GENDER, TIME USE AND MODELS OF THE HOUSEHOLD

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ABSTRACT

The aim of this paper is to explain why time use data are essential for analyzing issues of gender equity and the intra-household allocation of resources, for comparing living standards and for estimating the behavioral effects of changes in policy variables. The first step in the exposition is to show that the neglect of these data in much of the literature on household behavior, in both developed and developing economies, can be traced to unrealistic assumptions on domestic production and the mistaken idea that non-market time can be viewed as leisure. It is argued that an approach is required that makes explicit the need for data on the time family members spend on domestic work as well as on labor supply. An approach of this kind is outlined and used to identify the specialized assumptions that are employed when they are missing. The paper also discusses the limitations of available time use survey datasets that are due to deficiencies in survey design. The more serious and common problems are illustrated using as case studies the Statistics South Africa 2000 Time Use Survey and the time use module included in the Nicaraguan 1998 Living Standards Measurements Survey.

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1 Introduction

Time use survey data are an important input to policy analysis. They provide information on the allocation of time to household production of substitutes for market output, as well as on the allocation of time to leisure activities. This information is typically missing in other household survey datasets. Ostensibly, the economic analysis of policy is based on models of individual and household behavior that show how welfare depends on consumption and leisure. However, without access to information on time use outside the market, estimation of the models is inevitably limited to datasets that do not distinguish between the leisure time of a family member and the time each spends on household maintenance, management and care activities for other family members.

Time use survey data indicate that, in most countries, women work longer than men when the time they spend on domestic work is added to the hours they work outside the home and in family enterprises. The data for developing countries show that girls tend to spend more time on domestic chores than boys and thus have more limited opportunities for education and leisure activities.[1] These gender differences in time use can be expected to have welfare and policy implications that are missing in empirical work that does not distinguish between domestic work and leisure. The data also indicate considerable heterogeneity in the allocation of time between market and domestic work across households with the same observed market opportunities and demographic characteristics, in both developed and developing countries. The welfare and policy implications of this are also lost in studies using household survey data with missing information on work at home and leisure.

The aim of this paper is to explain why time use data are essential for policy analysis in a wide range of areas and, in particular, for analyzing the following:

(i) the intra-household allocation of resources and distribution of real income

(ii) household living standards

[1] For a survey of these studies, see World Bank (2001).

(iii) the effects of changes in policy variables on household decisions concerning, for example, market labor supply, domestic production, consumption and saving.

The central thesis of the paper is that the analysis of these issues requires a modeling approach that fully integrates the economics of household production. This requires time use data.

The paper is organized as follows. Section 2 begins with an overview of basic approaches to modeling the household. The section presents a discussion of the theoretical framework underpinning empirical work in developed economies, followed by an outline of the approach of the development literature, with its emphasis on agricultural production and on health and human capital outcomes. The aim is to show that while there are important differences between the modeling approaches of the two literatures, these largely reflect specific interests arising from differences in the development of outside markets. Their treatment of domestic production is essentially the same. Both fail to integrate fully the theory of household production in analyzing the work and leisure decisions of household members.

Section 3 turns to models of the multi-person household, summarizing first the household utility function approach adopted to deal with the fact that most individuals are members of families in which there are two or more adults present. The section then reviews the standard household model, identifying its implicit assumptions on household production as its major limitation. This is followed by an overview of more recent developments that focus on modeling the decisions of individual family members and the intra-household allocation of resources. A clear distinction is made between models that mistakenly interpret domestic work as leisure, and therefore omit household production altogether, and those that do not. The exposition emphasizes the importance of modeling the multi-person household as a small economy, engaged in production and exchange within the household, and of analyzing issues of gender and the effects of policy within such an approach. Section 4 contains a more technical presentation of the kind of

modeling framework that is required, and locates the various models discussed in earlier sections as specializations within that framework.

Time use data are essential for estimating the models presented in Section 4. Section 5 discusses some of the more serious limitations of currently available time use surveys. Of primary importance for policy analysis is the collection of data on all economically active members of the randomly selected households included in the survey. Omitting active members severely limits the purposes for which the data can be used. The section also discusses the advantages of conducting a time use survey as a module of a household income and expenditure survey. Because economists have tended to regard data on domestic time use as irrelevant for their purposes, many surveys have been designed in response to the interests and modeling approaches of other social science disciplines. As a consequence, they frequently omit data on economic variables that are required for modeling household production and demand systems. This makes the data difficult to use for policy evaluation. These problems are illustrated using as case studies the Statistics South Africa 2000 Time Use Survey and the time use module included in the Nicaraguan 1998 Living Standards Measurements Survey. A concluding comment is contained in section 6.

2 Basic modeling approaches

The appropriate approach to modeling the behavior of the household and the effects of changes in policy variables depends ultimately on the set of questions being asked. A clear distinction should be made between two stages of the modeling process: first, the stage in which a theoretical model is developed to address the questions at hand, independently of the issues of estimation and data availability; and secondly, the stage in which, in the light of the available data, a possibly specialized and simplified version of the model is specified for empirical estimation. At least one advantage of this process is the awareness of the implications of data limitations for the interpretation of the resulting empirical estimates. A second advantage is that, since it makes clear the costs imposed by

data limitations, it suggests what further data should be collected and how these should be used.

This section considers the basic approaches to modeling the household in the literatures on developed and developing economies. The main distinction between models of the household in these literatures is that the latter extend the former by adding a farm production sector. The following section goes on to consider major extensions to these basic models that attempt to take account of the fact that most individuals are members of multi-person households.

2.1 The basic model

First there is the standard model of the single-person household, in which utility depends on consumption of a market good and leisure, time is divided between market labor supply and leisure, and so consumption demands and labor supply are functions of the price of the market good (which, as numeraire, may be set at unity) and the market wage. This is of course the workhorse model of both theoretical and applied microeconomics, with a vast range of applications.

The extension to developing economies is made in the Basic Model presented by Singh, Squire and Strauss (1986) (hereafter SSS), in which an additional good, an agricultural staple, is introduced into the utility function, time is now divided between market labor supply (off-farm production), work on the household's production of the agricultural staple (on-farm production), and leisure, and a standard production function for on-farm production is introduced. There is also a bought-in farm labor input, which is available in perfectly elastic supply at the market wage rate, and which is a perfect substitute for the household input. All labor as well as the agricultural staple are bought and sold on perfect markets, and so there is a separation between consumption and production decisions.[2]

[2] This separation between production and consumption decisions in the presence of perfect markets is a very old result, which is for example found in the classic analysis of investment decision taking by Irving Fisher, and in the standard model of international trade (think of the economy as a household with both production and exchange possibilities).

This has as its main consequence that all demands and supplies for consumption and labor are functions only of the observable market prices and non-labor incomes. The household chooses its farm production plan by maximizing profit from farm production, and it then maximizes its utility subject to a budget constraint defined on the given prices, and an income found by adding its maximized farm profit to its full income[3] plus any non-labor income.

The separation result is crucially dependent on two assumptions: that the relevant decision variables internal to the household have perfect substitutes on outside markets, and that these markets are perfectly competitive. Relaxation of either of these assumptions destroys the separation and, while this presents no great difficulties for theoretical analysis,[4] it greatly increases data requirements for empirical estimation.[5] Optimal consumption and production decisions will be mutually interdependent, the household equilibrium will generally be characterized by implicit internal prices unequal to observable market prices, these prices may be household specific, i.e. dependent on preference and productivity parameters that may differ across households, and may be dependent on quantities. Estimation of models with these characteristics clearly requires individual household data.

2.2 Household production

Becker (1965) developed the idea that consumption could be viewed as a production activity in which the (single-person) household combined its time and bought-in market commodities to produce the goods that ultimately entered its utility function. These latter are more abstract than market commodities, consisting of goods such as warmth, nutrition and health, which, though in general measurable (albeit in some cases perhaps only with some ingenuity), are not observable on markets. This fact, and the extreme simplicity of the assumed production technology, provoked strong critiques, perhaps the most

[3] The market wage rate times total time available.
[4] See for example Hirshleifer's (1970) classic analysis of the investment decision in the presence of capital market imperfections.

influential of which was that by Pollack and Wachter (1975). Becker's model possesses in an extreme form the properties of endogeneity, quantity-dependence (except under assumptions of non-joint production and constant returns to scale) and household-specificity of prices that the Basic Model of SSS in the developing economy context so successfully avoids.

Later work that has used the concept of household production (Gronau, 1977, Apps and Rees, 1988, 2002) has moved away from the abstractness of the definition of household production activities in Becker. This work recognizes that household production activities, such as child care, meal preparation, laundry, house cleaning and shopping, typically have close but not perfect market substitutes and, in common with market production, have inputs and outputs that are inherently just as observable, although with varying degrees of difficulty. In the developing economy context one would add water collection and fuel gathering as important types of household production.[6] Given this redefinition of household production, the type of data collected in time use surveys are essential for the estimation of the production technology. However, a limitation of the surveys is that they tend to focus on collecting time inputs while excluding adequate measures of outputs of the household goods.[7]

The development of the Basic Model of SSS drew on early farm production models as well as on the Becker model, and was motivated by the fact that the main form of economic organization in developing countries is the agricultural household. As SSS note, roughly 70 per cent of the labor force in low-income countries was employed in the

[5] Throughout the SSS volume, including chapter 1, there is extensive discussion of the nature of these problems.

[6] These activities so obviously have close market substitutes that they are classified as SNA activities in many developing economy surveys.

[7] There would seem to be no a priori reason for assuming that the output of household production is more difficult to observe than that of market production due, for example, to on-the-job consumption. Difficulties associated with measuring on-the-job consumption could well be greater in the market place, particularly in large firms with hierarchical job structures that give rise to stratified levels of peer recognition and social status as well as to various forms of conspicious consumption. The more complex of these hierarchies have no parallel in the household. For a two-sector model of the incidence of income taxation as a trade tax under these conditions, see Apps (1982).

agricultural sector in 1980 in low-income developing countries, and almost 45 percent in middle income countries.[8]

In a formal sense, there are some similarities between household production models and the Basic Model of SSS, in that they all proceed by introducing a neo-classical type of production function containing household time, bought-in market goods and physical capital goods or land,[9] and they have time spent on household or on-farm production in addition to market labor supply and leisure in the time constraint. The key difference under the household production approach, however, is the insistence that the relevant market goods are not perfect substitutes for domestically produced goods, and so the endogeneity and household specificity of the implicit prices of the latter remain.

In the developing economy literature the household production approach has been applied to analyze household decisions on specific goods such as nutrition and health (see for example Pitt and Rosenzweig, 1986), on human capital formation (see Section 3 of Strauss and Thomas, 1995), and on water collection (Ilahi and Grimard, 2000). However, the approach has not been applied to modeling household production activities more generally, as is evident in the surveys by Behrman (1997) and Strauss and Thomas (1995) and the overview of studies on the intra-household allocation of resources by Haddad, Haddinott and Alderman (1997c).[10] This mirrors the failure in the developed economy literature to integrate the theory of household production into the mainstream theoretical and empirical work on modeling household behavior. The vast body of work in the developed economy literature on the microeconometric modeling of family labor supply,[11] consumption demands, life cycle consumption and saving decisions,[12] and

[8] Low income economies are defined as those with a 1981 per capita income of less the US$410 and middle income economies as those with a 1981 per capita income greater that US$410 (World Bank, 1983).
[9] Though where nothing essential is lost thereby only time may appear explicitly.
[10] There are several studies that estimate reduced form time allocation models but these do not represent applications of the household production approach described here because they treat domestic work as a perfect substitute for leisure, by specifying the net wage as the price of both. Examples include the Skoufias (1993) model and the treatment of women's work at home (in contrast to their time spent on water collection) in Ilahi and Grimard (2000).
[11] For a relatively recent survey, see Blundell and Macurdy (1999).
[12] For a survey, see Browning and Lusardi (1996).

household welfare comparisons,[13] implies a specialized treatment of household production that, as the sections to follow will show, allows it to be suppressed. The literature on models that do explicitly incorporate domestic production tends to be viewed as specializing rather than generalizing the standard approach to modeling the household, that is, as belonging to a subfield concerned with the detailed analysis of the household as a specific economic institution.[14]

In much of the relatively new literature on the intra-household allocation of resources in multi-person households, an approach has been adopted that omits household production altogether. Referred to as the "collective" model, the approach reflects the pervasive view in the labor supply literature that non-market time is pure leisure. Models that attempt to address the multi-person nature of households directly will now be examined in some detail.

3 Multi-person households

This section discusses the household utility function approach to modeling the decisions of a multi-person household, followed by an outline of explicitly individualistic models. In examining the latter, various strands in the literature are identified in terms of their assumptions on household production.

3.1 The household utility function approach

In the developed economy literature, the household utility function approach replaces the basic model whenever it seems impossible to ignore the fact that households typically consist of two adult members. For example, in the analysis of female labor supply, surveyed in Killingsworth and Heckman (1986), the analysis of household taxation in

[13] See, for example, Blundell, Preston and Walker (1994). The editors of the volume make no mention of domestic time use, nor household production, and confuse the only paper in the volume that is on housework and family welfare with models on the sharing rule that ignore it.
[14] The literature on household production is typically reviewed separately from that on labor supply and demand modeling. See, for example, the reviews of household production models by Gronau (1986) and female labor supply models by Killingsworth and Heckman (1986).

Boskin and Sheshinski (1983), and the microeconometric analysis of tax reform, a single household utility function is postulated which is said to contain three goods: an aggregate consumption good and male and female "leisure" goods. Each adult is assumed to divide his or her total time between market labor supply and "leisure", where, in empirical work, the latter is measured as the non-market time of each adult member.

The household income budget constraint in the model initially sets expenditure on the market good equal to the sum of individual net-of-tax labor and non-labor incomes. The *full income* budget constraint is then derived by combining the time constraints with the initial budget constraint and setting expenditure on the market good and individual non-market time uses equal to the sum of full labor and non-labor incomes, that is, total household full income. In this sense income can be said to be *pooled*. Solution of the model yields consumption and "leisure" (non-market time) demands/labor supplies as functions of the market wage rates (again the price of the consumption good is usually normalized at unity) and household full income.

In what follows, this model will be referred to as the *standard household model*. It is a highly simplified demand/labor supply model of a two-adult household. Empirical work on this model in the developed economy literature is based on household survey datasets with missing information on the allocation of time to non-market activities. The "leisure" variables of the model are each calculated by subtracting time spent in market work from total time available. To interpret the resulting number pure leisure is clearly a mistake, since it includes time spent in household production for other family members. Nevertheless, this has been a common practice. For example, in the survey by Blundell and MaCurdy (1999), the "standard family labor supply model" for the two-adult household is said to treat the family as a single decision-making unit that maximizes joint utility over consumption and the two leisures, where the former is market consumption and the latter refer to pure leisures as assigned goods.[15]

[15]See also Deaton's (1997, p. 229) discussion of leisure as an assigned good. The same interpretation is also evident in Bergstrom's (1997) survey of theories of the family. For example, in his discussion of the Schultz (1990) model, Bergstrom states that "Schultz is able to peek inside the family black box and observe consumptions of leisure by husbands and by wives". Schultz notes explicitly that the "leisure"

To bring out the inconsistencies implied by this approach I present here an alternative interpretation of the standard model, which is based on a logically coherent, though special, treatment of the "leisure" variables. I then discuss the standard model further in the light of this interpretation.

3.2 An alternative interpretation of the standard household model

The model can be interpreted as in fact containing a system of domestic production, but of a special kind. The empirical implementation of the model on household survey data is widely misunderstood to exclude such a system due to the interpretation of the "leisure" variables literally as pure leisures. To show that this is a mistake, the basic structure of the model is set out formally below for an n-person household.

With n individuals and one aggregate consumption good, x, the household utility function takes the form

$$u = u(x, l_1, ..., l_n) \qquad (1)$$

where l_i, i =1, .., n, are the non-market time allocations of the n household members. Given the time constraints

$$h_i + l_i = T \qquad i = 1, ..., n \qquad (2)$$

with h_i denoting market labor supply and T the total time available, the household's full income budget constraint can be written as

$$x + \Sigma w_i l_i = Y \qquad i = 1, ..., n \qquad (3)$$

with

$$Y \equiv \Sigma Y_i \equiv \Sigma(w_i T + m_i) \qquad i = 1, ..., n \qquad (4)$$

as household full income, where w_i is the wage rate and m_i the non-wage income of individual i. The price of the consumption good is unity and the wage rates differ across individuals. Solution of the model yields the demand functions

$$x = x(w_1, ..., w_n, Y) \qquad (5a)$$

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variables in his model include domestic work for other family members. They are not assigned

$$h_i = h_i(w_1, ..., w_n, Y) \qquad i = 1, ..., n \qquad (5b)$$

which can be given an empirical specification to obtain estimates of household parameters.

Empirical work in the developed economy literature typically estimates this system on household survey data that contains information on market hours of work, wage rates and non-labor incomes at the level of the individual and on market consumption expenditures at the level of the household. Data on non-market time uses, and therefore on pure leisure and time inputs to household production, as well as on outputs from household production, are missing. The convention is to compute non-market time, the l_i in equation (1), as the difference between market labor supply and the total time available for each individual.[16] The "leisure" variables therefore represent time spent on activities for own consumption and for the benefit of other household members.

Given this empirical implementation, logical consistency requires that the model should be specified as containing a household production system of the following kind. Let y_i be the aggregate amount of a household good consumed by all household members, and produced by the i'th member, according to the simple linear production function

$$y_i = k_i l_i \qquad i = 1 ,.., n \qquad (6)$$

where k_i is a domestic productivity parameter. The opportunity cost or price, p_i, of domestic good i is then

$$p_i = w_i/k_i \qquad i = 1 ,.., n \qquad (7)$$

Since data on the y_i are missing, they must be constructed. In effect, the standard household model does this by setting $k_i = 1$, which implies that each household member of type i is equally productive across all households, producing one unit of good i per hour, priced at w_i. In other words this is an implicit choice of the units in which y_i is measured, but one which constrains productivity in household production to be identical

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consumptions.

[16] Note that since data on total time allocated to non-market activity is not collected other than in time use surveys, there is an endogeneity problem associated with computing l_i from the time constraint.

across households.[17] From this more explicit formulation, household utility can now be seen as a function of n + 1 *aggregate consumption goods*, x and the y_i or equivalently the l_i, i = 1 to n. None of the goods in the household utility function in (1) can represent assigned consumptions. The demand functions in (5a,b) are *aggregate household demands* for the market and domestic goods.

Models estimated on household survey data with missing information on individual consumptions are inevitably limited to the estimation of systems in which the demands of all family members, including children,[18] are aggregated. Since all family members face the same prices for all goods, it is valid to impose the restrictions required for aggregation. As Bergstrom (1997) points out, if the indirect utility function of each individual household member is of the Gorman polar form, and *all face the same prices*, then aggregate demands are functions of these prices and aggregate household income. In other words, the pattern of household demands can be thought of as deriving from the behavior of a single representative individual endowed with total household income, Y, and facing prices, p_i, i = 1 to n.[19] In this sense the model can be said to represent a single decision-taking agent.[20]

Thus the model is consistent with an underlying individualistic decision taking process in which member i, i = 1 to n, maximizes

$$u_i = u_i(x_i, y_{i1}, ..., y_{in}) \qquad (8)$$

where x_i and y_{ij} are i's consumption of the composite market good and of the domestic good produced by member j, $y_j = \Sigma_i y_{ij}$, j = 1 to n, respectively. Individual preference parameters cannot be estimated due to missing data on the x_i and y_{ij}. It is straightforward to show that the household parameters represent unidentified individual preference parameters weighted by unidentified shares of household full income. And so unless

[17] Note that the Becker (1981) model of the household division of labor allows domestic productivities to vary, and therefore also treats the standard model as a special case.
[18] For a model that includes children explicitly, see Apps and Rees (2002). Systems that specify, for example health production and demand functions for children, and are estimated on anthropometric data, also represent models that include children explicitly.
[19] The conditions are set out in Deaton and Muellbauer (1980), Ch 6.

some specific (and essentially *ad hoc*) assumptions are made about the intra-household income sharing rule and preferences, the estimated parameters can tell us nothing about intra-family inequality.

If we were to insist, as the literature cited above seems to do, that the l_i are individual pure leisure demands, then this interpretation of the model as containing a household production system, with all demands and supplies as household aggregates, cannot be sustained. But then the interpretation of the model and its empirical implementation are logically inconsistent.

Moreover, if adult family members allocate time to market work and pure leisure only, and their wage rates differ, the aggregation property, requiring that all individuals face the same prices, no longer holds. Thus not even placing the strong restrictions on preferences implied by the Gorman polar form would validate the approach of treating the household as an individual. Theoretical consistency with an individualistic decision making process would require the formulation of a model yielding individual leisure demands/labor supplies as functions of own wage, w_i, but not of w_j. The w_j would only enter through the individual's income share, where this is a function of both wage rates. Thus, with assigned leisures and a single aggregate consumption good, the leisure demand/labor supply functions in (5b) would be of the form

$$h_i = h_i(w_i, s_i(.)) \qquad (9)$$

where $s_i(.)$ is individual i's share of household full income defined as a function of variables that may include the wage rate of individual j. Since both wage rates enter as prices in what is taken to be each member's leisure demand function in (5b), the system could be seen as mis-specified. However, this in not the view of the literature. Instead, in studies that assume that non-market time represents assigned leisure, the system is rationalized as a model representing a household with "common preferences" or, alternatively, a household with a patriarchal head who derives utility directly from the private consumptions of other family members.

[20] But, as Deaton and Muellbauer (1980) note, this individual is representative only of aggregate behavior and is not representative in any democratic sense.

Given the interpretation of the l_i, i = 1 to n, as pure leisure demands, it is then claimed that the model has at least two strong, testable restrictions on comparative statics effects:

- since the Slutsky matrix is symmetric, the compensated derivatives of each member's pure leisure demand/labor supply with respect to the other's wage are equal, so that the uncompensated derivatives differ only in respect of income effects;

- the effect of a change in total household income on consumption or leisure demand/labor supply is independent of the source of the change in this income, and, in particular, of whose wage rate or non-labor income change causes the income change. This is often called, misleadingly, the "income pooling hypothesis", and there is a growing literature concerned with showing that this hypothesis is rejected by the data.

The relevance of the first restriction depends not only on the assumption that non-market time is pure leisure, but also on its corollary, that there is no household production. Thus, it is important to keep in mind that the first restriction is relevant only if we view, for example, the time mothers spend on home child care as pure leisure, providing no private benefits for other family members, including the children who must, presumably, be looking after themselves. If we do not hold this view, then the leisure demand/labor supply functions appropriately take the form in (5b) and the model imposes the Slutsky symmetry restrictions only on *individual* compensated cross price effects. If the model is estimated on time use data that allow domestic production to be separated from pure leisure, the wage rates of other family members can, in general, also enter indirectly through the prices of domestic goods, as shown in Apps and Rees (1996).

These issues are not new. That the empirical specification of the standard household model, in which all demands are aggregated across family members, is inappropriate for a system estimated on data for assigned goods has long been recognized in the development literature on health and human capital outcomes. For example, Pitt and Rosenzweig (1986) in their analysis of health outcomes and food consumption discuss at length the limitations of the standard household model in the context of these assigned goods.

In regard to the second restriction, the term "income pooling" is used to refer to the condition that the partial derivative of household consumption demands with respect to non-labor incomes are equal, and therefore that the source of the income change is irrelevant. In other words, "income pooling" is taken to mean the aggregation restriction, that the partial derivatives, $\partial x/\partial Y$, $\partial l_i/\partial Y$, do not depend on the identity of the income recipient, holds.

To refer to this restriction as "income pooling" is, however, misleading. The standard household model assumes that income is pooled in the sense that the budget constraint sets expenditure on market consumption and the non-market time allocations equal to the sum of individual full incomes, as in (3) and (4). This formulation is not rejected by studies that find demands depend not only on pooled household income but also on the source of income.

The way in which individual wage or non-wage income changes affect household demands and supplies depends on the overall formulation of the model, and not just on that of the budget constraint. A good example of this in the developing economy literature is, again, the paper by Pitt and Rosenzweig (1986). They specify a household utility function defined on the consumptions, leisures (non-market time allocations) and health states of $n > 1$ household members. There is a pooled income budget constraint, a farm production function, and each household member has his or her own health production function and labor efficiency function. This model certainly does not have the "income pooling hypothesis" as a result, even though the budget constraint involves pooled incomes. Testing for "anonymity", rather than for "pooled income", would seem to be a potentially less misleading term for tests of the second restriction.

This terminology would, for example, help to clarify statements such as the following, which appears in the survey article by Strauss and Beegle (1996):

"Bourguignon, Browning, Chiappori and Lechene (1993) and Browning, Bourguignon, Chiappori and Lechene (1994) find that, in France and Canada respectively, [...] the ratio of income effects is not unity (and thus they reject income pooling)"

These studies do not test for income pooling but rather for anonymity. Strauss and Beegle may have been misled by the "sharing rule" interpretation of the household equilibrium in these articles, further discussed below. This is to be understood as an "as if" construction of how a household equilibrium may be characterized, based on the Second Theorem of Welfare Economics, rather than as a literal description of the way individuals in the household treat their joint income.

It is important to recognize that studies testing for anonymity, such as those cited by Strauss and Beegle above, can tell us nothing about the intra-family distribution of income. Nor can they tell us how income shares change in response to a change in member i's non-labor income, except under very special (and implausible) conditions. One such set of conditions are those implied by the assumption that there is no household production in a multi-person household. Under this assumption, the household utility function can be defined on two goods, one assigned and the other unassigned, such as leisure and consumption in the standard model, or bought-in-clothing in the Browning et al. studies cited by Strauss and Beegle.[21] But if a third good that is unassigned (such as domestic output) is introduced, nothing can be said about the intra-household distribution of income.

These implications of introducing an additional unassigned good are recognized in Pitt and Rosenzweig (1986) who have a model with three goods, one of which is assigned, in their case, health outcomes. The result for household production more generally is demonstrated formally in Apps and Rees (1997). The Pitt-Rosenzweig paper discusses at length the limitations of the standard household utility function approach, with its estimation of aggregate household demands, in analyzing the intra-household distribution of welfare and its determinants.

[21] The latter treat gender-identified clothing as the assigned good. The fundamental deficiency of these studies is not, as suggested by Bergstrom (1997), that "Browning and his coworkers" do not directly observe "who wears the trousers in Canadian families", or that each spouse may derive utility from what

To these limitations can be added those that arise from the model's extremely restrictive and inadequate system of household production.[22] For example, the model cannot be used to analyze heterogeneity in decision variables deriving from variation in domestic productivities across households. All such differences must be attributed to preferences. As will be argued more fully below, incorporating a more general system of household production allows a much richer and empirically more interesting analysis of heterogeneity in labor supply, domestic work and consumption and saving decisions across households. Before discussing this point however, the following section turns to models that set out to analyze explicitly the multi-person household and the intra-family welfare distribution.

3.3 Individualistic models of the household

Two strands in the literature on modeling the decisions of individuals in multi-person households can be distinguished. The first originates with Samuelson (1956), is applied in the exchange model in Apps (1982), and is given a general formulation in Apps and Rees (1988). The general formulation is based on the assumption that the household equilibrium is Pareto efficient, irrespective of the actual decision process through which it is reached. The household is viewed as a small economy in which members produce, consume, specialize and exchange. Each has a utility function defined on domestic output as well as market goods and leisure. Thus, the formulation extends the approach of Becker, which sees the household as a producing and consuming unit, to a model of the household as a small economy in which agents not only produce and consume but also trade within the household.

A second strand comprises the two-person models that adopt a Nash bargaining approach, originating with the papers of Manser and Brown (1980) and McElroy and Horney (1981), and receiving a general formulation in Chiappori (1988) that is labeled

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the other is wearing. A more serious problem is that the Browning et al. model omits domestically produced substitutes.

the "collective model" of the household. The earlier papers analyzed the household consumption allocation as the outcome of Nash bargaining, with threat points given either by what the partners could achieve by leaving the household, or, alternatively, in some later formulations, by the non-cooperative Nash equilibrium with both partners remaining within the household. Chiappori (1988) generalizes these models also by assuming that the household equilibrium is Pareto efficient and without specifying the particular process by which it is reached. His approach is based on the interpretation of the "leisure" variables of the standard household model as pure leisures. As in the papers by Manser and Brown and McElroy and Horney, Chiappori (1988, 92) specifies a model in which each individual has a utility function defined on consumption and pure leisure, and so instead of the individual utility function in (8), he has

$$u_i = u_i (x_i, l_i) \qquad i = 1,2 \qquad (10)$$

Household production is omitted entirely. In this crucial respect, particularly from a gender perspective, the model is more specialized than the standard model estimated on aggregate data, as set out in section 3.2. Subsequent studies that adopt the Chiappori model, and therefore omit household production, include Bourguignon et al. (1993), Browning et al. (1994), Fortin and Lacroix (1997), Blundell et al. (1998) and Bourguignon (1999). More recently, Fong and Zang (2001) extend the Chiappori model by distinguishing between two types of leisure, "independent (or private) leisure" and "spousal leisure" (time spent together).[23] The authors label these leisures as "unobservable" even though data on both are available in time use survey files.[24]

Thus, the general formulations in both strands employ the assumption that, whatever decision process may in fact determine the household equilibrium allocation, the latter

[22] This of course does not apply to the Pitt and Rosenzweig (1986) model for the household production of health, though the point can be made that household production needs to be defined more generally than as just health care.

[23] Hamermesh (1996, 1999) makes a similar distinction within a more general approach that recognizes that the household faces a coordination problem in its time allocation and household production decisions.

[24] Time use surveys frequently collect information on "social context" by recording the presence of other persons and their relationship to respondent. Examples include the Canadian 1992 General Social Survey (GSS) – cycle 7 Time Use and 1998 GSS – cycle 12 Time Use, the Australian ABS 1992 and 1997 Time Use Surveys and the UK Office of National Statistics 2000 Time Use Survey. Thus, a more sophisticated empirical model than one that distinguishes simply between independent and spousal leisure can be estimated on available data.

can be taken to be Pareto efficient. This is both a rationality postulate, replacing that of simple utility maximization in the one-person household model, and a solution procedure. Once the household allocation is assumed to be Pareto efficient, all the results of general equilibrium theory apply in a straightforward way, as pointed out in Apps and Rees (1988). In particular, the idea of an intra-family sharing rule is simply an application of the Second Theorem of Welfare Economics. The household can be modeled as choosing its time and consumption allocations directly, or equivalently, on the standard assumptions, as decentralizing this procedure by first sharing its full income amongst its members and then letting them choose their optimal allocations subject to the appropriate equilibrium prices.[25]

The focus of the Chiappori (1988) analysis is on the sharing rule. He shows that, in his model, the partial derivatives of the rule can be derived from empirical estimates of the market labor supply functions. This result however, is crucially dependent on omitting household production. As Apps and Rees (1997) demonstrate analytically, and Chiappori (1997) concedes, when his model is extended to include household production, the result on the partial retrievability of the sharing rule no longer holds in general, but requires specific restrictions on preferences and the household technology, which may or may not be considered reasonable.

An example is provided by the model presented in the first part of Chiappori (1997). This model essentially reproduces the results in SSS, in that it defines household production to be essentially the same as on-farm production. Given the resulting separation, Chiappori is able to show that his original results continue to hold. However, as emphasized in Section 2, the essence of household production is that while market goods may be close substitutes for some household goods, they are not perfect substitutes. Thus endogeneity and household specificity of implicit prices of household goods are a necessary feature of the equilibrium. Furthermore, with empirical work limited to the estimation of models on household survey data with missing information

[25] Note that, in the initial formulation of the model, in which the utility of one household member is maximized for a given utility level of the other, individual incomes are pooled to obtain the household budget constraint.

on household production, this type of model is inconsistent with the literature. The Apps and Rees (1997) conclusion is that collecting data on individual time use and consumptions within households is likely to be a much more reliable way to obtain estimates of household sharing rules.

We also show that unless household production is an integral part of the model, one obtains a wholly distorted picture of the nature of household economic activity as well as of the intra-household welfare distribution.[26] When time is assumed to be divided simply between market work and leisure, a mother with a low money income due to a low market labor supply must be enjoying a substantial amount of leisure as well as receiving a generous transfer of market goods from her partner. Thus, we would argue, the extension to two person households is *necessarily* accompanied by the explicit modeling of household production. The Apps-Rees formulation allows her consumption to be financed from an implicit payment made in exchange for the output of her domestic work. And the model allows for the possibility that a woman specializing in work and care activities at home may, in effect, be financing a transfer to her partner, by working longer hours. Since time use data, for both developed and developing economies, indicate that, on average, women work longer than men, this possibility is also highly probable. The issue is discussed further in Section 5 in the light of evidence from time use surveys for South Africa and Nicaragua.

A further fundamental implication of recognizing production for exchange within the family is that in an economy with an outside labor market, a partner specializing in household production can switch to market work in response to a fall in the implicit wage for domestic work.[27] She does not have to exit the household or choose an allocation at a non-cooperative Nash equilibrium, which are among the limited options of a model that omits household production for exchange. The approach therefore allows the analysis of the intra-household effects of policies that limit her outside opportunities, while she remains within the household.

[26] See Apps and Rees (1996) for an analysis based on time use data.
[27] And, in response to a fall in the outside net wage due to government policy, she may switch from market to domestic work.

The main concern of earlier papers adopting an exchange model, and of subsequent more general formulations, is with gender equity and with the welfare of women within the household as being determined by a household equilibrium strongly influenced by outside markets conditions and net earning opportunities. For example, if women tend to specialize in household production and men in market labor supply, the implicit rate of exchange between household and market goods at the household equilibrium, that will of course determine the distribution of welfare within the household, will be strongly influenced by factors such as labor market discrimination. In Apps (1982), for example, the analysis focuses on discrimination due to social and institutional barriers that crowd women into low wage occupations. Women are then crowded into household production due to the disincentive effects of low wages for market work.[28] Following the general formulation of the model in Apps and Rees (1988), subsequent papers have used the framework to analyze tax reform, the costs of children and life cycle saving.[29]

3.5 Is the household Pareto efficient?

The assumption of a Pareto efficient intra-household allocation of resources has been questioned in a number of studies. In general, we would expect to find that many of the conditions that rule out Pareto efficiency and lump sum redistribution in the outside economy would also be found within the household. These include information asymmetries between family members, agency problems of the kind discussed in Apps and Rees (2002), public goods and the free rider problem, etc. However, the appropriate model in a given context will depend on the issues of central interest. For example, in developed countries in which women have access to an outside job, the key determinants of the intra-household sharing rule may be distortions in the outside labor market causing a gender wage gap. Within-household distortions may be of "second order" importance, in which case Pareto efficiency may be a useful simplifying assumption. Thus an analysis that assumes a Pareto efficient household may still capture the relevant gender

[28] In the Nash bargaining models, in contrast, the influence of outside market opportunities enters through the threat points.
[29] (Apps and Rees,1999a,b, 2001, 2002)

effects of policy changes in a world where, as observed by Folbre (1997), there is neither a benevolent head of household nor a benevolent head of state.

In developing economies where there are no outside markets, the assumption may be less appropriate. Udry (1996), for example, presents an analysis of African agricultural households in six Burkina Faso villages, in which there are no outside markets for either labor or land. He finds that yields are substantially lower on plots controlled by women than on similar plots controlled by men planted with the same crop, in the same years in the same households. This is taken as evidence of non-Pareto efficiency in agricultural production and is used as the basis for rejecting the assumption in general.[30]

However, the results need to be interpreted in context, and with some caution. It would appear that the Pareto inefficiencies stem from the nature of the property rights in these villages. If, as efficiency would seem to require, men were allowed to work the women's plots, there is the risk that they would cease to be women's plots, as the paper points out. Thus the inefficiency is the price paid for the maintenance of existing control rights. The question then is whether, given the further constraints represented by this kind of consideration, the household allocation was Pareto efficient, i.e. the appropriate concept would seem to be that of *constrained Pareto efficiency.* In any concrete application of the multi-person household modeling approach, such constraints should be explicitly formulated and incorporated, even if this is not done in a more general treatment of the model.

4 Multi-person models with household production

This section outlines the structure of multi-person household production and demand models, paying particular attention to the valuation of domestic output and the importance of across-household heterogeneity, especially in respect of female labor supply and domestic work, in deriving measures of household welfare. Section 4.1

[30] Jones (1986) also obtains results that support the rejection of Pareto efficiency in the allocation of resources within the agricultural household.

recapitulates the standard household model. Section 4.2 sets out models based on the Apps-Rees approach and Sections 4.3 to 4.5 discuss applications involving heterogeneity and the measurement of living standards, intra-household inequality and child costs, and female labor supply and the demand for child care. Section 4.6 goes on to construct a model more directly relevant to developing economies, by adding a farm production sector to the model in section 4.2. The resulting model can be thought of as an extension of the Basic Model of SSS to a world of n-person households and household, as distinct from on-farm, production.

4.1 The standard household model and its limitations

In Section 3.2 the standard model was formulated for a household utility function defined on market consumption and the non-market time allocations of n members, l_i, i = 1, .., n. Maximizing this function, given in (1), subject to the time and budget constraints in (2) to (4) yields the demand functions in (5a,b). As explained, the utility function could equally well be defined on the market consumption good x and n domestically produced goods, y_i, i = 1, .., n. Given domestic goods prices, p_i, i =1, .., n, the household's problem can then be written as

$$\text{Max } u(x, y_1, ..., y_n) = u \qquad (11)$$

$$\text{s.t.} \quad x + \Sigma p_i y_i = Y \qquad (12)$$

and the aggregate household demand functions as

$$x = x(p_1, ..., p_n, Y), \qquad (13a)$$

$$y_i = y_i(p_1, ..., p_n, Y). \qquad (13b)$$

where $p_i = w_i/k_i$ for the linear production function in (6). Choosing units appropriately we can set $k_i = 1$, giving $p_i = w_i$.

This formulation makes it clear that empirical work on family labor supply and demand behavior using data on household consumption and market labor supplies is seriously deficient in at least two respects. First, as already emphasized, nothing can be learned about the intra-household sharing rule from the estimation of the aggregate demand

functions in (13a,b) or, equivalently, in (5a,b). This deficiency arises not from the underlying theoretical formulation of the model, but from the limitations of the datasets used for estimation.

A second and, arguably, more serious deficiency is the specialized treatment of household production. Setting $k_i = 1$ introduces the assumption that *all households have identical productivities in household production* (since one would not want to let the unit measure of domestic output vary across households). There are overwhelming reasons however for allowing domestic productivities to vary across households, as argued in Section 2.2 and to be elaborated in more detail below. The explicit formulation of the domestic production function in (6) needs to be retained, so the implicit price of household good i is given by w_i/k_i, the marginal cost of the good. Under this assumption household production is no longer valued at the wage rate, but at a price that depends also on productivity in household production.[31] This is of course on the assumption that individual i is at an interior solution with positive domestic and market labor supplies.

4.2 An Apps-Rees Model

If we want to be able to say something about the welfare of individual household members, as well as allow for productivity differences across households, the standard household model can be reformulated as follows. Let the utility function of the i'th household member be given by (8), that is, by $u_i = u_i(x_i, y_{i1}, ..., y_{in})$ where y_{ij} is her consumption of the good produced by member j, j =1, ..., n, and $\Sigma_j y_{ij}, = y_j$, j = 1, ..., n. Assuming Pareto efficiency, the household's problem then becomes

$$\max \Sigma_i \rho_i u_i(x_i, y_{i1}, ..., y_{in}) = u \qquad (14)$$

$$\text{s.t.} \quad \Sigma_i(x_i + \Sigma p_j y_{ij}) = Y \qquad (15)$$

where the weights $\rho_i > 0$ reflect a specific set of distributional preferences over the set of Pareto efficient allocations, and are in general functions of the wage rates and non-wage

[31] Note that the simple form of production function results in a quantity-independent implicit price of the domestic good, which varies inversely with the individual's productivity parameter k_i. Then across

incomes, among other things. For example they might be implied by Nash bargaining, by a "social choice process" within the household, or by competitive trade. Solution of this problem yields demands

$$x_i = x_i(p_1, ..., p_n, \rho_1, ..., \rho_n, Y) \quad (16a)$$

$$y_{ij} = y_{ij}(p_1, ..., p_n, \rho_1, ..., \rho_n, Y) \quad (16b)$$

.

Alternatively, we can apply the second theorem of welfare economics to show that the equilibrium allocation can be supported by a set of individual income shares s_i such that $\Sigma s_i = Y$, with each individual solving

$$\max u_i(x_i, y_{i1}, ..., y_{in}) = u_i \quad (17)$$

$$\text{s.t.} \quad x_i + \Sigma_j p_j y_{ij} = s_i \quad (18)$$

yielding demand functions

$$x_i = x_i(p_1, ..., p_n, s_i) \quad (19a)$$

$$y_{ij} = y_{ij}(p_1, ..., p_n, s_i) \quad (19b)$$

This approach can greatly simplify the comparative statics as well as empirical specifications. It also makes it very clear that if the model is estimated on household survey data with missing information on the x_i and y_{ij}, then the income shares, s_i, cannot be computed and individual preferences parameters are not identified.

If the model is estimated on time use data, the individual utility functions can then include pure leisure as an assigned good. Distinguishing pure leisure from time used for producing y_j, j = 1,..., n, and denoting it by t_i, the individual solves the problem

$$\max u_i(x_i, y_{i1}, ..., y_{in}, t_i) = u_i \quad (20)$$

$$\text{s.t.} \quad x_i + \Sigma_j p_j y_{ij} + w_i t_i = s_i \quad (21)$$

to yield demand functions

$$x_i = x_i(p_1, ..., p_n, w_i, s_i) \quad (22a)$$

$$y_{ij} = y_{ij}(p_1, ..., p_n, w_i, s_i) \quad (22b$$

$$t_i = t_i(p_1, ..., p_n, w_i, s_i) \quad (22c)$$

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households, the higher an individual's productivity the lower the implicit price of the good she produces

From this system it can be seen that "collective" models in which utility functions are defined on market consumption and pure leisure drop the household goods y_{ij}. Note also that individual demands in (22a-c) are functions of the domestic goods prices and own wage only. The wage of individual j enters only indirectly, through the price of domestic good j and the income share s_i. Thus the model does not imply symmetry of cross wage effects with respect to each member's leisure[32].

If we estimate a version of this model on data for a sample of two-adult households, and assume a single domestic good produced by the time inputs of both partners, the maximization problem for each adult i, i = f, m, reduces to

$$\max u_i(x_i, y_i, t_i) = u_i \tag{23}$$

$$\text{s.t.} \quad x_i + py_i + w_i t_i = s_i \tag{24}$$

to yield the demand functions

$$x_i = x_i(p, w_i, s_i) \tag{25a}$$

$$y_i = y_i(p, w_i, s_i) \tag{25b}$$

$$t_i = t_i(p, w_i, s_i) \tag{25c}$$

where

$$\Sigma y_i = y = y(l_f, l_m) \tag{26}$$

This system is estimated in Apps and Rees (1996) on data for a sample of households containing two adults, drawn from an Australian Bureau of Statistics (ABS) Time Use Survey. The aim of the study is to show that unless domestic production is an integral part of a demand/labor supply model, a wholly distorted picture of the intra-household distribution of income is obtained. This is because a model that assumes that non-market time is pure leisure implies that married women specializing in domestic work produce nothing for other family members. To make this point, results derived for the model above, labeled an "exchange model", are compared with those obtained for a system that omits household production and therefore permits income transfers only. The latter is labeled a "transfer model". Not only do the two models give very different results for the

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and the higher, *ceteris paribus*, the welfare of the household, as discussed more fully below.

[32] For detailed analysis of the comparative statics of this kind of model, see Apps and Rees (1997).

intra-household sharing rule, they also give conflicting estimates of labor supply elasticities.

Market goods may also be inputs to domestic production, as in Becker (1965). If, for example, we assume the production of a composite domestic good, y, by time inputs of all family members and domestic capital, K, then the production function takes the form

$$y = h(l_1, ..., l_n, K) \tag{27}$$

The implicit price of the domestic good, p, is then given more generally as the marginal cost of the domestic good

$$p = w_i/(\partial h/\partial l_i) = \pi/(\partial h/\partial K) \tag{28}$$

where π is the price of capital K. Thus, the higher are marginal productivities, the lower is the implicit price of the domestic good.

An advantage of time use data is that they provide information on leisure demands and on time inputs to domestic production required for the empirical implementation of this kind of modeling approach. Many surveys collect detailed information on different types of production and leisure activities and often include information on "social context" in terms of the presence of other persons and their relationship to respondent. These data allow the specification of a diverse range of systems for leisure activities[33] as well as for the domestic production of goods and services. Following the work of Hamermesh (1999, 2001), they also provide a database for analyzing the welfare implications of the timing of work and for modeling the household's time coordination problem.

If a time use survey is included as a module of a household income and expenditure survey, systems can be estimated on a single dataset containing detailed information on wage rates and incomes, as well as on time allocations and timing. Few economists have, until recently, seen the relevance of time use survey data for estimating behavioral models. As Juster and Stafford (1991) observe in their review of the time allocation literature: "While the importance of time allocation as an analytic construct is close to

[33] Note that the price of leisure will not necessarily be given by the net wage, but will depend on the assumptions implied by the system chosen for estimation.

being self-evident, the use of data on time allocation either to model economic behavior or to understand the dynamics of economic change over time has only recently begun to attract the interest of economists".

4.3 Heterogeneity

The most significant feature of the preceding model is that the decisions of family members depend on household specific domestic prices, as well as on market wage rates and prices. Thus, variation in domestic prices can offer an explanation for heterogeneity in female labor supply and domestic work observed across households with the same wage rates, non-labor incomes and demographic characteristics. It can also provide an explanation for heterogeneity in consumption and saving decisions observed to be associated with female labor supply. The standard household model does not provide an adequate framework for analyzing the policy implications of heterogeneity in these endogenous variables. By default, the model attributes such heterogeneity to differences in preferences (thereby ruling out welfare comparisons) or, quite implausibly, to measurement and optimization errors in empirical work.

By specifying household decisions as functions of domestic prices, the approach also highlights the importance of recognizing that domestic inputs and outputs, in common with those of market production, are inherently observable. Both domestic and market activities can involve varying degrees of on-the-job consumption but this does not provide an argument for abandoning the collection of data on either. Thus, in the absence of convincing evidence to the contrary, there is no apriori reason for believing that domestic production parameters are inherently more difficult to identify than those of market production and that no attempt should be made to identify them separately from preference parameters.

Since information on domestic output is typically missing in time use datasets, a household production model can be estimated only on the basis of some essentially arbitrary assumption about productivity and therefore about the price of domestic output.

An advantage of time use data is that they provide information on inputs and therefore reduce the number of assumptions required for estimating an empirical model. If output data only are missing, testing the sensitivity of results to alternative assumptions becomes more feasible. This is an important gain because opposing views on some of the most contentious issues in tax policy and design of welfare programs can be traced to conflicting assumptions on the productivity of domestic time. Examples are given in the following separate discussions of heterogeneity with respect to female labor supply and with respect to household saving.

Female labor supply heterogeneity

Developed economies (and now increasingly, transition economies) are characterized by a high degree of heterogeneity in female labor supply. In a significant proportion of households with young children, one parent, typically the mother, specializes in domestic work and home child care, while in an equally significant proportion of households she specializes in market work, buying in domestic services and child care. As we demonstrate in Apps and Rees (1999a), specialization in domestic production may result either from higher productivity (as envisaged for example in Becker's discussion of this subject), or, alternatively, from lower productivity in household work. High productivity in domestic production implies a low implicit price, and therefore a higher demand for domestic output and domestic labor supply. At the same time however the higher the productivity, the less time required to produce a given domestic output and the more time therefore available for market labor supply. The net effect will depend on the price elasticity of demand for domestic output in relation to domestic productivity. The main implication of this is that we cannot infer from observed market labor supply that a woman has higher or lower productivity in domestic production.

In the absence of output data, the assumption chosen will determine prices, and in turn the relative levels of welfare of household types distinguished according to female labor supply. If, for example, it is assumed that married women who specialize in work at home have relatively lower domestic productivity, then, for given net wage rates, their households will have a lower standard of living. The utility maximization problem in (20)

and (21) implies the indirect utility functions $v_i(p_1, ..., p_n, w_i, s_i)$ and, *other things being equal*, the higher are the implicit domestic prices, the lower are the utilities of the household members. Under this assumption, since these households will also have relatively lower market income, basing taxes or eligibility for welfare payments on household income can, under certain conditions, be justified on distributional grounds.

On the other hand, if women who specialize in work at home have relatively high domestic productivity, the implicit prices are relatively low, and the household has a high standard of living. In that case there would be no argument on distributional grounds for transferring income to these households through the tax system. In this case the distribution of household income (or consumption) can entirely misrepresent the true distribution of living standards. Low wage families, in which both parents work to gain a reasonable standard of living, can appear in the upper percentiles of the household income distribution, along with much higher wage families in which one parent specializes in household production.

This issue is particularly important in OECD countries, where the vast majority of workers earn around the median wage and the distribution is positively skewed. Under these conditions, tax systems, such as joint taxation as in the US and Germany and the earned income tax credit program of the US (and now proposed for the UK), have the effect of imposing higher rates on working married women,[34] and especially on those married to husbands on low to median earnings. Apps and Rees (1999a) show that tax-welfare programs of this kind can lead to an increase inequality within the household and across households, and impose significant efficiency losses by reinforcing gender roles.

To summarize: we observe considerable heterogeneity across households in female labor supply, after controlling for wage rates and demographic characteristics. A reasonable

[34] Under a system of joint income, both partners face the same marginal tax rate. However, what is often missed in the literature is that two couples with identical wage rates, non-labor incomes and demographics, and with the same preferences, face very different rates if there is heterogeneity in the labor supply of married women. Couples in which the female partner works typically face much higher marginal tax rates.

explanation for this would be in terms of differences in human and physical capital that cause differences in productivity in domestic production. These productivity differences in turn imply differences in household living standards. If domestic productivity is positively correlated with household market income, then the latter can serve as an indicator of living standards for the purpose of policy toward taxation and social welfare. If however the correlation is negative, then tying taxation and social welfare policies to household income as a positive indicator of household welfare leads to results that are the exact opposite of those desired.

In some OECD countries, effective marginal tax rates on married women are so high that average rates on their earnings are in the order of 50 per cent, especially in households in which the male partner's earnings are relatively low. At the same time, access to affordable child care is severely limited, due to a poorly organized child care sector and deficiencies in government policy.[35] Conditions of this kind offer an explanation for why traditional gender roles in developed economies persist, despite changes in social attitudes and the introduction of legal reforms prohibiting various forms of discrimination in the labor market. In fact, close examination of the tax and welfare reforms in a number of developed economies reveals that as the gender wage gap has narrowed in recent decades, reforms have been introduced that reverse the gains in terms of the net-of-tax wage gap.

Heterogeneity in female labor supply, together with its policy implications, is likely to become an increasingly important issue in transition economies, now that their systems of government funded child care are collapsing and fewer women are working. An implication of the preceding discussion is that the policy approach of developed economies does not provide a guide for reform in these economies.

In developing economies, there is extensive heterogeneity not only in female labor supply but also in the allocation of time to basic domestic chores, such as the collection of water

[35] These problems characterize, for example, the tax-benefit and child care systems in Australia. Australia now has, in effect, a system of joint taxation, due to recent changes in its Family Tax Benefit system.

and fuel. The Ilahi and Grimard (2000) study investigates the latter using community and household level data on water infrastructure to estimate the reduced form equations of a model specifying a production function for water of the form in (23). Households that must spend more time collecting water will face a higher implicit price per unit of output and will, ceteris paribus, be worse off.

It is the limitations of the standard household model in analyzing policy issues associated with this kind of heterogeneity that lead us to the view that the more serious deficiency of the model is its treatment of household production. Much of the recent literature on the economics of the household focuses on its limitations as a "black box" in regard to the intra-household distribution of income by gender. But this would seem to be of second order importance when intra-household gender differences are the result of government policies that can only be justified by a model that allows the contribution of household production to family living standards to be ignored.

In fact, the focus on intra-household household outcomes may be misdirected. A finding widely considered from a policy point of view to be one of the most important to emerge from intra-household studies is that additional income in the hands of mothers is more likely to be spent on the children. For example, the Lundberg et al. (1997) analysis of a change in the UK child benefit system finds that the transfer of resources from husbands to wives that followed the change led to an increase in household expenditure on women's and children's clothing. Results of this kind are taken as evidence of the advantage of targeting welfare programs to women.[36] However, if tax and welfare policies are structured to lower the net income of mothers as second earners, especially in households on relatively low wage rates, then why not recommend the introduction of a gender neutral tax-transfer system rather than a complex system of gender targeted transfers?

[36] See the discussion in Alderman, Haddad and Haddinott (1997a)

Household consumption and saving heterogeneity

In a model that fully integrates household production and consumption decisions, consumption expenditure is given by the household's spending on *full* consumption, defined to include market goods and domestic output. A standard assumption in the estimation of commodity demand systems is that consumption and leisure are separable. However, since the systems are typically estimated on household survey data for market consumption spending only, the assumption implies that market goods and non-market time are separable. This means that empirical work on the estimation of commodity demands systems assumes that the output of household production does not have close market substitutes. This is clearly implausible for developed economies, particularly in the case of families with young children. Thus, the parameter estimates can be expected to be subject to bias due to omitted domestic price variables and an incorrectly measured household consumption variable.

The practice of estimating demand systems on data for spending on market goods only is also problematic for modeling life cycle consumption and saving behavior. The core of the life cycle model of consumption choice is the hypothesis that the household chooses its consumption at any point in time in the light of its entire lifetime income stream, using the capital market to decouple current consumption from current income, so as to keep its discounted marginal utility of consumption constant over time.[37] In empirical work, the consumption variable is again expenditure on market goods and services, and the income stream that appears (usually exogenously) in the model is market wage income. In the developed economies' literature, when predicted consumption and saving paths are compared to the data, not surprisingly there are striking differences. These are presented as "puzzles" in need of solving. However, the differences can be explained by the life cycle profile of female labor supply, and the substitution of domestic for market output that it reflects, after the arrival of children, [38] together with the constraints of an imperfect capital market. Time use data show a large drop in pure leisure, particularly for the mother, after the arrival of children, which suggests that parents reduce their leisure to

[37] For a comprehensive survey of the theory and evidence see Deaton (1992).
[38] See Apps and Rees (2001)

support their children's full consumption rather than borrow at high interest rates in an imperfect capital market.

Equally problematic is the discussion of life cycle model in the "representative agent" framework. The data for many developed economies indicate that households in which the female partner allocates more time to market work also save more, ceteris paribus. In other words, the presence of a second earner increases household saving. A number of studies attempt to deal with the impact of female labor supply on saving within the standard framework by conditioning on employment status.[39] But this leads to the opposite result, expressed explicitly by Attanasio and Banks (1998) as: "an increase in female labor force participation is linked to a decrease in measured saving". To see that this is a mistake, consider two households with the same household net income, in one of which the wife works and in the other not. Then due to costs of going out to work, saving in the former household may be lower. But this is the wrong comparison. If one conditions first on the primary earner wage and non-wage income, as well as on the female wage and on demographics, one finds that households in which the wife works save significantly more than those in which she does not. In other words, the marginal propensity to save out of the second earner's income is very high, despite the presence of costs of going out to work. This is masked in the former case by the fact that saving increases with primary earner income, so a household with a non-working wife and a high wage primary earner may save a little more than a household with two lower wage earners and about the same household income. But to isolate the *incremental effect* of the female labor supply decision it is necessary, at the very least, to control for the primary earner wage. This example illustrates the importance of fully integrating household production in models of life cycle consumption and saving behavior, as well as in models of labor supply, if misleading results on the effects of polices that alter traditional gender roles are to be avoided.

4.4 Measurement of child costs

[39] See Blundell, Browning and Meghir (1994) and Attanasio and Banks (1998).

The modeling framework outlined in Section 4.2 can be applied to the analysis of the costs of children. The standard literature on measuring child costs (see Browning, 1992, for a survey) is based on the idea that the cost of a child is given by the compensating variation in income required to restore the parent's utility level[40] to that she would enjoy in the absence of the child. The glaring deficiencies of this approach have been well criticized by Pollak and Wales (1979). One problem is econometric: costs thus defined cannot be estimated from the usual household income and expenditure datasets. The other is conceptual: if a household has children, it must be because they increase utility, therefore the compensating variation must be negative.

In Apps and Rees (2002) the exchange model in (23) to (26) is extended to include children and developed as an alternative approach. The cost of a child is defined as the value of consumption of market and of domestically produced goods, especially child care produced with parental time, that the child receives at the household equilibrium, as well as of any increment in amounts of household public goods (housing space, heat, light) the child occasions. We are also interested in the incidence of these costs on the respective parents. The data from time use studies show that the advent of a child leads to a larger fall in the leisure time of the mother than of the father and, in the model we specify, this implies that the income share of the mother also falls by more, which in turn implies a heavier incidence of child costs on the mother than on the father. The key element in the approach is the evaluation of the effects of the arrival of children on the equilibrium allocation of the multi-person household with domestic production as well as on outside labor market opportunities.

The procedure adopted for estimation is as follows. Two samples of households are selected from the ABS 1993 Time Use Survey (TUS), one containing families with two children and the other, those who have not yet had children. Following Gronau (1991), adult preference parameters are estimated on the sample of couples without children. A pure trade model is specified and preference parameters that are unidentified in the

[40] The underlying utility and expenditure function framework is that of a single person household - see for example Deaton and Muellbauer (1980).

demand equation for the domestic good are assumed to be the same. A second model is then estimated on the sample of two-child families, assuming that transfers take place only between parents and children and that the children have the same preferences. Given the preference parameters of the adults, those of the children and of the sharing rule, can be identified. The complete set of parameters is then used to compute the transfer of income that each parent makes to the children. The result, that mothers transfer a greater share of their full income to the children than do fathers, rests on a positive association between the amount of time and the amounts of goods a parent transfers to children implied by the parameters. Ideally, data on individual consumptions would provide a firmer basis for these comparisons, but at least the approach makes clear the point that the incidence of child costs between parents is an important aspect of the intra-household real income distribution.

The resulting estimates of child costs indicate the extent to which those of the equivalence scale literature are biased downward because they omit the value of parental time spent in child care and the implicit costs of the domestically produced goods that children consume. As noted above, there is strong heterogeneity in the choice between providing direct parental time to child care and buying-in child care while working in the market place, across households facing the same market opportunities and with the same demographic characteristics. Estimates are therefore presented for families with the traditional market/household division of labor and for those in which both parents have a significant workforce attachment. In households with two children and the traditional division of labor, the overall cost of both children's consumption of market goods is estimated to be around 23 and 34 per cent of that of the household, depending on the precise specification of the distribution rule. These estimates increase to around 40 and 47 per cent in non-traditional households. When the costs of parental time devoted to child care and domestically produced goods are added in, the value of both children's consumption allocation is estimated to be around 51 and 56 per cent of full consumption in the first kind of household, and around 49 and 54 per cent in the second.

4.5 Modeling the demand for domestic and market child care

The standard treatment of the costs of child care in the labor supply and tax reform literature of developed economies is entirely unsatisfactory. Because the non-market time of mothers is interpreted to be pure leisure, bought-in child care is treated as a cost that is incurred only if the mother goes out to work. The time cost of domestic child care is assumed to be zero.[41] Consequently, the models can give results that seriously understate female wage elasticities.

While domestic child care is costly, an argument can be made that the price of market child care is kept higher than necessary, as a matter of government policy. In many developed countries there is a large gap between the level of per capita government funding for the education and care of children over the age of 4 years compared with that for those under this age. This disparity is maintained despite the evident failure of private markets to offer child care of an appropriate standard, and at an affordable price, for many mothers. At the heart of the problem is that, in an imperfect capital market, most mothers of young children cannot borrow at a reasonable interest rate to finance the high cost of good quality child care,[42] and governments do not act to correct the effects of this. Measures to correct this situation are likely to have a significant positive effect on female labor supply, and lead to an increase in the demand for market child care as a substitute for domestic child care.

The results of empirical studies for developing economies suggest that a simultaneous improvement in access to market work and child care is required for an increase in female labor supply without a decline in the demand for schooling by girls. The child costs model in the preceding section can be reformulated as a multi-person labor supply/schooling and child care demand system, for estimating the behavioral effects of labor market and child care policy reforms. A key feature of the child costs model is the specification of two domestic goods, a general domestic good and home child care

[41] See, for example, Hausman (1979) and, more recently, Duncan and MacCrae (1999).
[42] For further discussion of this issue, see Apps and Rees (2002).

produced by both parents (but predominantly by the mother). The model can be extended to take account of the substitutability of market child care for home child care directly, by making a distinction between two market goods, a general consumption good and bought-in child care. The latter would include the time inputs of siblings and other household members. The model would specify, as before, a domestic production system for home child care. The demand system would contain equations for both market and domestic child care, as functions of the price of market child care as well as that of domestic child care. [43]

Existing modeling work in this area includes Lokshin (2000) and Lokshin et al. (2000). The findings of the latter study indicate that, on the one hand, an increase in the mother's wage has a negative effect on the school enrollment of girls but, on the other, a lower price for child care has a positive effect on their school enrollment. Lokshin (2000) derives the result that replacing family cash transfers with subsidies for child care could have a strong positive effect on women's labor force participation. A similar result for developed economies is derived analytically in Apps and Rees (2001) on the basis of available estimates of relevant behavioral parameters. We find that child care subsidies have a strong positive effect on female labor supply and on fertility, because of the substitutability of market for domestic child care.

4.6 An Agricultural Model with Household Production

The model in Section 4.2 can be reformulated to include a farm sector. The resulting model can be seen as the extension of the Basic Model of SSS to multi-person households with domestic (as well as on-farm) production. Let z_i denote i's consumption of the agricultural good, f_i her labor supply to the household's farm production, z the

[43] A system of this kind could be seen as an extension of the time allocation model in Skoufias (1993), to incorporate household production. Skoufias estimates a system of demand equations for male and female time inputs to market work, domestic work and leisures, as well as time inputs to schooling by boys and girls in the household. However, the model does not specify a domestic production system for estimation, and so the time input demands are functions of the wage rates of the adults and children. Domestic prices are missing.

household's total output of the farm good, and q its market price. The farm production function is

$$z = g(f_1, ..., f_n) \tag{29}$$

which is assumed to be strictly increasing and concave, with continuous first derivatives g_i. To simplify the model, the possibility of bought in farm labor is ignored. Written at its fullest, the household's problem is

$$\max U = \Sigma_i \rho_i u_i(x_i, y_{i1}, ..., y_{in}, t_i, z_i) \tag{30}$$

$$\text{s.t.} \quad z = g(f_1, ..., f_n) \tag{31}$$

$$y_i = \Sigma_j y_{ji} = k_i l_i, \qquad i = 1, ..., n \tag{32}$$

$$\Sigma_i(x_i + qz_i) = \Sigma_i(w_i h_i + m_i) + qz \tag{33}$$

$$h_i + l_i + t_i + f_i = T \qquad i = 1, ..., n \tag{34}$$

$$y_{ij}, l_i, h_i, , t_i, f_i \geq 0 \qquad i = 1, ..., n \tag{35}$$

where it is assumed that all consumption quantities other than possibly the y_{ij} will be strictly positive at the optimum. Without going into detail on the derivations, which are straightforward but lengthy, the main features of the results are summarized here. There are seven possible cases of interest, corresponding to the number of activities to which an individual i supplies labor - the market, on-farm production and household production. We consider just four of these possibilities:

Case 1: every individual works in all three;

Case 2: at least one i works only in the market and on the farm;

Case 3: at least one i works only in the household and on the farm;

Case 4: at least one i works only in the household.

Case 1: In this case every choice variable is strictly positive at the optimum. The implicit price of each domestic good is $p_i = w_i/k_i$ as before, and there is a separation between farm production and consumption. Thus the household can be represented as choosing its farm inputs and outputs by maximizing farm profits $\pi = qg(f_1, ..., f_n) - \Sigma_i w_i f_i$, implying all marginal value products are equal to the respective w_i, and then finding its consumption optimum by solving

$$\max \Sigma_i \rho_i u_i(x_i, y_{i1}, ..., y_{i\,n}, t_i, z_i) = U \tag{36}$$

$$\text{s.t.} \qquad \Sigma_i(x_i + qz_i + p_i\Sigma y_{ji} + w_i t_i) = Y^* \tag{37}$$

where

$$Y^* \equiv \Sigma_i(w_i T + m_i) + \pi^* \tag{38}$$

with $\pi*$ the maximized profit from farm production. This problem in its turn allows a sharing rule formulation, with household member i receiving s_i such that $\Sigma s_i = Y^*$, and solving

$$\max u_i(x_i, y_{i1}, ..., y_{in}, t_i, z_i) = u_i \tag{39}$$

$$\text{s.t.} \qquad x_i + \Sigma_j p_j y_{ji} + w_i t_i + qz_i = s_i \tag{40}$$

from which we obtain demand functions

$$x_i = x_i(p_1, ..., p_n, w_i, q, s_i) \tag{41}$$

$$y_{ij} = y_{ij}(p_1, ..., p_n, w_i, q, s_i) \tag{42}$$

$$z_i = z_i(p_1, ..., p_n, w_i, q, s_i). \tag{43}$$

Case 2: Individual i is at a corner solution with respect to work in the household. In that case $l_i = 0$, h_i, $f_i > 0$. From the first order (Kuhn-Tucker) conditions we can then derive the inequality

$$p_i \leq w_i / k_i \tag{44}$$

where p_i is now the household's demand price for the domestic output of individual i at a zero level of this output. This demand price is no greater than the (constant) marginal cost of this output. In other words, i's domestic good is "too expensive" for the household, possibly because his wage rate is high, or his productivity is low, or both. He divides his time between farm and market, and so the value of his marginal product in farm production will be equal to his wage. Note that the household can decentralize this allocation by setting a price $p_i^* = w_i / k_i$ on i's services for household production.

Case 3: Individual i is at a corner solution with respect to work in the market. In that case $h_i = 0$, l_i, $f_i > 0$. Thus we have the inequality

$$w_i \leq qg_i = p_i k_i \tag{45}$$

The individual's market wage rate is no greater than her marginal value product in on-farm production, which is equal to her marginal value product in household production, with p_i the household's valuation of her marginal unit of domestic output. This equilibrium is decentralized by the household's setting her implicit wage equal to $w_i^* = qg_i = p_ik_i$.

Case 4: Individual i is at a corner solution with respect to market and on-farm work. In that case $h_i = 0 = f_i$, $l_i > 0$. Then we have the inequalities

$$p_i \geq w_i/k_i \tag{46}$$

$$p_ik_i \geq qg_i \tag{47}$$

Thus the marginal value of i's domestic output, p_i, is at least as great as its marginal cost, and the marginal value product of her time in on-farm production, at zero level of input, is less than or equal to the marginal value product of her time in domestic production. The household decentralizes this allocation by setting her wage at $w_i^* = p_ik_i$.

Time and space constraints preclude further discussion of this model. Clearly empirical applications will require data on time use and outputs from within the household, since many of the relevant prices are endogenous and household specific. The model does however provide a reasonably general and comprehensive framework within which gender issues can be discussed, and also demonstrates the importance of time use data for modeling household decisions.

5 Time use survey design

The central aim of the preceding section has been to set out an approach to modeling household behavior that is appropriate for analyzing the welfare effects of changes in policy. The particular model that is relevant in a given context, as I pointed out earlier, will depend on the set of questions being asked. Here, the questions of interest concern the effects of reforms on the intra-household allocation of resources, on living standards and on household behavior. I have emphasized that finding answers to these questions

requires an approach that allows gender inequality within and outside household to be identified. For this, a modeling framework that takes household production seriously is essential.

It was also noted at the outset that an important advantage in setting out such a modeling framework is that it makes clear the kinds of data that are required for analyzing the questions at hand. In addition, it makes clear the relevant unit of analysis and, therefore, for whom the data need to be collected. Available household datasets typically provide information on many of the key variables of the models set out above – market wage rates, exogenous incomes and labor supplies. However these are not sufficient. Time use data and information on domestic output are also required.

A fundamental feature of the modeling approach outlined is that the household is treated as the relevant economic unit, analogous to a small economy in which individuals engage in production and exchange. Thus the decisions of individual members cannot, in general, be modeled independently of the wage rates and incomes of other members. In particular, unless information on wages is collected for every active member, it is not possible to construct a household budget constraint.

The household survey datasets used by economists to estimate the standard demand/labor supply model typically provide information for all active members. However, time use surveys often do not. They are sometimes designed to include only one or two randomly selected members of each household interviewed. They also frequently fail to distinguish between labor and non-labor incomes, so that it is not possible to compute or estimate a gross wage for each active member. These and other deficiencies seriously limit the usefulness of many time use survey datasets as an input to policy analysis.

The aim of this section is to examine some of the main limitations of currently available time use surveys, and to show how many of the problems could have been avoided and, in some cases, without incurring a significant increase in cost. Two very different time use surveys for developing countries are selected for analysis. The first is the Statistics

South Africa (SSA) Time Use Survey 2000 (TUS2000). This was conducted as a separate survey. The second is the time use module included in the Nicaraguan 1998 Living Standards Measurement Survey (Encuestra de Hogares sobre Medicion de Nivel del Vida) (EMNV98). These two surveys are compared in terms of the information they provide on the intra-household distribution of resources and on living standards, and for estimating models within the theoretical framework outlined.

Section 5.1 provides a summary of the main features of these surveys. Section 5.2 discusses gender differences in hours of work and leisure based on data means for the two surveys and on the results of various time use studies in the literature. Section 5.3 examines the limitations of SAA TUS2000 for making welfare comparisons and for estimating behavioral models, and goes on to consider the merits of including a time use module in an LSMS, as in the EMNV98, rather than as a stand-alone survey. To highlight the importance of time use data for policy analysis, the section illustrates the deficiencies of consumption based measures of living standards when there is a high degree of heterogeneity in the allocation of time to market and domestic work across households. The analysis is based on the EMNV98 data and the derived measure of consumption per capita included in the file.

5.1 Data

The SSA TUS2000 was the first of its kind at a national level for South Africa. The survey was designed to contain a number of questions found in other SSA survey questionnaires to allow matching. These included questions on household demographics, labor force participation, industry and occupation. The survey was conducted in three tranches to capture seasonal variation.

The planned sample was 10800 dwelling units, drawn systematically from all provinces. All households in a selected dwelling unit were interviewed. The final sample contained a total of 8339 household records. Time use data were collected by diary from two randomly selected individuals, aged ten years or older, from each multi-person household

in the sample. The final sample comprised a total of 14306 individual records. Of these, approximately 80% represented individuals aged 18 years and over and the remainder, individuals aged 10 to 17 years. The diary had a fixed time interval of 30 minutes. A respondent could name up to three activities in each time slot, with a code to denote whether they were conducted simultaneously or sequentially. Fieldworkers administered face-to-face questionnaires that contained separate sections for questions at the level of the household, for those asked of each respondent and for the time use diary of each respondent.

The survey instruments for the Nicaraguan EMNV98 included three questionnaires: a household questionnaire, an anthropometric questionnaire and a price questionnaire. The time use module was included in the household questionnaire and administered to half the households in the surveyed dwellings, selected on the basis of "every other" household. The module was administered to all individuals in the household aged 6 and older and collected information on the time spent the day previous to the interview. The anthropometric information was collected from every household member. The price questionnaire was administered at the community level in rural areas and at the municipality level in urban areas.[44] The final full sample contained 23643 individual records and the sample for which time use data were collected, 9390 individual records. Of these, approximately 60% represent individuals aged 18 years and over and the remainder, 6 to 17 years.

The two surveys illustrate different problems. In the first instance, because the SSA TUS2000 collected data by diary, almost all records satisfy the time constraint and no record exceeds it. In the EMNV98 over 10% of records do not satisfy the time constraint, and of these almost half exceed it. A second advantage of the SAA file is that, as noted above, it contains information on up to three simultaneous activities in a given (half hour) episode. Information on a second simultaneous activity is particularly important because

[44] The goods included were based on the basic consumer basket used by the National Institute for Statistics and Census (Instituto Nacional de Estadistican y Censos) (INEC)

domestic child care is frequently combined with another activity.[45] The EMNV98 also collected information on simultaneous activities but as separate variables. The respondents were asked specifically about the amount of time they allocated to child care as a simultaneous activity. The difficulty with this approach is that the primary activity with which the second is associated cannot be identified.[46] For these reasons, the SSA TUS2000 data are superior in terms of accuracy and the information on time use that they provide.

However, the SSA2000 TUS gives rise to fundamental difficulties for policy analysis due to missing information on all economically active members of the household. There are also problems with the data on individual and household incomes. These are discussed below. In contrast, the EMNV98 provides data on all active members and, furthermore, the information on time use is combined with data on a wide range of income and economic activity variables that are needed for computing wage rates.

The importance of designing a time use survey to collect complete information on economically active members is emphasized by Klevmarken (1999).[47] Surprisingly, Harvey and Taylor (2000) in their survey on time use do not clarify this point. To the contrary, they suggest that different units may be equally important, that the analysis "may focus on the whole population, the subset of people who participate in an activity, an individual, a household, an activity, or an episode". The kinds of descriptive statistics that can be generated for several of these units are illustrated in Statistics South Africa (2001). While the results are interesting, they cannot in general provide information on the behavioral parameters required for deriving the welfare effects of policy changes, nor

[45] There would seem, however, little to be gained from collecting information on a third simultaneous activity. This has been the experience with time use survey data for developed countries. The ABS, for example, collected data on three simultaneous activities in its 1992 TUS but dropped the third activity in its 1997 survey.

[46] To satisfy the time constraint it is necessary to weight primary and secondary activities. This requires information on the primary activity with which the secondary activity is associated.

[47] In an oral discussion at the IZA 2002 Time Use Conference Klevmarken was particularly critical of the planned US time use survey for failing in this respect. His concerns are captured by the end line of his 1999 article: "Time-use data are too valuable to be left only to statistical agencies and national accounting people".

can they be used for making household living standard comparisons.

5.2 Gender and time use

As emphasized in the policy research report of the World Bank (2001), gender differences in the allocation of resources can be observed on many dimensions: health, education, access to productive resources and the allocation of time to work and leisure. The report suggests that differences on these "life" dimensions can be seen as indicators of poverty and inequality in developing economies. An underlying assumption is that, in general, it makes sense to assume that individual preferences for these "quality of life" variables do not differ significantly by gender. If preferences are identical then individuals facing the same resource constraints would chose to be equally healthy and equally educated, and they would choose to work the same total number of hours, either at home or in the market place.[48] Gender differences with respect to these endogenous variables would then reflect unequal "outside" opportunities and/or unequal shares of household full income. While there is an extensive body of research that investigates health and human capital outcomes as measures of poverty and inequality, it is only relatively recently that attention has focused on gender differences in work-leisure allocations as an indicator of inequality.

Evidence on time use presented in the World Bank (2001) Report shows that in most countries women work longer than men, when the "invisible" work done inside the home is included.[49] There is also a high degree of specialization. The report notes that gender differences in education and work begin at an early age, and become more pronounced as the children get older:

"In most of the world differences in household expenditure on girls' and boys' education tend to increase when children move from primary to secondary school. When girls

[48] This would seem to be a perfectly reasonable assumption, and has the advantage of avoiding the gender bias associated with assuming that observed differences, particularly in regard to labor supply, reflect differences in preferences by gender. As acknowledged by Heckman (1993), there may be no such "innate" differences.

[49] The vast majority of studies for Africa examined by Brown and Haddad (1995) also suggest that women work more hours on average than men.

reach adolescence they are generally expected to spend more time on such household activities as cooking, cleaning, collecting fuel and water, and caring for children. Meanwhile, boys tend to spend more time on farm or wage work. When young children get sick, teenage girls, not boys, tend to increase their time providing care – often at the expense of their schooling (Pitt and Rosenzweig 1990; Ilahi 1999a). Meanwhile, boys are increasingly engaged in market work, preparing to become the main breadwinners of their own household." (p.152).

These general patterns are supported by the SSA TUS2000 and EMNV98. Table 1 presents weighted means for the allocation of time to SNA work activities[50] and to domestic work and care activities,[51] by all individuals aged under 60 years in the SAA2000 sample. Panels A and B present the figures for those aged 18 to 59 years and 10 to 17 years, respectively, by gender. The results show women aged 18 to 59 years working over 20% more than men in the same age group, and girls aged 10 to 17 working almost 50% longer than boys in the same age group. Table 2 gives the data means for the EMNV98 for the same time use variables and age groups, by gender. Again, the figures show that women work longer than men, and girls longer than boys, although the differences are relatively smaller.

Table 1: SSA TUS2000 data means: time allocations by age and gender
(std. dev. in parenthesis)

Panel A: Individuals aged 18 – 59 years

Minutes per day	Female	Std.dev	Male	Std.dev
SNA work	170	(241)	281	(295)
Domestic work + care	289	(199)	97	(125)
Total work	459	(234)	379	(280)
Sample size	5319		4655	

Panel B: Individuals aged 10 - 17 years

Minutes per day	Female	Std.dev	Male	Std.dev
SNA work	27	(63)	44	(101)
Domestic work + care	132	(132)	65	(82)
Total work	159	(152)	109	(125)
Sample size	1513		1378	

[50] SNA work activities include "Employment for establishments", "Primary production activities not for establishments" and "Services for income and other production of goods not for establishments".
[51] Domestic work refers to activities classified as "Household maintenance, management and shopping for own household". Care activities are those included in the category "Care for children, the sick, elderly and disabled for own households".

If women and men have the same work-leisure preferences, and leisure is a normal good, then it seems reasonable to interpret these results as evidence of gender inequality – overall women have lower full incomes and so they consume less of all normal goods including leisure. There are a variety of factors that may contribute to the leisure differentials shown in the tables. The results are derived from individual records drawn randomly from households with different structures, different distributions of earning capacities, etc. Thus the overall differences in leisure means may in part be due, for example, to the gender composition of larger and poorer households (there is clear evidence of this in Table 3 below). It is not possible to isolate the contribution of intra-household differences even under the assumption of identical preferences.

Table 2: EMNV98 data means: time allocations by age and gender
(std. dev. in parenthesis)

Panel A: Individuals aged 18 – 59 years

Minutes per day	Female	Std.dev	Male	Std.dev
SNA work	182	(266)	406	(274)
Domestic work + care	339	(232)	85	(124)
Total work	520	(245)	491	(267)
Sample size	2518		2326	

Panel B: Individuals aged 10 - 17 years

Minutes per day	Female	Std.dev	Male	Std.dev
SNA work	33	(110)	124	(211)
Domestic work + care	205	(198)	92	(131)
Total work	237	(219)	216	(240)
Sample size	1185		1230	

While it may be reasonable to interpret a female/male leisure gap as an indicator of gender inequality, in general the idea that leisure and welfare are positively correlated needs to be viewed cautiously. Importantly, leisure may be negatively correlated with household living standards if rates of unemployment and underemployment are high among those at the bottom of the wage distribution. While households in poverty include those working long hours for very low wages, they may also comprise the unemployed working relatively few hours in the market place and at home. An explanation for the

latter is that, as unemployment rates rises, the productivity of domestic labor may fall due to scarcity of domestic capital in the form of market goods, health, education and housing. If domestic work is unproductive, then family members effectively face high domestic prices and, in response, may switch to leisure.[52] In some circumstances, they may have no choice – they are, in effect unemployed or underemployed at home as well as in the market place.

Table 3 presents weighted means that indicate this type of inverse relationship between work and leisure for two racial groups selected from the SSA TUS2000. Panel A reports weighted means for Africans and the Panel B, for whites, aged 18 to 59 years. These two

Table 3 SSA TUS2000 data means: time allocations of individuals aged 18 years and older, by gender and race (std. dev. in parenthesis)

Panel A: African

Minutes per day	Female	Std.dev	Male	Std.dev
SNA work	154	(238)	255	(287)
Domestic work + care	300	(197)	101	(124)
Total work	454	(231)	356	(277)
% Unemployed	31.3		18.9	
Household income	1140	(1370)	1201	(1411)
Household size	4.4	(2.6)	3.7	(2.5)
Sample size	4029		3589	

Panel B: White

Minutes per day	Female	Std.dev	Male	Std.dev
SNA work	246	(262)	380	(298)
Domestic work + care	258	(209)	94	(141)
Total work	504	(232)	474	(270)
% Unemployed	10.2		4.0	
Household income	5293	(3716)	5940	(3923)
Household size	3.1	(1.4)	3.2	(1.4)
Sample size	520		467	

[52] In general, household income can be expected to increase, and female leisure hours to decline, as female hours of market work rise. Ilahi (1999b) reports that women in the bottom two deciles of per capita consumption work longer than those in higher deciles, and therefore have less leisure. However, the analysis does not control for household size. We would not expect to find a negative relationship between female hours of work and household income, and therefore a positive relationship between leisure and household income, other than at high male wage rates.

groups have very unequal household incomes. The mean household income of whites is in the order of four to five times larger than that of African households, and the differential on a per capita basis is even greater. Rates of unemployment among Africans are 31.3% for women and 18.9% for men. These compare with rates among whites of 10.2% for women and 3.2% for men. Not surprisingly, the latter work longer hours than the former. The difference is particularly large for men, and reflects the gap between their market hours of work.

These comparisons highlight the importance of taking account of time inputs and the productivity of domestic work in measuring living standards. If households on low incomes cannot use non-market time productively while those on high incomes can produce close substitutes for market output at reasonable implicit prices, aggregate household income or consumption measures that exclude domestic output will yield results that understate the degree of inequality across households. There may also be serious errors in the ranking of households towards the middle and upper end of the distribution if domestic output is omitted in the measure of living standards.

5.3 SSA TUS2000 and EMNV98 as inputs to policy analysis

In presenting a case for collecting information on time use, the World Bank (2000) argues:

"... failing to recognize gender divisions of time and task allocations within households can result in policies that don't achieve their objectives or that produce unintended outcomes. For example, policies that increase demand for female labor may not elicit the expected supply response if women cannot reduce their time on household maintenance or care activities. Or girls may be taken out of school to cover for mothers who enter the labor force (Grootaert and Patrinos 1999; Ilahi 1999b; Lokshin, Glinskaya, and Garcia 2000). Understanding how households allocate time and other resources by gender can thus provide the basis for more effective policies – and policies that generate fewer unintended and undesirable consequences." (p.153-4)

As already emphasized, estimation of these types of behavioral effects of policy changes requires a model formulated within the framework outlined. They cannot be inferred from a comparison of data means for individuals, as in the preceding tables, or derived

from the parameters of hoc regression models based on individual data for some but not all economically active members of each household. One reason for this, among others, is that behavioral effects will depend indirectly, through domestic prices and income shares, on the wage rates of other family members, and these will be missing.

Modeling household behavioral effects on the SSA TUS2000 presents major difficulties. If we attempt to select a sample for which there is information on all economically active members, we are limited to households comprising either a single non-dependent person or two non-dependent persons who were both interviewed. To illustrate some of the problems that arise, a sample of households comprising two non-dependent adults, both interviewed, is drawn from the file. The sample is limited to families selected on the criteria that the two respondents are parents, at least one parent has a child under 18 years present, and there are no other non-dependent persons present. The sample contains 667 household records.

The weighted sample means for female and male time allocation to SNA work activities, domestic work and care activities are reported in Table 4, Panel A. The first problem is that these means are no longer for a random sample of two-parent families with dependent children. This is because families with children aged from 10 to 17 years will be under represented - records in which they are the respondent(s) instead of the parents will be omitted. A consequence of this is that families with younger children will tend to be over represented, and so if more time is allocated to younger children there will be an upward bias in the means for domestic work and care. Had the overall size of the survey been reduced and the saving in cost used to finance interviewing of all non-dependent household members, the end result could well have been a larger (as well as a more representative) sample of families selected on the same criteria. These problems are not encountered in the EMNV98 file. For comparison, Table 4, Panel B, reports data means for a sample selected on matching criteria. The sample contains 554 household records, representing families with two parents present, at least one child under 18 years and with no other adults.

Table 4 Data means: male and female time allocations
(std. dev. in parenthesis)

Panel A SSA TUS2000 TUS

Minutes per day	Female	Std.dev	Male	Std.dev
SNA work	170	(241)	373	(293)
Domestic work	227	(161)	77	(137)
Care	112	(123)	12	(30)
Total work	549	(211)	462	(277)
No of records	667			

Panel B EMNV98

Minutes per day	Female	Std.dev	Male	Std.dev
SNA work	170	(254)	465	(236)
Domestic work	329	(194)	72	(108)
Care	99	(135)	19	(55)
Total work	599	(215)	556	(214)
No of records	544			

The data means for both samples again indicate that women work longer than men do and that there is a high degree of specialization in domestic work and care activities by females and in SNA work by males. The female and male means for total hours of work are higher than in Tables 1 and 2 because the samples comprise families in the most intensive child rearing phases of the life cycle. In this respect the results are consistent with those of time use studies for developed countries.[53] However the means for care activities for both samples are much lower than those obtained for developed countries. Time use data for developed countries typically indicate the allocation of far more time to child care, even when there is a substantial input of market or bought-in child care.

Because the data means are for parents from the same household, the gender differences in leisures in Table 4 can be seen as an outcome of the intra-household allocation of resources. They therefore illustrate the extent to which a model that assumes time outside SNA activity is leisure can give entirely misleading results on the intra-family sharing rule. Instead of working longer than men, women would be seen to working less

[53] Parents are found to work much longer in the child rearing phases in developed countries, and particularly mothers (see Apps and Rees, 2001). We attribute this, together with the strong gender division of labor over these phases, to high borrowing rates in an imperfect capital market and to government policies that preclude the development of an efficient, high quality child care sector.

that half the time that men work on the basis of the data means for SNA activity. If market consumption is assumed to be shared equally, they would be seen as recipients of a substantial transfer within the household while enjoying long hours of leisure. In reality, they may be the source of transfers to other family members due to their longer total hours of work.

To estimate a labor supply/domestic work model on these data, information on individual wage rates and non-labor incomes is required. Here, again, we run into problems with the SAA TUS2000. The survey failed to collect separate information on individual earnings and non-labor incomes. The income variables reported are the "usual total monthly income" of the household and of each respondent in the household. There is also a question on source of income in each case. However, the latter required only a "Yes/No" answer. Thus it is not possible to work out how much income is earned and how much is from non-labor sources. Experience suggests that the latter information is rarely of any use in modeling the effects of policy. It could argued that this deficiency can be overcome by instrumenting for the wage, since the survey was designed to contain questions found in other SSA surveys questionnaires to allow matching. However, cross section data typically yield very poor instruments for wage rates and also for non-labor incomes. There is a further problem with the SAA TUS2000 income data. Quite extraordinarily, the categories of income that were summed to obtain individual incomes included transfers from other family members. This makes the information on individual incomes essentially unusable, since the inclusion of transfers from other family members leads to "double counting" at the household level.

In contrast, the EMNV98 contains detailed data on labor incomes for each individual and it reports separately non-labor incomes at the level of the household. The file also contains detailed data on outside child care which, together with the information on domestic time use, allows the estimation of a combined labor supply and market/domestic child care demand model as outlined in Section 4.5. The results of such a model could, for example, be used to analyze issues raised in the World Bank (2000)

Report concerning the effects of labor market reforms on female labor supply and the time siblings spend on domestic work, market work and schooling.

The EMNV98, by including a time use survey as a module of an LSMS, has a further advantage over the stand alone SAA TUS2000. Time use data collected for one day (or even two) have a high "noise to signal ratio" and can include a high proportion of zero observations because the respondent did not undertake the activity on the designated day.[54] By running a survey as a module of an LSMS or Household Income/Expenditure survey, time use data for one or two days can be supplemented with information on several key variables that are reported in the latter surveys for a longer time period. For example, the Nicaraguan LSMS collected information on hours worked in the last week, month and year, and also for previous years of employment, for each respondent. These data, together with information on earnings over a corresponding period, allow hourly earnings to be computed as a "less noisy" measure of the gross wage for each respondent. This can be important for computing measures of household living standards that attempt to incorporate domestic output when there is strong heterogeneity in female labor supply and data on output are missing.

With noisy time use data and missing information on wages, the SAA TUS2000 does not permit the construction of a welfare ranking other than on household income based measures. In contrast, the EMNV98 provides a rich data source for deriving a range of measures that adjust for market consumption and the market/domestic time allocations of household members. In addition to detailed consumption data, the file contains a derived *annual consumption aggregate* that incorporates the value of food consumed within and outside the home, housing and the use of durable goods, consumer durables and services. The aggregate is adjusted by indexes that take account of sampling design and geographical price differences. *Per capita consumption* (pcc) is obtained by dividing the aggregate by household size, and is included in the file as a measure that can be used to make living standard comparisons.

[54] These issues, and alternative procedures for handling them, are examined by Klevmarken (2002).

The aggregate consumption variable in the EMNV98 is described by Sobrado (2001) as a measure of wellbeing with a "unique set of desirable characteristics". One advantage cited is that consumption information has proven to be more reliable than income data which are subject to error due to concerns about privacy and difficulties in measuring informal earnings. However, the problem is that neither of these variables takes account of heterogeneity in hours of market and domestic work that, as the following rankings by pcc indicate, is strongly evident in the data. Pcc may therefore fail to provide a reliable measure on which to base living standard comparisons, if domestic work is productive.

Table 5 presents a quintile ranking of individual records for which time use data are available. Column 1 lists the mean pcc in cordobas per annum (pa) in each quintile. Column 2 presents the data means for market hours of work pa for the full sample and

Table 5 Quintile ranking of individual records by pcc pa

Quintile	All Pcc C$ pa	All Market hrs	Female Market hrs	Child 6-14 Market hrs
	1	2	3	4
1	1465	637	275	250
2	2664	710	386	215
3	4100	758	433	210
4	6038	839	595	178
5	16306	976	770	135
Overall	6976	806	531	112

column 3, for female hours only.[55] The final column shows the average hours worked by children aged 6-14 years. From the quintile means in columns 2 and 3 it is clear that the rise in average hours with pcc is largely a result of an increase in female hours across the ranking. Children work longer on average in the lower quintiles but this does not offset the effect of longer hours by women in the upper quintiles. If these profiles of hours could be reliably interpreted to reflect choices in response to rising earning opportunities, with households in each quintile making similar choices, pcc could then be expected to be strongly correlated with living standards. The increase in female hours with pcc

[55] Hours of work per annum are calculated from the information available on hours worked in the last week, month and year, and hours work per day, in the LSMS.

would simply mean that higher levels of pcc (together with fewer hours of work by children) are "bought" with longer hours of work by adults.

However there is considerable heterogeneity in female labor supply, as well as in the labor supply of children, as indicated in Table 6. Columns 1 and 3 of the table list average market hours of work by employed males and females aged 18-59 years in each quintile. Columns 2 and 4 give the percentage that each represents of the total number of males and females, respectively, in the same age group. Columns 5 and 6 report average domestic hours of work for women who are employed and those who are not. Columns 7 and 8 show, respectively, average hours worked by employed children who are aged 6-14 years, and the percentage they represent of all children in that age group.

Table 6 Quintile ranking by pcc: adults 18-59 and children 6-14

	Males 18-59		Females 18-59				Children 6-14	
	Employed		Employed			Not emp	Employed	
Quintile	Market	%	Market	%	Dom	Dom	Market	%
	1	2	3	4	5	6	7	8
1	1800	91.6	1634	31.2	1289	2481	1119	13.1
2	1923	88.2	1806	33.3	1213	2465	1013	13.8
3	2062	88.0	1802	40.5	1244	2144	1222	11.6
4	2011	81.9	2051	45.3	1225	2209	809	12.0
5	2040	82.0	2170	54.5	1079	1989	918	5.9
All	2031	86.0	1980	41.9	1180	2226	1043	11.7

From columns 1 and 2 it can be seen that most males of working age are employed and, on average, they work close to full time.[56] In contrast, only 41.9% of females are employed. The percentage rises from 31.2% in quintile 1 to 54.5% in quintile 5. The data means in columns 5 and 6 indicate that women who do not work in the market tend to spend twice as many hours in domestic work as those that do. Thus, in each quintile, achieving a given pcc can be the result of full time work by all household members, including the children. In others, only adult males may need to work to achieve the same pcc, while the women allocate more time to domestic production.

Unless domestic work is unproductive, these results suggest that the potential for ranking errors using pcc as a measure of living standards is significant. Part of the problem is the overall distribution of pcc. In common with the ranking by full time earnings discussed in Section 4.3, individual records are concentrated towards the median and the distribution is strongly positively skewed. As a result, a small change in pcc can lead to a large change in ranking over some ranges of pcc. For example, a two-parent low wage family in which the mother switches from domestic to market work could move up two quintiles in the ranking in Table 5, yet experience only a minimal improvement in the family's standard of living. The family may, for example, appear in quintile 2 with a mean pcc of C$2664 pa with just one parent working full time. If their pcc doubles because the second parent or a child, or possibly both, go out to work, the family may then appear in quintile 4 (the lower limit of quintile 4 is only C$4869). Equally problematic is the case cited in the World Bank (2000) Report, where children are taken out of school to cover for mothers in the labor force.

A policy implication of these results is that low wage households working long hours may be treated unfairly by programs targeted on pcc. Moreover, if market and domestic work become closer substitutes as pcc increases, the disincentive effects of such programs on female labor supply will tend to reinforce traditional gender roles.

6. Conclusions

This paper has surveyed the main approaches to modeling the household to be found in the literature on developed and developing countries. Beginning with the standard model of the one-person household dividing its time between work and leisure, supplemented, in the developing economy literature, with a farm production activity, I considered two major generalizations of this model. The first was to the multi-person household, the second was by the inclusion of household production. It was argued that for theoretical and empirical analysis of issues concerning the intra-household allocation of resources and distribution of real income, the across-household welfare distribution, and the

[56] Defined as 40 hours per week, 50 weeks per year.

impacts of policy changes on these, *via* their effects on household decisions, both steps are essential. In particular, the logical inconsistency of the approach that defines non-working time as pure leisure, and then estimates household labor supplies and consumption demands on datasets that give only hours worked and income and expenditure data, was emphasized. This critique holds true regardless of whether a "unitary" or "collective" approach is taken to modeling the multi-person household. From this it follows that time use data are indispensable in allowing estimation of empirical models that correspond to the theoretically appropriate modeling approach.

However, time use datasets often fail to provide the data required for economic analysis, probably because of the lack of interest economists have until now shown in them. The paper has accordingly discussed at some length two time use surveys carried out in developing countries, to illustrate some of the main limitations of the available datasets and to show how the problems could have been avoided without, on the whole, significant increases in cost. In particular, the paper demonstrates the deficiencies of consumption based measures of living standards when there is a high degree of heterogeneity in the allocation of time to market and domestic work across households. The aim of this discussion is both to emphasize the importance of time use data for policy analysis and to point the way to better data collection in the future.

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