



**COUNTING
WOMEN'S
WORK**

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Counting Women's Work Methodology**

Measuring the Gendered Economy: Counting Women's Work Methodology

Gretchen Donehower

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NATIONAL TRANSFER
ACCOUNTS



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1. Introduction

1.1. The generational and gendered economy

If we want to imagine the details of a person's life, one of the most relevant facts about that person we can know is age. Given age, we can take a decent guess at many other aspects of life, such as household arrangement, educational status, work life, risk of death, relationship with the public sector, and many other features. For example, a 2-year-old most likely lives with one or two parents, is not involved in formal education or the labor force, has a fairly low probability of death, and is neither paying taxes nor receiving more than a small amount of public benefits that might go toward health care or as part of a family benefit. In contrast, a 40-year-old most likely lives with a spouse or partner and one or more children, has completed education, is in the labor force earning income and paying taxes, as well as making substantial transfers to family members to support their consumption. The ability of age to tell us so much about a person's social and economic life is one of the central motivations behind the National Transfer Accounts (NTA) project.

NTA is a framework for studying the age dimension of economic activity by disaggregating national accounts by age and measuring transfers of resources from the ages in midlife when we are earning income to young and old ages when we are not. These flows arise between persons through transfers, but also within one person's life over time through the accumulation and disposition of assets. NTA is also a multi-national research project comprising research teams in over 60 countries applying a consistent methodology across countries for mapping that age dimension using survey and administrative data (www.ntaccounts.org, United Nations, 2013). The NTA project has revealed what it refers to as the "generational economy" in many countries over many different time periods, showing us how people produce, consume, share and save resources by age (Lee and Mason, 2011). It has yielded important theoretical and policy insights into how population change impacts economies and economic policy.

Given the NTA's ability to reveal the generational economy in different places at different times, a natural extension of understanding how people live in the world is to also map the gender dimension of the economy. In the example above of imagining the way a 40-year-old person would engage with the economy, the guess will be very different depending on whether this is a 40-year-old man or woman. The man is more likely to be in the labor force than the woman, the woman likely to spend more of her time working at home, taking care of family members and running a household. This differentiation of economic role by gender is different in different countries, of course, but on average if we had to guess, this would be a reasonable guess to make.

The Counting Women's Work project (www.countingwomenswork.org) is about adding the gender dimension to the age perspective of the NTA project and framework. If the generational economy tells us important things about how economic life is organized, so does the "gendered economy." This phrase has been used by many researchers before to mean different things (Kelly, 1991 is one example), but here we mean it to be the ways in which one's interaction with all facets of an economy are mitigated by gender. This includes interactions with the formal and informal labor force where men and women are channeled

into different levels and types of participation, men are encouraged into certain professions and women into others, etc. It also includes social dynamics around how much males and females participate in the household economy that is invisible to much of the field of economics. It includes differences in consumption in contexts where resources are allocated differently to boys and girls, or to men and women. It includes any gender-based differences in interactions with the public sector, based on a particular country's social welfare policies, taxation strategies, or other institutional or legal arrangements. It will certainly vary from country to country just as the generational economy has been shown to by the National Transfers Accounts project. Indeed, it is one of the contributions of the NTA project that it has shown the degree of variation across countries in the organization of their generational economies and the supporting cultural and governmental institutions. The gendered economy is also very different across countries, again with each country having unique institutions that sustain patterns of difference revealed in data.

Adding gender to the NTA perspective is not just layering on another independent dimension about economic life in addition to age. Age, gender, and economic life are linked because the phenomena that drive economic gender differentiation are themselves age-dependent lifecycle phenomena. Childbearing is the most obvious example. The processes of pregnancy and breastfeeding involve men and women in different ways based on our biology, and these processes happen at particular ages in the life course. The way these processes shape economic life for men and women is thus age-dependent. To a lesser extent, aging has similar features – it is an age-dependent process that men and women experience differently because disability and mortality differ by gender in most countries in predictable ways. This becomes economically meaningful as it differentiates work lives, healthcare consumption, and household arrangements by gender. Thus, understanding the generational economy requires understanding the gendered economy, and vice versa.

1.2. Including unpaid care work in economic measurement with National Time Transfer Accounts (NTTA)

The NTA framework for measuring the generational economy has one serious limitation in extending its approach to measurement of the gendered economy, however. NTA are based on disaggregating national accounts by age. NTA adds estimates of some transfer flows not measured in national accounts, but only those transfers of resources included within the production boundary of national accounts, that is what national accounts currently considers to be part of a nation's production. If we think of the usual definition of economics and economic activity as concerning the production, distribution, and consumption of goods and services,¹ the production boundary of national accounts does not include every type of economic activity, it includes some and leaves others out. Specifically, national accounts include flows that arise from the production and consumption of goods and services that are traded in a market for money, usually referred to as "market goods and services." They also include some flows that are not traded in markets for money: the value produced by owner-occupied housing, and the value of some types of financial transactions and services are imputed in national accounts (U.S. Bureau of Economic Analysis, 2008), as is the production

¹ This definition appears in multiple dictionaries of language and economics. Two online examples are <https://www.thefreedictionary.com/Economic+activity>, and <http://www.businessdictionary.com/definition/economic-activity.html>, both accessed on June 18, 2018.

and consumption of goods produced by households for their own use, mostly the value of food grown by a household for its own consumption. In some countries with a large subsistence agriculture sector this last piece can be a substantial imputation. The policies around measurement of own-use production are changing, and national statistical agencies' ability to measure this production and consumption varies widely. Conceptually, however, the national accounting boundary is supposed to include the value of the production and consumption of these home-produced goods. What is not included in the national accounts production boundary, however, is the value of home-produced services.

This slice of economic life is often referred to as unpaid care work, household production, or unpaid household services. I will use the term "unpaid care work" here. Unpaid care work (UCW) time inputs include productive activity that is not already accounted for in national accounts. UCW includes time spent in both direct care activities such as taking care of children, elders, sick or disabled persons, and of the community through volunteer activities, but also the indirect care activities of managing and maintaining a household. Cooking, cleaning, household management and maintenance are some of the activities included as indirect care activities.

The System of National Accounts (SNA) is a United Nations-led effort to codify national accounting and most countries around the world organize their national accounting concepts and practices following the most recent set of SNA guidelines (United Nations, 2009). The SNA is addressing the invisibility of UCW by defining it as inside a "general production boundary" that encompasses the traditional production boundary but also includes UCW. It defines UCW as the unpaid own-use "provision of services provided to household or family members, including:

- household accounting and management, purchasing and/or transporting goods;
- preparing and/or serving meals, household waste disposal and recycling;
- cleaning, decorating and maintaining one's own dwelling or premises, durables and other goods, and gardening;
- childcare and instruction, transporting and caring for elderly, dependent or other household members and domestic animals or pets, etc." (International Labour Organization, 2018)

While many researchers and advocates have noted for years that UCW is a valuable economic activity, we have finally reached the point where statistical agencies and international measurement and monitoring bodies such as the ILO and the UN explicitly include it in their work plans, goals, and reporting.²

² The nomenclature around unpaid care work can be confusing. Time inputs not accounted for in national income should not be confused with unpaid family work in household-owned farms or other enterprises, here referred to as "unpaid family work." This is in contrast to "unpaid care work" which is the unpaid care and housework not included in national income. Unpaid family work does not generate earnings for the unpaid family laborer, but does produce goods and services traded in the market thus generating income for the household that is already part of national income, or it produces goods consumed by the household which are not traded in a marketplace but are imputed as part of national income. Unpaid care work 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 National Income. 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

We are still years away from having the kind of consistent, comparable data across countries on UCW that we have for measures like GDP and marked labor force participation, but the day is certainly coming. In the meantime, NTA and CWW will follow the long-standing methodology that researchers have used to estimate the production of UCW, and then apply the NTA framework to highlight the age nature of UCW production and consumption in the same way that it has been able to demonstrate in the market economy. The Counting Women's Work project refers to this combination of the two methodologies – one to measure unpaid care work and the other to measure flows across age groups using NTA – as National Time Transfer Accounts (NTTA).

The development of NTTA is conceptually linked with gender due to the prevalence of women's specialization in UCW production which is 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). Establishing the empirical reality of the generational and gendered economy around the world, then, requires two distinct efforts: 1. disaggregating the current national accounts-based NTA by gender, and 2. adding the NTTA set of satellite accounts comparable to NTA that include unpaid care work. The technical aspects of that project will be laid out clearly in later sections, but first we shall consider at the outset what we hope to gain from the work.

1.3. Why measure the gendered economy?

When we integrate unpaid care work 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 preferences and 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. Results from the Counting Women's Work project show that the cost of an infant in parents'

included activities are performed outside of the household for non-household members. Examples are care for persons outside of the household and volunteer activities.

time can be as much if not more than the cost of market goods and services purchased for that infant (National Transfer Accounts, 2017). Measuring those time inputs gives us the total cost of children, which is relevant for understanding fertility decisions as well as human capital investment dynamics. 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 by elderly parents related to the time transfers the elder receives from them?

Measurement is the first step in answering all of these research questions. The next section will show some preliminary measurements in countries that have estimated NTA and NTTA by sex. Following this general discussion of results, detailed methodology is presented to disaggregate NTA by gender and to estimate NTTA by gender. While the NTA methodology has been developed over many years and has been in use for a long period of time (United Nations, 2013), the sex-disaggregation methodology and that for the NTTA is more recent. Its formalization here is the product of efforts over time by a working group on gender and time use within the National Transfer Accounts project network.³ This working group produced the Counting Women's Work project (www.countingwomenswork.org) and a track within a large European research project within the NTA research network to highlight gender and unpaid care work estimates (<http://www.agenta-project.eu/>).

2. Illustrative Results

To begin, we can examine what the generational and gendered economy looks like in market terms by showing NTA estimates separated by sex. The estimates for Sweden in Figure 1 give an example of the lifecycle deficit – consumption minus labor income –based on national accounts for Sweden in 2010, separately for men and women. These are age- and sex-specific average amounts, smoothed over age. The NTA methodology and how it is applied to sex-specific estimates is detailed in the next section, but to summarize, we begin with national accounts information on labor income and consumption for Sweden as compiled by Eurostat, and then use household surveys which include the age and sex of the household members to observe the relative shares of these total flows by age and sex. When a flow is not available in a household survey, such as those for consumption provided by the government, administrative data on program expenditures by age and sex are used.

When surveys give individual-level data, as they often do for market labor earnings, we can estimate the relative shares by age and sex separately in a straightforward manner. When surveys give household-level amounts only, as is more common for consumption or labor for household-owned enterprises like family farms or small businesses, we must impute amounts to individuals within the household. For the consumption of private health and education consumption, we use data-driven methods that relate household structure by age and sex to total amounts of spending on health and education of various types. For private consumption other than health and education, we assume age-specific consumption weights

³ The working group maintains notes on progress, documentation, and sample programs at <http://www.ntaccounts.org/web/nta/show/Gender%2c%20Time%20use>.

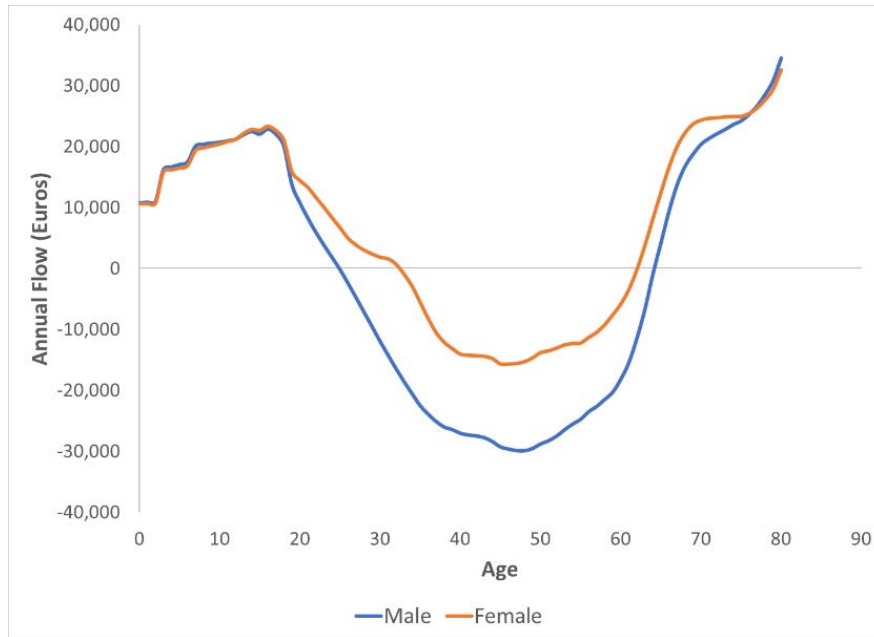
which are equal for same age males and females but assume a greater consumption share within the household for children versus adults. This approach somewhat limits our ability to detect sex differences in this type of consumption because it can only detect differences across households but assumes equality between same-aged persons of different sex within the same household.⁴ For allocating income from household-owned farms or businesses, we rely on indicators within surveys of participation by each individual to allocate the income earned to particular household individuals. Once relative flows by age and sex for consumption and labor income are determined, they are made consistent with national accounts for these flows at the aggregate level, creating what the NTA project calls an “age profile” – a schedule of age-specific average flows that are consistent with the aggregate flow as reported in a country's national accounts. In the case of including sex, the age profile will be sex-specific as well and still consistent with national accounts – multiplying the male age profile by male population counts at each age and adding that to the female age profile multiplied by female population counts at each age will reproduce the national account total for that flow. To produce the age profiles of the lifecycle deficit by sex in Figure 1, male and female age profiles of consumption and labor income are estimated, and the different of consumption and labor income at each age are the age profile for the lifecycle deficit.

In Figure 1, we see women producing smaller surpluses during their working years and incurring somewhat higher deficits when older. In particular, we see much higher deficits for women than men in their early 20s. This is partly due to women delaying entry into the labor market while spending heavily on education. The higher female deficits at older ages are due to older women's lower labor income compared to men. It is important to remember that this picture is a cross-section of different age groups as opposed to a cohort chart showing one age group's experience moving through the life course. This picture may look quite different in 30 years when the heavy investments in human capital by younger female cohorts today help them command higher salaries in the future when they are older.

The results from Sweden show gender in the market economy, but as discussed earlier, there is an entire realm of economic life left out of this picture – unpaid care work. Figure 2 shows both market and unpaid care work for economic lives in Mexico in 2014. On the left side of the figure, time spent in market is shown. This includes work for pay or unpaid work for household enterprises that create market goods or goods produced and consumed by the household. This labor, when valued by its earned wage or imputed wage, is included in NTA labor income age profiles. On the right hand side is time spent in unpaid care work, that is the unpaid time spent producing services consumed by household or community members. This labor, when valued by a replacement wage that approximates what this labor would cost to purchase in the market, is included in NNTA production age profiles. Figure 2 shows clearly that men and women are active in both spheres of the economy, but on average there is a great deal of specialization – men in market work and women in unpaid care work.

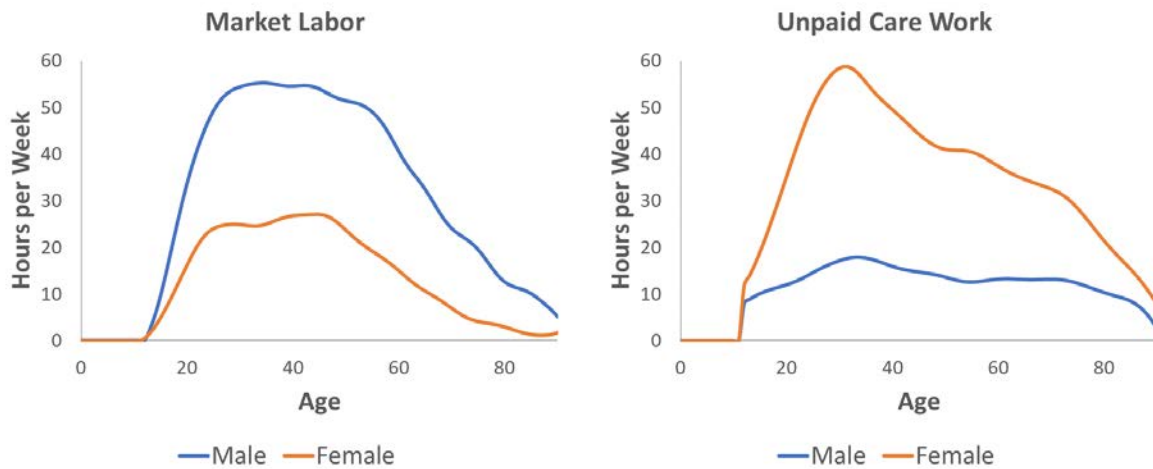
⁴ While there is a robust literature working on such estimates within households, the cross-time and cross-sectional nature of NTA estimates make applying these detailed methodologies across countries beyond the scope of NTA and CWW at this time.

Figure 1. NTA average lifecycle deficit estimates by age and sex, Sweden, 2010 (Euros per year).



Source: Agenta project database (<http://dataexplorer.wittgensteincentre.org/shiny/nta/>). The Agenta project is a research project of European countries within the NTA network. The methodology they used to implement these estimates is consistent with the concepts and procedures described here, adapted to the particular nature of data available across European countries (www.agenta-project.eu).

Figure 2. Average weekly time spent by type of labor, age, and sex, Mexico, 2014 (hours per week).



Source: Forthcoming from Counting Women's Work, courtesy of Estela Rivero, calculated from Mexico's Encuesta Nacional sobre uso del tiempo - ENUT (National Time Use Survey), 2014. Time spent in market labor includes related activities like job search and commuting time.

Figure 2 showed a picture of market and household economies in terms of time. The final set of illustrative examples demonstrates what can be learned combining market and household economies in monetary terms. Figure 3 represents estimates for the United States from 2009, all are age profiles representing average amounts for an age group for a particular type of flow. Consumption flows are shown in red, production in blue, and the difference between them in green. This difference is the lifecycle deficit, a measure of how much an age/sex group needs to get either in transfers or through assets from other age/sex groups in order to support its own consumption. Estimates are separated by sex, with male charted as solid lines, female as dotted lines. The top row of graphs in Figure 3 shows production and consumption of unpaid care work time measured in National Time Transfer Accounts (NTTA). For the production estimates, age profiles of average time spent in unpaid care work activities from the American Time Use Survey are weighted by an imputed wage for each type of household activity. Consumption of this time is imputed to household members and the average imputed amounts by age and sex form the age profile. Time spent caring for children or adults is imputed to the children or adults in the household in the target age group, while the consumption of general activities like cooking, cleaning and maintenance is divided equally across all household members. Details on the wage imputations and consumption estimates are given in later sections. The next row of charts in Figure 3 shows the age profiles for national accounts-based NTA flows of production (labor income, for the market economy) and consumption and the difference between them which is the lifecycle deficit. Finally, the bottom row of charts in Figure 3 shows the combined accounts adding NTTA and NTA to get an accurate representation of the total economy by age and sex.

We see in Figure 3 for the US in terms of money that, as in the Mexico example in terms of time, women do more unpaid care work and men do more market work. While the production curve for men is much higher for NTA production compared to NTTA production, for women the difference across economic sphere is less. Consumption looks roughly equal

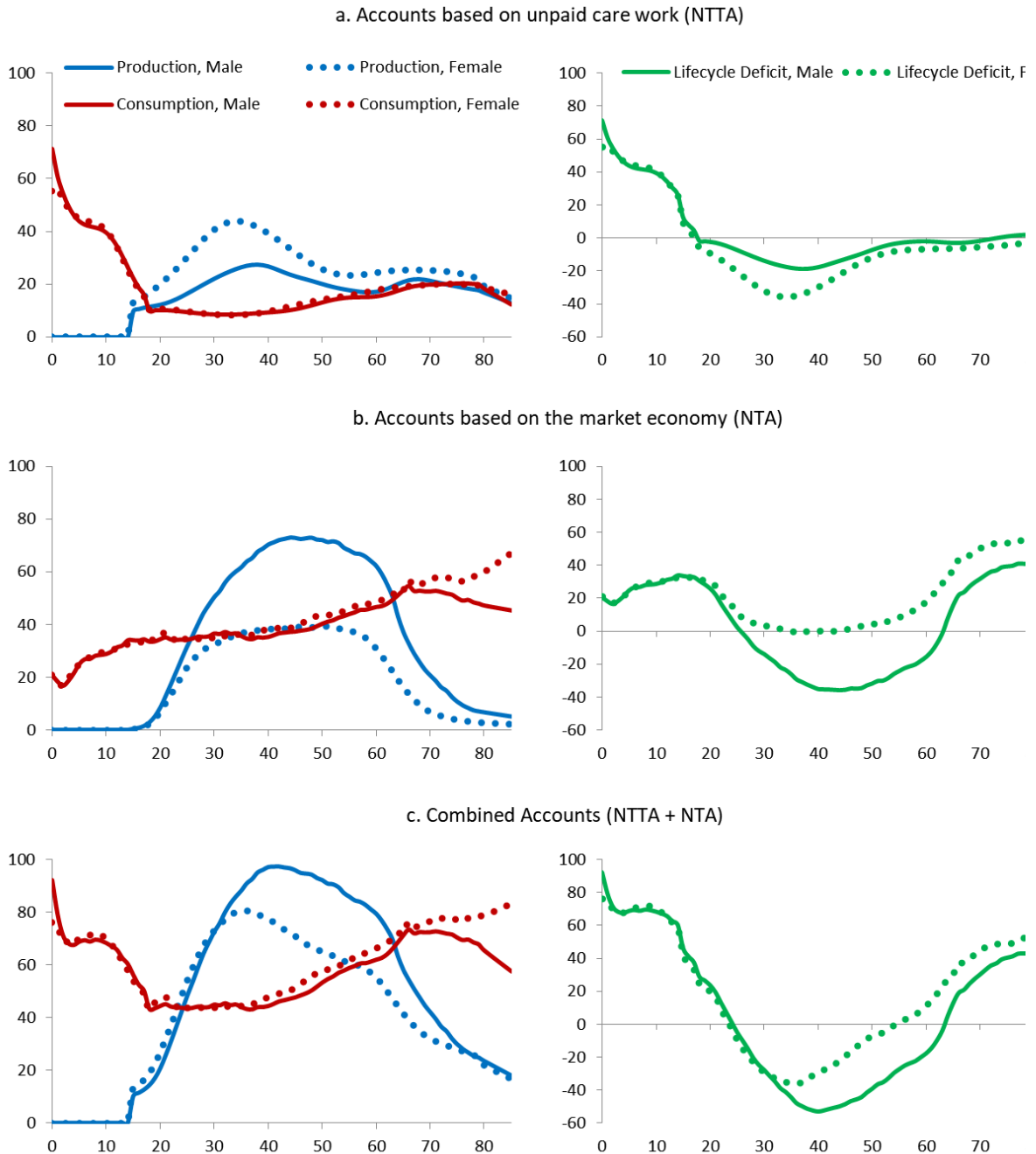
for male and female across age groups. The one exception to this is market consumption at oldest ages. This is greater for women than men largely because they are more likely to be disabled and/or live in nursing homes, both of which include much consumption of expensive health care.

We can also see that the scale of unpaid care work production when measured in dollars is quite a bit lower than for market production. Average NTA market labor income for men reaches a peak in the mid-40s age group at about \$73,000 per year, while the peak of the NTTA unpaid care work production curve is for women in the mid-30s age group and is only about \$44,000 per year. Although the time estimates are not shown, the time spent by these groups is in fact roughly the same. It is the low market replacement wages for care and household services that are responsible for the lower value of unpaid care work when expressed in monetary terms. There are many reasons why these market wages are low – competition between market and household providers, historical devaluing of women's occupations, lack of a developed market for certain services, among many other explanations. While NTTA estimates seek to redress the long-standing error unpaid care work's invisibility, they cannot "correct" for a history of gender-based economic discrimination which took for granted that this type of work would always be provided largely by women and largely for "free."

Given these limitations, it is important to note what adding NTTA can do for us. Considering the lifecycle deficit in NTA market terms only, we would conclude that US women produced no surplus at all at this time, having average consumption equal to or greater than their production. The deficit in NTTA however is substantial for women. Thus, when the accounts are combined, the sexes look much more similar in the size of their deficits and their ability to produce surplus than if we observed either of the spheres independently.

Clearly, an accurate representation of men's and women's productive activities is only possible with the inclusion of unpaid care work. Furthermore, failing to consider the huge amounts of unpaid care consumed by the very young and very old would considerably underestimate the value of inputs to them and the transfers they require to maintain their consumption.

Figure 3. Production, consumption, and lifecycle deficit for NTA, NTTA and combined per capita age profiles, United States, 2009 (annual US dollars, in thousands).



Source: Author's calculations, forthcoming from Counting Women's Work. Notes: The "production" line plotted for panel b. is labor income (wages, benefits, self-employment income). Results do not include impacts of multitasking (indication of more than one activity taking place during the same time unit).

3. Estimating NTA age profiles by sex

3.1. Introduction

The discussion in this section starts with a brief review of NTA and its notation. Once the basic NTA age profiles have been computed, the two main parts of separating out these profiles by sex follow: find gender-specific indicators of NTA age profiles to create separate profiles by sex, and then adjust those profiles so that they are consistent with the single group NTA profiles. Finally, a brief discussion recommends several sensitivity tests that produce estimates under different assumptions, which may or may not make a difference depending on the nature of the underlying data.

3.2. NTA review and notation

The calculation of NTA age profiles is covered extensively in a manual published by the United Nations (United Nations, 2013). Following the System of National Accounts (SNA), NTA flows cover those included in the SNA's "current account," which describes the accrual and disposition of income within a calendar year. There are further accounts that include wealth, capital, and assets as well as how price changes in assets affect balance sheets, but at this writing NTA methodology is sufficiently refined for extensive international comparison only for the current account. NTA is organized into different flows that cover consumption, labor income, transfers, asset income, and saving/dissaving. All flows except for labor income include flows channeled through the private and public sectors. Consumption, then, includes both private consumption paid for by households and public consumption of publicly provided health, education, and other general and administrative services. Transfers include private transfers within and between households, but also public transfers included in government tax and benefit programs. Asset income and saving/dissaving include flows generated from both public and private ownership of assets as well as flows that arise from borrowing or paying interest on debt. The methodology discussed here to separate all of these flows by sex applies generally, but it has been most commonly used in countries within the NTA research network on just consumption and labor income.

In general, creating each NTA age profile consists of two steps. First, a cross-sectional set of age-specific averages of the activity (referred to here as the age schedule) is estimated, giving the relative per capita amount of that activity by age. Often, the necessary data is provided in nationally-representative household surveys of income and expenditure. Such a survey will give the data to calculate age schedules for each individual of income earned, benefits received, taxes paid, and many other flows. For many flows, however, amounts at the individual level are not available, but a household amount is. For example, in a consumption survey an amount of expenditure on food is available for the household as a whole, but there is no direct measure of how much each individual consumed. For general private consumption, we use equivalent adult consumer weights to apportion this household consumption to each individual. Those weights are 0.4 for infants, rise linearly to 1.0 at age 20 and are 1.0 for all age 20 and older. We do not use different weights by sex, for there is no empirical basis on which to create these weights in a consistent way across all countries in the NTA research project, given the very different source data each country research team has to draw upon.

In the second step, we use aggregate measures of the particular economic flow from national accounts to serve as an aggregate control. Because some concepts NTA research focuses upon are not exactly specified in high-level SNA aggregates, there are usually some differences in NTA aggregate controls and the similar measure in SNA, but those differences are not large in most cases. 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 one-group macro control in equation form:

$$\begin{aligned}
 a: & \text{ age } a, \text{ ranges from } 0 \text{ to } \omega \text{ (usually } 85+ \text{ or } 90+) \\
 N(a): & \text{ population count, age } a \\
 X: & \text{ aggregate control} \\
 x(a): & \text{ per capita age schedule at age } a \\
 \theta = X / \sum_{a=0}^{\omega} x(a)N(a): & \text{ adjustment factor} \\
 \tilde{x}(a) = \theta x(a): & \text{ per capita NTA age profile, age } a \\
 \tilde{X}(a) = N(a)\tilde{x}(a): & \text{ aggregate NTA age profile, age } a
 \end{aligned}$$

Separate treatment of males and females to measure the gendered economy 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:

$$\begin{aligned}
 N(a, g): & \text{ population count, age } a, \text{ sex } g \\
 x(a, g): & \text{ per capita age schedule, age } a, \text{ sex } g
 \end{aligned}$$

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 one-group age profile $\tilde{x}(a)$. 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.

3.3. Sex-specific Age Schedules

Age schedules when data are available by individual's age

Data are readily available in national income and expenditure surveys for many types of economic behavior to estimate age schedules by sex. When one-group age schedules are calculated from individual-level survey data, the survey typically includes sex as a variable in the data along with age. In this case, we can use the same variables that are used in one-group NTA to indicate the age schedule of a particular activity and calculate age- and sex-specific means instead of just age-specific means, as in one-group NTA, to get age schedules by sex. For example, labor earnings is a component of labor income and is typically available in income surveys for each member of a household, down to some cut-off age. In this case, we can use the same data to get one-group age averages of earnings and to get age averages of earnings for women and men separately.

Some flows provided by government sources are not measured in household surveys precisely because they are provided by government and thus household members do not

have an accurate idea of how much they receive or consume. For these programs, administrative records are sometimes available that give age- and sex-specific schedules of public benefits. Alternately, requests for special tabulations of such information can be made to statistical agencies. Generational Accounts, which require many of the same data as NTA public sector accounts, are always estimated by gender as a preliminary data step, so where it is possible to calculate inputs to Generational Accounts, those same inputs could be used to produce NTA age schedules by gender (Auerbach et al., 1999).

Age schedules when data are available for households

As mentioned previously, 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 2. assumed relative age shares (equivalent adult consumer weights).

When regression is used to estimate age shares, we regress the household amount of a flow on the age structure of the household and any available indicator that a household member was involved in the household level flow. For example, private education spending at the household level would be regressed on the age structure of those in the household and whether or not they were enrolled in school. Similarly, household out-of-pocket spending on hospital or doctor bills would be regressed on household age structure and whether each household member was indicated to have been to a hospital or clinic. These regressions generate coefficients for each age group that are used as weights to apportion a household expenditure amount. This process gives the one-group estimates. For the sex-specific estimates, the sex of household members is included to generate coefficients that can differ for males and females of the same age. The examples given below show models with separate age factors for men and women, but other formulations that include sex have been explored, such as including a single additive term after the age terms. Researchers 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:

$$X_j = \sum_a \alpha(a)E_j(a) + \sum_a \beta(a)NE_j(a) + \varepsilon_j$$

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 $\alpha(a)$ and $\beta(a)$ 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 $\alpha(a, g)$ and $\beta(a, g)$ for each sex g :

$$X_j = \sum_a \sum_g \alpha(a, g)E_j(a, g) + \sum_a \sum_g \beta(a, g)NE_j(a, g) + \varepsilon_j$$

There are several other models described in the NTA manual (United Nations, 2013) section on consumption that might be used. Those methods can be expanded to include sex following the same principle that is described above: where an NTA regression equation has one term for a particular age group, expand that to 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 are 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 gender distribution of households. However, a priori we do not have enough information to assume any differences within households between same-age men and women across all countries involved in NTA.⁵

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 are computed in much the same way as for the one-group profiles.

For intra-household transfers, the procedure is the same as for one-group: the sharing algorithm is computed using aggregate adjusted microdata. That is, the profile values for the “ingredients” of the intra-household sharing model for each individual (not the age group averages) are adjusted as described in the section below with the age-specific factor that makes the sex-specific profiles consistent with the aggregate-adjusted one-group profiles. Then the same algorithm as for the one-group version can be run. 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, age schedules are smoothed to reduce noise and produce more informative visual representations. Schedules by sex may need more careful statistical smoothing than those for one-group NTA due to the smaller sample sizes but the implementation is the same. Researchers examine and adjust the smoother by the same means as when estimating one-group NTA, to preserve real discontinuities which might be brought about by public program incentives or age-defined cultural practices, and to eliminate as much as possible statistical

⁵ 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 gender within the household (Phipps and Burton, 1998). 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 will be an important priority for future revisions of the methodology. For the current methodology, researchers should be clear on the potential for bias in estimates of women's versus men's private consumption and sometimes it is more appropriate to show one-group consumption estimates instead of separate sex ones, where it is believed the chances of intra-household gender discrimination are high.

noise introduced by sampling or other types of random variation. NTA research groups use a cross-validation smoother called Friedman's Super Smoother.⁶

3.4. Adjustment for consistency with one-group 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 aggregate controls from national accounts and also with the one-group 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 one-group profiles.

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

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

$$\tilde{x}(a, g) = \theta(a)x(a, g) : \text{ per capita NTA age profile, age } a, \text{ sex } g$$

$$\tilde{X}(a, g) = N(a, g)\tilde{x}(a, g) : \text{ aggregate NTA age profile, age } a, \text{ sex } g$$

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 one-group age profile and will have a combined aggregate total equal to the aggregate control.

Adjusting the sex-specific profiles to be consistent with the one-group profile accomplishes the goal of making sub-group age profiles consistent with higher-level profiles, but it is also statistically expedient. The one-group profiles will have the most observations at each age and thus will produce the most accurate estimate of the age dimension of a particular flow. Any lower-level profile will be less well estimated in the data due to lower sample sizes so marking back to the higher-level profile enhances the reliability of the lower-level estimates.

3.5. Recommended sensitivity tests

There is more than one way to estimate any particular NTA age profile by sex. Sensitivity tests are an important part of understanding how our estimates work, examining different implementations to see if they create a different picture of results by gender. NTA researchers generally examine two alternative implementations of the methodologies described above. The first involves experimenting with different techniques to estimate

⁶ See Friedman, 1984; also <https://stat.ethz.ch/R-manual/R-devel/library/stats/html/supsmu.html> for implementation in the R statistical computing program, and <https://ideas.repec.org/c/boc/bocode/s458030.html> for implementation in the Stata statistical computing program.

within-household allocations for quantities that we only observe directly at the household level. The second involves changing 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 producing different patterns by gender. This has no impact on consumption or production but is potentially important in determining the observed age- and gender-dimensions of asset-based flows and some kinds of transfers. 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 housing. When we calculate a one-group 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 gender, 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 gender to the headship definition.⁷

As headship in NTA mainly impacts estimates through the ownership of assets, the ideal would be to identify the head as the legal 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 legal 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.

4. NTTA by Sex: Satellite Accounts Based on Time Use Data

4.1. Introduction

To produce NTTA estimates, we follow in the long-standing research tradition behind household production satellite accounting (Pan American Health Organization, 2010) that

⁷ Some possible definitions of headship are:

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

produces a national aggregate estimate of unpaid care work, and join it to the NTA framework which disaggregates national flows by age and imputes consumption and transfers of flows as well.

The previous section on the methodology for estimating NTA age profiles leaned heavily on a country's income and expenditure survey. Most nations have these surveys and many produce them on a regular basis. The same is not true for time use surveys, unfortunately, although they are becoming more common over time. They are the main ingredient in producing NTTA estimates, along with wage data so that an imputed wage can be used to value unpaid care work time in monetary units. Using time use survey data, the basic estimation strategy is as follows:

- i. identify available time use surveys, either a full time diary survey, or another type of survey that contains a comprehensive set of questions that observe many types of work activities,
- ii. identify time spent on household production activities by age and sex in the time use survey,
- iii. 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),
- iv. use assumptions and time use survey data on household composition to impute the age of the consumers of the unpaid care work time produced in the household, and
- v. 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 unpaid care work. The final part of this section discusses the role of the capital component of unpaid care work.

4.2. Identify available time use surveys

Ideally, NTTA are calculated using a time use survey with characteristics similar to the income and expenditure household surveys that generate NTA estimates:

- nationally representative
- each household members' age and sex is listed⁸
- the survey covers roughly the same time period as comparable NTA estimates, to facilitate comparison between NTA and NTTA
- 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, with appropriate weights so that such observations are correctly weighted relative to an annual time span)
- complete time use data for at least one person in each household

⁸ Some time use surveys have a full time diary for only one person in the household, others survey all representative adults, or all persons of a certain age or older. If a survey only has information about the age and sex of the time respondent in the household, a household production age profile can be produced based on the methodology here, but not imputed consumption or transfers.

- hours in a day add up to 24 or close to it, or omitted hours are understood to be non-productive⁹

There are far fewer time use surveys than household consumption or income surveys, so researchers in some countries may compromise on some of these characteristics. If a time use survey is available for a particular sub-region of the country, for example, or does not list household members or time use activities in sufficient detail to allow for the calculation of the complete NNTA system of production, consumption and transfers, even the limited results that such data can produce could be informative. 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. It will also be useful to show the potential for a more complete survey to give important results. Also, NTA results can be calculated differently to facilitate comparability with NNTA, for a particular sub-region, for example.¹⁰

4.3. 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 if they were 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 and still receive the benefit from it (Reid, 1934). Activities like sleeping, eating, sports and leisure activities would not be included, as paying someone to do these things would actually not give you the benefit of them. Any home management or care activities would qualify by the criterion.¹¹ 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 each researcher must work with the survey available in that particular country, but here are two examples of classifications and where to look for unpaid care work activities. The first example is in Table 1, showing the 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 and unpaid care work groups are indicated in bold and starred. These are activities which are not included in national income but would be if they were paid for in the market. Note that categories 1-3 represent contracted time already included in national

⁹ 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.

¹⁰ Keep in mind that aggregate 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.

¹¹ 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.

accounts. Categories 0 and 7-9 represent activities that generally could not be performed by one person and benefit another person, so they do not meet the third party criterion.¹²

Table 1. Major groups in the International Classification of Activities for Time Use Statistics (ICATUS). Categories of productive activities not in national income are bold and marked with *.

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

Table 2. Major activity categories in the American Time Use Survey. 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)
2. Household activities †
- 3. Caring for and helping household members ***
- 4. Caring for and helping non-household members ***
5. Work and work-related activities
6. Education
7. Consumer services †
8. Professional and personal care services †
- 9. Household services ***
10. Government services and civic obligations †
11. Eating and drinking
12. Socializing, relaxing and leisure
13. Sports, exercise and recreation
14. Religious and spiritual activities
- 15. Volunteer activities ***
16. Telephone calls †
17. Traveling †

If a particular time use 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 of unpaid care work activities. Another example of activity classification is that used in the American

¹² There are gray areas here, especially in personal care. Theoretically you could pay someone else to brush your teeth for you and still get the benefit of clean teeth, but in practice this only occurs at infrequent dental exams.

Time Use Survey (ATUS), shown in Table 2. There the major groups of activities involved in unpaid care work are bold and starred, but for some activity groups, some of the activities qualify and others do 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). For comparability in NTTA estimates, 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 NTTA estimates should include, data permitting.

Table 3. Grouping of household production activities in NTTA.¹³

Time Use Activity
1. Cleaning
2. Laundry (includes sewing and clothing repair)
3. Cooking (food and drink preparation)
4. Household maintenance and repair
5. Lawn and garden care
6. Household management (incl. finances, scheduling, coordinating, and related telephone calls)
7. Pet care (not veterinary care)
8. Purchasing goods and services
9. Travel (related to activities 1-8, 10-12)
10. Childcare <ul style="list-style-type: none"> • Care for household children • Care for non-household children
11. Care for adults and elders (these can be separated into two separate accounts if sufficient data are available) <ul style="list-style-type: none"> • Care for household adults and elders • Care for non-household adults and elders
12. Volunteering or other forms of care for community members (includes related travel)
13. Fetching wood or carrying water ¹⁴

Note that the direct care variables involving care of those inside or outside of the household can be separated into different accounts if the survey data are sufficiently detailed. Also,

¹³ 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.

¹⁴ Including fetching wood and carrying water is conceptually problematic, as these activities when they are unpaid are now considered to be labor to produce goods for household own-use, which is technically inside the market-based production boundary. This would make these market activities and their value would theoretically be included in national accounts measures covered by NTA estimates. However, in practice the estimation of these activities in measures such as GDP is so poor that it is not double counting to include them in NTTA estimates.

some activities may not be relevant in all countries, such as fetching wood and carrying water which will not appear as an activity in richer countries with more sophisticated infrastructure.

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 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 respondent or the classification scheme will in most cases make that decision for you in the way the activity is classified as either "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, and the pet would still get the benefit of the exercise 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 productive activity is no less valuable to consumers if the producer also gains satisfaction in the making of it.

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 childcare¹⁵ or with eating and drinking. Other surveys ask respondents what they were doing at a particular time, and then after an initial answer prompt the respondent to indicate if he or she was doing anything else at the same time. Unfortunately, this diversity across time use survey instruments in how questions about secondary or overlapping activities are framed poses a great problem for cross-country comparison. For this reason, NTTA estimates intended for cross-country comparison use primary activities only, and do not include any information on multitasking, overlapping activities or secondary activities. However, countries with surveys that include this type of data often estimate a separate 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. Where surveys report activities and allow respondents to indicate more than

¹⁵ 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.

one activity but none are indicated as the “primary activity” time units should be divided equally across all indicated activities for a particular time period.¹⁶

After identifying relevant activities, researchers explore the time use 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. Results in terms of time will relate to the lived experience of work just as much as results valued in monetary terms. It is also important to examine the time-valued accounts to understand the challenges faces in valuing that time by a wage: 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 part of any discussion of NTTA results.

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. Often in descriptive information on the time-valued NTTA accounts, however, the time will be kept at a rate more easily understood to relate to lived experience, like hours per week or per day.

For comparison, we usually want to include an estimate of time spent in non-NTTA activities, such as education, sleep, and most importantly paid work. Estimates of time spent in paid work for comparative purposes should also include a way to evaluate how much time is spent in work-related activities such as job searching, work-related socializing, and commuting.

4.4. 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? If everyone decided tomorrow to purchase all household services instead of

¹⁶ For alternate estimates including multitasking, if a unit of time is indicated to have one unpaid care work activity in that time, it should be assigned the full value of that time, even if it is shared with a leisure activity. If the unit of time is assigned to more than one productive activity, researchers should divide the time unit equally among the multiple productive 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. This way of handling multitasking preserves the 24 hour day and recognizes the research showing that the “multitasking miracle” is more myth than reality. Several other examples of time use and work 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. We want to treat unpaid care work in a similar manner and not penalize a less productive use of time or the inclusion of a leisure activity. 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.

do them as unpaid care work, how much would the market economy grow? The particular valuation method chosen has a big impact on the final NTTA accounts.¹⁷

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? That is more difficult from a data perspective, compared to the usually more available wages by occupation. To value outputs of time, we would need additional data sources on the price and quality of each *output* activity. Instead, we 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 or they would presumably not make that choice. But this is at least a way to produce a downward biased estimate in a way that is comparable across countries.

Valuing time inputs: specialist replacement method

Following NTA's focus on measurement, we 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.¹⁸ A study or survey on labor and earnings for the time period in question will be able to give average hourly wages 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

¹⁷ 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.

¹⁸ 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. This may be appropriate to use in some countries but not in others. If housekeepers are only employed by very wealthy households in a particular country, then 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.

would apply to time spent cleaning; and a food service wage would apply to time spent preparing food, serving it and cleaning up after. Researchers should 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. Where possible, 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. Weighting the average by the number of people employed in each level of occupation gives some measure of likely distribution by which skill levels and particular types of activities are also distributed across households.

Researchers use their country-specific knowledge to imagine what kind of worker a householder would hire to replace his or her own time inputs.¹⁹ The same imputed wage is used regardless of the gender of the person doing the same task.²⁰ 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. There is not much that can be done to correct for this, but it is important to keep in mind when discussing results and making conclusions.

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.²¹

¹⁹ 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.

²⁰ This assumes that men and women will be equally productive at the same task, which is most likely a poor assumption. Unpaid care work 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.

²¹ 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 unpaid care work unless the marginal value of the time spent in unpaid care work is no less than the after-tax

In addition to taxes paid by the person performing the service, 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, or if fringe benefits are an important part of total compensation, then the wage the employee receives is smaller than the actual amount earned. If an employer must pay an additional amount to the government for each employee for social protection insurance or for fringe benefits, 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, although that is not part of the wage the employee sees on his paycheck. Health care insurance premiums are often paid, at least in part, by the employer. 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 higher than just the average wage as observed in a labor force survey. A similar correction should be implemented if there are large fringe benefits accruing to market wage-earners that would not be observed in a paycheck. If, however, such fringe benefits are usually only paid to workers in other sectors of the economy than household services, adjustments for fringe benefits should not be made.

Finally, there is an issue of whether to adjust wages for potential differences in productivity either by sector or by the age of the person performing the unpaid care work. NTTA does not adjust estimates for differences in quality or efficiency in home versus market production, or for potential differences in efficiency by age. Although there are compelling arguments for these adjustments, there is no feasible empirical method for determining their magnitude that can be applied on a cross-national basis.²²

4.5. Estimating age schedules

Production

After activities are identified and wages assigned to those activities, then the average wage-weighted time spent in each group of activities, by age and sex, is the NTTA age schedule for production of that activity. Zeros are included in the average for people who do not perform a particular activity.

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.

²² 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 unpaid care work accounts, 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 unpaid care work 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 unpaid care work.

Most time use surveys do not interview younger children, and thus have a minimum age at which we can estimate unpaid care work production. In the absence of data, we must assume that children too young to be interviewed do not engage in home production activities or if they do it is sufficiently unproductive as to be not worth valuing in terms of a wage.

Researchers may aggregate the groups of activities in Table 3 for reporting and analysis, but for calculating consumption profiles, the activities are handled separately. The consumption of general household activities (Table 3 activities 1-9 and 13) will be calculated differently from consumption of direct care activities (Table 3 activities 10-12).

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.

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, like that used to apportion private health and education consumption in the NTA accounts, should be used. The utilization indicator for the regression method for direct care is 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 the regression equation will include membership in one- or two-year wide age groups for ages 0-18. As for NTA private health and education consumption allocations, a regression equation is estimated based on total household amount of care produced and the numbers of people in each age group who are potential targets of that care. The producer of the care is not included in the regression estimation even if he or she is in the target age group 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. The 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. Note that some surveys have information indicating exactly which household members were being care for during that activity. These can be used to make a direct allocation of the time produced to the consumer of that time.

There is one alternative method to assign direct childcare consumption that makes sense in some contexts: using age-targeted care produced in households with only one person in the target age group to provide weights to distribute care. For example, if you have a care variable that gives the time spent on childcare for persons aged 0-18, take a subset of households where there is only one person aged 0-18 in each household. Calculate the average time spent on childcare in households by the age of the child in the household. Then use this average schedule as weights to impute the consumption of all of the childcare produced in households with more than one child. Similarly, if your time use dataset has a variable for elder-care, use households with only one elderly person to provide weights to apportion care in households with more than one elderly person. This method will work well in contexts with relatively low fertility and small household size. In countries with very high fertility or complex household structures, a sample of very small households with only one child may give results not applicable to most households.

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 as consumption to all persons in the target population, using the age profile of consumption of care provided to household members as weights, or 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.²³ 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 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 among all potential recipients using known care consumption age profiles as weights.

Once all of the production is allocated as consumption, then producing the age- and sex-profiles is a matter of taking the age- and sex-specific average amounts. If not all persons in the household who are expected to produce unpaid care work are surveyed with the time use survey instrument, then production and consumption of care will be out of balance. Corrections for that are discussed in later sections.

Transfers

For some research questions, we may want to know not just production and consumption age profiles, but also the transfers. Total transfers of unpaid care work equal consumption minus production because there is no way to store unpaid care work in an asset and consume it later. We assume it must be consumed the moment it is produced and thus all unpaid care work consumption is a transfer inflow and all unpaid care work production is a transfer outflow. The unpaid care work "market" clears instantaneously. We can, however, look at different types of transfers, whether within or between households, and also take into account that some unpaid care work is produced and consumed by the same person.

²³ 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 to 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.

Inter-household transfers (between households) include all of unpaid care work production that is direct care for non-household persons, including volunteering, is an inter-household transfer outflow. All of the consumption of care provided to non-household persons, including volunteering is an inflow.

Intra-household transfers include unpaid care work that is direct care for household members, and a portion of the general household activities that are not produced and consumed by the same person. For example, if a person spends one hour making dinner for a family of four including himself, he produces an hour of cooking time, and each family member consumes 15 minutes. However, the person who did the cooking transfers only 45 minutes of that hour because 15 of the minutes was for his own consumption, which does not involve a transfer.

The system for assigning the consumption and transfers for general household activities represents the same unitary model for transfers in NTTA that are used 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. In practice, NTTA transfers are usually not the focus of much attention because the overall net transfer is easily accessible by taking the difference of the overall production and consumption profiles.

Other profiles

The only other profile to be considered is asset income. For the NTTA, this is the income derived from consumer durables – those machines such as dishwashers, ovens, vacuum cleaners, and other devices that make us more productive at unpaid care work. 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 could 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 do not 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. In practice, most countries with NTTA estimates only have the labor component included.

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.

4.6. Finalizing age profiles

Smoothing

As mentioned in the section on gender-specific NTA, profiles are smoothed. NTTA profiles may need more smoothing than NTA because of the generally smaller sample sizes for time use surveys compared to income and expenditure surveys, with the added sample size reductions from splitting the population up by gender. Researchers 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.

Adjusting to the aggregate control

These accounts do not exist in national accounts, so we have no true external aggregate control, but we do know that paired profiles must sum to zero in the aggregate, so aggregate consumption must equal production and aggregate inflows must equal outflows. If the methodology is followed correctly, that result must be obtained for the case of the unsmoothed profiles, but this can be altered depending on sampling weights and will also be altered by smoothing the profiles. To correct for this, a single adjustment factor is applied to both sexes. Because the time use surveys are designed to produce accurate estimates for production of time as opposed to the consumption, we treat production as the correct outflow amount and adjust consumption as the inflow to match the production. Mathematically, if P_{agg} is aggregate unpaid care work produced for a particular activity and C_{agg} is the consumption (or inflow), the multiplicative adjustment factor on consumption, θ , is calculated as follows:

$$\theta = \frac{P_{agg}}{C_{agg}}$$

The adjustment factors should be small (less than 5%) because they are mainly adjusting for differences that arise through smoothing. If they are too large, something may be wrong with the smoothing procedure, or the calculation of the unsmoothed profiles.

Documenting and archiving estimates

In practice, all underlying detail in the NTTA profiles should be preserved, even if only aggregated profiles are reported for comparison and 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. The lower-level details may also be of substantive interest for particular research questions such as attribution of higher-level differences.

Summarizing and comparing

Graphs of per capita age profiles are the main starting point for understanding NTTA results just as they are for NTA results. For some purposes, the complexity of the entire age profile can be reduced using average age calculations, or other summary measures. NTTA accounts will be of interest for many research questions. Some examples:

- Combining with NTA to see true nature of transfers, by age and by sex.
- Studying human capital investments 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.

4.7. 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:

$$\log(W_i) = \beta_0 + \beta_1(\text{age}_i^2) + \beta_2(\text{educ}_i) + \beta_3(\text{age}_i \times \text{educ}_i) + \varepsilon_i$$

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 and these can be used to produce an alternative set of accounts that could give a higher range on the production and consumption of unpaid care work.

Finally, for time spent caring for elderly relatives or the time spent by elderly persons caring for others, those events may be so rare, but time intensive when they do occur, that they are hard to measure in the typical time use survey. 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 much higher variance than events that happen every day. This could be an important problem for NTTA estimates of direct caregiving by and for older persons. 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. Similarly, if an adult

child's care for a parent is concentrated around a relatively rare event like a health crisis or planned surgery, the child may spend a great deal of time caring, but those intense bouts of care provision happen rarely and are thus harder to measure accurately. If a survey of older persons is available in a particular 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 can consult those surveys for data on care giving and receiving for older persons. These surveys can be large and complex, but they are designed to have large sample sizes at older ages where national surveys sometimes have very few observations. They are also often much more extensive on the details of care production and consumption and can provide much better estimates.

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