WHO TAKES CARE OF WHOM IN THE U.S.? EVIDENCE FROM MATRICES OF TIME TRANSFERS BY AGE AND SEX

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Abstract

Non-monetary intergenerational transfers of time, such as informal care time transfers, represent a largely unknown, yet pivotal component of the support system in a country. In this article, we offer estimates of time transfers, by age and sex, related to informal childcare and adult care in the United States. We developed methods to extract both intra-household and inter-household time transfers from the American Time Use Survey (2011-2013) and the recently-added Eldercare Roster. We then summarized the results in matrices of time flows by age and sex for the general U.S. population, as well as for the so-called "sandwich generation." We observed that most time transfers flow downwards from parents to young children. Grandmothers spend more time with newborn grandchildren than grandfathers, who, on the other hand, spend more time with slightly older grandchildren. The time produced by the sandwich generation is directed towards a more diverse population spectrum, including substantial intra-generational transfers to spouses. Estimates of time produced and consumed by the population with various demographic characteristics establish a foundation for extrapolating the degree to which the demand for care services will be met in the years to come. Extrapolation based on our findings reveals a steady rise in demand, relative to supply, of informal care lasting decades into the future. This projection indicates that, to maintain current levels of care, our society will have to either rely more heavily on the market or on an increased effort of caregivers.

INTRODUCTION

Informal care is an important component of intergenerational transfers. In 2012 alone informal care providers in the United States engaged in caregiving activities that amounted to over 1 billion hours[1] of work per week, equivalent to the work of approximately 30.45 million full-time home aides or healthcare staff.[2]

Modern Systems of National Accounts (SNAs) and the National Transfer Accounts (NTA) project monitor transfers of money and resources by employing various techniques that include the use of national economic surveys (Lee and Mason 2011). However, non-monetary transfers of time are typically unaccounted for. Consequently, there is a lot of uncertainty in the quantitative evaluation of overall transfers. There has been a recent effort, within the National Transfer Accounts project, to evaluate profiles of unpaid household production and consumption by age and sex (e.g., Donehower and Mejía-Guevara 2012; Zagheni and Zannella 2013). Our work builds on this literature to add a dimension to existing profiles and map, for the first time, matrices of time transfers in the form of care given and received.

In this paper, we use data from the American Time Use Survey (2011-2013) to evaluate flows of time transfers by age and sex in the U.S. We combine data from the standard time use diaries with the recently-added Eldercare Roster file. These data sources allow us to map time transfers for the general U.S. population and for its subgroups, like the so-called "sandwich generation." Our central aim is to provide a picture of time transfers from a previously-unexplored perspective, and to investigate the differences and similarities between the general population and subgroups that have simultaneous responsibilities towards adults and children. We hypothesize that the majority of non-monetary transfers are taking place between middle-aged parents and their young children and, to a lesser extent, their elderly parents or relatives. At the same time, we also expect to find some evidence of the care time transfers between grandparents and their grandchildren.

A number of studies have investigated transfers in the form of unpaid resources. However, we identified several advantages in using time use data. ATUS is conducted on an annual basis on a target sample drawn from the entire U.S. population. Moreover, its activity-based diaries allow for virtually unrestricted flexibility of choosing a unique area of interest. We found these features instrumental in generating detailed matrices of flows of informal care

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[1] 1.218 billion hours of work per week.

[2] Own elaboration on 2012 American Time Use Survey data. Full-time status is based on 40-hours of work per 7-day week

$$FT\ worker\ equivalent = \frac{\sum(\overline{T}_{per\ capita} \times \overrightarrow{D}) \times 7_{days}}{40_{weekly\ hours}} = \frac{174{,}004{,}717 \times 7}{40} = 30{,}450{,}826\ ,$$

where $\overline{T}_{per\ capita}$ is the mean amount of informal care time (in hours) produced on an average day in 2012 by the U.S. population in the age-sex group $\overrightarrow{D}$ (such as females 20-24 years old, males 45-49 years old, and so on).

transfers based on aggregate time of activities related to physical care and miscellaneous assistance to children and adults. In addition, time use data are collected in a large number of countries. Therefore our approach could be used for comparative analyses in the future.

The paper is organized as follows: first, we provide some background information about transfers of unpaid resources, with an emphasis on the literature that analyzed the sandwich generation. Second, we describe the data from the American Time Use Survey, and discuss the methods and definitions that we propose. Third, we present the main results, and discuss the innovative matrices of transfers of informal care, by age and sex, that we produced. Finally, we offer projections of future supply and demand of intergenerational informal care time, conditional on the expected demographic change and the current patterns of production and consumption. We anticipate that our estimates will have wide ranging implications. They could be used to project the economic value of the future supply of care and the society's capacity to meet the growing demand for care in the coming decades. We provide an example of this application based on our estimates of non-market production supply and informal care deficit, and discuss the implications drawn from the results, as well as the limitations of our approach.

BACKGROUND

Household production and intergenerational transfers of time

Time is a valuable asset and a limited resource, which has always had an important role in the study of intergenerational exchange. Influential work by Simon Kuznets (1934) and Margaret Reid (1934) dates back to the 1930s. A few decades ago, the work of Gary Becker (1965) on the theory behind allocation of time revived interest in time use. A large number of social scientists have delved into previously unexplored territories of time use research thanks also to the increasing availability of survey data collected via time use diaries.

It is essential to acknowledge the economic value of unpaid household work and informal caregiving, as such forms of family obligations are rapidly becoming more common and abundant among working age adults, especially women (Bianchi 2011). The aging generation of baby boomers requires more help and attention from younger generations, who strive to balance work responsibilities in a fast-paced and more demanding environment, while also tending to children and elderly parents (Goldschmidt-Clermont and Pagnossin-Aligisakis 1999). Choi (2011) argues that adult children's life advancement in terms of education, working status and, consequently, careers may fall under risk of delays, if these middle-aged sons and daughters are expected to provide care to their elderly parents who are in poor physical or mental health. At the same time, more and more adult children require parental support, either financially or in the form of housing, as they enter the long process of earning their post-secondary degrees, or as they have not yet attained financial independence to live off their own means (Schoeni and Ross 2005; Wiemers and Bianchi 2013). The importance of time use has become clear within the

international network of researchers in the National Transfers Accounts (NTA) project. One of the goals of the NTA project is to develop a system to measure economic flows across age groups. NTA members have developed methods to analyze monetary transfers. However, the same general concepts can be used to evaluate intergenerational transfers that do not involve monetary exchange (Donehower & Mejía-Guevara 2012).

Inclusion of household as well as informal non-household production into the measurement of economic activity could provide a much more accurate depiction of economic growth at the national level, while also elucidating the proportion of value produced by various demographic groups, particularly women (Zagheni and Zannella 2013). From an economic perspective, non-monetary transfers are important for two principal reasons: first, the unpaid labor associated with these flows produces unaccounted surplus economic value. Second, these transfers reduce an individual's capacity to engage in paid employment, thereby potentially decreasing the productive output of individuals as labor force participants (Riley and Bowen 2005). Previous work within the NTA framework led to the estimation of profiles of consumption and production of time, by age and sex (e.g., Zagheni and Zannella 2013). In our study, we focus on care and fully exploit the available time use data to estimate matrices of flows of time by age and sex. With our new perspective, the NTA profiles are equivalent to the marginal sums over rows and columns of the matrices that we present here. In other words, we provide a generalization of profiles of time consumption and production, and higher-granularity results for the case of care giving.

The "sandwich generation"

"Sandwich generation" is defined under the framework of intergenerational transfers that involve simultaneous responsibilities toward younger and older generations. There is, however, no rigid, universally accepted definition, as its specific details are often shaped by the availability of data and particular research objectives that social scientists establish in their studies. Some earlier studies identify simultaneous responsibilities of middle-aged men and women to their adult children and elderly parents (Ward and Spitze 1998), whereas others also discussed the transfers of time and/or money to and from grandchildren and parents-in-law (Grundy and Henretta 2006; Wiemers and Bianchi 2013). Overall, the sandwich generation phenomenon has been found relatively atypical or even rare at the national scale, generally falling well under 10% of the total country population (Ward and Spitze 1998; Fredriksen and Scharlach 1999). However, it may currently be above the 10% mark, if the transfers include money, gifts, informal and formal care time (Pierret 2006). In terms of transfer behavior, over two thirds of sandwiched caregivers were found to provide more task assistance than financial support in upward transfers, although males are more likely to contribute financially than women (Nichols and Junk 1997). From a purely demographic perspective, the phenomenon of the sandwich generation is projected to decrease in the U.S. in the future (Goldstein, Mason and Zagheni 2011).

In this paper, we defined a respondent "sandwiched" if, during the course of a single day, s/he provided care to at least one child and at least one adult. It is a fairly loose definition of "sandwichness." Some people may have care responsibilities towards the elderly and children in general, but not every day. Some other people may happen to help children and adults on a single day, but they generally do not have simultaneous care responsibilities. Some people may provide care to members of their own generation (e.g., spouses) and children. Overall, our definition captures the average daily simultaneous burden of care to both adults and children.

Patterns of care and characteristics of intergenerational care providers

In this section, we provide a brief background on the socio-demographic characteristics of caregivers and on the associated patterns of care.

Numerous studies have found that women produce the majority of time in informal care arrangements, both in the general population, or in its segment that bears characteristics of a sandwich generation. Evidence from the Wisconsin Longitudinal Study (Bianchi 2011) reveals that American women spend many more hours of unpaid caregiving to younger, older, or both generations than do men. This exerts considerable pressure on the women's employment decisions as well as destabilizes quality of life and/or marriage (Riley and Bowen 2005). Men are shown to perform some activities at home with other family members, although it is not clear whether those are directly related to informal care or to miscellaneous household tasks, such as repairs or gardening. It has been found that middle-aged women in developed countries, once locked in a dual generation "sandwich," tend to be more willing to provide additional care to the third generation (e.g. in-laws and extended family members). However, this may mean that such women abandon labor force in favor of informal caregiving and rely on their husbands or other family members to provide for their financial support (Grundy and Henretta 2006). Moreover, gender gap widens notably in the household production of childcare, since supporting a child is rather costly in the United States, meaning that mothers, more often than fathers or other family members, are compelled to spend more of their time on attending to their young children than working for pay (Anxo et al. 2011).

Concerns expressed in numerous surveys by the caregivers, particularly by those belonging to the sandwich generation, over their workload and its generally negative effect on their day-to-day lives are discussed by many researchers. Nevertheless, some evidence shows that even the sandwich generation may not experience as harsh of a reality as is envisioned by many, due to multiple factors that alleviate the burden caused by the informal care strain or financial responsibility. For instance, a study of intra-household unidirectional responsibilities suggests that parental reciprocity for time transfers in the form of care given by their adult children helps to ease the pressure on caregivers (Arrondel and Masson 2001). While most intra-household transfers are downward (i.e. from parents to children), the middle-aged caregivers were shown to be able to provide care to their elderly parents with the expectation that their

children will do the same as soon as they become adults. Whether parents expect to help their middle-aged children financially in the future as they grow old and require even more attention depends largely on whether or not they do so currently (Anuarbe 2009).

Spousal care, or intra-generational care, deserves its own treatment. Recent research discovered that married middle-aged recipients obtain the majority of their informal care time from their spouses, although this amount is smaller than in spousal transfers in older ages (Lima, Allen, Goldscheider, and Intrator 2008). At the same time, multiple caregiving responsibilities, as in the sandwich generation, were shown not to influence the patterns of spousal care.

DATA

For our analysis, we used data from the American Time Use Survey (2011-2013) and the recently-added Eldercare Roster. In order to obtain a sample size that is large enough for our analyses, we combined the surveys of 2011, 2012, and 2013.

The data collected in ATUS is self-reported by the study participants through the computer assisted telephone interviews (CATI) on a date indicated in an advance mailer sent to the respondents. Close to 26,400 participants are selected annually for interview from the pool of the respondents to the Current Population Survey (CPS) conducted by the U.S. Census Bureau. The response rates hovering at approximately 50% in the last three years yielded just over 12,000 observations per survey year available for detailed analysis. The key aspects of the ATUS sampling methodology are the selection of a range of demographic characteristics that represent the United States' population at large, stratified in 3 stages: by race/ethnicity, and by number and age of children, or adults, if no children are present. During an interview the ATUS respondents are asked to provide a detailed account of their activities, in which they were involved on the day prior to the interview, as well as the information related to these activities, including, but not limited to the activity type, duration, place, time, and people present.

The new addition to the ATUS, the Eldercare Roster, is a special dataset pertaining to care recipients who obtained unpaid care or assistance, which they required due to their old age or a condition related to aging. Unlike in other component files of ATUS, elder care recipients may or may not have been present in any activities during the interview day. However, the caregivers indicated providing help to those individuals at least once during the 3-4 months period prior to the interview. Compared to other files that comprise the ATUS set, the Eldercare Roster contains only a few essential indicators, such as age of the care recipient, whether or not they share a household together with their caregiver, their relationship to the caregiver, and for how long have they been receiving this type of care. The Eldercare Roster is a useful data source for estimating time transfers related to informal adult care, especially in the inter-household transfer domain.

The time use data contained in the ATUS allows for detailed differentiation of the respondents' daily activities, including providing unpaid physical care and other direct assistance

to both household members as well as non-household members. To examine the transfers of time in terms of unpaid informal care arrangements, we decided to target a range of activities that are broadly defined as childcare and adult care. These activities include physical care provided to household and non-household children and adults, such as helping to bathe or to dress, as well as other non-health related assistance, like children's education, help with household chores, shopping, etc.[3] The coding scheme in the ATUS activity lexicon allows one to distinguish all these activities from those performed as part of one's work or other kinds of professional involvement, such as volunteering. By virtue of this setup we could isolate informal care, that is, those activities that are not remunerated, nor are a part of a professional responsibility.

In addition to examining the population of providers of unpaid care in the United States, we are interested in understanding "extreme" situations, where informal care is manifested in the form of multiple simultaneous responsibilities to two or more generations. Thus, employing our definitions for childcare and adult care, we assigned "sandwich" status to every respondent who has engaged in at least one such activity related to childcare and, at least one activity that is characterized as adult care over the course of the day. Unlike many past research studies that restricted their definitions of sandwich generation to care given to own children and elderly parents simultaneously, our definition is neither limited by the relationship of the care recipient to caregiver, nor by the living arrangement, since the ATUS data facilitates the examination of more complex and less common forms of informal care transfers. Finally, diary-based survey data has been previously recommended for accurate measurement of informal care time over the data collected via recall method that tends to overestimate the time spent on caregiving (Van den Berg and Spauwen 2006).

However, one of the significant limitations of the ATUS data set is that it does not allow one to identify the age and sex of care recipients outside of the caregivers' households, with a few exceptions of elderly and the caregivers' own young children. This disadvantage does not affect national representativeness of caregivers' characteristics and time production. It only affects our estimates of care received by younger adults. As we explain in more detail in the next

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[3] Specific 6-digit activity codes from the ATUS activity lexicon that were included in the computation of time are: 0301xx, 0302xx, 0303xx, and 0401xx, 0402xx, 0403xx for household and non-household childcare, in addition to 0304xx, 0305xx, and 0404xx, 0405xx for household and non-household adult care. More specific second-tier activity category descriptions for both household and non-household members include "Caring For & Helping (Non-) Household Children," "Activities Related to (Non-) Household Children's Education," "Activities Related to (Non-) Household Children's Health," "Caring For (Non-) Household Adults," and "Helping (Non-) Household Adults." Travel time associated with the aforementioned caregiving activities is listed under the activity codes 1803xx and 1804xx for household and non-household members, respectively. Finally, a small portion of caregiving time was classified as helping household and non-household members in general, and is listed under activity codes 039999 and 049999.

For further details, see ATUS activity coding lexicon:
http://www.bls.gov/tus/lexiconwex2013.pdf

sections, we use indirect methods to evaluate inter-household flows of transfers by triangulating data from the main diaries and the Eldercare Roster. Given the data format, we expect our estimates of care received to be fairly accurate for children and the elderly. For the middle-aged population, we expect to slightly underestimate care received, because of the lack of information about inter-household care received by younger adults.

Additionally, ATUS data collection is limited to primary activities, with the exception of pre-teen childcare, such that any informal care that takes place during another activity that respondents indicate as primary is not recorded, and therefore cannot be considered in our analysis.

METHODS

We developed two distinct approaches for estimating the intra- and inter-household components of the overall transfer matrix, respectively. In the final step of the analysis, the two matrices are combined to provide a picture of overall transfers of time by age and sex. As a reference, and for comparison purposes, the terminal output of most operations conducted and presented in the next sections, including the overall matrix, is comprised of two parts or graphical elements, identical in structure and format, one pertaining to the total population of any type of caregivers, and another one for the "sandwich generation" only, unless indicated otherwise. Then, using the matrix concept we compute the average transfers of time by age and sex for the entire civilian population of the United States.

Intra-household transfers

In the process of aggregating matrices, we considered standard 5-year age groups, widely used by the U.S. Census Bureau (e.g. 15-19, 20-24, etc.) to classify a population. We then built matrices whose entries show the average amount of time that was transferred in the context of informal care activities from a specific age-sex group of caregivers to another age-sex group of care recipients. More specifically, we combined information from different files present in the ATUS. We linked the Activity Summary file, which provides the respondents' age and sex, as well as the duration of the activities, with the Who file, which contains information about the people who are present during each activity. We computed the entries for each matrix by aggregating the time in the relevant categories of care, transferred to care recipients, by age and sex, and cross-tabulating by the age and sex of care providers. If two or more people who qualify for being care recipients under the activity were present, the time of such single activity was split equally between these potential recipients. For instance, if two household children under 18 were present during an activity, marked as household childcare, and the activity lasted 10 minutes, each child would be assigned 5 minutes of this time. Once the cumulative time produced by

caregivers in each age-sex group was distributed among the various age-sex groups of care recipients throughout the matrix, the values were weighted using the ATUS weighting methodology.[4]

For validity check in the intra-household matrix, as well as for the estimation of the inter-household portion of the matrix, we have computed the weighted profiles that depict the total mean number of minutes spent on informal care by caregivers of both sexes, further disaggregated by their 5-year age groups. That is, in lieu of allocating total time produced by caregivers of certain age groups across the care recipients of various ages, we also independently evaluated the vectors of total production by age and sex, computed directly from the time diaries. We then compared the vectors of overall time production by age group obtained directly from the survey with those obtained by aggregating matrices in order to check for consistency.

Inter-household transfers

Intra-household transfers can be estimated in a straightforward way, since respondents record the time dedicated to various activities as well as the age and sex of household members who were present during the activity. Conversely, in the inter-household context the time use diary in the standard ATUS questionnaire does not record the age and sex of care recipients. Therefore we cannot estimate matrices of inter-household transfers directly, as we did for intra-household transfers. However, the Eldercare Roster provides a rare opportunity to estimate inter-household transfers indirectly.

The Eldercare Roster file lists the age of each care recipient, and whether they reside in the respondent's household or outside of it. This file is particularly relevant to evaluate inter-household elderly care. Almost all of the care recipients in the Eldercare Roster are 50 years old or older. 90.5% of the people in the 3-year data file were care recipients who lived outside of the respondent's household. The age of elderly care recipients is known, while their sex has been deduced based on their relationship to the respondents, where, for example, mothers, grandmothers, sisters, and aunts would be classified as females. Fathers, grandfathers, brothers, and uncles, would be identified as males. We assumed that spouses who live outside of the

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[4] $\overline{T} = \frac{\sum(t \cdot W_k)_j}{\sum W_k}$,

where $\overline{T}$ is the total mean time transferred by a number of caregivers of age group *k* to care recipients of age group *j*, and *t* is the raw amount of time produced/consumed in any given transfer, weighted by the sum of the final ATUS weights *W* of caregivers who produced this time. In the latter part of this analysis where we present the estimates of care support ratio and care deficit over time we replace the denominator by the sum of weights in the entire sample, regardless of presence of caregiving responsibilities, in order to obtain the mean distribution of time transferred in the entire civilian population of the United States.

household would be of the opposite sex of that of individual respondents, while the rest of the categories, such as neighbors, friends, and others would be split equally as a group between males and females.

As we established a data set containing the age and sex of care recipients, we aggregated the matrix containing frequencies of care recipients in various age and sex groups listed in a range of columns cross-tabulated by the caregivers' age and sex. For example, the cell in table 1 containing number 70 would indicate that there are 70 instances of time transfers (*not* 70% of all time) between male caregivers of age group 20-24 to female care recipients of age group 50-54; alternatively, there are 50 occasions on which female caregivers of age group 15-19 cared for males in age group 55-60 years old.

			Care recipients						
			Male			Female			
		Age	50-54	55-60	etc...	50-54	55-60	etc...	TOTAL
Caregivers	Male	15-19							
		20-24		***130***		***70***			***200***
		etc...							
	Female	15-19		***50***					***50***
		20-24							
		etc...							

Table 1. Illustrative example of the concept of a matrix of incidence of time transfers by age and sex.

Frequencies reported in each cell of such matrix were converted into percentages of the row total (i.e. by each age-sex group of caregivers), thus reflecting the proportions of recipients by age and sex. Rows totals of proportions in the matrix add up to 1. For instance, in table 1, the row total for male caregivers in age group 20-24 would add up to 200, whereupon converted into proportions, females of age group 50-54 received 0.35 (70/200, or 35%) of the instances of time transfers by this category of male caregivers, and males 55-60 received 0.65 (130/200, or 65%) of this time.

Although there is no variable that directly indicates activity time in the Eldercare Roster, we allocated time amounts to inter-household transfers in the Eldercare Roster by importing the values from the Activity file, where this time is clearly classified as "inter-household" for each ATUS respondent. While we knew how much time each respondent spent taking care of others outside of his or her household, we did not know among whom this time was delivered in terms of recipient's age and sex. We therefore made use of proportions of time transfer incidence, described above, to make some assumptions. More specifically, we assumed that the total inter-household time production of each caregiver should be allocated to age and sex groups proportionally to the respective frequency of instances of time transfers received. Thus we multiplied the age-sex profiles of average inter-household time transfers (obtained from the

Activity file[5]) by the matrix of fraction of instances of care by age and sex (obtained from the Eldercare Roster). To clarify, consider the illustrative example in table 1. If we knew that male caregivers of age group 20-24 produce on average 20 minutes of inter-household time, for example, then 65% of these 20 minutes (or 13 minutes) would be transferred to men 55-60 years of age, and the remaining 35% (or 7 minutes) to women in age group 50-54.[6]

The childcare portion of inter-household transfers was dealt with in a slightly different manner, based on the proportional distribution of informal childcare time in children under 18 years of age with known sex and age, that is, who live together with the respondents, or are their own non-household children. Due to the fact that Eldercare Roster is not representative of the younger segment of the population, intra-household childcare time transfers are best suited for approximation of the time distribution outside of the caregivers' households. Just as with the adult care component, the matrix of percentage of instances was multiplied by the profiles of average time devoted to inter-household childcare, by age-sex group of caregivers (same as in the example at the end of the previous paragraph). The combination of the two components (eldercare and childcare) represents the estimated inter-household transfer matrix, which, together with the intra-household matrix, comprise the overall matrix of unpaid care time transfers by age and sex of both caregivers and care recipients.

There are some important methodological considerations that we would like to discuss. By design, overall care to non-coresident children and adults in our matrices is consistent with total inter-household care reported in the time diaries by age and sex. However, there may be some bias in the distribution of this care time to the various age groups. We assume that relative care needs of children of different age groups, as they emerge from intra-household patterns, are not too different from inter-household ones. Deviations from this assumption would generate some bias. As for adult care, we distributed inter-household time according to frequencies observed in the Eldercare Roster, which focuses on the elderly. Therefore our approach would underestimate inter-household transfers of care to young and middle-aged adults. The reader should be aware of this limitation. However, we believe that the size of the bias should be small because young and middle-aged adults (19-49 years old) have better health and lower disability rates than older adults. In addition, we expect that those young adults in need of caregiving are more likely to co-reside with a spouse or parent. Thus transfers of care to them would be counted as intra-household transfers, for which we have more accurate estimates.

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[5] Same activities as outlined in note 3 above.

[6] In the event that there are no transfers to care recipients registered in the frequency matrix for specific age-sex group of caregivers, as extracted from the Eldercare Roster, yet there are values of time assigned to such group present in the time transfers profiles generated from the Activity file, we decided to distribute the actual value of time equally across all age-sex groups of care recipients in order to preserve the correspondence between the overall time that caregivers spent and the total time in the estimated matrices. This happened only in rare cases when the sample size was particularly small, and led, in those cases, to some repetition of values in the matrix rows.

Projections of informal care support ratio and care deficit

Once we have evaluated matrices of time transfers, we attempt to estimate the future patterns of informal care in the United States by employing the time transfer matrix concept described above. Intra- and inter-household matrices can be computed for both the general population and the subpopulation of those who engage in caregiving activities.

When we sum the elements of each row of the matrices of time transfers, we obtain a profile of per capita time production by age and sex. In other words, we obtain a vector of per capita production that is conceptually analogous to the production profiles generated in the National Transfer Accounts project. The use of the survey weights to estimate production guarantees that the profile is representative of the U.S. population.

When we sum the elements by columns, we obtain a vector that represents how the per capita production of time is distributed among age groups. This vector gives the relative per capita consumption of time by age and sex. It approximates per capita consumption, but there may be small discrepancies in levels, since the values of the matrix are weighted using ATUS survey weights for producers of time and not consumers. We rescaled the vector of per capita consumption in order to meet the constraint that total production at the population level in a given period of time is equal to total consumption. In other words, the sum of the product of per capita production and population counts by age and sex has to be equal to the product of per capita consumption and population counts by age and sex. We used population counts for 2010 from the World Population Prospects report (United Nations, the 2012 revision).

In our projection exercise, we evaluate the impact of demographic change on overall production and consumption of care. We project future caregiving time produced and consumed under the assumption that per capita profiles of consumption and production stay constant, and using population counts from the medium-fertility scenario of the UN World Population Prospects (2012). The goal is to isolate the effect of the future population change on informal care demand and supply, and to evaluate the extent of behavioral change that would be needed to adjust to potential gaps between projected demand and supply. As a reference, we also extrapolate care needs in the past, until 1950. This gives us a sense of the extent of transfers that we would have observed, if people had behaved like today, but in the demographic context of the 1950s.

As summary measures of imbalances between care demand and supply, we propose the "care support ratio." Conceptually, this quantity is analogous to the support ratio used in the National Transfer Accounts project. The support ratio is equal to ratio between total monetary production and total monetary consumption at the population level. At the numerator we have a weighted sum of per capita age-specific production profiles, where the weights are given by age-specific population counts. At the denominator, we have the analogous weighted sum for consumption. The "care support ratio" is computed in a way that is equivalent to the more standard support ratio, except that we use per capita profiles of time production and consumption, instead of monetary production and consumption.

Since in the baseline year we have that total care production is equal to total care consumption, the care support ratio is equal to 1 in the baseline year. Analogously, the "care deficit" (i.e., the difference between total care consumption and total care production) would be equal to 0 in the baseline year. For the purpose of interpretation, we express the care deficit in terms of equivalent number of full-time workers, assuming the replacement of informal care time deficit with formal full-time work of 2080 hours per calendar year per worker.

Economic value of non-market care activities

One step further in the analysis is to estimate the monetary value of unpaid caregiving. National Income and Product Accounts (NIPA), that typically measure and valuate market activities, recommended the creation of standardized satellite accounts in order to measure non-market activities and compare them with various market activities (Abraham and Mackie 2005). While such satellite accounts can include a variety of unpaid goods and services, ranging from household production to education and health, we offer some limited estimates of value of unpaid work related to informal care.

There is not universal agreement about measures that would reveal the true value of unpaid work. There is an extensive literature on how to value household production. It is beyond the scope of this article to discuss this literature. However, it is important to mention that the two main valuation methods: the opportunity cost and the replacement cost. One way to implement the opportunity cost approach is to use the person's market wage, if they have a job, or to impute it based on the person's characteristics, if not. The same activity would have a higher cost if the person is more highly educated and has higher income. We preferred the replacement or substitution method: the value of time is estimated as what the person would have to pay someone else to perform the task. This is the method that has been adopted within the NTA network of researchers.

One option, explored in previous studies on the cost of informal care, which we did not pursue, is to set federal minimum wage as a replacement for time spent in caregiving activities (Ettner 1996), in which case the estimates of value would most likely be underrated. A proxy for unpaid work that is often used is the market rate for the specific activity. That means that unpaid work is treated as if it were performed by professionals hired at the market rate. This approach is considered the basic principle of valuation of non-market work (Nordhaus 2006), although some researchers feel it is more appropriate to use federal minimum wage (Folbre, Reimers, and Yoon 2009) so as not to overestimate the value of unskilled care work.

Market rates published by agencies like the U.S. Bureau of Labor Statistics are considered reliable sources of records for valuating national-level non-market work. We use the latest national occupational employment data to approximate the value of supply of the current production of time in informal care transfers. Due to vast selection of market occupations that may serve as analogs for various types of work involved in household production, the imputation

of mean market wages has been generally recommended in the past literature (Arno, Levine, and Memmott 1999; Abraham and Mackie 2005; Landefeld et al. 2009). Therefore, we extract the mean hourly wages in three occupational categories[7] to arrive at the mean hourly rate of $10.31 (U.S. Department of Labor 2014a). Although other occupations might have been representative of the work carried out by informal caregivers, we did not wish to include highly specialized occupations, such as various forms of therapy or home nursing, because only a small proportion of survey respondents were capable of delivering these services routinely as part of their unpaid non-professional activity. With the aid of our estimates of time spent annually on informal care transfers and the mean hourly wage we computed the approximate economic value of unpaid care.

RESULTS

Our analysis indicates that informal caregivers comprise about a third of the United States' population, as shown in figure 1. About 3% of the caregivers belong to the sandwich generation, as we defined it. In addition to the different levels of informal care involvement, the three segments of the sample are distinct notably in their sex and age composition. Compared to the overall sample, informal childcare or adult care providers are much more likely to be in their thirties. This trend is even more apparent in the case of the sandwich generation, whose proportions of caregivers are the greatest in this age range. In regard to sex differences, female participation is largest both in the case of the general population and for the sandwich generation. While this is true for most age categories of caregivers, female involvement in caregiving is

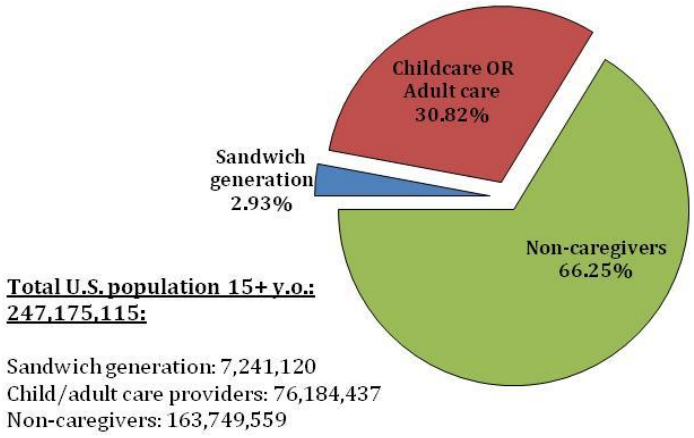


Fig. 1. Proportional distribution of informal caregivers in the Unites States among the population of 15 years of age or above (2011-2013 average), by type. Source: own elaborations on ATUS data.

[7] Three occupational categories include Home Health Aides (31-1011), childcare workers (39-9011), and personal care aides (39-9021).

especially salient in the working-age segment of the sandwich generation, as compared to males. Figure 2 shows these differences in details.

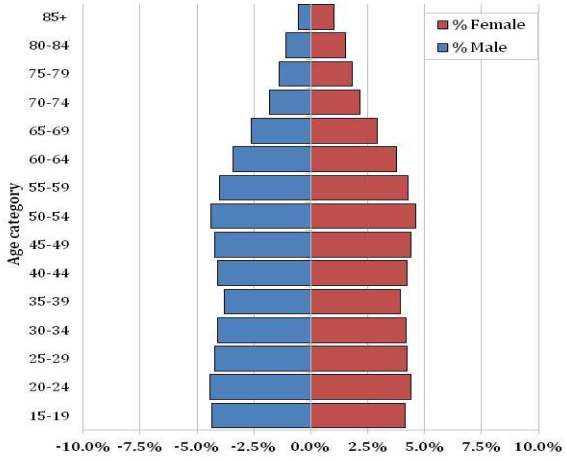
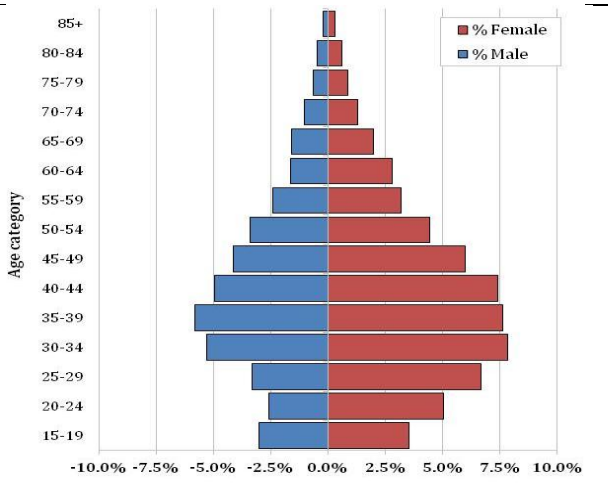
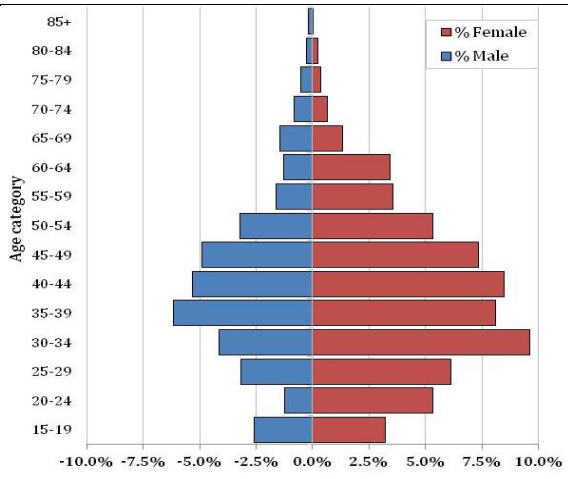
Total U.S. population 15 or older	
Childcare and/or adult care providers	
Sandwich generation	

Fig. 2. Comparison of age and sex distribution of the population of 15 years of age or older across the three groups in the United States (2011-2013 average). Source: own elaborations on ATUS data.

The time commitment of male and female caregivers is also very different. As illustrated in figure 3, women devote on average more time than men in virtually all situations, with the possible exception of inter-household transfers in the general U.S. population, where the time production is at the lowest levels for both males and females. Overall, those who engage in caregiving activities produce on average 126 minutes of informal care per day. Male and female caregivers spend an average of 110 and 137 minutes in caregiving activities, respectively. These levels are even higher for caregivers in the sandwich generation, who on average devote 172 minutes to informal caregiving per day. Of those, men spend 157 minutes, which is just under half hour less per day than the average of 181 minutes, produced by women with multiple intergenerational responsibilities. The vast majority of informal care time is produced by women, and is consumed within one's household. Although, as a whole, the sandwich generation produces on average more time than do caregivers in general, regardless of sex and type of transfer, the time allocation across specific age groups varies to a great extent. The matrices that follow depict these variations and signal peaks of mean time transferred between the different age-sex groups of caregivers and care recipients. The matrices displayed below show the total flows of time for caregivers and for the subset of caregivers that provide both childcare and adult care during a single day (what we defined "sandwich generation"). Matrices disaggregated into intra- and inter-household flows, may be found in the appendix A.

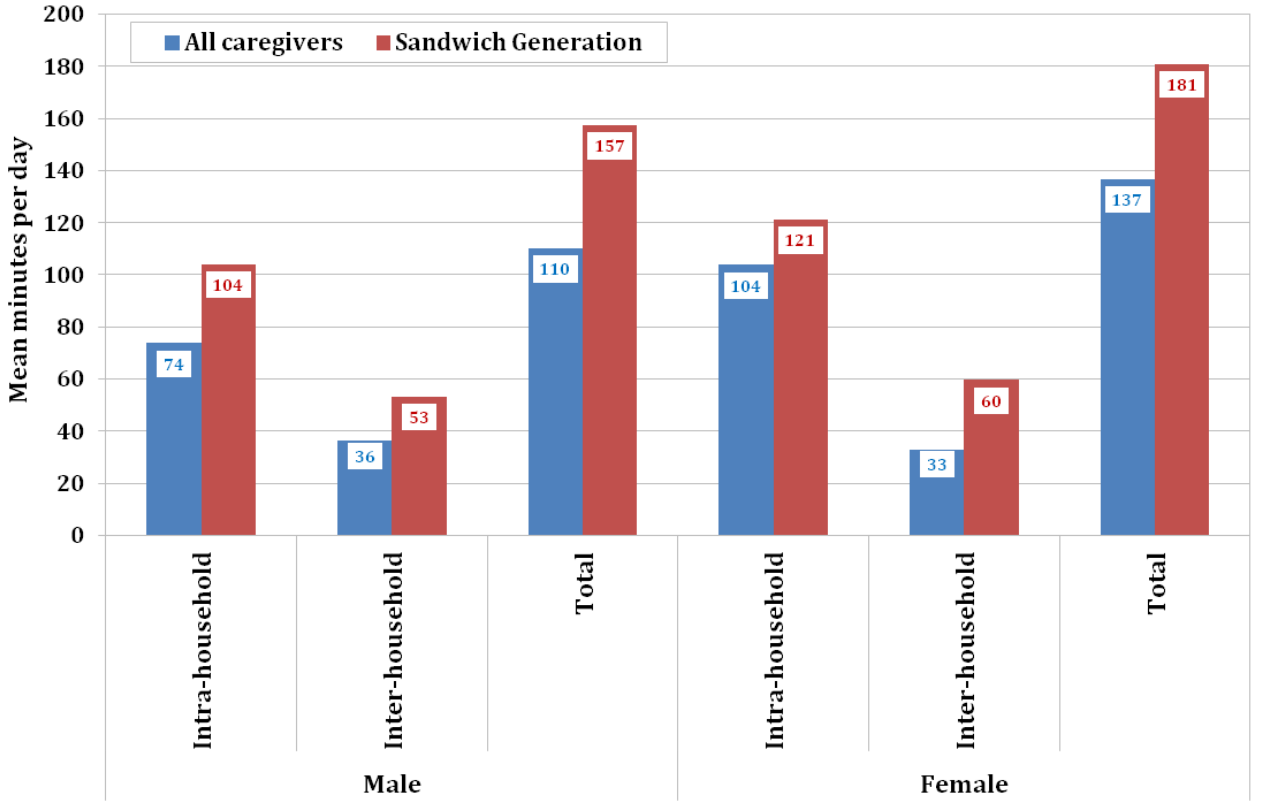
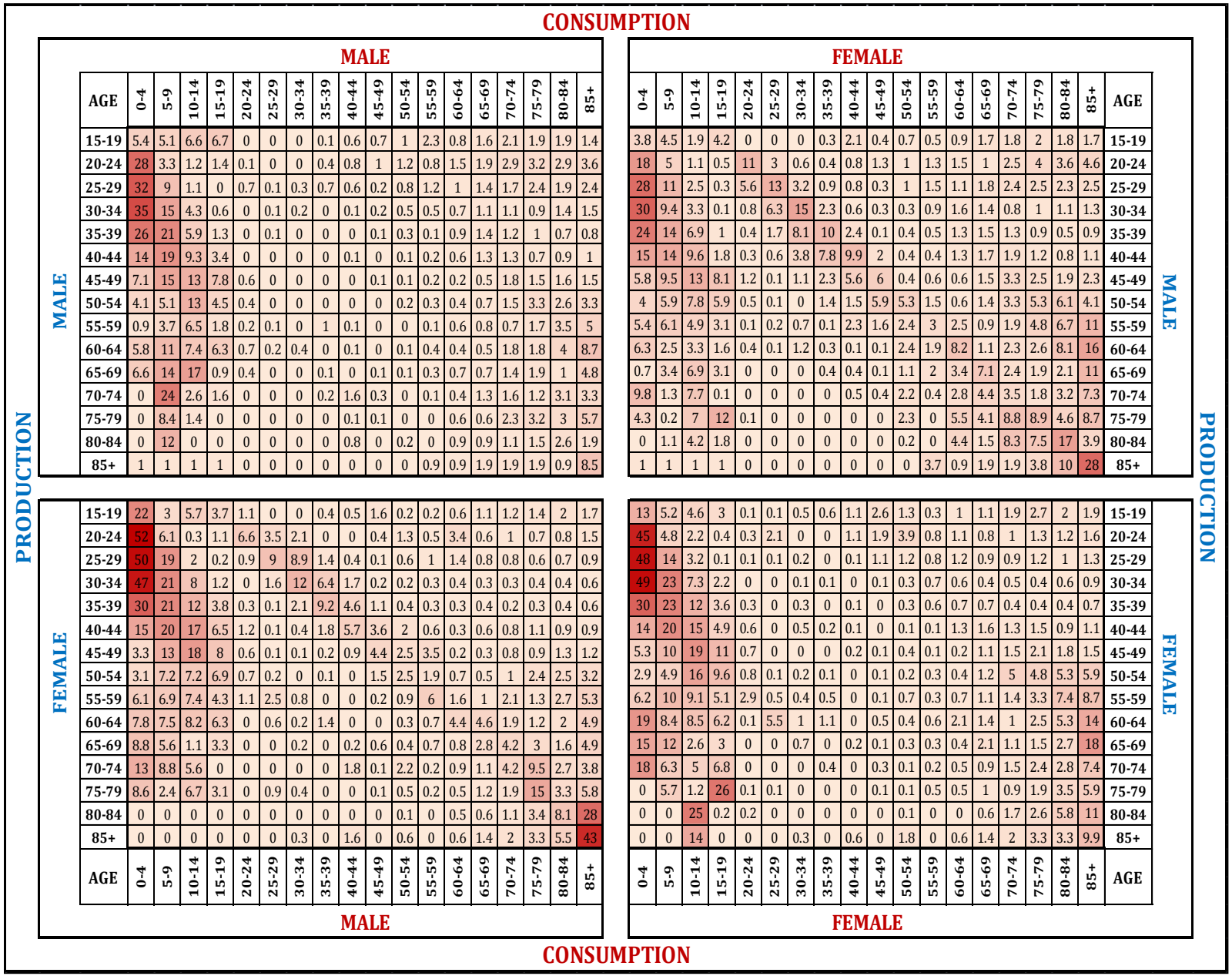


Fig. 3. Mean time commitment in minutes per day of males and females in the total population of caregivers and in the sandwich generation, by transfer type (ATUS 2011-2013). Source: own elaborations on ATUS data.



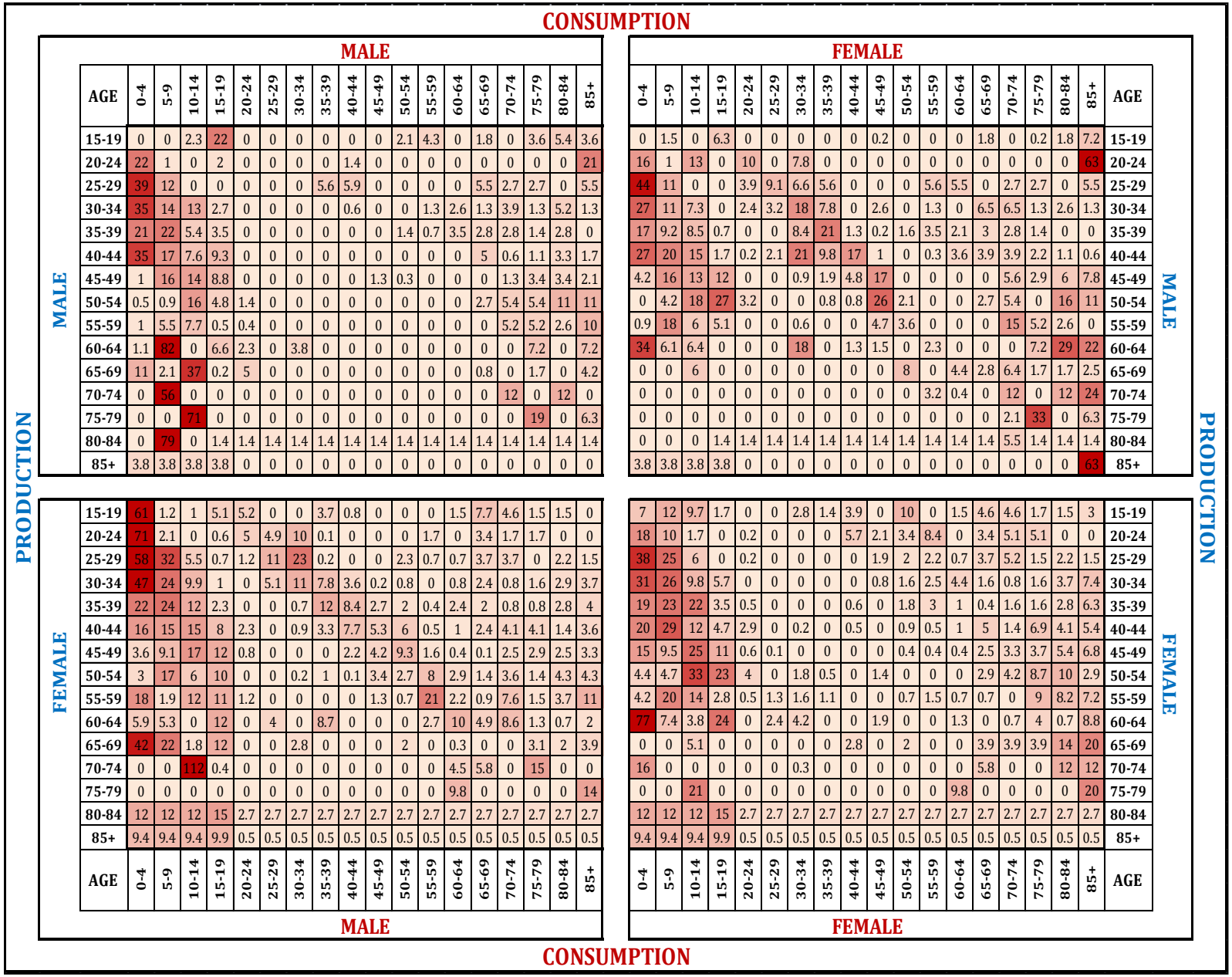
AGE	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
15-19	5.4	5.1	6.6	6.7	0	0	0	0.1	0.6	0.7	1	2.3	0.8	1.6	2.1	1.9	1.9	1.4
20-24	28	3.3	1.2	1.4	0.1	0	0	0.4	0.8	1	1.2	0.8	1.5	1.9	2.9	3.2	2.9	3.6
25-29	32	9	1.1	0	0.7	0.1	0.3	0.7	0.6	0.2	0.8	1.2	1	1.4	1.7	2.4	1.9	2.4
30-34	35	15	4.3	0.6	0	0.1	0.2	0	0.1	0.2	0.5	0.5	0.7	1.1	1.1	0.9	1.4	1.5
35-39	26	21	5.9	1.3	0	0.1	0	0	0	0.1	0.3	0.1	0.9	1.4	1.2	1	0.7	0.8
40-44	14	19	9.3	3.4	0	0	0	0	0.1	0	0.1	0.2	0.6	1.3	1.3	0.7	0.9	1
45-49	7.1	15	13	7.8	0.6	0	0	0	0	0.1	0.1	0.2	0.2	0.5	1.8	1.5	1.6	1.5
50-54	4.1	5.1	13	4.5	0.4	0	0	0	0	0	0.2	0.3	0.4	0.7	1.5	3.3	2.6	3.3
55-59	0.9	3.7	6.5	1.8	0.2	0.1	0	1	0.1	0	0	0.1	0.6	0.8	0.7	1.7	3.5	5
60-64	5.8	11	7.4	6.3	0.7	0.2	0.4	0	0.1	0	0.1	0.4	0.4	0.5	1.8	1.8	4	8.7
65-69	6.6	14	17	0.9	0.4	0	0	0.1	0	0.1	0.1	0.3	0.7	0.7	1.4	1.9	1	4.8
70-74	0	24	2.6	1.6	0	0	0	0.2	1.6	0.3	0	0.1	0.4	1.3	1.6	1.2	3.1	3.3
75-79	0	8.4	1.4	0	0	0	0	0	0.1	0.1	0	0	0.6	0.6	2.3	3.2	3	5.7
80-84	0	12	0	0	0	0	0	0	0.8	0	0.2	0	0.9	0.9	1.1	1.5	2.6	1.9
85+	1	1	1	1	0	0	0	0	0	0	0	0.9	0.9	1.9	1.9	1.9	0.9	8.5

0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+	AGE
3.8	4.5	1.9	4.2	0	0	0	0.3	2.1	0.4	0.7	0.5	0.9	1.7	1.8	2	1.8	1.7	15-19
18	5	1.1	0.5	11	3	0.6	0.4	0.8	1.3	1	1.3	1.5	1	2.5	4	3.6	4.6	20-24
28	11	2.5	0.3	5.6	13	3.2	0.9	0.8	0.3	1	1.5	1.1	1.8	2.4	2.5	2.3	2.5	25-29
30	9.4	3.3	0.1	0.8	6.3	15	2.3	0.6	0.3	0.3	0.9	1.6	1.4	0.8	1	1.1	1.3	30-34
24	14	6.9	1	0.4	1.7	8.1	10	2.4	0.1	0.4	0.5	1.3	1.5	1.3	0.9	0.5	0.9	35-39
15	14	9.6	1.8	0.3	0.6	3.8	7.8	9.9	2	0.4	0.4	1.3	1.7	1.9	1.2	0.8	1.1	40-44
5.8	9.5	13	8.1	1.2	0.1	1.1	2.3	5.6	6	0.4	0.6	0.6	1.5	3.3	2.5	1.9	2.3	45-49
4	5.9	7.8	5.9	0.5	0.1	0	1.4	1.5	5.9	5.3	1.5	0.6	1.4	3.3	5.3	6.1	4.1	50-54
5.4	6.1	4.9	3.1	0.1	0.2	0.7	0.1	2.3	1.6	2.4	3	2.5	0.9	1.9	4.8	6.7	11	55-59
6.3	2.5	3.3	1.6	0.4	0.1	1.2	0.3	0.1	0.1	2.4	1.9	8.2	1.1	2.3	2.6	8.1	16	60-64
0.7	3.4	6.9	3.1	0	0	0	0.4	0.4	0.1	1.1	2	3.4	7.1	2.4	1.9	2.1	11	65-69
9.8	1.3	7.7	0.1	0	0	0	0	0.5	0.4	2.2	0.4	2.8	4.4	3.5	1.8	3.2	7.3	70-74
4.3	0.2	7	12	0.1	0	0	0	0	0	2.3	0	5.5	4.1	8.8	8.9	4.6	8.7	75-79
0	1.1	4.2	1.8	0	0	0	0	0	0	0.2	0	4.4	1.5	8.3	7.5	17	3.9	80-84
1	1	1	1	0	0	0	0	0	0	0	3.7	0.9	1.9	1.9	3.8	10	28	85+

AGE	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
15-19	22	3	5.7	3.7	1.1	0	0	0.4	0.5	1.6	0.2	0.2	0.6	1.1	1.2	1.4	2	1.7
20-24	52	6.1	0.3	1.1	6.6	3.5	2.1	0	0	0.4	1.3	0.5	3.4	0.6	1	0.7	0.8	1.5
25-29	50	19	2	0.2	0.9	9	8.9	1.4	0.4	0.1	0.6	1	1.4	0.8	0.8	0.6	0.7	0.9
30-34	47	21	8	1.2	0	1.6	12	6.4	1.7	0.2	0.2	0.3	0.4	0.3	0.3	0.4	0.4	0.6
35-39	30	21	12	3.8	0.3	0.1	2.1	9.2	4.6	1.1	0.4	0.3	0.3	0.4	0.2	0.3	0.4	0.6
40-44	15	20	17	6.5	1.2	0.1	0.4	1.8	5.7	3.6	2	0.6	0.3	0.6	0.8	1.1	0.9	0.9
45-49	3.3	13	18	8	0.6	0.1	0.1	0.2	0.9	4.4	2.5	3.5	0.2	0.3	0.8	0.9	1.3	1.2
50-54	3.1	7.2	7.2	6.9	0.7	0.2	0	0.1	0	1.5	2.5	1.9	0.7	0.5	1	2.4	2.5	3.2
55-59	6.1	6.9	7.4	4.3	1.1	2.5	0.8	0	0	0.2	0.9	6	1.6	1	2.1	1.3	2.7	5.3
60-64	7.8	7.5	8.2	6.3	0	0.6	0.2	1.4	0	0	0.3	0.7	4.4	4.6	1.9	1.2	2	4.9
65-69	8.8	5.6	1.1	3.3	0	0	0.2	0	0.2	0.6	0.4	0.7	0.8	2.8	4.2	3	1.6	4.9
70-74	13	8.8	5.6	0	0	0	0	0	1.8	0.1	2.2	0.2	0.9	1.1	4.2	9.5	2.7	3.8
75-79	8.6	2.4	6.7	3.1	0	0.9	0.4	0	0	0.1	0.5	0.2	0.5	1.2	1.9	15	3.3	5.8
80-84	0	0	0	0	0	0	0	0	0	0	0.1	0	0.5	0.6	1.1	3.4	8.1	28
85+	0	0	0	0	0	0	0.3	0	1.6	0	0.6	0	0.6	1.4	2	3.3	5.5	43

0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+	AGE
13	5.2	4.6	3	0.1	0.1	0.5	0.6	1.1	2.6	1.3	0.3	1	1.1	1.9	2.7	2	1.9	15-19
45	4.8	2.2	0.4	0.3	2.1	0	0	1.1	1.9	3.9	0.8	1.1	0.8	1	1.3	1.2	1.6	20-24
48	14	3.2	0.1	0.1	0.1	0.2	0	0.1	1.1	1.2	0.8	1.2	0.9	0.9	1.2	1	1.3	25-29
49	23	7.3	2.2	0	0	0.1	0.1	0	0.1	0.3	0.7	0.6	0.4	0.5	0.4	0.6	0.9	30-34
30	23	12	3.6	0.3	0	0.3	0	0.1	0	0.3	0.6	0.7	0.7	0.4	0.4	0.4	0.7	35-39
14	20	15	4.9	0.6	0	0.5	0.2	0.1	0	0.1	0.1	1.3	1.6	1.3	1.5	0.9	1.1	40-44
5.3	10	19	11	0.7	0	0	0	0.2	0.1	0.4	0.1	0.2	1.1	1.5	2.1	1.8	1.5	45-49
2.9	4.9	16	9.6	0.8	0.1	0.2	0.1	0	0.1	0.2	0.3	0.4	1.2	5	4.8	5.3	5.9	50-54
6.2	10	9.1	5.1	2.9	0.5	0.4	0.5	0	0.1	0.7	0.3	0.7	1.1	1.4	3.3	7.4	8.7	55-59
19	8.4	8.5	6.2	0.1	5.5	1	1.1	0	0.5	0.4	0.6	2.1	1.4	1	2.5	5.3	14	60-64
15	12	2.6	3	0	0	0.7	0	0.2	0.1	0.3	0.3	0.4	2.1	1.1	1.5	2.7	18	65-69
18	6.3	5	6.8	0	0	0	0.4	0	0.3	0.1	0.2	0.5	0.9	1.5	2.4	2.8	7.4	70-74
0	5.7	1.2	26	0.1	0.1	0	0	0	0.1	0.1	0.5	0.5	1	0.9	1.9	3.5	5.9	75-79
0	0	25	0.2	0.2	0	0	0	0	0	0.1	0	0	0.6	1.7	2.6	5.8	11	80-84
0	0	14	0	0	0	0.3	0	0.6	0	1.8	0	0.6	1.4	2	3.3	3.3	9.9	85+

Table 2. **Overall** mean time transfers matrix showing time production by age-sex groups among caregivers *in general*, consumed by various age-sex groups of care recipients. Note: darkest shade denotes ≈ 50+ minutes per day.



AGE	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
15-19	0	0	2.3	22	0	0	0	0	0	0	2.1	4.3	0	1.8	0	3.6	5.4	3.6
20-24	22	1	0	2	0	0	0	0	1.4	0	0	0	0	0	0	0	0	21
25-29	39	12	0	0	0	0	0	5.6	5.9	0	0	0	0	5.5	2.7	2.7	0	5.5
30-34	35	14	13	2.7	0	0	0	0	0.6	0	0	1.3	2.6	1.3	3.9	1.3	5.2	1.3
35-39	21	22	5.4	3.5	0	0	0	0	0	0	1.4	0.7	3.5	2.8	2.8	1.4	2.8	0
40-44	35	17	7.6	9.3	0	0	0	0	0	0	0	0	0	5	0.6	1.1	3.3	1.7
45-49	1	16	14	8.8	0	0	0	0	0	1.3	0.3	0	0	0	1.3	3.4	3.4	2.1
50-54	0.5	0.9	16	4.8	1.4	0	0	0	0	0	0	0	0	2.7	5.4	5.4	11	11
55-59	1	5.5	7.7	0.5	0.4	0	0	0	0	0	0	0	0	0	5.2	5.2	2.6	10
60-64	1.1	82	0	6.6	2.3	0	3.8	0	0	0	0	0	0	0	0	7.2	0	7.2
65-69	11	2.1	37	0.2	5	0	0	0	0	0	0	0	0	0.8	0	1.7	0	4.2
70-74	0	56	0	0	0	0	0	0	0	0	0	0	0	0	12	0	12	0
75-79	0	0	71	0	0	0	0	0	0	0	0	0	0	0	0	19	0	6.3
80-84	0	79	0	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
85+	3.8	3.8	3.8	3.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0

0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+	AGE
0	1.5	0	6.3	0	0	0	0	0	0.2	0	0	0	1.8	0	0.2	1.8	7.2	15-19
16	1	13	0	10	0	7.8	0	0	0	0	0	0	0	0	0	0	63	20-24
44	11	0	0	3.9	9.1	6.6	5.6	0	0	0	5.6	5.5	0	2.7	2.7	0	5.5	25-29
27	11	7.3	0	2.4	3.2	18	7.8	0	2.6	0	1.3	0	6.5	6.5	1.3	2.6	1.3	30-34
17	9.2	8.5	0.7	0	0	8.4	21	1.3	0.2	1.6	3.5	2.1	3	2.8	1.4	0	0	35-39
27	20	15	1.7	0.2	2.1	21	9.8	17	1	0	0.3	3.6	3.9	3.9	2.2	1.1	0.6	40-44
4.2	16	13	12	0	0	0.9	1.9	4.8	17	0	0	0	0	5.6	2.9	6	7.8	45-49
0	4.2	18	27	3.2	0	0	0.8	0.8	26	2.1	0	0	2.7	5.4	0	16	11	50-54
0.9	18	6	5.1	0	0	0.6	0	0	4.7	3.6	0	0	0	15	5.2	2.6	0	55-59
34	6.1	6.4	0	0	0	18	0	1.3	1.5	0	2.3	0	0	0	7.2	29	22	60-64
0	0	6	0	0	0	0	0	0	0	8	0	4.4	2.8	6.4	1.7	1.7	2.5	65-69
0	0	0	0	0	0	0	0	0	0	0	3.2	0.4	0	12	0	12	24	70-74
0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.1	33	0	6.3	75-79
0	0	0	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	5.5	1.4	1.4	1.4	80-84
3.8	3.8	3.8	3.8	0	0	0	0	0	0	0	0	0	0	0	0	0	63	85+

AGE	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
15-19	61	1.2	1	5.1	5.2	0	0	3.7	0.8	0	0	0	1.5	7.7	4.6	1.5	1.5	0
20-24	71	2.1	0	0.6	5	4.9	10	0.1	0	0	0	1.7	0	3.4	1.7	1.7	0	0
25-29	58	32	5.5	0.7	1.2	11	23	0.2	0	0	2.3	0.7	0.7	3.7	3.7	0	2.2	1.5
30-34	47	24	9.9	1	0	5.1	11	7.8	3.6	0.2	0.8	0	0.8	2.4	0.8	1.6	2.9	3.7
35-39	22	24	12	2.3	0	0	0.7	12	8.4	2.7	2	0.4	2.4	2	0.8	0.8	2.8	4
40-44	16	15	15	8	2.3	0	0.9	3.3	7.7	5.3	6	0.5	1	2.4	4.1	4.1	1.4	3.6
45-49	3.6	9.1	17	12	0.8	0	0	0	2.2	4.2	9.3	1.6	0.4	0.1	2.5	2.9	2.5	3.3
50-54	3	17	6	10	0	0	0.2	1	0.1	3.4	2.7	8	2.9	1.4	3.6	1.4	4.3	4.3
55-59	18	1.9	12	11	1.2	0	0	0	0	1.3	0.7	21	2.2	0.9	7.6	1.5	3.7	11
60-64	5.9	5.3	0	12	0	4	0	8.7	0	0	0	2.7	10	4.9	8.6	1.3	0.7	2
65-69	42	22	1.8	12	0	0	2.8	0	0	0	2	0	0.3	0	0	3.1	2	3.9
70-74	0	0	112	0.4	0	0	0	0	0	0	0	0	4.5	5.8	0	15	0	0
75-79	0	0	0	0	0	0	0	0	0	0	0	0	9.8	0	0	0	0	14
80-84	12	12	12	15	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
85+	9.4	9.4	9.4	9.9	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+	AGE
7	12	9.7	1.7	0	0	2.8	1.4	3.9	0	10	0	1.5	4.6	4.6	1.7	1.5	3	15-19
18	10	1.7	0	0.2	0	0	0	5.7	2.1	3.4	8.4	0	3.4	5.1	5.1	0	0	20-24
38	25	6	0	0.2	0	0	0	0	1.9	2	2.2	0.7	3.7	5.2	1.5	2.2	1.5	25-29
31	26	9.8	5.7	0	0	0	0	0	0.8	1.6	2.5	4.4	1.6	0.8	1.6	3.7	7.4	30-34
19	23	22	3.5	0.5	0	0	0	0.6	0	1.8	3	1	0.4	1.6	1.6	2.8	6.3	35-39
20	29	12	4.7	2.9	0	0.2	0	0.5	0	0.9	0.5	1	5	1.4	6.9	4.1	5.4	40-44
15	9.5	25	11	0.6	0.1	0	0	0	0	0.4	0.4	0.4	2.5	3.3	3.7	5.4	6.8	45-49
4.4	4.7	33	23	4	0	1.8	0.5	0	1.4	0	0	0	2.9	4.2	8.7	10	2.9	50-54
4.2	20	14	2.8	0.5	1.3	1.6	1.1	0	0	0.7	1.5	0.7	0.7	0	9	8.2	7.2	55-59
77	7.4	3.8	24	0	2.4	4.2	0	0	1.9	0	0	1.3	0	0.7	4	0.7	8.8	60-64
0	0	5.1	0	0	0	0	0	2.8	0	2	0	0	3.9	3.9	3.9	14	20	65-69
16	0	0	0	0	0	0.3	0	0	0	0	0	0	5.8	0	0	12	12	70-74
0	0	21	0	0	0	0	0	0	0	0	0	9.8	0	0	0	0	20	75-79
12	12	12	15	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	80-84
9.4	9.4	9.4	9.9	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	85+

Table 3. **Overall** mean time transfers matrix showing time production by age-sex groups among caregivers in the *sandwich generation*, consumed by various age-sex groups of care recipients. Note: darkest shade denotes ≈ 50+ minutes per day.

The matrices in the tables 2 and 3 show interesting patterns of time transfers by age and sex. The average time spent by caregivers of different groups is typically not clustered in one cell or column, or age-sex group of care recipients. We observe a picture of time transfers that reveals a fairly large share of time allocated to childcare by caregivers of all ages, though particularly by women in their 30s and, to a lesser extent, older women in their late 50s and beyond. The matrices thus show the importance of parenting and grandparenting in terms of time transfers. Parenting requires on average a time effort that is 3-4 times bigger than grandparenting. Women's effort is 2-3 times larger than men's. We also observed that grandmothers spend a substantial time with very young grandchildren (0-4 years old). Grandfathers, on the other hand, spend relatively little time with newborns and more time with grandchildren in the age groups 5-9 and 10-14, in which same-gender transfers are the more prevalent form of caregiving.

In nearly all the matrices, we observe a ridge along the main diagonal, especially when considering the transfers from caregivers of opposite sex. This indicates the relevance of informal care taking place between spouses. The trend is pervasive, but typically does not display any values beyond 15 minutes per day on average, which sets it far apart from childcare for which the highest values range from ≈ 30 to 50 minutes on average in the general population of caregivers, and even higher, ≈ 35 to 70 minutes in the sandwich generation (as shown in tables 5 and 6 in the appendix A, respectively). Cells linked to age groups of elderly care recipients, on the other hand, are not uniformly loaded, with highest loading falling onto the inter-household portion of the overall transfers matrix with mean values ranging from ≈ 5 to 14 minutes per day. It is noteworthy to reiterate that time figures presented in the matrices in tables 5 and 6, or intra-household matrices, do not include mean time transfers presented in the respective tables 7 and 8, or inter-household transfers, and vice versa. In this manner intra-household and inter-household matrices depict entirely separate flows.

In general, the sandwich generation produces more time on average, in a cell-by-cell comparison with the overall population of caregivers. Remarkably, "sandwiched" caregivers provide noticeable amounts of time to their spouses and the elderly, substantially more than the general population of care providers. Male caregivers belonging to the sandwich generation appear substantially more active in producing and transferring their time to groups of people that are less served in the general caregiving population. Judging from the age in which these transfers occur, such groups are likely to include grandchildren, spouses, and elderly parents. One possible explanation of what we observed is selection: caregiving may not be equally distributed among members of an extended family. Those individuals who engage in caregiving practices that involve multiple generations may be more likely to dedicate more time to caregiving. Another explanation of what we observed is that certain groups of individuals may find themselves, because of demographic circumstances, in a situation where demand for care comes from both younger and older generations, or spouses. As a result of increased demand for care, those individuals may dedicate more time to caregiving.

Overall U.S. matrix, care support ratio and care deficit projections

The matrix in table 4 shows the average U.S. distribution of non-monetary intergenerational transfers of care time. Unlike the matrices presented above, this matrix reflects the total mean time devoted to day-to-day informal caregiving by the American population as a whole. At this level, early childcare remains the prevalent form of caregiving with mean values reaching as high as 30 minutes per day, where females provide twice as much time as males, regardless of the sex of care recipients. Caring for spouses emerges as the second largest trend with only up to 7 minutes on average a day, while grandparenting and eldercare become less noticeable, when compared to childbearing and caring for spouses.

The sums of time transfers across columns and rows of the overall matrix are presented in figure 4. These sums are the marginal totals for the matrices and represent profiles of daily mean per capita production and consumption of intergenerational informal care time, by age groups. Per capita consumption is at the greatest level for young children, peaking at approximately 6 hours per day in infants and toddlers, but drops incrementally toward teenage years. A slight spike in consumption is registered again in the middle-aged segment of the population. That may be related to care needs of women during pregnancy. Starting from the early 60s, we observe a steady increase in care needs as one enters the elderly age. Per capita production, on the other hand, is close to zero in the early ages and peaks at around 3 hours per day for people in their 30s and early 40s. It hereafter steeply declines to just under 1 hour per day in the 50s through 60s, and further diminishes in inverse proportion to consumption.

CONSUMPTION

MALE

AGE	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
15-19	1.3	1.2	1.6	1.6	0	0	0	0	0.1	0.2	0.2	0.5	0.2	0.4	0.5	0.5	0.4	0.3
20-24	5.5	0.7	0.2	0.3	0	0	0	0.1	0.2	0.2	0.2	0.2	0.3	0.4	0.6	0.6	0.6	0.7
25-29	8.6	2.4	0.3	0	0.2	0	0.1	0.2	0.2	0.1	0.2	0.3	0.3	0.4	0.5	0.6	0.5	0.6
30-34	15	6.7	1.9	0.2	0	0	0.1	0	0	0.1	0.2	0.2	0.3	0.5	0.5	0.4	0.6	0.6
35-39	13	11	3	0.7	0	0	0	0	0	0	0.2	0.1	0.5	0.7	0.6	0.5	0.4	0.4
40-44	5.9	8	3.8	1.4	0	0	0	0	0	0	0	0.1	0.2	0.5	0.5	0.3	0.4	0.4
45-49	2.3	5	4.2	2.6	0.2	0	0	0	0	0	0	0.1	0.1	0.2	0.6	0.5	0.5	0.5
50-54	1.1	1.3	3.3	1.2	0.1	0	0	0	0	0	0	0.1	0.1	0.2	0.4	0.9	0.7	0.9
55-59	0.2	0.8	1.3	0.4	0	0	0	0.2	0	0	0	0	0.1	0.2	0.2	0.4	0.7	1
60-64	0.9	1.7	1.2	1	0.1	0	0.1	0	0	0	0	0.1	0.1	0.1	0.3	0.3	0.6	1.4
65-69	1.4	3	3.4	0.2	0.1	0	0	0	0	0	0	0.1	0.1	0.2	0.3	0.4	0.2	1
70-74	0	4.6	0.5	0.3	0	0	0	0	0.3	0.1	0	0	0.1	0.3	0.3	0.2	0.6	0.6
75-79	0	1.3	0.2	0	0	0	0	0	0	0	0	0	0.1	0.1	0.4	0.5	0.5	0.9
80-84	0	1.9	0	0	0	0	0	0	0.1	0	0	0	0.1	0.1	0.2	0.2	0.4	0.3
85+	0.1	0.1	0.1	0.1	0	0	0	0	0	0	0	0.1	0.1	0.3	0.3	0.3	0.1	1.2

FEMALE

0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+	AGE
0.9	1.1	0.4	1	0	0	0	0.1	0.5	0.1	0.2	0.1	0.2	0.4	0.4	0.5	0.4	0.4	15-19
3.6	1	0.2	0.1	2.2	0.6	0.1	0.1	0.2	0.3	0.2	0.3	0.3	0.2	0.5	0.8	0.7	0.9	20-24
7.4	2.9	0.7	0.1	1.5	3.4	0.9	0.2	0.2	0.1	0.3	0.4	0.3	0.5	0.7	0.7	0.6	0.7	25-29
13	4.1	1.4	0	0.3	2.7	6.7	1	0.3	0.1	0.1	0.4	0.7	0.6	0.4	0.4	0.5	0.6	30-34
13	7.1	3.6	0.5	0.2	0.9	4.2	5.3	1.3	0.1	0.2	0.3	0.7	0.8	0.7	0.5	0.3	0.4	35-39
6.3	5.8	3.9	0.7	0.1	0.2	1.5	3.2	4.1	0.8	0.2	0.2	0.5	0.7	0.8	0.5	0.3	0.4	40-44
1.9	3.1	4.2	2.7	0.4	0	0.4	0.7	1.9	2	0.1	0.2	0.2	0.5	1.1	0.8	0.6	0.7	45-49
1	1.5	2	1.5	0.1	0	0	0.4	0.4	1.5	1.4	0.4	0.1	0.4	0.9	1.4	1.6	1.1	50-54
1.1	1.3	1	0.6	0	0	0.1	0	0.5	0.3	0.5	0.6	0.5	0.2	0.4	1	1.4	2.3	55-59
1	0.4	0.5	0.3	0.1	0	0.2	0	0	0	0.4	0.3	1.3	0.2	0.4	0.4	1.3	2.5	60-64
0.1	0.7	1.4	0.6	0	0	0	0.1	0.1	0	0.2	0.4	0.7	1.5	0.5	0.4	0.4	2.3	65-69
1.9	0.2	1.5	0	0	0	0	0	0.1	0.1	0.4	0.1	0.5	0.8	0.7	0.3	0.6	1.4	70-74
0.7	0	1.1	2	0	0	0	0	0	0	0.4	0	0.9	0.6	1.4	1.4	0.7	1.4	75-79
0	0.2	0.7	0.3	0	0	0	0	0	0	0	0	0.7	0.2	1.3	1.2	2.6	0.6	80-84
0.1	0.1	0.1	0.1	0	0	0	0	0	0	0	0.5	0.1	0.3	0.3	0.5	1.4	4	85+

MALE

PRODUCTION

FEMALE

15-19	6.2	0.9	1.7	1.1	0.3	0	0	0.1	0.1	0.5	0	0.1	0.2	0.3	0.4	0.4	0.6	0.5
20-24	20	2.4	0.1	0.4	2.5	1.4	0.8	0	0	0.2	0.5	0.2	1.3	0.3	0.4	0.3	0.3	0.6
25-29	26	10	1.1	0.1	0.5	4.8	4.7	0.7	0.2	0	0.3	0.5	0.8	0.4	0.4	0.3	0.4	0.5
30-34	30	13	5.1	0.8	0	1	7.3	4	1.1	0.1	0.1	0.2	0.3	0.2	0.2	0.2	0.3	0.4
35-39	20	14	7.9	2.5	0.2	0.1	1.4	6	3	0.7	0.3	0.2	0.2	0.2	0.1	0.2	0.3	0.4
40-44	9	12	10	3.8	0.7	0	0.2	1	3.4	2.1	1.2	0.3	0.2	0.4	0.5	0.6	0.6	0.5
45-49	1.5	5.8	8.1	3.7	0.3	0.1	0	0.1	0.4	2	1.1	1.6	0.1	0.2	0.3	0.4	0.6	0.5
50-54	1	2.3	2.3	2.3	0.2	0.1	0	0	0	0.5	0.8	0.6	0.2	0.2	0.3	0.8	0.8	1
55-59	1.5	1.7	1.9	1.1	0.3	0.6	0.2	0	0	0	0.2	1.5	0.4	0.3	0.5	0.3	0.7	1.3
60-64	2	1.9	2.1	1.6	0	0.1	0.1	0.3	0	0	0.1	0.2	1.1	1.2	0.5	0.3	0.5	1.2
65-69	2	1.3	0.3	0.8	0	0	0	0	0.1	0.1	0.1	0.2	0.2	0.6	1	0.7	0.4	1.1
70-74	2.7	1.8	1.1	0	0	0	0	0	0.4	0	0.4	0	0.2	0.2	0.8	1.9	0.6	0.8
75-79	1.4	0.4	1.1	0.5	0	0.1	0.1	0	0	0	0.1	0	0.1	0.2	0.3	2.3	0.5	0.9
80-84	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0.1	0.1	0.4	1.1	3.7
85+	0	0	0	0	0	0	0	0	0.1	0	0.1	0	0.1	0.1	0.2	0.3	0.5	4
AGE	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+

MALE

3.7	1.5	1.3	0.9	0	0	0.1	0.2	0.3	0.8	0.4	0.1	0.3	0.3	0.6	0.8	0.6	0.5	15-19
17	1.9	0.9	0.1	0.1	0.8	0	0	0.4	0.7	1.5	0.3	0.4	0.3	0.4	0.5	0.5	0.6	20-24
25	7.6	1.7	0	0.1	0	0.1	0	0.1	0.6	0.6	0.4	0.6	0.5	0.5	0.6	0.5	0.7	25-29
31	15	4.6	1.4	0	0	0	0	0	0	0.2	0.5	0.4	0.2	0.3	0.3	0.4	0.6	30-34
20	15	8	2.3	0.2	0	0.2	0	0.1	0	0.2	0.4	0.4	0.5	0.2	0.2	0.3	0.5	35-39
8.1	12	9.1	2.9	0.4	0	0.3	0.1	0.1	0	0	0.1	0.8	1	0.8	0.9	0.6	0.6	40-44
2.4	4.7	8.9	4.9	0.3	0	0	0	0.1	0.1	0.2	0	0.1	0.5	0.7	1	0.8	0.7	45-49
0.9	1.6	5	3.1	0.3	0	0.1	0	0	0	0.1	0.1	0.1	0.4	1.6	1.6	1.7	1.9	50-54
1.6	2.6	2.3	1.3	0.7	0.1	0.1	0.1	0	0	0.2	0.1	0.2	0.3	0.3	0.8	1.9	2.2	55-59
4.7	2.1	2.1	1.6	0	1.4	0.3	0.3	0	0.1	0.1	0.1	0.5	0.3	0.3	0.6	1.3	3.5	60-64
3.5	2.7	0.6	0.7	0	0	0.2	0	0	0	0.1	0.1	0.1	0.5	0.3	0.3	0.6	4.2	65-69
3.7	1.3	1	1.4	0	0	0	0.1	0	0.1	0	0	0.1	0.2	0.3	0.5	0.6	1.5	70-74
0	0.9	0.2	4.1	0	0	0	0	0	0	0	0.1	0.1	0.2	0.1	0.3	0.6	0.9	75-79
0	0	3.2	0	0	0	0	0	0	0	0	0	0	0.1	0.2	0.3	0.8	1.4	80-84
0	0	1.4	0	0	0	0	0	0.1	0	0.2	0	0.1	0.1	0.2	0.3	0.3	0.9	85+
0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+	AGE

FEMALE

PRODUCTION

CONSUMPTION

Table 4. **Overall** mean time transfers matrix showing time production by age-sex groups in the total civilian population of the United States, consumed by various age-sex groups of care recipients. Note: darkest shade denotes ≈ 30+ minutes per day.

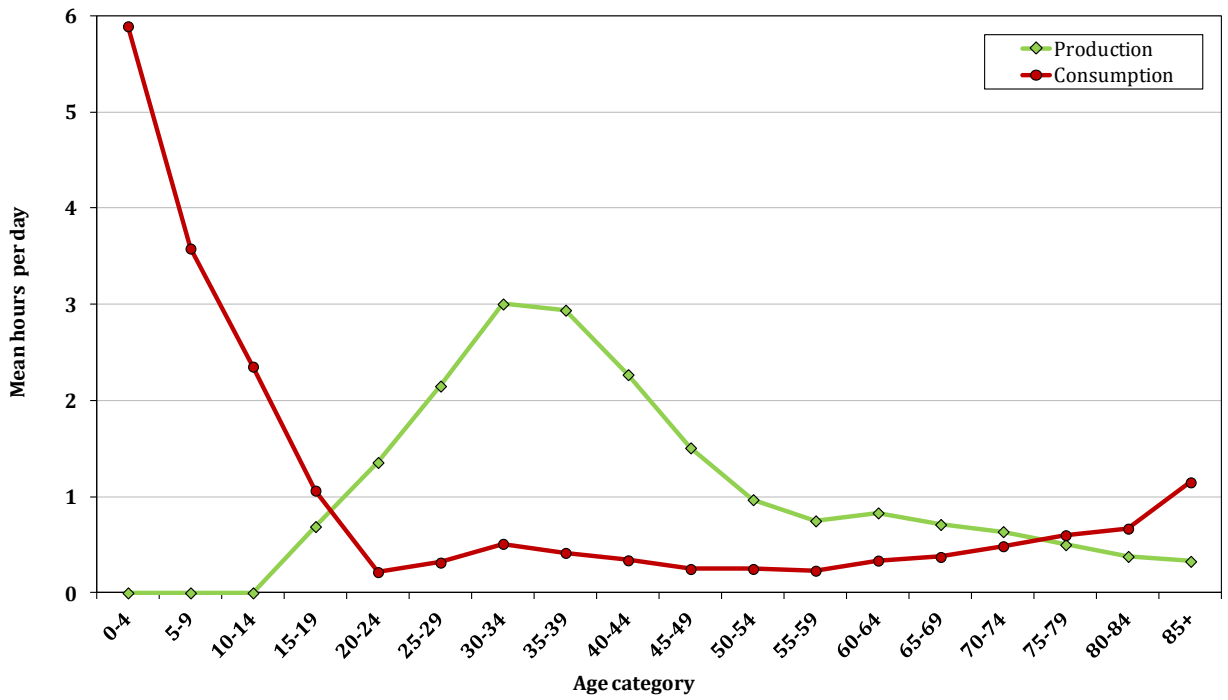


Fig. 4. Mean per capita production and consumption of non-monetary care time in the civilian population of the United States (2011-2013) in hours per day, by age group.

By multiplying the per capita age-sex profiles, extracted from the matrix of time flows, by the corresponding age-sex group population sizes in the U.S. in 2010, we obtained estimates of total time spent in informal care by Americans. Our estimates indicate an amount of approximately 184.1 million hours per day, all of which is consumed, according to our assumption. This, in turn, yields a care support ratio of 1 and care deficit of 0. The care support ratio is defined as the ratio between production of care weighted by population size and per-capita schedules of care production, and consumption of care weighted by population size and per-capita schedules of care consumption. It mimics the NTA support ratio, except that it uses time production and consumption, instead of financial production and consumption. The annual full-time care worker deficit is the difference between the number of workers needed to cover the consumption and the equivalent of the number of full-time care workers who would be capable of replacing actual caregivers for the time produced. Under the assumption that care cannot be "saved," the total population production must be equal to the total consumption for a given year. Thus the care support ratio is equal to 1, and the full-time care worker deficit is equal to 0, in the baseline year.

We keep per-capita profiles constant and extrapolate the consequences of demographic change for imbalances in care production and consumption. As we project for future years, the gap between the number of daily minutes produced and consumed is expanding. Figure 5 illustrates the projected pattern of care support ratio and care deficit for the U.S. in the coming decades. The projected care support ratio is anticipated to rise slightly above or remain very close to 1, up until the year 2020, indicating the sufficient supply of informal care time to cover

the demand. But, in the next couple of decades following year 2020, the care support ratio is projected to decline below the 1.0 mark, and full-time care worker deficit to rise to a range of 500,000-1,000,000 workers per year. The further decline is projected to be less rapid but stable. This estimated full-time care worker deficit equivalent comes as a result of decreased capacity of the middle-aged segment to generate sufficient amount of time to meet the demand of the two age groups with high economic dependency. As illustrated in figure 6 in the appendix B, the rate of growth of consumption in young and old age-dependent groups slightly surpasses the rate of growth of time production. However, for a few decades, the increase in the proportion of people in the middle-age group produces a sort of "care dividend" whereby increasing pressure created by dependent groups is counteracted by the increasing share of young and middle-aged adults.

Figures 5 and 6 also show extrapolations of care needs in the past, until 1950. This gives us a sense of the extent of transfers that we would have observed, if people had behaved like today, but in the demographic context of the 1950s. The unfavorable demographic context of the 1960s, with a large number of children per adult, would translate in relatively high care deficit.

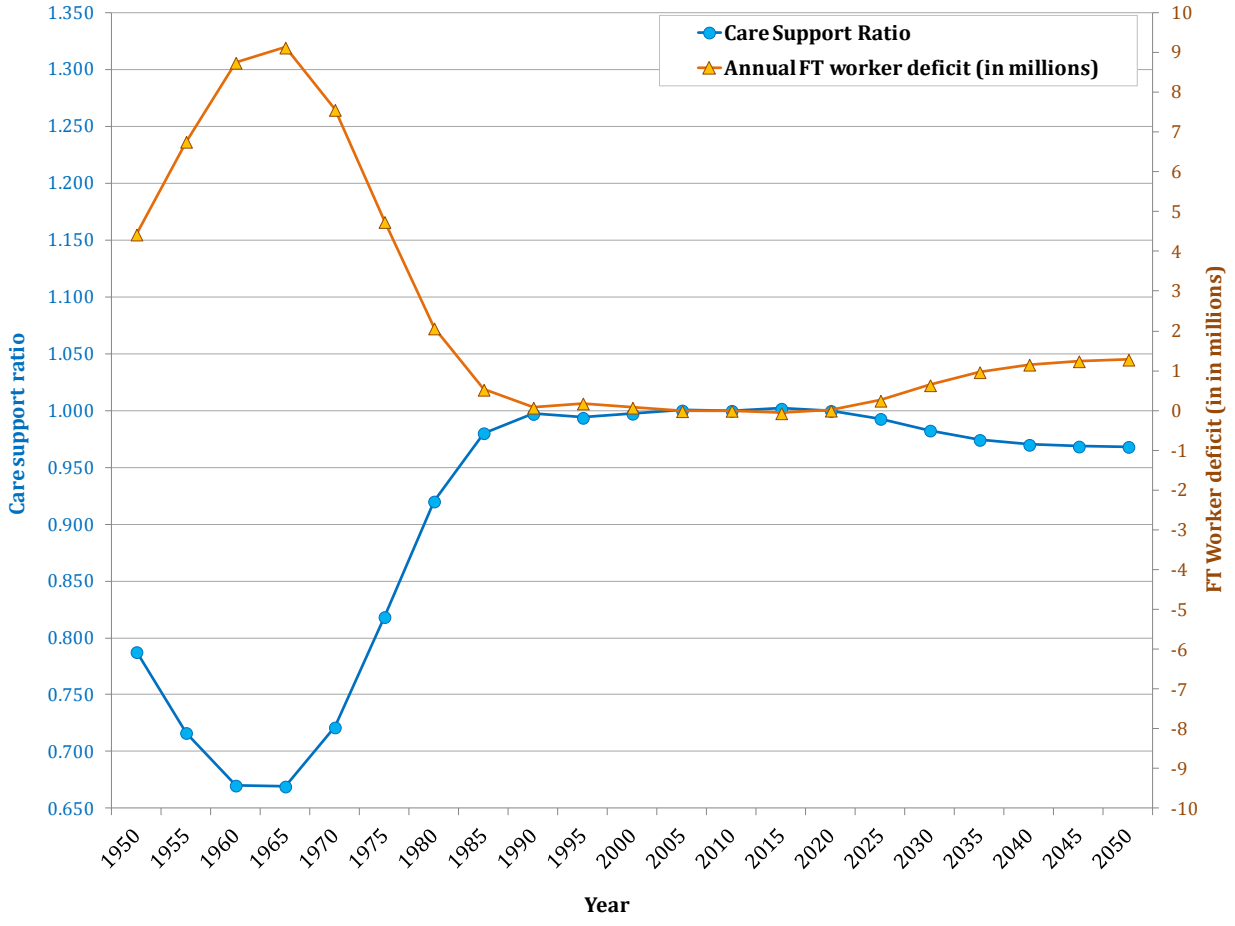


Fig. 5. Estimated care support ratio and care deficit (expressed in net annual full-time care worker equivalent) 1950-2050, time production held constant at 2011-2013 mean rate.

This extrapolation is shown for illustrative purposes and is intended to provide only a general sense of the relative impact of demographic change over time. The expected impact of demographic change in the next few decades, due to population aging, is relatively modest compared to the one related to a demographic event like the baby boom, assuming constant care needs of children.

Economic value of informal care time production

Building on the estimates of total informal care time produced and consumed in the span of one year, the approximate economic value of this production was computed. We found that in the recent years non-monetary intergenerational care transfers amounted to around 691 billion[8] dollars per year, the sum that constitutes close to 4.3% of the U.S. GDP in 2012 (U.S. Department of Commerce 2014). Following the projections of supply over the 40 years, the economic value may rise to 838.8 billion (expressed in 2012 U.S. dollars) by the year 2050, assuming constant hourly wage. That would represent 5.2% of the current national GDP (or cost of $2,092.50 per capita). Given constant production rate and hourly wage conditions, the economic value of time of "care deficit" in year 2050 is predicted to amount to around 27.5 billion in 2012 dollars, or approximately 0.17% of the present day GDP (or $69.59 in per capita value). Table 9 in the appendix B includes the full list of projected figures of total annual economic value of informal care production and care deficit beginning with 1950 up until year 2050, in billions of 2012 dollars, and as per capita value of the deficit, assuming replacement of caregiving time with the $10.31 constant mean hourly wage. It is important to remember that the value trends shown are driven by the population size, such that the population in 1960 was smaller than today, though, in relative terms, the proportion of high-consumption age groups (e.g. young children) to time generating groups was greater than today.

The overall economic value of caregiving is quite big, in the order of 4-5% of the GDP. The care deficits are more manageable. The projected care deficit for 2050 is approximately 0.17% of current GDP. It is equivalent to about 51 million hours of work per week at the population level. This means that, if people continue to dedicate the same amount of time to caregiving, in order for care recipients to receive the same amount of care time, about 1.3 million additional care workers would be needed via the market in 2050 (compared to 2010). The current number of workers in the three occupational groups, whose mean wages were considered earlier (Home Health Aides, childcare workers, and personal care aides), comprises roughly 2.54

[8] $Annual\ Economic\ Value = \sum T \times \overline{S} \times 7_{(days/week)} \times 52_{(annual\ weeks)} =$
$= 184{,}136{,}456.15 \times 10.31 \times 7 \times 52 = \$\ 691{,}034{,}658{,}084.67$

$\sum$ T is the estimated number of hours produced by the entire U.S. civilian population during an average day in 2011-2013, and S is the mean hourly salary of $10.31 of a hypothetical care provider in 2011-2013, as described in the methodology section of this paper.

million (U.S. Department of Labor 2014a). This means that we are in the range of at most 50% increase over four decades. We are likely overestimating the impact because the three groups of professional caregivers likely exclude other less common care occupations, low-skilled medical personnel, and educational workers, such as tutors. Most likely adjustments will be needed across multiple dimensions and will happen not only via the market. The illustrative extrapolation gives us an idea of the size of the adjustment that would be needed. Considering that it would be spread over several decades, the size of the adjustment appears to be quite manageable for the U.S.

DISCUSSION

Prior to our analysis we expected that the majority of informal care time transfers would be directed downwards, that is from parents to children, followed by transfers from grandparents to grandchildren. Upward transfers in the form of eldercare were found to be less frequent and last for much shorter durations than downward transfers. Hence our expectations have been largely validated by the results of our empirical analysis. What was partially surprising was the sizeable portion of time transferred within the same generation as part of spousal care. Our results emphasize that standard definitions of sandwich generation may be inadequate to capture the full extent of the phenomenon. Our analysis reveals that, to understand transfers and the burden of care for people in the sandwich generation, it is particularly important to account for care given to spouses. From the time use perspective, people who have simultaneous care responsibilities towards spouses and children or grandchildren are more under pressure than those who have responsibilities towards their parents and their children or grandchildren.

The estimates that we generated grant us a unique opportunity to view the subject through a wider lens, where emergent clusters of time production and consumption do not only become the focal points, but may also be seen in the context of a continuum of transfers where they are nested. For instance, although previous studies examined the care arrangements between elderly parents and young children, these were often limited to two- or three-generation households, in which caregivers cohabited alongside their care recipients. In our study we supplemented the evidence of such flows of time via inter-household analysis. We documented that caring for elderly parents and relatives is prevalent outside of one caregiver's household. The estimation of inter-household transfers is not new in the literature (e.g. McGarry and Schoeni 2005). Previous studies have relied mainly on surveys like the Health and Retirement Study (HRS) and the Panel Study of Income Dynamics (PSID), which provide rich data sets, but have also a number of limitations and idiosyncrasies. Some aspects of the definition of informal care do not correspond exactly across different data instruments. For instance, in ATUS, adult care activities related to helping adults over 18 years of age largely exclude household chore activities, such as cooking and cleaning, which might comprise the large chunks of unpaid time assistance, especially to young adults. Yet, one innovative aspect of our research is the combination of intra- and inter-

household transfers of care within the general framework of the NTA project, which so far has focused only on intra-household transfers. A second innovative aspect is the development of methods to evaluate matrices of flows from the ATUS. A third aspect is related to the evaluation of time transfers for subgroups of the population, like people in the so-called sandwich generation. By holding multiple responsibilities to multiple people with different caring needs, "sandwiched" caregivers may, at first glance, provide less time to certain groups within their household compared to single-generational caregivers. However, their time commitment outside of the household has been largely unexplored by various macro-scale projects, such as National Transfer Accounts or the System of National Accounts.

The projections of supply and demand of informal care time transfers lay further groundwork for developing policy implications. While market activities, such as formal care and monetary transfers, are well documented in prior research (Mason and Lee 2011), our estimates offer a new snapshot of non-monetary transfers. This analysis compares the current supply of time and examines to what extent it is projected to meet the demand for care in the next decades, conditional on the expected population growth and its rapidly changing age structure. Provided that current conditions are buffered against such changes, it is reasonable to expect the actual supply and demand trends to align with our estimates in the next couple of decades, and to predict the overall direction of these trends beyond this time frame, despite the uncertainty that future socio-economic and technological developments present. Recent research on economic transfers within the NTA framework in several European countries shows that money or wealth can be accumulated and saved, whereas informal care time cannot be (Prskawetz and Sambt 2014). Consequently, in theory, monetary savings, both in private funds as well as in public assets, can be tapped as needed to meet the rising demand for age-dependent support through monetary or formal care provisions, or both. On the other hand, the potential for production of informal care time is reliant on support from the population in age-specific groups at any given point in time, and may not be carried over for later use.

We showed that the distribution of informal care time production and consumption is uneven across age groups, with the largest care deficit occurring in the childhood portion of the life cycle (see figure 6 in the appendix B). The decrease in care support ratio with respect to childcare transfers may mean freed capacity to increase labor force participation or delivery of informal care time to other age groups, particularly to the elderly, given the strain on the economic support system anticipated over the next decades. Our care support ratio estimates follow a similar general pattern as the one of monetary support ratios, but the future decline in care support ratio is modest compared to monetary transfers. For instance, our estimated decline in informal care support ratio compares 3.2% to 11% decline in market transfers by 2050 (Miller 2011). This difference may be explained in terms of use of economic resources that can be spent to obtain market care or assistance, where elderly are not only in lesser need of time assistance than young children per capita, but are also more likely to opt for market services. The evidence of a large drop in our estimated informal care support ratio in the 1950s and 1960s, when the aggregate amount of time of informal care transferred to young children would have been

overwhelming, supports this contention. As such, eldercare may have greater impact on financial resources than on non-monetary or informal ones.

Enabling a better grip on reallocation of scarce time resources potentially carries more efficient use of public funds. It is crucial not to overlook the size of transfers, as our estimates indicate that the weekly effort expended on non-market transfers of care equates roughly to that of a fifth of the total United States civilian labor force (U.S. Department of Labor 2014b). The 4.28% of GDP in economic value that is vastly unaccounted for by the existing economic measures may not translate into much change outside of the private household production.

Appropriate transfers of resources have the potential to counteract expected imbalances. For instance, extra support to parents of young children, either in the form of community programs for children, tax breaks, and subsidies would potentially allow parents to pay for childcare services that they would otherwise have to provide themselves. Boushey (2011) suggests that comprehensive governmental initiatives may promote the increase in parents' labor force participation due to diminished time burden presented by childcare. This would also enable people to choose whether to dedicate more time to caring for the elderly through household production or to rely on professional services obtained via the market. Other popular policy implications proposed in the past are flexible working schedules and special medical leave programs (Arno et al. 1999) to ensure that caregivers maintain their working status and are incentivized for their time. In turn, an increase in informal caretaking in regard to elderly recipients has demonstrated to result in an effective reduction of use of formal care services, such as nursing home care (Van Houtven and Norton 2004), that amount to sizeable annual savings.

Caregivers in the sandwich generation bear multiple simultaneous intergenerational care responsibilities and are often considered time-poor. In this paper we find that although in some instances sandwich caregivers may transfer less time to a certain group of care recipients than caregivers in the general population, it is often the combination of the division of their time between multiple people that lead to larger transfers. As such, these caregivers may benefit from lessening of tension between the two or more responsibilities by outsourcing some of their care obligations. The effect of multiple responsibilities on spousal caregiving illustrated in our matrices is consistent with earlier findings (Lima et al. 2008) that sandwich caregivers, notably males, devote on average the same or larger amounts of time providing care to spouses as do caregivers in general. Males also appear to be more active caregivers toward their spouses in the elderly age. A spousal caretaking arrangement for the elderly may thus be construed as a good alternative to caregiving by adult children who often forego their wages and decrease their labor force participation. In the sandwich generation, this may also entail much sought relief for caregivers and higher quality of care for their other care recipients.

Our approach comes with some limitations that we would like to acknowledge. In particular, the matrices that we presented have not been smoothed. As a result, occasionally there may be some cells with outliers, especially when the sample size is small. We hope to be able to generate models of the matrices that highlight the key features of patterns of transfers, while

removing stochasticity. For this paper we preferred to show the data as they emerge from the time use surveys, without smoothing or modeling.

Due to data limitations that we discussed in the main text, there is a considerable degree of uncertainty in our estimates of inter-household flows to the care recipients of ages 19-49. We expect that our evaluations underestimate inter-household transfers to this group, due to lack of data. However, we also expect that the size of the bias to be quite small, since most of the transfers to this age group are typically intra-household (spousal transfers) for which we have accurate data.

In regard to our projections of future supply and demand for informal care, we assume no future change in per capita production rate, which is unlikely to manifest itself precisely in such manner, given a number of factors, such as future developments in household technology or improved health, as well as unpredictable variations in fertility and mortality, that may all impact the demand, and, to lesser extent, the supply. Lastly, we acknowledge that more research is necessary to fine tune the assessment of the economic impact of non-monetary intergenerational transfers. Our evaluation of the economic value of time dedicated to care is intended to provide an approximate estimate of the size. It could be refined in a number of ways. Moreover, future fluctuations in the cost of services as well as hourly wages of childcare workers and personal care aides cannot be easily foreseen, which means that estimates of the economic value of future supply and care deficit come with a fairly high degree of uncertainty.

Our study comes with limitations, but it also offers important new opportunities. Time use data are collected in a number of countries and thus our matrices of time transfers could be evaluated in a comparative perspective. Likewise, within a country, additional subgroups of the population could be analyzed. For instance, matrices of time transfers by socio-economic status or by race and ethnicity could be estimated using time use data. Although this is beyond the scope of this article, this manuscript lays the foundations for expansion of this line of work in several important directions.

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APPENDIX A – Intra- and Inter-household time transfers matrices

CONSUMPTION

MALE

PRODUCTION: MALE	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
15-19	3.2	3	4	4	0	0	0	0.1	0.5	0.6	0.7	1.8	0	0	0	0	0	0
20-24	22	2.6	0.9	1.1	0.1	0	0	0	0.4	0	0.2	0.1	0	1	0	0	0	0
25-29	29	8.1	1	0	0.5	0	0.2	0.6	0.5	0.1	0	0	0	0	0	0	0	0
30-34	33	14	4.1	0.5	0	0.1	0.2	0	0	0	0.3	0	0	0.3	0.1	0	0	0
35-39	24	20	5.4	1.2	0	0.1	0	0	0	0.1	0	0	0	0.1	0.2	0	0	0
40-44	14	18	8.8	3.3	0	0	0	0	0.1	0	0	0	0	0.1	0	0	0	0
45-49	6.5	14	12	7.3	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0
50-54	3.2	3.9	9.7	3.7	0.4	0	0	0	0	0	0	0	0	0	0	0.6	0	0
55-59	0.6	2.5	4.4	1.3	0.2	0.1	0	1	0	0	0	0	0	0	0	0	0	0.4
60-64	2.5	4.5	3.2	2.7	0.7	0.2	0.4	0	0.1	0	0	0.2	0	0	0	0	0	0
65-69	1	2.1	2.4	0.1	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
70-74	0	3.2	0.4	0.2	0	0	0	0.2	1.6	0	0	0	0	0	0	0	0	0
75-79	0	2	0.3	0	0	0	0	0	0.1	0.1	0	0	0	0	0	0	0	0
80-84	0	5.6	0	0	0	0	0	0	0.8	0	0	0	0	0	0	0	0	0
85+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AGE	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+

FEMALE

0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+	AGE
2.3	2.7	1.1	3.5	0	0	0	0.2	2.1	0.2	0.5	0	0	0	0	0	0	0	15-19
14	3.8	0.8	0.5	11	3	0.6	0	0	0	0	0.6	0	0	0	0	0	0.2	20-24
25	9.8	2.2	0.2	5.6	13	3.1	0.7	0.7	0.1	0.5	0.7	0.1	0	0	0	0	0	25-29
28	8.9	3.1	0.1	0.8	6.3	15	2.3	0.6	0.1	0.1	0.1	0.6	0.1	0	0	0	0	30-34
23	13	6.3	1	0.4	1.7	8.1	10	2.4	0.1	0	0.1	0.7	0.1	0	0	0	0	35-39
14	13	9.1	1.7	0.3	0.6	3.8	7.8	9.9	1.9	0.3	0.2	0.2	0.1	0	0	0.1	0	40-44
5.4	8.8	12	7.8	1.2	0.1	1.1	2.3	5.6	6	0.4	0.5	0	0	0	0.1	0.1	0.5	45-49
3.1	4.5	6	4.7	0.5	0.1	0	1.4	1.4	5.9	5.2	1.4	0	0.2	0	0.4	0.6	0.3	50-54
3.7	4.2	3.4	2.2	0.1	0.2	0.7	0.1	2.3	1.6	2.3	2.8	1.9	0.1	0.4	0	0	2.5	55-59
2.7	1.1	1.4	0.8	0.4	0.1	1.2	0.3	0.1	0.1	2.2	1.7	7.9	0	0	0	0	2	60-64
0.1	0.5	1	0.4	0	0	0	0.4	0.4	0	1	1.6	2.4	6.5	0.7	0.2	0.3	0.7	65-69
1.3	0.2	1	0.1	0	0	0	0	0.5	0.1	2.2	0.2	2.4	2.8	1.4	0.3	0.1	0	70-74
1	0	1.7	3	0.1	0	0	0	0	0	2.3	0	4.4	3.4	6	5.7	1.7	0	75-79
0	0.5	1.9	0.8	0	0	0	0	0	0	0	0	3.5	0.6	7.2	5	14	1	80-84
0	0	0	0	0	0	0	0	0	0	0	2.8	0	0	0	1.9	5.3	22	85+

PRODUCTION: MALE

FEMALE

PRODUCTION: FEMALE	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
15-19	13	1.8	3.5	2.5	1.1	0	0	0.4	0.4	1.5	0.1	0	0	0.2	0	0	0	0
20-24	49	5.8	0.3	1.1	6.5	3.5	2.1	0	0	0.4	0.9	0.1	2.7	0	0	0	0	0
25-29	48	18	1.9	0.2	0.9	9	8.8	1.4	0.4	0	0.4	0.6	0.8	0.2	0	0	0	0
30-34	46	20	7.8	1.2	0	1.6	12	6.4	1.7	0.2	0.1	0.1	0.1	0	0	0	0	0
35-39	30	21	12	3.8	0.3	0.1	2.1	9.2	4.5	1	0.4	0.2	0.1	0	0	0.1	0	0
40-44	14	18	16	6.1	1.2	0.1	0.4	1.8	5.7	3.6	1.9	0.5	0	0.1	0.1	0.1	0	0
45-49	2.6	10	14	6.7	0.6	0.1	0.1	0.2	0.9	4.4	2.4	3.4	0.1	0.1	0	0	0.1	0
50-54	1.9	4.3	4.3	4.3	0.7	0.2	0	0.1	0	1.5	2.4	1.6	0.4	0.1	0	0.3	0	0.3
55-59	2	2.3	2.5	1.7	1.1	2.5	0.8	0	0	0.2	0.8	5.7	1.1	0.1	1.3	0	0	0.6
60-64	2	1.9	2.1	2.1	0	0.6	0.2	1.4	0	0	0.1	0.4	4.1	3.6	1	0.1	0.1	0.2
65-69	1.9	1.2	0.2	0.7	0	0	0.2	0	0.1	0.5	0.1	0.3	0.4	1.7	3.1	2.1	0	1
70-74	1.8	1.2	0.8	0	0	0	0	0	1.8	0	2.1	0	0.2	0.1	2.9	7.9	0.1	0.1
75-79	1	0.3	0.8	0.4	0	0.9	0.4	0	0	0.1	0.5	0	0	0	1	13	0.3	1.6
80-84	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0.6	2.3	21
85+	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2.2	35
AGE	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+

FEMALE

0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+	AGE
7.8	3.2	2.8	1.9	0.1	0	0.5	0.5	1	2.6	0.9	0	0	0.2	0	1	0	0	15-19
42	4.6	2.1	0.4	0.2	2.1	0	0	1	1.7	2.8	0	0.4	0	0	0.1	0	0	20-24
46	14	3	0.1	0.1	0.1	0.2	0	0	0.7	1.1	0.3	0.6	0	0	0.3	0	0	25-29
48	22	7.1	2.1	0	0	0.1	0.1	0	0	0	0.3	0.2	0	0.1	0	0	0.1	30-34
30	22	12	3.6	0.3	0	0.3	0	0.1	0	0.1	0.3	0.3	0.1	0	0	0	0	35-39
13	19	14	4.7	0.6	0	0.5	0.2	0.1	0	0	0	0.5	0.1	0	0.1	0.1	0	40-44
4.2	8.3	16	8.8	0.7	0	0	0	0.2	0.1	0.3	0	0	0.3	0	0	0.3	0.2	45-49
1.7	2.9	9.3	6.2	0.8	0.1	0.2	0.1	0	0	0	0.1	0	0	1.4	0.2	0.4	0.8	50-54
2.1	3.4	3	1.8	2.9	0.5	0.3	0.5	0	0.1	0.5	0	0	0	0	0	0.3	2.1	55-59
4.8	2.2	2.2	1.6	0.1	5.5	1	1.1	0	0.5	0.2	0.3	1.7	0.3	0	0.6	0.2	3.7	60-64
3.2	2.5	0.6	0.6	0	0	0.7	0	0.2	0	0	0	0	1.3	0	0	0	6.3	65-69
2.5	0.8	0.7	0.9	0	0	0	0.4	0	0.2	0	0	0	0	0.2	0	0	0.3	70-74
0	0.6	0.1	2.9	0.1	0	0	0	0	0.1	0	0	0	0	0	0	0	0	75-79
0	0	1	0.2	0.2	0	0	0	0	0	0	0	0	0	0	0	0	1.3	80-84
0	0	3.4	0	0	0	0	0	0	0	1.3	0	0	0	0	0	0	2.1	85+

PRODUCTION: FEMALE

CONSUMPTION

Table 5. **Intra-Household** mean time transfers matrix showing time production by age-sex groups among caregivers *in general*, consumed by various age-sex groups of care recipients. Note: darkest shade denotes ≈ 50+ minutes per day.

CONSUMPTION

MALE

AGE	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
15-19	0	0	0.7	6.5	0	0	0	0	0	0	2.1	4.3	0	0	0	0	0	0
20-24	16	0.7	0	1.4	0	0	0	0	1.4	0	0	0	0	0	0	0	0	0
25-29	36	11	0	0	0	0	0	5.6	5.9	0	0	0	0	0	0	0	0	0
30-34	33	13	12	2.6	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0
35-39	20	21	5.2	3.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40-44	34	16	7.4	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45-49	0.9	15	14	8.5	0	0	0	0	0	0	0.3	0	0	0	0	0	0	0
50-54	0.4	0.7	12	4.4	1.4	0	0	0	0	0	0	0	0	0	0	0	0	0
55-59	0.6	3.3	4.6	0.4	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0
60-64	0.8	58	0	4.7	2.3	0	3.8	0	0	0	0	0	0	0	0	0	0	0
65-69	3.8	0.7	13	0.2	5	0	0	0	0	0	0	0	0	0	0	0	0	0
70-74	0	4.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75-79	0	0	4.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80-84	0	46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

FEMALE

0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+	AGE
0	0.4	0	1.9	0	0	0	0	0	0.2	0	0	0	0	0	0.2	0	0	15-19
11	0.7	9.4	0	10	0	7.8	0	0	0	0	0	0	0	0	0	0	0	20-24
40	10	0	0	3.9	9.1	6.6	5.6	0	0	0	5.6	0	0	0	0	0	0	25-29
25	10	6.9	0	2.4	3.2	18	7.8	0	0	0	0	0	0	0	0	0	0	30-34
16	8.8	8.2	0.7	0	0	8.4	21	1.3	0.2	0.2	0	0	0.3	0	0	0	0	35-39
26	19	15	1.7	0.2	2.1	21	9.8	17	1	0	0.3	0.3	0	0	0	0	0	40-44
4.1	15	12	12	0	0	0.9	1.9	4.8	16	0	0	0	0	0	0.3	0	3.9	45-49
0	3.4	14	22	3.2	0	0	0.8	0.8	26	2.1	0	0	0	0	0	0	0	50-54
0.6	11	3.6	3.1	0	0	0.6	0	0	4.7	3.6	0	0	0	0	0	0	0	55-59
24	4.3	4.5	0	0	0	18	0	1.3	1.5	0	2.3	0	0	0	0	0	0	60-64
0	0	2.1	0	0	0	0	0	0	0	8	0	4.4	2	6.4	0	0	0	65-69
0	0	0	0	0	0	0	0	0	0	0	3.2	0.4	0	0	0	0	0	70-74
0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.1	14	0	0	75-79
0	0	0	0	0	0	0	0	0	0	0	0	0	0	4.1	0	0	0	80-84
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	63	85+

PRODUCTION (MALE)

PRODUCTION (FEMALE)

FEMALE

AGE	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
15-19	40	0.8	0.6	3.4	5.2	0	0	3.7	0.8	0	0	0	0	3.1	0	0	0	0
20-24	59	1.8	0	0.6	5	4.9	10	0.1	0	0	0	0	0	0	0	0	0	0
25-29	52	29	5	0.7	1.2	11	23	0.2	0	0	2.3	0	0	0	0	0	0	0
30-34	45	23	9.7	0.9	0	5.1	11	7.8	3.6	0.2	0	0	0	0	0	0	0	0
35-39	21	23	12	2.2	0	0	0.7	12	8.4	2.7	2	0	0.1	0	0	0	0	0
40-44	14	14	14	7.5	2.3	0	0.9	3.3	7.3	5.3	6	0	0	1.1	0	0	0	0
45-49	2.8	7.2	13	10	0.8	0	0	0	2.2	4.2	8.9	1.1	0	0.1	0	0	0.4	0
50-54	2	11	4.1	7.7	0	0	0.2	1	0.1	3.4	2.7	8	1.5	0	0	0	0	0
55-59	11	1.2	7.2	8.3	1.2	0	0	0	0	1.3	0	21	1.4	0.1	7.6	0	0	0
60-64	1.9	1.7	0	3.9	0	4	0	8.7	0	0	0	2.7	9	4.9	7.9	0	0	0
65-69	6.7	3.5	0.3	1.9	0	0	2.8	0	0	0	0	0	0.3	0	0	3.1	0	0
70-74	0	0	1.8	0.4	0	0	0	0	0	0	0	0	4.5	0	0	15	0	0
75-79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
80-84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+	AGE
4.6	7.8	6.4	1.1	0	0	2.8	1.4	0.9	0	10	0	0	0	0	0.2	0	0	15-19
15	8.6	1.4	0	0.2	0	0	0	2.4	2.1	0	0	0	0	0	0	0	0	20-24
34	22	5.4	0	0.2	0	0	0	0	0.5	2	1.5	0	0	0	0	0	0	25-29
30	25	9.5	5.6	0	0	0	0	0	0	0	0.1	1.1	0	0	0	0	0.5	30-34
18	22	21	3.4	0.5	0	0	0	0.6	0	1	0.2	0.2	0	0	0	0	0	35-39
18	26	11	4.6	2.9	0	0.2	0	0	0	0	0	0.1	0	0	0.1	0	0	40-44
12	7.6	20	9.3	0.6	0.1	0	0	0	0	0	0	0	0	0	0	0	1.8	45-49
3	3.2	22	15	4	0	1.8	0.5	0	0	0	0	0	0	0.6	0	0	0	50-54
2.6	12	8.9	1.8	0.5	1.3	1.6	1.1	0	0	0	0	0	0	0	0	0	1.9	55-59
25	2.4	1.2	7.5	0	2.4	4.2	0	0	1.9	0	0	0	0	0	0	0	0	60-64
0	0	0.8	0	0	0	0	0	2.8	0	0	0	0	0	0	0	0	0	65-69
0.3	0	0	0	0	0	0.3	0	0	0	0	0	0	0	0	0	0	0	70-74
0	0	3.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	75-79
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80-84
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	85+

PRODUCTION (FEMALE)

MALE

CONSUMPTION

Table 6. **Intra-Household** mean time transfers matrix showing time production by age-sex groups among caregivers in the *sandwich generation*, consumed by various age-sex groups of care recipients. Note: darkest shade denotes ≈ 50+ minutes per day.

CONSUMPTION

MALE

AGE	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
15-19	2.2	2	2.6	2.7	0	0	0	0	0	0.1	0.3	0.4	0.8	1.6	2.1	1.9	1.9	1.4
20-24	6.4	0.8	0.3	0.3	0	0	0	0.4	0.4	1	1	0.8	1.5	1	2.9	3.2	2.9	3.6
25-29	3.2	0.9	0.1	0	0.2	0.1	0.1	0.2	0.1	0.2	0.8	1.2	1	1.4	1.7	2.4	1.9	2.4
30-34	1.9	0.8	0.2	0	0	0	0	0	0.1	0.2	0.2	0.5	0.7	0.8	1	0.9	1.4	1.5
35-39	1.9	1.6	0.4	0.1	0	0	0	0	0	0	0.3	0.1	0.9	1.3	1.1	1	0.7	0.8
40-44	0.8	1.1	0.5	0.2	0	0	0	0	0	0	0.1	0.2	0.6	1.2	1.3	0.7	0.9	1
45-49	0.5	1.1	1	0.5	0	0	0	0	0	0.1	0	0.2	0.2	0.5	1.8	1.5	1.6	1.5
50-54	1	1.2	3	0.8	0	0	0	0	0	0	0.1	0.3	0.4	0.7	1.5	2.7	2.6	3.3
55-59	0.3	1.2	2.1	0.5	0	0	0	0	0.1	0	0	0.1	0.6	0.8	0.7	1.7	3.5	4.6
60-64	3.3	6	4.2	3.6	0	0	0	0	0	0	0.1	0.2	0.4	0.5	1.8	1.8	4	8.7
65-69	5.7	12	14	0.8	0	0	0	0.1	0	0.1	0.1	0.3	0.7	0.7	1.4	1.9	1	4.8
70-74	0	21	2.3	1.4	0	0	0	0	0	0.3	0	0.1	0.4	1.3	1.6	1.2	3.1	3.3
75-79	0	6.4	1.1	0	0	0	0	0	0	0	0	0	0.6	0.6	2.3	3.2	3	5.7
80-84	0	6.5	0	0	0	0	0	0	0	0	0.2	0	0.9	0.9	1.1	1.5	2.6	1.9
85+	1	1	1	1	0	0	0	0	0	0	0	0.9	0.9	1.9	1.9	1.9	0.9	8.5

FEMALE

0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+	AGE
1.5	1.8	0.8	0.6	0	0	0	0.1	0	0.2	0.2	0.5	0.9	1.7	1.8	2	1.8	1.7	15-19
4.1	1.1	0.2	0	0	0	0	0.4	0.8	1.3	1	0.8	1.5	1	2.5	4	3.6	4.4	20-24
2.8	1.1	0.3	0	0	0.1	0.1	0.2	0.1	0.2	0.5	0.8	1	1.8	2.4	2.5	2.3	2.5	25-29
1.6	0.5	0.2	0	0	0	0	0	0	0.1	0.3	0.8	1	1.2	0.8	1	1.1	1.3	30-34
1.9	1	0.5	0.1	0	0	0	0	0	0.1	0.4	0.4	0.6	1.4	1.3	0.9	0.5	0.9	35-39
0.9	0.8	0.5	0.1	0	0	0	0	0	0	0.1	0.3	1.1	1.7	1.9	1.2	0.7	1.1	40-44
0.4	0.7	1	0.4	0	0	0	0	0	0	0.1	0.1	0.5	1.5	3.3	2.4	1.8	1.8	45-49
0.9	1.4	1.8	1.2	0	0	0	0	0.1	0	0.1	0.2	0.5	1.2	3.3	4.8	5.6	3.8	50-54
1.7	1.9	1.6	0.9	0	0	0	0	0	0	0.1	0.1	0.6	0.8	1.5	4.8	6.7	8.5	55-59
3.6	1.4	1.9	0.8	0	0	0	0	0	0	0.2	0.2	0.4	1.1	2.3	2.6	8.1	14	60-64
0.6	2.9	5.9	2.7	0	0	0	0.1	0	0.1	0.1	0.5	1.1	0.6	1.7	1.8	1.8	10	65-69
8.5	1.1	6.7	0	0	0	0	0	0	0.3	0	0.1	0.4	1.6	2.1	1.5	3.1	7.3	70-74
3.3	0.1	5.3	9.5	0	0	0	0	0	0	0	0	1.1	0.6	2.8	3.2	3	8.7	75-79
0	0.6	2.3	1	0	0	0	0	0	0	0.2	0	0.9	0.9	1.1	2.6	2.6	3	80-84
1	1	1	1	0	0	0	0	0	0	0	0.9	0.9	1.9	1.9	1.9	4.7	6.6	85+

PRODUCTION

MALE

PRODUCTION

FEMALE

AGE	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
15-19	8.6	1.2	2.3	1.2	0	0	0	0	0.1	0.1	0.1	0.2	0.6	0.8	1.2	1.4	2	1.7
20-24	2.5	0.3	0	0	0	0	0	0	0	0	0.3	0.3	0.7	0.6	1	0.7	0.8	1.5
25-29	1.6	0.6	0.1	0	0	0	0	0	0	0.1	0.1	0.4	0.6	0.6	0.8	0.5	0.7	0.9
30-34	1.5	0.7	0.3	0	0	0	0	0	0	0	0.1	0.2	0.3	0.3	0.3	0.4	0.4	0.6
35-39	0.4	0.3	0.2	0	0	0	0	0	0	0	0.1	0	0.2	0.3	0.2	0.2	0.4	0.6
40-44	1	1.3	1.2	0.4	0	0	0	0	0	0	0	0.1	0.3	0.5	0.8	1	0.9	0.9
45-49	0.7	2.5	3.5	1.3	0	0	0	0	0	0	0.1	0.1	0.1	0.3	0.7	0.8	1.2	1.2
50-54	1.3	2.9	2.9	2.6	0	0	0	0	0	0	0.1	0.3	0.4	0.4	1	2.1	2.5	2.8
55-59	4	4.6	4.9	2.6	0	0	0	0	0	0	0.1	0.3	0.5	0.9	0.8	1.3	2.7	4.7
60-64	5.8	5.5	6.1	4.3	0	0	0	0	0	0	0.1	0.3	0.3	1.1	0.9	1.1	1.9	4.7
65-69	7	4.4	0.9	2.6	0	0	0	0	0.1	0.1	0.3	0.4	0.3	1.1	1.1	0.9	1.6	3.9
70-74	11	7.6	4.8	0	0	0	0	0	0	0.1	0.1	0.2	0.7	1.1	1.3	1.7	2.6	3.7
75-79	7.6	2.1	5.9	2.8	0	0.1	0	0	0	0	0.1	0.2	0.5	1.2	0.9	1.5	2.9	4.2
80-84	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0.6	1.1	2.8	5.8	7
85+	0	0	0	0	0	0	0.3	0	0.6	0	0.6	0	0.6	1.4	2	3.3	3.3	7.8

FEMALE

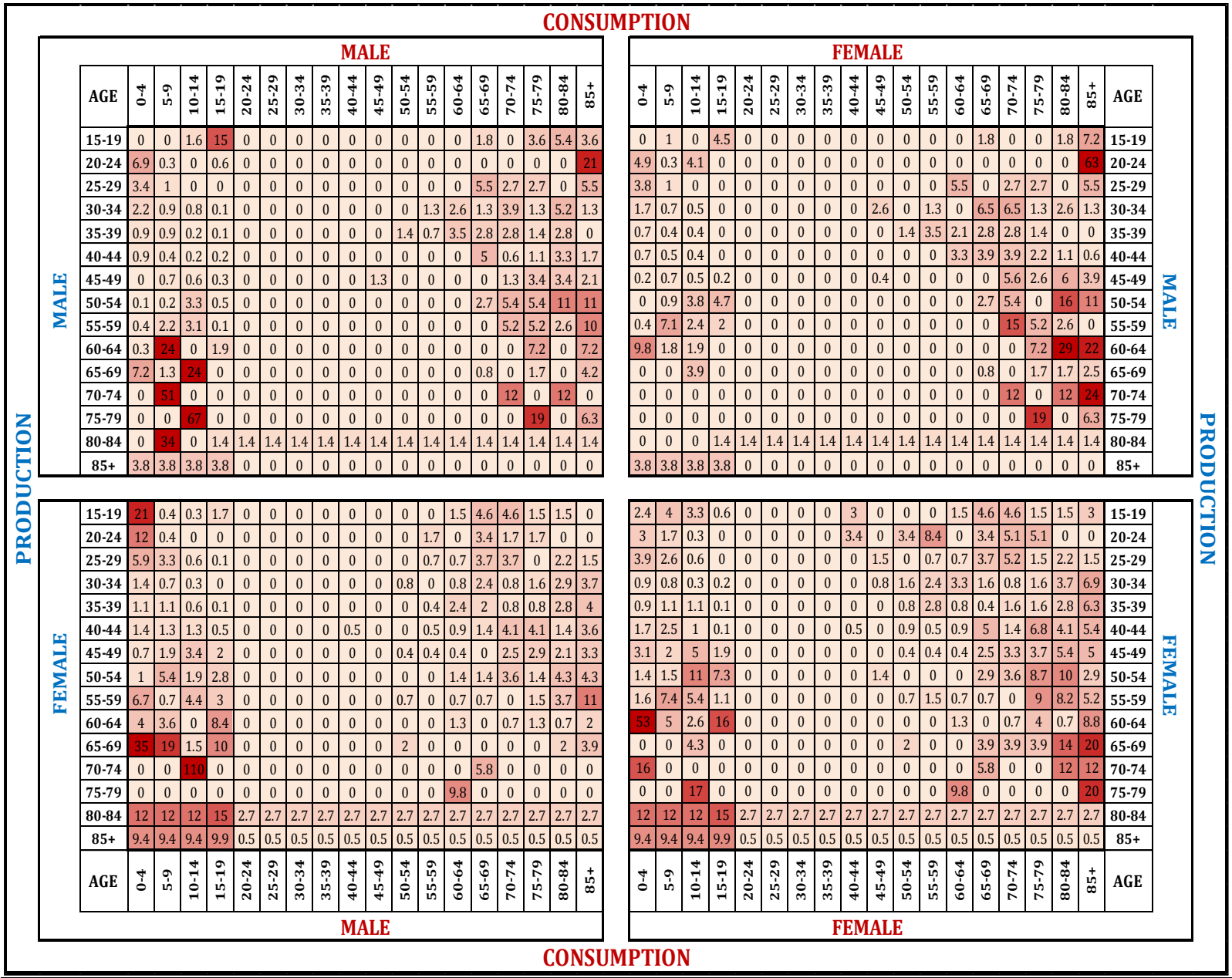
0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+	AGE
5.1	2.1	1.8	1.2	0	0.1	0	0.1	0.1	0	0.4	0.2	1	0.8	1.9	1.6	2	1.9	15-19
2.1	0.2	0.1	0	0	0	0	0	0.1	0.2	1.1	0.7	0.6	0.8	1	1.2	1.2	1.6	20-24
1.6	0.5	0.1	0	0	0	0	0	0.1	0.4	0.1	0.5	0.6	0.9	0.9	0.9	1	1.3	25-29
1.6	0.7	0.2	0.1	0	0	0	0	0	0.1	0.3	0.4	0.5	0.4	0.4	0.4	0.6	0.9	30-34
0.4	0.3	0.2	0	0	0	0	0	0	0	0.2	0.3	0.4	0.6	0.4	0.4	0.4	0.7	35-39
0.9	1.4	1	0.3	0	0	0	0	0	0	0.1	0.1	0.8	1.5	1.3	1.4	0.9	1.1	40-44
1.1	2.1	3.9	1.9	0	0	0	0	0	0	0.1	0.1	0.2	0.9	1.4	2.1	1.5	1.3	45-49
1.2	2	6.2	3.4	0	0	0	0	0	0.1	0.2	0.2	0.4	1.2	3.5	4.6	4.9	5.2	50-54
4.1	6.8	6	3.3	0	0	0	0	0	0	0.2	0.3	0.7	1	1.4	3.3	7.1	6.6	55-59
14	6.3	6.3	4.6	0	0	0	0	0	0	0.2	0.3	0.4	1	1	1.9	5.1	10	60-64
12	9.3	2.1	2.4	0	0	0	0	0	0.1	0.3	0.3	0.4	0.8	1.1	1.5	2.7	12	65-69
16	5.4	4.3	5.9	0	0	0	0	0	0.1	0.1	0.2	0.5	0.9	1.3	2.4	2.8	7.1	70-74
0	5.1	1.1	23	0	0.1	0	0	0	0	0.1	0.5	0.5	1	0.9	1.9	3.5	5.9	75-79
0	0	24	0	0	0	0	0	0	0	0.1	0	0	0.6	1.7	2.6	5.8	9.2	80-84
0	0	11	0	0	0	0.3	0	0.6	0	0.6	0	0.6	1.4	2	3.3	3.3	7.8	85+

MALE

FEMALE

CONSUMPTION

Table 7. **Inter-Household** mean time transfers matrix showing time production by age-sex groups among caregivers *in general*, consumed by various age-sex groups of care recipients. Note: darkest shade denotes ≈ 25+ minutes per day.



AGE	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
15-19	0	0	1.6	15	0	0	0	0	0	0	0	0	0	1.8	0	3.6	5.4	3.6
20-24	6.9	0.3	0	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	21
25-29	3.4	1	0	0	0	0	0	0	0	0	0	0	0	5.5	2.7	2.7	0	5.5
30-34	2.2	0.9	0.8	0.1	0	0	0	0	0	0	0	1.3	2.6	1.3	3.9	1.3	5.2	1.3
35-39	0.9	0.9	0.2	0.1	0	0	0	0	0	0	1.4	0.7	3.5	2.8	2.8	1.4	2.8	0
40-44	0.9	0.4	0.2	0.2	0	0	0	0	0	0	0	0	0	5	0.6	1.1	3.3	1.7
45-49	0	0.7	0.6	0.3	0	0	0	0	0	1.3	0	0	0	0	1.3	3.4	3.4	2.1
50-54	0.1	0.2	3.3	0.5	0	0	0	0	0	0	0	0	0	2.7	5.4	5.4	11	11
55-59	0.4	2.2	3.1	0.1	0	0	0	0	0	0	0	0	0	0	5.2	5.2	2.6	10
60-64	0.3	24	0	1.9	0	0	0	0	0	0	0	0	0	0	0	7.2	0	7.2
65-69	7.2	1.3	24	0	0	0	0	0	0	0	0	0	0	0.8	0	1.7	0	4.2
70-74	0	51	0	0	0	0	0	0	0	0	0	0	0	0	12	0	12	0
75-79	0	0	67	0	0	0	0	0	0	0	0	0	0	0	0	19	0	6.3
80-84	0	34	0	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
85+	3.8	3.8	3.8	3.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0

0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+	AGE
0	1	0	4.5	0	0	0	0	0	0	0	0	0	1.8	0	0	1.8	7.2	15-19
4.9	0.3	4.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	63	20-24
3.8	1	0	0	0	0	0	0	0	0	0	0	5.5	0	2.7	2.7	0	5.5	25-29
1.7	0.7	0.5	0	0	0	0	0	0	2.6	0	1.3	0	6.5	6.5	1.3	2.6	1.3	30-34
0.7	0.4	0.4	0	0	0	0	0	0	0	1.4	3.5	2.1	2.8	2.8	1.4	0	0	35-39
0.7	0.5	0.4	0	0	0	0	0	0	0	0	0	3.3	3.9	3.9	2.2	1.1	0.6	40-44
0.2	0.7	0.5	0.2	0	0	0	0	0	0.4	0	0	0	0	5.6	2.6	6	3.9	45-49
0	0.9	3.8	4.7	0	0	0	0	0	0	0	0	0	2.7	5.4	0	16	11	50-54
0.4	7.1	2.4	2	0	0	0	0	0	0	0	0	0	0	15	5.2	2.6	0	55-59
9.8	1.8	1.9	0	0	0	0	0	0	0	0	0	0	0	0	7.2	29	22	60-64
0	0	3.9	0	0	0	0	0	0	0	0	0	0	0.8	0	1.7	1.7	2.5	65-69
0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	12	24	70-74
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	0	6.3	75-79
0	0	0	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	80-84
3.8	3.8	3.8	3.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	85+

AGE	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
15-19	21	0.4	0.3	1.7	0	0	0	0	0	0	0	0	1.5	4.6	4.6	1.5	1.5	0
20-24	12	0.4	0	0	0	0	0	0	0	0	0	1.7	0	3.4	1.7	1.7	0	0
25-29	5.9	3.3	0.6	0.1	0	0	0	0	0	0	0	0.7	0.7	3.7	3.7	0	2.2	1.5
30-34	1.4	0.7	0.3	0	0	0	0	0	0	0	0.8	0	0.8	2.4	0.8	1.6	2.9	3.7
35-39	1.1	1.1	0.6	0.1	0	0	0	0	0	0	0	0.4	2.4	2	0.8	0.8	2.8	4
40-44	1.4	1.3	1.3	0.5	0	0	0	0	0.5	0	0	0.5	0.9	1.4	4.1	4.1	1.4	3.6
45-49	0.7	1.9	3.4	2	0	0	0	0	0	0	0.4	0.4	0.4	0	2.5	2.9	2.1	3.3
50-54	1	5.4	1.9	2.8	0	0	0	0	0	0	0	0	1.4	1.4	3.6	1.4	4.3	4.3
55-59	6.7	0.7	4.4	3	0	0	0	0	0	0	0.7	0	0.7	0.7	0	1.5	3.7	11
60-64	4	3.6	0	8.4	0	0	0	0	0	0	0	0	1.3	0	0.7	1.3	0.7	2
65-69	35	19	1.5	10	0	0	0	0	0	0	2	0	0	0	0	0	2	3.9
70-74	0	0	110	0	0	0	0	0	0	0	0	0	0	5.8	0	0	0	0
75-79	0	0	0	0	0	0	0	0	0	0	0	0	9.8	0	0	0	0	0
80-84	12	12	12	15	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
85+	9.4	9.4	9.4	9.9	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+	AGE
2.4	4	3.3	0.6	0	0	0	0	3	0	0	0	1.5	4.6	4.6	1.5	1.5	3	15-19
3	1.7	0.3	0	0	0	0	0	3.4	0	3.4	8.4	0	3.4	5.1	5.1	0	0	20-24
3.9	2.6	0.6	0	0	0	0	0	0	1.5	0	0.7	0.7	3.7	5.2	1.5	2.2	1.5	25-29
0.9	0.8	0.3	0.2	0	0	0	0	0	0.8	1.6	2.4	3.3	1.6	0.8	1.6	3.7	6.9	30-34
0.9	1.1	1.1	0.1	0	0	0	0	0	0	0.8	2.8	0.8	0.4	1.6	1.6	2.8	6.3	35-39
1.7	2.5	1	0.1	0	0	0	0	0.5	0	0.9	0.5	0.9	5	1.4	6.8	4.1	5.4	40-44
3.1	2	5	1.9	0	0	0	0	0	0	0.4	0.4	0.4	2.5	3.3	3.7	5.4	5	45-49
1.4	1.5	11	7.3	0	0	0	0	0	1.4	0	0	0	2.9	3.6	8.7	10	2.9	50-54
1.6	7.4	5.4	1.1	0	0	0	0	0	0	0.7	1.5	0.7	0.7	0	9	8.2	5.2	55-59
53	5	2.6	16	0	0	0	0	0	0	0	0	1.3	0	0.7	4	0.7	8.8	60-64
0	0	4.3	0	0	0	0	0	0	0	2	0	0	3.9	3.9	3.9	14	20	65-69
16	0	0	0	0	0	0	0	0	0	0	0	0	5.8	0	0	12	12	70-74
0	0	17	0	0	0	0	0	0	0	0	0	9.8	0	0	0	0	20	75-79
12	12	12	15	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	80-84
9.4	9.4	9.4	9.9	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	85+

Table 8. **Inter-Household** mean time transfers matrix showing time production by age-sex groups among caregivers in the *sandwich generation*, consumed by various age-sex groups of care recipients. Note: darkest shade denotes ≈ 25+ minutes per day.

APPENDIX B – Projections of supply and demand of informal care

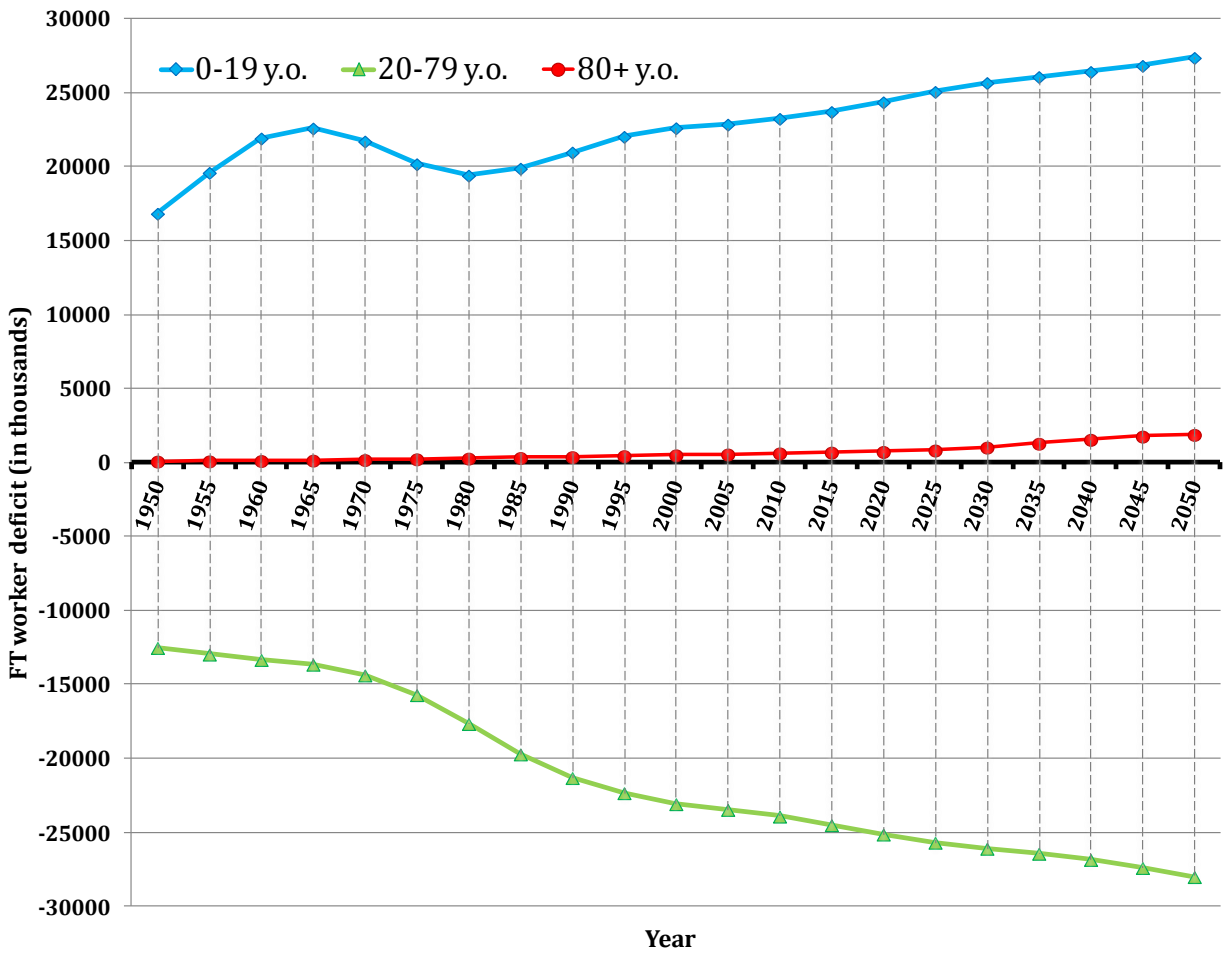


Fig. 6. Projected informal care deficit expressed in annual full-time care worker equivalent (in thousands) 1950-2050, by age group.

YEAR	INFORMAL CARE SUPPLY		CARE DEFICIT	
	Value (bln 2012 dollars)	*Value per capita ($)*	*Value (bln 2012 dollars)*	*Value per capita ($)*
1950	$ 351.61	$ 2,227.99	$ 94.76	$ 600
1955	$ 365.63	$ 2,138.97	$ 144.63	$ 846
1960	$ 380.33	$ 2,040.81	$ 187.09	$ 1,004
1965	$ 395.44	$ 1,980.30	$ 195.25	$ 978
1970	$ 418.95	$ 1,996.04	$ 161.77	$ 771
1975	$ 457.84	$ 2,086.39	$ 101.50	$ 463
1980	$ 510.55	$ 2,218.07	$ 44.27	$ 192
1985	$ 562.83	$ 2,327.00	$ 11.33	$ 47
1990	$ 604.65	$ 2,375.79	$ 1.69	$ 7
1995	$ 633.42	$ 2,363.17	$ 3.94	$ 15
2000	$ 657.93	$ 2,311.83	$ 1.70	$ 6
2005	$ 673.08	$ 2,257.41	$ (-0.20)	$ (-1)
2010	**$ 691.03**	**$ 2,213.10**	**$ -**	**$ -**
2015	$ 712.36	$ 2,191.01	$ (-1.33)	$ (-4)
2020	$ 36.64	$ 2,179.51	$ 0.09	$ 0
2025	$ 758.88	$ 2,164.35	$ 5.43	$ 15
2030	$ 776.14	$ 2,140.31	$ 13.74	$ 38
2035	$ 790.28	$ 2,116.07	$ 20.76	$ 56
2040	$ 804.36	$ 2,099.25	$ 24.80	$ 65
2045	$ 820.64	$ 2,092.88	$ 26.64	$ 68
2050	$ 838.78	$ 2,092.50	$ 27.50	$ 69

Table 9. Summary of projected economic value of informal care production and care deficit 1950-2050, in 2012 dollars and estimated $10.31 mean hourly wage.

APPENDIX C – Miscellaneous characteristics of the sample

Matrix type	Age group	All Caregivers			Sandwich Generation			Total ATUS sample (general population)		
		Male	*Female*	TABLE #	*Male*	*Female*	TABLE #	*Male*	*Female*	TABLE #
Overall	15-19	243	281	**2**	19	23	**3**	1061	1000	**4**
	20-24	173	396		11	39		715	842	
	25-29	326	924		25	86		999	1509	
	30-34	724	1320		58	127		1430	1914	
	35-39	856	1318		68	126		1558	1934	
	40-44	787	1202		68	114		1692	1903	
	45-49	563	864		62	90		1545	1774	
	50-54	434	581		33	59		1550	1702	
	55-59	291	430		15	44		1408	1673	
	60-64	220	361		17	35		1278	1529	
	65-69	200	296		14	17		1047	1335	
	70-74	116	198		7	12		661	1038	
	75-79	79	118		6	6		511	831	
	80-84	54	91		3	4		387	725	
	85+	29	40		1	1		236	520	
Intra-Household	15-19	104	155	**5**	10	15	**6**	-	-	**-**
	20-24	88	328		8	31		-	-	
	25-29	239	861		21	82		-	-	
	30-34	623	1254		53	124		-	-	
	35-39	752	1257		66	124		-	-	
	40-44	685	1102		65	108		-	-	
	45-49	444	709		58	83		-	-	
	50-54	299	386		28	46		-	-	
	55-59	155	192		12	34		-	-	
	60-64	92	141		10	22		-	-	
	65-69	78	88		7	6		-	-	
	70-74	42	71		3	5		-	-	
	75-79	31	37		3	2		-	-	
	80-84	20	20		1	0		-	-	
	85+	11	12		1	0		-	-	
Inter-Household	15-19	156	147	**7**	16	17	**8**	-	-	**-**
	20-24	98	100		8	28		-	-	
	25-29	111	135		16	53		-	-	
	30-34	141	169		34	76		-	-	
	35-39	149	170		35	71		-	-	
	40-44	148	211		36	72		-	-	
	45-49	166	249		33	52		-	-	
	50-54	159	250		17	47		-	-	
	55-59	154	274		10	33		-	-	
	60-64	136	245		12	30		-	-	
	65-69	133	221		11	16		-	-	
	70-74	80	135		7	12		-	-	
	75-79	53	83		5	5		-	-	
	80-84	35	71		3	4		-	-	
	85+	19	28		1	1		-	-	

Table 10. ATUS 2011-2013 sample distribution across various matrices presented in the analysis, by age and sex of caregivers (production). Total ATUS 2011-2013 sample size is 36,307.

Note: The sum of Intra- and Inter-Household samples exceeds the total sample in the Overall matrices due to a large number of caregivers who provide care to people both inside their immediate households and outside of them.