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Abstract

We present a structural empirical analysis of how labor market participation impacts individual welfare. Our analysis models household allocations of material consumption and time, while allowing for rich heterogeneity in individual preferences and intrahousehold decision processes. Our structural methodology is of the revealed preference type and intrinsically nonparametric, making it robust to functional specification error. For multi-person households, it allows us to evaluate the welfare of individual household members while accounting for intrahousehold consumption inequality and economies of scale associated with public consumption. Our empirical application uses cross-sectional data from the US Panel Study of Income Dynamics (PSID) and comprises 9,034 adult individuals, of which about 18% are unemployed. We

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informatively identify the effects of unemployment and education on individual welfare in terms of within-household bargaining power and poverty. We document significant heterogeneity in welfare depending on the education level and employment status of the two spouses. The employment effects systematically dominate the education effects.

Keywords: labor market participation, individual welfare, marriage, collective model, revealed preferences, PSID.

JEL classifications: C14, D12, D13, J22.

1 Introduction

It goes without saying that an individual's employment status has important welfare effects. For example, unemployment reduces income and thus consumer spending, which ultimately decreases individuals' welfare due to lower standards of living and limited access to necessities and amenities. As most income and expenditure data are collected at the household level, traditional methods of poverty and welfare analysis assessed these employment effects at the aggregate household level. It is then implicitly assumed that household members do not have conflicting preferences, and that resources are shared equally within households. However, growing evidence shows that the consumption inequality *within* households is often substantial, and in many cases individual welfare is distributed very differently than household welfare (see, e.g., Lise and Seitz, 2011).[1] This pleads strongly for assessing the welfare effects of (un)employment at the individual level. Such an explicit individualistic perspective can only improve the effectiveness of policies that aim at mitigating the welfare impact of unemployment.

[1]More recent studies have shown that ignoring intrahousehold inequality may substantially underestimate poverty rates. For example, Dunbar, Lewbel, and Pendakur (2013) conduct individual-level poverty analysis for Malawian men, women and children and find that child poverty rates are much higher when accounting for within-household inequality. Similarly, Calvi (2020) finds that poverty rates are much higher among Indian women than among men, as a result of intrahousehold inequality.

Household consumption and individual welfare. The current paper assesses these individual welfare effects by starting from a structural modeling of the household decision process that underlies the observed consumption behavior. Such a structural approach is instrumental to assessing the welfare of individuals within multi-person households, as it allows us to identify the within-household consumption allocation (and, thus, individuals' welfare) from the aggregate household consumption that is observed. We adopt a modeling framework that integrates the collective household model (à la Chiappori, 1988, 1992) with marriage market restrictions.[2] In contrast to the unitary model, which views the household as a single decision making unit, the collective model explicitly regards households as consisting of multiple decision makers (i.e., adult household members); and the observed household consumption is then the cooperative (i.e., Pareto-efficient) outcome of a within-household bargaining process.

Following Cherchye, Demuynck, De Rock, and Vermeulen (2017), we take it that the individuals' bargaining positions in this process are crucially defined by their outside options on the marriage market: better exit options from marriage (i.e., becoming single or remarrying) imply higher bargaining power within marriage.[3] Building on this premise, these authors derived the empirical implications of the assumption of marital stability for household consumption patterns; and this formed the basis for a structural methodology to empirically analyze intrahousehold allocation patterns. An attractive feature of this methodology is that it is of the revealed preference type and intrinsically nonparametric, meaning that it abstains from imposing any (non-verifiable) functional structure on the collective decision process. Moreover, it allows for an informative analysis of intrahousehold sharing patterns in a cross-sectional setting with only a single observation per household and fully heterogeneous individual preferences across households.

Structurally analyzing the welfare effects of unemployment is challenging from

[2] In what follows, "marriage" stands for "in a romantic relationship" rather than "being legally married".

[3] Essentially, this structurally integrates the collective model of household consumption with the economic model of marriage that was introduced by Becker (1973, 1974), which assumes that individuals' marital choices are driven by utility maximization.

an empirical point of view. While previous research on intrahousehold inequality has typically focused on material consumption, an adequate model of intrahousehold resource sharing should arguably also account for inter-individual differences in time use (including leisure and domestic production; see, e.g., Couprie, 2007, and Bostyn, Cherchye, De Rock, and Vermeulen, 2023).[4] However, modeling intrahousehold time use allocations requires information on the individual (shadow) wages. Therefore, the empirical studies that have simultaneously modeled material consumption and time use are standardly restricted to households where all adult members are actively working (see, e.g., Cherchye, Rock, and Vermeulen, 2012b; Cherchye, Cosaert, De Rock, Kerstens, and Vermeulen, 2018, and Cosaert, Theloudis, and Verheyden, 2023); they do not explicitly model the decision to participate in the labor market. This is unattractive in welfare analyses, because it excludes (unemployed) individuals who are often most vulnerable to poverty. The few existing studies on collective household decision making that have developed models to incorporate labor force participation decisions are either theoretical in nature and/or do not include a thorough welfare analysis (see, e.g., Donni, 2003; Blundell, Chiappori, Magnac, and Meghir, 2007, and Bloemen, 2010). The current paper complements this earlier work by providing an empirical analysis that specifically focuses on the individual welfare effects associated with employment status.

Our contributions. We extend the methodology of Cherchye et al. (2017) by showing that it provides a productive basis to model labor market participation decisions in a collective consumption setting. It naturally allows for dealing with unobserved (shadow) wages of the unemployed in a fully nonparametric manner. Technically, we can treat these wages as unknowns in a set of linear constraints that characterize the observed household behavior in terms of a stable marriage allocation. As we will explain in the following sections, this obtains a structural framework for analyzing individual welfare while accounting for (i) labor force participation,

[4] Hamermesh (2019) offers a comprehensive analysis of how people allocate their time across various activities in the US and other wealthy countries, highlighting the cultural and economic factors that influence differences in time use among individuals and households.

(ii) intrahousehold consumption inequality, and (iii) economies of scale associated with public consumption in multi-person households (à la Browning, Chiappori, and Lewbel, 2013, and Cherchye, De Rock, Surana, and Vermeulen, 2020).

We use this framework to empirically analyze households with unemployed individuals. We consider a cross-sectional data set that is drawn from the Panel Study of Income Dynamics (PSID) survey, which provides a large representative sample of the US population and contains detailed information on household expenditures and individual time use. We assume a labor supply setting where households spend their total potential income on individual leisure, domestic production (including childcare), private material consumption and public material consumption. Our revealed preference methodology enables us to informatively (set) identify intrahousehold resource allocations, which we use to conduct individual welfare and poverty analysis.

Apart from assessing the welfare effects of labor force participation, our empirical analysis also pays specific attention to examining the gendered impact of education. Education is known to be a primary driver of individual welfare. We will distinguish between two education categories (low and high education) and two employment categories (employed and unemployed), which defines four education-employment types per gender.[5] Our application will then specifically focus on three empirical questions. First, we identify the intrahousehold allocation patterns for each combination of the four male and four female types. Second, we examine heterogeneity in individual bargaining power across alternative matches of female and male types. Third, we use our estimates of individual resource shares to examine the incidence of poverty for each female and male type. Our findings reveal significant variation in individual welfare across households depending on the employment status and education level of the two spouses.

[5] It is crucial to clarify that we solely employ education-employment types to organize the presentation of our results concerning individual welfare, and they do not constitute a component of our structural model of household consumption behavior. In this regard, our type concept differs substantially from the concept used in the literature on marital matching, following the tradition of Choo and Siow (2006), which seeks to identify the gains to marriage associated with matching female and male types based on observed marriage patterns.

Outline. The rest of the paper is structured as follows. Section 2 motivates our empirical research question by describing the matching patterns for our female and male (employment-education) types and the associated household consumption allocations. Section 3 presents our revealed preference methodology to structurally analyze the intrahousehold allocation patterns and individual welfare, while accounting for unobserved wages for the unemployed. Section 4 discusses our empirical findings on individual welfare for the different male and female types that we study. Section 5 examines the trade-off between material consumption and time use. Section 6 concludes.

2 Marital Matching and Intrahousehold Allocations: Descriptive Analysis

The data for our empirical analysis come from the Panel Study of Income Dynamics (PSID). The PSID data collection started in 1968 with a nationally representative sample of more than 18,000 individuals residing in 5,000 families across the United States. This data set contains an extensive range of information on households' labor supply, income, wealth, health, time use and other sociodemographic variables. Starting from 1999, the panel data is supplemented by detailed information on households' consumption expenditures.

We draw our sample from the 2019 wave of the PSID, which provides information on 9,569 households. We focus on households with adult individuals aged between 25 and 65 and drop households with important missing information on age, education or time use. We also remove outliers by leaving out households in the 1st and 99th percentiles of the male and female wage distribution. These selection criteria result in a sample consisting of 9,034 adult individuals: 5,920 individuals in 2960 couples, 1,908 single females and 1,206 single males. We present summary statistics in Section 4. Table 16 in Appendix C.1 reports the number of household observations that remain after each step in our sample selection procedure.

We motivate our following analysis by documenting some empirical facts on the matching patterns based on employment status and education level. We consider two employment categories (employed and unemployed) and two education categories (low stands for at most a high school degree and high for a higher degree). In total, this defines four individual female and male types. Each of these four types may be married to one of the four types of the other gender, which defines 16 possible couple types.

Tables 1 and 2 present the fractions of individuals in our sample of households categorized by different employment and education categories. Two observations stand out. First, in a majority of the observed couples both spouses are employed: 76.22% of all observed couples have both spouses working. Among couples with at least one unemployed individual, it is more likely that the husband is employed and the wife is not. Single males and females have similar employment status: about 81% are employed. Second, there clearly is assortative mating in education: 73.55% of all observed couples belong to the same education category. Nonetheless, there is also a substantial fraction of "mixed" couples. Further, we observe that the fraction of low educated single males and females slightly exceeds the fraction of low educated married individuals, and that single females are more likely to be high educated than single males.

Table 1: Percentage shares of employment types in the sample

	couples		
	female unemployed	female employed	total
male unemployed	3.78	5.88	9.66
male employed	14.12	76.22	90.34
total	17.91	82.09	
	singles		
	unemployed	employment	
males	18.82	81.18	
females	18.61	81.39	

A distinctive feature of our data is that we observe how much every household spends on various consumption categories, as well as how much time each spouse

Table 2: Percentage shares of education types in the sample

	couples		
	female low	female high	total
male low	22.33	18.72	41.05
male high	7.74	51.22	58.95
total	30.07	69.93	
	singles		
	low	high	
males	46.27	53.73	
females	39.68	60.32	

spends on labor supply and domestic production. In particular, we observe household expenditures on food and drinks (at home and outside), schooling, computer, recreation, vacation, housing, transportation, childcare and healthcare. We use the observed time spent on market and domestic work to calculate the leisure time of each spouse. Specifically, we assume that every individual needs eight hours per day for personal care and sleep. This implies a total time endowment of 112 hours per week for each individual. We compute leisure hours as total time endowment minus the sum of hours spent on market and household work.

In Tables 3 and 4, we report the average total weekly consumption (expressed in monetary value) and average weekly leisure hours for our couple and single types, respectively. Several interesting patterns emerge. First, there appears to be quite some heterogeneity in the total material and leisure consumption of different household types: the average material consumption ranges from $634 to $1589 among couples, and from $358 to $781 among singles; and the average leisure time ranges from 52 (49) hours to 101 (85) hours among married men (women), and from 59 (56) hours to 99 (92) hours among single men (women). Second, we find that material consumption increases with employment and education. This suggests that households in which individuals are employed or more educated are materially better off.

However, this first inspection of our data does not account for the fact that couples benefit from economies of scale in consumption (due to public consumption), which means that the value of the total consumption summed over the two spouses may well exceed the household consumption expenditures. In addition, it ignores the possibility of unequal consumption sharing between household members. If within-household allocations are highly imbalanced, individual poverty may be substantially different from household poverty. We will account for both these features in the structural framework that we introduce next.

Table 3: Total consumption and leisure hours per couple type

male		female		total	leisure	leisure
employment	education	employment	education	consumption	male	female
no	low	no	low	634.53	101.32	80.14
		no	high	679.70	91.00	76.94
		yes	low	722.88	93.19	57.50
		yes	high	1040.27	94.79	56.91
no	high	no	low	955.84	80.00	80.10
		no	high	1589.03	100.38	85.48
		yes	low	788.21	91.62	62.50
		yes	high	1218.56	92.32	56.87
yes	low	no	low	840.76	59.34	69.17
		no	high	917.59	59.03	69.33
		yes	low	997.25	55.81	51.00
		yes	high	1188.65	55.27	48.85
yes	high	no	low	1170.13	58.11	69.00
		no	high	1415.54	54.40	66.80
		yes	low	1166.26	54.64	53.17
		yes	high	1425.69	52.61	49.67

3 Theoretical Framework

In what follows, we present the revealed preference characterization of our structural decision model, and we will argue that this provides a productive basis to empirically identify the within-household allocation of consumption from the observed household

Table 4: Total consumption and leisure hours per single type

	single female		
employment	education	total consumption	leisure
no	low	360.41	97.30
no	high	571.94	99.05
yes	low	592.68	61.89
yes	high	780.77	59.00
	single male		
employment	education	total consumption	leisure
no	low	358.30	92.57
no	high	524.75	90.12
yes	low	604.24	58.00
yes	high	768.10	56.57

behavior. It can account for unobserved wages of the unemployed by treating these wages as unknowns in a set of linear constraints that characterize the observed household behavior in terms of a stable marriage allocation. We end by defining the welfare measures that we will use in our empirical analysis.

3.1 Household Consumption under Marital Stability

Intrahousehold consumption allocation. Consider a couple formed by man m and woman w. This couple consumes goods bought on the market, as well as time spent on own leisure and household production (including childcare) by both individuals. Let us denote by $q_{m,w} \in \mathbb{R}_+^n$ the set of n private goods, and by $Q_{m,w} \in \mathbb{R}_+^N$, the set of N public goods purchased on the market. Let $q_{m,w}^m \in \mathbb{R}_+^n$ and $q_{m,w}^w \in \mathbb{R}_+^n$ be the private consumption of man m and woman w, with $q_{m,w} = q_{m,w}^m + q_{m,w}^w$. The intrahousehold allocation of material consumption is thus given by $(q_{m,w}^m, q_{m,w}^w, Q_{m,w})$. Further, each individual $i \in \{m, w\}$ spends her or his total time ($T \in \mathbb{R}_{++}$) on leisure ($l^i \in \mathbb{R}_+$), market work ($o^i \in \mathbb{R}_+$) and household work ($h^i \in \mathbb{R}_+$). The time constraint for each individual is given by:

$$T = l^i + o^i + h^i.$$

We will assume that individual leisure time is consumed privately whereas time spent on household production is consumed publicly (Becker, 1965). In our set-up, individual spouses produce different household goods through efficient one-input technologies that are characterized by constant returns to scale. This allows us to use the value of time spent on household production as the output value of the household goods that are produced.

Consumption decisions are made under budget constraints. For the couple (m, w), let $y_{m,w} \in \mathbb{R}_+$ denote their full potential income, and $y_{m,\phi}$ and $y_{\phi,w} \in \mathbb{R}_+$ denote the full potential income of m and w when single. The price of an individual's time is their offered wage for market work. Let $\Omega^m_{m,w}$ and $\Omega^w_{m,w}$ be the offered wages of m and w when in a couple and $\Omega^m_{m,\phi}$ and $\Omega^w_{\phi,w}$ be their offered wages when single. Further, let $p_{m,w} \in \mathbb{R}^n_{++}$ be the prices of private goods and $P_{m,w} \in \mathbb{R}^N_{++}$ the prices of public goods. Similarly, let $p_{m,\phi}$ and $P_{m,\phi}$ be the prices faced by man m as single, and $p_{\phi,w}$ and $P_{\phi,w}$ the prices faced by woman w as single.

Stable matching allocation. We assume a marriage market with a finite set of men M and a finite set of women W. A matching function $\sigma : M \cup W \to M \cup W$ defines who is married to whom, and satisfies the following properties:

- for all men $m \in M$, $\sigma(m) \in W$,
- for all women $w \in W$, $\sigma(w) \in M$, and
- $\sigma(m) = w$ if and only if $\sigma(w) = m$.

For a given σ, the matching allocation $S = \{(q^m_{m,\sigma(m)}, q^{\sigma(m)}_{m,\sigma(m)}, Q_{m,\sigma(m)},\ l^m, h^m, l^{\sigma(m)}, h^{\sigma(m)})\ \}_{m \in M}$ represents the collection of household allocations for all matched couples. We say that a matching allocation is stable if it is "individually rational" and has "no blocking pairs". To formally define these stability criteria, we assume that every individual i is endowed with a utility function $u^i : \mathbb{R}_+^{n+N+3} \to \mathbb{R}_+$, which associates a utility level with every bundle $(q^i, Q, l^i, h^i, h^{\sigma(i)})$. These utility functions are assumed to be non-negative, increasing, continuous and concave. Notably, we account for the fact that each individual i has its own utility function u^i, that is, individual preferences are fully heterogeneous.

The "individual rationality" criterion requires that no individual wants to become single. This means that no married individual can afford a bundle when single (given the prices and income she or he faces as single) that gives a higher utility level than the one in her or his current marriage. Clearly, if this condition were not satisfied, then the marriage market would be unstable, as the individual would prefer to divorce and become single.

Next, the "no blocking pairs" criterion imposes that there is no unmatched couple (m, w) that (given the prices and income faced) can afford a bundle that makes both the male m and female w better off, with at least one of them strictly better off, than in their current marriages. If this condition were violated, then these individuals would prefer to break their current marriages and remarry each other, which would again make the current marriage market unstable.

To ease the notational burden, our formal exposition will not explicitly discuss singles; we will model all observed individuals as "married" and, thus, $|M| = |W|$. Importantly, however, the analysis does implicitly include the possibility that some males or females in the data set are actually singles. Specifically, single females (males) correspond to (virtual) couples with the male (female) consuming nothing. We will include singles in our empirical following application.

3.2 Revealed Preference Characterization

Our empirical analysis will build on the revealed preference characterization of a stable marriage market, which defines the testable implications for observed household behavior to be rationalizable in terms of a stable matching allocation. To define these conditions, we assume a data set $\mathcal{D}$ that contains the following information:

- matching function σ,

- consumption bundles $(q_{m,\sigma(m)}, Q_{m,\sigma(m)})$ and time use information $(l^m, m^m, h^m, l^{\sigma(m)}, m^{\sigma(m)}, h^{\sigma(m)})$ for all matched couples $(m, \sigma(m))$,
- prices $(p_{m,w}, P_{m,w})$ for all males $m \in M$ and females $w \in W$,
- offered wages $\Omega^m_{m,w}$ and $\Omega^w_{m,w}$ for all employed individuals $m \in M$ (with $o^m > 0$) and $w \in W$ (with $o^w > 0$).

Rationalizable behavior. We say that the data set $\mathcal{D}$ is rationalizable by a stable matching if, for all males m and females w, there exist individual quantities $q^m_{m,\sigma(m)}$ and $q^{\sigma(m)}_{m,\sigma(m)}$ with $q^m_{m,\sigma(m)} + q^{\sigma(m)}_{m,\sigma(m)} = q_{m,\sigma(m)}$, offered wages $\Omega^m_{m,w}$ and $\Omega^w_{m,w}$, and utility functions u^m and u^w such that the matching allocation $(q^m_{m,\sigma(m)}, q^{\sigma(m)}_{m,\sigma(m)}, Q_{m,\sigma(m)}, l^m, h^m, l^{\sigma(m)}, h^{\sigma(m)})$ is stable (i.e. it satisfies the criteria "individual rationality" and "no blocking pairs"). We can establish the following revealed preference characterization:[6]

Proposition 1 *The data set $\mathcal{D}$ is rationalizable by a stable matching if and only if there exist*

(a) individual quantities $q^m_{m,\sigma(m)}, q^{\sigma(m)}_{m,\sigma(m)}$ for all matched couples $m \in M$ and $\sigma(m) \in W$, with $q^m_{m,\sigma(m)} + q^{\sigma(m)}_{m,\sigma(m)} = q_{m,\sigma(m)}$,

(b) offered wages $\Omega^m_{m,\phi}$ and $\Omega^w_{\phi,w}$ for all individuals $m \in M$ and $w \in W$ and $\Omega^m_{m,w}$ and $\Omega^w_{m,w}$ for all couples $(m, w) \in M \times W$, which equal the observed wages for the employed individuals $m \in M$ (with $o^m > 0$) and $w \in W$ (with $o^w > 0$),

(c) personalized prices $P^m_{m,w}, P^w_{m,w}$ (for market-purchased public goods), $\Omega^{m,m}_{m,w}, \Omega^{m,w}_{m,w}$ (for household production by male) and $\Omega^{w,m}_{m,w}, \Omega^{w,w}_{m,w}$ (for household production by female) for all couples $(m, w) \in M \times W$, with $P^m_{m,w} + P^w_{m,w} = P_{m,w}$, $\Omega^{m,m}_{m,w} + \Omega^{m,w}_{m,w} = \Omega^m_{m,w}$ and $\Omega^{w,m}_{m,w} + \Omega^{w,w}_{m,w} = \Omega^w_{m,w}$,

[6] Appendix A presents the proof of Proposition 1, which builds on Crawford and Polisson (2015), Cherchye et al. (2017) and Browning et al. (2021). A specific feature is that we use rationing constraints to model the labor supply decision. Indeed, individual i's time constraint $(l^i + h^i \leq T)$ is effectively a rationing constraint, which is binding (i.e., $l^i + h^i = T$) when the individual does not participate in the labor market. See Varian (1983) for an early discussion of rationing constraints within the context of revealed preference analysis.

such that the following constraints are satisfied:

(i) individual rationality restrictions for all $m \in M$ *and* $w \in W$*,*

$$
\begin{aligned}
y_{m,\phi} &\leq p_{m,\phi} q^m_{m,\sigma(m)} + P_{m,\phi} Q_{m,\sigma(m)} + \Omega^m_{m,\phi} l^m + \Omega^m_{m,\phi} h^m + \Omega^{\sigma(m)}_{m,\phi} h^{\sigma(m)} \\
y_{\phi,w} &\leq p_{\phi,w} q^w_{\sigma(w),w} + P_{\phi,w} Q_{\sigma(w),w} + \Omega^w_{\phi,w} l^w + \Omega^{\sigma(w)}_{\phi,w} h^{\sigma(w)} + \Omega^w_{\phi,w} h^w,
\end{aligned}
$$

(ii) no blocking pair restrictions for all $(m, w) \in M \times W$*,*

$$
\begin{aligned}
y_{m,w} \leq\ & p_{m,w}(q^m_{m,\sigma(m)} + q^w_{\sigma(w),w}) + P^m_{m,w} Q_{m,\sigma(m)} + P^w_{m,w} Q_{\sigma(w),w} + \\
& + \Omega^m_{m,w} l^m + \Omega^w_{m,w} l^w + \Omega^{m,m}_{m,w} h^m + \Omega^{m,w}_{m,w} h^{\sigma(w)} + \Omega^{w,m}_{m,w} h^{\sigma(m)} + \Omega^{w,w}_{m,w} h^w.
\end{aligned}
$$

In this proposition, condition (a) requires that the (unobserved) individual private quantities must add up to the (observed) aggregate private quantities. Condition (b) relates to individual wages. Every individual receives a wage offer for market work, which equals the observed wage for working individuals and poses no restrictions for non-working individuals. Condition (c) introduces personalized prices for the three types of public consumption within households. For every potential couple (m, w), the personalized prices for each good must add up to the actual prices. The adding up condition of personalized prices corresponds to a Pareto efficient provision of public goods, which means that these personalized prices can actually be interpreted as Lindahl prices. We assume that the prices of public goods purchased in the market $(P_{m,w})$ are observed. However, the prices of time inputs to household production by male $(\Omega^m_{m,w})$ and female $(\Omega^w_{m,w})$ are unobserved for individuals that do not actively participate in the labor market. For the unemployed individuals, we treat these unobserved (shadow) wages as unknowns in our empirical analysis.[7]

[7] It is worth indicating that we may well include information on the shadow wages of the unemployed if such information is available and/or we want to exclude unrealistic wage scenarios. For example, we may bound their possible values through linear constraints, so complying with our linear characterization of marital stability in Proposition 1. Obviously this can only better the revealed preference analysis (e.g., tighter (set) identification of the RICEBs that we define in Section 3.3). We will not go this route in our main empirical application. We will show in Section 4 that we can obtain informative identification results even in this minimalistic scenario. In this respect, see also our robustness check in Appendix D.1.

The rationalizability conditions (i) and (ii) have an intuitive revealed preference interpretation. Condition (i) imposes individual rationality, which –to recall– requires that no married individual can afford a bundle that provides more utility than the one consumed in the current marriage. Formally, under the budget conditions that individuals face as singles (i.e., prices $\left(p_{m,\phi}, P_{m,\phi}, \Omega^{m}_{m,\phi}, \Omega^{\sigma(m)}_{m,\phi}\right)$ and income $y_{m,\phi}$ for man m, and prices $\left(p_{\phi,w}, P_{\phi,w}, \Omega^{\sigma(w)}_{\phi,w}, \Omega^{w}_{\phi,w}\right)$ and income $y_{\phi,w}$ for woman w), they cannot buy a bundle that is more expensive than the bundle consumed in their current marriages (i.e., $\left(q^{m}_{m,\sigma(m)}, Q_{m,\sigma(m)}, l^{m}, h^{m}, h^{\sigma(m)}\right)$ for man m and $\left(q^{w}_{\sigma(w),w}, Q_{\sigma(w),w}, l^{w}, h^{\sigma(w)}, h^{w}\right)$ for woman w).

Condition (ii) imposes the no blocking pair restrictions, which imposes that no two unmatched individuals can afford a bundle that makes both better off than in their current marriages. Formally, the right hand side of the inequality represents the sum of costs of purchasing the bundles consumed by man m (i.e.,$\left(q^{m}_{m,\sigma(m)},\ Q_{m,\sigma(m)},\ l^{m},\ h^{m},\ h^{\sigma(m)}\right)$) and woman w (i.e, $\left(q^{w}_{\sigma(w),w}, Q_{\sigma(w),w}, l^{w}, h^{\sigma(w)}, h^{w}\right)$) in their current marriages, evaluated at the prices that (m, w) would face if they formed a couple (i.e., $\left(p_{m,w}, P^{m}_{m,w}, P^{w}_{m,w}, \Omega^{m}_{m,w}, \Omega^{w}_{m,w}, \Omega^{m,w}_{m,w}, \Omega^{m,w}_{m,w}, \Omega^{w,m}_{m,w}, \Omega^{w,w}_{m,w}\right)$). The inequality requires that the income available to the couple (i.e., $y_{m,w}$) should not exceed this sum. If this condition were violated, then the couple (m, w) could afford a bundle that makes both members better off than the one they consume in their current marriages, and (m, w) would be a blocking pair.

Practical implementation. Interestingly, the testable conditions in Proposition 1 are linear in the unknown individual quantities, offered wages and personalized prices for a given data set $\mathcal{D}$. This means that they can be checked by simple linear programming techniques in practice.

However, the conditions are strict in nature. The observed behavior will either satisfy the constraints or not. This means that the conditions as such can (only) be used to check whether or not the data set $\mathcal{D}$ is *exactly* rationalizable. However, in reality, marriage and consumption decisions are not entirely driven by economic gains. Non-economic factors such as love and companionship also drive marital decisions. Moreover, frictions and search costs in the marriage market make that the observed behavior may not be exactly compatible with the revealed preference conditions. Following Cherchye et al. (2017), we account for these aspects by using stability indices that allow for deviations from the strict rationalizability restrictions.

Next, to deal with our large sample size and to avoid issues related to outlier behavior, we make use of subsampling to bring the rationalizability conditions to our empirical data. We randomly draw 100 subsamples of 100 households from our original sample; a sample size of 100 households represents approximately 1.6% of our original sample of 6,074 households. In our empirical analysis, we will report summary results for these 100 subsamples. A similar subsampling procedure was used by Browning et al. (2021).

For compactness, we have relegated a detailed discussion on the practical application of our revealed preference methodology to Appendix B. This appendix also outlines our approach to implementing the stability indices and subsampling procedure in our empirical analysis. Furthermore, it presents our empirical findings regarding the stability indices, and demonstrates how we can use the values of these indices to construct an adjusted data set that is effectively rationalizable by a stable matching.

3.3 Welfare Analysis

We follow conventional practice and measure individual welfare solely in terms of material consumption. In principle, one may argue that measures of individual welfare must also include time use. In fact, there may well be a trade-off between material consumption and leisure time (see, e.g., Couprie, 2007 and Bostyn et al., 2023); we will also examine this trade-off for our own data in Section 5. If such a trade-off exists, this indicates the need to consider welfare metrics that encompass both material consumption and time allocation. But then the question remains how to evaluate leisure time and domestic production. One possible choice is to use individual wages, but (shadow) wages are unobserved for the unemployed. As explained above, we treat these unobserved wages as unknowns that are subject to linear constraints. In principle, this methodology also allows us to identify these unobserved wages, but for compactness –and to focus our discussion– we do not go this route in our following analysis.[8] Still, we effectively do account for the trade-off between material consumption and leisure time in terms of producing individual utility in the marital matching restrictions that we use to identify the within-household allocations of material consumption. Conveniently, by only focusing on material consumption, our individual welfare results are more directly comparable to commonly used measures, which typically also exclude time use.

RICEBs and CEBs. In our empirical application, we will analyze individual welfare through male and female "relative individual costs of equivalent bundle" (RICEBs; see also Cherchye et al. (2020) for a detailed discussion). The RICEB of male m (resp. female $\sigma(m)$) measures the fraction of current household expenditures that m (resp. $\sigma(m)$) would need as single to purchase the same material consumption as in the given marriage. Formally, these RICEB measures are defined as follows:[9]

$$R^{m}_{m,\sigma(m)} = \frac{p_{m,\sigma(m)} q^{m}_{m,\sigma(m)} + P_{m,\sigma(m)} Q_{m,\sigma(m)}}{p_{m,\sigma(m)} q_{m,\sigma(m)} + P_{m,\sigma(m)} Q_{m,\sigma(m)}},$$
$$R^{\sigma(m)}_{m,\sigma(m)} = \frac{p_{m,\sigma(m)} q^{\sigma(m)}_{m,\sigma(m)} + P_{m,\sigma(m)} Q_{m,\sigma(m)}}{p_{m,\sigma(m)} q_{m,\sigma(m)} + P_{m,\sigma(m)} Q_{m,\sigma(m)}}.$$

The RICEBs capture the intrahousehold allocation of resources to males and females. In particular, they account for both the economies of scale that follow from public consumption and the intrahousehold sharing that corresponds to the division of private consumption. Generally, a higher share of public consumption in the household will increase the RICEBs of both spouses, reflecting the gains to marriage. In addition, at any level of public consumption, obtaining a higher share

[8]More specifically, we can (set) identify these wages in a similar way as the RICEBs, CEBs and intrahousehold shares, which we explain at the end of this section.

[9]Technically, the RICEB of male m (resp. female $\sigma(m)$) could also be defined using the prices $(p_{m,\phi}, P_{m,\phi})$ (resp. $(p_{\phi,\sigma(m)}, P_{\phi,\sigma(m)})$) that apply for m (resp. $\sigma(m)$) under singlehood. In our empirical application, however, the prices of material consumption are the same within and outside marriage, so this would not affect our conclusions. The same qualification applies to our measures of scale economies and intrahousehold sharing that we introduce below.

of private consumption will increase the RICEB of that individual and decrease the RICEB of her/his spouse. Below we will explain how we can measure the degree of scale economies and intrahousehold inequality separately in empirical analyses.

The RICEB measures can also be seen as money metric welfare indices that fix the consumption level of the individuals at their within-marriage level when evaluating their outside-marriage counterfactual situation as singles. As such, they effectively constitute Slutsky-type welfare measures. An alternative would be to consider Hicksian-type welfare measures, which fix the individuals' utilities (instead of consumption bundles) at their within-marriage levels. Such measures have been introduced by Browning et al. (2013) and Chiappori and Meghir (2015) within a collective consumption set-up similar to ours. Our (Slutsky-type) RICEB measures can be interpreted as providing upper bounds for these Hicksian-type measures.

In addition to the RICEBs, our empirical application will also consider male and female "costs of equivalent bundle" (CEBs), which express the individuals' total (i.e., private plus public) consumption in absolute expenditure terms. Formally, these CEB measures are the numerators of the RICEB measures defined above. Attractively, the CEBs allow us to conduct a poverty analysis at the level of individual members in households (rather than at the aggregate household level, which is the common practice). Our framework allows us to conduct such a poverty analysis while accounting for both economies of scale in consumption (through public consumption) and unequal intrahousehold sharing (reflecting individuals' bargaining positions). As the CEBs evaluate material consumption, such a poverty analysis is directly comparable to standard poverty analyses that are conducted at the household level (which typically ignore time use).

Scale economies and intrahousehold shares. A higher RICEB/CEB for a given individual may be due to either more public consumption within the household, reflecting scale economies, or more private consumption for the individual, reflecting a better intrahousehold bargaining position. We next introduce measures to evaluate the relative importance of these two effects.

To document the level of scale economies that arise within each couple type, we use a measure that was originally proposed by Browning et al. (2013). The measure computes the expenditures needed by household members as singles to obtain the same consumption bundles as within their current marriages. More specifically, for an observed couple $(m, \sigma(m))$, this measure is defined as:

$$R_{m,\sigma(m)} = \frac{p_{m,\sigma(m)} q_{m,\sigma(m)} + 2 \times P_{m,\sigma(m)} Q_{m,\sigma(m)}}{p_{m,\sigma(m)} q_{m,\sigma(m)} + P_{m,\sigma(m)} Q_{m,\sigma(m)}}.$$

The denominator in the above definition gives the total expenditures of the couple for the bundle $(q^m_{m,\sigma(m)}, q^{\sigma(m)}_{m,\sigma(m)}, Q_{m,\sigma(m)})$ that is consumed in the given marriage. The numerator is the sum of the expenditures the two spouses would incur if they purchased the same consumption bundle as singles (i.e., $(q^m_{m,\sigma(m)}, Q_{m,\sigma(m)})$ for male m and $(q^{\sigma(m)}_{m,\sigma(m)}, Q_{m,\sigma(m)})$ for female $\sigma(m)$) under the prevalent household prices $p_{m,\sigma(m)}$ and $P_{m,\sigma(m)}$. By construction, the value of $R_{m,\sigma(m)}$ is situated between one and two, with higher values implying greater scale economies. In the extreme case when everything is consumed privately, there are no economies of scale and $R_{m,\sigma(m)} = 1$. In the other extreme scenario, when everything is consumed publicly, the individuals would need twice the current household expenditures as singles to obtain the same consumption bundle as in their current household, which yields $R_{m,\sigma(m)} = 2$.

Next, we define the "intrahousehold share" of an individual as the ratio of (i) the expenditures this individual would need as single to consume the same bundle as in her/his current marriage over (ii) the expenditures needed by the two household members together to consume their within-marriage bundles as singles (i.e., the numerator of our scale economies measure above). Formally, these intrahousehold shares are defined as follows for male m and female $\sigma(m)$ in the couple $(m, \sigma(m))$:

$$\gamma^m_{m,\sigma(m)} = \frac{p_{m,\sigma(m)} q^m_{m,\sigma(m)} + P_{m,\sigma(m)} Q_{m,\sigma(m)}}{p_{m,\sigma(m)} q_{m,\sigma(m)} + 2 \times P_{m,\sigma(m)} Q_{m,\sigma(m)}},$$
$$\gamma^{\sigma(m)}_{m,\sigma(m)} = \frac{p_{m,\sigma(m)} q^{\sigma(m)}_{m,\sigma(m)} + P_{m,\sigma(m)} Q_{m,\sigma(m)}}{p_{m,\sigma(m)} q_{m,\sigma(m)} + 2 \times P_{m,\sigma(m)} Q_{m,\sigma(m)}}.$$

By construction, intrahousehold shares take values between zero and one. They quantify the level of inequality in the intrahousehold allocation of resources. If everything is consumed equally by the household members, the intrahoushold share of each spouse will equal exactly one half. By contrast, if only one spouse consumes all household expenditures, there is no public consumption and all private goods are consumed by this one member), then the intrahousehold share of this member will be one and that of the other member will be zero. Generally, higher intrahousehold shares reflect better intrahousehold bargaining positions.

Set identification. In our following empirical analysis, we use the rationalizability conditions in Proposition 1 to "set" identify the RICEBs, CEBs and intrahousehold shares that we defined above. In practice, this requires computing upper and lower bounds that define an interval containing all values for these measures that are consistent with our rationalizability restrictions. Conveniently, because the measures are linear in the unknown personalized quantities $q^m_{m,\sigma(m)}$ and $q^{\sigma(m)}_{m,\sigma(m)}$, this set identification can advance through the utilization of standard linear programming techniques. We refer to Appendix B for an in-depth explanation of how the set identification operates in practice.

4 Empirical Welfare Analysis

We next turn to evaluating the welfare of the individuals in our PSID sample. We start by providing additional details on our data set and the set-up of our empirical analysis, thus complementing our introductory analysis in Section 2. In a following step, we present our RICEB and CEB estimates for the individuals under consideration, hereby paying specific attention to how the RICEBs vary as a function of spouses' employment status and education levels. We then use these RICEB estimates to analyze households' economies of scale and within-household sharing patterns. We conclude by assessing poverty at the individual level for the different employment-education types that we study, on the basis of our CEB results.

4.1 Data and Set-up

Table 5 provides more summary statistics for the sample we introduced in Section 2. About 18% of the individuals in our sample are unemployed: 18-19% of the married females and singles, and 10% of the married males. For the employed, wages are expressed as net hourly wages. On average, married males earn more than their female counterparts, and married individuals earn more than their single counterparts. Labor hours, household work hours and leisure hours are the weekly hours spent on market work, household production (including childcare) and leisure. Private and public consumption are expressed as Hicksian aggregate expenditures, in dollars per week. We assume that expenditures on food and drinks (at home and outside), schooling, computer, and recreation are privately consumed. Expenditures on vacation, housing, transportation, childcare and healthcare are assumed to be partly public and partly private.[10] Following Cherchye et al. (2017), we assume that 50% of these expenditures within households is privately consumed, while the other 50% is publicly consumed.[11] Table 5 further reports on household characteristics such as the presence of children and the age and education level of the adult individuals.

Labor supply setting. Following our presentation in Section 3, we consider a labor supply setting in which a household's full income is spent on material consumption and time use. Material consumption comprises public and private (Hicksian) components. Private material consumption is not assignable to the individual

[10]We implicitly presume that spending on children is accounted for within the preferences of parents through either individual or public consumption. For alternative methods of addressing children within collective consumption models, we refer to Bargain and Donni (2012), Cherchye et al. (2012b), and Dunbar et al. (2013).

[11]This implies average scale economies of 1.37 for the couples in our sample, with a minimum of 1.11 and a maximum of 1.50; see also Section 4.3 for more details. These economies of scale are similar in magnitude to those estimated in the literature; see Table 25 in Appendix D.2 for a summary of estimates of household scale economies and categorizations of private and public goods made in the literature. As a further robustness check, we also consider the scenario in which the degree of public consumption is endogenously identified through Barten scales (using the method of Cherchye et al., 2020). Specifically, instead of assuming that we know which expenditures are public and private, we now put bounds of [40%, 60%] and [30%, 70%] on the degree of publicness in the total household consumption. We find that the main qualitative conclusions of our empirical analysis remain intact. See Appendix D.2.

Table 5: Summary statistics

	couples		singles	
	male	female	male	female
N	2960	2960	1206	1908
employment = yes (in %)	90.33	82.09	81.18	81.39
presence of children = yes (in %)	51.86	51.86	10.70	35.48
education = low (in %)	41.05	30.07	46.27	39.67
$25 \leq$ age ≤ 35 (in %)	24.29	29.80	44.28	32.18
$36 \leq$ age ≤ 50 (in %)	42.09	41.18	31.76	33.07
$51 \leq$ age ≤ 65 (in %)	33.61	29.02	23.96	34.75
hourly wage	32.95	24.60	23.42	20.02
labor hours	38.21	29.43	32.16	28.94
household work hours	15.53	28.40	12.58	19.56
leisure hours	58.26	54.17	67.25	63.50
private consumption	774.98	774.98	422.97	416.12
public consumption	453.12	453.12	228.32	241.39

household members. Further, an individual's time is spent on market work, leisure and household production. Hours spent on leisure represent private consumption that is fully assignable, while hours spent on household production represent public consumption.

Further, we compute a consumption-based household nonlabor income by subtracting the labor income from the observed household consumption expenditures. We treat individual nonlabor incomes associated with outside situations as unknowns that are subject to the condition that they must add to the total nonlabor income in the current marriage. Following Cherchye et al. (2017), we further restrict individual post-divorce nonlabor incomes to lie between 40% and 60% of the current total nonlabor income. Moreover, we assume that wages outside marriage are the same as inside marriage (i.e., exiting marriage does not affect labor productivity). In principle, the wages and incomes in the counterfactual situations of being single or with a different partner can also be imputed. However, the wage rate inside marriage is arguably a good benchmark when individuals compare their opportunity sets inside their current marriage and outside marriage as a single or with a different partner.

Importantly, the offered wages are only observed for individuals who participate actively in the labor market. For those individuals, we incorporate this information into our rationalizability conditions. However, for the unemployed, we regard the offered wages as unknowns (see Proposition 1).[12]

Age-restricted marriage markets. Our empirical strategy is to model household allocations of material consumption and time use under the assumption that the observed marriage allocation is stable. When it comes to operationalizing our marital stability conditions, it may well be argued that the individuals in our sample do not consider each individual of the opposite gender as a potential mate. Therefore, we define individual-specific marriage markets on the basis of age differences. More specifically, each male's set of potential partners includes all females (single or married) who are at most 7 years older and 12 years younger than him. Conversely, each female's set of potential partners consists of all males that are at most 7 years younger and 12 years older. These age brackets are defined on the basis of the age differences between spouses in observed couples in the sample; they correspond to the 2.5th and 97.5th percentiles of the age difference distribution in our sample of couples.

4.2 Relative Individual Cost of Equivalent Bundle

Panels A and B of Table 6 report the identified RICEB bounds for males and females, respectively.[13] The results show that our revealed preference method has significant identifying power: the lower and upper bounds are informatively close to each other.

[12]As a robustness check, we also consider scenarios where we restrict the shadow wages of the inactive spouses to be close to (or equal to) the average observed wages of similar individuals. Comfortingly, putting these extra restrictions on the shadow wages does not change our main empirical conclusions. See Appendix D.1.

[13]As discussed in Appendix B, by starting from our revealed preference characterization of marital stability, we can use linear programming to define lower and upper bounds on these average RICEBs, thus obtaining set identification. Our subsampling procedure yields multiple values of these bounds for every female and male education-employment type in our sample. We use the averages of the bounds as our lower and upper bound estimates for the individual RICEBs.

Some interesting patterns emerge. First, we find that employed individuals have significantly higher RICEBs than their unemployed counterparts. This is true for both genders and both education levels. Second, for both education levels, employed males have substantially higher RICEBs than their female counterparts. Third, among unemployed individuals, the average male and female RICEBs are of similar magnitude. These observations imply that the increase in resource shares when going from unemployed to employed is higher for males than for females. Notably, these employment effects generally dominate the education effects for both genders.

Table 6: RICEBs

employment	education	lower	upper
A: male			
no	low	48.86	63.42
no	high	46.06	58.26
yes	low	72.36	80.84
yes	high	74.23	84.30
B: female			
no	low	46.86	56.01
no	high	44.02	50.48
yes	low	59.56	68.20
yes	high	57.54	68.40

Each row in Table 6 shows the average RICEB bounds over all individuals of a given type. Importantly, however, intrahousehold resource allocations may also vary depending on the spousal type. We explore this further by making a distinction based on the employment status and education level of the spouse for each male and female type. Table 7 shows our results for males, and Table 8 for females. The panels A1-A4 and B1-B4 correspond to the four employment-education types of the two genders. For each of these categories, we provide the lower and upper RICEB bounds based on the spouse's type, along with the lower and upper CEB bounds, which are expressed in absolute expenditure terms. We will use these CEB results for our poverty analysis in Section 4.4. At this point, it is interesting to compare these CEBs to the average weekly expenditures of singles of a given type (in our sample), which are given in the last column of Tables 7 and 8. We find that married individuals are generally better off in material terms than singles of the same type, independent of the spousal type. This reflects the scale economies that are intrinsic to multi-person household consumption. We will investigate these scale economies in more detail in Section 4.3.

The RICEB results enable us to examine the effect of the spouses' employment status and education levels on the intrahousehold distribution of material welfare. We observe substantial heterogeneity in the identified RICEBs. Table 7 reveals that, for any male type, changing the wife's employment status from unemployed to employed results in a substantial drop in the male's RICEB. We find a similar pattern for the female RICEBs in Table 8. Comparing panel A3 in Table 7 with panel B3 in Table 8 suggests that the RICEB of a low educated employed female who is matched with a high educated male is below the RICEB of a low educated employed male matched with a high educated female. Similarly, comparing panel A4 in Table 7 with panel B4 in Table 8, we find that the RICEB of a high educated employed female who is matched with an employed male is lower than that of a high educated employed male matched with an employed female. Again, the employment effects are substantially more pronounced than the education effects.

4.3 Economies of Scale and Intrahousehold Sharing

We begin by documenting the level of economies of scale that arise within each couple type. Table 9 reports the average level of scale economies for each couple type. On average, individuals in couples would need between 34% to 40% more expenditures as singles to purchase the same material goods as in their current marriages. We also observe some heterogeneity across household types. Most notably, households with high educated females are generally characterized by a higher share of public consumption and, therefore, realize more scale economies. As these households typically have higher total consumption expenditures than households with low educated females, they achieve greater material gains to marriage. Generally, however, we find

Table 7: Male RICEBs and CEBs by spousal type

couples						singles
spousal type		RICEB		CEB		weekly
employment	education	lower	upper	lower	upper	expenditure
A1: male employment = no, education = low						
no	low	50.53	71.09	387.11	532.86	360.41
no	high	60.71	87.97	445.07	630.88	
yes	low	43.34	51.33	311.63	369.39	
yes	high	42.58	49.25	423.67	496.84	
A2: male employment = no, education = high						
no	low	60.34	88.04	592.61	846.56	571.94
no	high	58.33	81.76	839.86	1166.6	
yes	low	42.36	54.07	326.13	395.23	
yes	high	39.51	45.73	495.36	578.34	
A3: male employment = yes, education = low						
no	low	86.77	92.46	801.21	849.34	592.68
no	high	92.44	96.25	826.84	852.78	
yes	low	73.37	81.09	748.84	830.88	
yes	high	66.94	76.96	784.70	909.19	
A4: male employment = yes, education = high						
no	low	87.26	94.99	1065.80	1126.80	780.77
no	high	91.84	95.56	1354.30	1403.20	
yes	low	75.27	82.31	933.19	1018.00	
yes	high	70.63	82.19	1023.50	1181.70	

Table 8: Female RICEBs and CEBs by spousal type

couples						singles
spousal type		RICEB		CEB		weekly
employment	education	lower	upper	lower	upper	expenditure
B1: female employment = no, education = low						
no	low	65.25	85.81	461.56	607.31	358.30
no	high	50.00	77.68	554.99	808.93	
yes	low	41.08	46.77	393.56	441.69	
yes	high	40.24	47.97	463.62	524.63	
B2: female employment = no, education = high						
no	low	51.29	78.55	411.10	596.92	524.75
no	high	56.19	79.62	883.52	1210.20	
yes	low	39.79	43.60	351.68	377.62	
yes	high	40.82	44.53	567.60	616.53	
B3: female employment = yes, education = low						
no	low	85.65	93.63	625.33	683.09	604.24
no	high	79.62	90.74	592.24	661.35	
yes	low	55.56	63.28	562.92	644.97	
yes	high	54.64	61.68	605.43	690.27	
B4: female employment = yes, education = high						
no	low	89.09	95.76	889.28	962.45	768.10
no	high	89.92	96.14	1105.00	1187.90	
yes	low	60.31	70.32	707.26	831.75	
yes	high	54.96	66.51	759.53	917.67	

that the scale economies effects of spouses' education levels and employment status are fairly modest.

Table 9: Economies of scale and male intrahousehold shares per couple type

male		female		total	scale	male intrahousehold share	
employment	education	employment	education	consumption	economies	lower	upper
no	low	no	low	634.53	1.36	0.40	0.54
		no	high	679.70	1.40	0.45	0.61
		yes	low	722.88	1.36	0.32	0.37
		yes	high	1040.27	1.38	0.30	0.34
no	high	no	low	955.84	1.38	0.41	0.58
		no	high	1589.03	1.38	0.43	0.58
		yes	low	788.21	1.34	0.33	0.41
		yes	high	1218.56	1.36	0.29	0.33
yes	low	no	low	840.76	1.35	0.65	0.68
		no	high	917.59	1.36	0.66	0.69
		yes	low	997.25	1.36	0.55	0.60
		yes	high	1188.65	1.37	0.49	0.56
yes	high	no	low	1170.13	1.35	0.65	0.70
		no	high	1415.54	1.37	0.69	0.71
		yes	low	1166.26	1.37	0.57	0.62
		yes	high	1425.69	1.37	0.52	0.61

Let us then turn to the employment and education effects on within-household inequality. Table 9 shows our lower and upper bound estimates for the male intrahousehold shares. It suffices to only report the male intrahousehold shares; by construction, female shares equal one minus these male shares. It follows from our above explanation that share values closer to (resp. farther away from) one half reveal a more (resp. less) equal intrahousehold allocation, with higher values revealing greater consumption by the male.

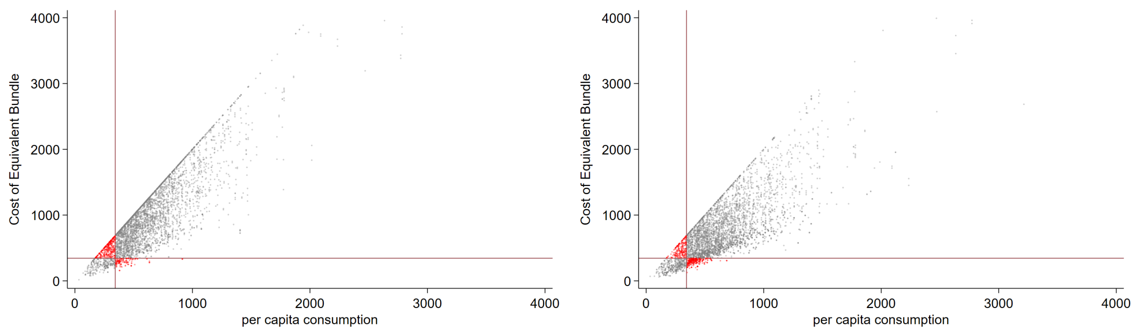
We find that couples composed of similar female and male types are more likely to have an egalitarian distribution. By contrast, couples in which only of the spouse is employed reveal a substantial degree of inequality. For example, the intrahousehold share of a low educated employed male matched with a low educated unemployed female amounts to about two thirds (i.e., between 65% and 68%), while the share of a low educated unemployed male matched with a low educated employed female equals no more than about one third (i.e., between 32% and 37%). Once more, the employment effects are substantially stronger than the education effects.

4.4 Poverty Analysis

Our framework allows us to conduct a poverty analysis directly at the level of individuals rather than at the level of aggregate households (as is commonly done), hereby specifically accounting for unequal intrahousehold sharing of resources. To motivate the relevance of such an individual-based poverty analysis, we begin by comparing our (midpoint) estimates of the CEBs (summarized in Table 6 above) to poverty thresholds; and we contrast this comparison with one that is based on per-capita consumption, which equals half of total household consumption for couples (implicitly assuming equal intrahousehold sharing). Specifically, Figure 1 plots our estimated CEBs for married individuals as well as the per-capita household consumption, for males (left panel) and females (right panel). Each dot corresponds to an individual in one of our subsamples, and we show the results for all 100 subsamples together. As our poverty threshold we use 60% of the median per-capita household consumption in our sample; this threshold is represented by the solid lines in Figure 1.

We partition these plots for males and females into four regions depending on whether an individual's estimated cost of the equivalent bundle or per-capita consumption is above or below the poverty threshold. For individuals who are situated in the lower-left quadrants, both the CEB-based measure and the per-capita measure yield the conclusion that these individuals are poor. Similarly, for individuals in the upper-right quadrants, both measures agree that the individuals are non-poor. However, individuals in the lower-right quadrants are misclassified as non-poor by the per-capita measure (relative to the CEB-based measure), whereas individuals in the upper-left quadrants are misclassified as poor. We observe that these misclassifications apply to a significant portion of men and women in our sample. Figures 3 and 4 in Appendix E show similar graphs based on individuals' education levels. We find that low educated married men are more likely to be misclassified as poor, while both low educated and high educated married women are about equally likely to be misclassified as either poor or non-poor.

Figure 1: CEBs and per-capita consumption



Male Female

To quantify the impact of economies of scale and within-household sharing patterns on individual poverty, we next perform two different exercises. In our first exercise, we define the poverty rate in the usual way, as the percentage of households with consumption below the poverty line. Like before, per-capita consumption equals half of the total household consumption for couples; and it is equal to the total household consumption for singles. Households with a consumption level below this poverty line are considered poor. This also measures individual poverty as if there are no economies of scale and household resources are shared equally between the household members. The results of this exercise are presented in Table 10 under the heading "no economies of scale, equal sharing". We find that the poverty rate decreases with employment and education. As expected, poverty is highest among low educated and unemployed individuals: 49.73% (44.27%) of the couples with a low educated and unemployed male (female) are labeled as poor. In a similar vein, poverty is lowest among high educated individuals who are employed: 7.18% (7.77%) of the couples with a high educated and employed male (female) are labeled poor.

In our second exercise, we consider the possibility that total household consumption exceeds expenditures due to economies of scale, while also accounting for unequal resource allocation among household members. This boils down to computing poverty rates on the basis of our CEB estimates. In particular, we identify an in-

Table 10: Poverty rates (in %)

		couples			singles
		no economies of scale, equal sharing	with economies of scale, unequal sharing		
employment	education		lower	upper	
A: male					
no	low	49.73	43.80	54.38	62.35
no	high	21.35	27.44	32.31	38.46
yes	low	21.41	8.54	13.26	27.02
yes	high	7.18	3.83	7.00	9.26
total		15.27	8.99	12.85	23.80
B: female					
no	low	44.27	44.40	51.83	58.90
no	high	18.28	24.69	27.84	34.56
yes	low	23.41	16.12	23.52	19.89
yes	high	7.77	6.64	11.06	7.98
total		15.27	14.04	19.68	19.08

dividual as poor if her or his CEB is below the poverty line that we defined above. Similar to before, we identify lower and upper bounds for the poverty rate of each individual type in every subsample, and we report the mean of the identified bounds across the subsamples. The results of this exercise are given in Table 10 under the heading "with economies of scale, unequal sharing". Comparing these results with the ones of our first exercise shows that poverty rates can be significantly lower or higher for certain types because of unequal sharing. Employed men have poverty rates well below the ones computed under the assumption of equal sharing, while we observe no such effect for employed women. By contrast, unemployed women tend to suffer from unequal sharing: the lower and upper rates of female poverty are above the ones computed under the standard assumption of equal sharing. In our opinion, these results highlight the importance of explicitly considering the unemployed in individual welfare analyses, as they are often most vulnerable to poverty.

As a further analysis, we investigate the variation in individual poverty depending on the type of the spouse. Table 11 shows individual poverty rates of every male type as a function of the spousal type. For reference, we also show the poverty rate of single males of each type (first row in each panel). The results document the prevalence of within-type variation in individual poverty rates depending on who the person is matched with. For each male type, matching with a high educated spouse generally reduces the incidence of poverty. This is driven by a higher total consumption of these households (see Table 3). Interestingly, even though males matched with an employed spouse enjoy higher total consumption, unequal sharing can shift resources towards females, which may drive up the male poverty rates. Like before, the employment effects are stronger than the education effects.

Table 12 has a directly similar interpretation as Table 11 but applies to females. Analogous to before, women matched with employed and high educated males generally have lower poverty rates. This is again driven by higher total consumption of the household. However, unequal sharing significantly deteriorates the poverty rates of women who are matched with employed spouses: both lower and upper bounds on individual poverty rates are higher than the ones computed under the assumption of equal sharing. On the other hand, unequal sharing also means that employed women matched with unemployed men are less likely to experience poverty.

5 Material Welfare versus Time Use

The analysis in the previous section follows conventional standards by emphasizing material consumption. However, time use is another crucial aspect of individual welfare. Therefore, we conclude our empirical analysis by examining the trade-off between material consumption and leisure time.

As a first exercise, Figure 2 shows the relation between leisure time and our RICEB measure of individual welfare. It presents binned scatter plots to describe the mean relationship between the identified RICEB and the observed leisure consumption for males and females, respectively.[14] Intuitively, it divides the data into

[14]For the sake of illustration, we use the midpoint of the lower and upper bounds of the identified RICEB as the dependent variable. However, our conclusions are the same when considering the

Table 11: Male poverty rates by spousal type

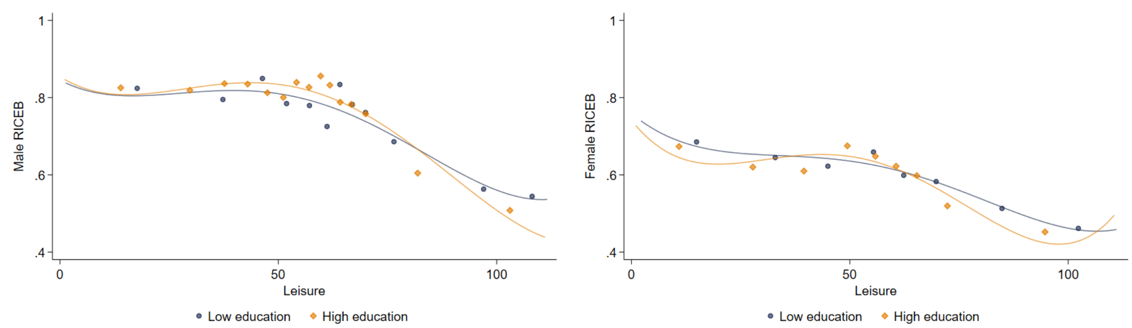
spousal type		no economies of scale, equal sharing	with economies of scale, unequal sharing	
employment	education		lower	upper
A1: male employment = no, education = low				
no	low	66.67	31.64	61.73
no	high	55.56	37.50	46.88
yes	low	50.00	53.72	68.33
yes	high	22.73	45.32	48.25
A2: male employment = no, education = high				
no	low	50.00	26.92	42.31
no	high	9.52	4.41	4.41
yes	low	37.50	47.83	54.35
yes	high	16.07	27.59	32.69
A3: male employment = yes, education= low				
no	low	41.26	7.97	11.34
no	high	28.33	11.40	13.16
yes	low	23.43	9.10	13.32
yes	high	12.04	8.13	10.37
A4: male employment = yes, education = high				
no	low	21.74	10.17	13.28
no	high	11.83	1.50	2.27
yes	low	12.10	10.04	13.43
yes	high	5.43	3.18	5.82

Table 12: Female poverty rates by spousal type

spousal type		no economies of scale, equal sharing	with economies of scale, unequal sharing	
employment	education		lower	upper
B1: female employment = no, education = low				
no	low	66.67	28.24	35.65
no	high	50.00	23.08	38.46
yes	low	41.26	54.58	57.66
yes	high	21.74	36.72	41.53
B2: female employment = no, education = high				
no	low	55.56	39.06	60.94
no	high	9.52	7.35	13.24
yes	low	28.33	54.97	61.99
yes	high	11.83	18.86	21.42
B3: female employment = yes, education = low				
no	low	50.00	9.62	13.97
no	high	37.50	2.17	17.39
yes	low	23.43	20.43	30.19
yes	high	12.10	12.74	18.15
B4: female employment = yes, education = high				
no	low	22.73	0.58	2.92
no	high	16.07	0.93	6.02
yes	low	12.04	8.12	14.03
yes	high	5.43	7.54	11.94

bins according to the value of leisure hours, and then calculates the average RICEB for individuals with leisure hours lying in each bin. The points in these plots show the sample averages in each bin. Additionally, the solid lines show piece-wise polynomial fits of degree four to the binned scatter plots; see Cattaneo, Crump, Farrell, and Feng (2022) for more details on the binned scatter plot procedure that we use. We implement this procedure for the two education classes separately, but we present the two plots in a single figure. Both plots in Figure 2 clearly reveal a trade-off between RICEB and consumed leisure: individuals with higher leisure consumption generally have lower RICEB. This clearly suggests that lower material consumption may be compensated through more leisure.

Figure 2: RICEBs and leisure; by education



Male Female

Expanding upon these findings, we use our PSID data to evaluate the "time poverty" experienced by individuals in our sample. The concept of time poverty pertains to the lack of adequate time available to individuals to engage in activities that are essential for their well-being, such as leisure, family time, self-care, and community engagement. It highlights the imbalance between the time people have and the activities they need or want to pursue. Clearly, time poverty is a multifaceted concept that reflects the insufficient allocation of time to meet various personal and societal needs. In principle, measurement requires consideration of both the quan-

lower or upper bounds separately. See Appendix F, which also shows the correlation between our RICEB estimates and housework time, as well as our CEB estimates and leisure time.

tity and quality of time available to individuals across different domains of life; see Williams, Masuda, and Tallis (2016) for a general discussion.

We make use of a "relative" measure of time poverty. This measure mirrors the poverty measure of material consumption that we utilized in the preceding section. Specifically, we label an individual as "time poor" if her or his leisure time is below 60% of the median leisure time of the individuals in our sample (which equals 36 hours per week). Arguably, this is a rather basic measure of time poverty, yet it effectively serves our purpose in illustrating the potential trade-off between consumption of material goods and time allocation.

Table 13 reports time poverty rates for the different employment-education types in our sample. These results are directly comparable to those presented in Table 10 regarding material poverty. There is an obvious trade-off: while material poverty tends to decrease with employment, we observe that time poverty actually increases with employment. The impacts of education on time poverty are somewhat more varied. The trade-off is further illustrated in Table 14, which reports the proportions of individuals categorized as poor and non-poor in both the dimensions of time and material consumption: only a very small fraction of individuals turns out to be poor in both dimensions. Finally, a noteworthy observation from Tables 13 and 14 is that women typically experience greater levels of time poverty compared to men. The gender gap seems notably more pronounced in this aspect than in material consumption.

6 Conclusion

We have presented a structural empirical analysis of how labor market participation impacts individual welfare. Existing applications of collective consumption models that account for households' consumption and time use allocations typically only consider households where all adult members are employed. By contrast, we have adopted a collective consumption framework that enables us to study household allocations of both time use and material consumption in the presence of households with unemployed adults. Our framework allows us to analyze individual welfare while

Table 13: Time poverty rates (in %)

employment	education	couples	singles
A: male			
no	low	0.55	1.85
no	high	3.88	0.00
yes	low	14.24	11.36
yes	high	15.35	9.78
total		13.65	8.71
B: female			
no	low	19.08	2.74
no	high	17.91	5.15
yes	low	22.93	17.66
yes	high	24.86	16.26
total		23.31	14.31

Table 14: Poverty classification

	material poverty = yes	material poverty = no
A: married male		
time poverty = yes	0.24	12.26
time poverty = no	7.97	79.54
B: married female		
time poverty = yes	2.12	21.05
time poverty = no	13.35	63.49
C: single male		
time poverty = yes	0.69	7.96
time poverty = no	22.10	69.25
D: single female		
time poverty = yes	1.25	13.20
time poverty = no	18.52	67.02

accounting for labor force participation, intrahousehold consumption inequality and economies of scale characterizing multi-person households. Our methodology follows a revealed preference approach that is intrinsically nonparametric, making it robust to functional specification error. It (only) assumes a single consumption observation per household and fully heterogeneous individual preferences and intrahousehold decision processes across households.

Our empirical application used cross-sectional data from the US Panel Study of Income Dynamics (PSID) and comprised 9,034 adult individuals, of which about 18% is unemployed. We first examined intrahousehold consumption allocations by identifying the relative individual costs of equivalent bundles (RICEBs) and costs of equivalent bundles (CEBs) for the married individuals in our sample. Our specific focus was on identifying the average RICEBs for four female and male types defined in terms of employment status (employed and unemployed) and education (low education and high education). We studied heterogeneity in resource sharing across households with different female and male types, and we used our identification results for the CEBs to conduct a poverty analysis at the level of individual household members.

We documented that individuals' intrahousehold bargaining power (and, thus, individual welfare) varies significantly with their own and spousal characteristics. Our findings reveal that education has a fairly modest effect on intrahousehold inequality, while the effect on individual poverty is more substantial and negative. Low educated men and women are generally more vulnerable to poverty than high educated men and women for the different household types that we study.

The main empirical contribution of our study is that we also study the welfare impact of employment status, and we find that these (un)employment effects systematically dominate the education effects. First, unemployed individuals generally have lower RICEBs than their employed counterparts. Second, employed women typically have lower intrahousehold resource shares than their male counterparts. Third, we identify substantial within-type heterogeneity in resource shares depending on who is matched to whom. For any female and male type, being matched with an employed spouse results in a lower RICEB than being matched with an unemployed spouse. Finally, our poverty analysis shows that unequal division of household resources substantially exacerbates the poverty rate. In particular, we find that ignoring within-household inequality makes that poverty among unemployed individuals is underestimated. From a policy perspective, our findings strongly motivate accounting for these different aspects in poverty and inequality analyses, particularly when focusing on the welfare of the unemployed.

In our analysis, we have adhered to standard practice by assessing individual well-being solely through material consumption. As demonstrated in Section 5, however, there appears to be a potential trade-off between material consumption and leisure time: lower material consumption may be compensated through more leisure. This suggests the consideration of welfare metrics that incorporate both material consumption and time allocation. While we did not pursue this approach in the present study, we view the exploration of such metrics as a compelling direction for future research.

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Appendix A Proof of Proposition 1

In the main text, we denoted by q and Q the material (market-purchased) private and public consumption in the household, by l the privately consumed leisure, and by h the publicly consumed household production. For the sake of the exposition, in our proof we will assume that for any household the entire set of private goods is denoted by $q \in \mathbb{R}^n_+$ (which includes both market-purchased private goods and leisure) and the entire set of public goods is denoted by $Q \in \mathbb{R}^N_+$ (which includes both market-purchased public goods and household production by the two spouses). Thus, for any pair (m, w), $(q_{m,w}, Q_{m,w})$ represents the entire aggregate consumption bundle of private and public goods. Similarly, let $p \in \mathbb{R}^n_{++}$ and $P \in \mathbb{R}^N_{++}$ denote the price of private and public goods, respectively.

Our proof builds on Crawford and Polisson (2015), Cherchye et al. (2017) and Browning et al. (2021). The optimization problem for any pair (m, w) involves maximization of a weighted sum of individual utilities subject to a linear budget constraint and rationing constraints. We use rationing constraints to model the labor supply decision. Following Varian (1983), these rationing constraints are formulated as $a_{m,w}q + A_{m,w}Q \leq b_{m,w}$, assuming $a_{m,w} \geq 0$, $A_{m,w} \geq 0$ and $b_{m,w} \geq 0$ for all (m, w). Indeed, individual i's time constraint ($l^i + h^i \leq T$) is effectively a rationing constraint, which is binding (i.e., $l^i + h^i = T$) when the individual does not participate in the labor market. The optimization problem is then given by

$$\max_{q^m, q^w, Q} u^m(q^m, Q) + \mu_{m,w} u^w(q^w, Q) \quad \text{such that}$$

$$p_{m,w}(q^m + q^w) + P_{m,w}Q \leq y_{m,w},$$

$$a_{m,w}q + A_{m,w}Q \leq b_{m,w}.$$

Assuming differentiability of the utility functions, the couple's first order conditions are

$$\frac{\partial u^m}{\partial q_k^m} = \lambda_{m,w}\Big(p_{m,w,k} + \frac{a_{m,w,k}\gamma_{m,w}}{\lambda_{m,w}}\Big) \quad \text{for all } q_k^m,$$
$$\mu_{m,w}\frac{\partial u^w}{\partial q_k^m} = \lambda_{m,w}\Big(p_{m,w,k} + \frac{a_{m,w,k}\gamma_{m,w}}{\lambda_{m,w}}\Big) \quad \text{for all } q_k^w,$$
$$\frac{\partial u^m}{\partial Q_l} + \mu_{m,w}\frac{\partial u^w}{\partial Q_l} = \lambda_{m,w}\Big(P_{m,w,l} + \frac{A_{m,w,l}\gamma_{m,w}}{\lambda_{m,w}}\Big) \quad \text{for all } Q_l,$$
$$\lambda_{m,w} \geq 0,\ \gamma_{m,w} \geq 0,\ \gamma_{m,w} = 0 \ \text{ if } a_{m,w}q + A_{m,w}Q < b_{m,w}$$

where the multiplier $\lambda_{m,w}$ is the marginal utility of income and the multiplier $\gamma_{m,w}$ is the marginal cost of rationing the goods. We can represent the demand generated under this scenario by considering an optimization problem where we replace the market prices with “support” prices. The support prices are such that an unrationed decision problem would generate exactly the same demands as those generated under rationing. Let us denote the support price of the k-th private good by $\pi_{m,w,k}$ and the support price of the l-th public good by $\Pi_{m,w,l}$. We have,

$$\pi_{m,w,k} = p_{m,w,k} + \frac{\gamma_{m,w}a_{m,w,k}}{\lambda_{m,w}} \quad \text{for all } q_k,$$
$$\Pi_{m,w,k} = P_{m,w,k} + \frac{\gamma_{m,w}A_{m,w,l}}{\lambda_{m,w}} \quad \text{for all } Q_l,$$
$$\text{with } \gamma_{m,w} = 0 \ \text{ if } a_{m,w}q + A_{m,w}Q < b_{m,w}.$$

These support prices are identical to the market prices for unrationed goods purchased in the market and equal to ‘virtual’ prices for rationed goods. These virtual prices can be interpreted as the lowest prices consistent with rationed demands in the absence of rationing constraints. Using these support prices, we can represent the demand of the above optimization problem as the solution to the following optimization problem:

$$\max_{q^m, q^w, Q} u^m(q^m, Q) + \mu_{m,w} u^w(q^w, Q) \quad \text{subject that}$$
$$\pi_{m,w}(q^m + q^w) + \Pi_{m,w} Q \leq y_{m,w}.$$

Necessity. Towards a contradiction, suppose that the matching is stable and there is a pair (m, w) such that for all support vectors $\pi_{m,w}$, $\Pi^m_{m,w}$, $\Pi^w_{m,w}$ with $\Pi^m_{m,w} + \Pi^w_{m,w} = \Pi_{m,w}$, it is the case that

$$y_{m,w} > \pi_{m,w}(q^m_{m,\sigma(m)} + q^w_{\sigma(w),w}) + \Pi^m_{m,w} Q_{m,\sigma(m)} + \Pi^w_{m,w} Q_{\sigma(w),w}.$$

We first show that under the assumptions stated above, there is an allocation $(q^m_{m,w}, q^w_{m,w}, Q_{m,w})$ within the budget of (m, w) such that either $u^m(q^m_{m,w}, Q_{m,w}) \geq u^m(q^m_{m,\sigma(m)}, Q_{m,\sigma(m)})$ or $u^w(q^w_{m,w}, Q_{m,w}) \geq u^w(q^w_{\sigma(w),w}, Q_{\sigma(w),w})$. Let us assume that $(q^m_{m,w}, q^w_{m,w}, Q_{m,w})$ is a Pareto efficient allocation for the couple (m, w) and let $\pi_{m,w}$, $\Pi^m_{m,w}$, $\Pi^w_{m,w}$ with $\Pi^m_{m,w} + \Pi^w_{m,w} = \Pi_{m,w}$, be the support price vectors. By the second fundamental theorem of welfare economics, the optimization problem of the couple can be decentralized by a division of the total income $y_{m,w} = y^m_{m,w} + y^w_{m,w}$ such that

$$(q^m_{m,w}, Q_{m,w}) \in \text{ arg max } u^m(q^m, Q) \text{ such that } \pi_{m,w} q^m + \Pi^m_{m,w} Q \leq y^m_{m,w},$$
$$(q^w_{m,w}, Q_{m,w}) \in \text{ arg max } u^w(q^w, Q) \text{ such that } \pi_{m,w} q^w + \Pi^w_{m,w} Q \leq y^w_{m,w}.$$

Given that for all support vectors $\pi_{m,w}$, $\Pi^m_{m,w}$, $\Pi^w_{m,w}$ with $\Pi^m_{m,w} + \Pi^w_{m,w} = \Pi_{m,w}$, it is the case that

$$y_{m,w} > \pi_{m,w}(q^m_{m,\sigma(m)} + q^w_{\sigma(w),w}) + \Pi^m_{m,w} Q_{m,\sigma(m)} + \Pi^w_{m,w} Q_{\sigma(w),w}.$$

It must be that either

$$y^m_{m,w} > \pi_{m,w} q^m_{m,\sigma(m)} + \Pi^m_{m,w} Q_{m,\sigma(m)}, \text{ or } y^w_{m,w} > \pi_{m,w} q^w_{\sigma(w),w} + \Pi^w_{m,w} Q_{\sigma(w),w}.$$

This implies either

$$u^m(q^m_{m,w}, Q_{m,w}) > u^m(q^m_{m,\sigma(m)}, Q_{m,\sigma(m)}), \text{ or } u^w(q^w_{m,w}, Q_{m,w}) > u^w(q^w_{\sigma(w),w}, Q_{\sigma(w),w}).$$

Without loss of generality, assume that there is a bundle within the budget of (m, w) which gives m at least as much utility as the bundle $(q^m_{m,\sigma(m)}, Q_{m,\sigma(m)})$. Consider the following optimization problem

$$\begin{aligned}
(q^m_{m,w}, q^w_{m,w}, Q_{m,w}) \in \arg\max\ u^w(q^w, Q) \text{ such that} \\
\pi_{m,w}(q^m + q^w) + \Pi_{m,w}Q \leq y_{m,w} \\
u^m(q^m, Q) \geq u^m(q^m_{m,\sigma(m)}, Q_{m,\sigma(m)}).
\end{aligned}$$

The above problem is feasible and the solution to the problem will be Pareto efficient. Further, note that the second constraint will be binding (i.e., $u^m(q^m_{m,w}, Q_{m,w}) = u^m(q^m_{m,\sigma(m)}, Q_{m,\sigma(m)})$). Let $(\pi_{m,w}, \Pi^m_{m,w})$ be the gradient of the hyperplane through the bundle $(q^m_{m,w}, Q_{m,w})$ tangent to the indifference curve for this utility level and let $(\pi_{m,w}, \Pi^w_{m,w})$ be the slope of a hyperplane through the bundle $(q^w_{m,w}, Q_{m,w})$ tangent to the indifference curve for w for the utility level $u^w(q^w_{m,w}, Q_{m,w})$. Because preferences are quasi-concave, such hyperplane exists. Moreover, as the bundle $(q^m_{m,w}, Q_{m,w})$ lies on the same indifference curve as the bundle $(q^m_{m,\sigma(m)}, Q_{m,\sigma(m)})$, it must be the case that

$$\pi_{m,w}q^m_{m,w} + \Pi^m_{m,w}Q_{m,w} \leq \pi_{m,w}q^m_{m,\sigma(m)} + \Pi^m_{m,w}Q_{m,\sigma(m)}.$$

From the budget constraint, we know that

$$\pi_{m,w}(q^m_{m,w} + q^w_{m,w}) + (\Pi^m_{m,w} + \Pi^w_{m,w})Q_{m,w} = y_{m,w}.$$

This implies

$$\pi_{m,w}q^w_{m,w} + \Pi^w_{m,w}Q_{m,w} > \pi_{m,w}q^w_{\sigma(w),w} + \Pi^w_{m,w}Q_{\sigma(w),w}.$$

This shows that the bundle $(q^w_{\sigma(w),w}, Q_{\sigma(w),w})$ lies below the hyperplane tangent to the indifference curve of the bundle $(q^w_{m,w}, Q_{m,w})$. From quasi-concavity of the utility function, it follows that:

$$u^w(q^w_{m,w}, Q_{m,w}) > u^w(q^w_{\sigma(w),w}, Q_{\sigma(w),w}).$$

As such, we have that $u^m(q^m_{m,w}, Q_{m,w}) = u^m(q^m_{m,\sigma(m)}, Q_{m,\sigma(m)})$ for the man m and $u^w(q^w_{m,w}, Q_{m,w}) > u^w(q^w_{\sigma(w),w}, Q_{\sigma(w),w})$ for the woman w. This means that (m, w) forms a blocking pair.

Sufficiency. Suppose that there exist individual quantities and support price vectors such that the individual rationality and no blocking pairs restrictions are satisfied. Let us define numbers $c, C \in \mathbb{R}_{++}$ that satisfy

$$c < \min_{m,w,k,l} \{[\pi_{m,w,k}], [\Pi^m_{m,w,l}], [\Pi^w_{m,w,l}]\} \text{ and}$$
$$C > \max_{m,w,k,l} \{[\pi_{m,w,k}], [\Pi^m_{m,w,l}], [\Pi^w_{m,w,l}]\}.$$

Define the piece-wise linear function $v : \mathbb{R} \to \mathbb{R}$,

$$v(x) = \begin{cases} Cx & \text{if } x \leq 0, \\ cx & \text{if } x > 0. \end{cases}$$

We use this function to define individual utilities. For man $m \in M$, consider the utility function:

$$u^m(q, Q) = \sum_{k=1}^{n} v([q]_k - [q^m_{m,\sigma(m)}]_k) + \sum_{l=1}^{N} v([Q]_l - [Q_{m,\sigma(m)}]_l).$$

For the bundle consumed in the current marriage $(q^m_{m,\sigma(m)}, Q_{m,\sigma(m)})$, this utility function obtains zero utility. As a implication, to form a blocking pair, the man m would need positive utility in the new match. Similarly, we define the utility function for woman $w \in W$ as:

$$u^w(q, Q) = \sum_{k=1}^{n} v([q]_k - [q^w_{\sigma(w)}]_k) + \sum_{l=1}^{N} v([Q]_l - [Q_{\sigma(w),w}]_l).$$

Suppose that for these utility functions the dataset is not rationalizable by a stable matching. This means that there exists a couple $(m, w) \in M \times W$ and a feasible allocation (q^m, q^w, Q) such that

$$\begin{aligned} u^m(q^m, Q) &\geq u^m(q^m_{m,\sigma(m)}, Q_{m,\sigma(m)}) = 0, \\ u^w(q^w, Q) &\geq u^w(q^w_{\sigma(w),w}, Q_{\sigma(w),w}) = 0, \end{aligned}$$

with at least one strict inequality.

For man m, if $[q^m]_k > [q^m_{m,\sigma(m)}]_k$, then by definition $c([q^m]_k - [q^m_{m,\sigma(m)}]_k) < \pi_{m,w,k}([q^m]_k - [q^m_{m,\sigma(m)}]_k)$ and if $[Q]_l > [Q_{m,\sigma(m)}]_l$, then $c([Q]_l - [Q_{m,\sigma(m)}]_l) < \pi^m_{m,w,l}([Q]_l - [Q_{m,\sigma(m)}]_l)$. On the other hand, if $[q^m]_k \leq [q^m_{m,\sigma(m)}]_k$, then by definition $C([q^m]_k - [q^m_{m,\sigma(m)}]_k) \leq \pi_{m,w,k}([q^m]_k - [q^m_{m,\sigma(m)}]_k)$ and if $[Q]_l \leq [Q_{m,\sigma(m)}]_l$, then $C([Q]_l - [Q_{m,\sigma(m)}]_l) \leq \pi^m_{m,w,l}([Q]_l - [Q_{m,\sigma(m)}]_l)$. As $u^m(q^m, Q) \geq 0$, it implies

$$\sum_{k=1}^{n} \pi_{m,w,k}([q^m]_k - [q^m_{m,\sigma(m)}]_k) + \sum_{l=1}^{N} \Pi^m_{m,w,l}([Q]_l - [Q_{m,\sigma(m)}]_l) \geq 0.$$

This means

$$\pi_{m,w} q^m + \Pi^m_{m,w} Q \geq \pi_{m,w} q^m_{m,\sigma(m)} + \Pi^m_{m,w} Q_{m,\sigma(m)}.$$

Using the same reasoning for woman w, we have

$$\pi_{m,w} q^w + \Pi^w_{m,w} Q \geq \pi_{m,w} q^w_{\sigma(w),w} + \Pi^w_{m,w} Q_{\sigma(w),w},$$

and one of the two inequalities above is strict. Adding the two inequalities gives

$$\pi_{m,w}(q^m + q^w) + \Pi_{m,w} Q > \pi_{m,w}(q^m_{m,\sigma(m)} + q^w_{\sigma(w),w}) + \Pi^m_{m,w} Q_{m,\sigma(m)} + \Pi^w_{m,w} Q_{\sigma(w),w}.$$

Using the budget constraint, we know that the left hand side of the above inequality is less than or equal to $y_{m,w}$. This gives

$$y_{m,w} > \pi_{m,w}(q^m_{m,\sigma(m)} + q^w_{\sigma(w),w}) + \Pi^m_{m,w} Q_{m,\sigma(m)} + \Pi^w_{m,w} Q_{\sigma(w),w}.$$

This is a violation of the no blocking pair constraint.

Appendix B Practical Implementation

B.1 Subsampling

To deal with our large sample size and to avoid issues related to outlier behavior, we make use of subsampling to bring the rationalizability conditions to our empirical data (similar to Browning et al., 2021). We randomly draw 100 subsamples of 100 households from our original sample. A sample size of 100 households represents approximately 1.6% of our original sample of 6,074 households. We conduct targeted random sub-sampling based on household types, which are defined in terms of age and education level of the adult individuals, and the presence of children in the household.

More specifically, we follow a two-step procedure. In the first step, we draw 100 household types from a weighted distribution, where the weights are based on the distribution of household types in the sample (as summarized in Tables 17-20 in Appendix C.2). In the second step, given the number of each household type obtained in the first step, we draw households of that type (with replacement) from the full sample. We then apply the revealed preference methods that we outlined in Appendix B.2 below to every subsample separately. In the main text, we report the summary results for these 100 subsamples. Particularly, our subsampling procedure yields multiple values of the lower and upper bounds for RICEBS, CEBs and intrahousehold shares for every female and male education-employment type in our sample. We use the averages of these identified bounds as our lower and upper bound estimates for the individual RICEBs.

We also conducted two robustness checks to assess the sensitivity of our results to the specific subsampling procedure that we use. First, we consider alternative subsample sizes of 50 and 150. Technically, increasing the size of the subsamples leads to smaller feasible sets characterized by the rationalizability constraints in Proposition 1. In turn, this leads to sharper upper and lower bounds (i.e., tighter set identification). Second, we consider an alternative setting where, instead of targeted random subsampling, we do a simple random draw of 100 households for each subsample. The results of both robustness checks show that our main qualitative conclusions remain intact; see Appendices D.3 and D.4.

B.2 Stability Indices and Set Identification

For every subsample that we consider in subsampling procedure, our identification process proceeds in two steps. We will explain the second step only for RICEBs; the procedure for CEBs and intrahousehold shares is readily analogous.

Step 1: Computing the Stability Indices. The revealed preference conditions in Proposition 1 are strict in nature. The observed behavior will either satisfy the constraints or not. Given a subsample, we account for deviations from the strict rationalizability restrictions by using stability indices. Formally, introducing stability indices boils down to replacing conditions (i) and (ii) in Proposition 1 by:

$$
\begin{aligned}
y_{m,\phi} - s_{m,\phi} &\leq p_{m,\phi} q^{m}_{m,\sigma(m)} + P_{m,\phi} Q_{m,\sigma(m)} + \Omega^{m}_{m,\phi} l^{m} + \Omega^{m}_{m,\phi} h^{m} + \Omega^{\sigma(m)}_{m,\phi} h^{\sigma(m)}, \\
y_{\phi,w} - s_{\phi,w} &\leq p_{\phi,w} q^{w}_{\sigma(w),w} + P_{\phi,w} Q_{\sigma(w),w} + \Omega^{w}_{\phi,w} l^{w} + \Omega^{\sigma(w)}_{\phi,w} h^{\sigma(w)} + \Omega^{w}_{\phi,w} h^{w}, \\
y_{m,w} - s_{m,w} &\leq p_{m,w} (q^{m}_{m,\sigma(m)} + q^{w}_{\sigma(w),w}) + P^{m}_{m,w} Q_{m,\sigma(m)} + P^{w}_{m,w} Q_{\sigma(w),w} \\
&\quad + \Omega^{m}_{m,w} l^{m} + \Omega^{w}_{m,w} l^{w} + \Omega^{m,m}_{m,w} h^{m} + \Omega^{m,w}_{m,w} h^{\sigma(w)} + \Omega^{w,m}_{m,w} h^{\sigma(m)} + \Omega^{w,w}_{m,w} h^{w},
\end{aligned}
$$

where the stability indices $s_{m,\phi}$, $s_{\phi,w}$ and $s_{m,w}$ take positive values. Clearly, if $s_{m,\phi} = s_{\phi,w} = s_{m,w} = 0$, the restrictions are the same as in Proposition 1. Higher values of the stability indices impose weaker restrictions, thus allowing for deviations from exact rationalizability.

In our application, the values of these stability indices are computed by solving the following optimization problem:

$$
\min \Big(\sum_{m \in M} s_{m,\phi} + \sum_{w \in W} s_{\phi,w} + \sum_{(m,w) \in M \times W} s_{m,w} \Big) \text{ subject to}
$$

$$
\begin{gathered}
s_{m,\phi} \geq 0,\ s_{\phi,w} \geq 0,\ s_{m,w} \geq 0, \\
q_{m,\sigma(m)} = q^{m}_{m,\sigma(m)} + q^{\sigma(m)}_{m,\sigma(m)},\ q^{m}_{m,\sigma(m)} \geq 0,\ q^{\sigma(m)}_{m,\sigma(m)} \geq 0, \\
P_{m,w} = P^{m}_{m,w} + P^{w}_{m,w},\ P^{m}_{m,w} \geq 0,\ P^{w}_{m,w} \geq 0, \\
\Omega^{m}_{m,w} = \Omega^{m,m}_{m,w} + \Omega^{m,w}_{m,w},\ \Omega^{m,m}_{m,w} \geq 0,\ \Omega^{m,w}_{m,w} \geq 0, \\
\Omega^{w}_{m,w} = \Omega^{w,m}_{m,w} + \Omega^{w,w}_{m,w},\ \Omega^{w,m}_{m,w} \geq 0,\ \Omega^{w,w}_{m,w} \geq 0, \\
\Omega^{m}_{m,w} \geq 0,\ \Omega^{m}_{m,\phi} \geq 0,\ \Omega^{\sigma(m)}_{m,\phi} \geq 0,\ \Omega^{w}_{m,w} \geq 0,\ \Omega^{w}_{\phi,w} \geq 0,\ \Omega^{\sigma(w)}_{\phi,w} \geq 0, \\
(\Omega^{m}_{m,\phi} T + n_{m,\phi}) - s_{m,\phi} \leq p_{m,\phi} q^{m}_{m,\sigma(m)} + P_{m,\phi} Q_{m,\sigma(m)} + \Omega^{m}_{m,\phi} l^{m} + \Omega^{m}_{m,\phi} h^{m} + \Omega^{\sigma(w)}_{m,\phi} h^{\sigma(m)}, \\
(\Omega^{w}_{\phi,w} T + n_{\phi,w}) - s_{\phi,w} \leq p_{\phi,w} q^{w}_{\sigma(w),w} + P_{\phi,w} Q_{\sigma(w),w} + \Omega^{w}_{\phi,w} l^{w} + \Omega^{\sigma(w)}_{\phi,w} h^{\sigma(w)} + \Omega^{w}_{\phi,w} h^{w}, \\
(\Omega^{m}_{m,w} T + \Omega^{w}_{m,w} T + n_{m,w}) - s_{m,w} \leq p_{m,w} (q^{m}_{m,\sigma(m)} + q^{w}_{\sigma(w),w}) + \Omega^{m}_{m,w} l^{m} + \Omega^{w}_{m,w} l^{w} \\
+ P^{m}_{m,w} Q_{m,\sigma(m)} + P^{w}_{m,w} Q_{\sigma(w),w} + \Omega^{m,m}_{m,w} h^{m} + \Omega^{m,w}_{m,w} h^{\sigma(w)} + \Omega^{w,m}_{m,w} h^{\sigma(m)} + \Omega^{w,w}_{m,w} h^{w},
\end{gathered}
$$

where $n_{m,\phi}$, $n_{\phi,w}$, and $n_{m,w}$ represent nonlabor incomes. Clearly, if the optimal values of the stability indices are all zero, we conclude that the observe marriage market is exactly stable. In general, higher values of the stability indices indicate more severe deviations from exact rationalizability.

This use of stability indices to account for deviations from exact rationalizability follows Cherchye et al. (2017), with the only difference being that these authors used stability indices that were multiplicative in nature (i.e., multiplying the left hand side of the strict conditions in Proposition 1), whereas our indices are additive (i.e., subtracting a term from the left hand side of the strict conditions). We use additive indices to preserve linearity of the stability restrictions since, in our setting, total potential incomes $((\Omega^{m}_{m,\phi} T + n_{m,\phi})$, $(\Omega^{w}_{\phi,w} T + n_{\phi,w})$, and $(\Omega^{m}_{m,w} T + \Omega^{w}_{m,w} T + n_{m,w}))$ consist of the sum of the individuals' nonlabor incomes and potential labor incomes. Post-divorce nonlabor incomes and, for the unemployed, the potential labor incomes are unobserved, which makes that potential incomes are unknown.

We use the values of the stability indices that solve the above optimization problem to adjust the potential incomes levels $(\Omega^m_{m,\phi}T+n_{m,\phi}-\hat{s}_{m,\phi})$, $(\Omega^w_{\phi,w}T+n_{\phi,w}-\hat{s}_{\phi,w})$, and $(\Omega^m_{m,w}T + \Omega^w_{m,w}T + n_{m,w} - \hat{s}_{m,w})$. This obtains an adjusted data set that is effectively rationalizable by a stable matching.

Step 2: Identifying RICEBs. In the second step, we use the rationalizability conditions to "set" identify the RICEB measures. Specifically, we focus on the identification of average male and female RICEBs of female and male individuals belonging to a given employment and education type. We use our revealed preference characterization of marital stability to define lower and upper bounds on these average RICEBs, thus obtaining set identification.

To illustrate our identification procedure more formally, let $\tau : M \cup W \to T_M \cup T_W$ be a type function that maps each man m to a type $\tau(m) \in T_M$ and each woman w to a type $\tau(w) \in T_W$, where T_M and T_W are the four individual types defined by education and employment. Let us denote a typical element of T_M by ψ. To obtain a lower bound on average RICEBs of males belonging to type ψ, we solve the following optimization problem:

$$
\begin{gathered}
\min \sum_{m\in M, \tau(m)=\psi} R^m_{m,\sigma(m)} \text{ subject to} \\
q_{m,\sigma(m)} = q^m_{m,\sigma(m)} + q^{\sigma(m)}_{m,\sigma(m)},\ q^m_{m,\sigma(m)} \geq 0,\ q^{\sigma(m)}_{m,\sigma(m)} \geq 0, \\
P_{m,w} = P^m_{m,w} + P^w_{m,w},\ P^m_{m,w} \geq 0,\ P^w_{m,w} \geq 0, \\
\Omega^m_{m,w} = \Omega^{m,m}_{m,w} + \Omega^{m,w}_{m,w},\ \Omega^{m,m}_{m,w} \geq 0,\ \Omega^{m,w}_{m,w} \geq 0, \\
\Omega^w_{m,w} = \Omega^{w,m}_{m,w} + \Omega^{w,w}_{m,w},\ \Omega^{w,m}_{m,w} \geq 0,\ \Omega^{w,w}_{m,w} \geq 0, \\
\Omega^m_{m,w} \geq 0,\ \Omega^m_{m,\phi} \geq 0,\ \Omega^{\sigma(m)}_{m,\phi} \geq 0,\ \Omega^w_{m,w} \geq 0,\ \Omega^w_{\phi,w} \geq 0,\ \Omega^{\sigma(w)}_{\phi,w} \geq 0, \\
(\Omega^m_{m,\phi}T + n_{m,\phi}) - \hat{s}_{m,\phi} \leq p_{m,\phi}q^m_{m,\sigma(m)} + P_{m,\phi}Q_{m,\sigma(m)} + \Omega^m_{m,\phi}l^m + \Omega^m_{m,\phi}h^m + \Omega^{\sigma(w)}_{m,\phi}h^{\sigma(m)}, \\
(\Omega^w_{\phi,w}T + n_{\phi,w}) - \hat{s}_{\phi,w} \leq p_{\phi,w}q^w_{\sigma(w),w} + P_{\phi,w}Q_{\sigma(w),w} + \Omega^w_{\phi,w}l^w + \Omega^{\sigma(w)}_{\phi,w}h^{\sigma(w)} + \Omega^w_{\phi,w}h^w, \\
(\Omega^m_{m,w}T + \Omega^w_{m,w}T + n_{m,w}) - \hat{s}_{m,w} \leq p_{m,w}(q^m_{m,\sigma(m)} + q^w_{\sigma(w),w}) + \Omega^m_{m,w}l^m + \Omega^w_{m,w}l^w \\
+P^m_{m,w}Q_{m,\sigma(m)} + P^w_{m,w}Q_{\sigma(w),w} + \Omega^{m,m}_{m,w}h^m + \Omega^{m,w}_{m,w}h^{\sigma(w)} + \Omega^{w,m}_{m,w}h^{\sigma(m)} + \Omega^{w,w}_{m,w}h^w.
\end{gathered}
$$

Dividing the optimal value of the objective function in the above optimization problem by the number of males belonging to type ψ, we obtain a lower bound on average RICEBs of males of type ψ. Similarly, to obtain an upper bound, we maximize the objective function subject to the same linear conditions. This effectively set identifies the measure through linear programming.

B.3 Stability Indices: Results

We recall from our above discussion that our stability indices take positive values, with higher values reflecting greater violations of the strict rationalizability conditions. For each individual, we define an individual rationality index (IR) and two no blocking pair indices (NBP avg and NBP max). The IR index represents the individual's gain from divorcing and becoming single. The NBP avg index measures the individual's average gain from remarriage across all potential mates, and the NBP max index measures the individual's gain corresponding to the most attractive remarriage option. We express these measures as fractions of the households' current total consumption expenditures and, for the ease of interpretation, we multiply these ratios by 100.

Table 15 provides summary results on these stability index for our sample; we report the average values defined over all individuals taken up in our 100 random subsamples. The IR and NBP avg indices reveal that women's gains from divorcing and selecting the average outside option (being single or remarrying) are generally lower than men's. However, the NBP max index suggests that, on average, women may gain more from their most attractive remarriage option than men. Overall, we find that the values of the stability indices are generally quite small, indicating that the observed marriage allocation is close to exactly stable.

Table 15: Stability indices (as % of household expenditures)

	male	female
IR	1.13	0.11
NBP avg	3.62	2.64
NBP max	21.00	38.11

Appendix C Additional Data Information

C.1 Sample Selection Procedure

Table 16 reports the number of household observations that remain after each step in the sample selection procedure. Note that these numbers depend on the order of the sample selection criteria; however, they do give an indication of the restrictiveness of each criterion.

Table 16: Sample selection

Selection criteria	N (observations dropped)
raw data	9569
trim top 1% and bottom 1% of observed male wages	9465 (104)
trim top 1% and bottom 1% of observed female wages	9358 (107)
drop if missing time-use information	9128 (230)
drop if defined leisure male is negative	8821 (307)
drop if defined leisure female is negative	8045 (776)
restricting male age between 25 and 65	6938 (1107)
restricting female age between 25 and 65	6155 (783)
drop if missing education	6074 (81)

C.2 Household Types

Our empirical application defines household types to perform targeted random subsampling. Tables 17 and 18 show the distribution of household types formed by single females and single males, respectively. There are 12 types of single females and single males based on two education categories, two categories for presence of children and three age categories. Tables 19 and 20 show the distribution of the household types formed by couples. In principle, there can be 72 couple types (based on two education categories and three age categories for the two spouses, and two categories for the presence of children in the household). However, we only observe 59 distinct types in the data. For example, we do not observe any household (with or without children) formed by a low educated man aged between 25 and 35 years who is matched with a low educated woman aged between 51 and 65 years.

In our application, we conduct an empirical welfare analysis of individuals, where individual types are defined in terms of two education categories (low and high educated) and two employment categories (employed and unemployed). This defines 16 distinct couple types and 4 distinct single types. Table 21 shows the distribution of types for couples, single males and single females in our sample.

Table 17: Household types – single females

education	presence of children	age	N	%
low	no	25-35	74	1.22
low	no	36-50	102	1.68
low	no	51-65	281	4.63
low	yes	25-35	142	2.34
low	yes	36-50	118	1.94
low	yes	51-65	40	0.66
high	no	25-35	266	4.34
high	no	36-50	204	3.36
high	no	51-65	304	5.00
high	yes	25-35	132	2.17
high	yes	36-50	207	3.41
high	yes	51-65	38	0.63

Table 18: Household types – single males

education	presence of children	age	N	%
low	no	25-35	190	3.13
low	no	36-50	152	2.50
low	no	51-65	154	2.54
low	yes	25-35	26	0.43
low	yes	36-50	29	0.48
low	yes	51-65	7	0.12
high	no	25-35	293	4.82
high	no	36-50	166	2.73
high	no	51-65	122	2.01
high	yes	25-35	25	0.41
high	yes	36-50	36	0.59
high	yes	51-65	6	0.10

Appendix D Robustness Checks

D.1 Bounding Wages

In our main analysis, we treat the unobserved wages of unemployed individuals as unknown variables that are (only) constrained by the revealed preference conditions for marital stability; we do not impose any further restrictions on these unknowns. As a following robustness check, we consider an alternative approach where we limit the range of possible values for these unobserved wages. We consider two scenarios. In the first scenario, we set the shadow wages of unemployed individuals equal to the average observed wage of similar individuals. Specifically, we use education level, age category, and presence of children to define "similar" individuals. In the second scenario, we allow the shadow wages to be unknown but constrain them to be within half a standard deviation of the wages used in the first scenario. Table 22 outlines the restrictions imposed on the shadow wages in these two scenarios. The results from this robustness check are presented in Tables 23 and 24. Comfortingly, the estimated bounds on the RICEBs are very similar to those in Table 6 in the main text.

Table 19: Household types – couples

male		female				
education	age	education	age	presence of children	N	%
low	25-35	low	25-35	no	20	0.33
low	25-35	low	36-50	no	6	0.10
low	25-35	high	25-35	no	32	0.53
low	25-35	high	36-50	no	3	0.05
low	36-50	low	25-35	no	3	0.05
low	36-50	low	36-50	no	50	0.82
low	36-50	low	51-65	no	13	0.21
low	36-50	high	25-35	no	16	0.26
low	36-50	high	36-50	no	52	0.86
low	36-50	high	51-65	no	11	0.18
low	51-65	low	25-35	no	1	0.02
low	51-65	low	36-50	no	32	0.53
low	51-65	low	51-65	no	202	3.33
low	51-65	high	36-50	no	18	0.30
low	51-65	high	51-65	no	137	2.26
low	25-35	low	25-35	yes	100	1.65
low	25-35	low	36-50	yes	17	0.28
low	25-35	high	25-35	yes	67	1.10
low	25-35	high	36-50	yes	14	0.23
low	36-50	low	25-35	yes	43	0.71
low	36-50	low	36-50	yes	118	1.94
low	36-50	low	51-65	yes	3	0.15
low	36-50	high	25-35	yes	42	0.69
low	36-50	high	36-50	yes	122	2.01
low	36-50	high	51-65	yes	7	0.12
low	51-65	low	36-50	yes	20	0.33
low	51-65	low	51-65	yes	33	0.54
low	51-65	high	36-50	yes	17	0.28
low	51-65	high	51-65	yes	16	0.26

Table 20: Household types – couples (contd.)

male		female				
education	age	education	age	presence of children	N	%
high	25-35	low	25-35	no	13	0.21
high	25-35	low	36-50	no	4	0.07
high	25-35	high	25-35	no	190	3.13
high	25-35	high	36-50	no	12	0.20
high	36-50	low	25-35	no	1	0.02
high	36-50	low	36-50	no	25	0.41
high	36-50	low	51-65	no	6	0.10
high	36-50	high	25-35	no	27	0.44
high	36-50	high	36-50	no	120	1.98
high	36-50	high	51-65	no	13	0.21
high	51-65	low	25-35	no	2	0.03
high	51-65	low	36-50	no	10	0.16
high	51-65	low	51-65	no	67	1.10
high	51-65	high	25-35	no	2	0.03
high	51-65	high	36-50	no	48	0.79
high	51-65	high	51-65	no	289	4.76
high	25-35	low	25-35	yes	24	0.40
high	25-35	low	36-50	yes	3	0.05
high	25-35	high	25-35	yes	197	3.24
high	25-35	high	36-50	yes	17	0.28
high	36-50	low	25-35	yes	20	0.33
high	36-50	low	36-50	yes	39	0.64
high	36-50	low	51-65	yes	2	0.03
high	36-50	high	25-35	yes	82	1.35
high	36-50	high	36-50	yes	423	6.96
high	36-50	high	51-65	yes	8	0.13
high	51-65	low	36-50	yes	6	0.10
high	51-65	low	51-65	yes	7	0.12
high	51-65	high	36-50	yes	43	0.71
high	51-65	high	51-65	yes	45	0.74

Table 21: Percentage shares of education and employment types in the sample

	couples				
	female low, unemployed	female low, employed	female high, unemployed	female high, employed	total
male low, unemployed	2.13	1.96	0.61	1.49	6.18
male low, employed	4.83	13.41	2.03	14.59	34.86
male high, unemployed	0.34	0.54	0.71	1.89	3.48
male high, employed	1.55	5.33	5.71	42.91	55.47
total	8.85	21.22	9.05	60.88	
	singles				
	low, unemployed	low, employed	high, unemployed	high, employed	
males	13.43	32.84	5.39	48.34	
females	11.48	28.20	7.13	53.20	

Table 22: Bounds on shadow wages

			average wage		within 0.5 std. dev.	
education	presence of children	age	male	female	male	female
low	no	25-35	16.40	15.01	[13.56, 19.24]	[12.51, 17.50]
low	no	36-50	21.94	17.94	[17.88, 26.00]	[15.13, 20.76]
low	no	51-65	23.02	17.17	[19.41, 26.63]	[14.49, 19.85]
low	yes	25-35	19.09	14.81	[16.49, 21.69]	[12.53, 17.09]
low	yes	36-50	22.84	15.62	[19.49, 26.19]	[13.42, 17.83]
low	yes	51-65	24.26	16.69	[20.50, 28.02]	[13.75, 19.62]
high	no	25-35	27.99	23.81	[23.16, 32.81]	[20.51, 27.11]
high	no	36-50	31.99	26.59	[26.36, 37.62]	[22.55, 30.63]
high	no	51-65	42.75	26.17	[35.10, 50.40]	[22.19, 30.16]
high	yes	25-35	28.80	23.91	[24.42, 33.17]	[20.33, 27.50]
high	yes	36-50	38.45	26.53	[32.42, 44.47]	[22.49, 30.56]
high	yes	51-65	41.59	27.08	[35.24, 47.94]	[22.98, 31.18]

Table 23: Stability indices (as % of household expenditures); bounding wages

	average wage		within 0.5 std. dev.	
	male	female	male	female
IR	1.28	0.25	1.20	0.20
NBP max	21.58	43.77	21.53	43.68
NBP avg	3.78	2.91	3.76	2.80

Table 24: RICEBs; bounding wages

		average wage		within 0.5 std. dev.	
employed	education	lower	upper	lower	upper
Panel A: male					
no	low	49.15	60.43	49.61	62.48
no	high	49.00	61.38	47.40	57.59
yes	low	74.30	82.51	74.73	82.36
yes	high	74.35	84.08	73.69	83.69
Panel B: female					
no	low	46.07	54.60	48.77	57.92
no	high	42.88	48.28	41.70	47.06
yes	low	57.87	65.90	58.67	66.60
yes	high	57.60	68.12	58.03	68.67

D.2 Using Barten Scales to Define Public Consumption

Our framework requires that the researcher observes the aggregate private and public consumption within current marriages. In our main analysis, we assume that expenditures on food and drinks (at home and outside), schooling, computer, and recreation are part of the Hicksian private consumption good. In addition, we assume that 50% of the total expenditures on vacation, housing, transportation, childcare and healthcare is also private. The remaining 50% is assumed to form the Hicksian public consumption of the household. This definition implies an average scale economies of 1.37 for couples, with a minimum of 1.11 and a maximum of 1.50. Our categorization of private and public consumption in the households is similar to other categorizations used in the literature; see Table 25.

As a further robustness check, we consider the scenario in which the nature of consumption (public or private) is unknown to the researcher. We follow the methodology of Cherchye et al. (2020), who identify economies of scale in household consumption by assuming a consumption technology that is characterized by Barten scales. More specifically, let $A \in [0, 1]$ denote the degree of publicness in the aggregate consumption quantity. If everything is consumed entirely privately, then $A = 0$. Similarly, if everything is consumed entirely publicly, then $A = 1$. If the pair (m, w) buys the bundle $z_{m,w}$, then the public consumption $Q_{m,w}$ can be represented as $Az_{m,w}$ and $(1 - A)z_{m,w}$ gives the corresponding private consumption. In our robustness check, we consider two cases. In the first case, we assume that A lies between 0.3 and 0.7. In the second case, we assume that A lies between 0.4 and 0.6. We show the results of these exercises in Tables 26 and 27. We find that our empirical rationalizability conditions become less restrictive when allowing for more public consumption. More importantly, however, we find that our RICEB estimates are only marginally affected when endogenously defining the public consumption in the household. Our main qualitative conclusions turn out to be robust.

Table 25: Economies of scale

	private	public	scale economies or % share
Lise and Seitz, 2011	everything else	housing, electricity, durable goods	31%
Bargain and Donni, 2012			1.65 – 1.98
Cherchye et al., 2012a	food outside home, vices, medical, schooling, gifts, clothing, leisure expenditure, personal care	rent, utilities, childcare, transportation, insurance, alimony, debt payment, trips and holidays, food at home	79%
Cherchye et al., 2012b			1.62
Browning et al., 2013			1.52
Cherchye et al., 2017	50% of non-assignable + assignable	50% of non-assignable	1.37

Notes: Cherchye et al., 2017 define non-assignable consumption as expenditures on mortgage, rent, utilities, transport, insurance, daycare, alimony, debt, holiday expenditures, housing expenditures, other public expenditures, and child expenditures. Assignable consumption included food at home and outside home, tobacco, clothing, personal care products and services, medical care and health costs not covered by insurance, leisure time expenditures, (further) schooling expenditures, donations and gifts, and other personal expenditures.

Table 26: Stability indices (as % of household expenditures); with Barten scales

	$0.3 \leq A \leq 0.7$		$0.4 \leq A \leq 0.6$	
	male	female	male	female
IR	0.90	0.17	0.86	0.18
NBP max	17.50	35.23	21.51	39.20
NBP avg	2.95	2.40	3.65	2.85

Table 27: RICEBs; with Barten scales

		$0.3 \leq A \leq 0.7$		$0.4 \leq A \leq 0.6$	
employed	education	lower	upper	lower	upper
Panel A: male					
no	low	44.22	59.24	51.26	65.53
no	high	42.48	55.77	49.07	60.67
yes	low	71.05	80.57	74.80	83.14
yes	high	71.01	82.34	75.07	85.20
Panel B: female					
no	low	43.87	55.13	51.96	61.58
no	high	37.40	44.57	45.79	52.73
yes	low	52.73	61.47	59.75	67.43
yes	high	53.15	65.30	59.51	70.36

D.3 Subsample Size

In our baseline empirical setting, each subsample consisted of 100 randomly drawn households. As a robustness check, we use respectively 50 and 150 randomly drawn households for each subsample. Tables 28 and 29 show our results. We find that increasing the sample size generally leads to tighter bound estimates. Overall, however, the results that we obtain are very similar to the ones in the main text.

Table 28: Stability indices (as % of household expenditures); subsample size

	sample size = 50		sample size = 150	
	male	female	male	female
IR	0.78	0.09	0.77	0.15
NBP max	15.12	23.74	22.34	40.34
NBP avg	3.23	2.41	3.22	2.35

Table 29: RICEBs; subsample size

		sample size = 50		sample size = 150	
employed	education	lower	upper	lower	upper
Panel A: male					
no	low	48.35	65.18	48.38	60.06
no	high	48.63	66.41	49.42	61.86
yes	low	72.54	82.42	73.43	81.62
yes	high	72.97	85.08	74.73	84.23
Panel B: female					
no	low	46.04	60.94	47.99	56.43
no	high	40.65	50.06	42.81	48.59
yes	low	57.24	66.61	59.04	67.20
yes	high	56.53	69.50	57.63	67.87

D.4 Random Subsampling

In the main text, we conducted a targeted random subsampling based on household types, where types were defined in terms of education and age of both spouses, and the presence of children in the household. As a robustness exercise, we perform a simple random subsampling by drawing 100 random household from the full sample. Table 30 shows the identified RICEB bounds. Once again, the estimates are similar to the ones shown in the main text, which indicates that our main conclusions are robust.

Appendix E Education and Poverty Misclassification

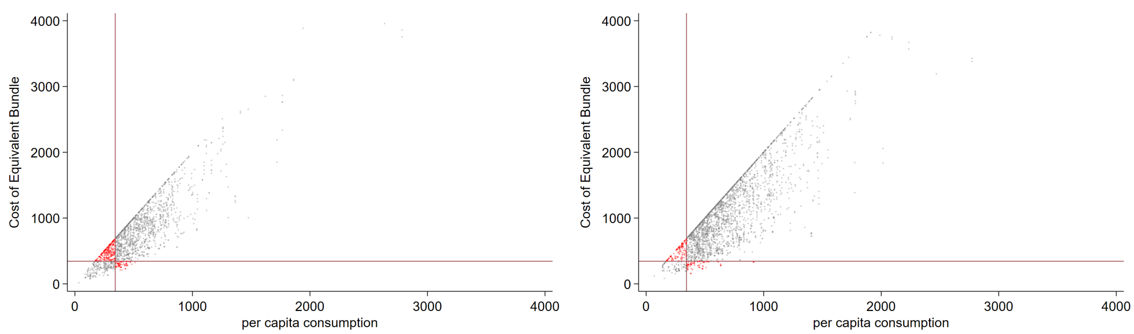
Figures 3 and 4 plot the estimated individual CEBs against per-capita household consumption by education level for males and females, respectively. Each dot corresponds to one individual in a subsample and we show the results from all 100 subsamples. We set the poverty line at 60% of the median per-capita household

Table 30: RICEBs; random sample

employed	education	lower	upper
Panel A: male			
no	low	49.73	64.46
no	high	46.50	58.22
yes	low	73.80	82.57
yes	high	74.04	84.52
Panel B: female			
no	low	48.19	58.79
no	high	42.65	49.40
yes	low	56.87	65.02
yes	high	57.56	68.78

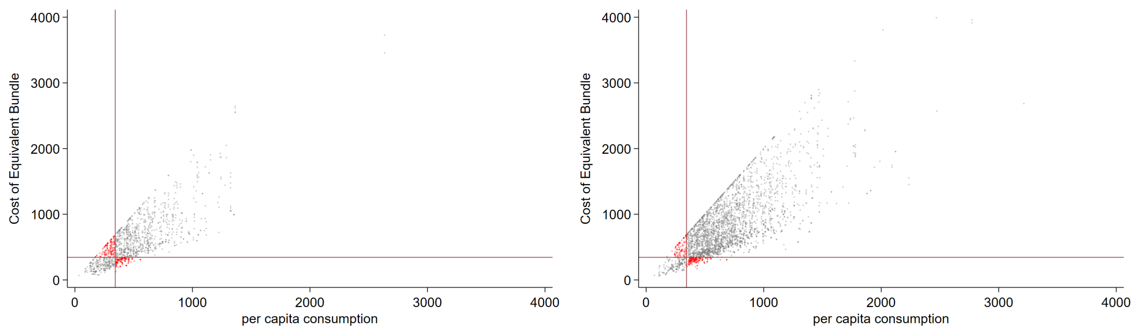
consumption in our sample of households. The construction and interpretation of the figure is directly similar to that of Figure 1 in the main text. We find that low educated married men are more likely to be misclassified as poor, while both low and high educated married women are equally likely to be misclassified as either poor or non-poor by the per-capita measure.

Figure 3: Male CEBs and per-capita consumption; by education



Low education High education

Figure 4: Female CEBs and per-capita consumption; by education



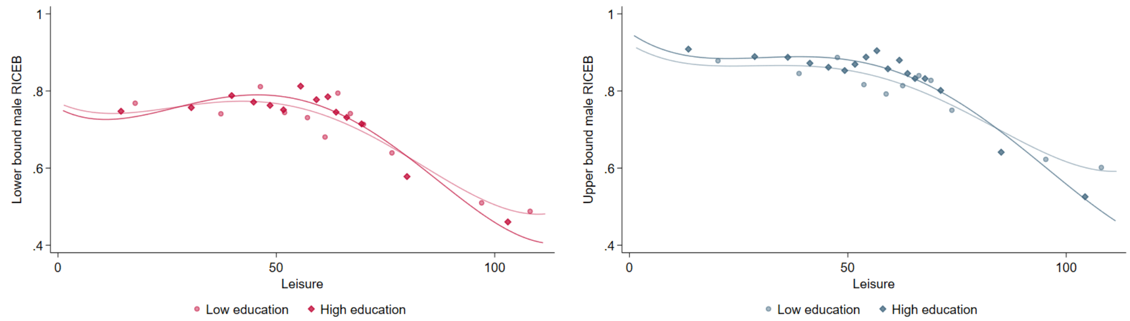
Low education

High education

Appendix F Material Good Consumption versus Time Use: Additional Results

Figures 5 and 6 show binned scatter plots to describe the mean relationship between the identified lower and upper RICEB bounds and the observed leisure consumption for males and females, respectively. Figure 7 shows binned scatter plots that describe the mean relationship between the identified RICEB bounds and the observed housework of males and females. Like before, we generate these plots for the two education classes separately, but we show them in one figure. Figure 8 shows binned scatter plots that describe the mean relationship between the identified RICEB bounds and the observed leisure consumption, by employment status of males and females. Finally, Figure 9 shows the mean relationship between the identified CEB and observed leisure of males and females, by marital status and education. Note that, for the sake of illustration, in Figures 7-9 we have used the midpoints of the lower and upper bounds as the dependent variables.

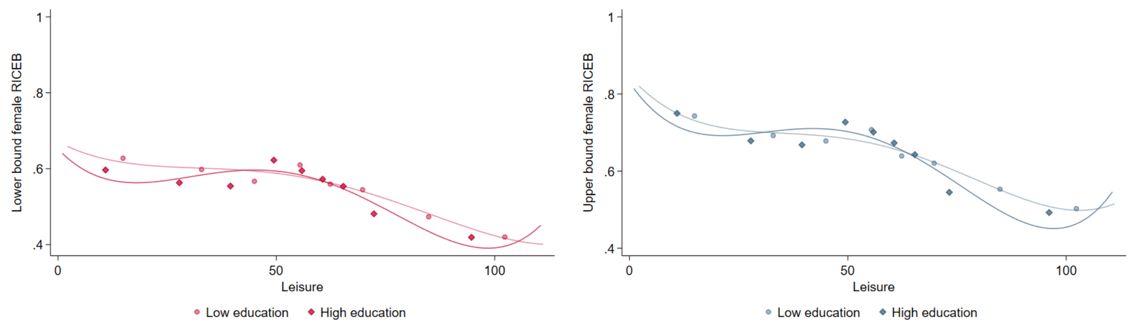
Figure 5: Male RICEBs and leisure



Lower bound

Upper bound

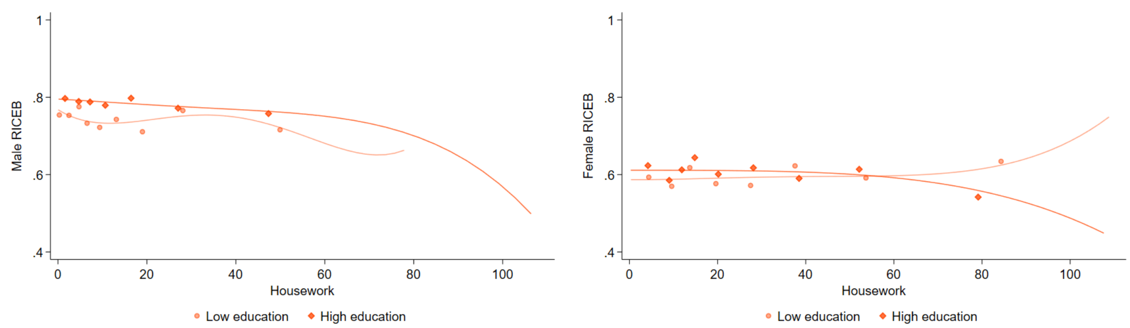
Figure 6: Female RICEBs and leisure



Lower bound

Upper bound

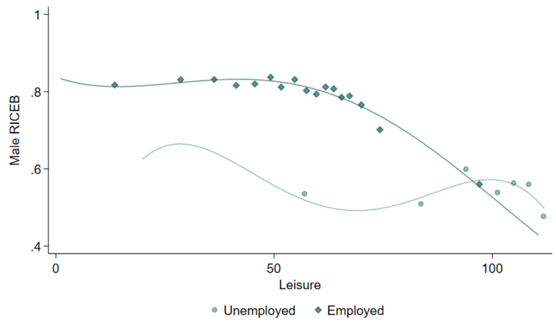
Figure 7: RICEBs and housework; by education



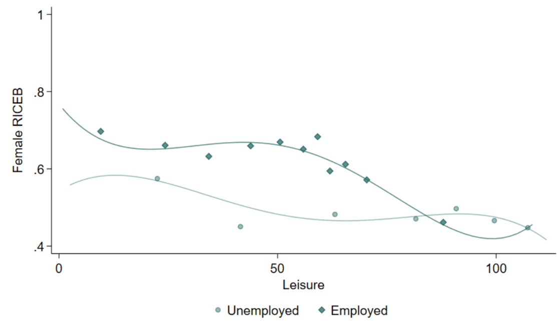
Male

Female

Figure 8: RICEBs and leisure; by employment

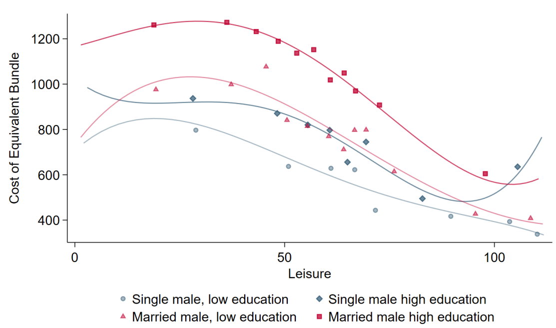


Male

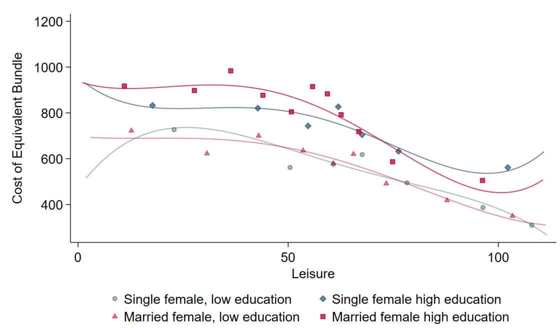


Female

Figure 9: CEBs and leisure; by marital status and education



Male



Female