I Z A Institute
of Labor Economics
Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 11707

Intra-Household Wealth and Welfare Inequality in the US: Estimations from a Collective Model of Labor Supply

Jose Alberto Molina
Jose I. Gimenez-Nadal
Jorge Velilla

JULY 2018

I Z A Institute
of Labor Economics

Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 11707

Intra-Household Wealth and Welfare Inequality in the US: Estimations from a Collective Model of Labor Supply

Jose Alberto Molina
University of Zaragoza, BIFI and IZA

Jose I. Gimenez-Nadal
University of Zaragoza and BIFI

Jorge Velilla
University of Zaragoza

JULY 2018

IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

Intra-Household Wealth and Welfare Inequality in the US: Estimations from a Collective Model of Labor Supply*

This paper analyzes the intra-household distribution of wealth and welfare in the United States, within a theoretical framework based on a collective model of labor supply, where household decisions are Pareto efficient, and spouses negotiate a sharing rule for non-labor income. Using the American Time Use Survey for the years 2003 to 2015, estimates show a positive correlation between individual wages and labor supply, while cross-wages go in the opposite direction. Additionally, we find that wives tend to be more altruistic in comparison to their husbands regarding the intra-household allocation of income, which leads to wealth inequalities. However, the intra-household processes appear to be efficient in terms of welfare, as increases in any source of household income are associated with decreases in intra-household inequality, as measured by the spouses' estimated indirect utility. Our results shed light on the spouses' wealth shares and the sharing rule guiding the individual allocations, which may be important in the design of policies aimed at alleviating poverty.

JEL Classification: D15, J22

Keywords: collective model, labor supply, sharing rule, intra-household inequality, welfare, American Time Use Survey

Corresponding author:
José Alberto Molina
Department of Economic Analysis
Faculty of Economics
University of Zaragoza
C/ Gran Via 2
50005 Zaragoza
Spain

E-mail: jamolina@unizar.es

* This paper was partially written while Jose Alberto Molina was Visiting Fellow at the Department of Economics of Boston College (US), to which he would like to express his thanks for the hospitality and facilities provided. It has benefited from funding from the Government of Aragón ("Program FSE 2014-2020") and from the Regional Government of Aragon and the European Fund of Regional Development (Grant S32_17R).

1. Introduction

This paper analyzes inequality in the intra-household distribution of wealth in the United States, in a framework where the labor-supply decisions of household members are assumed to be Pareto efficient, following the collective model of labor supply with distribution factors (Chiappori et al., 2002). The analysis of inequalities in the United States is important because, compared to Europe, the United States has shown very high levels of inequality since the 1970s, in terms of both income and private wealth (Piketty and Saez, 2014). However, studies of inequality often ignore an important source that emerges from the intra-household allocation of resources, which can lead to an incomplete view of the situation (Chiappori and Meghir, 2015; Radchenko, 2015).[1] Inequality may increase if resources within the household are allocated in a way that endowment differences are reinforced, while inequality may decrease if resources are allocated in a way that endowment differences are compensated. Thus, an analysis of the spouse's wealth share and the sharing rule guiding individual allocations, is relevant for the design of policies aimed at alleviating poverty.

Prior to the 1980s, 'the family' had primarily been studied by following a "unitary" approach, where households were seen as units with a single utility function. However, this approach gave rise to certain difficulties, including the lack of theoretical foundations and non-convincing empirical results. In the early 1980s, motivated by the work of Gary Becker (Becker, 1973;1974;1981), several approaches were developed to analyze the intra-household decision process, which treated the process as a cooperative game (Manser and Brown 1980; McElroy and Horney 1981), a non-cooperative game (Lundberg and Pollak 1994; Bergstrom 1997), independent individual models (Grossbard-Shechtman 1984), and household social welfare programs (Chiappori 1988, 1992). Among the different approaches, a number of empirical applications rely on Chiappori's collective mode, first proposed by Chiappori (1988, 1992) and Bourguignon et al. (1993). Browning and Chiappori (1998) then introduced the concept of "distribution factor", and Chiappori et al. (2002) developed the general collective model of labor supply, including distribution factors. Since then, the collective model has become one of the main frameworks used in the study of family behaviors, and several authors have demonstrated the validity of this approach, against the traditional unitary

[1] Most of the studies of inequality omit inequalities resulting from intra-household processes, and that type of inequality would only be negligible in an economy with identical individuals, identical couples, no divorces, perfectly divisible private goods, without externalities, and without economies of scale. Hence, "any attempt at measuring inequality (or its evolution over time) that ignores allocation of resources within the family is unreliable at best (Chiappori and Meghir, 2015)".

approach (see the surveys by Donni and Chiappori (2011) and Chiappori and Mazzocco (2018)).

The collective model addressed several of the problems of the unitary approach, derived from the fact that the family is considered as a 'black box' and household formation and/or dissolution is not considered. In this context, the unitary approach imposes a series of restrictions on observed behavior, which include that it does not allow for the establishment of the intra-household distribution of consumption, nor of productive resources, and consequently, of intra-household well-being. But the latter consideration allows researchers to use the collective model to study wealth, welfare, and inequality within families. Thus, the collective model of household behaviors seems to be the ideal tool to examine how households allocate their resources, their income, and their welfare (Chiappori and Mazzocco, 2018).

Against this background, the objective of our paper is to study the intra-household inequality in wealth and welfare in the United States. Using the American Time Use Survey for the years 2003 to 2015 for our empirical analysis, and using the theoretical framework proposed in Chiappori et al. (2002) as our framework of reference, we estimate their collective model to derive a sharing rule of non-labor income. This allows us to analyze the bargaining power of household members, and whether they attain an equitable division of household resources. The sharing rule allows us to estimate individual labor supply in terms of own wages and shares of non-labor income. From these estimates, we can define, according to the theoretical model, a system of indirect utility functions for men and women. More importantly for our purpose, we use these indirect utilities to examine the relationship between intra-household welfare inequality and resource allocation.

Our results indicate that efficient labor supply is determined by the own wage, but also by the spouse, through the cross-wage term. Estimates reject the unitary approach to the study of the family, as individual non-labor income is found to have a significant effect on labor supply. Additionally, we find that husbands tend to be egoistic in the allocation of resources within the family, but wives tend to be altruistic. This difference leads to wealth inequalities within households. Finally, estimates show that men and women have different preferences, which again enforces the collective approach against unitary models, as wives' utility depends on wages and non-labor income, while that of husbands depends mainly on wages. Intra-household inequality, measured through indirect utility, tends to decrease through increases in spouse's wages and non-labor income.

The contributions of the paper are twofold. First, we study intra-household welfare inequality within households, using indirect utilities derived from the collective model, in terms of individual wages and non-labor income. To the best of our knowledge, this is the first empirical work to analyze the indirect utility of household members within a collective framework. We find that intra-household processes are efficient at allocating welfare, as increases in spouses' wages and shares of non-labor income are negatively correlated with intra-household inequality. Second, we perform an empirical test on household collective models of labor supply, with recent data for the United States. We use time use data for the US that has not been previously used for these purposes. Our results indicate that household behaviors in the US have changed since the 1980s (Chiappori et al., 2002), and husbands are now more egoistic, while wives are now more altruistic, in comparison to each other.

The rest of the paper is organized as follows. Section 2 reviews the collective model of labor supply with distribution factors. Section 3 describes the data. Section 4 shows the empirical strategy and results, and Section 5 summarizes our conclusions.

2. Theoretical framework

In this section, we provide a brief summary of the general collective model of labor supply with distribution factors (Chiappori et al., 2002). We assume that households consist of two spouses, i = 1, 2, with distinct preferences and individual utility functions, $U^i = U^i(1 - h^i, C^i, \mathbf{z})$, where h represents market work time (and $1 - h$ represents leisure), C represents the consumption of a Hicksian good with unitary price, and $\mathbf{z}$ represents a vector of K preference factors.[2] It is important to note that these utility functions are egoistic, a particular type of "caring" preference (Becker, 1981). We assume that utility functions are strictly quasi-concave, increasing, and continuously differentiable.

The collective framework assumes that the decision process leads always to Pareto-efficient outcomes, given that spouses know each others' preferences.[3] Then, there exists a Pareto weight, $\mu = \mu(w_1, w_2, y, \mathbf{z}, s) \in [0, 1]$, such that the household solves Problem (P_1):

[2] The general collective model has evolved in recent decades to include, for example, public commodities (Blundell et al., 2005; Chiappori and Weiss, 2007), participation in employment (Blundell et al., 2007), domestic production (Browning et al., 2013), and time dimensions (Chiappori and Mazzocco, 2018). See Chiappori and Meghir (2015) for a review of the different collective models and their implications in terms of intra-household inequality.

[3] Assuming Pareto efficiency grants that, given the outcome chosen by household members, there are no alternatives preferred by both spouses. This assumption is restrictive, especially in a dynamic framework, but it

$$\max_{\{h^1,h^2,C^1,C^2\}} \mu U^1 + (1-\mu)U^2$$

(P$_1$)

subject to: $w_1 h^1 + w_2 h^2 + y \geq C^1 + C^2$,

$$0 \leq h^i \leq 1, \ i = 1, 2.$$

where *w* represents the individual wage rate, *y* represents household non-labor income, and *s* is a (vector) distribution factor(s), with these distribution factors affecting intra-household decisions but not individual preferences or consumption.

With the hypotheses proposed for the utility functions U^i, and assuming Pareto efficiency, the problem (P$_1$) is equivalent, on the basis of the Second Fundamental Welfare Theorem, to a decentralized two-stage process where, first, household members negotiate the allocation of non-labor income, according to a "sharing rule", $\phi = \phi(w_1, w_2, y, \mathbf{z}, s) \in [0, y]$, such that agent 1 receives $\phi_1 = \phi$, and agent 2 receives $\phi_2 = y - \phi$. Then, each household member *i* solves, individually, Problem (P$_2$):

$$\max_{\{h^i,C^i\}} U^i(1 - h^i, C^i, \mathbf{z}),$$

(P$_2$)

subject to: $w_i h^i + \phi_i \geq C^i$,

$$0 \leq h^i \leq 1.$$

The solution of the household problem takes the form of a pair of Marshallian labor supply functions: $h^i = H^i(w_i, \phi_i(w_1, w_2, y, \mathbf{z}, s), \mathbf{z})$, for i = 1, 2, where a set of testable restrictions can be derived to find a system of partial derivatives that allow recovery of a functional form of the sharing rule, ϕ, up to an integration constant.

Let us assume without loss of generality that, within each household, individual i = 1 refers to the wife, and individual i = 2 refers to the husband. When we specify the usual semi-log parametric form of individual labor supply equations:

$$h^1 = f_0 + f_1 \log w_1 + f_2 \log w_2 + f_3 y + f_4 \log w_1 \log w_2 + f_5 s + \mathbf{f}_6 \mathbf{z}, \qquad (1)$$

---

is also standard in many economic contexts, and the literature of game theory studying the household has found that efficiency should prevail (at least asymptotically) (Chiappori and Mazzocco, 2018). In static collective models, the Pareto efficiency hypothesis refers to the ability of spouses to be aware of the preferences of each other (even when individual preferences are egoistic), and act cooperatively to take advantage of marriage. In dynamic collective models, the efficiency hypothesis is more restrictive, and several settings have emerged, such as the full intertemporal commitment (FIC) models, and the limited intertemporal commitment (LIC) models (e.g., Mazzocco, 2007).

$$h^2 = m_0 + m_1 \log w_1 + m_2 \log w_2 + m_3 y + m_4 \log w_1 \log w_2 + m_5 s + \mathbf{m}_6 \mathbf{z},$$

then, if $\frac{m_3}{f_3} \neq \frac{m_5}{f_5}$, it is possible to find a set of partial derivatives of the sharing rule that allows them to integrate the following expression of the sharing rule, which is valid if and only if $\frac{m_4}{f_4} = \frac{m_5}{f_5}$, and up to an integrating constant $\kappa(\mathbf{z})$:

$$\phi = \frac{1}{f_3 m_5 - f_5 m_3}(m_1 f_4 \log w_1 + f_2 m_4 \log w_2 + f_3 m_4 y + f_4 m_4 \log w_1 \log w_2 + m_4 f_5 s) + \kappa(\mathbf{z}). \quad (2)$$

Note that the sharing rule is well-defined, by hypothesis, as $\frac{m_3}{f_3} \neq \frac{m_5}{f_5}$. This condition is likely to be satisfied, as non-labor income is expected to operate similarly for wives and husbands, and the opposite happens with distribution factors. Given this form of the sharing rule, it is also possible to recover a functional form for individual labor supply functions:

$$h^1 = \alpha_1 \log w_1 + \alpha_2 \phi + \alpha_3(\mathbf{z}), \quad (3)$$

$$h^2 = \beta_1 \log w_2 + \beta_2 (y - \phi) + \beta_3(\mathbf{z}),$$

where $\alpha_1 = \frac{f_1 m_4 - f_4 m_1}{m_4}$, $\alpha_2 = \frac{f_3 m_4 - f_4 m_3}{m_4}$, $\beta_1 = \frac{f_4 m_2 - f_2 m_4}{f_4}$, $\beta_2 = \frac{f_4 m_3 - f_3 m_4}{f_4}$, $\frac{\alpha_1}{w_1} - \alpha_2 h^1 \geq 0$, and $\frac{\beta_1}{w_2} - \beta_2 h^2 \geq 0$.

Finally, as we are departing from a semi-log parametrization of labor supply equations, the indirect utility functions of household members can be derived (see Stern (1986) for a detailed development), up to the constants $\alpha_3(\mathbf{z})$ and $\beta_3(\mathbf{z})$:[4]

$$V^1(w_1, \phi, \mathbf{z}) = \frac{e^{\alpha_2 w_1}}{\alpha_2}(\alpha_2 \phi + \alpha_3(\mathbf{z}) + \alpha_1 \log w_1) - \frac{\alpha_1}{\alpha_2} \mathrm{E_i}(\alpha_2 w_1), \quad (4)$$

$$V^2(w_2, y - \phi, \mathbf{z}) = \frac{e^{\beta_2 w_2}}{\beta_2}(\beta_2 (y - \phi) + \beta_3(\mathbf{z}) + \beta_1 \log w_2) - \frac{\beta_1}{\beta_2} \mathrm{E_i}(\beta_2 w_2).$$

These functions can be used to develop intra-household welfare analyses, in terms of the exogenous variables. Note that the expression "$\mathrm{E_i}(.)$" represents the standard exponential integral, $\mathrm{E_i}(x) = \int_{-\infty}^{x} \frac{e^t}{t} dt$, which has no analytical expression in general terms.

---

[4] From an individual (semi-log) general labor supply function, $h = \alpha \log w + \beta \phi + \gamma$, the associated expenditure (or, in this case, non-labor income) function can be defined as $m = \phi = e^{-\beta w}\left(v + \frac{\alpha}{\beta} E_i(\beta w)\right) - \frac{\gamma}{\beta} - \frac{\alpha}{\beta} \log w$, by integrating the expression $\frac{\partial \phi}{\partial w} + \beta \phi 0 - \alpha \log w - \gamma$, and using the factor $e^{\beta \phi}$. Slutsky conditions would then be rejected if $\alpha < 0$ and $\beta > 0$ (Stern, 1986). By inversion, it is straightforward to derive the indirect utility function, which is the form of system (4) using the notation of the collective model.

3. Data

We use the American Time Use Survey (ATUS) from the years 2003 to 2015 to develop our empirical analysis. The ATUS is part of the Integrated Public Use Microdata Series (IPUMS) project, it is considered the official time use survey of the US, and is administered by the US Bureau of Labor Statistics (http://www.bls.gov/tus/). The ATUS provides cross-sectional information on individual time use, and information on household characteristics such as socio-demographics, geographic and economic aspects, household composition, and spouse's characteristics, among others (Hofferth et al., 2017). Thus, the ATUS provides us with sufficient information to develop an empirical test of the collective model presented in the previous section.

We restrict the sample to heterosexual (married or cohabiting) couples in which both spouses report positive labor supply and hourly wages. As the ATUS does not collect information about income for the self-employed, they are omitted from the sample.[5] Further, we only retain households where both spouses (or partners) are of working age, i.e., between 16 and 65 years old (inclusive). Finally, we eliminate those households that can be considered outliers in terms of spouses' wages, labor supply, and household non-labor income, using the *blocked adaptive computationally efficient outlier nominators algorithm* (Billor et al., 2000).[6] These restrictions leave us with information for 30,724 households (30,724 husbands and 30,724 wives).[7]

The ATUS contains information on individual time use, based on diaries where respondents report their activities throughout a day, which allows us to define the time spent in market work activities, although this diary-based information is only available for one individual in each household (i.e., the "respondent"), and so we cannot compute the labor supply of respondents' spouses from diaries. The ATUS contains additional information about the hours usually worked per week, for the respondent and his/her spouse. We then define the labor supply of household members as the hours per week that they usually spend working. Panel A of Table 1 shows summary statistics of individual-level variables, and we

[5] As self-employed workers have been reported to show different behaviors with respect to the labor market than employees, this should not be considered a limitation of the analysis. However, sampling restrictions may lead to selection bias. We follow Chiappori et al. (2002) and omit this bias.

[6] Table A2 in the Appendix shows the main estimates, not excluding the outliers from the sample. Results are qualitatively robust to the main analysis.

[7] Because of restrictions on the theoretical specification, same-gender marriages are not considered in the sample.

can observe that women in the sample spend, on average, 37.4 hours per week working (around 7 hours 30 min per day), vs 44.2 hours per week worked by men (8 hours 50 min per day). These differences are statistically significant at standard levels.

Concerning income, the ATUS contains information about the nominal hourly and weekly earnings of household spouses. For the sake of comparison with the labor supply, we define the wages of husbands and wives as the weekly reported earnings, respectively, deflated using the deflator of the Federal Reserve Bank of St. Louis. Additionally, the ATUS includes information about the household family income, which includes "money from jobs; net income from business, farm or rent; pensions; dividends; Social Security Payments; and any other monetary income received by family members", measured in dollars per year.[8] We define the household non-labor income as family income, minus the income that comes from household members' wages, divided by 1,000. It is important to note that the definition of family income of the ATUS does not directly consider savings (consistent with life-cycle models (Blundell and Walker, 1986 and Chiappori et al., 2002). Table 1 shows an average labor income per week of wives (husbands) of $752.80/week ($1,064/week). Differences between men and women are significant at standard levels. Panel B in Table 1 shows summary statistics of the variables defined at the household level, and we can observe an average household non-labor income of $6,178/year, with an associated coefficient of variation of 2.22, indicating a high variability between interviewed households.

The ATUS also contains information about the age of the spouses (in years), their race, their Hispanic origin, and the maximum level of formal education achieved. We define three levels of education: primary, secondary, and University. Additionally, the ATUS also allows us to compute the number of children present in each household. As the age of children is important in terms of the time-allocations of workers (see Miller and Mulvey, 2000; Silver, 2000), we also identify whether households have any children under age 13, or between 13 and 17 years old. Summary statistics of these variables are shown in Table 1.

Following Chiappori et al. (2002) and Molina, Gimenez-Nadal and Velilla (2018), we take the gender ratio as a distribution factor, since variations in the number of males to females may determine the bargaining power of spouses within households, and then

[8] Family income is reported by the ATUS in brackets, and we then redefine it as the mean value of each bracket. Brackets defined by the ATUS are the following: <$5,000, $5,000-$7,499, $7,500-$9,999, $10,000-$12,499, $12,500-$14,999, $15,000-$19,999, $20,000-$24,999, $25,000-$29,999, $30,000-$34,999, $35,000-$39,999, $40,000-$49,999, $50,000-$59,999$, $60,000-$74,999, $75,000-$99,999, $100,000-$149,999, and >$149,999.

marriage market conditions can lead to large differences in intra-household allocations.[9] We define the gender ratio as the number of males to the total population, using data from the United States Current Population Survey (CPS) of the IPUMS.[10] As marriages are in general limited to race and territory, we compute the gender ratios by State, and separately for white and non-white individuals. Furthermore, we define this ratio by 5-year age groups, where men and women are compared in age groups with a difference of two years (as, on average, women are two years younger than men; Grossbard and Amuedo-Dorantes, 2007).

4. Empirical analysis

Expected wages and non-labor income

The first empirical analysis consists of estimating the system of labor supply equations that characterize the collective model of household supply (Equation (1)) and, from those estimates, deriving the sharing rule (Equation (2)). We then estimate the individual labor supply equations (Equation (3)), and define the individual indirect utility functions (Equation (4)). However, estimates of the collective model incorporate wages as explanatory variables for labor supply, and this relationship is endogenous, possibly leading to spurious correlations that may bias the estimates. To deal with this issue, we follow Blundell et al. (2007) and estimate "expected" (or predicted) wages, following a standard human capital approach, where wages are defined in terms of a second-order polynomial on age and education, not dependent on the characteristics of the partner:

$$w_i = \gamma_{0i} + \boldsymbol{\gamma}_{1i} P(\text{age}_i, \text{education}_i) + \gamma_{2i}\text{race}_\text{i} + \varepsilon_i, \tag{5}$$

for $i = 1, 2$. In the rest of the empirical analysis, expected wages, $\widehat{w_i}$, for $i = 1, 2$, will be used. A similar approach is used for non-labor income, which is also treated as endogenous and so we use predicted values, $\hat{y}$, in terms of a second-order polynomial on age and education of both spouses:

$$y = \xi_0 + \boldsymbol{\xi}_1 P(\text{age}_1, \text{age}_2, \text{education}_1, \text{education}_2) + \boldsymbol{\xi}_2 \text{race}_{1,2} + \varepsilon. \tag{6}$$

[9] Nonetheless, intra-household allocations are sensitive to certain other external factors (Chiappori and Meghir, 2015), and the gender ratio has been criticized, because it has been found to have some effects on the labor market (Grossbard and Amuedo-Dorantes, 2007). Some authors have included cash transfer programs (Attanasio and Lechene, 2014; Lyssiotou, 2017) and inheritances (Blau and Goodstein, 2016) as distribution factors. The availability of suitable data on this topic is limited, and further research is needed.

[10] ATUS respondents are part of the sample of the CPS, although CPS data comprise a larger sample than the ATUS. Thus, by using the CPS rather than the ATUS, we may find a more accurate measurement of the gender ratio.

Equation (5) is estimated simultaneously for wives (i = 1) and husbands (i = 2), using Seemingly Unrelated Regression Equations (SURE), while Equation (6) is estimated using Ordinary Least Squares (OLS). Estimates are shown in Table A1 in the Appendix, and include metropolitan and year fixed effects. For simplicity, we will denote predicted wages and non-labor income as w_i and y throughout the rest of the analysis.

The collective model of labor supply

Once expected wages and non-labor income have been predicted, we estimate the system in Equation (1). These equations are estimated simultaneously for wives and husbands, using a SURE specification, and results are shown in Table 2. First, we estimate the "unrestricted" model, where no restrictions are imposed on the coefficients (Columns (1) and (2) of Table 2). Once the parameters have been estimated, we check that the hypothesis required to derive the sharing rule, $\frac{m_3}{f_3} \neq \frac{m_5}{f_5}$, is satisfied at standard levels, using a Wald test (p-value < 0.01). Further, the necessary and sufficient condition imposed on coefficients, $\frac{m_4}{f_4} = \frac{m_5}{f_5}$, is also satisfied at standard levels (p-value > 0.10). This indicates that the hypothesis of collective rationality is fulfilled by households in the United States. Following Chiappori et al. (2002), we also estimate a "restricted" version of the model, where the necessary and sufficient condition is imposed on the model. Results are shown in Columns (3) and (4) of Table 2, and we can observe that the coefficients are qualitatively invariant to the unrestricted model. The hypothesis required to derive the sharing rule is again satisfied at standard levels (p-value < 0.01).

Estimates indicate that own wages are positively correlated to own labor supply, for both wives and husbands. For instance, a 1% increase in wives (husbands) wage is associated with an increase of around $\frac{4.16}{100}$ ($\frac{2.68}{100}$) hours of work per week. The coefficient associated with the wage of husbands is not significantly linked to the labor supply of wives, and the same happens with respect to the wage of wives and the labor supply of husbands. Nevertheless, husbands' labor supply has some effect on wives' hours of work, through the cross-wage term, which is negative and significant. The cross-term is not significant in the husbands' equation, indicating more selfish behavior in comparison to wives. In any case, estimates indicate a negative correlation between non-labor income and spouses' labor supply. A 1%

increase in non-labor income is associated with decreases of wives' (husbands') labor supply of around 0.18 (0.39) hours per week.

The effect of gender ratios is qualitatively robust to the restrictions in the restricted model. For instance, increases in the ratio of males to the total population are correlated with decreases of wives' labor supply, indicating that in regions where there are more men, women may have difficulty finding full-time or specialized jobs, and then have fewer labor opportunities, since the gender ratio can be considered an indicator of potential labor supply and is related to female labor attributes (Kanter, 1977; Dreher, 2003). In the case of husbands, the gender ratio is non-significant.

For the rest of the explanatory variables, results show a negative and statistically significant correlation between wives' age and their labor supply, although this relationship is not statistically significant in the case of husbands. Education plays a non-statistically significant role in wives' labor supply, but husbands who have completed secondary and university education work around 1.0 and 1.3 more hours per week, respectively, in comparison to their counterparts with only primary education. The number of children is negatively correlated with wives' labor supply, but positively with that of husbands. This may indicate that women continue to carry out most of the domestic work in the US, having different time allocations than men (Aguiar and Hurst, 2007; Gimenez-Nadal and Sevilla, 2012). Most of that negative correlation can be attributed to children under 13 years old, since the fact of having a child between the ages of 13 and 17 is positively correlated with wives' (and husbands') labor supply.

The sharing rule of non-labor income

We define the sharing rule from Equation (2), and we use the estimated coefficients of the restricted model in Columns (3) and (4) of Table 2 to estimate the sharing rule. As the hypothesis to define the sharing rule is satisfied, and the necessary and sufficient conditions are imposed on these estimates, we can assume that the sharing rule is correctly defined. Column (1) in Table 3 shows estimates on the sharing rule. We find that, on average, wives lose in the negotiation process, as they transfer wealth to their husbands. For instance, wives lose, on average, $7,916 per year, against $14,094 per year received by husbands throughout the intra-household negotiation, indicating that, in the United States, the bargaining power of men within couples is significantly higher than that of women. When we consider wages, we

find that the total amount earned by the average wife is $31,348 per year. Against that, the total amount earned and received by the average husband is $69,422 per year. These estimates show a large intra-household wealth inequality among United States households, and shed light on the importance of considering intra-household inequality when studying inequality in general terms, to avoid an important source of bias (Chiappori and Mazzocco, 2018).

Column (2) in Table 3 shows estimates of the partial derivatives, which, in the corresponding cases, are computed with respect to wages, not the log of wages. Thus, Column (2) shows the marginal change in the share of non-labor income allocated to wives, after the first-stage negotiation process, to changes in the exogenous variables. Results indicate that a $1.00 increase in a wife's weekly wage is associated with a transfer of $2.00 per year to her husband. This indicates an altruistic behavior of wives in the United States, as they are willing to share their earned income with their husbands. A $1.00 increase in a husband's weekly wage is associated with a transfer of $1.00 per year to him, indicating an egoistic and selfish behavior of husbands.

One important fact regarding couples in the United States is that the distribution of (labor) income within households has been found to be sharply unequal. This is especially the case among couples where wives have a high level of human capital, which cannot be explained from standard economic models of marriage (Bertrand et al., 2015). Nonetheless, our empirical estimates show that collective models are a valid theoretical frameworkwithin which to study intra-household income inequality. In particular, they allow us to study not only the distribution of labor income, but also the effect of the distribution of non-labor income. Thus, collective models allow us to study whether intra-household negotiation processes lead to an increase or decrease of wealth inequality within households.

We compare the distribution of the share of labor income earned by the wives, relative to that of husbands ($\frac{w_w}{w_w+w_h}$), and the corresponding distribution of labor and non-labor income, conditional on the sharing rule (re-scaling non-labor income into dollars per week: $\frac{w_w+\varphi/52}{w_w+w_h+y/52}$). In Figure 1, we represent the kernel density estimates of the share of labor, and labor plus non-labor income, of wives in the sample. The vertical line, that divides the graph in two panels, indicates the point of complete intra-household equity. The left panel then represents inequality in favor of husbands (husbands earn more than their wives), and the right panel represents inequality uin favor of wives (wives earn more than their husbands). The probability mass of labor income is concentrated in the left-panel of the figure, indicating

that most of the wives analyzed earn less than do their husbands, consistent with the summary statistics of our sample. Furthermore, the sharing rule of non-labor income has a significant and negative effect on intra-household equity. This indicates that intra-household processes do not lead to an equitable division of non-labor income, as they lead to more inequality, in terms of income. As husbands behave egoistically, and wives altruistically, this result goes in the same direction as identity roles, especially among households with high wives' income. Hence, collective models of household behavior would (at least partially) explain the identity roles described by Bertrand et al. (2015).

Individual labor supply

Once the negotiation process (the first stage of the decentralized problem) takes place, and spouses allocate non-labor income, the second stage of the decentralized problem assumes that individuals maximize their utility individually, and then the solution of that problem is a pair of *individual* labor supply equations, where spousal characteristics are interiorized within the sharing rule. Thus, we can estimate the system in Equation (3), conditional on the sharing rule. We estimate this system of equations simultaneously for wives and husbands, using a SURE model.

Results are shown in Table 4. Column (1) is restricted to wives, and Column (2) is restricted to husbands. We observe that estimates of the correlation between labor supply and wages are robust to estimates of the collective model in Table 2. For instance, a 1% increase in wives' wage is associated with an increase in her labor supply of around $\frac{0.80}{100}$ hours per week. In the case of husbands, the direction of the correlation is equivalent, but the quantitative effect is more than double, with an associated increase of around $\frac{1.97}{100}$ hours per week.[11] It is worth noting that household non-labor income is negatively correlated with labor supply, especially for husbands (Table 2). Table 4 shows that *individual* non-labor income is only negative and significantly correlated with wives' hours of work, while in the case of husbands it is non-significant. This rejects one of the restrictions of the traditional unitary models of household behavior (the so-called "income pooling" property) as, according to the unitary approach, individual non-labor income should not affect household behaviors. Our estimates provide evidence in favor of the collective model in the case of the United States,

[11] It is important to note that part of the correlation between wages and labor supply is collected through the sharing rule, and then the decrease in the estimated coefficients is not necessarily due to statistical bias.

and reject the validity of the unitary approach (in line with a large number of prior studies that have rejected the income-pooling property).

Indirect utility and intra-household welfare inequality

From the coefficients estimated in Table 4, we can define the system of indirect utilities of wives and husbands proposed in Equation (4). First, it is important to note that the last term on the right-hand side of the equalities is negligible in the case of wives, and almost negligible for husbands, as:

$$\mathrm{E_i}(\alpha_2 w_1) = \int_{-\infty}^{\alpha_2 w_1} \frac{e^t}{t} dt = 0 \qquad (7)$$

$$\mathrm{E_i}(\beta_2 w_2) = \int_{-\infty}^{\beta_2 w_2} \frac{e^t}{t} dt = 0.0002.$$

Using the expressions of Equation (4), plus Equation (7), we can define the indirect utilities of wives (V_1) and husbands (V_2) in the sample. To avoid the effects of scales, we use z-scores of indirect utilities, and then standardize them. These indirect utilities will be used as proxies for the well-being of spouses.

Columns (1) and (2) in Table 5 show estimates of the indirect utility of wives and husbands, respectively. Estimates show that wages are positively related to the indirect utilities of husbands and wives, as expected. Furthermore, wives' share of non-labor income is positively correlated with their indirect utility, but individual non-labor income is not significantly correlated with husbands' indirect utility. This indicates that wives' altruistic behavior (in terms of non-labor income) does not increase their indirect utility, and that they are willing to assume some losses in favor of the marriage. In the case of men, estimates indicate that their indirect utility is invariant to their individual non-labor income. Hence, we cannot attribute husbands' egoistic behavior to their utility. Here, other factors, such as social norms or identity roles, may be of importance (Akelof and Kranton, 2000; Bertrand et al., 2015). Identity roles may determine individual behaviors, even when they are not optimal. That is to say, individuals may assume costs in terms of utility in order to follow the prescribed social norm, due to the sense of belonging to a concrete social category. In such a way, we could attribute intra-household behaviors to gender roles, and not to utilities. Women would behave altruistically, and allow husbands to behave in an egoistic way, because social norms prescribe that, traditionally, husbands have the responsibility of generating income. Then, women would be able to work fewer hours, and transfer income to their husbands, in

order to respect those norms, even assuming high opportunity costs and then decreases in individual utility (but not in household utility). Analogously, the identity role for husbands goes in the opposite direction, reinforcing opposite behaviors of wives and husbands with respect to intra-household distribution of income. Hence, gender identity roles would represent the transfer of income, and then utility, from wives to husbands, because it is expected according to social norms. Nevertheless, the effect of such norms on household utility (i.e., the sum of husbands and wives utility) is not clear, as it would depend on bargaining powers (Pareto-weights), which are not observable.

Finally, in order to study intra-household welfare inequalities, we define:

$$D_V = |V_1 - V_2| \geq 0. \tag{8}$$

Note that $D_V = 0$ only in the corner case of full equality (i.e., the indirect utility of the wife is equal to that of the husband). As this measure is defined in absolute values, it does not allow us to study whether husbands or wives show a higher level of indirect utility, but only whether inequalities exist, either in favor of men or in favor of women. However, the interpretation of coefficients in a regression model of this variable is clearer than in other measures, such as the difference (not in absolute value), as positive coefficients will represent increases in household inequality, while negative coefficients represent decreases.

Column (3) of Table 5 shows the estimates of Equation (9), representing the z-scores of D_V in terms of the exogenous variables:

$$z(D_V) = \zeta_0 + \zeta_1 \log w_1 + \zeta_2 \log w_2 + \zeta_3 \phi_1 + \zeta_4 \phi_2 + \zeta_5 s + \boldsymbol{\zeta}_6 \mathbf{z}. \tag{9}$$

The estimated coefficients indicate that intra-household processes are efficient in terms of welfare inequality, as increases in husbands' or wives' wages, or their shares of non-labor income, lead to decreases of intra-household inequality. Increases in the husband's wages, in particular, have an effect on reductions of inequality three times greater than similar increases in the wife's wages, indicating that the best way to reduce intra-household inequities would be to increase the labor income of men, even when this is associated with selfish behavior. However, intra-household processes, together with external factors, such as divorce, or the structure of the labor market, institutions, or gender wage gaps, may explain this result. In addition, the greater preference of men for labor income could also explain that.

Concerning the rest of the explanatory variables, wives' ages are positively correlated to inequality, but those of the husbands are negative. The same happens with respect to education, as higher education is correlated with higher (lower) intra-household inequality in

the case of wives (husbands). Further, estimates indicate that, in families formed by white spouses, there are lower levels of intra-household inequality. Finally, a greater number of children is associated with a higher intra-household inequality, which may again be attributed to the role of differential household responsibilities.

5. Conclusions

This paper proposes an empirical test of household collective models of labor supply, with a focus on the intra-household distribution of wealth and intra-household inequalities, using data from the American Time Use Survey for the years 2003 to 2015. Results point to the validity of the collective model, compared to the classical unitary approach to the study of the family. We find that household behaviors appear to have changed from the 1980s to today, especially for males, who now are willing to work more for a higher wage (in contrast to estimates of Chiappori et al. (2002)). Furthermore, the derivation of spouses' indirect utility functions indicates that the allocation of resources within households are not equitable, as men show selfish behaviors with respect to household income, while women are more altruistic. These behaviors are associated with husbands having a greater bargaining power than wives, in the US, where the former receive an average total amount of earned and non-earned income more than double that of the latter. These differential behaviors are in line with preferences, as our estimates show that husbands have different preferences for wages and non-labor income than do wives, perhaps due to their greater bargaining power. Nonetheless, these intra-household processes lead to efficient outcomes in terms of utility and welfare, as increases in both spouses' wages or non-labor income are associated with reductions in intra-household welfare inequality.

Although increases in spouses' wages are correlated with reductions of welfare inequality, the fact that, according to our estimates, the best way to reduce inequality within families is to promote higher wages for men, is quite controversial. However, these results are based on a sample where men earn, on average, $300 per week more than women. Further, men show a greater preference for their own earned wage than do women. Hence, researchers and policy-makers should consider these results cautiously, and take into account that the main conclusion derived from the analysis is that the allocation of resources within US households is unequal between men and women. However, the intra-household processes underlying this negotiation lead to efficient outcomes in terms of utility and welfare, and so

the estimates provide empirical support to the collective model and, in particular, the assumption of Pareto efficiency.

The empirical analysis entails certain limitations. First, we deal with spurious correlations between wages, non-labor income, and labor supply, by using expected wages and non-labor income, in a human capital approach. Despite that this approach appears robust in the case of wages, estimates of expected non-labor income are weaker. Second, the data used throughout the analysis is cross-sectional, and so our estimates are limited to conditional correlations. Third, the reference theoretical model considers only market work (i.e., labor supply) and leisure, and omits household production and other uses of time. Finally, the empirical analysis is limited to labor supply, and does not consider the other branch of study through collective models that is related to consumption.

References

Aguiar, M. & Hurst, E. (2007). Measuring Trends in Leisure: The Allocation of Time Over Five decades. Quarterly Journal of Economics, 122(3), 969-1007.

Akelof, G. A. & Kranton, R. E. (2000). Economics and identity. Quarterly Journal of Economics, 115(3), 715-753.

Attanasio, O. & Lechene, C. (2014). Efficient responses to targeted cash transfers. Journal of Political Economy, 122(1), 178-222.

Becker, G. S. (1981). A treatise on the family. Cambridge: Harvard University Press.

Bertrand, M., Kamenica, E. & Pan, J. (2015). Gender identity and relative income within households. Quarterly Journal of Ecomics, 130(2), 571-614.

Blau, D. M. & Goodstein, R. M. (2016). Commitment in the household: Evidence from the effect of inheritances on the labor supply of older married couples. Labour Economics, 42, 123–137.

Blundell, R. W., Chiappori, P. A. & Meghir, C. (2005). Collective labor supply with children. Journal of Political Economy, 113(6), 1277-1306.

Blundell, R. W., Chiappori, P. A., Magnac, T. & Meghir, C. (2007). Collective labour supply: Heterogeneity and non-participation. Review of Economic Studies, 74(2), 417-445.

Blundell, R. W. & Walker, I. (1986). A life-cycle consistent empirical model of family labour supply using cross-sectional data. Review of Economic Studies, 53, 539-85.

Bourguignon, F., Browning, M., Chiappori, P.A. & Lechene, V. (1993). Intra household allocation of consumption: a model and some evidence from French data. Annales d'Economie et de Statistique, 29, 137–156.

Browning, M. & Chiappori, P. A. (1998). Efficient intra-household allocations: A general characterization and empirical tests. Econometrica, 66, 1241–78.

Browning, M., Chiappori, P. A. & Lewbel, A. (2013). Estimating consumption economies of scale, adult equivalence scales, and household bargaining power. Review of Economic Studies, 80(4), 1267-1303.

Chiappori, P. A. (1988). Rational Household Labor Supply. Econometrica, 56(1), 63–90.

Chiappori, P. A. (1992). Collective labor supply and welfare. Journal of Political Economy, 100, 437-67.

Chiappori, P. A., Fortin, B. & Lacroix, G. (2002). Marriage market, divorce legislation, and household labor supply. Journal of Political Economy, 110(1), 37-72.

Chiappori, P. A. & Mazzocco, M. (2018). Static and intertemporal household decisions. Journal of Economic Literature. Forthcoming.

Chiappori, P. A. & Meghir, C. (2015). Intrahousehold inequality. Handbook of Income Distribution, 2, 1369-1418.

Chiappori, P. A. & Weiss, Y. (2007). Divorce, remarriage and child support. Journal of Labor Economics, 25(1), 37-74.

Donni, O. & Chiappori, P. A. (2011). Nonunitary Models of Household Behavior: A Survey of the Literature. In Molina, J. A. (Ed.), Household Economic Behaviors (pp. 1–40). Springer New York.

Dreher, G. F. (2003). Breaking the glass ceiling: The effects of sex ratios and work-life programs on female leadership at the top. Human Relations, 56, 541-562.

Gimenez-Nadal, J. I. & Sevilla, A. (2012). Trends in Time Allocation: A Cross-Country Analysis. European Economic Review, 56(2), 1338-1359.

Grossbard, S. & Amuedo-Dorantes, C. (2007). Cohort-level sex ratio effects on women's labor force participation. Review of Economics of the Household, 5, 249-278.

Hofferth, S. L., Flood, S. M. & Sobek, M. (2017). American Time Use Survey Data Extract Builder: Version 2.6 [dataset]. College Park, MD: University of Maryland, and Minneapolis, MN: University of Minnesota.

Kanter, R. M. (1977). Some effects of proportions on group life: Skewed sex ratios and responses to token women. American journal of Sociology, 82(5), 965-990.

Lyssiotou, P. (2017). The impact of targeting policy on spouses' demand for public goods, labor supplies and sharing rule. Empirical Economics, 53(2), 853-878.

Mazzocco, M. (2007). Household intertemporal behavior: A collective characterization and a test of commitment. Review of Economic Studies, 74, 857-895.

Miller, P. & Mulvey, C. (2000). Women's time allocation to child care: Determinants and consequences. Australian Economic Papers, 39(1), 1-24.

Molina, J. A., Gimenez-Nadal, J. I. & Velilla, J. (2018). Intertemporal labor supply: A household collective approach. IZA DP 11276.

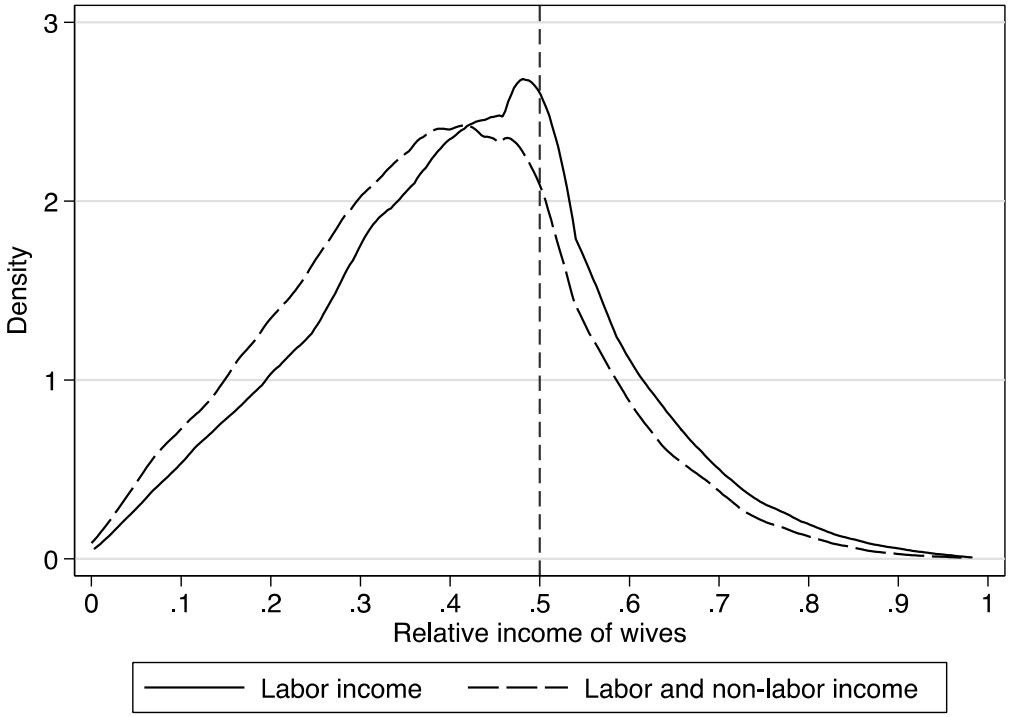
Piketty, T. & Saez, E. (2014). Inequality in the long run. Science, 344(6186), 838-843.

Rapoport, B., Sofer, C. & Solaz, A. (2011). Household production in a collective model: some new results. Journal of Population Economics, 24, 23-45.

Silver, C. (2000). Being there: The time dual-earner couples spend with their children. Canadian Social Trends, 57(11-008), 26-30.

Stern, N. (1986). On the specification of labour supply functions. In Blundell, R. & Walker, I. (Eds), Unemployment, Search and Labour Supply. Cambridge: Cambridge University Press.

Figure 1. Relative (labor and non-labor) income of wives



Note: The sample (ATUS 2003-2015) is restricted to two-member households where wives and husbands report positive labor supply. Wages and non-labor income are deflated.

Table 1. Descriptive statistics

	Wives		Husbands		Difference
	Mean	S.D.	Mean	S.D.	p-value
A*) *Individual-level:					
Weekly market work hours	37.373	11.054	44.208	10.057	(<0.001)
Deflated wage	752.778	550.262	1064.234	650.922	(<0.001)
Age	40.922	10.069	42.901	10.404	(<0.001)
Being white	0.870	0.337	0.867	0.339	(0.042)
Hispanic origin	0.112	0.316	0.114	0.318	(0.285)
Primary education	0.042	0.201	0.058	0.234	(<0.001)
Secondary education	0.503	0.500	0.527	0.499	(<0.001)
University education	0.455	0.498	0.415	0.493	(<0.001)

	Mean	S.D.
B*) *Household level:		
Gender ratio	0.452	0.039
Non-labor income	6.178	13.719
N. of children	1.238	1.100
Child under 13 years	0.540	0.498
Child 13-17 years	0.232	0.422
Interviewed: husband	0.476	0.499
N. Observations	30,724	

Note: T-type test p-values for differences between wives and husbands in parentheses. The sample (ATUS 2003-2015) is restricted to two-member households where wives and husbands report positive labor supply. Deflated wages are measured in dollars per week. Deflated non-labor income is measured in dollars per year, divided by 1,000.

Table 2. Estimates of the collective model

	Unrestricted model		Restricted model	
	(1) Wives	(2) Husbands	(3) Wives	(4) Husbands
Log wife (expected) wage	4.157***	0.294	4.159***	0.322
	(0.829)	(0.912)	(0.784)	(0.900)
Log husband (expected) wage	0.351	2.670***	0.352	2.685***
	(0.877)	(0.822)	(0.837)	(0.806)
(Expected) non-labor income	-0.183***	-0.394***	-0.183***	-0.393***
	(0.042)	(0.038)	(0.040)	(0.040)
Cross-log (expected) wage	-0.274**	-0.094	-0.274**	-0.098
	(0.132)	(0.134)	(0.125)	(0.132)
Gender ratio	-5.242***	-0.512	-5.201***	-1.860[†]
	(1.831)	(1.834)	(1.869)	(0.458)
Age	-0.036***	0.002	-0.036***	0.002
	(0.010)	(0.009)	(0.009)	(0.009)
Being white	-1.218***	1.020***	-1.219***	1.000***
	(0.200)	(0.208)	(0.197)	(0.189)
Secondary education	-0.410	1.040***	-0.409	1.044***
	(0.374)	(0.310)	(0.378)	(0.307)
University education	0.646	1.250***	0.646	1.260***
	(0.470)	(0.382)	(0.456)	(0.375)
N. of children	-1.264***	0.160**	-1.264***	0.161**
	(0.101)	(0.081)	(0.106)	(0.080)
Child under 13 years	-1.387***	-0.146	-1.387***	-0.144
	(0.212)	(0.176)	(0.206)	(0.174)
Child 13-17 years	0.821***	0.476***	0.821***	0.474***
	(0.190)	(0.159)	(0.180)	(0.155)
Constant	28.285***	28.649***	28.260***	28.306***
	(5.338)	(5.441)	(5.019)	(5.195)
Observations	30,724	30,724	30,724	30,724

Note: Bootstrapped standard errors in parentheses. The sample (ATUS 2003-2015) is restricted to two-member households where wives and husbands report positive labor supply. The dependent variables are the weekly market work hours of wives (Columns (1), (3)), and husbands (Columns (2), (4)). (Deflated) wages are measured in dollars per week. (Deflated) non-labor income is measured in dollars per year, divided by 1,000. The hypothesis $m_3/f_3 \neq m_5/f_5$ is satisfied at standard levels (p-values < 0.01), and then the sharing rule is well-defined. The restriction $m_4/f_4 = m_5/f_5$ is satisfied at standard levels (p-value > 0.10) in the unrestricted model, and is imposed as a restriction in the restricted model.

*** Significance at the 1%. ** Significance at the 5%. * Significance at the 10%.

[†] P-value of a Wald test for nullity of m_5 in parentheses.

Table 3. Estimates of the sharing rule

	(1) Sharing rule	(2) Derivatives
Log wife (expected) wage	2.136***	-0.002***
	(0.437)	(0.000)
Log husband (expected) wage	1.596***	-0.001***
	(0.422)	(0.000)
(Expected) non-labor income	-0.176***	-0.160***
	(0.010)	(0.007)
Cross-log (expected) wage	-0.443***	-
	(0.068)	
Gender ratio	-5.722***	-5.627***
	(0.504)	(0.463)
Constant	-8.724***	-1.598***
	(2.743)	(0.220)
Observations	30,724	30,724

Note: Bootstrapped standard errors in parentheses. The sample (ATUS 2003-2015) is restricted to two-member households where wives and husbands report positive labor supply. (Deflated) wages are measured in dollars per week. (Deflated) non-labor income is measured in dollars per year, divided by 1,000. Derivatives of the sharing rule are computed with respect wages, not with respect log-of-wages.
*** Significance at the 1%. ** Significance at the 5%. * Significance at the 10%.

Table 4. Estimates of individual labor supply, conditional on φ

	(1) Wives	(2) Husbands
Log (expected) wage	0.801***	1.971***
	(0.238)	(0.165)
Individual non-labor income	-0.267***	-0.006
	(0.026)	(0.004)
Gender ratio	-7.189***	1.444
	(1.752)	(1.850)
Age	-0.077***	-0.047***
	(0.008)	(0.008)
Being white	-1.054***	1.512***
	(0.189)	(0.178)
Secondary education	-0.365	1.191***
	(0.351)	(0.315)
University education	1.055**	1.546***
	(0.439)	(0.320)
N. of children	-1.233***	0.211***
	(0.113)	(0.080)
Child under 13 years	-1.443***	0.016
	(0.216)	(0.181)
Child 13-17 years	0.889***	0.583***
	(0.189)	(0.160)
Constant	39.149***	28.968***
	(1.465)	(1.248)
Observations	30,724	30,724

Note: Bootstrapped standard errors in parentheses. The sample (ATUS 2003-2015) is restricted to two-member households where wives and husbands report positive labor supply. The dependent variables are the weekly hours spent in market work tasks by wives (Column (1)), and husbands (Column (2)). (Deflated) wages are measured in dollars per week. Individual non-labor income is defined conditional on φ.
*** Significance at the 1%. ** Significance at the 5%. * Significance at the 10%.

Table 5. Estimates of indirect utilities

	Individual utility		Intra-household inequality
	(1) Wives	(2) Husbands	(3) Difference
Log wife (expected) wage	1.635***	-	-0.471***
	(0.310)		(0.146)
Log husband (expected) wage	-	1.748***	-1.513***
		(0.142)	(0.209)
Wife non-labor income	0.028***	-	-0.055***
	(0.005)		(0.009)
Husband non-labor income	-	-0.000	-0.008***
		(0.000)	(0.001)
Gender ratio	-1.431***	-1.331***	1.130***
	(0.410)	(0.259)	(0.213)
Age (wife)	0.006*	-	0.009***
	(0.004)		(0.002)
Age (husband)	-	-0.001	-0.005***
		(0.002)	(0.002)
White (wife)	0.266***	-	-0.052**
	(0.097)		(0.025)
White(husband)	-	0.061***	-0.078**
		(0.017)	(0.040)
Secondary education (wife)	0.184	-	0.187**
	(0.233)		(0.080)
University education (wife)	0.169	-	0.411***
	(0.280)		(0.148)
Secondary education (husband)	-	0.547***	-0.644***
		(0.062)	(0.076)
University education (husband)	-	0.039	-0.263*
		(0.124)	(0.159)
N. of children	-0.010	-0.018**	0.024***
	(0.009)	(0.008)	(0.008)
Child under 13 years	-0.094***	0.029	-0.021
	(0.025)	(0.019)	(0.017)
Child 13-17 years	-0.052***	0.018	-0.019*
	(0.014)	(0.012)	(0.011)
Constant	-8.139***	-11.730***	12.774***
	(1.542)	(0.758)	(0.608)
Observations	30,724	30,724	30,724

Note: Bootstrapped standard errors in parentheses. The sample (ATUS 2003-2015) is restricted to two-member households where wives and husbands report positive labor supply. Dependent variables are the z-scores of the indirect utility of wives (Column (1)), husbands (Column (2)), and the absolute difference (Column (3)). (Deflated) wages are measured in dollars per week. (Deflated) non-labor income is measured in dollars per year, divided by 1,000.

*** Significance at the 1%. ** Significance at the 5%. * Significance at the 10%.

Appendix A. Additional estimates

Table A1. Estimates of expected wages and non-labor income

	Wages		Non-labor income
	(1) Wives	(2) Husbands	(3) Household
Age (wife)	34.338***	-	-0.013
	(2.181)		(0.144)
Age (husband)	-	69.103***	-0.368***
		(2.861)	(0.138)
Age sq. (wife)	-0.377***	-	-0.000
	(0.029)		(0.004)
Age sq. (husband)	-	-0.698***	0.004
		(0.040)	(0.003)
Cross age	-0.037**	-0.099***	0.002
	(0.018)	(0.028)	(0.006)
Secondary education (wife)	14.333	-	-0.968
	(32.507)		(2.046)
University education (wife)	201.815***	-	2.037
	(39.191)		(2.241)
Secondary education (husband)	-	-8.732	1.404
		(45.782)	(1.685)
University education (husband)	-	132.515**	-1.330
		(52.939)	(1.931)
Age (wife) *			
Secondary education	4.415***	-	0.054
	(0.819)		(0.051)
University education	9.122***	-	-0.046
	(0.994)		(0.056)
Age (husband) *			
Secondary education	-	5.521***	-0.018
		(1.096)	(0.046)
University education	-	13.287***	0.041
		(1.267)	(0.052)
White (wife)	24.456**	-	-0.635
	(11.261)		(0.562)
White (husband)	-	151.609***	-0.198
		(12.780)	(0.554)
Hispanic origin (wife)	-89.809***	-	0.561
	(10.317)		(0.524)
Hispanic origin (husband)	-	-187.976***	-0.750
		(12.224)	(0.514)
Gender ratio	-202.135**	-7.411	-4.133
	(96.082)	(114.633)	(3.724)
Constant	-371.367***	-1,147.881***	9.798***
	(66.372)	(87.667)	(3.207)
MSA F.E.	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes
Observations	30,724	30,724	30,724
R-squared	0.272	0.322	0.030

Note: Robust standard errors in parentheses. The sample (ATUS 2003-2015) is restricted to two-member households where wives and husbands report positive labor supply. The dependent variables are wife and husband weekly (deflated) wages (Columns (1) and (2)), and household (deflated) non-labor income (Column (3)). Age squared is defined as age^2/100 (for wives and husbands).
*** Significance at the 1%. ** Significance at the 5%. * Significance at the 10%.

Table A2. Robustness check:
Estimates of labor supply and the sharing rule including outliers

	Unrestricted model		Restricted model		Sharing rule	
	(1) Wives	(2) Husbands	(3) Wives	(4) Husbands	(5) Equation	(6) Derivatives
Log wife (expected) wage	3.865***	0.011	3.867***	0.057	1.260***	-0.001***
	(0.841)	(0.958)	(0.796)	(0.928)	(0.273)	(0.000)
Log husband (expected) wage	0.104	2.430***	0.106	2.455***	0.998***	-0.001***
	(0.894)	(0.849)	(0.798)	(0.845)	(0.266)	(0.000)
(Expected) non-labor income	-0.211***	-0.406***	-0.211***	-0.403***	-0.133***	-0.120***
	(0.040)	(0.036)	(0.039)	(0.035)	(0.008)	(0.006)
Cross-log (expected) wage	-0.223*	-0.048	-0.223*	-0.055	-0.282***	-
	(0.134)	(0.141)	(0.122)	(0.137)	(0.043)	
Gender ratio	-6.251***	-0.824	-6.184***	-1.534[†]	-4.576***	-4.476***
	(1.920)	(1.827)	(1.853)	(0.670)	(0.354)	(0.349)
Age	-0.032***	0.005	-0.032***	0.006		
	(0.009)	(0.008)	(0.010)	(0.009)		
Being white	-1.337***	0.852***	-1.339***	0.821***		
	(0.201)	(0.198)	(0.201)	(0.172)		
Secondary education	-0.408	1.109***	-0.408	1.114***		
	(0.368)	(0.299)	(0.394)	(0.306)		
University education	0.546	1.323***	0.547	1.340***		
	(0.480)	(0.352)	(0.484)	(0.344)		
N. of children	-1.249***	0.154*	-1.249***	0.155*		
	(0.104)	(0.084)	(0.100)	(0.082)		
Child under 13 years	-1.438***	-0.175	-1.438***	-0.172		
	(0.207)	(0.180)	(0.193)	(0.184)		
Child 13-17 years	0.772***	0.455***	0.772***	0.453***		
	(0.186)	(0.165)	(0.187)	(0.158)		
Constant	30.267***	30.378***	30.225***	29.821***	-7.314***	-3.452***
	(5.493)	(5.676)	(4.951)	(5.450)	(1.712)	(0.164)
Observations	30,886	30,886	30,886	30,886	30,886	30,886

Note: Robust standard errors in parentheses. The sample (ATUS 2003-2015) is restricted to two-member households where wives and husbands report positive labor supply (including outliers in terms of labor supply, wages, and non-labor income). The dependent variables are the weekly market work hours of wives (Columns (1), (3)), and husbands (Columns (2), (4)). (Deflated) wages are measured in dollars per week. (Deflated) non-labor income is measured in dollars per year, divided by 1,000. The hypothesis $m_3/f_3 \neq m_5/f_5$ is satisfied at standard levels (p-values < 0.01), and then the sharing rule is well-defined. The restriction $m_4/f_4 = m_5/f_5$ is satisfied at standard levels (p-value > 0.10) in the unrestricted model, and is imposed as a restriction in the restricted model. Derivatives of the sharing rule are computed with respect wages, not with respect log-of-wages.

*** Significance at the 1%. ** Significance at the 5%. * Significance at the 10%.

[†] P-value of a Wald test for nullity of m_5 in parentheses.