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# **Intergenerational transfers around the world: introducing a new visualization tool**

Lili Vargha  
Bernhard Binder-Hammer  
Gretchen Donehower  
Tanja Istenič

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Intergenerational transfers around the world: introducing a new visualization tool

Lili Vargha

Bernhard Hammer

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## **ABSTRACT**

Age-specific data is typically visualized as simple line graphs. However, if results from many countries are displayed then researchers end up having too many lines in one figure or having too many separate panels in one figure. These visualizations make it difficult to recognize the real age-specific differences among countries. In order to overcome the problems with visualizing age- and gender-specific data for several countries, we introduce heatmap-like figures to visualize age profiles of National Transfer Accounts (Lee and Mason 2011, United Nations 2013) and National Time Transfer Accounts (Donehower 2019). Our figures are more insightful with regard to real age- and gender-specific differences of intergenerational transfers across the countries than traditionally used figures. We also share publicly available codes for replicating the figures.

Keywords: visualization, National Transfer Accounts, National Time Transfer Accounts

Corresponding author:

Lili Vargha



# Intergenerational transfers around the world: introducing a new visualization tool

Lili Vargha (Humboldt University of Berlin, Hungarian Demographic Research Institute)

Bernhard Hammer (Technische Universität Wien, Vienna Institute of Demography)

## BACKGROUND

Age-specific data is typically visualized as simple line graphs. However, if results from many countries are displayed then researchers end up having too many lines in one figure or having too many separate panels in one figure. These visualizations make it difficult to recognize the real age-specific differences among countries.

## OBJECTIVE

In order to overcome the problems with visualizing age-specific data for several countries, we present a new visualization tool to depict age-specific economic activity and intergenerational transfers around the world.

## METHODS

Apart from traditional heatmaps, we introduce heatmap-like figures to visualize age profiles of National Transfer Accounts (Lee and Mason 2011, United Nations 2013) and National Time Transfer Accounts (Donehower 2014, Vargha et al. 2017). We use two different colours and a

variety of their shades for the different positive and negative values. In single figures we visualize labour income and the life cycle deficit/surplus in 77 countries, public transfers in 50 countries, private transfers in 47 countries and time transfers in 28 countries in the 2000s for all ages from age 0 to 85+. We also visualize gender specific age profiles for as many countries as possible.

## RESULTS

Our figures highlight the cross-country differences of giving/receiving transfers by age and gender. The visualizations indicate the important points of the age profiles: when net transfers turn negative/positive, representing whether an age group is net receiver or net giver of transfers. Consequently, it is easier to compare the length of surplus/deficit phases across countries on our plots than on simple line graphs. The shades of the two colours also make it possible to explore the differences in how much transfer is received or given by age in the different countries.

## CONTRIBUTION

Our visualization tool is more insightful with regard to real age- and gender-specific differences of intergenerational transfers across the countries than traditionally used figures. We encourage researchers to use our visualization tool instead of line graphs when they compare age and gender specific intergenerational transfers or similar data across many countries.

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## **1. Introduction**

Age-specific economic activities and transfers among generations are crucial elements of societies, and central to demographic analysis. To highlight differences across countries they are mostly visualized as line graphs. This becomes confusing when results from many countries are displayed on one figure: either too many lines end up on the figure, or there are too many separate panels on it. None of these solutions make it possible to easily compare the results by age across a wide range of countries. Our aim is, therefore, to introduce a visualization tool of intergenerational transfers that is more insightful with regard to real age- and gender-specific differences across countries.

We introduce heatmap-like figures to visualize age-specific economic data from National Transfer Accounts (NTA, Lee and Mason 2011, United Nations 2013) and National Time Transfer Accounts (NTTA, Donehower 2014, Vargha, Gál and Crosby-Nagy 2017, Donehower 2019). The NTA/NTTA data includes detailed age- and gender-specific information. They measure market and nonmarket economic flows between generations and genders and thereby provide a unique framework to analyze the relation between changing population age structures and economic processes, such as demographic dividends, intergenerational and gender equity, public finances, and others.

The huge value of NTA lies in the comparability of the data that is collected for a large number of countries around the world, not only from high-income, but also from middle-income and low-income countries. We visualize age-specific labour income and consumption data in 77 countries from the 2000s, public and private transfers in 50 and 47 countries, respectively. Moreover, we visualize nonmarket time transfers by gender and age in 28 countries (1999-2015). These visualizations help to summarize the NTA and NTTA datasets and to understand the differences in the organization of the economic life course and the intergenerational support system. We also give an example how alternative visualizations can be used instead of line graphs in order to

highlight two-dimensional differences on a figure, especially if both negative and positive values are displayed. Our novel approach is simple, but it offers more insight to real age- and gender-specific differences of intergenerational transfers across countries.

## **2. Data and methods**

### **2.1. The National Transfer Accounts Framework**

The NTA framework introduces the age dimension into national accounting and offers a new way to analyze how resources are reallocated between age groups. NTA show how economic activities, such as working consuming, sharing and saving vary across age groups. Average consumption at younger and older ages is higher than average labour income, while at working ages consumption is higher than average labour income. This difference between average consumption and average labour income is called life cycle deficit (LCD) if positive and life cycle surplus (LCS) if negative. The difference between consuming and producing explains the flows from one age group to another: Whenever consumption exceeds production, the phase of dependency has to be financed through monetary flows either by (1) public transfers via government (taxes; benefits and services), or (2) private or familial transfers, mostly within the household, or (3) asset-based reallocations (net capital income and property income). The basic NTA data includes a range of age profiles, including the per capita averages of income, public/private transfer payments and benefits, consumption and saving by age.

### **2.2. National Transfer Accounts and aggregate data from National Accounts**

NTA quantities have equivalents in NA. Labour income in NTA includes wages, most of mixed income, as well as all types of labour-related taxes. Consumption consists of private consumption as well as of consumption of goods and services provided by the public sector (such as public

health care, education, general public goods) less taxes levied on consumption. The most important public transfer inflows are pensions, education, health services and general public services. The outflows consist mainly of taxes and social contributions registered in NA. Net private transfers are the age specific differences of family transfer inflows and outflows. Their estimation is based on assumptions about the consumption of children and other household members and on age specific data on income using household surveys. It is a novelty of NTA that it estimates the tertiary redistribution of after-tax revenues within the household (such as parents paying for the consumption of their dependent children) or between households (such as retired parents supporting their non-cohabiting adult children) and counts them as private transfers.

### 2.3. National Time Transfer Accounts

The nonmarket transfers within the household economy complement the NTA accounts using NTTA estimations calculated for a wide range of countries. NTTA are estimated using time use surveys and a detailed valuation procedure (Donehower 2014; Vargha et al. 2016). The accounts include gender and age-specific measures of the production and consumption of unpaid household labor: the provision of childcare (such as physical care, supervision of child, teaching, reading, talking with child, etc.) and other household goods and services (such as cooking, cleaning, making repairs etc.). By calculating which age groups are the beneficiaries of these services, they also include intergenerational transfers of unpaid household labor (“time transfers”). They are initially measured in time units, but are also calculated in monetary terms by imputing a market wage for the different household production activities in each country, as is generally done to produce Household Satellite Accounts complementing NA (Ironmonger 1996; Holloway, Short, and Tamplin 2002; Soupourmas and Ironmonger 2002). Calculations are available in time and in monetary terms, in this paper we plot only time transfers by age and gender in hours per day.

## 2.4. Data

The NTA and NTTA estimates provide us comparable, cross-sectional per capita measures of market and nonmarket production and consumption as well as the various types of transfers (private, public, time) by age in a particular year. Time transfers are also available by gender for a wide range of countries.

Our visualizations are based on the NTA estimations developed by (1) research teams around the globe using the standard methodology<sup>1</sup> as well as by (2) the European AGENTA Project (Istenič et al. 2016), which is accessible through an online database.<sup>2</sup> The NTTA estimations we use are developed by (1) the European AGENTA Project (Vargha et al. 2016), which is accessible through an online database,<sup>3</sup> (2) the Counting Women's Work Project (Counting Women's Work (2020)), which is also accessible online after registering,<sup>4</sup> as well as (3) by individual researchers who are members of the NTA research network (Hammer 2014; Gál, Szabó and Vargha 2017).

The NTA and NTTA data we apply are from 1999-2016, depending on the most recent data available in the individual countries. The datasets distinguish inflows (benefits, i.e. receiving a transfer) and outflows (contributions, i.e. making a transfer). We calculate the age specific LCD/LCS (market consumption minus labour income), net transfers of private and public transfers (inflows minus outflows) and also net time transfers by gender (consumption of unpaid household labour minus production of unpaid household labour).

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<sup>1</sup> The entire NTA database is restricted to members of the NTA research network, but many parts of that database are available to the general public and can be found at: <http://www.ntaccounts.org>

<sup>2</sup> <http://dataexplorer.wittgensteincentre.org/nta/>

<sup>3</sup> <http://dataexplorer.wittgensteincentre.org/nta/>

<sup>4</sup> <https://www.countingwomenswork.org/data>

We normalize the NTA values at each using the average labour income of the specific countries during age 30-49, in order to have comparable measures of the different country results. For some countries NTA and NTTA age profiles are accessible for ages 0-80+ (0 till age 80 or older) for some countries 0-85+ (0 till age 85 or older) and for some countries 0-90+ (0 till age 90 or older), depending on the data available in the individual countries. We plot data 0-85+ for all countries. For countries with the last data point 80+ we assume that the per capita averages for ages 81-85+ equals the 80+ average. For countries with the last data point 90+ we use the simple average of the 85-90+ values. Since population data by age is not accessible for all of these countries for such old ages, we are not able to use population weighted averages.

## 2.5. Visualization

We present heatmaps of NTA data (for labour income profiles) and introduce two coloured heatmaps for age profiles with negative and positive values (for LCD/LCS, net TF, TG and time transfer age profiles). The positive and negative values of the calculated age profiles vary by age: there are phases of dependency with positive values and phases of surplus with negative values. The difference between these surplus and dependency phases is made salient on our visualizations by using two different colours for positive and negative values (in our examples below, red and blue, respectively). As a result we are able to signify the important points of the age profiles: the age when net transfers turn negative/positive, representing whether an age group is net receiver or net giver of transfers. By using a two-colour scheme, it is easier to compare the cross-sectional length of surplus/deficit phases in the different countries than on simple line graphs. We also use different shades of the two colours for the different values from lighter to darker colours and highlight the basic difference how much transfer is given / received in the countries by single years of age. In our examples below we order the countries according to the age when positive values

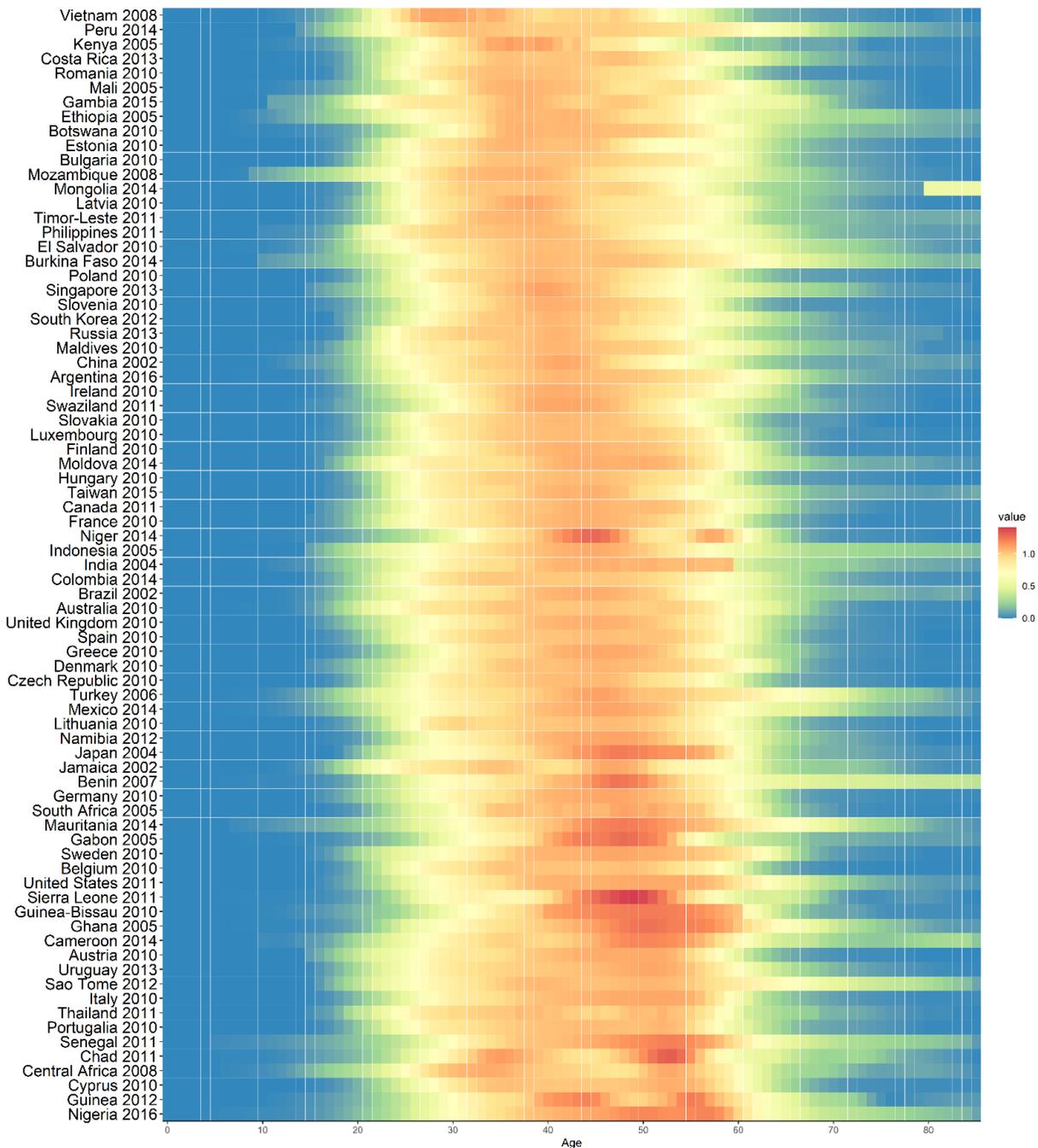
turn negative values, or in other words, when the cross-sectional dependent phase ends and the surplus phase starts. Users could obviously change this ordering and rank the countries alphabetically or according to other information. It is also possible to use different colours to display the age profiles, for example the colour schemes used for heatmaps in R. These solutions will highlight other important information of the age profiles (for example highest and lowest values).

### **3. Results and Discussion**

#### 3.1. Labour income

On Figure 1 we plot labour income age profiles for 77 countries using traditional heatmap style. The countries ordered according to the age of maximum in ascending order. Differences about the age of the highest labour income can be compared as well as its magnitude. Interesting results on child labour and labour income in old age can be also found.

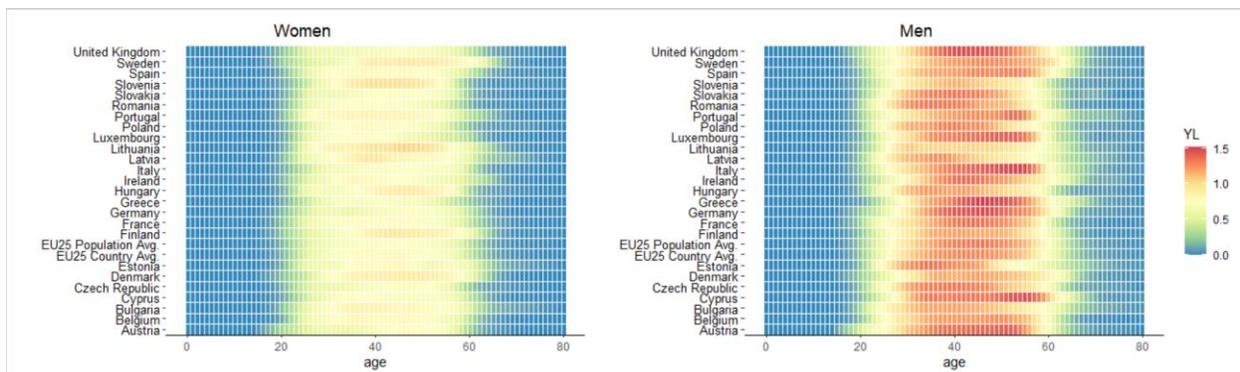
**Figure 1: Labour income by age in 77 countries (2002-2016)**



**Note:** The values at each age are normalized using the average labour income of age 30-49. **Source:** Lee and Mason 2011, Istenič et al. 2019

On Figure 2 we plot labour income age profiles by gender for European countries. On this plot countries are ordered alphabetically.

**Figure 2: Labour income by gender and age in EU countries, 2010**



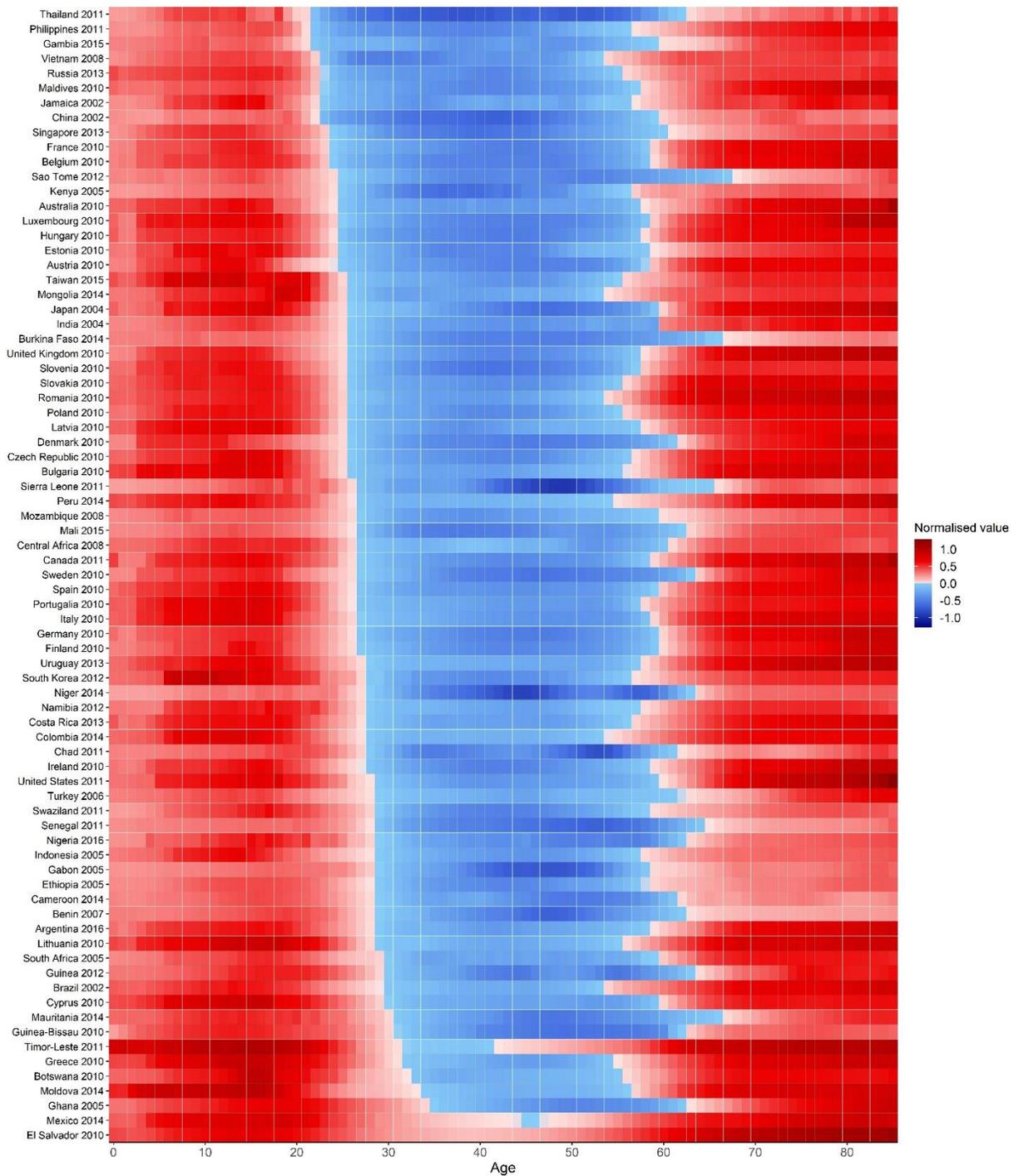
### 3.2. Life cycle deficit

The life cycle deficit/surplus (LCD/LCS) illustrates the basic pattern of the economic life course, with long periods of dependency in childhood and old age, when consumption exceeds labour income, and the period of surplus during working ages, when labour income exceeds consumption. On Figure 3 we plot the LCD/LCS for 77 countries 2002-2016, with age on the x-axis and countries on the y-axis. The differently coloured tiles are for the values at different ages, from 0 to 85+. Those of working age tend to consume less than their labour income, which results in an LCS, indicated by the blue colours on the figure. Meanwhile, those who are not of working age (young or old) consume more than their labour income, which results in a deficit (red colours).

The length of the LCD and LCS phases and the age-borders of positive and negative values vary greatly across countries. In the majority of the countries the LCS phase starts between age 25 and 30 and ends between age 55 and 65. Exceptions are the countries at the bottom of Figure 3, including El Salvador (2010), Mexico (2014) or Moldova (2014), where a large part of

consumption is not financed by labour income generated in the own country, but by remittances. In El Salvador (2010) consumption exceeds labour income at all ages, in Mexico (2014) at almost all ages. Remittances are also important in countries having a short surplus (blue) phase.

**Figure 3: Life cycle deficit/surplus by age in 77 countries (2002-2016)**



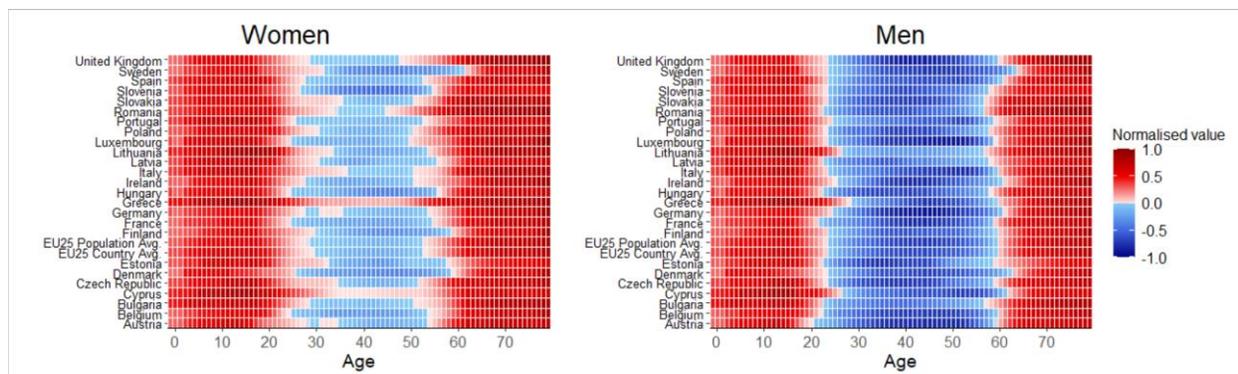
**Note:** The lifecycle deficit/surplus (LCD/LCS) is defined as age specific consumption less labour income. It is positive during the dependent years (shown in red colours), when consumption exceeds labour income, and negative during the working years (shown in blue colours), when labour income exceeds consumption. The values at each age are normalized using the average labour income of age 30-49. **Source:** Lee and Mason 2011, Istenič et al. 2019

Due to the education system and early labour market entry, in Thailand (2011), Philippines (2011) and Gambia (2015), surplus providing starts at the youngest age (22). In all the other countries it starts later, for example in the United States (2011) at age 29. Surplus provision of the older population differs widely across countries as well, independent of their income level. For example, in Vietnam (2008), Mongolia (2014), but also in Greece (2010) and Romania (2010) the LCS phase ends before age 55. On the other hand it lasts until about 65 in Sierra Leone (2011), Burkina Faso (2014) and Sao Tome (2012), but also till age 63 on Sweden (2010) and age 61 in Denmark. These results reflect a combination of social norms and the organization of old-age provision in the given countries.

From Figure 3 the biggest differences in the values can be also read by the different shades of blue and red. For example in Thailand (2011) the surplus phase between age 22 and 62 is not only long, but the darker shade of blue also indicates that the LCS is relatively high during these ages. LCS is also high in Sierra Leone (2011), mostly around age 50, which is the peak of the labour income age profile. The highest LCD at older ages is found in Luxembourg (2010) and the US (2011), since general consumption and mostly the consumption of health and long term care at older ages is high in these countries. In Benin (2007) and Senegal (2011) LCD in old ages is relatively the lowest. The highest LCD during childhood is found in South Korea (2012) and Taiwan (2015), due to the high consumption of education and also due to low fertility levels, since there is a quantity-quality trade-off between LCD during childhood and fertility (Ogawa et al. 2009, Vargha and Donehower 2019). LCD is relatively high during both childhood and old-age, labour income is relatively low and remittances finance a big part of consumption in Timor Leste (2011).

On Figure 4 we plot gender specific LCD/LCS age profiles for EU countries from 2010.

**Figure 4: Life cycle deficit/surplus by gender and age in EU countries, 2010**



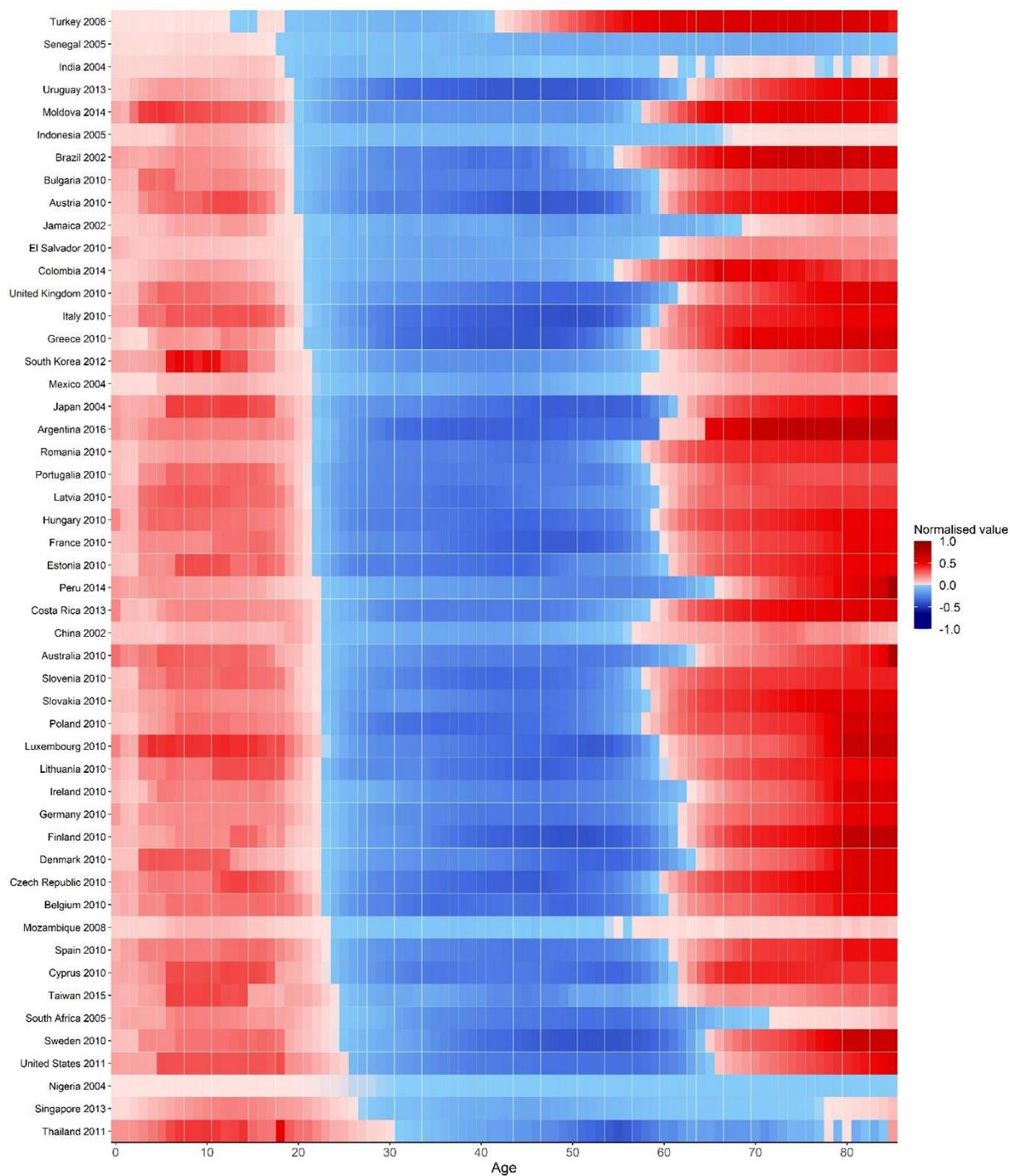
### 3.3. Public transfers

Public transfers redistribute a large share of income in some countries, but are almost negligible in other countries. On Figure 5 we show net public transfers for 51 countries, 2002-2016, defined as taxes less cash and in-kind benefits. While public transfers cover most of the consumption of elderly in most European and some Latin-American countries (like Brazil 2002 and Argentina 2016), as indicated by the darker red colours at the older ages, public transfer inflows are negligible or even nonexistent in several Asian and African countries (for example Nigeria 2004, Singapore 2013, Thailand 2011, Indonesia 2005, Senegal 2011, etc.), as indicated by the light red and blue colours at older ages.

The age spans of being net beneficiaries and net givers of public transfers are obvious and easy to compare on Figure 5. In some African countries, like Senegal (2005), Nigeria (2004), and also in Thailand (2011) and Singapore (2013) not only the working age population, but the elderly are net contributors (shown by the blue coloured tiles at older ages), reflecting the payment of taxes and the low amount of benefits received. In the majority of the countries however, the public transfers

received in old age is much higher than during childhood: the red colours are darker at older ages than during childhood. Relatively, it is the highest in Turkey (2006), Argentina (2016) and Brazil (2002), but also in European countries, especially for the oldest old. For the younger generations, net public transfers are the lowest in African countries (such as Senegal 2011, Mozambique 2008, Nigeria 2004) and they are the highest in South Korea (2012), Japan (2004), Thailand (2011), Luxemburg (2010) and Moldova (2014) due to high per capita public education.

**Figure 5: Net public transfers by age in 50 countries (2002-2016)**



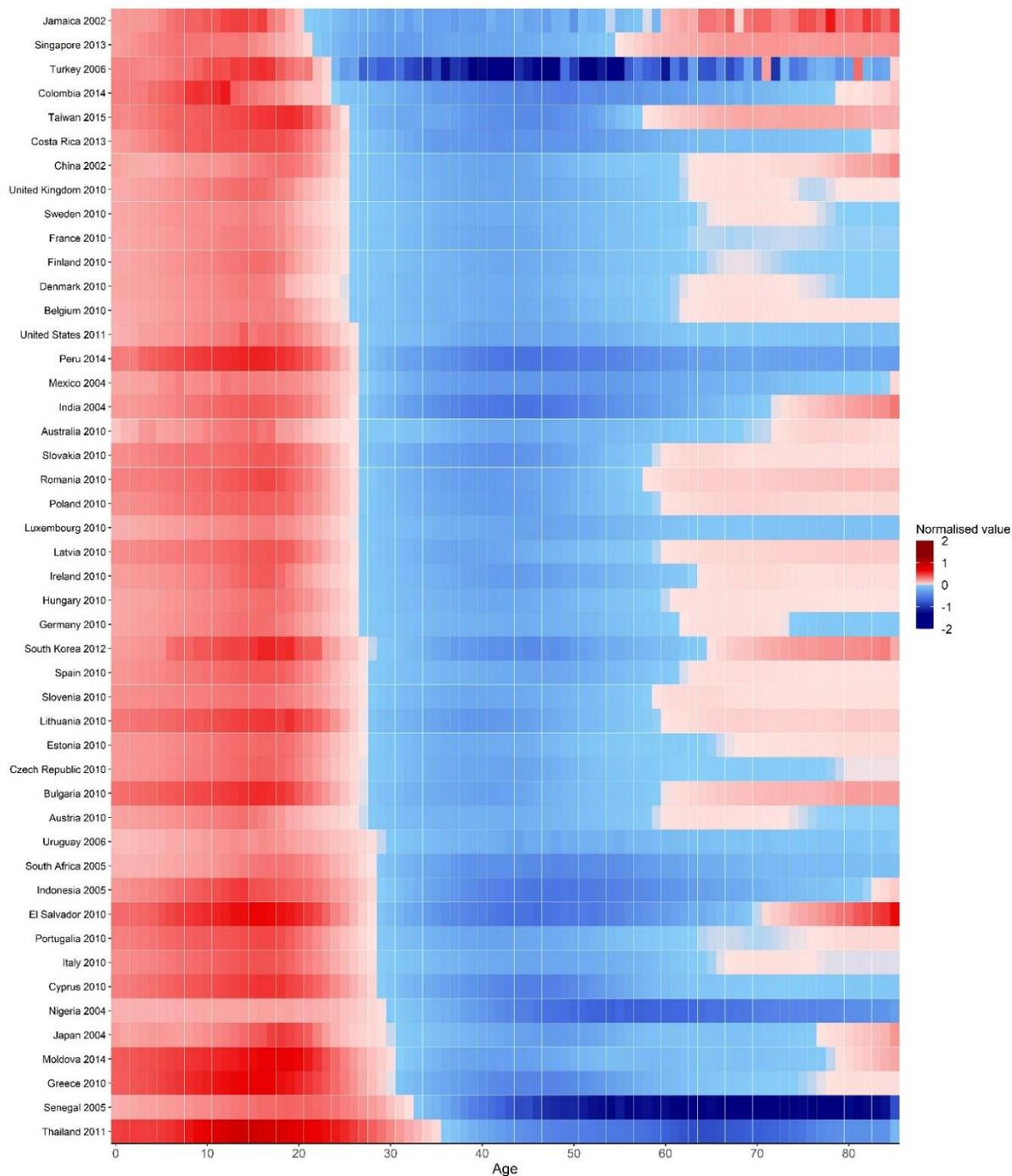
**Note:** Net public transfers are the age specific differences between public transfer inflows (benefits) and outflows (contributions) that are mediated by the public sector. The most important public transfer inflows are pensions, education, health services and general public services. The outflows consist mainly of taxes and social contributions registered in National Accounts. The figure shows which generations are net beneficiaries of public transfers (shown in red colours) and net givers (shown in blue colours). The values at each age are normalized using the average labour income of age 30-49. **Source:** Lee and Mason 2011, Istenič et al. 2019

### 3.4. Private transfers

One of the biggest novelties of NTA is the estimation of private transfers between age groups, which are mainly directed to the young population in all countries. Net private transfers are shown on Figure 6 for 47 countries, 2002-2016. Children are net receivers of private transfers in all countries, and the amount received by them is higher in almost all countries than the amount received by the elderly as indicated by the darker shades of red tiles. Children in Thailand (2011) receive relatively the highest amount of per capita private transfers. On the other hand children living in countries with the highest fertility, Nigeria (2004) and Senegal (2005), and also in South Africa (2005) and Uruguay (2006) the value of per capita transfers are lower, because total transfers provided are shared by more children, decreasing the average amount.

There is a big variation among the countries, whether they provide or receive private transfers in old age. There are many countries across the globe, where people in old age are net supporters of private transfers (shown by the blue coloured tiles in older ages), in some countries also including the oldest old (France 2010, Peru 2014, United States 2011, Luxembourg 2010, Uruguay 2006, South Africa 2005, Cyprus 2010, Nigeria 2004, Senegal 2011, Thailand 2011). In these countries, not only the working age population, but the elderly are net givers of private transfers. On the other hand there are also many countries, where older people are net receivers of private transfers. The value of private transfers received by the elderly, however, is generally not high, as indicated by the light red colours, except for Jamaica (2002) and the oldest old in El Salvador (2010).

**Figure 6: Net private transfers by age in 47 countries (2002-2016)**



**Note:** Net private transfers are the age specific differences of family transfer inflows and outflows. They consist of transfers between households and transfers within households. The level of transfers within households, particularly the transfers from parents to children, are much higher than the transfers between households. They are not captured in National Accounts. Therefore, their estimation is based on assumptions about the consumption of children and on age specific data on income. The figure shows which generations are net beneficiaries of private transfers (shown in red colours) and net givers (shwon in blue colours). The values at each age are normalized using the average labour income of age 30-49. **Source:** Lee and Mason 2011, Istenič et al. 2019

Jamaica (2002) has the youngest age (age 21), in which the generations become net givers of private transfers, and Thailand (2011) has the oldest age (age 36). Senegal (2005), with one of the highest fertility of the countries on the figure and a low importance of public transfers, has relatively the highest amount of per capita net private transfers given during working ages and old age as indicated by the darkest blue tiles. The working age population also transfers a relatively high amount of private transfers in Turkey (2006).

### 3.5. Nonmarket time transfers

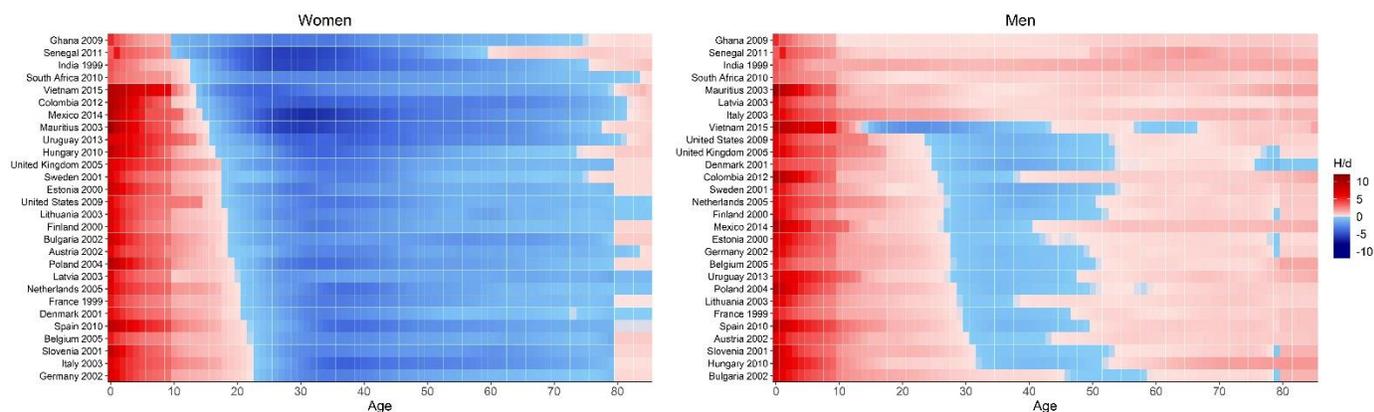
So far we have shown intergenerational transfers within the national economy, for which the aggregated totals are measured in NA. On Figure 7 we plot age- and gender-specific nonmarket intergenerational transfers within the household economy for 28 countries (1999-2015) in hours per day. Again, the age groups with negative values are net givers of time transfers (again indicated by the blue coloured tiles), while age groups with positive values are net receivers (indicated by the red coloured tiles). Like the previous figures, Figure 7 also highlights the large differences among the countries in the number of ages, when women and men generations are net providers/beneficiaries of time transfers.

In all countries there are more age groups of woman who are net givers of time, providing a much higher quantity of household services (indicated by the darker shades of blue tiles). In Ghana (2009) and Senegal (2011), women are net givers of care and household services starting from age 10, in India (1999) and South Africa (2010) at age 13. On the other hand in Slovenia (2001), Germany (2002) and Italy (2003) women are net givers of unpaid household labour starting only from age 23. The length of surplus period in case of women is much longer than for men: Women are net givers of care and household services almost till the end of their life in some countries,

while in the remaining ones, only the oldest old women receive some time transfers. As indicated by the darker shades of blue coloured tiles, women in general also give a much higher amount of time transfers than men, especially during childbearing ages, when they care for young children. The amount of time transfers given is the highest in Mexico (2014), Mauritius (2003), Senegal (2011) and India (1999) around age 20 and 30.

Compared to women, there are more age groups of men, who are receivers of time transfers than givers, as indicated by the more amount of red tiles on the plot for men. Indeed, in Ghana (2009), Senegal (2011), India (1999), South Africa (2010), Mauritius (2003), Latvia (2003) and Italy (2003), there are not a single age group of men, who are net givers of time transfers. Even though some unpaid household labour is produced by men in these countries at all ages (after around age 10 or so), the amount they consume from the work of women is higher at all ages. There are striking age-specific differences in those countries where men also provide care and household services in net terms. In Vietnam (2015) men provide household services at the earliest ages, starting from age 14, and in the United States (2009) starting from age 24. In many countries only men with relatively young children are net providers of care and household services in their late 20s, 30s and 40s. The exception is Bulgaria (2002), where only older men between age 46 and 58 are net givers of time transfers, due to the high amount of time spent on gardening.

**Figure 7: Net time transfers by age and gender in 28 countries (1999-2015), Hours per day**



**Note:** Time transfers are transfers of services that are produced through unpaid work (care and household services) and not captured in National Accounts. They are calculated using time use data. Women are net providers of time transfers from early adulthood almost until death. Men are not producers only at a few age – if at all. Although older men and women receive transfers of time, the main beneficiaries of time transfers are children.

**Source:** Counting Women’s Work 2020, Vargha et al. 2016, Hammer 2014, Gál, Szabó and Vargha 2017

The figure also demonstrates that the highest amount of time transfers are received by the youngest children (both men and women). In the first year of their life the per capita time consumed by a newborn is more than 10 hours per day in some countries, and it is high all countries. The amount of time transfers received decreases gradually with age in all countries included on our figure.

#### 4. Replication files

Replication files for the global and EU NTA plots can be found here: <https://osf.io/ys5br>

Replication files for the NTTA plot can be found here: <https://osf.io/kjq48>. Regular updates will be published on OSF and GitHub.

## 5. Concluding Remarks

In this research material we present a simple offline solution for visualizing intergenerational transfers for many countries. We reveal important age-specific differences in receiving and giving intergenerational transfers among a wide range of countries. The visualizations highlight (1) labour income by age (Figure 1 and 2), (2) the different age spans of LCD/LCS phases, and the role of remittances in some countries (Figure 3 & 4), (3) the important role of public transfers in old age in most European and some Latin-American countries, and their non-importance in several Asian and African countries (Figure 5), (4) the difference in the provision of private transfers in old age (Figure 6), and (5) the large age-specific variation among women and men across the countries, when time transfers are given (Figure 7), among other differences.

The differences are easily explored on our figures, on traditionally used line graphs many of these differences are much harder to inspect, and researchers need many panels of figures and extra tables to display their data. The visualizations signify the important cutting points of intergenerational transfers: at what age net transfers turn negative/positive, representing whether an age group is net receiver or net giver of the different types of transfers. Consequently it is easier to compare the length of surplus/deficit phases in the different countries than on simple line graphs. The shades of the two colours also make it possible to explore how the amount of transfer received/given varies by age and gender.

The visualization tool we present also summarizes the fairly complex datasets of NTA and NTTA data and demonstrates the differences among the age patterns of LCD/LCS, public, private and time transfers. We find this important, since this unique cross-nationally comparable data is accessible for more and more country across the globe, not only for high-income, but also for

middle-income and low-income countries. It is also a big advantage that one can look for her own country (if included) and compare the age specific results with other countries. The suggested visualization tool could be also used in other cases instead of simple line plots, when there are many data points on both axes (for example many countries, years, ages, etc.), and the researcher would like to highlight differences between negative and positive values. We are now working on new varieties of the figures by plotting country specific differences to the country averages as well as age specific compositional NTA and NTTA data for as many countries as possible.

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