**Incorporating Gender[[1]](#footnote-1) and Time Use into NTA:**

**Estimating NTA and National Time Transfer Accounts by Sex**

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Previous version was April, 2013.

Method changes since the previous version are highlighted with footnotes describing the rationale.

See Appendix C at the end of this document for a list of pending issues that need to be addressed.

Please email gretchen@demog.berkely.edu with any comments, suggestions or questions.

# 1. Introduction

The National Transfer Accounts (NTA) project examines how people produce, consume, share and save by age for many different nations and times. A natural extension of the NTA perspective is to add sex as an additional characteristic. This involves two distinct efforts: disaggregating the current national accounts-based NTA by sex, and adding a satellite account for time inputs, here called National Time Transfer Accounts (NTTA). Time inputs include productive activity that is not already accounted for in national accounts.[[2]](#footnote-2) We will refer to this as “household production.”[[3]](#footnote-3)

The development of NTTA is conceptually linked with gender due to the prevalence of women’s specialization in production outside of national income. Simply disaggregating NTA profiles by gender without adding the NTTA data on time use would give a misleading picture of productive activity and contributions to the household (Waring, 1999). Instead, when we incorporate household production and market production into our understanding of economic lives, we open up possibilities for new research questions. Some of these questions are historical and philosophical – how did gender specialization come about, how is it changing, is it fair, is the specialization maintained by coercion and discrimination or is it the product of free choice? This is not just a matter of women’s opportunities, either, as enforced gender niches restrict the opportunities available to both genders. Beyond questions of ethics, there are questions of efficacy and efficiency – is it the most efficient use of resources to restrict how each person contributes to the economy based on gender? When societies invest in the human capital of their members, are some of those investments wasted if we do not allow each person to deploy his human capital in those areas in which he or she has particular gifts that confer a competitive advantage? Is productivity helped or hindered by gender specialization?

In addition to issues of gender, accounting for time spent caring for others is important for many other reasons that are relevant to NTA research concerns. If we wish to understand the full age-nature of consumption and production, we should include time inputs along with market inputs. For example, the production of a family dinner includes not only the inputs of food growers, but of home cooks as well. The family consumes not just the food items, but also the time of the home cook. A child at the dinner table receives a transfer of the value of the food, along with a transfer of the time spent cooking it. Time use is also important for accurately valuing human capital investment and the cost of youth and old age dependency. Preliminary results show that the cost of an infant in parents’ time far outweighs the cost of market goods and services purchased for that infant. Measuring those time inputs gives us the total cost of children. This type of measurement also allows us to examine tradeoffs between money and time: are intra-household transfers received by co-resident elderly offset by their time spent in child care, cooking, or other home production that is transferred to others in the household? Or are co-resident elderly even costlier when we include time spent caring for them by younger household members? Are bequests to adult children planned in an elderly person’s will related to the time transfers he receives from them?

Measurement is the first step in answering all of these research questions and this document lays out the methodology for estimating NTA by sex and NTTA by sex as well. The methodology is based on the efforts of a working group on gender, chaired by Gretchen Donehower. Several members of that group met in Berkeley in June, 2011 to share their research experience and discuss best practices for this work. Since that first workshop, many other NTA teams have begun to estimate NTA by sex and to add time-use based NTTA accounts, also by sex. Further refinement of the methodology was possible after sharing results at the Eighth NTA Workshop in Brazil in December, 2011, at the European NTA group’s meeting in October, 2012, and at the Ninth NTA Workshop in Spain in June 2013. The process of improving and refining the methodology is ongoing, so this document will certainly be revised in the future.

Please send all comments to Gretchen Donehower at gretchen@demog.berkeley.edu. Also, contact her if you would like to be included in the NTA Working Group on Gender and Time Use.

# 2. NTA by Sex

### 2.1 Introduction

The discussion in this section starts with a brief review of NTA notation, although it is assumed that anyone working on this topic already has a detailed knowledge of single-sex NTA methodology and has calculated a full set of NTA single-sex age profiles or at least the lifecycle deficit NTA age profiles (consumption and labor income). The two main parts of incorporating gender into NTA follow: find sex-specific indicators of NTA age schedules, and then adjust those schedules so that they are consistent with the single-sex NTA profiles and with macro controls. Finally, a brief discussion recommends several sensitivity tests that produce comparable estimates under different assumptions.

### 2.2 NTA review and notation

This material is covered in detail in the main NTA manual (United Nations, 2013) and on the NTA wiki sections detailing methodology (http://ntaccounts.org/web/nta/show/Documents/Methods). I include a brief review here. Each NTA age profile consists of two parts. First, we need a cross-sectional set of age-specific averages of the activity (referred to here as the age schedule), giving the relative per capita amount of that activity by age. Second, we need an aggregate measure of an economic activity from national accounts to serve as a macro control. We then find a multiplicative adjustment factor that shifts the entire age schedule up or down so that the aggregate NTA amount matches the control, given the population age distribution.

To introduce the notation that will be followed throughout, here is the adjustment to the single-sex macro control in equation form:

 $a$: age a, ranges from 0 to ω (usually 85+ or 90+)

 $N\left(a\right)$: population count, age a

 $X$: macro control

 $x(a)$: per capita age schedule, age a

 $θ=X / \sum\_{a=0}^{ω}x\left(a\right)N(a)$: adjustment factor

 $\tilde{x}\left(a\right)=θx(a)$: per capita NTA age profile, age a

 $\tilde{X}\left(a\right)=N(a)\tilde{x}\left(a\right)$: aggregate NTA age profile, age a

Separate treatment of gender in these accounts means age schedules and age profiles are estimated by sex. Sex-specific items will be indicated with an additional index *g* as follows:

 $N(a,g)$: population count, age a, sex g

 $x(a,g)$: per capita age schedule, age a, sex g

To create sex-specific age profiles, you find *x(a,g)* for both sexes, and adjust both age schedules so that they are consistent with the macro-adjusted single-sex age profile $\tilde{x}\left(a\right)$. This means that the adjustment is different at different ages but is the same for both sexes at each age group. More details on this process are given below.

### 2.3 Sex-specific Age Schedules

#### Age schedules when data are available by individual’s age

Data are readily available for many types of economic behavior to estimate age schedules by sex. When single-sex age schedules are calculated from individual-level survey data, the survey typically includes sex as a variable along with age. Use the same variables that are used in single-sex NTA to indicate the age schedule of a particular activity and collapse to age- and sex-specific means instead of just age-specific means, as in single-sex NTA, to get age schedules by sex.

Administrative records are sometimes used to estimate age schedules of public benefits and these are sometimes published by age and sex, or requests for special tabulations can be made to statistical agencies. Generational Accounts, which require many of the same data as NTA public sector accounts, are always estimated by sex as a preliminary data step, so where it is possible to calculate inputs to Generational Accounts, those same inputs might be used as NTA age schedules by sex.

#### Age schedules when data are available for households

When the age profile is based on household-level data, NTA uses two main methods to allocate household-level data to individuals by age: 1. data-driven methods like regression or iteration, or 2. assumed relative age shares (equivalent adult consumer weights).

When regression or iteration is used to estimate age shares, sex should be added to the model. The examples given below show models with separate age factors for men and women, but other formulations that include sex could be explored, such as including a single additive term after the age terms. If researchers explore these other options, they should decide based on goodness of fit tests which model is the most appropriate.

For example, a regression equation used for estimating the NTA age schedule of education consumption when an enrollment indicator is available is as follows:

$$X\_{j}=\sum\_{a}^{}α\left(a\right)E\_{j}\left(a\right)+\sum\_{a}^{}β\left(a\right)NE\_{j}\left(a\right)+ε\_{j}$$

where $E\_{j}(a)$ is the number of enrolled members age *a* and $NE\_{j}(a)$ is the number of unenrolled members age *a*. Note that where appropriate for the variable X, age *a* is grouped in 2- or 5-year groups to reduce noise. The positive $α(a)$ and $β(a)$ coefficients are assigned to the relevant age groups and used as weights to distribute the household amount spent on education. To add sex into this equation, we can double the number of coefficients by estimating $α\left(a,g\right)$ and $β(a,g)$ for each sex *s*:

$$X\_{j}=\sum\_{a}^{}\sum\_{s}^{}α\left(a,s\right)E\_{j}\left(a,s\right)+\sum\_{a}^{}\sum\_{s}^{}β\left(a,s\right)NE\_{j}\left(a,s\right)+ε\_{j}$$

There are several other models described in the NTA manual section on consumption that might be used. In addition, see the appendix of pending issues for a discussion of different regression specifications and methods to implement these. To expand those to include sex, follow the same principle that is described above: where an NTA regression equation has one term for a particular age group, expand that to two terms for the age and sex group.

For some other types of profiles, mainly private consumption, NTA uses assumed relative age shares, also called equivalent adult consumer (EAC) weights. For sex-specific profiles, the same EAC weights should be used for same-aged males as females. Some gender differentiation will still show in the final age schedules because different amounts of consumption will be observed depending on the age and sex distribution of households.

While this method will be used so that the sex-specific profiles will be consistent with the existing NTA methodology, it is important to note that the assumption of same age males and females receiving the same share of household resources is a very strong assumption. It is strongly encouraged that country teams explore regression methods for general consumption to see if there is any significant difference between the results with the strong equality assumption. If possible, separate regressions should be estimated for different types of consumption, such as separating out food at home, food outside the home, alcohol, tobacco, transportation, etc. The regression methods are still unable to detect any differential consumption when same age males and females share a household, but there is usually enough diversity in the age- and sex-distribution within households that if there is strong gender differentiation in consumption, at least some of it will be picked up by regression methods.[[4]](#footnote-4)

#### Age schedules from imputation

Some age profiles are not observed directly, but instead are imputed based on NTA methodology. Specifically, age profiles for intra-household transfers are imputed based on the results of other NTA age profiles and an assumed sharing model, and the private saving profile is computed as a balancing residual of all other profiles. The sex-specific versions of these profiles should be computed in much the same way as for the single-sex profiles.

For intra-household transfers, the procedure should be the same as for single-sex: the sharing algorithm is computed using control-total adjusted microdata. That is, the profile values for the “ingredients” of the intra-household sharing model for each individual (not the age group averages) should be adjusted as described in the section below with the age-specific factor that makes the sex-specific profiles consistent with the macro-adjusted single-sex profiles. Then the same algorithm as for the single-sex version can be run. As for other types of profiles, the results should be collapsed by age- and sex-specific means.

For private saving, the age profile is the final balancing residual for all of the other profiles: labor income plus net transfers plus asset income minus consumption. The only modification for the two-sex version is that the calculation is done separately by sex, using only “ingredient” age profiles for that sex.

#### Smoothing

In NTA, we smooth age schedules to reduce noise and produce more informative visual representations. Schedules by sex may need more careful statistical smoothing than those for single-sex NTA due to the smaller sample sizes but the implementation is the same. Researchers must examine and adjust the smoother by the same means as when estimating single-sex NTA, to preserve real discontinuities which might be brought about by public program incentives or age-defined cultural practices, but to eliminate as much as possible statistical noise introduced by sampling or other types of random variation.

### 2.4 Adjustment to macro controls and for consistency with single-sex NTA

Once the age schedules have been calculated and smoothed, researchers must implement an adjustment so that the sex-specific age profiles are consistent with the macro controls and also with the single-sex NTA estimates. Note that we do not have sex-specific national accounts, so instead of adjusting the sex-specific NTA profiles to macro controls, we instead implement an adjustment so that the sex-specific profiles are consistent with the macro-adjusted single-sex profiles.

Specifically, we must adjust both the male and female profiles at each age so that they are consistent with the single-sex profile that has been adjusted to the macro control. The adjustment factor for a profile at age *a* is the ratio of the single-sex macro-adjusted profile value at that age to the weighted average of the unadjusted sex-specific age schedules:

 $θ\left(a\right)=\frac{\tilde{x}\left(a\right)}{x\left(a,mal\right)N\left(a,mal\right)/N(a)+x\left(a, fem\right)N(a, fem)/N(a)}$ : adjustment factor, age a

 $\tilde{x}\left(a,s\right)=θ(a)x(a,s)$: per capita NTA age profile, age a, sex s

 $\tilde{X}\left(a,s\right)=N(a,s)\tilde{x}\left(a,s\right)$: aggregate NTA age profile, age a, sex s

This produces an age schedule of adjustment factors which are applied to each age of the male and female age schedules. The factors differ by age, but within age the factor is the same for men and women. After this adjustment, the male and female age profiles will be consistent with the single-sex age profile, and will have a combined aggregate total equal to the macro control.

### 2.5 Recommended sensitivity tests

As part of this work, we want to explore different ways to produce gender estimates in NTA. Sensitivity tests can be an important part of this work, examining different implementations to see if we get a different picture of results by sex. Two further studies are recommended here, once researchers are finished with the sex-specific NTA estimates as described above. The first involves experimenting with different techniques to estimate within-household allocations for quantities that we only observe directly at the household level. The second involves changing our assumptions about household headship.

As mentioned above, there are many reasons that the assumption of equal gender weights when using equivalent adult consumer weights may be misleading. These weights are used to allocate private consumption within the household. Researchers should examine the private consumption results using an alternate data-driven method such as iteration or regression to get a different allocation to compare. For example, apply the same regression method used for health or education, without any utilization measures, use the coefficients to allocate the household amount, and compare the resulting profiles with those obtained under the equal gender weights assumption.

The role of headship is the other area where NTA methodology may be having a large role in producing patterns by sex. Headship is determined in survey data and the household head is assumed in NTA to be the only one in the household who can own assets, go into debt, give or receive inter-household transfers, and give or receive intra-household transfers based on owned assets (like owned housing). When we calculate a single-sex asset income profile, the headship assumption will not matter much for the case of two spouses of similar age. One is assumed to have all the assets, the other none, but they are averaged together in the age profile. Separate these age profiles by sex, however, and in many contexts different assumptions about who is the household head will create very different gender-differentiated age profiles.

Researchers are encouraged to try different definitions of headship to determine the sensitivity of results by sex to the headship definition. Some possible definitions of headship are:

1. Survey-defined (this is the NTA default)
2. Highest wage earner in the household
3. Owner or renter of housing unit (if available in survey)
4. Equal headship (assign headship-related roles equally to all adults in the household)
5. Proportional headship (assign all assets and other headship roles to adult in the household based on their wages or some other indicator)

As headship in NTA mainly impacts estimates through the ownership of assets, the ideal would be to identify the head as the owner of the assets in question. For allocations related to housing, the head is the legal owner or renter, divided among any multiple owners. For allocations related to asset income, the head is the owner of the assets. As most surveys will not include this level of information, researchers should examine the default survey definition of headship and then identify at least one plausible alternative definition to establish and report a range of possible estimates. Understanding the role of headship is another priority for future refinements in this methodology.

# 3. NTTA by Sex - Accounts Based on Time Use Data

### 3.1 Introduction

Using time use survey data, the basic estimation strategy is as follows:

* + 1. identify available time use surveys
		2. identify time spent on household production activities by age and sex
		3. find appropriate wages to impute the value of the time spent on those activities (this creates the NTTA production age profile, the equivalent of labor income in NTA)
		4. use assumptions and time use survey data on household composition to impute the age of the consumers of the household production time
		5. use existing NTA methodology to impute household production time transfers for men and women

Each step is examined in more detail below. These five steps account only for the labor component of household production. The final sub-section of NTTA by Sex discusses including the capital component of household production.

### 3.2 Identify available time use surveys

Ideally, we want to estimate NTTA using a time use survey with characteristics similar to the household surveys we use to calculate NTA:

* nationally representative
* each household members’ age and sex should be listed[[5]](#footnote-5)
* roughly the same time period as NTA calculations
* able to represent an annual amount of time spent (i.e. time use information includes the impact of weekends, holidays or any other special times)
* complete time use data for at least one person in each household
* hours in a day add up to 24 or close to it, or omitted hours are understood to be non-productive[[6]](#footnote-6)

There are far fewer time use surveys than household consumption or income surveys, so researchers may have to compromise on some of these characteristics. Your time use survey may end up being for a particular sub-region of the country, or not list household members or time use activities in sufficient detail to allow for the calculation of the complete NTTA system of production, consumption and transfers. Even if you are only able to calculate production of time for some portion of the population, it will still be useful to compare to NTA results. Also, NTA results can be calculated differently to facilitate comparability with NTTA, for a particular sub-region, for example.[[7]](#footnote-7)

### 3.3 Identify time spent on productive activities not included in national income

We want to include in these satellite accounts those activities that would be included in national income were they performed for wages instead of by non-market labor. One way to determine if an activity meets this standard is the “third party criterion”: you can pay someone else to do it (Reid, 1934). Thus activities like sleeping, eating, sports and leisure activities would not be included, but any home management or care activities would be.[[8]](#footnote-8) The activities we are interested in recording are not included in national income, but could be if they were contracted for instead of unpaid.

There are many different ways to classify activities, and you will have to work with your own survey, but here are two examples of classifications and where to look for household production activities. The first example is in Table 1, showing the trial International Classification of Activities for Time Use Statistics (ICATUS), maintained by the UN (<http://unstats.un.org/unsd/methods/timeuse/icatus/icatus_2.htm>). Major activity groups are shown and those which are not included in national income but would be if they were contracted for are shown in bold and starred. Note that categories 1-3 represent contracted time already included in national accounts. Categories 0 and 7-9 represent activities that could not be performed by someone else for you, so they do not meet the third party criterion.

Table 1. Major groups in the ICATUS. Categories of productive activities not in national income are bold and marked with \*.

|  |
| --- |
| 1. Personal care
 |
| 1. Employment for establishments
 |
| 1. Primary production activities not for establishments
 |
| 1. Services for income and other production of goods not for establishments
 |
| 1. **Household maintenance, management and shopping for own household \***
 |
| 1. **Care for children, the sick, elderly and disabled for own household \***
 |
| 1. **Community services and help to other households \***
 |
| 1. Learning
 |
| 1. Social, cultural and recreational activities
 |
| 1. Mass media use
 |

Table 2. Major activity categories in the ATUS. Categories of productive activities not included in national income are bold and marked with a \*. Categories which contain such activities along with other types are marked with a †.

|  |
| --- |
| 1. Personal care (mostly sleep)
 |
| 1. Household activities †
 |
| 1. **Caring for and helping household members \***
 |
| 1. **Caring for and helping non-household members \***
 |
| 1. Work and work-related activities
 |
| 1. Education
 |
| 1. Consumer services †
 |
| 1. Professional and personal care services †
 |
| 1. **Household services \***
 |
| 1. Government services and civic obligations †
 |
| 1. Eating and drinking
 |
| 1. Socializing, relaxing and leisure
 |
| 1. Sports, exercise and recreation
 |
| 1. Religious and spiritual activities
 |
| 1. **Volunteer activities \***
 |
| 1. Telephone calls †
 |
| 1. Traveling †
 |

If your survey does not follow the classification in Table 1, see the UN documentation for more details on what is included in the three relevant categories. Another example is the classification of time used in the American Time Use Survey (ATUS), shown in Table 2. There the major groups of activities we are interested in are bold and starred, but for some activity groups, some of the activities are relevant and others are not. These are marked with a dagger.

As you can see in Table 2, there is more mixing of activities by productive and national income status in the ATUS classification. There, a researcher must go through each type of activity and decide one by one whether it meets the criteria for inclusion (not in national income, but could be if paid for, and meets the third party criterion). However, we all want to end up with the same general list of activities. Table 3 shows the overall list of eleven groups of activities that country teams should follow, data permitting. As an example, Appendix A included at the end of this document gives the detailed list of activity codes used by the US group to create the eleven activities in Table 3 from the “Activity Lexicon” used in the American Time Use Survey.

Table 3. Grouping of household production activities in NTTA.[[9]](#footnote-9)

|  |  |
| --- | --- |
| **Time Use Activity** | **Quality Adjustment** |
| 1. Cleaning | 0.75 |
| 2. Laundry (includes sewing and clothing repair) | 0.75 |
| 3. Cooking (food and drink preparation) | 0.75 |
| 4. Household maintenance and repair | 0.75 |
| 5. Lawn and garden care | 0.75 |
| 6. Household management (incl. finances, scheduling, coordinating, and related telephone calls) | 0.75 |
| 7. Pet care (not veterinary care) | 1 |
| 8. Purchasing goods and services | 1 |
| 9. Childcare | 1 |
| 10. Eldercare and care outside the home (includes volunteering) | 1 |
| 11. Travel (related to care activities and purchasing goods and services) | 1 |

Note that the care variables (9 and 10 in Table 3) involve care of those inside or outside of the household. While these are shown as one category in the table because we will use one imputed wage for the whole category, researchers should estimate the care variables in two parts: one where the care is of persons inside the household, the other is where the care is going to persons outside of the household. This will be important when we impute the age profile of consumption of care.

Some activities in Tables 1 and 2 represent human capital investments that we might be interested in, except that they are done for oneself, such as education or attending to one’s health. While we would be interested in these categories for an analysis of total human capital investment, we would not consider them in NTTA accounts because they do not meet the third party criterion and could not be traded in a market.

Also, when we think of some aspects of time spent on caring for others, it is unclear whether those activities should be considered productive work or leisure. Is taking a child to the movies leisure for the parents or care for the child? While this is conceptually ambiguous, the time use survey instrument will probably have made that decision for you at the time the survey respondent decides whether the activity was “going to the movies” or “childcare.” As a general principle, though, we would like to recognize this as childcare instead of leisure because you could pay someone else to take your child to the movies. Also, if you did not spend that time with your child, you would have to get someone else to provide that care, even if the care is just sitting next to the child. Pet care is another potentially ambiguous task. While you may walk your dog or play with him as a leisure activity, you could pay someone else to do it, so we include it as a productive activity. As a final related argument, there may be many pleasurable aspects to one’s paid employment, but the market does not deduct from your wages if you are having too much fun at work. Household accounts should not do this either.

A final note about gathering up the relevant activities pertains to “multitasking.” In some surveys, more than one activity can be reported for a unit of time. For example, in the American Time Use Survey, respondents report a primary activity but are also asked if any of the time spent on that activity was concurrent with secondary childcare[[10]](#footnote-10) or with eating and drinking. Unfortunately, there is great diversity across time use survey instruments in how questions about secondary or overlapping activities are framed. This undermines the great strength of NTA, which is our ability to compare results across countries. For this reason, we will not include any information on multitasking, overlapping activities or secondary activities in our comparative NTTA results.

However, countries with surveys that include this type of data are strongly encouraged to estimate a set of age profiles which include multitasking, as it may suggest the potential downward bias of our estimates due to missing the impact of multitasking. Furthermore, the policy makers in your country will most likely be interested in the results, even if they are not comparable to estimates from other countries. Methodology notes on handling multitasking are included in the footnote at the end of this paragraph.[[11]](#footnote-11)

After identifying relevant activities, researchers should do a good bit of exploration of the time data by age and sex before moving on to the next step of imputing a wage. Age profiles of productive time use alone are worth exploring in their own right and indicate the degree of specialization by gender in an economy. Often those results will be the most interesting to any audience because while we all may have different jobs in the marketplace, we all have to accomplish the same basic tasks at home. Also, the greater the specialization in time use by gender, the harder it will be to impute a proper wage because there will be greater differences between the economy represented in national accounts and that within the household. This should be stated upfront in any papers or presentations.

Finally, the time should be estimated at an annual level to be consistent with the annual amounts estimated in NTA. If the survey represents one week, it should be multiplied by 52. If it represents a day, multiply by 365, and so on.

### 3.4 Impute a wage to productive activities not included in national income

#### Valuing inputs versus outputs

While time-based differences are crucial for understanding the gendered nature of production, the ultimate goal is to compare NTTA with NTA, so we must transform time units into monetary units. If these activities were included in national income, how much would they be worth? The method used here has a very big impact on the final NTTA accounts.[[12]](#footnote-12)

National income includes the total value of production, which is determined in the market when the produced good is bought by someone for a particular price. The inputs to production are labor and capital. The value of the labor inputs is indicated by wages and the value of the capital services is what is left over from selling goods after the labor has been paid. To make NTTA comparable to NTA based on national income, we would ideally want to value what is produced in the time spent (Abraham and Mackie, 2005). What would the price of each service be? But that is very difficult from a data perspective. We would need additional data sources on the price and quality of each *output* activity. Instead, we choose to estimate the value of the labor *inputs* only in NTTA, and value the time spent by the wage that would be earned by someone doing the activity, instead of the price that someone would pay to have that activity performed. This decreases the data burden and removes many other methodological problems such as how to avoid double counting production that involves purchased and un-purchased inputs. An example of this would be valuing a home-cooked meal: national accounts already include the value of the raw food inputs, so how do we identify a comparable price in the market for just the cooking inputs? Thus, the time inputs will be valued by their wage value, not their production value. This may mean that NTTA estimates are biased downwards – if a person is doing home production rather than working in the market, then the value of time in home production must be higher than the value of time in the market – but there seems to be no other way to produce estimates.

#### Valuing time inputs: specialist replacement method

Following NTA’s focus on measurement, we will use the “specialist replacement” method to value time inputs – if the person had to pay someone else to perform each task, how much would it cost? We find an appropriate wage for persons in the market performing each activity in Table 3, with a different wage for cleaning, cooking, childcare, etc.[[13]](#footnote-13) Consult a study or survey on labor and earnings for the time period in question and find the average hourly wage relevant to each activity in Table 3. Most labor surveys produce tables of average wages by job or occupation and it is likely much easier to use these tables than the microdata from the surveys. An average of babysitter, childcare worker and early education teacher wages would apply to time spent doing child care; a maid or janitorial service wage would apply to time spent cleaning; and a food service wage would apply to time spent preparing food, serving it and cleaning up after. Be careful to choose wages for jobs which an average person could actually do. For example, time spent fixing the house should be valued at a handyman’s wage instead of a skilled carpenter’s wage, or an electrician’s or a plumber’s, depending on the job. Certainly some persons fixing their own houses may have the skills of a trained carpenter, electrician or plumber, but most will not. Of course, broad classifications of activities will involve broad levels of skill. Some home cooks will approximate the production of an executive chef, some a short-order cook. Using population-weighted average wages across various levels of occupations will address this issue. Taking the average wage across all food service occupations will include the wages of executive chefs, short-order cooks, and dishwashers. If you weight the average by the number of people employed in each type of occupation, you achieve some measure of likely distribution by which skill levels and particular types of activities are also distributed across households.

Researchers should use their country-specific knowledge to imagine what kind of worker a householder would hire to replace his or her own time inputs. As more countries gain experience implementing this methodology, we hope to find a standardized way to identify occupations for imputing wages. Be sure to keep a table of the wages used and what occupations or job classifications they represent, as that will be an important table to report in any published work and an important piece of information for the NTA project to gather so we can compare and possibly modify this part of the methodology. As an example, Appendix B presents the wage table used in the implementation of this methodology for the United States, 2009 NTTA accounts shown in Figure 3. We will use the same imputed wage for men and women doing the same task.[[14]](#footnote-14)

Note that overall NTTA results will be very sensitive to the method chosen for wage imputation. See the later section on “Sensitivity Tests” for suggestions to evaluate this impact.

Before moving on to more specifics, a final note about selection bias is warranted. Any imputation of wages for unpaid work based on data from paid work is bound to have selection bias: a sample of experience in the market is bound to be different from the conditions outside of the market. There may be systematic differences in productivity, use of capital, and investment between the paid workplace and the household, and different people with different skills and abilities may choose to specialize in home production versus market production. As much as possible, these considerations should be included in our wage imputation methods and adjustments made to correct for bias when feasible.

#### Taxes and Other Adjustments for Total Labor Costs

An issue in valuing time is whether the valuation should be on a pre-tax or post-tax basis. As a default, NTTA accounts will be based on pre-tax imputed wages. Pre-tax values are relevant to questions involving the total cost of care.[[15]](#footnote-15)

In an issue related to taxes, there are other payments which may make the market wage different from the value of the time spent in the market. If employers must pay payroll taxes for each employee, then the pre-tax imputed wage should include the value of those payroll taxes, on the idea that they were provided to the employee, but immediately taxed by the government.[[16]](#footnote-16) If an employer must pay an additional amount to the government for each employee for social protection insurance, we would consider that part of the value of the employee’s time input, even if that employee does not see that cost on his paycheck as part of his wage. For example, in the United States, employers match the contributions of employees to Social Security and Medicare schemes to a total of an additional 7.65% of the employees earnings, although that is not part of the wage the employee sees on his paycheck. Thus, in NTTA we want to make sure our imputed wages valuing household production are increased to reflect that, if this activity was done in the market, the value of the labor input would be necessarily be higher than just the average wage as observed in a labor force survey.

Finally, NTTA will not be adjusting estimates for differences in quality or efficiency in home versus market production, or adjusting for potential differences in efficiency by age. Although there are compelling arguments for these adjustments, we have not developed a feasible empirical method for determining their magnitude.[[17]](#footnote-17)

NOTE THAT IMPLEMENTING AN AGE-PRODUCTIVITY CORRECTION IS A MAJOR PENDING ISSUE.

### 3.5 Estimate age schedules

#### Production

If you have gotten this far, with activities identified and wages assigned to those activities, then take the average wage-weighted time spent in each group of activities, by age and sex, to create the NTTA age schedules for production. Make sure to include zeros in the average for people who do not perform the activity.

Researchers may want to aggregate the eleven activities in Table 3 for reporting and analysis, but for calculating other age profiles down the line, you need to maintain the activities in separate profiles. The consumption of general household activities (Table 3 activities 1-8 and 11) will be calculated differently from those targeted to specific individuals (Table 3 activities 9 and 10).

#### Consumption

We do not directly observe people consuming the value of the time in the NTTA production account. Instead, we use assumptions to allocate the value of time in production to consumers in the household. Often in time use surveys, we know the age and sex of everyone in the household, but only have the time production of one person in the household, and only have sample weights provided to produce accurate point estimates based on age and sex of the person who gave the time use information. Thus, after the estimates of time production are completed, in units of time and money, estimating the consumption of that time (and transfers, in the following sections) involves several more steps:

1. For each time respondent age A and sex G, create variables for each activity assigning the time produced to the age A’ and sex G’ of the consumer
2. Using survey weights, collapse to age-sex group averages, so that the each line in the data is for age A and sex G and each variable indicates the average time consumed of a particular activity produced by persons age A and sex G consumed by persons age A’ and sex G’
3. Multiply each row of the collapse data by the number of persons age A and sex G to get an aggregate matrix of production and consumption.
4. Divide each column by the number of persons age A’ and sex G’ to get a matrix of average consumption of activities produced by persons age A and sex G
5. Sum each column to get the total consumption of persons age A’ and sex G’

In step i. in the list above, we have different rules for imputing the consumption depending on the type of activity and whether it benefits those within the household or outside of it. For general activities within the household (cleaning, maintenance, etc.), the time produced is divided equally among all household members. This makes the most sense theoretically because the consumption of these activities is mostly uniform across the household, or at least the data to make finer consumption distinctions is not available. For example, certain age groups in the household may make more of a mess, requiring more household cleaning to be done, but all household members consume the cleaned house equally, or if not equally then the data to make a better assumption – how much time each household member spent in the household – is not available.

For age-targeted care activities in the household, however (childcare, adult care, or eldercare), the regression approach should be used, with the utilization indicator being membership in the target age group. The target age group will be determined by how the survey was conducted. If the survey defines “childcare” as care for those aged 0-18, for example, then do the regression equation in one- or two-year age groups for ages 0-18. This regression methodology is the same as in NTA private health and education consumption allocations – a regression equation is estimated based on total household amount of care and the numbers of people in each age group who are potential targets of that care. Make sure that the producer of the care is not included in the regression estimation because he or she is not a potential target of the care. The regression equation generates coefficients that are used as weights in allocating the household amount to individuals. The reason for using regression for care is that infants and very elderly adults definitely require more care than older children or younger elderly. Our regression approach will not capture all of these differences, as it only works by detecting the variability between households of different age and sex composition, not actual differences within households of similar age and sex composition. It is at least no worse than the equal allocation assumption and, in fact, gives similar results in countries where fertility is low and there is little intergenerational coresidence because there is less variability across households to exploit.

For time caring for persons outside of the household, if there is no indication of the specific age and sex of the person being cared for, distribute the production equally to all persons in the target population. If there is an indication of who is being cared for outside of the household, assign the production to the age and sex of that person.[[18]](#footnote-18) For care activities in general, if the survey indicates the recipient of the care, the consumption should be assigned to the target individual. If the survey indicates only the broad age characteristics of the recipient, the consumption should be assigned to all those in the targeted age group, to the sexes in proportion of their representation in that age group. If nothing is known about the care targets, the care should be divided equally among all potential recipients. Design the computing of this to/from matrix carefully as it is also used in the calculation of transfers.

NOTE THAT ALLOCATING CONSUMPTION OF INTER-HOUSEHOLD CARE IS A PENDING ISSUE AND WE MAY SWITCH TO ASSUMING THAT THE RELATIVE AGE LEVELS OF CONSUMPTION OF THAT INTER-HOUSEHOLD CARE IS THE SAME AS THAT IMPUTED TO INTRA-HOUSEHOLD CARE.

Once all of the production is allocated as consumption, then steps ii. through iv. are straightforward. A “toy” example with a five household sample population and a reduced list of activities and age groups is worked through in a spreadsheet that has been uploaded to the NTA wiki, on the page for the Working Group on Gender and Time Use (http://ntaccounts.org/web/nta/show/Gender%2c%20Time%20use). It is accessible here: <http://ntaccounts.org/doc/repository/Methodology%20Example%20Spreadsheet.xlsx>. Note that this document is currently accessible to members of the NTA network only.

#### Inter-household transfers

For inter-household transfers, start with the same matrix of production and consumption of care as described in the section on consumption above, but only for those activities where the target of the care is outside of the household. These are the activities in Table 3, items 9 and 10, whose targets are outside of the household. Take all of the production based on this time caring for persons outside of the household as the transfer outflow for the person performing the care. Similarly, all of the consumption of that time is the inflow. The calculations of inter-household transfers are also shown in the “toy” example spreadsheet mentioned above and available on the NTA wiki page for the Working Group.

#### Intra-household transfers

There are two types of intrahousehold time transfers: targeted care (Table 3 activities 9 and 10, where the targets are household members) and time spent benefitting everyone in the household (Table 3 activities 1-8, 11). The intra-household flows for targeted care activities are calculated just as inter-household flows: the production of these activities is the outflow and the consumption of these activities is the inflow.

For general household activities, you create the same to/from matrix of production and consumption, but leave out the time that one spends producing for one’s own consumption. For example, if I spend one hour making dinner for my family of four, I produce an hour of time and we each consume one quarter of an hour. However, I only transfer 45 minutes of that hour because 15 of the minutes was for my own consumption, which does not involve a transfer. These calculations are also shown in the “toy” example spreadsheet.

This system for general activities represents the same unitary model for transfers in NTTA that we use in intra-household transfers in NTA, but simplified because there is no saving, dis-saving or public transfers of household production. Consumption must equal production in the household, and inflows must equal outflows.

#### Other profiles

The only other profile to be considered is asset income. For the NTTA, this is the income derived from consumer durables. It is the analog to NTA asset income – the portion of income derived from the role of capital in the production process. Some countries will have data estimated on the flow of services generated by consumer durables. If so, the annual amount should be allocated using the same age schedule as household headship, following the NTA assumption that the head owns all assets. As mentioned previously, to consider the full impact of gender on NTA, various definitions of headship should be studied.

While this is meant to fill in the capital share of household production, it is very different from the way capital’s share of self-employment income is included in NTA. There, we assume 1/3 of the total income of businesses owned by households is generated by capital and 2/3 by labor. However, for NTTA we don’t have an output value of household production to divide between labor and capital or a developed literature indicating reasonable default shares of labor and capital attributions. In countries that do have estimates of the flow of services of consumer durables, it will be interesting to compare these amounts to the total labor inputs we estimate and evaluate the shares we find.

Most countries, however, will not have data on the flow of services of consumer durables. If not, they will not be able to estimate this profile. Their NTTA production account, then, will be comparable to NTA labor income, not NTA labor income plus asset income.

As far as other profiles found in NTA, they have no analog in NTTA. There is no saving or dissaving of household production, and no public sector. There are instances where one could imagine public time-based production – serving on a jury, community service as a penalty for law breaking or other compelled unpaid service to the government – but these will be very small compared to the private amounts in most contexts.

### 3.6 Finalizing age profiles

#### Smoothing

As mentioned in the section on sex-specific NTA, you may need more smoothing with NTTA profiles than NTA because of the generally smaller time use surveys compared to consumption ones and splitting the population up by sex. You may also need to group ages instead of taking profiles by single years of age to dampen some of the noise in the time use data.

Also, the consumption and transfer inflows of care time by infants (i.e. age 0) should not be smoothed, because of the large amounts of care required by infants compared to older children and any smoothing of this age group will likely underestimate their total care consumption significantly. This is similar to the market-NTA estimation practice of not smoothing health care consumption for infants because any smoothing there would likely be an underestimate as well.

Instead, compute the smoothed age schedule using the whole age range, but replace the smoothed values for age 0 with the unsmoothed values. You should also examine the value for age 1 and decide if a smoothed value there is likely to be causing an underestimate. If it seems to be, replace it with the unsmoothed value.

#### Adjusting to the macro control

The handling of macro controls for NTTA is similar to that of intra-household transfers in NTA: these accounts do not exist in national accounts, so we have no true macro control. We do know that paired profiles must sum to zero, so aggregate consumption must equal production and aggregate inflows must equal outflows. If the methodology is followed correctly, that result must be obtained at least for the case of the unsmoothed profiles, but this should be checked to make sure that the equality holds. By construction, unsmoothed total production must equal unsmoothed total consumption in NTTA, and unsmoothed total transfer inflows must equal unsmoothed total transfer outflows, for both intra- and inter-household transfers.

Once profiles are smoothed, small discrepancies between paired profiles will arise. To correct for this, use the same adjustment as we do for NTA intra-household private transfers to restore the net aggregate balance. These adjustments are done for both sexes combined, and a single adjustment factor applied to both sexes. The adjustments should be done by the following pairs of profiles which must match are as follows:

* Total production must equal total consumption
* Total inter-household inflows must equal total inter-household outflows
* Total intra-household inflows must equal total intra-household outflows

For convenience, we will follow the same procedure for NTA transfer profiles and adjust only the outflows (treat production as the outflow and consumption as the inflow for that pair of profiles). Mathematically, if *Oagg* is aggregate outflow and *Iagg* is the inflow, the multiplicative adjustment factor on outflows, θ, is calculated as follows:

$$θ= \frac{I\_{agg}}{O\_{agg}}$$

The adjustment factors should be small (less than 5%). If they are too large, something may be wrong with the smoothing procedure, or the calculation of the unsmoothed profiles.

#### Documenting and archiving estimates

Teams should preserve as much of the detail of lower-level profiles as possible, even if they report only aggregated profiles for analysis. Preserving the lower-level profiles helps in the case of a revision in the methodology for a lower level profile – the researcher can fix that profile and not have to re-estimate all of the other ones. In addition, age-targeted care variables, such as for children or the elderly, will be particularly relevant to many research questions and should be separable from the overall profiles.

#### Summarizing and comparing

Summarizing NTTA results will be similar to procedures for summarizing NTA age profiles. Graphs of per capita age profiles are the main starting point, and the complexity of the entire age profile can be reduced using average age calculations, or graphical summaries. NTTA accounts will be of interest for many research questions. Here are just a few:

* Combining with NTA to see true nature of transfers, by age and by sex.
* Studying human capital investment including care.
* Grandparents as care givers and receivers.
* Examining shares of time-based versus market-based production in poor and rich countries.
* Changes over time, across countries.
* Changes in time-production at time of life course changes: having children, starting work, retiring, etc.

Depending on the particular research project, different summary techniques will be relevant. At this time, not enough countries have estimated NTTA to provide solid comparative material.

### 3.7 Recommended sensitivity tests

As for sex-specific NTA accounts, the results for NTTA accounts may be very sensitive to the choice of methods and the specific implementation of a method in a particular context with a particular data source. Sensitivity tests should be used to evaluate just how sensitive results are to these choices. For NTTA, researchers may want to implement alternative estimates using opportunity cost wage imputation (instead of specialist replacement) because this will most likely produce the largest difference in results.

Valuing an hour of time by the persons’ opportunity cost can be implemented using the person’s hourly market wage if they also have a paid job, or imputing an hourly wage based on their characteristics if not. The imputation takes place in two steps. First, a regression is estimated using the wages and characteristics of those who receive wages:

$$log⁡(W\_{i})=β\_{0}+β\_{1}(age\_{i}^{2})+β\_{2}(educ\_{i})+β\_{3}(age\_{i}×educ\_{i})+ε\_{i}$$

where $W\_{i}$ is wage rate of person *i*,and $age\_{i}$ and $educ\_{i}$ are the age and education. Second, the estimated model is used to predict the wage rate of persons not receiving wages, based on age and education.

While it may seem like sex should be included in this equation as well, that would introduce the same gender bias found in the paid work world into the unpaid work world. In fact, it could be just this gender bias that explains some of the gender-based specialization in paid or unpaid work. Of course, some of the gender differences in paid work may be ascribed not to discrimination but to observed patterns in attachment to the paid labor force. In a US study of professionals, similar women earned less than men because they worked fewer hours and had periods of withdrawal from the labor force, due to childbearing and raising young children (Bertrand, et al.2010). It is unclear how this result from the market work world should be reflected in imputing wages to work that is done in the household.

Also, as mentioned above, some countries’ time use surveys include information about multitasking, or whether some activities are being done concurrent with other activities. If your survey includes information on multiple activities for a single unit of time, an alternative production age profile including multitasking can be calculated, to contrast with the NTTA “official” method of only including primary productive activities.

Finally, for time spent caring for elderly relatives or the time spent by elderly persons caring for others, those events may be so rare that they are hard to measure in the typical time use survey. If a survey of older persons is available in your country, such as the Health and Retirement Survey (HRS) or one of the many HRS-like surveys that have been done across the globe, researchers should consult those surveys for data on care giving and receiving for older persons. These surveys can be large and difficult to manage, but at the very least researchers should see if their HRS-like survey has time use information in it and if any other researchers have examined the patterns of care giving and receiving for older persons.

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# Appendix A. ATUS codes used in the 2009 US classification ([www.bls.gov/tus/lexiconwex2009.pdf](http://www.bls.gov/tus/lexiconwex2009.pdf))

|  |  |  |
| --- | --- | --- |
| **Unpaid household work category** | **6-digit activity codea** | **Description** |

|  |  |  |
| --- | --- | --- |
| 1. Cleaning
 | 020101 | Interior cleaning |

|  |  |  |
| --- | --- | --- |
| 1. Laundry
 | 020102 | Laundry |
| 020103 | Sewing, repairing and maintaining textiles |

|  |  |  |
| --- | --- | --- |
| 1. Cooking
 | 020201 | Food and drink preparation |
| 020202 | Food presentation |
| 020203 | Kitchen and food clean-up |
| 020299 | Food and drink prep, presentation, and clean-up, n.e.c. |

|  |  |  |
| --- | --- | --- |
| 1. Household maintenance and repair
 | 020301 | Interior arrangement, decoration, and repairs |
| 020302 | Building and repairing furniture |
| 020303 | Heating and cooling |
| 020399 | Interior maintenance, repair and decoration, n.e.c. |
| 020401 | Exterior cleaning |
| 020402 | Exterior repair, improvements, and decoration |
| 020499 | Exterior repair, improvements, and decoration, n.e.c. |
| 020701 | Vehicle repair and maintenance (by self) |
| 020799 | Vehicles, n.e.c. |
| 020801 | Appliance, tool, and toy set-up, repair, and maintenance |
| 020899 | Appliances and tools, n.e.c. |

|  |  |  |
| --- | --- | --- |
| 1. Lawn and garden care
 | 020501 | Lawn, garden, and houseplant care |
| 020502 | Ponds, pools, and hot tubs |
| 020599 | Lawn and garden, n.e.c.\* |

|  |  |  |
| --- | --- | --- |
| 1. Household management (includes related telephone calls)
 | 020104 | Storing interior household items, including food |
| 020199 | Housework, n.e.c. |
| 020901 | Financial management |
| 020902 | Household and personal organization and planning |
| 020903 | Household and personal mail and messages (except e-mail) |
| 020904 | Household and personal e-mail and messages |
| 020905 | Home security |
| 020999 | Household management, n.e.c. |
| 029999 | Household activities, n.e.c. |
| 160103 | Telephone calls to/from education service providers |
| 160104 | Telephone calls to/from salespeople |
| 160105 | Telephone calls to/from professional or personal care service providers |
| 160106 | Telephone calls to/from household service providers |
| 160107 | Telephone calls to/from paid child or adult service providers |
| 160108 | Telephone calls to/from government officials |

|  |  |  |
| --- | --- | --- |
| 1. Pet care
 | 020601 | Care for animals and pets (not veterinary care) |
| 020602 | Walking, exercising, playing with animals |
| 020699 | Pet and animal care, n.e.c. |

|  |  |  |
| --- | --- | --- |
| 1. Purchasing goods and services
 | 070101 | Grocery shopping |
| 070102 | Purchasing gas |
| 070103 | Purchasing food (not groceries) |
| 070104 | Shopping, except groceries, food and gas |
| 070105 | Waiting associated with shopping |
| 070199 | Shopping, n.e.c. |
| 070201 | Comparison shopping |
| 070299 | Researching purchases, n.e.c. |
| 070301 | Security procedures related to consumer purchases |
| 070399 | Security procedures related to consumer purchases, n.e.c. |
| 079999 | Consumer purchases, n.e.c. |
| 080101 | Using paid childcare services (time spent facilitating use of paid services) |
| 080102 | Waiting associated with purchasing childcare services |
| 080199 | Using paid childcare services, n.e.c. |
| 080601 | Activities related to purchasing/selling real state |
| 080602 | Waiting associated with purcahsing/selling real state |
| 080699 | Using real state services, n.e.c.\* |
| 080701 | Using veterinary services |
| 080702 | Waiting associated with veterinary services |
| 080799 | Using veterinary services, n.e.c.\* |
| 090101 | Using interior cleaning services |
| 090102 | Using meal preparation services |
| 090103 | Using clothing repair and cleaning services |
| 090104 | Waiting associated with using household services |
| 090199 | Using household services, n.e.c.\* |
| 090201 | Using home maint/repair/decor/construction services |
| 090202 | Waiting associated with home main/repair/decor/construction |
| 090299 | Using home main/repair/decor/construction services, n.e.c.\* |
| 090301 | Using pet services |
| 090302 | Waiting associated with pet services |
| 090399 | Using pet services, n.e.c.\* |
| 090401 | Using lawn and garden services |
| 090402 | Waiting associated with using lawn and garden services |
| 090499 | Using lawn and garden services, n.e.c.\* |
| 090501 | Using vehicle maintenance or repair services |
| 090502 | Waiting associated with vehicle Maint. or repair services |
| 090599 | Using vehicle Maint. and repair services, n.e.c.\* |
| 099999 | Using household services, n.e.c.\* |
| 100103 | Obtaining licenses and paying fines, fees, taxes |

|  |  |  |
| --- | --- | --- |
| 1. Childcare
 | 030101 | Physical care for household children |
| 030102 | Reading to/with household children |
| 030103 | Playing with household children, not sports |
| 030104 | Arts and crafts with household children |
| 030105 | Playing sports with household children |
| 030106 | Talking with/listening to household children |
| 030108 | Organization and planning for household children |
| 030109 | Looking after household children (as a primary activity) |
| 030110 | Attending household children's events |
| 030111 | Waiting for/with household children |
| 030112 | Picking up/dropping off household children |
| 030199 | Caring for and helping household children, n.e.c. |
| 030201 | Homework (household children) |
| 030202 | Meetings and school conferences (household children) |
| 030203 | Home schooling of household children |
| 030204 | Waiting associated with household children's education |
| 030299 | Activities related to household child's education, n.e.c. |
| 030301 | Providing medical care to household children |
| 030302 | Obtaining medical care for household children |
| 030303 | Waiting associated with household children's health |
| 030399 | Activities related to household child's health, n.e.c. |
| 040101 | Physical care for non-household children |
| 040102 | Reading to/with non-household children |
| 040103 | Playing with non-household children, not sports |
| 040104 | Arts and crafts with non-household children |
| 040105 | Playing sports with non-household children |
| 040106 | Talking with/listening to non-household children |
| 040108 | Organization and planning for non-household children |
| 040109 | Looking after non-household children (as a primary activity) |
| 040110 | Attending non-household children's events |
| 040111 | Waiting for/with non-household children |
| 040112 | Dropping off/picking up non-household children |
| 040199 | Caring for and helping non-household children, n.e.c. |
| 040201 | Homework (non-household children) |
| 040202 | Meetings and school conferences (non-household children) |
| 040203 | Home schooling of non-household children |
| 040204 | Waiting associated with non-household children’s education |
| 040299 | Activities related to non-household children’s education, n.e.c. |
| 040301 | Providing medical care to non-household children |
| 040302 | Obtaining medical care for non-household children |
| 040303 | Waiting associated with non-household children’s health |
| 040399 | Activities related to non-household children’s health, n.e.c. |

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| --- | --- | --- |
| 1. Eldercare and care outside the home (includes volunteering)
 | 030401 | Physical care for household adults |
| 030402 | Looking after household adult (as a primary activity) |
| 030403 | Providing medical care to household adult |
| 030404 | Obtaining medical and care services for household adult |
| 030405 | Waiting associated with caring for household adults |
| 030499 | Caring for household adults, n.e.c. |
| 030501 | Helping household adults |
| 030502 | Organization and planning for household adults |
| 030503 | Picking up/dropping off household adult |
| 030504 | Waiting associated with helping household adults |
| 030599 | Helping household adults, n.e.c. |
| 039999 | Caring for and helping household members, n.e.c. |
| 040401 | Physical care for non-household adults |
| 040402 | Looking after non-household adult (as a primary activity) |
| 040403 | Providing medical care to non-household adult |
| 040404 | Obtaining medical and care services for non-household adult |
| 040405 | Waiting associated with caring for non-household adults |
| 040499 | Caring for non-household adults, n.e.c. |
| 040501 | Housework, cooking, and shopping assistance for non-household adults |
| 040502 | House and lawn maintenance and repair assistance for non-household adults |
| 040503 | Animal and pet care assistance for non-household adults |
| 040504 | Vehicle and appliance maintenance/repair assistance for non-household adults |
| 040505 | Financial management assistance for non-household adults |
| 040506 | Household management and paperwork assistance for non-household adults |
| 040507 | Picking up/dropping off non-household adult |
| 040508 | Waiting associated with helping non-household adults |
| 049999 | Helping non-household adults, n.e.c. |
| 150101 | Volunteer, Computer use |
| 150102 | Volunteer, Organizing and preparing |
| 150103 | Volunteer, Reading |
| 150104 | Volunteer, Telephone calls (except hotline counseling) |
| 150105 | Volunteer, Writing |
| 150106 | Volunteer, Fundraising |
| 150199 | Volunteer, Administrative and support activities, n.e.c. |
| 150201 | Volunteer, Food preparation, presentation, clean-up |
| 150202 | Volunteer, Collection and delivering clothing and goods |
| 150203 | Volunteer, Providing care |
| 150204 | Volunteer, Teaching, leading, counseling, mentoring |
| 150299 | Volunteer, Social service and care activities, n.e.c. |
| 150301 | Volunteer, Building houses, wildlife sites, other structures |
| 150302 | Volunteer, Indoor and outdoor maintenance, repair, clean-up |
| 150399 | Volunteer, Indoor and outdoor maintenance, building and clean-up activities, n.e.c. |
| 150401 | Volunteer, Performing |
| 150402 | Volunteer, Serving at volunteer events and cultural activities |
| 150499 | Volunteer, Participating in performance & cultural activities |
| 150501 | Volunteer, Attending meetings, conferences, and training |
| 150599 | Volunteer, Attending meetings, conferences, training, n.e.c. |

|  |  |  |
| --- | --- | --- |
| 10. Eldercare and care outside the home (includes volunteering), continued | 150601 | Volunteer, Public health activities |
| 150602 | Volunteer, Public safety activities |
| 150699 | Volunteer, Public health and safety activities, n.e.c. |
| 150701 | Volunteer, Waiting associated with volunteer activities |
| 150799 | Volunteer, Waiting associated with volunteer activities, n.e.c. |
| 150801 | Volunteer, Security procedures related to volunteer activities |
| 150899 | Volunteer, Security procedures, n.e.c. |
| 159999 | Volunteer activities, n.e.c. |

|  |  |  |
| --- | --- | --- |
| 11. Travel (related to care activities and purchasing goods and services) | 180201 | Travel related to housework |
| 180202 | Travel related to food & drink |
| 180203 | Travel related to interior maintenance, etc. |
| 180204 | Travel related to exterior maintenances, etc. |
| 180205 | Travel related to lawn, garden and houseplant care  |
| 180206 | Travel related to care for animals and pets (not veterinary care) |
| 180207 | Travel related to vehicles care and maintenance |
| 180208 | Travel related to appliance, tool and toy set-up, repair and maintenance |
| 180209 | Travel related to household management |
| 180299 | Travel related to household activities, n.e.c. |
| 180301 | Travel related to caring for and helping household children |
| 180302 | Travel related to household children’s education |
| 180303 | Travel related to household children’s health |
| 180304 | Travel related to caring for household adults |
| 180305 | Travel related to helping household adults |
| 180399 | Travel related to caring for and helping household members, n.e.c |
| 180401 | Travel related to caring for and helping non-hh children |
| 180402 | Travel related to non-household children’s education |
| 180403 | Travel related to non-household children’s health |
| 180404 | Travel related to caring for non-household adults |
| 180405 | Travel related to helping non-household adults |
| 180499 | Travel related to caring for and helping non-household members, n.e.c |
| 180701 | Travel related to grocery shopping |
| 180702 | Travel related to purchasing gas |
| 180703 | Travel related to purchasing food (not groceries) |
| 180704 | Travel related to shopping, ex. groceries, food and gas |
| 180799 | Travel related to consumer purchases, n.e.c. |
| 180801 | Travel related to using childcare services |
| 180802 | Travel related to using financial services and banking |
| 180803 | Travel related to using legal services |
| 180804 | Travel related to using medical services |
| 180805 | Travel related to using personal care services |
| 180806 | Travel related to using real estate services |
| 180807 | Travel related to using veterinary services |
| 180899 | Travel related to using professional and personal care services, n.e.c. |
| 180901 | Travel related to using household services |
| 180902 | Travel related to using home maint./repair/decorator/construction services |
| 180903 | Travel related to using pet services (not veterinary) |
| 180904 | Travel related to using lawn and garden services |
| 180905 | Travel related to using vehicle maintenance & repair services |
| 180999 | Travel related to using household services, n.e.c. |

aThese 6-digit activity codes correspond to the ATUS 2009 lexicon.

n.e.c. stands for "not elsewhere classified".

# Appendix B. Average wages used to impute value to household production activities, United States, 2009.

Where more than one code is used in imputation, the resulting average hourly wage is the employment-weighted average of occupations

|  |  |  |
| --- | --- | --- |
| **Time Use Activity** | **Standard Occupational Classifications** **Used for Wages (and Codes)** | **Average Hourly Wage US, 2009** |
| 1. Cleaning | Maids and housekeeping cleaners (37-2012) and their supervisors (37-1011) | 11.33 |
| 2. Laundry (includes sewing and clothing repair) | Laundry and dry-cleaning workers (51-6011), hand sewers (51-6051), tailor, dressmakers, and custom sewers (51-6052) | 10.43 |
| 3. Cooking (food and drink preparation) | Food preparation and serving related occupations (major category 35-0000) | 10.04 |
| 4. Household maintenance and repair | Maintenance and repair workers, general (49-9042), Helpers—installation, maintenance, and repair workers (49-9098) | 17.08 |
| 5. Lawn and garden care | Landscaping and groundskeeping workers (37-3011) and their supervisors (37-1012), grounds maintenance workers (37-3019) | 13.15 |
| 6. Household management (incl. finances, scheduling, coordinating, and related telephone calls) | Management occupations (major category 11-0000), business and financial occupations (major category 13-000) and office and administrative support occupations (major category 43-0000) | 24.59 |
| 7. Pet care (not veterinary care) | Nonfarm animal caretakers (39-2012) | 10.50 |
| 8. Purchasing goods and services | Personal care and service occupations (major category 39-0000) | 11.87 |
| 9. Childcare | Child care workers (39-9011), preschool teachers, except special education (25-2011), and child, family and school social workers (21-1021) | 13.42 |
| 10. Eldercare and care outside the home (includes volunteering) | Community and social service occupations (major category 21-0000) and personal and home care aides (39-9021) | 17.85 |
| 11. Travel (related to care activities and purchasing goods and services) | Taxi drivers and chauffers (53-3041) | 11.51 |

Note that these wages are increased by an additional 24.4% to reflect imputed supplements to wages and salaries and make imputed household wages similar to market compensation as measured in NTA. From national accounts, 24.4% is the ratio of supplements to wages and salaries to base wages and salaries.

# Appendix C. Pending issues in finalizing NTTA and NTA by gender methodology

### Rare events

There is the issue in time use research of the difficulty in measuring rare events. Because the surveys often ask about the activities of just a single representative day, estimates of events which may only happen once a month or once year will have high variance. This could be an important problem for NTTA estimates if there is a lot of caregiving. For example, if grandparents are caring for grandchildren for a whole week, but only once a year, a survey would have a hard time picking that up. Also, if the grandparental care was provided by the grandparents but in the household of the adult children, a household-based time use survey would never include the grandparents’ time transfer.

### Age gradient of productivity

Should we impose an age gradient to household activities, to take into account that you are likely less efficient at housework at age 90 than at age 40? This is difficult to measure and the fact that we see so much time spent in housework by older persons may not reflect just differences in efficiency. Instead, it may reflect cohort differences in preference for doing housework oneself instead of contracting for it in the market, or different preferences for how clean the house should be or how a meal should be produced. The one way that seems legitimate to estimate the age gradient is to use survey data on household production activities done in the market and see if there is an age gradient for the persons performing those tasks for pay. For example, do 80-year old cooks make much less per hour than 40-year old cooks? This will be difficult because it is unlikely that a wage survey would have enough older workers to make a good estimate. If it was possible to estimate the age shape, though, it could be implemented on the household production so that the overall average imputed wage matched the population average wage in the market.

### Cases of inadequate or no time use survey data

Many countries have issues with their time use survey and we should consider if there are any modifications that allow us to use imperfect data. For example, what if the age detail of non-time respondents in the household is limited to large age ranges instead of single years of age? Or what if there is no time use survey per se, but a few time use questions in another survey. Is there ways to use this data at all?

Some countries have no time use survey at all. In that case, should they estimate NTA by gender without the time use component? Could they supplement these results with NTTA results from another country in their region, just to show some indication of what a complete analysis would look like?

### Government involvement in household production of care

Are we accounting for government-subsidized family care correctly? Where will it show up in NTA and NTTA if family members receive payments from the government for caring for an elderly person at home. Similarly with parental leave?

### Role of household structure

Need to think carefully about how household structure impacts results, not that it causes incorrect results, just that it will have a large role in determining different transfer systems, both for money and time transfers. How can NTA study these impacts in a systematic way?

### First age of available time use information

Most time use surveys do not interview younger children, and we have to assume that children too young to be interviewed do not engage in home production activities. However, the “cut off age” for beginning to interview is different for different surveys. This undermines the comparability of our estimates across countries. Should we impose a common age cut off?

### Implementing the Regression Method for Imputation of Household Amounts to Individuals

This is a general comment that has to do with the basics of NTA’s use of the regression method to impute individual-level consumption amounts based on household-level amounts and household structure by age and sex. We have never stressed any evaluation of the goodness of fit of regression equations or checking that the assumptions of OLS regression are borne out once implemented. The justification for this has been that the regression method is really just a short cut for estimating group means and is not being used in any statistical, probabilistic sense, so we are not worried about statistical validity. Perhaps this is incorrect, though, and we are sacrificing better estimates by not checking these conditions. Specifically, should we determine whether or not the error term of any estimated equation is normally distributed? If not, it is probably because there are household specific characteristics which we could try to control for, improving the estimates. One possibility is to introduce interaction terms that controls for those characteristics (household income, etc.). If the new error term is more normally distributed, this method is statistically speaking better.

Also, we could then use the estimated new beta's (without the interactions) to calculate the consumption by age, and then check what proportion of the variation in household amounts is explained by the more detailed method versus the simpler one. If the proportion explained is higher with the new method than with the old one, then we should use the new one.

1. Note that throughout this document, “sex” will be used to refer to the category designation of male or female. “Gender” will be used to describe the socially constructed concept of appropriate roles and behaviors for males and females. [↑](#footnote-ref-1)
2. Time inputs not accounted for in national income should not be confused with unpaid family work in household-owned farms or other enterprises. Unpaid family work does not generate earnings for the unpaid family laborer, but it does produce goods and services traded in the market or goods not traded in the market but their value is imputed in national income, thus generating income for the household that is already part of national income. Time inputs are those for which the value of the time is never paid to anyone and is not included in national accounts measures such as Gross Domestic Product or Gross Domestic Income. Examples are housework, household management and maintenance, caring for children and other household members, and volunteering. Time spent by household members producing food and goods intended for consumption by household members is not included in household production. While these items are never exchanged in the market, national accountants do estimate the value of those goods and the imputed value is included in national income. Thus, the value of time spent growing food or producing goods for household consumption is already included in national income and so is not included in household production. [↑](#footnote-ref-2)
3. While the name “household production” has become common in the literature for referring to productive activities not resulting in market goods or services, note that some of the included activities are performed outside of the household for non-household members. Examples are care for persons outside of the household and volunteer activities. [↑](#footnote-ref-3)
4. In the past, some NTA researchers have examined data driven methods to estimate an equivalent consumer scale by sex, but the differences found have been relatively small (Lindh et al, 2010). Researchers outside of the NTA group argue that a unitary sharing model within the household is inaccurate (Browning and Chiappori, 1998) and find that both spousal market income and gender roles contribute to different consumption by sex within the household (Phipps and Burton, 1998). This is but one example of a large literature by feminist economists pointing out that gender-blind imputation methods produce erroneous results. Given these previous studies, we would expect women to receive a lower share than same age men in the household, which would lower their consumption and lifecycle deficits. Examining alternatives to the equal gender weights assumption is an important priority for fully understanding our results and may be incorporated in the main methodology if it gives compelling results. For the current methodology, researchers should be clear on the potential for bias in estimates of women’s versus men’s private consumption. [↑](#footnote-ref-4)
5. Often, time use surveys have a full time diary for only one person in the household. If you only have information about the age and sex of the time respondent in the household, you will be able to produce a household production age profile based on the methodology here, but not to impute consumption or transfers. We may try to work on a methodology to do this when household rosters are not available, if that is the case for many NTA countries’ time use surveys. If you have full time diary information for one person in the household, but also have the age and sex of others in the household, you will be able to computer household production, consumption, and transfers using the methodology here. [↑](#footnote-ref-5)
6. If the total number of hours is very close to 24, researchers may adjust all hours so that they equal 24. If respondents show a range of 23-25 hours, that range of error is relatively small so the adjustments will not be large. For a person whose answers total 23 hours, for example, all of his time allocations could be multiplied by 24/23= 1.0435 to make a total of 24 hours. [↑](#footnote-ref-6)
7. Keep in mind that macro controls may not be available for sub-regions. If they are not, survey-based shares of aggregate activities can be used to apportion national macro controls to sub-regions. [↑](#footnote-ref-7)
8. Some household management activities may be productive but not meet the third party criterion because they must be done in person. The management of some financial and legal matters might seem like they could be outsourced to a personal assistant, for example, but for activities like applying for bank loans or consulting with lawyers must be done face to face for the most part. Interactions with government entities will also be mixed up between tasks that could be “outsourced” and those which must be done in person. You could have someone else drop off forms or submit tax payments at government entities for you, but for things like applying for a drivers’ license you must present yourself in person to verify your identity. Researchers should examine coding resources closely and make the best guess as to what could be outsourced and what could not. [↑](#footnote-ref-8)
9. In future revisions of this methodology, this table may change as more countries contribute information on categories relevant to their context. Also, in future methodology revisions, we would like to investigate international occupation coding schemes to standardize the wage imputations discussed in the next section. [↑](#footnote-ref-9)
10. The survey defines “secondary childcare” as responsibility for a child under age 13 while doing another activity. This contrasts with the childcare definition used with primary activities where the “child” is defined as under age 18. [↑](#footnote-ref-10)
11. If teams do work with multitasking, we would like everyone to do so in a uniform way: if any of the activities, primary or secondary, listed for a unit of time are productive activities, the entire time unit should be assigned to the productive activity; if the unit of time is assigned to more than one productive activity, researchers should divide the time unit equally among the multiple activities. In other words, no unit of time can be counted more than once, but it should be divided among productive activities. For example, if someone spent an hour cooking while taking care of children, those are both productive activities, so it should count as a half-hour of cooking and half-hour of childcare. Similarly if someone spent an hour of paid work also doing childcare, half the hour should count as paid work and the other half as childcare. If the hour was spent cooking and watching television, that is one productive activity and one leisure activity, so the hour is counted as one hour of cooking. Several examples of time use show the justification for handling multiple tasks in this way. First, while working at a paid job, a worker is paid for an hour at work even if she was not being productive every minute of that hour or even if she was concurrently doing a leisure activity like listening to the radio. Also, paid breaks or lunch hours are often part of paid work because an employee is still “on the job” at the time. Second, if someone is doing a leisure activity while responsible for housework or childcare, the time is considered productive because if that adult was not also performing the housework or childcare while doing the leisure activity, he would have to pay someone else to do those productive tasks. Finally, if two productive activities are occurring at the same time, the even split of time attribution means that the total time unit is being valued at a wage which is the average of the two activities. [↑](#footnote-ref-11)
12. While it has a very big impact on the aggregate value of NTTA accounts, preliminary research indicates that it does not make a huge difference in relative age profiles by sex. [↑](#footnote-ref-12)
13. [This footnote discusses the other main alternatives in valuing time inputs, so NTA researchers will be aware of what other research methods are being used in the literature on time use and household production, and why we chose specialist replacement as the most appropriate fit with NTA concepts and methods.] The other main valuation alternative is opportunity cost, valuing a person’s time by the opportunity cost of it. This tends to give a very high estimate because it imputes skilled inputs to jobs that may not require those skills or that require completely different skills. It would also often lead to valuing an hour of home production time by a man as more valuable than by a woman, because men’s wages in the market are generally higher than women’s, whereas the woman might produce a superior output more quickly. A load of clean laundry is likely not worth more if the launderer is more highly educated or commands a higher market wage. For this reason, NTTA will not use opportunity cost-based wage imputation. Another alternative is still a replacement method, but is “generalist replacement” instead of specialist. The generalist replacement method involves finding one appropriate wage that would but used for all household production activities. This is usually a housekeeper wage. We do not recommend this method because in many countries housekeepers may only be employed by very wealthy households. In this case the housekeeper wage will be quite high and not a good approximation of what an average household would have to pay to replace the activity in the market. However, in countries where housekeepers are more common and there is sufficient wage data to identify a housekeeper wage, generalist replacement may be used. [↑](#footnote-ref-13)
14. This assumes that men and women will be equally productive at the same task, which is most likely a poor assumption. Home production tasks are delineated by gender in many contexts and we would expect any gender specialization in a task contributes to that gender’s efficiency and productivity at that task. At this point in the research, we do not include any estimates of these effects, but in future revisions, we may investigate methods to adjust imputed wages for men versus women based on the degree of sex-specialization in an activity. For example, if 90% of the household cleaning is done by women, we might estimate some factor by which men’s productivity at household cleaning is lower than women’s. This is a conceptually difficult idea, however. Would we also consider a man’s hour spent doing childcare to be less efficient than a woman’s hour in a context where women do most of the childcare? It is more difficult here to justify an idea of relative efficiency or productivity. [↑](#footnote-ref-14)
15. Post-tax valuations will be more relevant when the research question is about the choices individuals face to pay for an activity to be performed or to do it themselves. One could argue that an individual will not engage in home production unless the marginal value of the time spent in home production is no less than the after-tax market wage that could be earned. Hence, studies using opportunity cost wage values would be more logically done on a post-tax basis, those using replacement costs on a pre-tax basis. [↑](#footnote-ref-15)
16. Previously, this section included instructions to include an estimate of fringe benefits along with any employer-paid taxes. However, this has been eliminated because of the high likelihood that the bulk of fringe benefits provided in an economy are going to higher-wage workers and are not a good representation of what compensation might be expected in the market for household services. [↑](#footnote-ref-16)
17. For the specialist replacement method, some time use researchers argue that we should recognize the fact that performing some tasks in the market may be more efficient than in the household. Specialized equipment and training is used in the market but probably less so in the household (Abraham and Mackie, 2005). On the other hand, some argue that market production can become less efficient over time, due to short-term profit or other considerations (Braverman, 1974). Unfortunately, there have been no systematic efforts to measure the differences in productivity between the market and the household. In some countries’ estimates of household production, ad hoc estimates of relative efficiency for particular tasks are assigned (Landefeld et al., 2009), but these are arbitrary estimates and may not be appropriate for the type of cross-national estimates that the NTA project produces. In addition to issues of efficiency in the market versus the home, there is also the issue of efficiency of the young versus the old. Failing health and mobility may make older persons much less efficient at household production than younger persons. We could assume that the wage gradient in the paid labor market for household production activities represents this effect, but few countries will have sufficient survey data to estimate this. Also, applying the market NTA labor income age gradient is not appropriate because at oldest ages, the mix of activities being done by the oldest workers is very different from the mix of activities in household production. This is a pending issue in the project and is discussed further in the “pending issues” listed in appendix C. [↑](#footnote-ref-17)
18. If, for example, you know from the survey that the time is being spent caring for a non-co-resident parent, and you know the age and sex of the parent, assign that production equally to all in that age and sex group. Or if you do not know the age of the parent, you could assign the amount to the age group an average generation length older than the age of the time producer. If you do not know if the elderly parent was a mother or father, divide the amount proportionally based on the sex distribution of the target age group. [↑](#footnote-ref-18)