



Ageing Europe – An Application of National Transfer Accounts for Explaining and Projecting Trends in Public Finances

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Abbreviations and acronyms

AGENTA	Ageing Europe: An application of National Transfer Accounts (NTA) for explaining and projecting trends in public finances
CCH	Household consumption, childcare
CHW	Household consumption, housework
CIH	Household consumption, inter-household unpaid labour
ECHP	European Community Household Panel survey
ESA	European System of National and Regional Accounts
EU	European Union
EU-SILC	European Union Statistics on Income and Living Conditions survey
GDP	Gross domestic product
HETUS	Harmonised European Time Use Survey
ILO	International Labour Organization
IPUMS	Integrated Public Use Microdata Series
ISCO	International Standard Classification of Occupations
LCD	Life cycle deficit
LCS	Life cycle surplus
LFS	Labor Force Survey
MTUS	Multinational Time Use Study
NA	National Accounts
NTA	National Transfer Accounts
NTTA	National Time Transfer Accounts
OWW	Occupational Wages around the World database
PCH	Household production, childcare
PHW	Household production, housework
PIH	Household production, inter-household unpaid labour
SES	Structure of Earnings Survey
SNA	System of National Accounts



TUS	Time use survey
UN	United Nations
WB	World Bank



1 Overview of the comparative European National Time Transfer Accounts

1.1 Introduction

In order to analyse the role of demography in macroeconomic issues, Lee & Mason (2011) opened a new chapter in national accounting: National Transfer Accounts (NTA). The project developed a methodology to disaggregate national accounts by age. By examining age patterns in economic activity and estimating inter-age transfers, NTA explores how different generations acquire and use economic resources. Nevertheless economic flows generated by household production are missing elements in the NTA resource reallocation framework. Services provided to other household members such as care, cooking, shopping and cleaning constitute an important part of intergenerational transfers. Different calculations are needed to estimate how these non-market economic activities vary by age and by gender and to assess the providers and the beneficiaries of these services within these groups. In this manual we provide the methodology of such calculations using publicly available harmonised European data.

Because household production is to a large degree carried out by women and because it is not included in national accounts the calculations are crucial to make women's total economic contribution and the resources flowing to children more visible. The comparative quantification would also enable easier observation by policy makers and the public as well. Following Donehower (2014) we call these estimations the National Time Transfer Accounts (NTTA). The accounts include cross-sectional age profiles (averages by age and gender) of household production and consumption as well as net time transfers. Net time transfers are calculated by subtracting production from consumption, age group by age group, and they show whether an age group is a net beneficiary or net giver of household products and services.

Our estimations include cross-sectional NTTA age profiles for 17 European countries representing about 84 per cent of the population of the European Union.



Comparative calculations are made not only for recent years, but for more time points in the past if data are available. All together 32 time points are included in the database (see Table 1). The manual will discuss the details of constructing all these accounts. The data can be downloaded directly from the website of the AGENTA data explorer: <http://witt.null2.net/shiny/agenta/> as well as through the links on the AGENTA webpage: <http://www.agenta-project.eu>.

In this European NTTA manual we give a detailed explanation of our methods and the creation of harmonised comparative European NTTA in 17 countries. We introduce the data and explain the main steps of constructing the accounts. At the end of discussing each step we also briefly present the basic results. In the remaining part of Section 1 we briefly introduce the NTA project and give an overview of our comparative NTTA and the data these accounts are based on. Section 2 focuses on household production by age and gender in time, while Section 3 on consumption, and Section 4 on net time transfers. In Section 4 we also introduce how we priced household production and present NTTA age profiles in monetary terms. At the end of the manual Section 5 summarizes which age profiles have been estimated and gives brief guidelines how to use the AGENTA data explorer for accessing the NTTA age profiles.

1.2 The NTA Project

Global population aging – caused primarily by fertility decline and increasing survival at older ages – will profoundly change the age structure of societies. Aging is an unprecedented, long-term demographic phenomenon: it has never been experienced before and is unlikely to be reversed in the future. There is a rising concern about aging because it implies changes regarding the economic and social well-being of societies. In response numerous policy-oriented research programs on topics related to aging have been initiated over the last twenty years. One of them is the NTA Project,¹ which is a large-volume joint-research effort by researchers from around the world (Asia, Latin-America, America, Africa and

¹ The website of the project is www.ntaccounts.org



Europe). The two founders and coordinators of NTA are Ronald Lee and Andrew Mason.

The NTA project has developed a methodology to measure and analyze the economic consequences of the changing population age structure. By examining the age patterns of economic activity and inter-age transfers, it explores the economic relations between generations. How do different age groups acquire and use economic resources and how does this pattern of resource acquisition change with population aging? These are two main questions the NTA project originally aimed to answer.

The most important basic activities that determine the economic lifecycle are working, consuming, sharing and saving. NTA² measures the age profiles of these economic activities: labour income, consumption, public transfers, private transfers and asset-based reallocations, and shows how they vary across different age groups. The aggregate numbers of these age profiles are consistent with the System of National Accounts (NA), which administer flows among institutions (government, households and corporations). The NTA framework therefore introduces the age-dimension into NA and offers a new way to analyze how resources are reallocated between age groups.

During childhood and old age average consumption is higher than average labour income. This difference between average consumption and average labour income is called Lifecycle deficit (LCD) if positive, and lifecycle surplus (LCS) if negative. Labour income in NTA includes all the income generated through the input of labour in production, including all types of labour-related taxes. Consumption consists of private consumption, as well as of consumption of goods and services provided by the public sector (such as public health care, education, general public goods). While all generations use economic resources and their *per capita*

² The method of National Transfer Accounts was established by Lee (1994a,b). An NTA manual was published by Mason *et al.* (2009) and a revised manual by the Population Division of the United Nations (United Nations, 2013). A comprehensive introduction to the method, including theoretical foundations, comparative results and a wide range of country studies can be found in Lee and Mason (2011a).



consumption does not vary much with age, labour income is concentrated in the working ages and is minimal or zero in childhood and old age. Those of working age tend to consume less than their labour income, which results in a lifecycle surplus. Meanwhile those who are not of working age consume more than their labour income, which results in a lifecycle deficit.

The difference between consuming and producing explains the flows from one generation to another. Whenever consumption exceeds production there is a period of dependency that has to be financed through a reallocation of resources: either by (1) public transfers via the government (tax payments and benefits), or (2) private or familial transfers, mostly within the household, or (3) asset-based reallocations (net capital income and property income). In childhood and old age the average individual is economically dependent, because his consumption has to be covered by the output produced by the working age population.

There are numerous studies on intergenerational transfers; nevertheless they tend to focus only on segments of the reallocation system instead of the system as a whole. NTA, on the other hand, makes it possible to analyze transfer system in parts as well as comprehensively. There are three major benefits of the NTA framework for the analysis of intergenerational transfers: first, the focus on the individual instead of institutions; second, the coverage of the full set of transfers in generational economy including private market transfers, mostly within the family;³ and third, the consideration of each generation in the reallocation system, children, the working age and the older population. The calculations are cross-sectional, but with more time points in time longitudinal analysis is also possible. NTA, however, only partly covers reallocation patterns within the household because it does not cover flows generated by household production. Activities, such as different types of housework and care (such as cooking, cleaning, making home repairs, or caring for children or others), also play an important role in the

³ NTA estimates age patterns of primary allocation and secondary redistribution of income as well as tertiary redistribution of after-tax revenues within the household (such as parents paying for the consumption of their dependent children) or between households (such as retired parents supporting their non-cohabiting adult children) and counts them as private transfers. The market part of familial transfers of the household economy is thus covered in the accounts.



process of reallocating resources between age groups and genders. By supplementing NTA with NTTA, we include economic flows generated by household production in the resource reallocation model.

1.3 Household Satellite Accounts and NTTA

Extending measures of national income with the value of goods and services produced at home is not new. The estimations need special consideration, as the output of production in the household is not observed by surveys and there is no market-mechanism valuing it. Therefore the calculations are based on time use surveys and a pricing procedure. First estimates of Household Satellite Accounts were published in the early 2000s (for example Holloway, Short and Tamplin, 2002; Soupourmas and Ironmonger, 2002, Sik and Szep, 2003). Comparative accounts are also accessible for Europe (Gianelli et al 2011) and for OECD countries (Miranda 2011).

Adding the dimension of age into the household economy and incorporating transfers of household goods and services into intergenerational reallocation patterns is a new direction of research that extends both the NTA and Household Satellite Accounts frameworks. The first initiative was Phananiramai (2011) on estimating time transfers for Thailand followed by the elaboration of a comprehensive methodology by Donehower (2014; earlier version from 2011), after which an increasing number of researchers began to apply national time use surveys to estimate NTTA and extend NTA with them. The first results and analyses on Europe are available for Austria (Hammer 2014), France (Solaz and Stancanelli 2012; d'Albis et al 2013), Germany (Kluge 2014), Hungary (Gál, Szabó and Vargha 2015), Italy (Zannella 2015), Slovenia (Sambt and Malačič 2014) and Spain (Renteria et al 2016), all of which provide insightful analysis about the reallocation patterns of individual countries. As a part of the Counting Women's Work Project,⁴ research teams in Africa, Latin America and Asia also work on

⁴ The website of the project is: <http://ww.cww-dpru.uct.ac.za>.



estimating household goods and services flowing across different ages and genders.

Full comparative NTTA based on harmonised data have been still missing in Europe. Pioneer approximations of comparative accounts have been presented by Zagheni and Zannella (2013), Hammer, Prskawetz and Freund (2015) and Zagheni et al. (2015). These estimations, however, have limitations. They do not include children, but focus on working ages, the elderly and gender disparities in production patterns. As an improvement upon these earlier works, we include all age groups including children aged zero or older in our analysis, and in this way account for all time produced and consumed by all individuals of all ages. Also, the pioneer approaches do not price household labour, making it impossible to compare NTA with NTTA; or they use a single wage for all activities of household labour. In this paper we mobilize the harmonised data about wages in order to differentiate between the values of various activities.

1.4 Overview of the methodology of the comparative NTTA

Like Household Satellite Accounts, NTTA are estimated using time use surveys and wage data. Our calculations are based on methods of National Time Transfer Accounts by Donehower (2014). The main steps of this method are (1) identifying time spent on household production activities by age and gender in time use surveys; (2) finding appropriate wages to impute the value of time spent on the chosen activities; and (3) estimating consumption of household labour by allocating the goods and services produced through unpaid work to the members of the household. The last step is performed using the household roster of time use surveys that includes information about the household composition as well as the age and gender of all household members.

This method could easily be applied by researchers using national time use surveys. However, for international comparisons working with separate national datasets it is often not feasible or would require considerable resources and time. The two publicly available European harmonised sources of data – the Harmonised European Time Use Survey Web Application (HETUS) and the Multinational Time



Use Study (MTUS) – have the advantage that they are harmonised and include comparable European data.⁵ Therefore activities and other important variables are already standardised, making the first part of creating European NTTA relatively straightforward.

Nevertheless, these data sources have limitations, because they do not include the household roster and include only limited information about the household composition of the producer. Moreover the HETUS application calculates user-defined and comparable statistical tables but it is not a micro-database *per se*. Consequently, using these harmonised time use data for estimations of consumption of unpaid household labour requires more assumptions and methodological decisions than using national time use surveys.

We therefore supplement the original Donehower methodology (Donehower 2014) to account for these special features of the harmonised data available. We introduce a special imputation method of harmonised time use data to representative samples in order to allocate time spent on home production among consumers in the households. We discuss this in more detail in Section 3. The valuation process of time spent on non-market activities also requires special consideration, as the method has to be harmonised across all countries. Using time use data and a pricing procedure to estimate the output of production in the household has some flaws and limitations, which we will review in more detail while discussing the valuation of household production in Section 4.2.

⁵ For more details about these two data sources see the following subchapter.



1.5 Overview of the data sources used for constructing comparative NTTA

1.5.1 Harmonised time use data: HETUS and MTUS

Our NTTA estimations are fundamentally based on publicly available harmonised time use data downloaded from the HETUS⁶ website (<https://www.h5.scb.se/tus/tus/>) and from the MTUS website (<http://www.timeuse.org/mtus.html>). Since the early 1990s, Eurostat has been working together with national statistical institutes to harmonise time use surveys in the European Union. Guidelines are developed for time use surveys (TUS) in the European Union, including guidelines for the sample design, survey forms, interview and coding of the activities.⁷ There are still considerable differences in the exact design, the sampling and the timing of the surveys. HETUS provides TUS data at high level of comparability as harmonization is done prior to data collection. MTUS contain ex-post harmonised surveys, which limits comparability; but MTUS includes time use surveys from several time points. NTTA age profiles based on HETUS are the best choice for cross-country comparisons, while comparisons over time are only possible with NTTA age profiles based on MTUS.

HETUS enables users to calculate user defined, comparable statistical tables on time use data in 15 European countries from the time period 1999-2005. We have processed the time use data for all 14 EU countries from the dataset.⁸ MTUS⁹ on the other hand enables users to download micro-datasets. We have processed 22 MTUS micro-datasets for 7 EU countries, covering the time period from 1974 to 2010. For most of the countries, we have estimated the age profiles for at least two time points. For Austria only one MTUS survey is available from 1992, so these

⁶ HETUS is an effort by the EU to harmonise European time use surveys. It is currently maintained by Statistics Sweden. All important information, documentation and metadata can be found on its website: <https://www.h2.scb.se/tus/tus/default.htm>.

⁷ <http://ec.europa.eu/eurostat/documents/3859598/5909673/KS-RA-08-014-EN.PDF>

⁸ Norway is excluded from our analysis at this point.

⁹ The MTUS offers harmonised episode and context information on time use surveys and currently encompasses over 60 datasets from 25 countries from around the world. The MTUS data and documentation can be found at: <http://www.timeuse.org/mtus>.



results are available for only this year. New or updated MTUS data may be available in the future, leaving us the opportunity of encompassing even larger time periods. Estimation might be also possible for additional countries such as France and Slovenia for more than one time point.

It has to be mentioned that MTUS data are available in two forms: as an *aggregate* or *simple* dataset. The former contains more detailed information about individual and household characteristics, which consequently affects the imputation method we used and consumption estimates. Additionally, everyday activities are defined slightly differently in *simple* and *aggregate* dataset. Thus, some adjustments were needed to be done to make the production profiles derived from either dataset as similar as possible. All the consequences of using different MTUS datasets and necessary methodological adjustments are described later in the text.

In Table 1 and 2 we summarise the details of the representative European national time use surveys that serve as basis of our calculations and which are accessed through HETUS and MTUS, respectively (such as the year of the national data collection, sample size, and the age of the population covered).



Country	Fieldwork period	Age of the population covered in the national survey	Sample size	Age of the population on the HETUS website
Belgium	2005	12+	12824	12+
Bulgaria	2001/2002	7+	7603	10+
Estonia	1999/2000	10+	5728	10+
Finland	1999/2000	10+	5332	10+
France	1998/1999	15+	15441	15+
Germany	2001/2002	10+	12655	10-75
Italy	2002/2003	3+	55760	10+
Latvia	2003	10+	3804	10+
Lithuania	2003	10+	4768	10+
Poland	2003/2004	15+	20264	16+
Slovenia	2000/2001	10+	6190	10+
Spain	2002/2003	10+	46774	10+
Sweden	2000/2001	20-84	3998	20-84
United Kingdom	2000/2001	8+	10366	10+

Source: HETUS

Table 1: Summary information on national time use surveys included in the HETUS database



Country	Fieldwork period	Sample size	Age of the population in MTUS dataset	Simple/ Aggregate dataset
Austria	1992	24771	10+	aggregate
Denmark	2001	6428	16-74	simple
Denmark	1987	3389	16-74	simple
Germany	2001/2002	34783	10+	simple
Germany	1991/1992	25739	12+	aggregate
Italy	2002/2003	50968	3+	simple
Italy	1988/1989	38069	3+	aggregate
The Netherlands	2005	15257	12+	aggregate
The Netherlands	2000	12525	12+	aggregate
The Netherlands	1995	22477	12+	aggregate
The Netherlands	1990	23612	12+	aggregate
The Netherlands	1985	22714	12+	aggregate
The Netherlands	1980	18911	12+	aggregate
The Netherlands	1975	9063	12+	aggregate
Spain	2009/2010	19243	10+	aggregate
Spain	2002/2003	46578	10+	aggregate
The United Kingdom	2005	4834	16+	aggregate
The United Kingdom	2000/2001	19911	8+	aggregate
The United Kingdom	1995	1883	16+	aggregate
The United Kingdom	1987	11172	14+	aggregate

The United Kingdom	1983/1984	9366	14+	aggregate
The United Kingdom	1974/1975	20076	5+	aggregate

Source: MTUS

Table 2: Summary information on national time use surveys included in the MTUS database

1.5.2 Other harmonised data sources

As we have introduced, the estimation of transfers within households requires full information on the household structure in order to allocate time spent on home production among consumers in the households, in particular the age and sex of the household members. Since the harmonised time use data lack all these pieces of information we externally take surveys which include this information and impute data on time use to these surveys. The following harmonised surveys are employed (depending on the time period they cover): the European Union Statistics on Income and Living Conditions survey (EU-SILC), the European Community Household Panel survey (ECHP), several samples of the Labor Force Survey (LFS) and census samples accessible through the Integrated Public Use Microdata Series, International (IPUMS) (for an overview see Table 3). More details about these data sources are found in Section 3.

In order to end up with comparable home production measures in monetary terms, we use harmonised wage data: the European Structure of Earnings Survey (SES) and World Bank data (WB). For our estimations from HETUS we used the SES from 2002 and for MTUS estimates we used the WB data, which is accessible for the years 1983-2008. Some adjustments are also used during the pricing procedure which we discuss in full detail in Section 4. For a summary about our cross-sectional NTTA estimations in time and in monetary terms as well as an overview of the data used see Table 3. Apart from these databases we also used Eurostat population figures by age and gender for all countries.



Country	Year of age profiles in time	Year of age profiles in monetary terms	Harmonised time use data	Survey/sample used for imputation	Wage data
Austria	1992	1992	MTUS	IPUMS	WB
Belgium	2005	2002	HETUS	EU-SILC	SES
Bulgaria	2002	2002	HETUS	EU-SILC	SES
Denmark	1987	1987	MTUS	ECHP	WB
	2001	2001	MTUS	ECHP	WB
Estonia	2000	2002	HETUS	EU-SILC	SES
Finland	2000	2002	HETUS	EU-SILC	SES
France	1999	2002	HETUS	EU-SILC	SES
Germany	1992	1992	MTUS	ECHP	WB
	2001/2002	2001/2002	MTUS/HETUS	ECHP/EU-SILC	WB/SES
Italy	1988	1988	MTUS	ECHP	WB
	2002/2003	2002/2003	MTUS/HETUS	ECHP/EU-SILC	WB/SES
Latvia	2003	2002	HETUS	EU-SILC	SES
Lithuania	2003	2002	HETUS	EU-SILC	SES
Netherlands	1975	1975	MTUS	LFS	WB
	1980	1980	MTUS	LFS	WB
	1985	1985	MTUS	LFS	WB
	1990	1990	MTUS	ECHP	WB
	1995	1995	MTUS	ECHP	WB
	2000	2000	MTUS	ECHP	WB
	2005	2005	MTUS	EU-SILC	WB
Poland	2004	2002	HETUS	EU-SILC	SES
Slovenia	2001	2002	HETUS	EU-SILC	SES
Spain	2003	2002/2003	HETUS/MTUS	EU-SILC	SES
	2010	2010	MTUS	EU-SILC	SES
Sweden	2001	2002	HETUS	EU-SILC	SES
United Kingdom	1974	1974	MTUS	LFS	WB
	1983	1983	MTUS	LFS	WB
	1987	1987	MTUS	IPUMS	WB
	1995	1995	MTUS	ECHP	WB
	2001	2001/2002	MTUS/HETUS	ECHP/EU-SILC	WB/SES
	2005	2005	MTUS	EU-SILC	WB

Table 3: List of countries and years in the AGENTA NTTA data explorer and sources of the harmonised data used

2 NTTA production age profiles in time

We have now introduced the main ideas and basic concept of NTTA. In the following sections we focus on how to construct the age profiles and we start with the household production age profiles (and also other time use activities).

2.1 What is household production?

Time use surveys differentiate among many activities, such as reading, working, sleeping, etc. For our purposes the most important part is time spent on household production (unpaid household labour).¹⁰ Activities of household production are selected based on the *third-person principle*: activities that can be done by someone else (a third person) on behalf of the respondent, such as cooking, cleaning, making repairs, shopping or caring for someone else. An exception is personal care: although it is sometimes carried out by a third person (e.g. hairdresser), personal care carried out for oneself is not regarded as household production. For our calculations we omitted parallel activities from the time use data.¹¹ Table 4 summarizes the selected activities of household production in case of the HETUS and MTUS data.

¹⁰ Parts of household production are included in national income, such as part of the food production for own consumption and the construction of the owner-occupied house. Since we add up intergenerational transfers in the national and the household economy, it would be preferable to avoid double registration of activities. However, we are not able to filter out these activities using the HETUS or MTUS data, and they are therefore included in both accounts.

¹¹ Time use questionnaires usually allow parallel (or 'secondary') activities, such as cleaning the dishes or helping a child with homework, to be recorded at the same time. However, as a result of the considerable variance in the time spent on these activities across European countries – and in line with the Donehower-methodology – we left these secondary activities out from our analysis.



		HETUS	MTUS
Total household production	<i>General housework activities</i>	Food preparation; Dish washing; Cleaning the dwelling; Other household upkeep tasks; Laundry; Ironing; Handicrafts; Gardening; Tending domestic animals; Caring for pets; Walking the dog; Construction and repairs; Shopping and services; Other domestic work; Organisational work; Travel related to shopping	Food preparation, cooking; dish washing; cleaning; laundry; ironing, clothing repair; home/vehicle maintenance, collect fuel; other domestic work; shopping and services; pet care, walking dogs; adult care; voluntary/ civic/organisational activity; gardening/ forage; hunting/fishing; domestic travel
	<i>Childcare activities</i>	Physical care and supervision of child; Teaching, reading and talking to a child; Transporting a child	Physical or medical childcare; teaching, reading, talking to, playing with a child, help with homework; supervision, childcare related travel ¹² ; other childcare
	<i>Inter-household activities</i>	Informal help provided to other households	-

Table 4: Categories of household production activities in HETUS and MTUS

For our main purpose three different age profiles of household production are constructed using the HETUS data: general housework, childcare and inter-household labour. The latter includes those household production activities which are carried out for other households, such as help in housework activities or caring for a person living in another household.¹³ General housework includes all household production activities other than childcare carried out for the own household. In the HETUS harmonised data nor adult-care or old-age care appear as separate activities, therefore we included them in the general housework category. Using inter-household activities as a separate age profile we acknowledge the fact that it is hard to capture informal help provided to other households with diaries, as they are typically not taking place every day.

¹² In MTUS, one variable includes both childcare- and adult-care-related travel. Since production in the form of childcare is substantially higher than production in the form of adult-care at most ages, we decide to categorize child- and adult-care-related travel as part of childcare rather than a part of housework (under which adult-care is classified).

¹³ In Belgium inter-household unpaid work is 0 and is included in the childcare and general housework age profiles.

In the MTUS data we differentiate between two groups of activities as a part of total household production: childcare and housework. Informal help to other households (i.e. inter-household production) is a separate category in HETUS, but not a separate category in MTUS – rather, it is already included in childcare and housework. Due to this fact, there are small differences between HETUS and MTUS (childcare and housework) production profiles.

One should also note that childcare and housework activities are slightly different in MTUS compared to HETUS dataset. We tried to make household production activities as comparable between the two datasets as possible, but some differences in definitions are present and cannot be eliminated due to how the variables are defined in the different datasets.

Another problem emerges in constructing the estimates due to differences between MTUS *simple* and *aggregate* datasets. As already mentioned, *aggregate* datasets are more detailed and this fact is also reflected in how daily activities (variables) are defined. In the MTUS *aggregate* datasets, there are 69 daily activities defined, while the *simple* datasets include more aggregated data in the form of 25 daily activities. Therefore, household production activities are broader categories in the *simple* datasets. For example, variable 'shopserv' is defined as part of household production when using *simple* data. This variable includes the following activities: 1. shopping; 2. consuming personal care services; 3. consuming other services (bank, post office etc.). In contrast, when using *aggregate* data we consider only shopping and consumption of other services as household production, while consumption of personal care services is treated as personal care. Omitting this problem would jeopardize the comparability of production profiles based on *aggregate* or *simple* data (in general, *simple* profiles would give much higher estimates of household production).

To solve this problem, when using *simple* data we classify a proportion of the variable 'shopserv' as household production and the rest as personal care. In this way, we ensure that daily activities which are considered as household production in *aggregate* dataset are defined in the same way also in *simple* dataset. The adjustment is done by calculating the average share of consumption of personal



care services in total 'shopserv' variable at each specific age, separately for men and women (the average share is calculated from the data for all of the countries with *aggregate* data available). Next, when using *simple* data we assign part of the variable 'shopserv' to household production and the rest to personal care, proportional to the calculated shares (instead of treating the whole variable 'shopserv' as household production). We do this in all of the cases when household production is defined broader in *simple* than in *aggregate* dataset.

2.2 Estimating household production by age and gender

After selecting the household production activities in HETUS and MTUS the average amount of household labour is estimated by gender and age. From the HETUS web application we download mean time spent on selected activities for each country, calculated as the sum of all time spent of all survey participants divided by their number. These figures represent the average time spent on each activity on an average day in each country. Averages in minutes are downloaded for each activity by gender for every single age in each country¹⁴ and then summed up for the three different functional categories (general housework, childcare and inter-household unpaid work) as well as total household production.

In MTUS, we first need to ensure that all of the daily activities reported by respondents add up to 1440 minutes per day (this may not be the case due to unspecified time use, etc.). We use an adjustment factor to obtain higher accuracy of data. In particular, we multiply the time for each activity with the ratio between 1440 and the number of minutes reported by the respondent. Averages by age and gender are then estimated and the following age profiles of household production are constructed: general housework, childcare and total household production. Just as in the case of HETUS we calculate averages in minutes by gender for each country and each available year.

¹⁴ In HETUS no averages are shown if the number of diaries in a cell is less than 25. We found a few of these cases for older ages. In such cases we used larger age groups (for example if no single age data were displayed between age 70 and 74 we used the average time use of the 70-74 aggregate age group for each single age).



MTUS surveys usually include information on the time use of people who are 10 years old or older. When younger respondents are included in the survey, we follow the standard assumption that those below the age of 10 do not perform household work. On the other hand, some MTUS surveys do not start at the age of 10, but with older respondents. In such cases, we impute the missing values. We calculate the value of production at a particular age as a share¹⁵ of production at that age compared to the average production of people who are between age 30 and 49.¹⁶

2.2.1 Smoothing household production age profiles

The age profiles are smoothed one by one by Friedman's SuperSmoother. We smooth production age profiles for a specific age group. The youngest age groups (usually below age 10), whose household production values are 0, are not included in the smoothing procedure, nor the oldest old age group, in our case 80 years old or older. The reason for this is twofold: we do not want to underestimate household production for the ones who are 79 or younger; nor overestimate household production for the ones who are 80+. Therefore for the 80+ age group we use the original average of household production. In MTUS, weights (i.e. the number of respondents in each age group by gender) are applied for the smoothing procedure, in HETUS we did not have access to these weights. All these age profiles in minutes per day can be found in the AGENTA NTTA data explorer for 17 countries and 32 time points.

2.3 Aspects of household production age profiles in time

Figure 1 shows the average time spent on household production in 16 European countries with comparative results from early 2000s.¹⁷ People start working in the

¹⁵ We calculate the shares based on the data for other EU countries which include people aged 10+. For the age profiles before year 2000 we use the average of three countries (Austria 1992, Italy 1988 and the UK 1974), while for the age profiles after 2000 we use the average of two countries (Spain 2010 and the UK 2001).

¹⁶ These age limits were selected because they correspond to the chosen age limits in standard NTA methodology.

¹⁷ Belgium, Bulgaria, Denmark, Estonia, Finland, France, Germany, Italy, Latvia, Lithuania, Netherlands, Poland, Slovenia, Spain, Sweden and the United Kingdom. See Table 3 for more details.



household at a young age, probably at even younger ages than indicated here, because most national samples do not include children below the age of ten. There is already a gender gap in childhood as young girls spend more time with household production than young boys. The gap grows larger with age and reaches its maximum between age 30 and 40. Around this age, there is a peak in the average amount of unpaid work provided by women because of the provision of childcare. This peak for women aged 30-40 is found in all countries. Women of this age work more than 5 hours per day at home in these countries. The average time spent on home production by men between the ages of 30 and 40 is around 2.5 hours, 2.5 hours less than by women of the same age. The peak at this age for men is less pronounced than for women, as they spend significantly less time on childcare, on average 0.5 hour. The peak in the childcare age profile for men is also shifted a few years forward, as the average age of becoming a father is higher than that of becoming a mother.

Time spent on producing goods and services in the household increases again after retirement, and this increase is higher for men. The curve for men increases until the age of 70 and reaches a maximum of 4 hours of household production while for women the maximum is 5.6 hours at the age of 64 on average in the 16 European countries. Consequently the gender gap in household production gets smaller with age. On average the second increase for women in their 60s is a little higher than the first increase for women in their 30s.



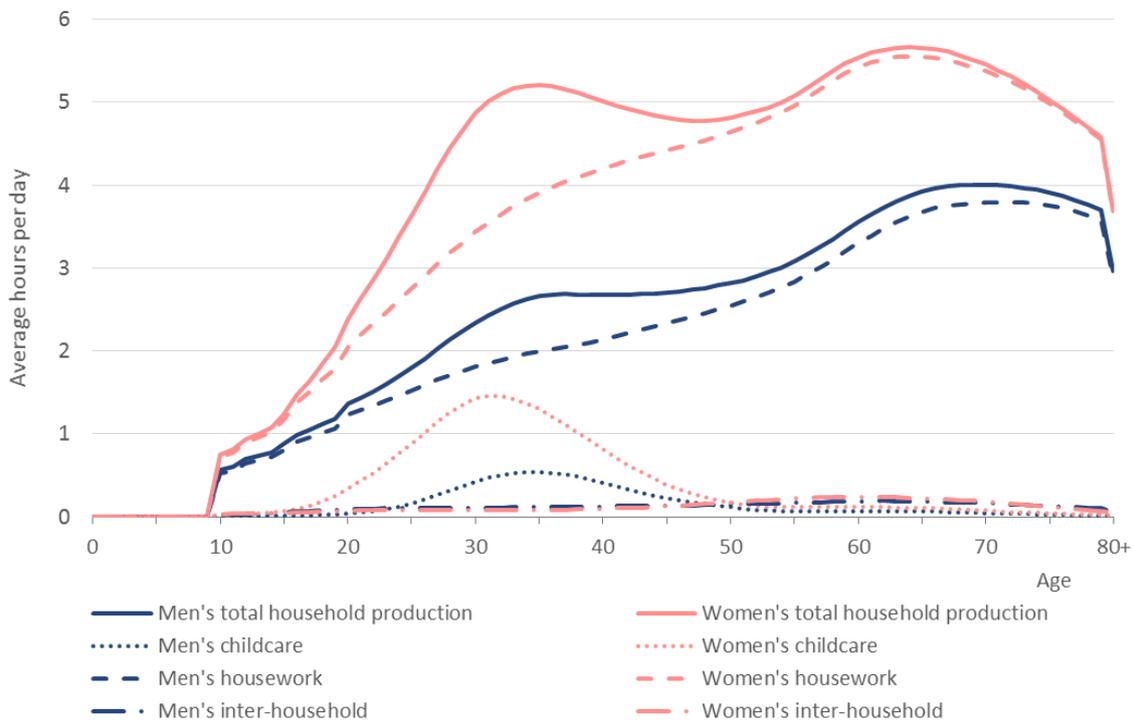


Figure 1: Daily per capita production of childcare, housework and inter-household unpaid labour by age and gender in 16 European countries in early 2000s

Source: Own calculations based on HETUS and MTUS data.

Note: Simple average of countries with comparable data from early 2000s, which are the following: Belgium, Bulgaria, Denmark, Estonia, Finland, France, Germany, Italy, Latvia, Lithuania, Netherlands, Poland, Slovenia, Spain, Sweden and the United Kingdom. See Table 3 for more details. In Belgium, Denmark and the Netherlands production of inter-household unpaid labour is 0 and is included in childcare and housework production age profiles.

Figure 1 also shows that in general unpaid work for other households (including childcare carried out for children not living in the household) is relatively small compared to intra-household home production.¹⁸ Between age 60 and 75 the average time spent on inter-household care and childcare is only 10 minutes for men and 2 minutes more for women on an average day. Data is not consistent nor in the national time use surveys, nor in the harmonised datasets (HETUS and MTUS) based on these. There are differences in how national time use surveys

¹⁸ In Belgium, Denmark and the Netherlands production of inter-household unpaid labour is 0 and is included in childcare and housework production age profiles.



have registered time spent on childcare in one’s own household for children living elsewhere, caring for children outside the household, and other inter-household care. For these reasons identifying and comparing the care of grandparents is problematic. Nevertheless, by measuring time spent on childcare in households without children, we are able to identify the childcare of older people and allocate it accordingly.

2.4 Age profiles of other activities by age and gender in time

Even though for our main purpose the most important activity is time spent on household production, the AGENTA NTTA data explorer also includes other age profiles of time use. The major groups of activities other than household production are the following: 1. time spent on paid work, 2. education, 3. leisure and 4. personal care. The per capita sum of time spent on all the activities is 1440 minutes, i.e. one day. Table 5 summarizes the selected activities of these major categories of spending time in case of the HETUS and MTUS data.

	HETUS	MTUS
<i>Paid work</i>	Main and second job; Activities related to employment; Travel to from work	Main, second or other job (at home or elsewhere); unpaid work to generate household income; travel as a part of work; work breaks; other time at workplace; look for work; travel to or from work
<i>Education</i>	School and university; Homework; Free-time study; Travel related to study	Regular schooling; doing homework; education course or training; education-related travel
<i>Leisure</i>	Participatory activities; Visits and feasts; Other social life; Entertainment and culture; Resting; Walking and hiking; Other sports outdoor activities; Computer and videogames; Other computing; Other hobbies and games; Reading books; Other reading; TV and video; Radio and music; Unspecified leisure; Travel related to leisure; Unspecified travel	Religious activity; general out-of-home leisure; attend sporting/cultural/social/ other public events; visit restaurants/pubs; general sport; walking; cycling; other out-of-doors recreation; playing games; general indoor leisure; artistic or musical activity; written correspondence; knit, crafts or hobbies; relax, think, do nothing; read; listen to music, radio; watch TV; play computer games; other computing; no activity or change of location; travelling for other purposes (also leisure)

<i>Personal care and sleeping</i>	Sleep; Eating; Other personal care; Unspecified time use	Imputed personal or household care; sleep and naps; imputed sleep; wash, dress, care for self; meals or snacks; consume personal care services
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Table 5: Categories of activities other than household production in HETUS and MTUS

Age profiles are smoothed one by one by Friedman’s SuperSmooter. The details of smoothing are similar to the ones previously described for household production. We smooth production age profiles for a specific age group, where the start was the youngest age with a value of production and the oldest was 79. For the 80+ age group the original value is used so as not overestimate the value. In MTUS, weights (i.e. the number of respondents in each age group) were applied for the procedure, in HETUS we did not have access to these weights.



3 NTTA consumption age profiles in time

NTTA introduces two novelties into the analysis of time use and to household satellite accounts. First, as we have seen, it measures household production by age. Second, it measures age-specific consumption of the goods and services produced through unpaid household labour. In the following section we introduce a novel imputation method of harmonised European time use data (both HETUS and MTUS) to nationally representative household surveys in order to assign time spent on home production to consumers in households.

3.1 Introducing the imputation method

There are no surveys that record the consumption of the products and services of non-market labour. As we have seen with the production figures, the majority of services produced through unpaid labour is consumed within households (intra-household). Estimates for the age specific consumption of goods and services produced by households through unpaid work are based on the assumption that the products and services – except for care – are enjoyed equally by all household members, while care is consumed more age specifically (Donehower 2014). However, we have only a limited amount of information about the household structure in the harmonised time use data, so we impute the values of household production into surveys with full information on the household structure. From HETUS and MTUS data we use average values of household production by different individual characteristics, such as age, gender and household type in each country and year.

Work by Bruil and van Tongeren (2014) using Dutch time use data influenced us to develop this method. They imputed the household production values by age group and gender in a register sample of the Dutch census for estimating consumption by age. Gianelli et al (2011) also used an imputation method of HETUS time use and imputed values by gender and a variable called 'lifecycle' (which is a simple variable that combines large age groups with the family status of the individual) for a cross-country analysis of total home production in Europe.



We extend both these methods for our purposes by imputing values of production by smaller age groups, gender and a more detailed household structure.

In characterizing the household structure one of the most important pieces of information is the age of the children living in the household. We would ideally have used censuses or micro-censuses like Bruil and van Tongeren (2014), but we did not have access to such data for many countries. We have looked for publicly available harmonised European data that could be used for as many countries as possible. For time use in 2000's we use the register sample of the EU-SILC survey,¹⁹ like Gianelli et al (2011). For data from the 1990's we use the European Community Household Panel survey (ECHP).²⁰ In the case of older time use data several samples of the Labor Force Survey (LFS)²¹ and census samples that are accessible through the Integrated Public Use Microdata Series, International (IPUMS)²² are employed. For detailed information by country and year, see Table 6.

We have done our best to find publicly available, harmonised surveys with the sufficient information needed for the imputation: detailed household structure, age and gender of all household members. In some countries there are some years between the data collection of the time use survey and the representative survey or census sample we employed. The reason is that we do not want to exclude any countries or years where we could access time use data because of missing representative household survey data. The most important information, general household structure and the age and gender of the population does not change so

¹⁹ EU-SILC, EU statistics on income and living conditions is the reference source for comparative statistics on income distribution and social inclusion in the European Union (EU). For more details see: <http://ec.europa.eu/eurostat/web/microdata/european-union-statistics-on-income-and-living-conditions>

²⁰ ECHP, the European Community Household Panel is a panel survey covering a wide range of topics concerning living conditions. For more details see: <http://ec.europa.eu/eurostat/web/microdata/european-community-household-panel>

²¹ The Labour Force Survey is a large household sample survey providing quarterly results on labour participation of people. For more details see: <http://ec.europa.eu/eurostat/web/microdata/european-union-labour-force-survey>

²² IPUMS-International is a project dedicated to collecting and distributing census data from around the world (Minnesota Population Center 2015). For more details see: <https://international.ipums.org/international/>



rapidly. For historical age profiles the difference is generally higher as it is hard to access representative household surveys for the 1970s and 1980s.

	Country	Year of time use survey fieldwork period (Source: HETUS, MTUS)	Representative sample fieldwork period
EU-SILC²³	Belgium	2005	2004
	Bulgaria	2001/2002	2007
	Estonia	1999/2000	2004
	Finland	1999/2000	2004
	France	1998/1999	2004
	Germany	2001/2002	2005
	Italy	2002/2003	2004
	Latvia	2003	2005
	Lithuania	2003	2005
	The Netherlands	2005	2006
	Poland	2003/2004	2005
	Slovenia	2000/2001	2005
	Spain	2009/2010	2011
	Spain	2002/2003	2004
	Sweden	2000/2001	2004
	UK	2005	2006
UK	2000/2001	2005	
ECHP	Denmark	2001	2001
	Denmark	1987	1994
	Germany	2001/2001	2001
	Germany	1991/1992	1994
	Italy	1988/1989	1994
	The Netherlands	2000	2001
	The Netherlands	1995	1996
	The Netherlands	1990	1994
	UK	2000/2001	2001
	UK	1995	1996
LFS²⁴	The Netherlands	1985	1985

²³ In EU-SILC the age variable is the age from the income reference year, thus from the year previous to the fieldwork.

²⁴ In LFS, age is given only in 5-year age groups which greatly affects the imputation method. Using these age groups the results of the childcare consumption profiles would be not accurate, as there

	The Netherlands	1980	1983
	The Netherlands	1975	1983
	UK	1983	1983
	UK	1974	1983
IPUMS	Austria	1992	1991
	UK	1987	1991

Table 6: Survey years used for imputing time use to representative surveys or census samples

By applying this method of imputation we are still not able to capture individual variation of non-market labour, but we can take into account the full available information set that has an effect on the average consumption figures by age. First of all, both gender and the age of the producer has an effect on how much is produced and then reallocated within a household. Secondly, analysis of the consumption of non-market goods and services in the household shows that the number and age of children²⁵ as well as the number of household members – especially in the case of older people – are among the most important determinants of the amount of household production (and thus consumption). Because of the limitations of the harmonised time use data we are not able to consider other variables for the imputation process, such as activity status, marital status, educational level etc., which have an effect on the average time use and more particularly on the time spent on domestic housework and childcare. We think that age, gender and a detailed household structure fit best our purpose of deriving age profiles of household consumption.

would be no variation within these age groups. To solve this problem, we randomly assign children, who are from 0 to 17 years old in the sample, to single age categories (taking into account real population distribution). In this way, age of children is given in 1- instead of 5-year age groups and imputation method is more precise. We perform a robustness check to validate that this method generates reliable results.

²⁵ Children are defined as persons aged 0-17 in HETUS and in MTUS which we follow throughout this study.



3.2 Details of the household structure used for the imputation

In the previous section we introduced a novel imputation method of time use to representative household surveys in order to estimate consumption of unpaid household labour by age and sex. In practice average time use figures of household production calculated in each country and year are imputed to a representative survey sample according to individual characteristics such as age, gender and household type. Our aim is to use as many household types as possible in order to keep as much variation of household production as possible. In HETUS and MTUS the household types we create are slightly different, because of the available information on the household of the producer. In this section we summarize the household types we use in the case of HETUS and MTUS.

3.2.1 Household structure in HETUS

In the HETUS harmonised dataset variables about the household of the producer we use are the following: number of household members, number of children lower than age 7; number of children aged 7-17, and the age of the youngest child in the household. For the imputation based on individual characteristics we create 12 types of households for general housework activities, and to allocate time spent on childcare we create 18 types of households.

In a first step the following nine default household types are made for imputing housework: 1. Single with no children; 2. Two or more household members with no children; 3. One child aged 0-3; 4. One child aged 4-6; 5. One child aged 7-17; 6. Two children, one aged 0-3, the other aged 7-17; 7. Two children, one aged 4-6, the other aged 7-17; 8. Two or more children, with a minimum of two aged 0-6 and the youngest aged 0-3; 9. Two or more children aged 7-17 but no smaller children. Three extra household types also have to be created because the default HETUS types do not cover a few individuals in the EU-SILC sample. In these cases we could use information about the youngest child. These are as follows: 10. Youngest child aged 0-3; 11. Youngest child aged 4-6; 12. Youngest child aged 7-17.



In the case of childcare only one HETUS variable is used in the taxonomy of households: the age of the youngest child living there (age 0, 1, 2, 3, etc., up until the age of 17). Thus the first type constitutes households with the youngest child aged 0; the second type includes households with the youngest child aged 1, etc., until the eighteenth type which includes households with the youngest child aged 17.²⁶

From the HETUS application we download averages of housework and childcare by the gender and age of the producer and by the different types of household he or she lives in and impute these values into the micro-dataset. Averages of home production in minutes are downloaded for age groups consisting of five-year intervals (for example, ages 20-24 or 75-79) by gender and by 12 household types in each country in the case of housework production.²⁷ The averages of childcare production are downloaded by gender, age groups and by the 18 household types in each country. The size of the age groups in case of childcare is country specific.²⁸ There is considerable variation in these values which enables us to estimate the average consumption of household labour by age and gender in each country.

3.2.2 Household structure in MTUS

Like in HETUS, for each MTUS dataset average time spent on production of childcare and housework is imputed to a representative survey sample according to three characteristics: age, gender and household type. In MTUS 8 household types are created for housework imputation and 18 household types for childcare imputation.²⁹

²⁶ All households are assigned to these household types, not only the ones with a single child.

²⁷ As mentioned above the HETUS web application provides no averages if the number of diaries in a cell is less than 25. This happened only on a few occasions in the case of individuals living in uncommon household types and also in countries with smaller samples. We substituted these cases with the average production values or, when reasonable, with production values of neighbouring age groups.

²⁸ For childcare, the age of the producer is again dependent on how large the samples are in the national time use surveys: with large samples age groups consisting of five-year intervals could be used, however for countries with smaller samples these intervals are bigger.

²⁹ In some cases it is only possible to form 3 household types for childcare imputation, see below.



Whenever possible we define household types in the same way as for HETUS data. This is possible when MTUS dataset offers detailed variable 'agekid2' which provides the age of the youngest child in the household in 1-year age groups. Otherwise, we use variable 'agekidx' which provides the age of the youngest child in the household, but in wider age groups (ages 0-4; 5-12; 13-17). In such cases, household types are defined slightly different than in HETUS. The MTUS variable 'agekid2' is only available in *aggregate* datasets, while 'agekidx' is given in *simple* datasets as well as in some cases in the *aggregate* datasets.³⁰

For housework imputation, we use 8 household types: 1. Single household (no children); 2. Household with two or more members, without children; 3. One child aged 0-3; 4. One child aged 4-6; 5. One child aged 7-17; 6. Two or more children, the youngest one aged 0-3; 7. Two or more children, the youngest one aged 4-6 years old; 8. Two or more children, the youngest aged 7-17. When only variable 'agekidx' is given, household types are slightly modified using age boundaries which correspond to the age groups as defined by 'agekidx' (0-4 instead of 0-3, 5-12 instead of 4-6 and 13-17 instead of 7-17 years of age).

Similarly as in the case of HETUS data, household types for imputing childcare are made according to the age of the youngest person living in the household. Therefore 18 household types are created: 1. Age of the youngest person in household is 0; 2. Age of the youngest person in household is 1; 3. Age of the youngest person in household is 2; ... 18. Age of the youngest person in household is 17). Again, when using *simple* data (and in some cases also *aggregate* data, see below) only variable 'agekidx' is given instead of 'agekid2'. Taking into account age boundaries defined by 'agekidx' we need to modify household types and create only 3 household types for childcare imputation with the age groups defined by this variable (age of the youngest child is 0-4; 5-12; 13-17).

³⁰ Because of the limitation of the different MTUS datasets we have to use variable 'agekidx' in case of the following countries and time points: Denmark 1987, 2001; Germany 1992, 2001; Italy 2002, Netherlands 1975, 1985, 1990, 1995, United Kingdom 1983, 1995, 2005.



In general, it is not possible to calculate MTUS averages for all possible combinations of age, gender and household type. When this is the case, we impute childcare and household production based only on age and gender of the respondents.

3.3 Imputation in practice

For every combination of age, gender and household type, two values are assigned to each individual in HETUS or MTUS, one for housework and one for childcare. Thus, in each national sample the time spent on household production of housework and childcare, respectively, is assigned to each individual between age 0 and 80+.

In order to validate that our method is reliable, we perform different robustness checks (see Section 3.7 below as well). In each country we check whether the age profiles of household production by gender remained intact after imputation, and there are only slight dissimilarities. Production values by household types are less reliable for countries with smaller samples of time use surveys in HETUS (such as Estonia). Results for these countries could therefore be less accurate. For the sample sizes see Table 2.

3.4 Allocating time within the household after imputation

Once intra-household production values are assigned to every individual in each household we could aggregate the time spent on non-market activities at the household level and allocate it to each member. Since many of the services produced through housework are a type of public good within the household (e.g. cleaning), we assume that each household member consumes the same share of these services following Donehower (2014).³¹

³¹ In MTUS, adult-care is defined as care for adults and should therefore be allocated only to those aged 18+. However, we treat adult-care as a part of 'housework' and allocate it to all household members regardless of their age. In this way, MTUS age profiles are consistent with HETUS profiles where adult-care cannot be estimated separately and is also assigned to all household members. The error that we make by assigning adult care to all household members (instead of just to those aged 18+) is very small since the production in the form of adult-care is very low at all ages (on average around 2 per cent of total household production). Using estimations in Italy by Zannella

Childcare is consumed only by children, and the allocation is straightforward in all households with only one child present. If there is more than one child living in the household, time has to be distributed among these children. For this we apply data driven weights (an equivalence scale) generated separately for each country. From HETUS website, we have downloaded average time spent on childcare for all households with the smallest child being 0, 1, 2, 3 ... or 17 years old in each country; and in each household with two or more children we used these figures to calculate the shares for allocating childcare among siblings. According to this scale the share decreases by age, but the exact weights depend on the number and age of children living in the household; and they are calculated independently (see these equivalence scales in Appendix A). We unfortunately could not take into account the gender of the children in question as we do not have this information in the standardised European time use surveys.

When estimating MTUS profiles over time, we use the HETUS equivalence scale in those cases when the MTUS survey year is close to the year for which the HETUS equivalence scale is estimated. In this way, we improve the comparability of HETUS and MTUS results. Additionally, we use HETUS equivalence scale when MTUS data do not offer information about the youngest person in the household in 1-year age groups. In such cases, equivalence scale based on MTUS data would not accurately reflect the differences in consumption among the youngest children.³²

For some countries we cannot obtain equivalence scale from HETUS so we estimate it from the nationally representative surveys after average MTUS production estimates are imputed. Following Hammer (2014) we keep only households with one child and assume that total household childcare production equals childcare consumption of that one child. The equivalence scale is then

(2015) if adult-care is allocated to all household members instead of adults only, the average difference in the consumption age profile is less than 3 minutes (1 per cent of total consumption) for children (age 0-17) and less than 2 minutes (1 per cent of total consumption) for adults (age 18+).

³² We use HETUS equivalence scale for the following MTUS countries: Germany (1992 and 2001), Italy (2002), Spain (2003 and 2010) and the UK (1995, 2001 and 2005).



based on average childcare consumption of single children at different ages (see Appendix B).³³

Having the production age profiles by household type allows us to identify childcare performed in households without children in the HETUS data, such as when grandparents care for their non-cohabiting grandchildren. The consumption of this type of childcare is allocated in the same way as childcare within the household. The values are finally added to the general childcare consumption age profile. Likewise, inter-household unpaid labour, which is estimated only using HETUS data, is distributed by intra-household consumption patterns.

3.5 Estimating household consumption by age and gender

After the allocation of consumption to household members we calculate the age averages by taking means over age-groups in the different micro-datasets.

3.5.1 Adjustment of childcare age profiles using MTUS simple data

Occasionally in MTUS, one additional step is needed to calculate the final childcare age profiles. As mentioned above, when using *simple* MTUS data (and in some cases also *aggregate* data, i.e. when only the variable 'agekidx' is available) we are able to impute childcare for only 3 household types defined by the age of the youngest child living in the household (ages 0-4; 5-12; 13-17). This also means that after calculating the averages by age, the variation of consumption within these age groups is not high; not like as if childcare values were imputed according to the single age of the youngest child. Consequently, the age profiles of childcare consumption in these cases are not as steep as when variation in consumption is captured among 1-year age groups. This is especially problematic in the case of young children.

Due to this problem, we adjust the childcare consumption age profiles for all MTUS countries and years for which only the variable 'agekidx' is given. In this way, we

³³ As we have mentioned we calculate MTUS equivalence scale only when detailed information about the age of the youngest child in the household is available (i.e. in 1-year age groups). When this does not hold, we use the equivalence scale from the closest year available.



ensure the comparability of all the profiles based either on *simple* or *aggregate* dataset. More specifically, we multiply male and female childcare consumption profiles with a country-specific adjustment factor. This adjustment factor is calculated in each country for those years where both aggregate and simple MTUS datasets are available. We estimate the consumption age profiles derived from both *simple* (where only variable 'agekidx' is available) and *aggregate* dataset (where the more detailed variable 'agekid2' is available). The methodology we apply in both cases is completely the same except for the childcare imputation method (using 18 household types when 'agekid2' is available and 3 types when only 'agekidx' is available).

The age specific adjustment factor is then calculated using these two estimations in each country. More precisely it is calculated as the ratio of the level of childcare consumption based on *aggregate* compared to *simple* dataset. For all those years when only a dataset with 'agekidx' is available, we multiply the estimated childcare consumption profiles with these adjustment factors calculated from a different year.³⁴

3.5.2 Smoothing household consumption age profiles

The final age profiles are smoothed separately for housework, childcare and inter-household unpaid work using Friedman's Super Smoother. In the case of housework consumption, smoothing is done for the age group 0-80+. Weights are applied for the procedure for both HETUS and MTUS estimates (i.e. the number of respondents in the surveys used in each age group by gender). For childcare we smooth consumption age profiles for ages 0-17. For infants (0 year old) the care time is not smoothed and therefore the original estimated value is given, so as not to underestimate the value (Donehower 2014).

The total amount of household production in a country has to be consumed by the population, therefore some minor adjustments are needed after consumption age

³⁴ Due to lack of data, it is not possible to calculate the adjustment factor for Denmark and Germany. Thus, we use the average adjustment factor of other EU countries.



profiles are estimated in the micro-datasets. For adjusting consumption profiles by age and gender to total household production figures we use population data by age and gender.³⁵ These final age profiles in minutes per day can be found in the AGENTA NTTA data explorer for the 17 countries and 32 time points.

3.6 Aspects of household consumption age profiles in time

Figure 2 demonstrates that consumption of household labour for both genders is relatively small in active age, but twice as much in old age and even more for small children. It is highest for the newborn; on average a child aged 0 in the 16 European countries consumes 7 hours of unpaid household labour. The consumption curve declines gradually with age and reaches its minimum between age 30 and 40 with a value around 2 hours. At this age a large share of housework is devoted to children living in the same household. Above age 40 it increases again reaching a second maximum (4.5 hours) around age 70. Receiving pensions allows the population to abstain from paid work and devote the time to household production. Since it is assumed that all household members consume the same amount of housework, the consumption patterns are similar for men and women.

³⁵ We retrieve age and gender-specific population data from Eurostat. For the MTUS profiles we use weighted population which represents the midpoint of the time use survey period. In HETUS mid-year population is used for one of the years of the survey period.



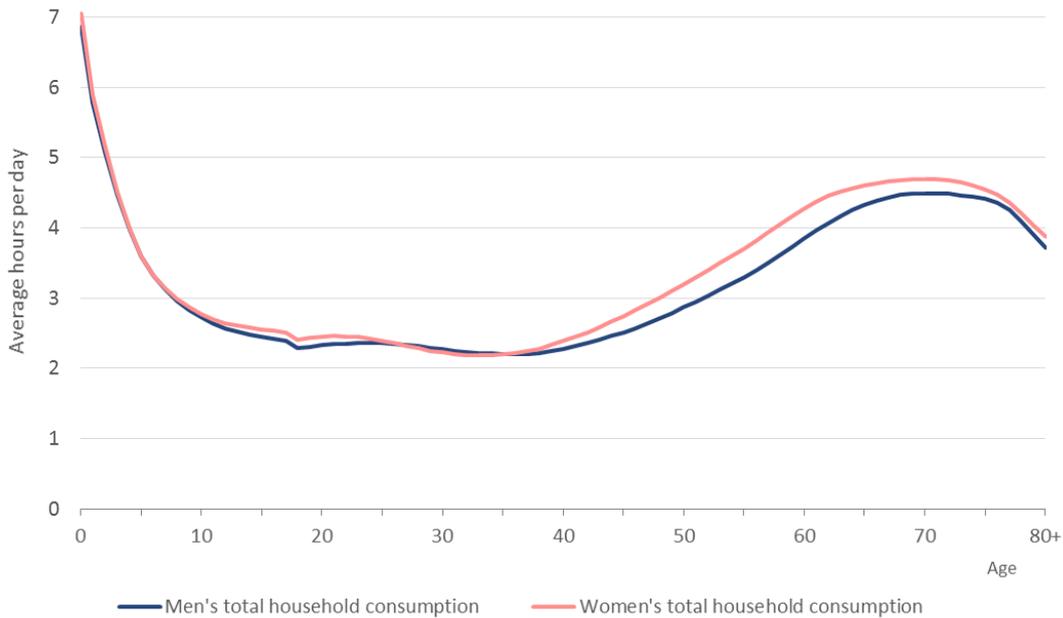


Figure 2: Daily per capita household consumption in hours by age and gender in 16 European countries in early 2000s

Source: Own calculations based on HETUS, MTUS, ECHP, EU-SILC and Eurostat population data.
 Note: Simple averages of countries with comparable data from early 2000s, which are the following: Belgium, Bulgaria, Denmark, Estonia, Finland, France, Germany, Italy, Latvia, Lithuania, Netherlands, Poland, Slovenia, Spain, Sweden and the United Kingdom. See Table 3 for more details.

Figure 3 shows consumption patterns according to the different types of household production activities. It demonstrates that the high consumption of young children is due to the high value of care they receive in time. On average the per capita care consumed by children aged 0-17 in time is around 1.5 hours on an average day. The consumption of childcare time decreases gradually with age. On average it is 5 hours for infants (0-year-olds), 4 hours for 1-year-olds, and 3 hours for 2-year-old children in the 16 European countries; it is around 1 hour for a 9-year-old, and the curve reaches 8 minutes on average by the age of 17. The consumption of goods and services produced through unpaid housework correspond to 2.7 hours per day for a working age adult (age 19-65) and the per capita consumption by the elderly (65+) is on average 4.3 hours in all countries combined.



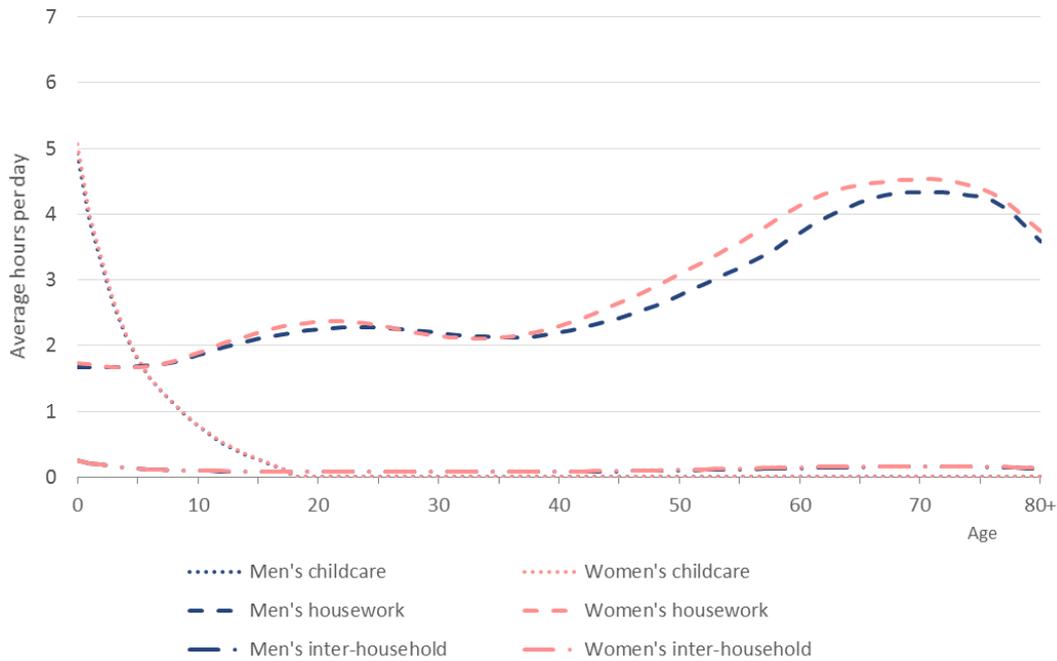


Figure 3: Daily per capita consumption of childcare, housework and inter-household unpaid labour in hours by age and gender in 16 European countries in early 2000s

Source: Own calculations based on HETUS, MTUS, ECHP, EU-SILC and Eurostat population data.
 Note: Simple averages of countries with comparable data from early 2000s, which are the following: Belgium, Bulgaria, Denmark, Estonia, Finland, France, Germany, Italy, Latvia, Lithuania, Netherlands, Poland, Slovenia, Spain, Sweden and the United Kingdom. See Table 3 for more details. In Belgium, Denmark and the Netherlands consumption of inter-household unpaid labour is 0 and is included in childcare and housework production age profiles.

3.7 Robustness checks

To see whether our estimates constructed using harmonised European data and the imputation method are robust across countries, first we compare our profiles with the age profiles estimated from national time use surveys and second, we also compare our own HETUS and MTUS results from some of the same countries and years.



3.7.1 Robustness checks of HETUS/MTUS estimates and national NTTA profiles

We are able to compare our profiles with the age profiles estimated from national time use surveys in three cases: for Spain (2010), France (1999) and Italy (harmonised results from 2003 with results from national profiles of 2008).

Renteria et al (2016) estimate Spanish production and consumption age profiles from the original national time use survey, the exact source of the Spanish MTUS data we used for estimating the harmonised age profiles. Figure 4 shows the two different sets of age profiles. Production profiles are very similar, except that childcare in the case of females is a little higher in the case of the estimated MTUS profiles. Consumption profiles are also very similar for men and slightly different for women, which is probably the result of having exact measures of childcare by the gender of children in the national TUS as well as the different method of allocating childcare.



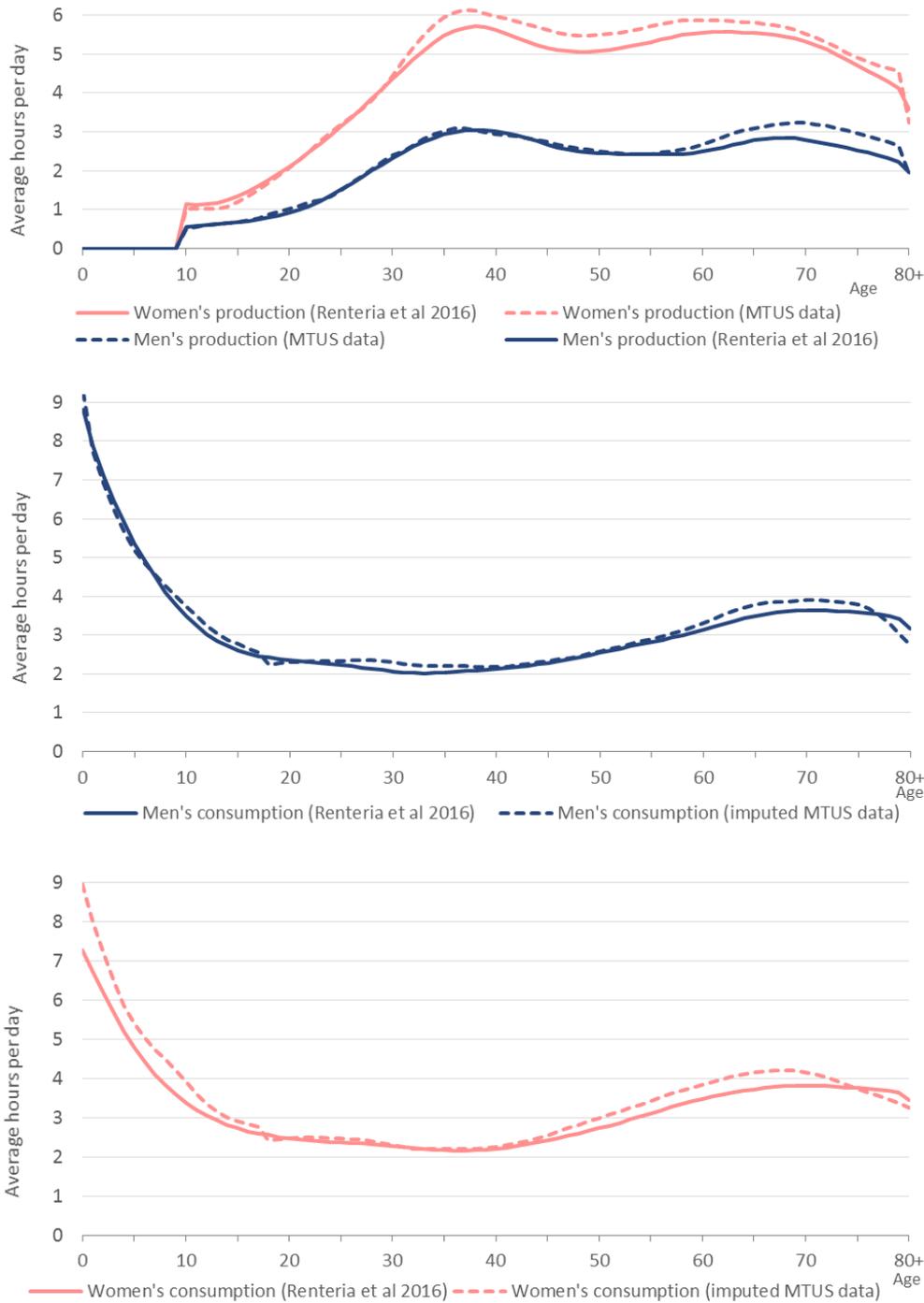


Figure 4: Household production and consumption age profiles in hours per day in Spain (2010) estimated by Renteria et al (2016) and using MTUS data with the imputation method



In the case of comparing results for France (1999), we use estimations by Solaz and Stancanelli (2012), who calculate French production and consumption age averages from the original national time use survey, the exact source of the French HETUS averages. The upper panel of Figure 5 shows that production profiles are similar: the shape of the profiles are the same, but there is some difference in the production figures for all ages.

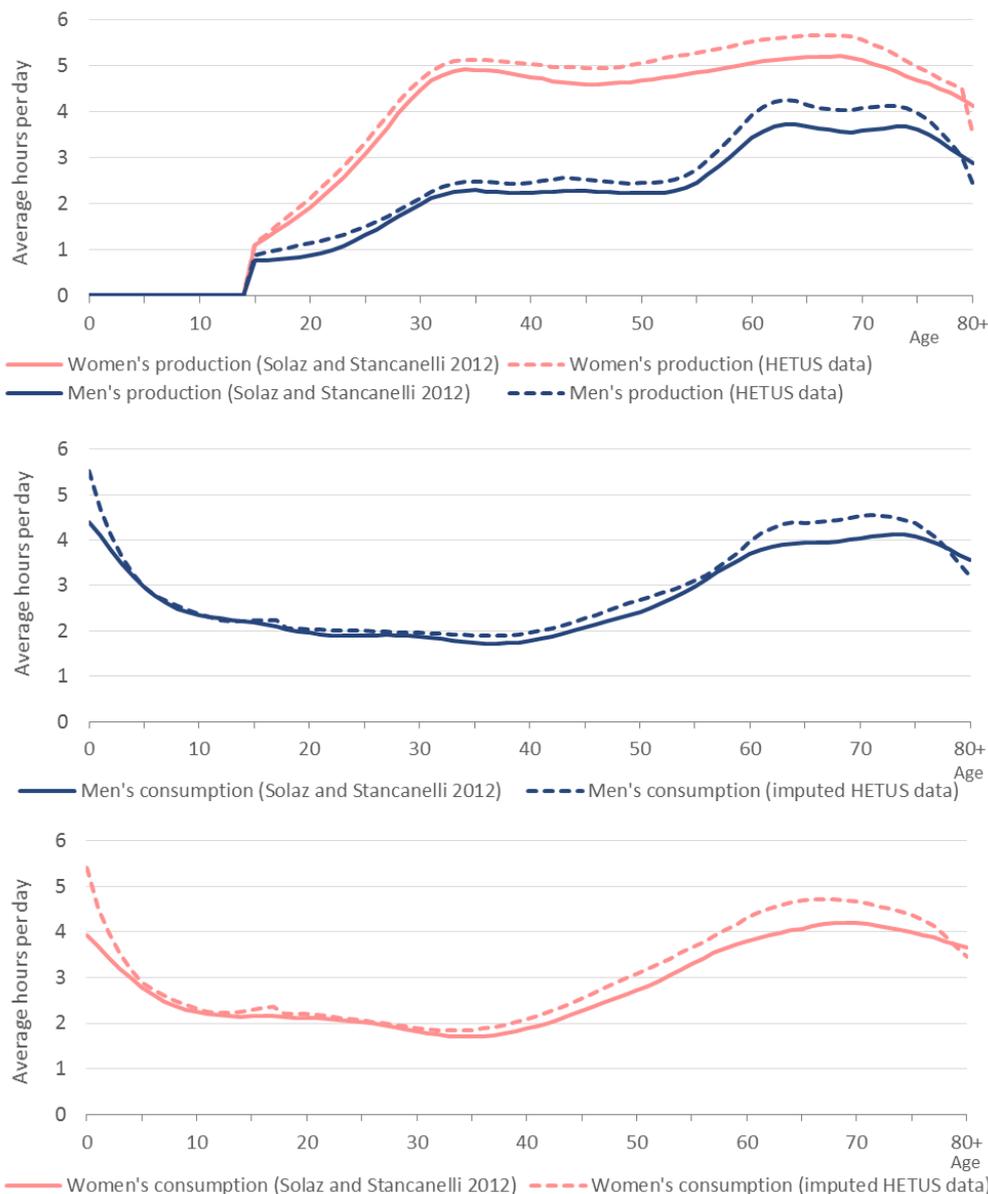


Figure 5: Household production and consumption age profiles in hours per day in France (1998/1999) estimated by Solaz and Stancanelli (2012) and using HETUS data with the imputation method



The reason for the general difference in household production age profiles is probably because of the inter-household unpaid labour, which is included in the HETUS calculations. It is also obvious that the methods for distributing childcare differ in these two estimations. The flatter childcare consumption age profile at early ages in the case of the calculations by Solaz and Stancanelli (2012) and the steeper age profile in the HETUS estimations are the result of using different equivalence scales for allocating childcare in a household as well as of using different smoothing techniques. The HETUS estimations apply a higher weight for smaller children and the value of consumption for infants (age 0) is not smoothed (see above). Apart from these differences, age profiles for people older than three have the same shape using the different sources and methods (see Figure 5).

In case of Italy, production and consumption age profiles are estimated by Zannella (2015) using the national time use survey from 2008 and our estimated age profiles are from 2003 using the HETUS data. It has to be mentioned that it is hard to compare these age profiles because of the difference in the year of the estimations. We would only like to point out that the patterns of consumption are very similar using the national time use survey and the methodology by Donehower (2014) and the harmonised time use data applying the imputation method we have described in the sections above (see Figure 6).



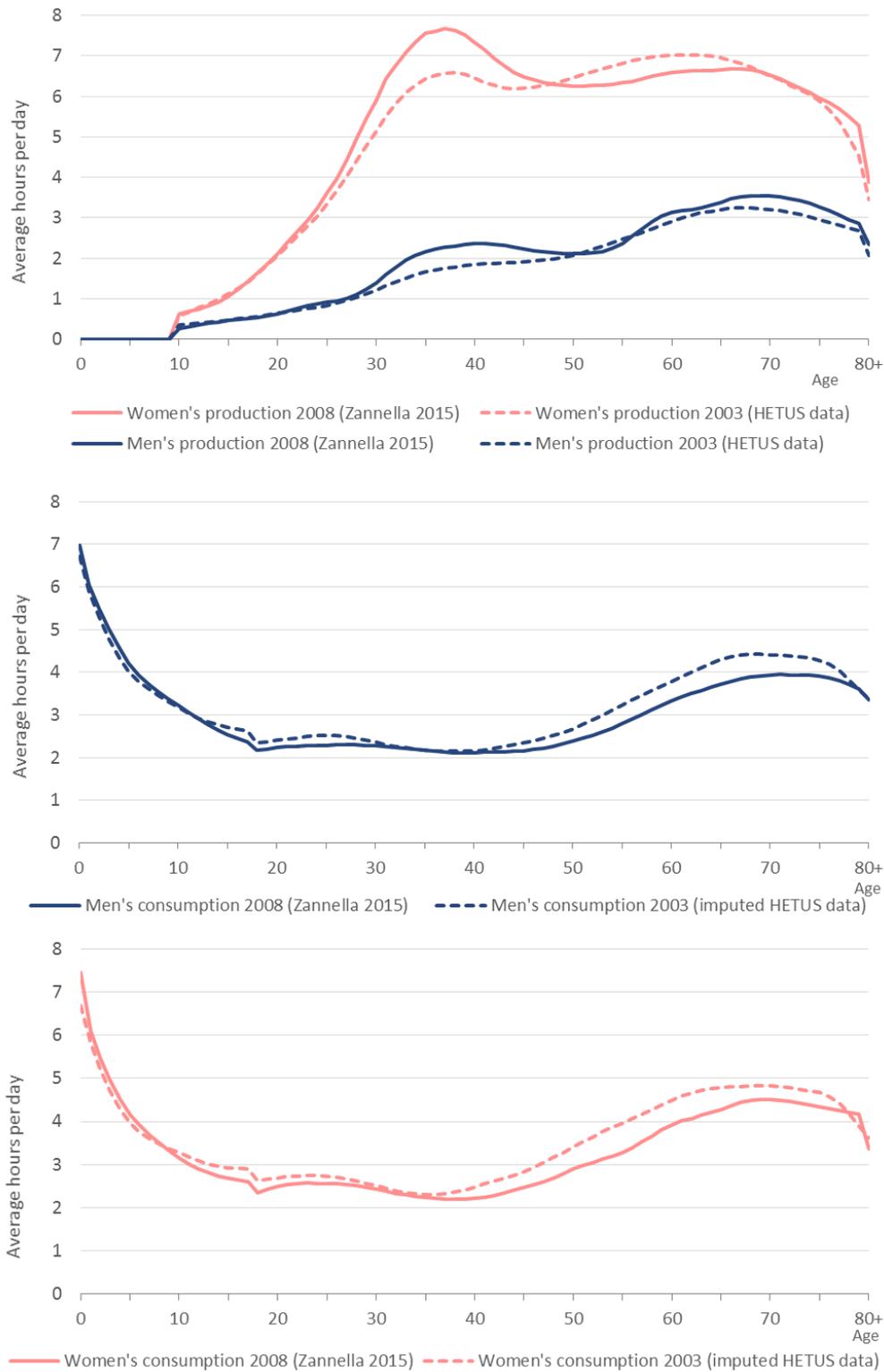


Figure 6: Household production and consumption age profiles in hours per day in Italy (2003 and 2008) estimated by Zannella (2015) and using HETUS data with the imputation method



3.7.2 Robustness checks of HETUS and MTUS estimates

We compare our own age profiles estimated using the HETUS and MTUS data as well in two cases, for the UK (2001) and Spain (2003). Figure 7 and Figure 8 both show that the age profiles using HETUS and MTUS data and the imputation method are almost identical.

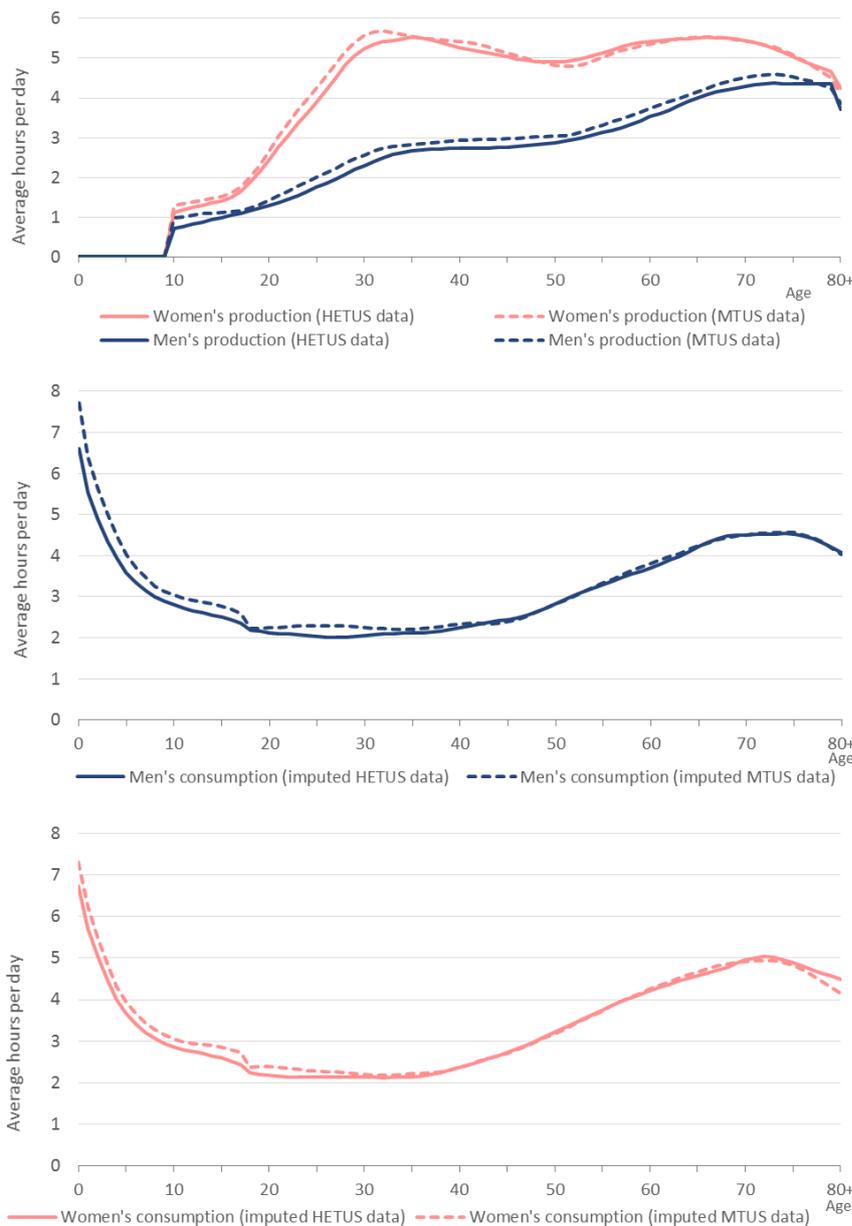


Figure 7: Household production and consumption age profiles in hours per day in the UK (2001) estimated using HETUS and MTUS data with the imputation method



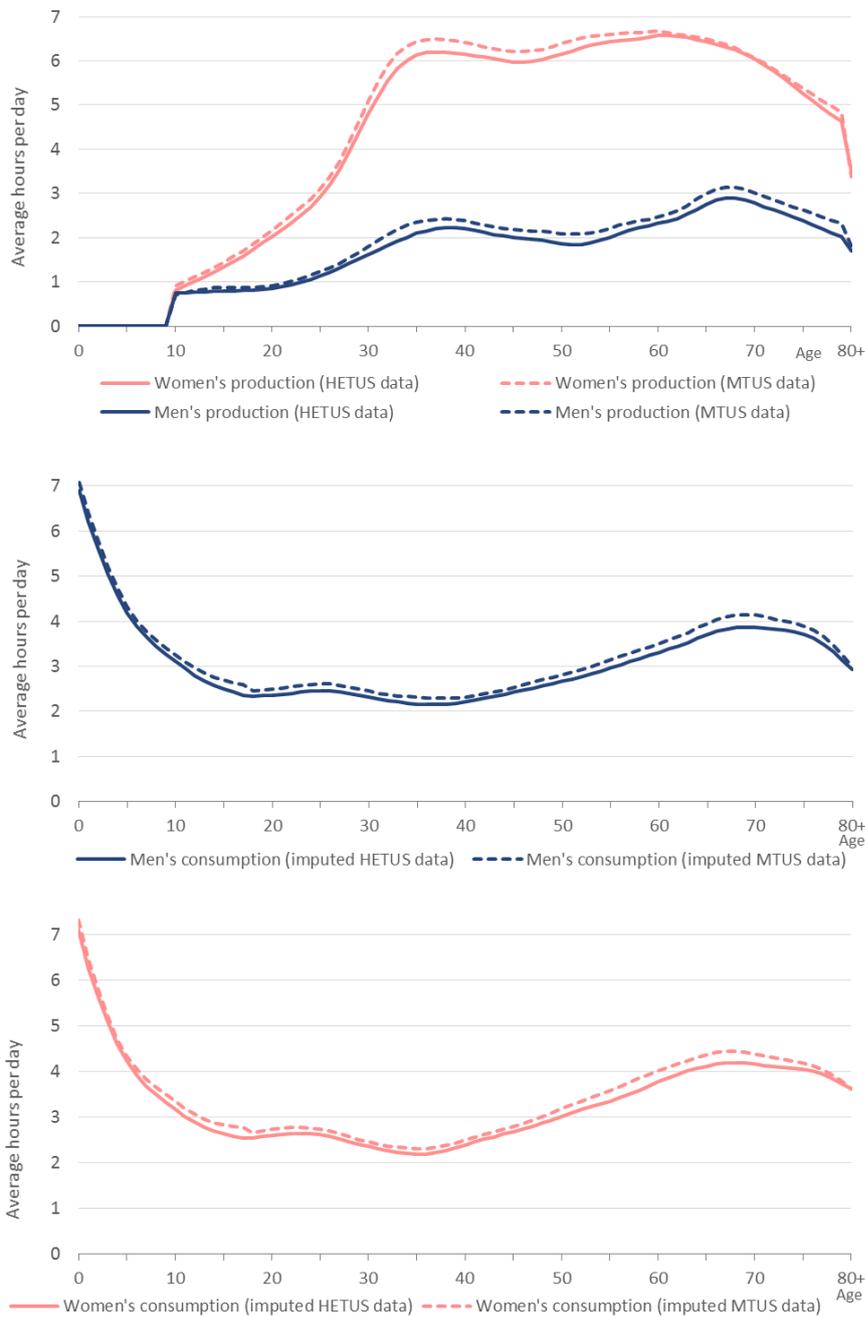


Figure 8: Household production and consumption age profiles in hours per day in Spain (2003) estimated using HETUS and MTUS data with the imputation method

4 NTTA age profiles of time transfers

Net time transfers are calculated by subtracting production from consumption, age by age. They are the non-market counterpart of lifecycle deficit and surplus (LCD/LCS) in the national economy. They show the amount of household goods and services flowing among people of different age groups or gender in net terms. Age groups with negative values are net givers while age groups with positive values are net receivers of time transfers. Again, all these age profiles are included in the AGETNA NTTA data explorer.

4.1 Aspects of time transfer age profiles

Age profiles of net time transfers by gender are presented in Figure 7 in hours. The solid lines in the right panel present the age profiles of net time transfers in 16 EU countries, respectively for men and women, and show whether an age group is a net giver or receiver of home goods and services. Men are generally net beneficiaries, while women produce a huge surplus in the household economy. They are net providers above the age of 20 years almost until they die and the average net time given by all age groups of women is almost an hour of work on an average day (see Table 7).



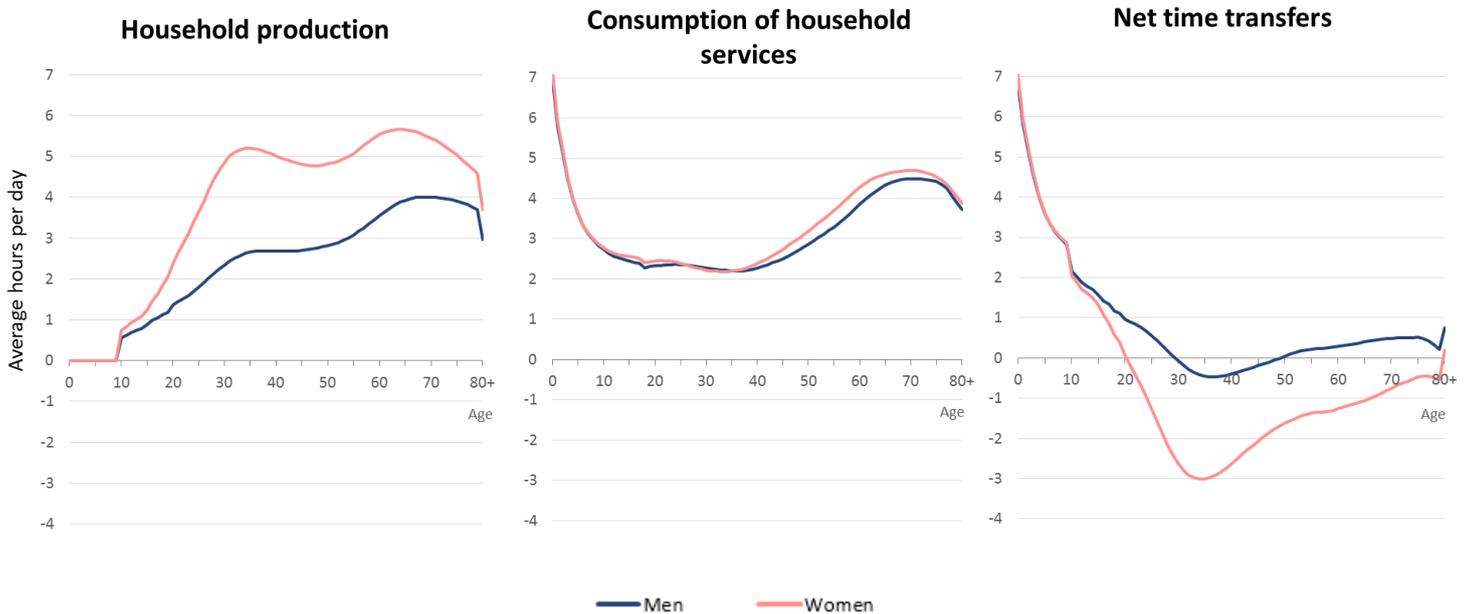


Figure 9: Daily per capita household production and consumption and net time transfers by age and gender in hours in 16 European countries in early 2000s

Source: Own calculations based on HETUS, MTUS, ECHP, EU-SILC and Eurostat population data. Note: Simple average of countries with comparable data from early 2000s, which are the following: Belgium, Bulgaria, Denmark, Estonia, Finland, France, Germany, Italy, Latvia, Lithuania, Netherlands, Poland, Slovenia, Spain, Sweden and the United Kingdom. See Table 3 for more details.

The main receivers of services produced within the households are clearly young children on average in the 16 countries. The biggest givers are their mothers, usually women at age 25 to 45. Above this age the surplus women produce declines gradually, shown by the increase of the solid pink line on the right panel of the graph. Women are still net givers, but with their children growing up and becoming independent they give less and less time to others in net terms on average. On the other hand men are net givers only between age 30 and 49. After the childrearing period, the net time transfer benefits for men increases with age and reaches a maximum for the oldest old (age 80+) with 0.75 hour of net time transfers.

As we have seen for consumption figures, time received is especially high for younger children. In the case of the elderly (65+) only older men are net receivers – receiving an average of around half an hour net time transfer. Even though consumption is high at older ages, older age groups of both men and women

produce a significant amount in the household. Older people tend to live separately from their younger relatives. Therefore the majority of household production by older people is consumed by older people themselves. We note that if old-age care and inter-household family care were better captured in time use surveys (see above in Section 2.1), net time transfers flowing to the oldest age groups would be probably a little higher.

	Age group											
	All ages			0-17			18-60			65-		
	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women
Production	3.1	2.2	4.0	0.5	0.4	0.6	3.7	2.6	4.8	4.5	3.8	5.0
Consumption	3.1	3.0	3.3	3.4	3.3	3.4	2.8	2.7	2.9	4.3	4.3	4.4
Net Time Transfers	0	0.8	-0.7	2.9	3.0	2.8	-0.9	0.1	-1.9	-0.2	0.5	-0.6

Table 7: Daily per capita household production and consumption and net time transfers in hours in 16 European countries in early 2000s

Source: Own calculations based on HETUS, MTUS, ECHP, EU-SILC and Eurostat population data.
 Note: Simple average of countries with comparable data from early 2000s, which are the following: Belgium, Bulgaria, Denmark, Estonia, Finland, France, Germany, Italy, Latvia, Lithuania, Netherlands, Poland, Slovenia, Spain, Sweden and the United Kingdom. See Table 3 for more details.

4.2 Pricing household labour

Like for household satellite accounts, a pricing procedure is applied in NTTA in order to account not only for the time but also the value of home production. In the following sections we outline our methodological decisions about our pricing procedure and introduce the data sources we employed.

4.2.1 Output or input pricing?

The literature distinguishes between the output and the input method of valuing household production. The former derives the value of an activity from the value of the product created by the activity (such as the value of a dinner for the activity cooking). This approach allows the differences in productivity and economies of scale to be taken into account, which is an advantage compared to the input

approach. Productivity of labour depends on age: on average, a 40-year-old person finishes a task faster than an 80-year-old. Output pricing assigns the same value to the same dinner irrespective of the time spent preparing it. By contrast, input pricing assigns a higher value to the same dish prepared by someone who spends more time on it and who is less productive. The activities of older people, who are slower, are eventually valued more than those carried out by faster-working younger people. In addition, input pricing does not capture the economies of scale. Following our example of food production, it does not account for the number of dishes prepared. Five times the same dish in a restaurant costs five times the unit price; so does output pricing. However, five times the same dish in a household does not take five times more time to be prepared. In this way input pricing tends to undervalue household labour.

Time use surveys unfortunately do not usually include information about the output of household production. Data on other means of production – such as the imputed rent of a home and the value of household durables – are also very limited. Therefore, in line with the Donehower methodology (Donehower 2014) and with almost all studies on the value of household labour (for example Holloway, Short and Tamplin, 2002; Soupourmas and Ironmonger, 2002, Sik and Szep, 2003); we apply the input approach: we assign wages to the different activities of household production to estimate the value of home production.

Valuing household production is, however, not straightforward even when using the simpler input approach. It is difficult because it is unpaid: there is no market mechanism that attributes monetary values to these activities. Applying observable market prices raises two problems. First, it is not obvious whose wage should be considered: the wage of the person who is doing the household work (the opportunity cost approach) or that of the person whose job is done (specialist replacement wage approach). In the first approach we apply the unit wage of the respondent of the survey (an IT expert for instance, even if she just washes up the dishes). In the second approach we use the regular market wage of someone who washes dishes full-time as his or her main job. Since much household labour requires basic or no skills, the opportunity cost approach assigns higher value to



household labour than the replacement wage approach, in particular tasks done by men. We follow the approach of the Donehower methodology (Donehower 2014), which applies the specialist replacement wage.

The two main flaws of the input approach mentioned above, insensitivity to productivity differentials and economies of scale, make the labour produced by older people appear to be more valuable than it is in reality. We demonstrated this in the case of age-specific productivity differentials above. Economies of scale create such an age effect because the household size is also age dependent. Older people in Europe typically live alone or in couples and do not live together with their adult children. The households of older people are therefore smaller on average. The current standard of NTTA does not correct for any of these two deficiencies and we would need to make a series of assumptions to correct for them.

4.2.2 Monetary estimation of HETUS age profiles

In the case of time use age profiles estimated using the HETUS data for 14 countries from early 2000s, our aims for pricing have been the following in order to construct comparable age profiles for the different countries: 1. employ standardised wage data and 2. use as much detailed wage data as possible. Most skills that are used in household production are in the unskilled category; no higher degree is likely required to perform these activities. Washing dishes, driving a car or grocery shopping are some of the few activities that would not likely be paid the average wage. This would make any pricing of household labour based on average wages overpriced. In order to present a more fine-tuned and representative picture of household economies by country, we therefore match activities to occupation categories.



Data for valuing home production for the 14 HETUS countries during the years 1999-2005 come from the four-yearly waves of the Structure of Earnings Survey (SES).³⁶ Our calculations are based on the 2002 wave.

Pricing of time use profiles from HETUS is conducted in the following steps: assignment of time use activities to ISCO occupational codes; extraction of wages per minute by occupation using the SES data; calculating missing data if necessary; adjusting to employer paid taxes and contributions; and if needed rescaling for cross-country comparisons. A number of methodological decisions are made in order to arrive at comparable, standardized and as much detailed data as possible across the countries.³⁷

For each household production activity one occupational code is chosen using the International Standard Classification of Occupations (ISCO-88) applied in SES 2002. The structure of the SES micro-data is different for the different countries: for some countries more detailed minor ISCO categories are accessible and for other countries we find only broader occupational categories within the major ISCO groups. In order to obtain more standardised figures we use the broader occupational categories.³⁸ Table 8 shows a detailed list of codes for HETUS household production categories.

We use the median hourly earnings by occupation calculated from SES. The average is sensitive to extreme values and the median value provides a better representation of the central tendency of these occupational wages. We did not access the SES 2002 micro-data for Germany and Slovenia; therefore in these two cases we use wages from the Eurostat website based on the SES 2002 survey. For these countries we have to limit ourselves to the major ISCO-88 groups. The

³⁶ The compilation of structural statistics on earnings is based on local units and enterprises, and provides information on employees in enterprises with 10 or more employees. SES data are centrally processed by Eurostat. More information about SES can be found here: <http://ec.europa.eu/eurostat/web/microdata/structure-of-earnings-survey>.

³⁷ Age profiles in monetary terms are estimated for the full year of 2002. The HETUS time-use data are sometimes earlier or later than 2002, but the age patterns of home production and consumption do not change in one to three years.

³⁸ Detailed explanations of the ISCO-88 codes may be found on the website of the International Labour Organization: <http://www.ilo.org/public/english/bureau/stat/isco/isco88/major.htm>



Eurostat website provides the average hourly earnings by occupation,³⁹ which we then adjust with an average mean-median ratio calculated from the micro-data. In the case of the activity 'Teaching, reading and talking to a child' we use wages of ISCO 4 not to overestimate the value with the wage of ISCO 3. Similarly to this approach if SES micro-data for certain chosen ISCO codes are occasionally missing for some countries in the database, we substitute the value with the adjusted data from the Eurostat website. This happened in the cases of Belgium (ISCO 83, ISCO 91-93) and Finland (ISCO 33) only.

HETUS category of household production activities	ISCO-88 occupational code	Label of ISCO-88 code
Food preparation	51	Personal and protective services workers
Dish washing	91	Sales and services elementary occupations
Cleaning dwelling	91	Sales and services elementary occupations
Other household upkeep	91	Sales and services elementary occupations
Laundry	91	Sales and services elementary occupations
Ironing	91	Sales and services elementary occupations
Handicraft	73	Precision, handicraft, craft printing and related trades workers
Gardening	92	Agricultural, fishery and related labourers
Tending domestic animals	92	Agricultural, fishery and related labourers
Caring for pets	92	Agricultural, fishery and related labourers

³⁹ <http://ec.europa.eu/eurostat/web/labour-market/earnings/database>

Walking the dog	92	Agricultural, fishery and related labourers
Construction and repairs	93	Labourers in mining, construction, manufacturing and transport
Shopping and services	91	Sales and services elementary occupations
Physical care, supervision of child	51	Personal and protective services workers
Teaching, reading, talking with child	33	Teaching associate professionals
Other domestic work	51	Personal and protective services workers
Organisational work	41	Office clerks
Travel related to shopping	83	Drivers and mobile plant operators
Transporting a child	83	Drivers and mobile plant operators
Other domestic travel	83	Drivers and mobile plant operators
Informal help to other households	51	Personal and protective services workers

Table 8: ISCO-88 categories used for the different home production activities in HETUS

Simple adjustments are done after matching the wage data with the time data. Since time figures refer to a day they are annualized so that they are consistent with the NTA figures. The SES provides employee gross earnings with the exclusion of taxes and contributions paid by employers. Labour income in NTA however accounts for the total labour costs, including taxes nominally paid by the employers. In order to have a consistent NTTA with NTA, these taxes are added, too. An adjustment factor for each country is therefore created using the ratio of

the National Accounts entries of compensation of employees to gross wages and salaries downloaded from Eurostat.⁴⁰

The HETUS age profiles in monetary terms are estimated for the full year of 2002. The HETUS time-use data are sometimes earlier or later than 2002, but the age patterns of home production and consumption do not change in one to three years. The AGENTA NTTA data explorer includes comparative HETUS age profiles in monetary terms estimated from 2002.

4.2.3. Monetary estimation of MTUS age profiles

In the case of MTUS time use age profiles starting from 1970s, our aims for pricing have been the following in order to construct comparable age profiles for different countries and years: 1. employ standardised wage data, 2. use as much detailed wage data as possible. We estimate monetary profiles for the same years for which the estimates in minutes are calculated. For these reasons wage data for MTUS age profiles are retrieved from World Bank Data website. Specifically, we use the 'World Development Report 2013: Occupational Wages around the World' database (hereinafter: OWW), which contains wage data for 159 occupations in around 170 countries around the world for the time period from 1983 to 2008⁴¹ (Oostendorp, 2012).

The general approach when estimating MTUS profiles in monetary terms, similarly to estimating HETUS profiles, is the following: first, we choose activities which best represent household production activities and retrieve wage data from OWW dataset. Secondly, we calculate missing data or adjust obtained data if necessary. Thirdly, we adjust retrieved data to represent total labour costs. Finally, if necessary we re-scale the data (using growth in total labour costs) in order to derive the average wages for the years of time use surveys.

⁴⁰ Eurostat table GDP and main components (output, expenditure and income): http://ec.europa.eu/eurostat/en/web/products-datasets/-/NAMQ_10_GDP

⁴¹ The OWW data are derived from the International Labour Organization (hereinafter: ILO) October Inquiry database (laborsta.ilo.org). By harmonizing the original ILO data normalised wage rates are obtained for each occupation.



MTUS activities of household production can be classified using ISCO occupational codes similarly to the way HETUS household production activities and SES data have been matched. However, due to lack of data we could not estimate accurate average wages for different ISCO levels from OWW dataset. First of all, we do not know the average wages of all occupations belonging to the specific second-level ISCO codes that would represent MTUS household production activity the most. Furthermore, there is no information about which occupations are more represented in the population, therefore it is impossible to measure the weighted averages for more general ISCO occupations. Last but not least it is important that the data on average wages for the chosen occupations are available for most of the countries and years in order for our methodology to be as consistent as possible across countries and over years.

Due to these limitations, we use a slightly different approach for estimating the wages from the OWW dataset compared to using the SES database. Namely, based on the available list of detailed occupations, we choose 3 main occupations which best represent the household production activities as defined in MTUS. These occupations are the following: 1. Cook (ISCO level 5); 2. Room attendant/chambermaid (ISCO level 9); and 3. Kindergarten teacher, which is in general classified as ISCO level 3, but sometimes we use ISCO level 4 value in order not to obtain too high estimates for production in the form of childcare (for more details see below). We use average wages for these 3 occupations found in the OWW dataset and use them for monetary estimations of household production activities, as defined in MTUS. Table 9 shows how OWW occupations are matched with MTUS activities⁴².

⁴² Although the OWW dataset includes data on numerous occupations, very few are related to household production activities. Therefore, the occupations chosen to represent different household production activities may not be a perfect match, but are the closest possible approximation. For a detailed list of occupations, please see: <http://laborsta.ilo.org/applv8/data/to1ae.html>



OWW occupation	MTUS category of household production activities
Cook (ISCO 5)	Cooking, food preparation, setting the table, putting away dishes
Kindergarten teacher (ISCO 3 or adjusted ISCO 4 occupation)	All childcare activities (except childcare-related travel)
Room attendant/chambermaid (ISCO 9)	All other household production activities (cleaning, laundry, ironing, clothing repair, home/vehicle maintenance, other domestic work, shopping and services, pet care, adult care, voluntary activities, gardening, domestic travel)

Table 9: Occupational categories used for the different home production activities in MTUS from the OWW database

From the OWW we obtain data on the average hourly wage rates for adult workers for each of the chosen occupations. Although median hourly wage rates would be more appropriate for monetary estimation, unfortunately the OWW dataset does not offer such information. We use OWW data for all of the age profiles based on MTUS, including the profiles for more recent years (after 2000). While monetary estimation for more recent age profiles could be based on SES data, we rather rely on WB data for greater comparability of results over time (the methodological procedures applied in the SES and OWW are different). We use SES data only for Spain since there is no data for Spain in OWW dataset. When estimating wages for Spain from SES for the years 2003 and 2010⁴³, we use the same methodological approach as for HETUS profiles.

After choosing occupations which best represent household production activities and retrieving wage data from OWW dataset,⁴⁴ we calculate missing data or adjust obtained data if necessary. In case data are missing for a certain occupation for a specific country and year, we use data for another occupation. We also adjust the average wage of this other occupation with a ratio which is the average wage rate

⁴³ For Spain, we use SES 2002 data to estimate the age profile for 2003 and SES 2010 data to estimate the age profile for 2010.

⁴⁴ We use variable 'hw3wl' from the OWW database which is expressed in local currency units.

of the original ISCO level divided by the average wage rate of the ISCO the new occupation belongs to. For example, if data for occupation 'cook' is not available, we use the wage rate for occupation 'room attendant/chambermaid' and multiply it with the adjustment ratio, which is the ratio of wage rate for ISCO level 5 ('cook') and wage rate for ISCO level 9 ('room attendant/chambermaid').

Occasionally, another problem occurred when estimating the wage rates for occupation 'kindergarten teacher' used for the monetary estimation of childcare activities. In SES and most of OWW estimations, childcare wage rates are somewhat higher than other household production activities. However, in the OWW dataset wage rates for this occupation are sometimes extremely high compared to other activities⁴⁵. In such cases, we adjust the wage rate with the adjustment factor described above (i.e. ratio between two ISCO levels, similar to methodology described in previous paragraph). We face the opposite problem (too low childcare wage rate) for Denmark for 1987. In this case, we use the same approach and adjust the data using adjustment factor.

After obtaining the wages we multiply the rates for the three specific occupations with the total labour costs factor (i.e. the ratio between compensation of employees and wages and salaries) like in the case of SES wage data. We download these data from Eurostat,⁴⁶ using ESA 2010 standards (the newest internationally compatible EU accounting framework: the European System of National and Regional Accounts). Unfortunately, for most of the countries the ESA 2010 data are available only starting from year 1995. For years prior to 1995, we use data on compensation of employees and wages and salaries from ESA 95. If data on compensation of employees or wages and salaries are missing, we calculate them as a share of GDP (assuming the same share as in 1995 or the first available year in ESA 2010).

⁴⁵ Usually, the wage rate for occupation 'kindergarten teacher' is around 40% higher than the wage rate for occupation 'room attendant'. However, for some countries and years the wage rate for 'kindergarten teacher' is even up to 2 or 3 times higher.

⁴⁶ Eurostat table GDP and main components (output, expenditure and income): http://ec.europa.eu/eurostat/en/web/products-datasets/-/NAMQ_10_GDP



It is not possible to estimate wage data for all of the countries for years which correspond to MTUS estimates. We have estimated age profiles of household production for 1974/75 and 1980 while the OWW data is available only for the time period starting from 1983. In such cases, we have to adjust wage estimations to years of MTUS age profiles. This is done by using data on growth rates of labour compensation per hour worked, retrieved from the EUKLEMS webpage.⁴⁷ As a final step we annualize the monetary age profiles to make them comparable to NTA estimates.

4.3 The aggregate value of household production in Europe

After pricing household production activities we can give an approximation of the total value of household labour and estimate economic activity not accounted for in National Accounts. Table 10 shows the estimated value of labour devoted to home production of non-market services as a percentage of GDP in each country using the HETUS time use profiles and SES wages. In 2002 the value varies between 24 per cent in Latvia up to 57 per cent in Germany. The average ratio is 43 per cent.⁴⁸

Monetary estimations of MTUS profiles and the OWW data give similar results. For example, aggregate value of household labour represents 51.9 per cent of GDP for Germany in 2001, 44.5 per cent of GDP for the UK in 2002, 38.3 per cent for Spain in 2003 (based on SES) and 42 per cent for Italy in 2002. Women's share in the aggregate amount oscillates between 60-70 per cent around 2000s. However, their production and net contribution varies by age.

⁴⁷ The EUKLEMS project created a database on measures of economic growth, productivity, employment creation, capital formation and technological change at the industry level for all European Union member states from 1970 onwards. <http://www.euklems.net/>

⁴⁸ These results are similar to Gianelli et al (2011). They estimate the gross value of total home production between 12 and 47 per cent of GDP in 24 European countries using SES wages. They also find the highest levels of home production in monetary terms in Germany and Belgium and the lowest in Latvia. If we clean our calculations from employer paid taxes the gross values are between 19 and 46 per cent of national GDPs.



country	Year	Total aggregate value of home production as a share of GDP
Belgium	2002	53.7
Bulgaria	2002	36.0
Estonia	2002	36.9
Finland	2002	47.5
France	2002	48.9
Germany	2002	56.9
Italy	2002	54.7
Latvia	2002	23.6
Lithuania	2002	30.7
Poland	2002	49.2
Slovenia	2002	38.0
Spain	2002	40.5
Sweden	2002	44.1
United Kingdom	2002	45.5

Table 10: Total aggregate value of home production as a share of GDP in the respective countries and years (%)

Source: Own calculations based on HETUS, SES and Eurostat population data.

4.4 NTTA production, consumption and net time transfer age profiles in monetary terms

After imputing wages to the different household production categories NTTA age profiles are estimated. In case of HETUS age profiles we have not imputed priced production profiles to the representative surveys again; instead we adjust the different consumption age profiles in minutes to the aggregate total value of household production. Since previously we estimated three different types of production and consumption profiles (childcare, housework and inter-household production), the distortion caused by not going through the steps of the imputation procedure is very small and does not have an effect on the results. In MTUS, production age profiles in minutes are converted to monetary units based on the

estimated wages. Production averages in monetary terms are then imputed to the corresponding micro-data survey to calculate consumption age profiles.

4.4.1 Smoothing age profiles in monetary terms

After the assignment of wages, age profiles are smoothed separately for housework, childcare and inter-household care using Friedman's Super Smoother. The same smoothing techniques are used for these production and consumption age profiles as described above (see Sections 2.2.1 for smoothing household production and Section 3.5.2 for consumption).

The AGENTA NTTA data explorer includes age profiles in euros for years later than 2000. Historical (MTUS) age profiles are expressed in currency units of EU member states.⁴⁹

4.5 Aspects of NTTA age profiles in monetary terms

In order to facilitate cross-country comparability the priced age profiles are rescaled using per capita GDP. In Figure 10 we present priced age profiles showing production and consumption of household labour by gender. Country profiles are rescaled using per capita GDP in order to facilitate cross-country comparability. According to our calculations, the youngest age group (age 0) on average in 16 European countries consumes almost an equivalent of 120 per cent of GDPs in the form of household goods and services. Except for the oldest old age groups, older women in general are net givers of household goods and services. Women age groups of working age contribute the most to the household economy. Between ages 30 and 40 women give an equivalent of 45 per cent of GDPs in the form of household goods and services on average. On the other hand working age men are net providers only during childbearing ages. While their value of net time transfers in monetary terms is on average 8.4 per cent of GDPs in the 16 European countries. Men above 51 are net beneficiaries of home production receiving on

⁴⁹ In euros: Austria, Germany, Italy, the Netherlands and Spain; in local currency unit: Denmark and the UK.



average an equivalent of 4 per cent of per capita GDP. Among the 80 years old or older men it grows up to 11 per cent.

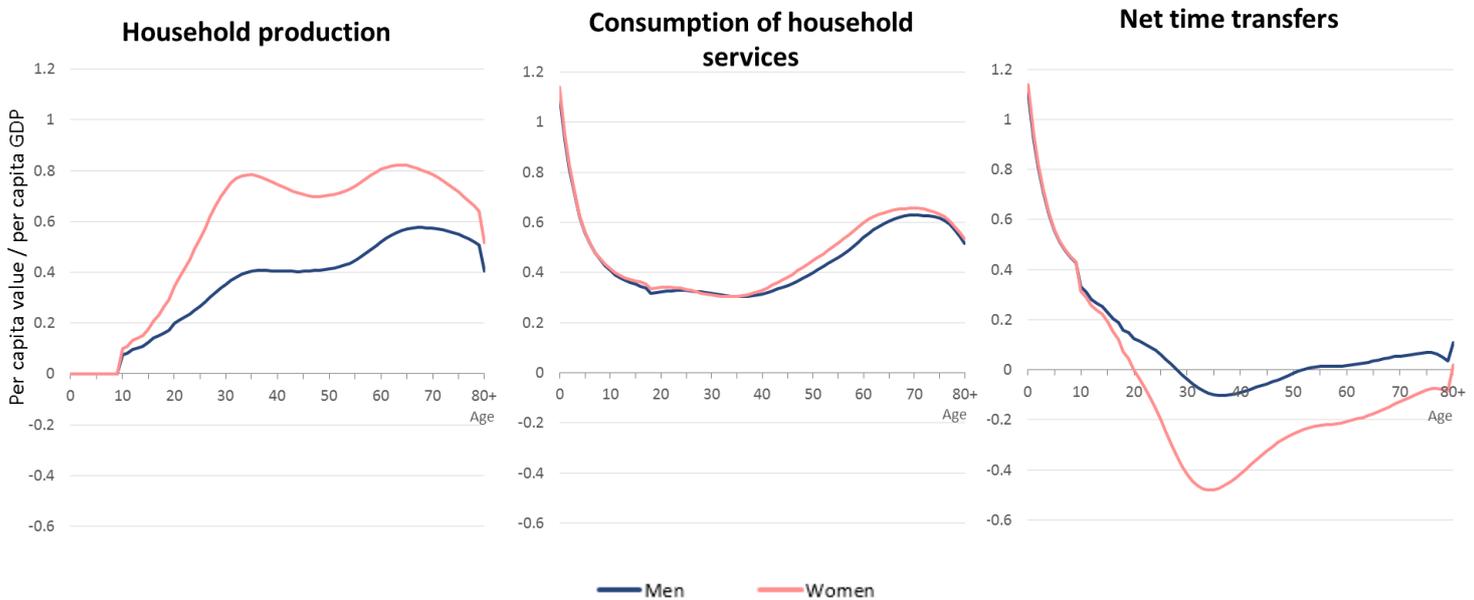


Figure 10: Per capita household production and consumption and net transfers of household products and services in monetary terms by age and gender in 16 European countries in early 2000s

Source: Own calculations based on HETUS, MTUS, ECHP, EU-SILC, SES, and Eurostat population data.

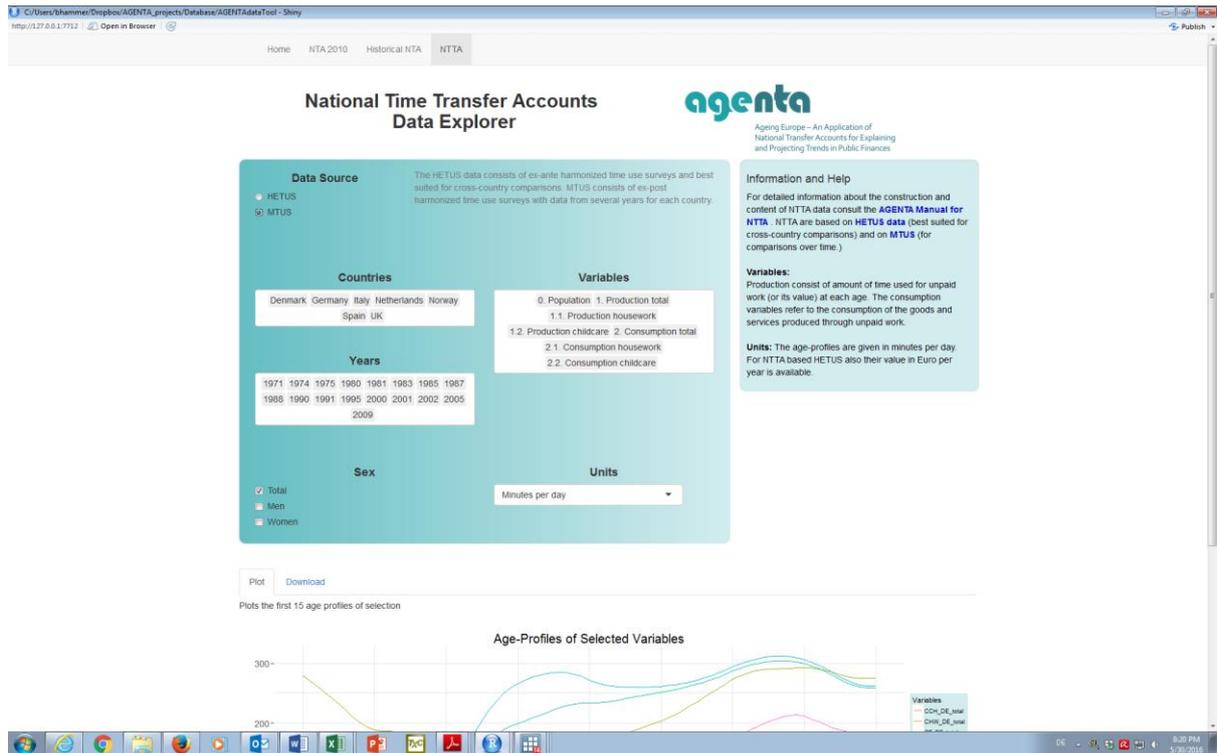
Notes: Age profiles are normalised using per capita GDPs of the respective countries. Simple average of countries with comparable data from early 2000s, which are the following: Belgium, Bulgaria, Denmark, Estonia, Finland, France, Germany, Italy, Latvia, Lithuania, Netherlands, Poland, Slovenia, Spain, Sweden and the United Kingdom. See Table 3 for more details.

5 How to use the AGENTA NTTA data explorer?

The National Transfer Accounts and the Time Transfer Accounts data is publicly accessible through the AGENTA Data Explorer. The data explorer is a simple tool that allows a visual exploration and the download of the NTA and NTTA data. It can be accessed through the link on the AGENTA homepage: <http://witt.null2.net/shiny/agenta/>. The data explorer is divided into three different panels: the *NTA 2010* panel serves for analyzing and downloading NTA from the year 2010 for 26 European countries. Through the *NTA historical* panel NTA from 8 countries for several years can be accessed. The earliest year is 1993,



the latest year 2009. Finally, the *NTTA* panel serves to access NTTA data containing age-specific estimates of household production and consumption. After making the choice of data sources, countries, variables, years and gender the age profiles (age-averages) can be downloaded. The selected age profiles are also plotted on the screen.



Picture 1: Screenshot of the AGENTA NTTA data explorer

5.1. Step 1: Selecting data source

The first choice, which has to be made for accessing NTTA in the data explorer, is the source data. As we have described in this manual, there are two types of NTTA data: NTTA based on the Harmonised European time use surveys (HETUS) and NTTA based on the Multinational Time Use Survey (MTUS). HETUS is the best choice for cross-country comparisons for early 2000s while comparisons of NTTA over time are only possible with NTTA based on MTUS (for more detail see Section 1.5).



5.2. Step 2: Selecting countries and years

There is NTTA data for 14 countries based on HETUS, and for 7 countries based on MTUS. NTTA based on HETUS is so far available only for one year per country. The NTTA in time units refer to this country-specific-year of the survey. The data in monetary terms refers to the year 2002, since the wage data that has been used to value the household production activities are from the year 2002. The availability of data from different years is country-specific in MTUS; an overview is given in Table 3.

5.3. Step 3: Selecting variables

NTTA data contains information on household production and consumption. Production consist of the time or the value of the time spent on unpaid household production activities, distinguishing housework (PHW), childcare (PCH) and inter-household unpaid labour (PIH, only in the case of HETUS data). For an overview about these household production activities see Section 2.1. As we have shown the consumption age profiles are estimates of how much household products and services are consumed at each age (Section 3). Consumption is also distinguished into consumption of housework (CHW), consumption of childcare (CCH) and consumption in form of inter-household unpaid work (CIH).



5.4. Step 4: Selecting sex and units

All of the profiles are available for men and women separately and the total values including men and women. For HETUS based NTTA estimates are available in per capita minutes per day as well as per capita Euros for the full year. The value in monetary terms is based on wage data from the year 2002. MTUS based NTTA values are also available in form of per capita time per day, while it is country dependent whether the age profiles in monetary terms are in per capita Euros or national currency for the full year.

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Appendices

Appendix A: Equivalence scales for allocating childcare with two or more children living in a household based on HETUS data

Age of child	Belgium	Bulgaria	Estonia	Finland	France	Germany	Italy	Latvia	Lithuania	Poland	Slovenia	Spain	Sweden	UK
0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1	0.70	0.77	0.75	0.85	0.80	0.78	0.80	0.53	0.92	0.81	0.83	0.85	0.75	0.74
2	0.53	0.60	0.71	0.62	0.65	0.52	0.71	0.41	0.65	0.65	0.49	0.73	0.61	0.63
3	0.47	0.41	0.44	0.48	0.52	0.43	0.58	0.37	0.52	0.52	0.41	0.59	0.52	0.59
4	0.44	0.47	0.52	0.34	0.44	0.36	0.49	0.30	0.34	0.41	0.31	0.53	0.47	0.47
5	0.33	0.28	0.36	0.29	0.44	0.39	0.45	0.32	0.31	0.39	0.31	0.46	0.41	0.40
6	0.41	0.28	0.33	0.22	0.37	0.35	0.39	0.27	0.22	0.31	0.33	0.36	0.41	0.36
7	0.27	0.23	0.21	0.15	0.37	0.27	0.31	0.23	0.24	0.28	0.21	0.29	0.34	0.28
8	0.21	0.17	0.23	0.12	0.29	0.24	0.29	0.19	0.20	0.25	0.20	0.29	0.35	0.23
9	0.17	0.13	0.21	0.09	0.27	0.15	0.24	0.19	0.11	0.21	0.17	0.24	0.29	0.21
10	0.17	0.09	0.10	0.07	0.19	0.09	0.20	0.07	0.05	0.16	0.06	0.13	0.31	0.12
11	0.14	0.09	0.06	0.04	0.18	0.09	0.13	0.05	0.04	0.11	0.08	0.11	0.25	0.12
12	0.06	0.03	0.05	0.03	0.10	0.07	0.10	0.06	0.04	0.08	0.03	0.06	0.19	0.07
13	0.07	0.03	0.06	0.05	0.08	0.06	0.06	0.03	0.01	0.06	0.05	0.06	0.17	0.06
14	0.05	0.02	0.03	0.04	0.08	0.04	0.08	0.03	0.01	0.03	0.04	0.02	0.16	0.05
15	0.04	0.01	0.02	0.04	0.05	0.05	0.05	0.02	0.01	0.03	0.02	0.03	0.10	0.04
16	0.04	0.01	0.01	0.02	0.05	0.02	0.04	0.01	0.01	0.01	0.02	0.02	0.06	0.02
17	0.01	0.01	0.00	0.02	0.04	0.01	0.04	0.01	0.00	0.01	0.01	0.01	0.11	0.02

Source: Own calculations based on HETUS data.

Appendix B: Equivalence scales for allocating childcare with two or more children living in a household based on MTUS data

Age of child	Austria (1992)	Denmark (1987)	Denmark (2001)	Italy 1988	The Netherlands (2000)	The Netherlands (2005)	The UK (1987)
0	1	1	1	1	1	1	1
1	0.97	0.95	1.07	1.03	0.87	0.85	1
2	0.96	0.98	1.06	0.73	0.56	0.76	1
3	0.94	0.92	1.03	0.58	0.50	0.73	1
4	0.94	0.80	0.85	0.57	0.59	0.59	0
5	0.26	0.86	0.52	0.38	0.50	0.59	0.45
6	0.27	0.62	0.45	0.40	0.40	0.56	0.52
7	0.26	0.13	0.46	0.37	0.49	0.46	0.38
8	0.26	0.14	0.38	0.33	0.26	0.38	0.35
9	0.25	0.13	0.46	0.23	0.30	0.41	0.31
10	0.17	0.13	0.32	0.19	0.24	0.32	0.25
11	0.15	0.10	0.26	0.13	0.27	0.31	0.32
12	0.12	0.09	0.46	0.11	0.18	0.25	0.21
13	0.15	0.18	0.09	0.09	0.24	0.26	0.16
14	0.13	0.07	0.13	0.05	0.18	0.22	0.22
15	0.12	0.12	0.23	0.03	0.17	0.16	0.17
16	0.08	0.04	0.13	0.04	0.19	0.14	0.14
17	0.12	0.03	0.12	0.02	0.15	0.13	0.16

Source: Own calculations based on MTUS data