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Time use, intrahousehold inequality and individual welfare: revealed preference analysis

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Abstract

We make use of rich micro data from the Belgian MEqIn survey, which contains detailed information on individual consumption, public consumption inside households and time use. We explain the observed household behavior by means of a collective model that integrates marriage market restrictions on intrahousehold allocation patterns. We adopt a revealed preference approach that abstains from any functional form assumptions on individual utility functions or intrahousehold decision processes. This allows us to (set) identify the sharing rule, which governs the intrahousehold sharing of time and money, and to quantify economies of scale within households. We use these results to conduct a robust and meaningful individual welfare and inequality analysis, hereby highlighting the important role of detailed consumption and time use data.

Keywords: collective model, time use, intrahousehold inequality, individual welfare, revealed preferences

JEL Codes: D60, D63, I32, J22

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1 Introduction

For decades, poverty and inequality have posed major public policy challenges worldwide. Even though extreme poverty has been steadily decreasing, except for a recent spike due to the COVID-19 crisis, the level of inequality has been rising consistently in most rich countries. For example, at the start of the 1980s, the top decile of richest people earned seven times more than the bottom decile. In 2015, the income of the top decile was already ten times higher (Keeley, 2015). To adequately assess the associated impact on the welfare of individuals in households, it is of vital importance to also consider the intrahousehold allocation of resources. If the within-household distribution of resources is highly unbalanced, inequality between individuals in households will be very different from inequality between households. Moreover, individual welfare comparisons should arguably also account for inter-individual differences in time use (including leisure and domestic production) and, relatedly, inter-household differences in economies of scale (resulting from public consumption).

The current paper presents a structural empirical analysis of individual welfare (poverty and inequality) that effectively accounts for these different aspects. We make use of a rich micro dataset that is drawn from the Belgian MEqIn survey, which contains detailed information on individual consumption, public consumption inside households and time use. Our structural model assumes a collective model of household consumption (à la Chiappori, 1988, 1992) that integrates marriage market restrictions on intrahousehold allocation patterns.[1] Particularly, we adopt the revealed preference methodology of Cherchye, Demuynck, De Rock, and Vermeulen (2017).[2] This methodology is intrinsically nonparametric in that it does not impose any prior functional structure on the individual preferences or intrahousehold decision processes, so maximally avoiding functional specification error. Moreover, it

[1] Throughout, 'marriage' stands for legal marriage as well as cohabitation.

[2] For the revealed preference approach to analyzing collective consumption behavior and identifying intrahousehold sharing rules, see also Cherchye, De Rock, and Vermeulen (2007, 2011); Cherchye, Lewbel, De Rock, and Vermeulen (2015); Cherchye, De Rock, Surana, and Vermeulen (2020). Alternative parametric approaches for sharing rule identification have been proposed by Lewbel and Pendakur (2008); Bargain and Donni (2012); Browning, Chiappori, and Lewbel (2013) and, more recently, Lechene, Pendakur, and Wolf (2022).

allows for an informative empirical analysis, even when (only) using a cross-sectional dataset containing a single observation per household and when accounting for any (unobservable) heterogeneity across households (in terms of individual preferences and within-household decision processes). The methodology allows us to informatively (set) identify the sharing rule that governs the intrahousehold sharing of time and money, and to quantify economies of scale within households. We exploit these features to conduct a robust and meaningful individual welfare analysis.

Our analysis will particularly highlight the role of time use information. Existing poverty and inequality studies typically consider material consumption only, and abstract from inter-individual differences in time use. However, one may well question whether two individuals with the same material consumption levels are equally well off if one has double the leisure time of the other. In this respect, data gathered by the OECD show an important gender gap in average time spent on leisure, with women having less time off than their male counterparts.[3] By providing detailed time use data, the MEqIn survey allows us to assess whether accounting for inter-individual time use differences can substantially impact the conclusions of empirical welfare analyses. Specifically, in our empirical application we will include individuals' leisure time (treated as private consumption by the individual) as well as time spent on domestic production (treated as public consumption by the household), and we will evaluate how this information affects our empirical findings on individual poverty and inequality.

Next, in welfare comparisons between singles and individuals in multi-person households, a most notable difference relates to public consumption inside households. Indeed, a defining characteristic of multi-person households is that some goods are partly or completely publicly consumed, which gives rise to economies of scale. Motivating examples include housing, transportation, and commodities produced by household work. Obviously, singles do not benefit from such scale economies, so impacting their welfare level in comparison to

[3] See `www.oecd.org/gender/data/balancingpaidworkunpaidworkandleisure.htm`.

individuals in multi-person households. Our MEqIn dataset allows us to empirically assess this impact by providing information on both private and public consumption of households.

Our empirical results reveal that accounting for unequal sharing, time use and economies of scale can significantly affect the empirical welfare analysis. For example, we find that women are substantially more likely to be considered as poor due to smaller expenditure shares (particularly on private material consumption). Moreover, poverty and inequality rates generally decrease when accounting for time use information. This suggests that less material consumption may often be compensated through more leisure time. Finally, accounting for economies of scale substantially deteriorates the poverty rate of singles relative to individuals in multi-person households. Overall, our analysis strongly indicates the importance of taking these different aspects seriously in individual welfare analysis (and subsequent policy conclusions).

The rest of our paper is structured as follows. Section 2 introduces our revealed preference methodology. Section 3 present the setup of our empirical application. Section 4 shows the results of our individual welfare analysis. Section 5 concludes.

2 Theoretical framework

Cherchye, De Rock, Demuynck and Vermeulen (2017, hereafter CDDV) introduced a methodology to recover informative bounds on the intrahousehold sharing rule by linking observed consumption behavior with observed marriage allocations. The current section sets the stage for our following empirical analysis by briefly recapturing CDDV's theoretical framework and their identification strategy based on the assumption of marital stability.

2.1 Notation

We assume a marriage market with a set of males M and a set of females W. The marriage market is characterized by a matching function σ that defines the marital matchings.

Particularly, every man $m \in M$ and woman $w \in M$ is assigned to a partner of the other gender (denoted as $\sigma(m) = w$ and $\sigma(w) = m$) or remains single (denoted as $\sigma(m) = \emptyset$ and $\sigma(w) = \emptyset$). Each single or married couple then decides upon the consumption of private and public goods.[4] We assume n private goods with quantities $q_{m,\sigma(m)} \in \mathbb{R}^n_+$, and k public goods with quantities $Q_{m,\sigma(m)} \in \mathbb{R}^k_+$. When married, private consumption is shared between the household members in a way that defines male quantities $q^m_{m,\sigma(m)} \in \mathbb{R}^n_+$ and female quantities $q^{\sigma(m)}_{m,\sigma(m)} \in \mathbb{R}^n_+$ such that $q^m_{m,\sigma(m)} + q^{\sigma(m)}_{m,\sigma(m)} = q_{m,\sigma(m)}$. In turn, this obtains the intrahousehold allocation $(q^m_{m,\sigma(m)}, q^{\sigma(m)}_{m,\sigma(m)}, Q_{m,\sigma(m)})$.

Consumption decisions are made under budget constraints, which are defined by the prices and incomes faced by each (potential) couple (m, w). Prices are denoted by $p_{m,w} \in \mathbb{R}^n_{++}$ for the private goods and $P_{m,w} \in \mathbb{R}^k_{++}$ for the public goods. Similarly, a single man faces the prices $p_{m,\emptyset}$ and $P_{m,\emptyset}$, and a single woman the prices $p_{\emptyset,w}$ and $P_{\emptyset,w}$ Furthermore, $y_{m,w} \in \mathbb{R}_{++}$ represents the income of the couple (m, w), and $y_{m,\emptyset}$ and $y_{\emptyset,w}$ the incomes of a single man and a single woman, respectively.

Finally, as we motivated in the Introduction, a specific feature of our empirical analysis is that we take up time use information. More specifically, we will consider individual leisure as a privately consumed good and time spent on domestic work as a publicly consumed good. The associated prices will be set equal to the individuals' wages. As we include both material consumption and time use in the households' consumption allocations, we will use so-called 'full' incomes (i.e. nonlabor incomes plus potential labor incomes) in our following application.

2.2 Stable matching allocation

To keep our exposition simple, we assume that all observed individuals are matched in our theoretical setup. However, in our empirical application we will use a dataset that includes singles, and we account for the possibility that a married individual may consider remarrying

[4]Admittedly for a single the distinction between private and public is redundant. For the ease of notation we ignore this.

a single of the other gender. If all observed individuals are married, we have that $|M| = |W|$. Correspondingly, we can define the *matching allocation*

$$\left(q^{m}_{m,\sigma(m)}, q^{\sigma(m)}_{m,\sigma(m)}, Q_{m,\sigma(m)}\right)_{m\in M}.$$

We say that this matching allocation is stable if it simultaneously meets the following three requirements: (1) *Pareto efficiency*, (2) *individual rationality*, and (3) *no blocking pairs*.

First, *Pareto efficiency* implies that for any married couple $(m, \sigma(m))$, there does not exist a feasible consumption allocation (for the given prices and income) that strictly increases one member's utility while not making the other member worse off. In the collective household literature, we say that the observed consumption behavior is *collectively rational* if it satisfies this Pareto efficiency condition (see, for example, Browning and Chiappori, 1998).

Second, *individual rationality* requires that no individual male or female is better off as single than in the current marriage: (s)he can not afford a consumption bundle as a single (for the given prices and income faced as a single) that achieves a higher utility level than the one within marriage. Clearly, if this requirement were not met, then the marriage market would be unstable as the individual would prefer to become single.

Third, the *no blocking pairs* condition states that an unmatched couple (m, w) cannot afford (for the given prices and income in the counterfactual situation) a consumption bundle that makes at least one of them strictly better off than in his/her current marriage without making the other individual worse off than in her/his current matching. Indeed, if this condition did not hold, then these individuals would have an incentive to remarry each other and the observed matching allocation would be unstable.

2.3 Revealed preference conditions

CDDV define testable implications for observed behavior to be consistent with a stable matching allocation. Observed behavior is summarized in terms of a dataset $\mathcal{D}$ that contains the following information: (1) the matching function σ, (2) the consumption bundles $\left(q_{m,\sigma(m)}, Q_{m,\sigma(m)}\right)$ for each matched couple $(m, \sigma(m))$, with $m \in M$, (3) the budget conditions for any possible marital outcome (i.e. potential couple and single), i.e., the prices $p_{m,w}, P_{m,w}$ and incomes $y_{m,w}$ for all $m \in M \cup \emptyset$ and $w \in W \cup \emptyset$.

CDDV's testable conditions are of the revealed preference type and intrinsically nonparametric, meaning that they do not require any functional structure for the utility functions that represent the individual preferences.[5] The conditions allow us to check whether there exists at least one possible specification of these individual utilities that rationalizes the dataset $\mathcal{D}$ in terms of a stable matching allocation. An attractive feature of the conditions is that they are linear in the unknowns, which makes them easy to use empirically. The conditions are stated in the next result (Cherchye et al., 2017, Proposition 1).

Proposition 1. *If the dataset $\mathcal{D}$ is rationalizable by a stable matching, then there exist*

1. *individual quantities $q^m_{m,\sigma(m)}, q^{\sigma(m)}_{m,\sigma(m)} \in \mathbb{R}^k_{++}$, for each matched couple $m \in M$ and $\sigma(m) \in W$ such that*

$$q^m_{m,\sigma(m)} + q^{\sigma(m)}_{m,\sigma(m)} = q_{m,\sigma(m)},$$

   which define a matching allocation $\left(q^m_{m,\sigma(m)}, q^{\sigma(m)}_{m,\sigma(m)}, Q_{m,\sigma(m)}\right)\}_{m\in M}$, and

2. *personalized prices $P^m_{m,w}, P^w_{m,w} \in \mathbb{R}^k_{++}$ for each couple (m, w) $(m \in M, w \in W)$ such that*

$$P^m_{m,w} + P^w_{m,w} = P_{m,w},$$

that satisfy the following constraints:

(i) all males and females are individually rational, i.e., for any $m \in M$ and $w \in W$,

$$y_{m,\emptyset} \leq p_{m,\emptyset} q^m_{m,\sigma(m)} + P_{m,\emptyset} Q_{m,\sigma(m)},$$

$$y_{\emptyset,w} \leq p_{\emptyset,w} q^w_{\sigma(w),w} + P_{\emptyset,w} Q_{\sigma(w),w}, \text{ and}$$

[5] More precisely, individual utility functions are (only) assumed to be nonnegative, increasing, continuous and concave.

(ii) there is no blocking pair, i.e., for any $m \in M$ and $w \in W$,

$$y_{m,w} \leq \left(p_{m,w}q^m_{m,\sigma(m)} + P^m_{m,w}Q_{m,\sigma(m)}\right) + \left(p_{m,w}q^w_{\sigma(w),w} + P^w_{m,w}Q_{\sigma(w),w}\right).$$

In this proposition, condition (1) requires, for every matched couple $(m, \sigma(m))$, that the (unobserved) individual private quantities $q^m_{m,\sigma(m)}$ and $q^{\sigma(m)}_{m,\sigma(m)}$ must add up to the (observed) aggregate private quantities $q_{m,\sigma(m)}$. Next, condition (2) introduces the concept of personalized prices, which represent the individuals' willingness-to-pay for the publicly consumed quantities. For each potential pair consisting of male m and female w, these personalized prices $P^m_{m,w}$ and $P^w_{m,w}$ must add up to the observed actual prices $P_{m,w}$. This adding up condition effectively makes that the personalized prices may also be interpreted as Lindahl prices corresponding to a Pareto efficient provision of public goods.

The rationalizability conditions (i) and (ii) have an intuitive 'revealed preference' interpretation in terms of the stable matching requirements that we described before. First, condition (i) imposes individual rationality. It requires that individuals as singles cannot afford a bundle that is more expensive than the bundle they consume within their current marriage. More formally, this means that under the budget conditions as single (i.e., prices $p_{m,\emptyset}, P_{m,\emptyset}$ and income $y_{m,\emptyset}$ for male m, and prices $p_{\emptyset,w}, P_{\emptyset,w}$ and income $y_{\emptyset,w}$ for female w), the individuals cannot buy a bundle that is more expensive than the bundle $\left(q^m_{m,\sigma(m)}, Q_{m,\sigma(m)}\right)$ for any male m and the bundle $\left(q^w_{\sigma(w),w}, Q_{\sigma(w),w}\right)$ for any female w. Indeed, if condition (i) did not hold, then at least one male or female could attain a higher utility by becoming single.

Similarly, condition (ii) imposes the no blocking pair condition. The right hand side of the inequality constraint represents the sum value of the bundles consumed by male m (i.e., $\left(q_{m,\sigma(m)}, Q_{m,\sigma(m)}\right)$) and female m (i.e., $\left(q^w_{\sigma(w),w}, Q_{\sigma(w),w}\right)$ in their current marriages, evaluated at the prices that would prevail if m and w formed a couple (i.e., $p_{m,w}$ for the private goods and $P^m_{m,w}$, $P^w_{m,w}$ for the public goods). The inequality constraint then requires that the income $y_{m,w}$ available to the pair (m, w) does not exceed this sum value. If condition (ii) did not hold, then some pair (m, w) could effectively afford a bundle that makes the two individuals better off than in their current marriage, i.e., (m, w) is a blocking pair.

The revealed preference conditions in Proposition 1 are 'sharp': they only tell us whether observed behavior is exactly rationalizable or not. Moreover, they only allow us to check marital stability in terms of observable consumption/economic gains that drive marriage decisions. However, in reality marriage typically cannot be explained by these economic gains only; immaterial benefits such as love and companionship also play an important role. This makes that observed household consumption behavior need not exactly fit the testable conditions explained above. In addition, marriage markets may be characterized by frictions and search costs, which can equally lead to violations of the rationalizability conditions that we defined above. To account for these aspects, CCDV introduce the concept of stability indices to relax their sharp individual rationality and no blocking pairs conditions. Formally, they replace the corresponding inequality conditions in Proposition 1 by

$$\begin{gathered}\left(s^{IR}_{m,\emptyset} \times y_{m,\emptyset}\right) \leq p_{m,\emptyset} q^{m}_{m,\sigma(m)} + P_{m,\emptyset} Q_{m,\sigma(m)}, \\ \left(s^{IR}_{\emptyset,w} \times y_{\emptyset,w}\right) \leq p_{\emptyset,w} q^{w}_{\sigma(w),w} + P_{\emptyset,w} Q_{\sigma(w),w}, \text{ and} \\ \left(s^{NBP}_{m,w} \times y_{m,w}\right) \leq \left(p_{m,w} q^{m}_{m,\sigma(m)} + P^{m}_{m,w} Q_{m,\sigma(m)}\right) + \left(p_{m,w} q^{w}_{\sigma(w),w} + P^{w}_{m,w} Q_{\sigma(w),w}\right),\end{gathered}$$

where the stability indices $s^{IR}_{m,\emptyset}$, $s^{IR}_{\emptyset,w}$ and $s^{NBP}_{m,w}$ take values between zero and one. Clearly, $s^{IR}_{m,\emptyset} = s^{IR}_{\emptyset,w} = s^{NBP}_{m,w} = 1$ reproduces the sharp conditions in Proposition 1. Generally, lower values for the stability indices imply less stringent rationalizability requirements, so accounting for possible deviations from exact rationalizability. Basically, the outside options (single or remarried) become less attractive, which weakens the incentive to leave the current marriage purely on the basis of (anticipated) material payoffs.

Intuitively, we may also interpret these stability indices as divorce costs. More specifically, $\left(1 - s^{IR}_{m,\emptyset}\right) \times 100$ and $\left(1 - s^{IR}_{\emptyset,w}\right) \times 100$ then indicate the divorce cost associated with becoming single for male m and female w, respectively. In the same way, $\left(1 - s_{m,w}^{NBP}\right) \times 100$ gives the divorce cost for m and w if they remarry each other. In our application, we will compute the maximum values of the stability indices that allow us to rationalize the observed matching and consumption behavior. These values correspond to the minimal divorce costs that are needed to represent the observed marital matches as economically stable.

2.4 Estimation procedure

In a first step of our estimation procedure we compute

$$\max_{s_{m,\emptyset}^{IR}, s_{\emptyset,w}^{IR}, s_{m,w}^{NBP}} \sum_{m} s_{m,\emptyset}^{IR} + \sum_{w} s_{\emptyset,w}^{IR} + \sum_{m} \sum_{w} s_{m,w}^{NBP}, \tag{1}$$

subject to the rationalizability restrictions (with stability indices) that we outlined above. As we explained in the previous section, this obtains the minimal divorce costs that are required to rationalize the observed marital matching as stable.

Subsequently, we multiply the solution values for $s_{m,\emptyset}^{IR}$, $s_{\emptyset,w}^{IR}$, $s_{m,w}^{NBP}$ with the original income levels, $y_{\emptyset,w}, y_{w,\emptyset}, y_{m,w}$. This gives an adjusted dataset that can be rationalized by a stable matching. In turn, this allows us to set identify the intrahousehold resource allocation based on our characterization of stable marriage behavior (so using marital stability as our key identifying assumption).

In their empirical analysis, CDDV focused on identifying a 'general' sharing rule, which specifies the individual incomes that are assigned to either the male m or female w, hereby accounting for both private and public expenditures. In contrast to CDDV, our following empirical analysis will make use of the conditional sharing rule, which (only) captures the individual private consumption shares $q_{m,\sigma(m)}^{m}$ and $q_{m,\sigma(m)}^{\sigma(m)}$ conditional upon the public consumption $Q_{m,\sigma(m)}$ (see, for example, Browning et al., 2014, for a detailed discussion). As we will detail in Section 4, using this conditional sharing rule will effectively allow us to conduct an informative welfare analysis. Formally, the conditional income shares of males and females are defined as, respectively,

$$z^m_{m,\sigma(m)} = p_{m,\sigma(m)} q^m_{m,\sigma(m)} \text{ and } z^{\sigma(m)}_{m,\sigma(m)} = p_{m,\sigma(m)} q^{\sigma(m)}_{m,\sigma(m)},$$

where $z^m_{m,\sigma(m)} + z^{\sigma(m)}_{m,\sigma(m)}$ must add up to the total private expenditures of the household. This conditional sharing rule can be set identified through linear programming techniques. In particular, by maximizing (minimizing) $z^m_{m,\sigma(m)}$ and $z^{\sigma(m)}_{m,\sigma(m)}$ subject to our linear rationalizability conditions, upper (lower) bounds on the income shares are obtained. These bounds enable welfare analysis at the level of individuals in households (instead of the aggregate households), which we will use in our empirical application.

3 Empirical application

We first discuss the setup of our empirical application. Subsequently we introduce our data and finally we present our obtained results for the conditional sharing rule. All this will form the basis for our individual welfare analysis in Section 4.

3.1 Setup

Our empirical application considers a collective supply labor setting in which each household's full income is spent on material consumption and time use (including leisure, domestic work and child care). Material consumption is measured as a Hicksian aggregate good that consists of a private and a public component. Private consumption is partly assignable and partly nonassignable. For some expenditures (for example, clothing) it is observed who consumes what, while other expenditures (for example, holidays or rents) are not directly assignable to individuals. While the assignable expenditures are assumed to be fully privately consumed, part of the nonassignable expenditures of each couple will be treated as public consumption, while the remainder will be treated as nonassignable private consumption (see Section 3.2 for more details). Adding this information to the constraints in Proposition 1 is straightforward; it simply imposes lower bounds on the unknown private quantities $q^m_{m,\sigma(m)}$ and $q^w_{\sigma(w),w}$.

In our following analysis, we will use two different methods (Methods A and B) to calculate leisure. In Method A, we distinguish between leisure time and time spent on domestic work and child care. This avoids that a part-time working mother appears to consume a high amount of leisure, while, in reality, she is spending a significant amount of time on household work and child care. Hours devoted to domestic work and child care are then modeled as an input that is consumed within the household (Becker, 1965). In our empirical analysis, we follow CDDV by assuming that individual spouses produce different household goods through efficient one-input technologies that are characterized by constant returns to scale. As an implication, the value of time spent on domestic production can act as the output value of the household goods. These household goods are then evaluated at personalized Lindahl prices, which have to add up to the wage of the spouse that produced the good. For example, when the male spends an hour on cleaning a room, both spouses have Lindahl prices for this household work (reflecting their willingness to pay for a clean room) that must add up to the male's observed wage.

Next, Method B does not distinguish between leisure time and time spent on domestic work and child care. As such, it treats all time not spent on the labor market as leisure. This effectively mimics practical applications that make use of datasets lacking detailed information on individuals' time use allocations. It will allow us to assess whether such a "simplified" model setup creates a bias in the welfare analysis.

3.2 Data

We make use of Belgian household data drawn from the MEqIN survey, which contains a rich set of variables with information on households' labor supply, consumption expenditures, time use, wealth, wages, and other sociodemographic variables.[6] In what follows,

[6]The MEqIn survey was collected by a team of researchers from the Université Catholique de Louvain, the KU Leuven, the Université libre de Bruxelles and the University of Antwerp. The collection of the

we first present descriptive statistics of the variables that we use in our empirical application. Subsequently, we briefly elaborate on our construction of individual-specific marriage markets.

Sample selection. Our empirical analysis targets households with adult individuals aged between 24 and 65 years old. In order for couples to be included in the sample, both adults have to work at least 10 hours per week. Also, the self-employed are left out of the sample. Their wages are not as straightforwardly obtained as for salaried workers, in part because of the rather vague distinction between private and work-related expenditures. In addition, households with important missing data on age, consumption, wage, time use and marital status were deleted. Finally, our dataset also includes singles, so expanding the remarriage options (i.e., potentially blocking pairs) for the married individuals. These selection criteria result in a sample that consists of 161 couples, 118 single females and 65 single males.

As previously mentioned, consumption can be divided into an assignable part and a nonassignable part. In the MEqIn data, several good categories, such as food, restaurants, cigarettes, clothing, personal care products, education expenses and transportation can be assigned to a particular individual. The remaining part of the observed household consumption is nonassignable, which ranges from rent and mortgages to holiday expenses and medical care. Throughout our analysis, we will assume that 50% of these nonassignable expenditures within households is privately consumed while the other half is publicly consumed. The same assumption was used by Cherchye et al. (2017).[7]

Table 1 presents summary statistics for all married couples in our sample, for both Methods A and B. Wages are expressed as net hourly wages. On average, males earn more than their female counterparts. Full income, expressed in euros per week, is calculated by summing both spouses' maximum labor income and the household's total nonlabor income.

MEqIn data was enabled by the financial support of the Belgian Science Policy Office (BELSPO) through grant BR/121/A5/MEQIN (BRAIN MEqIn).

[7]We could relax this assumption by implementing the method introduced in Cherchye et al. (2020). For simplicity of our exposition, we abstract from this extension in the current analysis.

Table 1: Summary statistics for married couples

	Mean	SD	Min.	Max.
Male wage	10.635	3.101	3.22	22.44
Female wage	9.93	2.652	3.401	21.719
Full income	2242.95	540.421	1169.816	4096.556
Total private consumption	532.358	174.773	145.154	1253.769
Assignable male private consumption	122.022	56.65	8.769	311.538
Assignable female private consumption	121.403	61.59	9	369.231
Public consumption	288.932	128.35	74.423	991.846
Male age	41.248	9.128	25	64
Female age	38.658	8.668	25	61
Number of children	1.168	0.976	0	4
Male dummy for college degree	0.429	0.496	0	1
Female dummy for college degree	0.565	0.497	0	1
Method A				
Male leisure	49.111	14.559	2	84
Female leisure	44.259	15.236	0	80.5
Male household work	16.006	12.171	0	63
Female household work	27.609	15.502	1	98
Method B				
Male leisure	65.117	10.179	26	90
Female leisure	71.725	9.519	41	98.25

Notes: Leisure and household work are in hours per week. Wages are in euros per hour while full income and consumption are denoted in euros per week.

Total private consumption equals each individual's assignable consumption plus 50% of the nonassignable expenditures, and public consumption corresponds to the other 50% of the nonassignable expenditures. Table 1 also reports on several household characteristics such as age, number of children and whether the male or female attended college or university.[8] Leisure is denoted in hours per week. We calculate leisure time by making the standard assumption that each individual needs eight hours per day for personal care and sleep. This means that only 112 hours ($(24 - 8) \times 7$) is maximally spent on the labor market per week. As explained above, Method A further distinguishes between leisure and domestic work plus child care, while Method B treats all time not spent on market labor as leisure. When

[8]Due to privacy reasons, we (only) obtained clusters of three years for the age variable. To calculate the average age of a couple, the middle number in each age cluster is used. For example, individuals in the age cluster between 24 and 26 years are listed as 25 year old.

using Method B, women seem to have more leisure than men. However, this conclusion no longer holds under Method A, because women spend on average substantially more time on domestic work and child care. In our following analysis, we will check whether this alternative specification of leisure time yields different welfare conclusions.

Lastly, we compute individual nonlabor incomes associated withe the different (re)marriage options. For observed couples, nonlabor income is calculated by subtracting labor income from the reported consumption expenditures (i.e., consumption-based nonlabor income). Following CDDV, individual nonlabor incomes associated with remarriage are treated as unknowns in our linear programming method, which are subject to the condition that they must add up to the total nonlabor income in the observed marriage. Formally, these individual nonlabor incomes are treated similarly as the individual quantities $q^{m}_{m,\sigma(m)}$ and $q^{\sigma(m)}_{m,\sigma(m)}$, and the personalized prices $P^{m}_{m,w}$ and $P^{\sigma(m)}_{m,\sigma(m)}$, which are also unknown and subject to an adding up condition.

Marriage markets. Our Belgian sample consists of males and females aged between 24 and 65 years. Arguably, married males and females do not consider all individuals of the other gender as potential remarriage options. Therefore, in our empirical analysis we construct individual-specific marriage markets on the basis of age (differences). Specifically, each male's individual marriage market contains all females that are at most 12 years younger and at most 6 years older. Similarly, each female's individual marriage market consists of all males that are at most 6 years younger and at most 12 years older. The age brackets that we use for these individual-specific marriage markets are defined on the basis of the age differences between the spouses of observed couples in our Belgian dataset; 95 % of the observed marriages respect these age bounds. We refer to Appendix A for a more detailed presentation of these individual-specific marriage markets.

3.3 Estimation results

Proposition 1 states the conditions that a dataset must satisfy in order to be rationalizable by a stable matching. In a first step of our empirical analysis, we examine whether and to what extent the Belgian household data satisfy these sharp rationalizability restrictions. By solving the maximization problem (1), we can compute the minimal divorce costs that are required for the dataset to satisfy the individual rationality and no blocking pairs conditions, as $(1 - s^{IR}_{m,\emptyset}) \times 100, (1 - s^{IR}_{\emptyset,w}) \times 100$ and $(1 - s^{NBP}_{m,w}) \times 100$. Overall, we find that small divorce costs are needed to meet the individual rationality constraints, while the (rationalizing) divorce costs for the no blocking pairs constraints are somewhat higher, especially when using Method B. A more detailed discussion of the divorce costs can be found in Appendix B.

By using the computed stability indices, we can address identification of the conditional sharing rule. As explained in Section 2, this conditional sharing rule defines the within-household allocation of private consumption (conditional on the given level of public consumption). Table 2 reports the bounds on the conditional sharing rule that we obtain when using Method A. For a given spouse, the 'Diff' columns in Table 2 describes the difference between the lower and upper bounds in percentage points. Our results clearly show that our revealed preference methodology has significant identifying power: the average difference between the lower and upper bounds is very low. In addition, we find that men have on average a larger consumption share than women: the average male share is between 55.9% and 57.7% while the average female share is between 42.3% and 44.1%.

Finally, the average bounds on the conditional sharing rule are even narrower for Method B. This is documented in Table 3, which has a directly similar interpretation as Table 2. We observe the same general patterns as for Method A. The average difference between male and female consumption shares is somewhat smaller, reflecting the fact that Method B treats all nonlabor time as privately consumed leisure time, so particularly increasing the assignable private consumption of females. Thus, erroneously specifying domestic work as leisure seems to create an upward estimation bias for female welfare and a downward estimation bias for male welfare.

Table 2: Method A - Conditional sharing rule identification

	Men			Women		
	Lower	Upper	Diff	Lower	Upper	Diff
Mean	0.559	0.577	0.181	0.423	0.441	0.181
Standard Deviation	0.098	0.099	0.018	0.010	0.098	0.018
Minimum	0.310	0.328	0.000	0.133	0.056	0.000
First Quartile	0.496	0.513	0.005	0.367	0.381	0.005
Median	0.559	0.574	0.014	0.4263	0.441	0.014
Third Quartile	0.617	0.633	0.025	0.485	0.504	0.025
Maximum	0.850	0.867	0.108	0.672	0.690	0.108

Table 3: Method B - Conditional sharing rule identification

	Men			Women		
	Lower	Upper	Diff	Lower	Upper	Diff
Mean	0.520	0.533	0.133	0.467	0.480	0.133
Standard Deviation	0.089	0.088	0.014	0.088	0.089	0.014
Minimum	0.258	0.272	0.000	0.150	0.164	0.000
First Quartile	0.464	0.480	0.003	0.417	0.426	0.003
Median	0.525	0.542	0.011	0.458	0.475	0.011
Third Quartile	0.574	0.583	0.018	0.520	0.536	0.018
Maximum	0.836	0.850	0.089	0.730	0.742	0.089

4 Individual welfare analysis

We use our identification results for the conditional sharing rule to conduct a welfare analysis at the level of individuals within households. More specifically, our aim is to assess whether and to what extent accounting for unequal intrahousehold sharing, time use and scale economies (through public consumption) impacts the conclusions of poverty and inequality analyses.

4.1 Economies of scale and intrahousehold sharing

To assess the importance of public consumption sharing, we begin by estimating the economies of scale that arise within households. This allows the total value of household consumption to exceed the household expenditures, as the same good may be consumed simultaneously by both spouses. Browning et al. (2013) introduced an economies of scale measure that compares the expenditures needed as singles to obtain the same consumption bundles as when married. More specifically, for each matched pair, this economies of scale measure is defined as:

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

The denominator in this expression equals the expenditures of a couple for the bundle $(q^m_{m,\sigma(m)}, q^{\sigma(m)}_{m,\sigma(m)}, Q_{m,\sigma(m)})$ that is consumed in the observed marriage, and the numerator gives the expenditures that the two spouses would incur to attain the same individual consumption levels as singles (with public expenditures counted twice). By construction, the value of $R_{m,\sigma(m)}$ is situated between one and two. When all consumption is private, there are no gains to marriage and $R_{m,\sigma(m)} = 1$. By contrast, when all consumption is public, then the married individuals will need twice as much resources as singles to achieve the same level of consumption as in marriage, which yields $R_{m,\sigma(m)} = 2$. Generally, higher $R_{m,\sigma(m)}$-values reveal greater scale economies.

Table 4 reports on the $R_{m,\sigma(m)}$-estimates for our Belgian MEqIn sample. We consider three scenarios: (1) consumption includes no time use (i.e., only material consumption), (2) consumption includes time use by using Method A, (3) consumption includes time use by using Method B. Note that these scenarios change both the numerator (i.e. different consumption bundles) and the denominator (i.e. different budgets). As a result, including time use in the analysis does not necessarily need to result in higher or lower estimates of scale economies. By contrast, using Method B instead of Method A will yield less economies of scale by construction; Method B wrongly classifies publicly consumed domestic work as

Table 4: Economies of scale measure

Material consumption only	Mean	Median	Std. Dev.
All couples	1.3469	1.3580	0.0582
Childless couples	1.3111	1.3234	0.0674
Couples with 1 child	1.3481	1.3493	0.0464
Couples with more than 1 child	1.3735	1.3797	0.0399
Method A: Material consumption + time use			
All couples	1.3257	1.3176	0.1128
Childless couples	1.2230	1.2280	0.0661
Couples with 1 child	1.3536	1.3388	0.0958
Couples with more than 1 child	1.3874	1.3777	0.0947
Method B: Material consumption + time use			
All couples	1.1623	1.1630	0.0536
Childless couples	1.1247	1.1269	0.0431
Couples with 1 child	1.1655	1.1613	0.0405
Couples with more than 1 child	1.1893	1.1824	0.0510

privately consumed leisure, thus generating a downward estimation bias.

When only material consumption is included, married individuals need on average approximately 35% more expenditures as singles to achieve the same bundle of goods. Also, we observe that children imply more public expenditures and, through this channel, more gains from being married. Next, in Method A time spent on household tasks and child care are treated as public goods, which leads to additional scale economies. Therefore, we find that individuals as single would need more expenditures to attain the same consumption level as in their current marriage, i.e., about 32% more on average. Again, this increases with the number of children. Finally, Method B does not consider time use as public consumption. As an implication, individuals as single now only need 16% extra expenditures to buy the bundle $(q^m_{m,\sigma(m)}, q^{\sigma(m)}_{m,\sigma(m)}, Q_{m,\sigma(m)})$. In our opinion, these results clearly highlight how alternative treatments of time use information may significantly impact the empirical analysis of the welfare of individuals (in particular singles). Particularly, wrongly specifying domestic work as leisure (as in Method B) can lead to severe underestimation of the scale economies experienced by multi-person households.

Building further on these $R_{m,\sigma(m)}$-results, we can compute the income that an individual would need as single to buy the same bundle as consumed in the current marriage. To do so, we make use of the concept RICEB (i.e., relative individual cost of equivalent bundle) that was introduced by Cherchye et al. (2020). Basically, individual RICEBs account simultaneously for both the scale economies and the intrahousehold allocation of resources to assess the welfare of individuals in households. They are defined as follows for male m and female $\sigma(m)$ in the couple $(m, \sigma(m))$:

$$R^m_{m,\sigma(m)} = \frac{p_{m,\emptyset} q^m_{m,\sigma(m)} + P_{m,\emptyset} Q_{m,\sigma(m)}}{y_{m,\sigma(m)}}, \text{ and}$$
$$R^{\sigma(m)}_{m,\sigma(m)} = \frac{p_{\emptyset,\sigma(m)} q^{\sigma(m)}_{m,\sigma(m)} + P_{\emptyset,\sigma(m)} Q_{m,\sigma(m)}}{y_{m,\sigma(m)}}.$$

In words, these RICEBs $R^m_{m,\sigma(m)}$ and $R^{\sigma(m)}_{m,\sigma(m)}$ give the incomes that the individuals would need as singles (expressed as fraction of the current household income) to attain the same consumption level as in their given marriage. In computing these required income levels, the RICEBs include both the intrahousehold sharing of private consumption (as identified through the conditional sharing rule) and the economies of scale that follow from public consumption.

Table 5: RICEBs

	RICEB men			RICEB women		
	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.
Only material consumption						
With economies of scale	0.7473	0.7433	0.0869	0.5996	0.5906	0.0772
Without economies of scale	0.5737	0.5768	0.0769	0.4262	0.4232	0.0769
Material consumption + time use						
Method A: with economies of scale	0.7073	0.7184	0.0868	0.6184	0.6232	0.0843
Method B: with economies of scale	0.5866	0.5919	0.0804	0.5406	0.5424	0.0762
Method A: without economies of scale	0.5206	0.5285	0.0795	0.4794	0.4715	0.0795
Method B: without economies of scale	0.5230	0.5288	0.0761	0.4770	0.4712	0.0761

Table 5 summarizes our RICEB estimates. To interpret these results, we recall that our revealed method actually allows us to identify bounds on the conditional sharing rule.

However, as the estimated lower and upper bounds are very close to each other (see Table 2), we restrict ourselves to only reporting the average of these lower and upper bounds. Next, we consider the same three scenarios as before regarding the treatment of time use information (i.e. only material consumption, and including time use through Method A or Method B). For each of these three scenarios we report results 'with economies of scale' and 'without economies of scale'. The former indicates that we consider public consumption as simultaneously consumed by both members (as in the RICEBs defined above), while the latter means that we treat all public consumption as private consumption that is equally split between the spouses (i.e., scale economies are assumed away).

From Table 5 we learn that male RICEBs are substantially above female RICEBs when only considering material consumption. With economies of scale, the average RICEB is 0.7473 for men against 0.5996 for women. When excluding economies of scale, the RICEB values are –not surprisingly– substantially lower, but the average difference between males and females remains closely similar (i.e., 0.5737 versus 0.4262). However, the picture changes quite drastically when including time use information. While male RICEBs are still systematically above female RICEBs, the gap decreases rather substantially. Moreover, we find that Methods A and B yield very different results. When using Method B, men appear only slightly better off than women, because women's time invested in domestic work and child care is treated as (privately consumed) leisure. By contrast, when using Method A (treating domestic work and child care as public consumption), the gap between males and females widens again. Overall, when only considering material consumption, women are worse off than men. When including time use, this inequality reduces, but this reduction largely depends on how leisure is defined. Our results once more demonstrate the importance of adequately modeling domestic work to avoid a bias in the (male versus female) welfare analysis.

Generally, our estimates of the conditional sharing rule and male and female RICEBs show that intrahousehold resource sharing is often very unequal. In most cases, the share of women is below that of their husbands. Moreover, economies of scale do make individuals living together better off than singles. These analyses call into question the current practice of measuring consumption levels merely in terms of household expenditures while ignoring time use, scale economies and resource sharing within households. Therefore, in the next sections we will evaluate the effect of these aspects on estimated poverty and inequality rates.

4.2 Poverty

The poverty rate is commonly calculated as the fraction of households/individuals that is situated under the poverty line. In policy practice, one of the most widely used poverty lines is the US$1.90 per day measure of the World Bank (Jolliffe et al., 2014); individuals are then considered as poor when the household per-capita expenditures are below this line. However, this measure assumes that resources are shared equally within households. Also, it abstains from any notion of consumption sharing. For example, individuals in a six-person household that spends US$18 are assumed to be equally well-off as a single individual spending US$3. One way of tackling this issue is to make use of equivalence scales, which make it possible to compare the required expenditures of households with different sizes to achieve the same utility level. For instance, it allows for concluding that a household of two adults and one child will need less than three times the expenditures of a single household to reach the same utility level. A prominent example are the OECD equivalence scales, which are meant to correct for differences in scale economies across household types. However, measuring poverty by using equivalent scales still ignores the possibility of unequal resource sharing within households.

The collective model has been used quite extensively to assess individual poverty while accounting for unequal intrahousehold sharing. For example, Cherchye et al. (2015) use estimated sharing rule bounds to investigate the poverty of individual household members. They find that poverty is substantially more prevalent at the individual level than at the household level. Moreover, individual poverty is particularly present among women. Cherchye et al.

(2020) extend this analysis by considering economies of scale in addition to unequal sharing in the analysis of individual poverty. By using the RICEB concept that we introduced in the previous section, these authors find once more that women are worse off than men because of unequal intrahousehold sharing. In addition, they find that the fraction of poor households decreases when intrahousehold scale economies are accounted for.

Dunbar et al. (2013) implement the collective household model to estimate resource shares of both adult household members and children. Their method makes use of Engel curves of assignable private goods to measure individual poverty in Malawi. Strikingly, child poverty appears to be heavily underestimated when assuming equal sharing: over 90% of children are identified as poor in their analysis. Calvi et al. (2021) extend the method of Dunbar et al. (2013) to allow for different family structures that are more prevalent in developing countries, such as extended families that include multiple children or additional adults. Their results reveal that being part of a larger family leads to a trade off between, on the one hand, gains from public consumption (i.e., scale economies) and, on the other hand, smaller individual income shares on average. Calvi et al. (2021) then conduct a poverty analysis that takes into account both unequal resource allocations and consumption sharing. They conclude that this identifies more poor children in Mexico, and more poor women and children in Bangladesh.

Finally, whether or not to include time use information can also have important implications for welfare indices measuring poverty and inequality. Intuitively, two individuals might enjoy the same level of material consumption while having completely different levels of leisure. Are they then truly equally well off? When including time use, defining it as private or public consumption also raises questions. For example, does it make a significant difference if domestic work and child care is treated as public consumption or as privately consumed leisure? Using a general equilibrium model, Boerma and Karabarbounis (2021) find that considering home production increases inequality in US households. By contrast, Attanasio et al. (2015) show that including time use has a mitigating effect on consumption

Table 6: Poverty rate: couple level

Only material consumption	All couples	Childless couples	Couples with 1 child	Couples with more than 1 child
Only private consumption, no public cons.	4.35	3.85	7.32	2.94
Private + Public consumption, no economies of scale	9.99	11.54	12.20	7.35
Private + Public consumption, economies of scale	10.56	13.46	12.20	7.35
Material consumption + time use				
Method A: no economies of scale	1.86	0.00	4.88	1.47
Method A: economies of scale	3.73	3.85	4.88	2.94
Method B: no economies of scale	1.86	0.00	4.88	1.47
Method B: economies of scale	1.86	0.00	4.88	1.47

inequality in the US between 1980 and 2010. More specifically, these authors describe how material consumption has grown more rapidly for highly educated households relative to lowly educated families, which has led to more inequality. However, lowly educated people have been spending more time on leisure than their highly educated counterparts, which muted the initial increase in inequality.[9]

Motivated by these existing studies, in Tables 6 and 7 we report estimated poverty rates (for couples and individuals) for different household types in our selected sample of Belgian households. We again consider three scenarios regarding the treatment of time use information, and two scenarios regarding the presence of scale economies.

Table 6 reports computed poverty rates at the household/couple level. We use a standard measure in developed countries to calculate the household poverty line: 60% of the median consumption level in the relevant sample. All households with a consumption level below this poverty line are denoted as poor. It is important to recall that we only include couples in which both spouses worked at least 10 hours per week in our empirical analysis. This results in a different (i.e., higher) poverty line than for other samples that also include unemployed or retired individuals.

When only considering material consumption, the inclusion of public consumption raises the poverty rate in our sample. Intuitively, when public consumption is shared, this gives rise to economies of scale, which makes that particularly childless couples (with little public

[9]Notably, in Attanasio et al. (2015) leisure does not include domestic work such as child care or cleaning.

consumption) are identified as poor. In contrast, including time use (through Methods A or B) generally implies lower poverty rates. For Method B, including scale economies does not alter the result by construction (as all nonlabor time is treated as privately consumed leisure). However, for method A, which considers time spent on household work and child care as public consumption, we again find that more couples are identified as poor, in particular childless couples.

Table 7 documents the prevalence of poverty at the individual level. Individual poverty lines are calculated by halving the couple poverty lines. Generally, we find that both single and married women are considerably worse off than their male counterparts. In particular, married women seem to have much lower private material consumption than their husbands, with almost 32% of them being identified poor when ignoring time use. This is somewhat mitigated when including public consumption: this reduces the poverty of married women to 21.12%, but nonetheless their are still significantly more poor women than men. Not surprisingly, by allowing individuals in couples to benefit from sharing (material) public consumption, these individuals are considerably less likely to be seen as poor, while the opposite applies to singles.

The patterns again change when including time use information. Married women are still worse off than married males for both Methods A and B. However, the difference is not as large as when only material consumption is taken into account. For Method A, the fraction of poor married women rises considerably when allowing for economies of scale. As women spend on average more time on child care and domestic work, this results in higher consumption. However, this public time use is shared by the two spouses, and thus comes to the benefit of both the male and the female. This eradicates the women's advantage, resulting in a higher poverty rate of the married women. Because couples can share their consumption, singles are again considerably poorer for both methods when accounting for economies of scale. As public consumption is larger by construction in Method A, this method implies higher poverty rates among singles than Method B, so again illustrating

Table 7: Poverty rate: individual level

Only material consumption	All individuals	All males	All females	All married individuals	All married males	All married females	All single individuals	All single males	All single females
Only private consumption, no public cons.	14.06	5.81	17.73	18.94	6.21	31.68	5.46	3.08	6.78
Total consumption, no economies of scale	11.29	6.69	13.66	13.66	6.21	21.12	7.10	7.69	6.78
Total consumption, economies of scale	15.25	15.70	18.90	10.87	7.45	14.29	22.95	21.54	23.73
Material consumption + time use									
Method A: no economies of scale	2.77	2.03	3.20	3.11	1.86	4.35	2.19	3.08	1.69
Method A: economies of scale	9.99	11.05	12.79	5.56	3.73	7.45	17.49	15.38	18.64
Method B: no economies of scale	3.37	2.62	3.49	4.04	3.11	4.97	2.19	3.08	1.69
Method B: economies of scale	4.75	4.94	4.94	4.35	4.35	4.35	5.46	6.15	5.08

that a bias is generated when erroneously classifying domestic work as leisure.

4.3 Inequality

Chiappori and Meghir (2015) highlight the importance of taking into account the within-household allocation of resources when measuring inequality. For example, Lise and Seitz (2011) analyze the evolution of inequality in the U.K. between 1968 to 2001 by using structural estimates of the sharing rule. One of their main findings is that initial consumption inequality was underestimated by 50% when not considering intrahousehold resource sharing. Strikingly, from 1980 onwards consumption inequality within households has declined. However, this did not result in lower total inequality due to a strong increase of between-household inequality. In addition, Lise and Seitz found that including time use (i.e., leisure) in their structural estimates did not change their results dramatically. However, it did lower the between-household inequality as households with unemployed members were compensated for their lower consumption through additional leisure time.

We conclude our empirical analysis by describing inequality in Belgium at the level of households and individuals. Inequality is measured by using the Gini coefficient. This Gini coefficient equals one in the perfect inequality scenario where a single household or individual owns all resources, while a Gini coefficient of zero reflects perfect equality.

Table 8 shows inequality rates at the couple level, i.e., without accounting for intrahousehold inequality. Overall, the distribution of consumption in Belgium is relatively equal, with a Gini coefficient of 0.1749 when only considering private consumption and a slightly higher

Table 8: Gini coefficient: couple level

Only material consumption	All couples	Childless couples	Couples with 1 child	Couples with more than 1 child
Only private consumption, no public cons.	0.1749	0.1651	0.1729	0.1798
Both, no economies of scale	0.1802	0.1621	0.1607	0.1941
Both, economies of scale	0.1876	0.1669	0.1580	0.2023
Material consumption + time use				
Method A: no economies of scale	0.1325	0.1378	0.1103	0.1352
Method A: economies of scale	0.1435	0.1422	0.1249	0.1373
Method B: no economies of scale	0.1325	0.1378	0.1103	0.1352
Method B: economies of scale	0.1365	0.1340	0.1133	0.1440

Gini coefficient when also including public goods. Similar to the results in Lise and Seitz (2011), including time use somewhat lowers our inequality estimates as households with less material consumption compensate through more leisure.

Table 9: Gini coefficient: individual level

Only material consumption	All individuals	All males	All females	All married individuals	All married males	All married females	All single individuals	All single males	All single females
Only private consumption, no public cons.	0.2342	0.2021	0.2364	0.2569	0.2084	0.2454	0.1919	0.1807	0.1956
Total consumption, no economies of scale	0.2165	0.2012	0.2183	0.2161	0.2004	0.1997	0.2121	0.2017	0.2169
Total consumption, economies of scale	0.2158	0.2124	0.2072	0.2072	0.2008	0.1949	0.2121	0.2017	0.2169
Material consumption + time use									
Method A: no economies of scale	0.1568	0.1547	0.1553	0.1562	0.1558	0.1478	0.1561	0.1378	0.1641
Method A: ecnomies of scale	0.1696	0.1710	0.1624	0.1581	0.1543	0.1515	0.1561	0.1378	0.1641
Method B: no economies of scale	0.1586	0.1557	0.1596	0.1591	0.1621	0.1504	0.1561	0.1378	0.1641
Method B: economies of scale	0.1579	0.1592	0.1551	0.1570	0.1615	0.1479	0.1561	0.1378	0.1641

Finally, Table 9 reports on inequality between individuals. Overall, the levels of inequality are higher than in Table 8, especially when only including material consumption and ignoring time use information. When we include time use information, albeit that the level of inequality is reduced, it is still higher than when measured at the level of couples. Finally, using Method A or B does not seem to affect the inequality rates significantly, nor does (not) accounting for economies of scale.

5 Conclusion

We have used the methodology of Cherchye et al. (2017) to recover within-household patterns of consumption sharing under the identifying assumption of marital stability. The method is intrinsically nonparametric and only requires a single observation per household while allowing for full heterogeneity across households (in terms of individual utilities and intrahousehold decision processes). Attractively, our application to the Belgian MEqIn data obtained informative empirical results on individual welfare (poverty and inequality) under these minimalistic assumptions.

Our particular focus was on the impact of time use information on the welfare conclusions that are obtained. Specifically, we compared welfare results under three specifications of individual consumption, which includes respectively (1) only material consumption (ignoring time use information), (2) material consumption and both (private) leisure time and (public) domestic work (called Method A), and (3) material consumption and all nonlabor time treated as (private) leisure (thus ignoring domestic production; called Method B). In addition, we evaluated how economies of scale (resulting from public consumption) affect the individual welfare analysis of singles versus individuals in multi-person households.

Our empirical results indicate that intrahousehold inequality, inter-individual differences in time use and inter-household differences in scale economies may significantly impact individual welfare analyses. First, including time use information reduces poverty and inequality rates, indicating that lower consumption may be compensated through more leisure. Next, as women typically have lower intrahousehold resource shares, welfare analyses that focus on aggregate household consumption typically underestimate female welfare. In this respect, we have also shown that wrongly classifying domestic work as leisure may severely bias the empirical (female versus male) welfare analysis. Finally, ignoring scale economies of multi-person households makes that poverty among singles is underestimated. From a policy perspective, our findings strongly motivate accounting for these different aspects when analyzing poverty and inequality analysis, and when evaluating policy decisions aimed at creating a more equal society.

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Appendix A: individual-specific marriage markets

Table 10 presents summary statistics on the sizes of the separate, age-based marriage markets of all married individuals. Note that these marriage markets contain both married and single individuals. As can be seen from the table, the average marriage market for males (133 women) is substantially larger than the average female marriage market (103 men). In addition, we find considerable heterogeneity across individuals. For example, the smallest and largest marriage markets for men consist of, respectively, 46 and 207 women.

Table 10: Summary statistics on size of individual-specific marriage markets

	Males	Females
Mean	132.5	102.5
Standard Deviation	56.64	46.12
Minimum	46	18
First Quartile	85	64
Median	136	112
Third Quartile	191	142
Maximum	207	156

Appendix B: Divorce costs

Table 11 shows the distribution of the divorce cost (defined on the basis of stability indices; see our exposition in the main text) that are required to obtain data consistency with the individual rationality constraints for marital stability. We express these divorce as a percentage of the post-divorce full incomes as we calculate them for the alternative (re)marriage opportunities. No divorce cost is needed to rationalize the marriage decisions with respect to the individual rationality conditions when using Method A, while 98.76 percent of males and 100 percent of females satisfy the sharp individual rationality conditions for Method B. These results indicate that almost no individuals in the sample can afford as a single their consumption level in the observed marriage. The explanation is that individuals in marriage benefit from scale economies (through public consumption), which are lost when they become single. By construction, these economies of scale are greater for Method A than Method B, as the former method also treats domestic work and child care as public consumption, while the latter method treats this time use as privately consumed leisure.

Table 12 has a similar interpretation as Table 11 but pertains to the no blocking pair conditions in Proposition 1. For each matched pair, the mean represents the necessary divorce cost for the average remarriage option. This is calculated by taking the mean of the

Table 11: Cost of divorce as a fraction of post-divorce full income: Individual Rationality

	Method A		Method B	
	Males	Females	Males	Females
Fraction zero	100	100	98.76	100
Mean	0.00	0.00	0.025	0.00
Standard Deviation	0.00	0.00	0.23	0.00
Minimum	0.00	0.00	0.00	0.00
First Quartile	0.00	0.00	0.00	0.00
Median	0.00	0.00	0.00	0.00
Third Quartile	0.00	0.00	0.00	0.00
Maximum	0.00	0.00	2.53	0.00

Notes: Columns 2 and 3 represent the distribution of the divorce cost associated with the individual rationality constraints for Method A. Columns 4 and 5 display the distribution of these divorce cost for Method B.

values $(1 - s^{NBP}_{m,w'}) \times 100$ and $(1 - s^{NBP}_{m',\sigma(m)}) \times 100$ over all w' and m'. In the same way, the maximum index equals the value of the required divorce cost to rationalize the most attractive remarriage option (i.e., the highest values $(1 - s^{NBP}_{m,w'}) \times 100$ and $(1 - s^{NBP}_{m',\sigma(m)}) \times 100$ over all w' and m'). In addition, the 95th percentile index is calculated as the 95th percentile of the values $(1 - s^{NBP}_{m,w'}) \times 100$ and $(1 - s^{NBP}_{m',\sigma(m)}) \times 100$ over all w' and m'. This index is less prone to outliers compared to the maximum index. Generally, data consistency with marital stability requires higher divorce costs for the no blocking pair conditions than for the individual rationality conditions. Intuitively, this indicates that individuals are more likely to be better off under remarriage than when ending up single.

For Method A, we find that 3.73 percent of all couples do not need any divorce cost to satisfy the no blocking pair conditions. When rationalizing the current marriage for the 95th percentile of all remarriage options, more than one quarter of all households satisfy the sharp rationality conditions (27.33 %). These fractions are substantially higher than for Method B. The mean divorce cost needed to rationalize the average remarriage option equals 0.29 percent. Next, the mean divorce cost associated with the most attractive remarriage option equals 3.39 percent. Lastly, to rationalize the remarriage option in the 95th percentile, a divorce cost of only 1.75 % is needed for rationalizability.

The interpretation for the results for Method B is directly analogous. Like for the individual rationality constraints, the revealed divorce costs are generally higher for Method B than for Method A. As expected, we can conclude that the observed consumption data are more consistent with the assumption of marital stability for Method A than for Method B.

Table 12: Cost of divorce as a fraction of post-divorce full income: No Blocking Pairs

	Method A			Method B		
	Mean	Maximum	95th pctl	Mean	Maximum	95th pctl
Fraction zero	3.73	3.73	27.33	0.62	0.62	4.97
Mean	0.29	4.45	1.75	0.53	4.91	2.86
Standard Deviation	0.39	2.36	1.72	0.57	2.09	1.66
Minimum	0.00	0.00	0.00	0.00	0.00	0.00
First Quartile	0.09	2.80	0.00	0.25	3.60	1.56
Median	0.22	4.69	1.44	0.45	5.16	3.04
Third Quartile	0.35	6.12	2.77	0.59	6.35	4.13
Maximum	3.39	11.12	7.19	4.73	9.39	7.30

Notes: Columns 2 to 7 represent the distribution of divorce costs associated with the no blocking pair constraints. Column 2 refers to the average divorce cost (Mean index), column 3 to the maximum divorce cost (Maximum index) and column 4 to the divorce cost on the 95th percentile (95th percentile index) for Method A. Column 5 refers to the average divorce cost (Mean index), column 6 to the maximum divorce cost (Maximum index) and column 7 to the divorce cost on the 95th percentile (95th percentile index) for Method B.