum's birth index	0.005 (0.020)	0.005 (0.009)	0.002 (0.020)	0.005 (0.010)	0.005 (0.020)	0.010 (0.009)	−0.001 (0.022)	0.010 (0.009)
Shea's partial R^2	0.0756	0.0585	0.0699	0.0560	0.0513	0.0787	0.0504	0.0787

Shea partial R^2 for the instrumented variables reported in the last row. Bold figures indicate statistical significance at the 5% level

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Chapter 8
Measuring the Transmission of Economic Shocks Among the Household Members of the Same Extended Family

Ernesto Villanueva

Abstract To what extent members of the same extended family insure each other's consumption against the occurrence of an unexpected income drop? While existing tests have clearly rejected full risk sharing within the USA extended family, less is known about the *degree* of consumption insurance. I propose an alternative test of partial insurance that examines if the earnings shocks of a household member of an extended family affect the consumption of other members of the same extended family. Building on the empirical papers that examine the consumption consequences of involuntary displacement, I examine if the food consumption in the household of a parent is affected by the job loss of a member of a separate household where his or her adult child lives. The findings suggest that there is partial insurance in the USA: when a young adult loses his or her job, the consumption of his/her parents' household falls by 2.7 percentage points.

Keywords Consumption insurance • Lay-offs • Extended families

JEL Codes D21 • E21

1 Introduction

To what extent members of the same extended family insure each other's consumption against the occurrence of an unexpected income drop? While full risk sharing among households of the same extended family has been clearly rejected using US data, less is known about the *degree* of consumption insurance. Previous literature has examined if monetary transfers among family members react to adverse economic shocks of any of the parties involved. Unfortunately,

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economic theory does not pin down the timing of inter vivos transfers unless credit constraints are prevalent. In those conditions, the most appropriate test of the hypothesis of family insurance requires panel data on both inter vivos transfers among family members and good information about the economic situation of households belonging to the same extended family. Up to my knowledge, existing sources of information in the USA only partially fulfill those requirements.

Hence, I estimate the degree of family insurance from an alternative perspective. The extreme version of the perfect family insurance predicts that the distribution of consumption of all households belonging to the same family remains unaffected by changes in the distribution of income within the family. Now, it is well understood that there are many reasons that, even in the case that households are altruistically linked that may lead that prediction to fail (Villanueva 2002 or McGarry 1999). Hence, I take a step back, and claim that any model imperfect of consumption insurance within households that belong to the same extended family predicts that whenever a member of the extended family experiences an income drop, the consumption of members of that extended family *other than that experiencing the shock* should fall. I use data from the 1985–1992 waves of the PSID to test if the (food) consumption of a household falls when a relative belonging to another household within the same extended family experiences a spell of unemployment because of an involuntary job loss. My results support the notion that the (food) consumption in the household of a parent falls when the head of the household, where his or her child lives, experiences an involuntary job loss.

2 Theoretical Framework

One of the most popular models of the family is that of the altruistic extended family. According to that model, individuals of the same extended family maximize a joint utility function (with some weights) subject to a common budget constraint. That is, households act as if all incomes are pooled and consumption allocated according to the determinants of the marginal utility of consumption of each household member of the extended family. The solution of that problem is the following:

$$U'(C_{ht}) = \delta_t \tag{8.1}$$

That is, the marginal utility of consumption C_{ht}in each period of each household member of the family is the same across households of the same extended family. Any redistribution of income within the extended family should be neutralized andnot affect relative levels of consumption. That prediction has been rejected in a number of papers (Altonji et al. 1992). The rejection of full altruism may be due to a number of issues, such as imperfect information, or incentive problems (see Villanueva 2002).

Now, rejecting full altruism does not necessarily imply that members of the same extended family do not share resources *at all*. In this study, I take a simpler approach, and rather than testing the extreme prediction (1), I test a weaker version:

$$C_{ht} = f(Y_{-ht}) \tag{8.2}$$

where Y_{-ht} represent earnings shocks to other members of the extended family (living in other households). That is, I estimate if earnings shocks to one member of the extended family affect the consumption of other members.

3 Dataset and Empirical Strategy

3.1 Dataset

The PSID is uniquely suited for the study of the influence of earnings shocks on the consumption of other household members belonging to the same dynasty. The original survey interviewed in 1968 all individuals in some 5,000 households. In the following years, the PSID kept track of all individuals as they left to form their own household. Hence, it is possible to observe the economic performance of the members of the same extended family in the same year even if they live in different households. Our study follows Altonji et al. (1992) and focuses on the links between adult members of a dynasty (a set of individuals belonging to the same extended family, but not necessarily living in the same household). Hence, we select "children" who are at least 25 years of age. Similarly, we use "parents" who are at least 38 years of age. Those restrictions and the need of having large samples lead me to use the years 1978–1992. Finally, following the literature that examines consumption insurance and also to minimize the impact of divorce, I consider only the sample of parents during the years when they are married.

3.2 Empirical Strategy

I follow the literature on the impact of job loss on household consumption (see Stephens 2004) and I run reduced-form models of household food consumption on the event that a member of a dynasty experiences an unemployment spell after an involuntary job loss. OLS regressions with household fixed-effects are ran separately ran for the households who were "parents" (i.e., individuals originally present in 1968 as heads of household and who were fathers or mothers and subsequently interviewed by the PSID) or "children."

$$\ln C_{ht} = \alpha_h + \beta_1 D_{ht}^{\text{own}} + \beta_2 D_{ht}^{\text{other}} + \sum_{t=1978}^{t=1992} \delta_t \text{year}_t + \gamma X_{ht} + \varepsilon_{ht}$$

where C_{ht} is the expenditure on food of household h in period t, α_h is an individual fixed-effect, year reflect year dummies intended to capture macro shocks and X capture demographic characteristics of the household of either the parent or the child, depending on the specification. The parameters of interest are β_1 and β_2. When the sample used is that of parents, β_1 measures the (instantaneous within the year) food consumption drop that the parental household experiences when the head is laid off. A literature (Gruber and Dinarski 1997) has documented that such drops are substantial in the USA.

The focus of this chapter is parameter β_2, which measures the food consumption drop that the parental household experiences when the head in the household of the *adult child* loses his or her job. In the absence of shocks that are common to all family members, the only reason we can think that leads the household of the parent to experience a consumption drop following the job loss by an adult child who lives in another household is family insurance: either parents transfer resources to their children or, alternatively, start saving to provide resources in the future. In the absence of family insurance, β_2 would be 0. If family insurance is indeed present in the data, β_2 would be negative.

I estimate (1) using household fixed-effect models on the 1978–1992 waves of the Panel Study of Income Dynamics. I correct for the unbalanced panel and possible autocorrelation in the residuals by adjusting standard errors for arbitrary correlation within observations belonging to the same household. The sample of parents is confined to those who are married in the year we observe them, and are between 38 and 89 years of age. The children considered are between 24 and 65 years of age. The PSID does not include food consumption in years 1988 and 1989, so those years are excluded from the analysis. The final parental sample contains 936 parents from 881 original PSID households in 1968, contributing 7,135 observations. The reason for the difference between the number of parents and the number of 1968 households is that we included as separate observations those parents who experience a divorce. The sample of children contains 13,233 observations from 2,241 children (i.e., adult individuals who were observed in the original 1968 household as dependent of the head).

The dependent variable: It is calculated as the sum of food expenditures at home, food expenditures away from home, and the net value of food stamps. The question is this: "How much do you spend on the food you use at home in an average week?" A comparable question is asked about food away from home. I assume that expenditure on food reflects the current year, following most of the literature using that information. A problem with the analysis is that other nondurable food components are absent (expenditure on services, clothes, and other items). The issue would be less problematic if food consumption was separable from other goods, which is not necessarily the case. In any case, given the fact that food exhibits less sensitivity to income than other goods, our estimates can be seen as lower bounds on the welfare consequences of own and other members of the dynasty job loss. Furthermore, given that the aim of this study is to compare the response of household food consumption of own and other member's job loss, the issue of nonseparabilities could affect our estimates only if households cut different expenses when they are to help other members of the dynasty and when they are to adjust to their own earnings shocks. I am not aware of empirical evidence in this regard.

The independent variable: The PSID asks individuals who report having changed jobs "What happened to that job?" I use the answers "employer moved/plant closed" and "laid-off/fired". I also focus on job losses experienced by the head of the household of either the child or the parent, as some evidence (not shown) seemed to indicate that the consumption of the household of the child was not affected much by the fact that the secondary earner in the household of a married child lost his or her job.

A second threat to validity is that the shock we are examining is correlated with own exposure to income shocks. For example, assume that the event "a parent experiences an income drop" is highly correlated with the event "the child loses the job." Such correlation may arise if parents and adult children tend live in the same region and there are similar labor market conditions that reflect in income growth. Alternatively, a correlation may arise if there are permanent income shocks that are specific to education groups and there is substantial correlation in educational attainment. In any of these events, even if there was not insurance within the family there would be a negative parental consumption would fall. To account for that type of omitted variable biases, we include year effects (that control for macroeconomic factors that affect every individual in the PSID sample) and examine the sensitivity of the estimates of β_2 when controls for displacement of other members of the dynasty are excluded.

4 Results

4.1 Summary Statistics

Table 8.1 presents summary statistics.

4.2 Response to Displacement

The first column of Table 8.2 shows the impact of involuntary job loss of the parent and child on the consumption of the household of the parent. The estimate in row 2 shows that following the job loss of the parent, the consumption of food in the household of the parent drops by 3.6 percentage points (standard error: 0.24). While not surprising, the estimate is smaller than that reported by Stephens (2004), that could be due to the particular age group of parents (who are around 55 years

Table 8.1 Summary statistics of the parents and children sample

	Parents	Children
Log consumption	7.32 (.474)	7.154 (.442)
Head in household of the adult child loses his/her job	.107	.069
Head in household of the parent loses his/her job	.043	.040
Number of children between 0 and 2	.030 (.188)	.399 (.57)
Number of children between 3 and 5	.031 (.184)	.40 (.582)
Number of children between 6 and 13	.212 (.551)	.654 (.878)
Number of females between 14 and 17	.164 (.438)	.052 '(.243)
Number of males between 14 and 17	.153 (.413)	.0567 (.255)
Number of adults	2.59 .88	2.038 (.236)
Age of the household head	53.79 (5.908)	31.40 (4.39)
	7135	13233

Source: Sample obtained from the 1978-1992 waves of the Panel Study of Income Dynamics. The sample of children contains individuals who were living with their parents as of 1968 and subsequently established their own household. The sample of parents contains households that contained in 1968 an individual who established a household subsequently interviewed by the PSID.

The parental sample contains 936 parents from 881 original PSID households in 1968, contributing 7135 observations. The sample of children contains 13233 observations from 2241 children

of age and may bridge an unemployment spells from accumulated wealth or by using other public programs) and also to the fact that we are not conditioning on working age parents. Interestingly, when the head of the household of the child loses his or her job, the food consumption of the household of the parent drops significantly by 2.4 percentage points. The estimate is significant at the 10% confidence level (standard error 1.48 percentage points) and suggests that parents indeed adjust their consumption when the household of their adult child experiences an earnings shock related to job loss. As I mentioned, that result is consistent with the existence of insurance within the extended US family.

In the second column of Table 8.2, I exclude the intercept for whether or not the parent lost the job. The idea here is that, if the event "the head in the household of the adult child loses his job" is correlated with income drops of the parents, the drop in consumption estimated by β_2 should be sensitive to the inclusion of proxies of the labor market condition of the household of the parent. The estimate of "the head in the household of the child" loses his job in the new specification is shown in the first row, second column of Table 8.2, and amounts to -2.4, virtually identical to that in column 1, suggesting that there is little correlation between the shocks of children and parents.

Finally, columns 3 and 4 examine if the consumption in the household of the child reacts at all to changes in the economic condition of the parent. The evidence in Table 8.2 documents that, indeed, experiencing a job loss has a negative impact on the consumption of the child's household. The estimate is -0.069 (standard error: 0.019). The estimate is in the ballpark estimated by Stephens, who estimates a negative response of -0.85, but using a different sample and including PSID observations prior to 1978. Now, the event "the parent lost his job" has no discernible impact on the consumption of the household of the child.

Table 8.2 The reaction of parent and adult children food consumption to each other's job displacement

Sample	Parents		Adult children	
Dependent variable	Log of household food consumption, parent		Log of household food consumption, child	
Estimation method	OLS with household fixed-effects			
	(1)	(2)	(3)	(4)
1. Head in household of the adult child loses his/her job	**−.027 (.015)***	**−.027 (.015)***	−.0686 (.019)**	–
2. Head in household of the parent loses his/her job	−.036 (.021)	–	**−.014 (.017)**	**−.0145 (.017)**
Number of children between 0 and 2	.130 (.067)	.131 (.061)	.082 (.029)	.081 (.029)
Number of children between 3 and 5	.163 (.047)	.164 (.047)	.1147 (.035)	.114 (.0303)
Number of children between 6 and 13	.191 (.032)	.191 (.032)	.112 (.0316)	.111 (.032)
Number of females between 14 and 17	.194 (.031)	.193 (.030)	.107 (.043)	.106 (.042)
Number of males between 14 and 17	.165 (.030)	.165 (.030)	.131 (.037)	.132 (.037)
Number of adults	.181 (.025)	.181 (.024)	.274 (.033)	.274 (.034)
Family size, squared	−.008 (.0027)	−.008 (.003)	−.004 (.004)	−.003 (.004)
Constant	7.468 (.471)	7.44 (.473)	7.636 (.726)	7.744 (.725)
Sample size	7135		13233	
R2	.69	.69	0.64	0.64

The coefficients shown are OLS estimates of a regression of the logarithm of food consumption on the covariates shown plus year dummies and a fourth order polynomial of the age of the household head and a household fixed-effect. Both samples use households where the head is married. Coefficients in bold show the impact on household consumption of a layoff in other family members' household. Standard errors clustered at the household level.

5 Interpretation of the Results

In sum, the results of Table 8.2 suggest that earnings shocks associated to involuntary transitions into unemployment by children are indeed shared among members of the extended family (parents). The food consumption of parents falls by about 2.4–3 percentage points when the husband in the household of their child experiences an involuntary job loss. The result holds when we control for labor shocks experienced by parents (also when we limit to the sample of parents who are below the age of 64, not shown). My interpretation is that the extended family partially absorbs earnings shocks experienced by young cohorts early in life partly. Nevertheless, following an earnings shock suffered by an adult child living in his/her own household, the consumption response in the household of that child is much higher than that experienced by the household of the parents (7 percentage points vs. 2.4 percentage points). Whether this fact reflects partial insurance or the fact that parents have accumulated assets that permit them helping their children without cutting consumption remains an open issue.

I find less evidence suggesting that younger cohorts share losses with their parents. Household consumption in the household of the child is basically unaffected by whether or not the parent experiences a layoff. Whether the absence of response of child's consumption is due to the fact that a job loss late in life can be smoothed in an easier way than shocks early in life or alternatively, whether altruism is one-sided (from parents to children, but not the other way round) is a separate issue than merits further investigation.

Finally, there is an active discussion on how to measure the welfare consequences of job displacement. Some authors estimate larger earnings responses than consumption responses to involuntary job loss and suggest that earnings losses overestimate the welfare cost of job. Such conclusion is unwarranted if we fail to measure the consumption drop of all members of the same extended family who are affected by an earnings shock.

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