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National Inclusion Accounts Manual

Measuring and Analysing Social Group Differences in the Generational Economy

Department of Economic and Social Affairs
Population Division

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United Nations Department of Economic and Social Affairs, Population Division

The Department of Economic and Social Affairs of the United Nations Secretariat is a vital interface between global policies in the economic, social and environmental spheres and national action. The Department works in three main interlinked areas: (i) it compiles, generates and analyses a wide range of economic, social and environmental data and information on which States Members of the United Nations draw to review common problems and take stock of policy options; (ii) it facilitates the negotiations of Member States in many intergovernmental bodies on joint courses of action to address ongoing or emerging global challenges; and (iii) it advises interested Governments on the ways and means of translating policy frameworks developed in United Nations conferences and summits into programmes at the country level and, through technical assistance, helps build national capacities.

The Population Division of the Department of Economic and Social Affairs provides the international community with timely and accessible population data and analysis of population trends and development outcomes for all countries and areas of the world. To this end, the Division undertakes regular studies of population size and characteristics and of all three components of population change (fertility, mortality and migration). Founded in 1946, the Population Division provides substantive support on population and development issues to the United Nations General Assembly, the Economic and Social Council and the Commission on Population and Development. It also leads or participates in various interagency coordination mechanisms of the United Nations system. The work of the Division also contributes to strengthening the capacity of Member States to monitor population trends and to address current and emerging population issues.

National Transfer Accounts

The goal of the National Transfer Accounts (NTA) project is to improve understanding of how population growth and changing population age structure influence economic growth, gender and generational equity, public finances, and other important features of the macroeconomy. Research teams in more than 100 countries are constructing accounts measuring how people at each age produce, consume, share resources, and save for the future. These accounts complement the UN System of National Accounts, population data, and other important economic and demographic indicators.

The NTA logo represents the general shape of consumption and production age profiles, highlighting the lifecycle deficits and surpluses that consequently help to understand intergenerational flows of resources and how changing population age structure influences economic growth, gender and generational equity.

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Foreword

Demographic shifts are reshaping economies and societies across the world. In some countries, the share of the population in the working ages is growing, offering a window of opportunity for accelerated economic growth per capita, the so-called "demographic dividend". Achieving this, however, requires that appropriate investments and policies be implemented, enabling people to be healthy, educated and productively employed. In other countries, rapid population ageing is placing new demands on families, markets and public institutions. In both situations, these changes do not affect everyone in the same way, with economic circumstances varying widely across generations and among people of the same age.

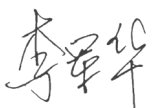
National Transfer Accounts have helped make these dynamics visible. They show how people produce, consume, share resources and save at different stages of life. The National Inclusion Accounts methodology presented in this National Inclusion Accounts Manual: Measuring and Analysing Social Group Differences in the Generational Economy provides a way to take this work further by examining how economic flows vary not only by age but also by education, income, family and household type, place of residence, migration status and other characteristics relevant to national circumstances. By doing so, analysts gain the ability to reveal inequalities that national averages alone may conceal.

This work is especially timely. Through the Pact for the Future and its Declaration on Future Generations, United Nations Member States have committed to promoting intergenerational solidarity, justice and equity and called for long-term and intergenerational thinking to be systematically embedded in decision-making, supported by science, data and statistics. Similarly, the 2030 Agenda for Sustainable Development pledges to leave no one behind and to reach those furthest behind first. By examining differences across generations and within them, National Inclusion Accounts can provide evidence to support all of these commitments.

The methodology presented in this manual can help policymakers see whether public programmes are reaching the people they intend to serve. It can show how education, healthcare, pensions and other forms of social protection are distributed across age and socioeconomic groups, and it can reveal how consumption is financed through labour income, public and private transfers and assets. Through the analysis of family arrangements, educational attainment and income alongside age, the manual provides tools to identify persistent disadvantages and to assess whether policies reduce or reinforce inequality.

National Inclusion Accounts are expected to be useful for strengthening long-term planning, as the methodology in this manual brings together national accounts, population data, household surveys and administrative records. It can be used to examine, for example, how changes in population age structures and educational attainment may affect future labour income, economic growth, demographic dividends and the fiscal sustainability of public programmes. This type of analysis can help countries better understand how investments and policy choices made today may shape economic capacity and public finances in the years ahead.

I encourage national statistical offices, researchers and policymakers to apply and further develop the approaches presented in this manual, in accordance with national priorities and available data. Extending National Transfer Accounts to include relevant social and economic characteristics can strengthen the evidence used to understand demographic change, monitor inequality and assess public policy. By making visible how resources and responsibilities are distributed across ages and social groups, National Inclusion Accounts can support more comprehensive and equitable policymaking for present and future generations.



Li Junhua
Under-Secretary-General for Economic and Social Affairs

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National Inclusion Accounts Manual: Measuring and Analysing Social Group Differences in the Generational Economy was prepared by the United Nations Department of Economic and Social Affairs (UN DESA), through its Population Division, in collaboration with the United Nations regional commissions for Latin America and the Caribbean (UN ECLAC) and Asia and the Pacific (UN ESCAP). The report was prepared under the responsibility of John Wilmoth, Simone Cecchini and Srinivas Tata by a team of United Nations staff comprised of Cheryl Sawyer, Sabine Henning, Zulma Sosa, Nicole Mun Sim Lai, Marco Roncarati, Raul Luis Holz Carcamo and Napaphat Satchanawakul.

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The team appreciates the chapter contributions from Ronald Lee (Chapter 1); Gretchen Donehower, Andrew Mason and Nicole Mun Sim Lai (Chapter 2); Marisa Bucheli and Cecilia González (Chapter 3); Bernhard Hammer and Alexia Prskawetz (Chapter 4); and Gemma Abio, Tanja Istenič, Ció Patxot and Guadalupe Souto (Chapter 5).

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The team extends its sincere appreciation to the country representatives and organizations who contributed valuable feedback during the pilot phase, using this manual to develop their National Inclusion Accounts:

Colombia: National Administrative Department of Statistics (DANE), Ministry of Equality and Equity, Ministry of Housing, City, and Territory, Ministry of Health and Social Protection, National Planning Department, National Unit for Disaster Risk Management (UNGRD), Territorial Renewal Agency, Presidential Agency for International Cooperation, Central Bank, Administrative Department for Social Prosperity, National University of Colombia and New Granada Military University.

Costa Rica: National Institute of Statistics and Census (INEC), Ministry of National Planning and Economic Policy, Pension Superintendency, Joint Social Welfare Institute, Comptroller General of the Republic, Costa Rican Social Security Fund, Central Bank of Costa Rica and University of Costa Rica.

Jamaica: Ministry of Health and Wellness, Ministry of Labour and Social Security, Planning Institute of Jamaica (PIOJ) and University of the West Indies.

Lao PDR: Department of Economic Statistics, Lao Statistics Bureau, Lao Academy of Social and Economic Sciences (LASES), Ministry of Education and Sports, Ministry of Health and Ministry of Planning and Investment.

Malaysia: Department of Statistics Malaysia and National Population and Family Development Board (LPPKN) and Universiti Putra Malaysia.

Maldives: Maldives Bureau of Statistics.

Uruguay: Central Bank, Ministry of Economy and Finance, Ministry of Education and Culture, Ministry of Labor and Social Security, Ministry of Public Health, Ministry of Social Development, National Institute of Statistics (INE) and Office of Planning and Budget, Social Security Bank.

Viet Nam: General Statistical Office.

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Contents

Explanatory notes

The following symbols have been used in the tables throughout this report:

A minus sign (-) before a figure indicates a decrease or negative number. A full stop (.) is used to indicate decimals.

Years given refer to 1 July.

Use of a dash (–) between years, for example, 1995–2000, signifies the full period involved, from 1 July of the first year to 1 July of the second year.

Numbers and percentages in this table do not necessarily add to totals because of rounding.

References to region, development group, country or area:

The designations employed in this publication and the material presented in it do not imply the expression of any opinions whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The term "country" as used in this report also refers, as appropriate, to territories or areas.

In this publication, data for countries and areas are often aggregated in six continental regions: Africa, Asia, Europe, Latin America and the Caribbean, Northern America, and Oceania. Further information on continental regions is available from: https://unstats.un.org/unsd/methodology/m49/. Countries and areas have also been grouped into geographic regions based on the classification being used to track progress towards the Sustainable Development Goals of the United Nations (see: https://unstats.un.org/sdgs/indicators/regional-groups/).

The designation of "more developed" and "less developed", or "developed" and "developing", is intended for statistical purposes and does not express a judgment about the stage in the development process reached by a particular country or area. More developed regions comprise all countries and areas of Europe and Northern America, plus Australia, New Zealand and Japan. Less developed regions comprise all countries and areas of Africa, Asia (excluding Japan), Latin America and the Caribbean, and Oceania (excluding Australia and New Zealand).

The group of least developed countries (LDCs) includes 45 countries, as of 8 May 2024, located in sub-Saharan Africa (32), Northern Africa and Western Asia (2), Central and Southern Asia (3), Eastern and South-Eastern Asia (4), Latin America and the Caribbean (1), and Oceania (3). Further information is available at: https://www.un.org/ohrlls/.

The classification of countries and areas by income level is based on gross national income (GNI) per capita as reported by the World Bank (May 2024). These income groups are not available for all countries and areas. Further information is available at: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519.

List of abbreviations

CFC	Consumption of fixed capital
EAC	Equivalent adult consumer
EHI	Equivalised household income
ESR	Economic support ratio
EU-SILC	European Union-Statistics on Income and Living Conditions
GDP	Gross domestic product
GMI	Gross mixed income
GOS	Gross operating surplus
HBS	Household Budget Survey
LCD	Life cycle deficit
LDC	Least Developed Countries
NA	National accounts
NPISH	Non-profit institutions serving households
NSO	National statistical office
NTA	National Transfer Accounts
NTA-I	National Inclusion Accounts
NTTA	National Time Transfer Accounts
OECD	Organisation for Economic Co-operation and Development
OOP	Out-of-pocket
PAYGO	Pay-as-you-go
PPP	Purchasing power parity
RoW	Rest-of-world
SDGs	Sustainable Development Goals
SES	Socioeconomic status
SHARE	Survey of Health, Ageing and Retirement in Europe
SNA	System of National Accounts
UN DESA	United Nations Department of Economic and Social Affairs
UN ECLAC	United Nations Economic Commission for Latin America and the Caribbean
UN ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNFPA	United Nations Population Fund
VAT	Value-added tax

Preface

The Population Division of the United Nations Department of Economic and Social Affairs (UN DESA), in collaboration with the National Transfer Accounts (NTA) network, has taken a leading role in publishing manuals containing standard guidelines for implementing the NTA accounting framework. The various components of this framework can be used to measure and analyse the flow of economic resources in relation to age, gender and socioeconomic status. Over 80 countries across Africa, Asia, Europe, Latin America and the Caribbean, Oceania and Northern America have used the NTA framework to better understand the policy implications of demographic change.

In addition to producing manuals, UN DESA has conducted workshops to build national capacities for estimating and utilizing the NTA framework and associated tools. Over the past eight years, more than 300 participants from over 30 countries have attended such workshops. Key partners in this initiative include the United Nations Economic Commission for Latin America and the Caribbean (UN ECLAC), the United Nations Economic and Social Commission for Asia and the Pacific (UN ESCAP), and the United Nations Population Fund (UNFPA).

The present volume, the *National Inclusion Accounts Manual: Measuring and Analysing Social Group Differences in the Generational Economy*, has been developed in collaboration with ECLAC and ESCAP as part of a United Nations Development Account project entitled "Inclusive and Sustainable Economic Growth in a Society for All Ages in the Post-COVID-19 Era in Asia and Latin America and the Caribbean". The objective of the project is to enhance government capacities to develop evidence-based, intergenerational policies for inclusive and sustainable economic growth in the context of population ageing.

The overall motivation underlying the NTA framework derives from the demographic transition – a global phenomenon of the modern era that brings substantial changes in population growth rates and age structures, which have multiple and sometimes unexpected implications for national economies. Many low-income and lower-middle-income countries, particularly those in sub-Saharan Africa or elsewhere that are in an earlier stage of the demographic transition, are experiencing rapid growth in the working-age population and related changes that have the potential to accelerate economic growth given the right enabling conditions – a phenomenon known as the "demographic dividend". By contrast, the current demographic situation of many high-income and upper-middle-income countries is dominated by slower growth, rapid population ageing and, in some cases, population decline.

The first volume in this series, the *National Transfer Accounts Manual: Measuring and Analysing the Generational Economy* (United Nations, 2013), lays out the conceptual and empirical foundations of a national accounting framework that tracks economic flows by age. This elaboration of the System of National Accounts (SNA) identifies important ways that economic resources (from labour income, asset income and transfer inflows) and their use (for consumption, saving and transfer outflows) vary over the life cycle. The introduction of age into aggregate economic accounts has enriched our understanding of the flow of intergenerational transfers, which are dominated by inflows to children and older persons and by outflows from those in the working ages. Without the age dimension, such transfers all but disappear in aggregate accounts. These accounts also provide a natural interface between the population age distribution and the macro-economy.

The second volume, the *National Time Transfer Accounts Manual: Measuring and Analysing the Gendered Economy* (United Nations, 2024), was developed to strengthen understanding of the macroeconomic role of gender over the life cycle. This goal is challenging because the SNA aggregates the value of market goods and services only. The SNA does not assign a value to non-market productive activities, such as childbearing, childrearing and caregiving, to which women make a disproportionate contribution. National Time Transfer Accounts (NTTAs) rely on time use surveys to measure the volume and the value of unpaid household labour and other productive activities that are external to the market. Valuing non-market measures of time use allows for a more nuanced approach to measuring economic flows across age groups and between men and women.

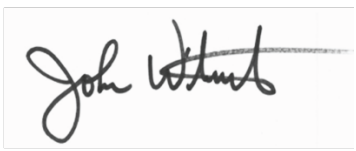
The present volume, the *National Inclusion Accounts Manual: Measuring and Analysing Social Group Differences in the Generational Economy*, introduces methods for a further expansion of the NTA framework. The underlying objective is to derive estimates that depict additional distributional features of economic transfers within a population, opening up new and potentially useful ways of describing flows of resources over the life cycle. Evidence about inequalities of consumption and income is essential for assessing social welfare. Distributional measures of sectoral economic flows, e.g., spending on education and health, can prove critical to formulating and assessing public policies. More generally, National Inclusion Accounts (NTA-I) offers guidelines for exploring how resource flows vary by social or economic group, by household type and living arrangements, by race and ethnicity, and by location of residence, limited only by the availability of data and the imagination of analysts.

The NTA-I framework builds directly on the foundations established by Ronald Lee and Andrew Mason and the global NTA network. The conceptual underpinnings are elaborated in *Population Aging and the Generational Economy* (Lee and Mason, 2011), which provides a comprehensive exposition of the economic life cycle, intergenerational transfers and asset-based reallocations, along with the long-term economic implications of changes in population age structure. Many experienced researchers affiliated with the network have contributed to the present manual, reflecting the continuity and ongoing evolution of the NTA research programme.

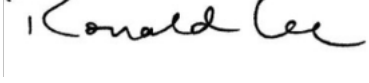
The NTA project has benefited from the leadership provided by the Population Division of the UN Department of Economic and Social Affairs (DESA), the United Nations Population Fund (UNFPA), the U.S. National Institute on Aging, the Center on the Economics and Demography of Aging at the University of California, Berkeley, and many foundations. The most significant contributions to the development of NTA have come from universities, research groups and international agencies, as well as governments in more than 80 countries, which are strengthening their national capacities and promoting the integration of age-structured economic data into policy analysis. Although no longer involved, the East-West Center in Honolulu previously provided administrative and technical support that was critical to the establishment and early development of the NTA project.

This manual presents both the conceptual foundations and the practical tools needed for estimating National Inclusion Accounts. Chapter 1, prepared by Ronald Lee, introduces the theoretical background and applications of NTA-I. Chapter 2, authored by Gretchen Donehower, Andrew Mason and Nicole Mun Sim Lai, describes in detail the methods for constructing NTA-I data sets and demonstrates their application using microdata from the United States of America. Chapter 3, authored by Marisa Bucheli and Cecilia González, analyses age-related economic transfers in relation to educational attainment for several Latin American countries. In Chapter 4, Bernhard Hammer and Alexia Prskawetz examine age-related economic transfers disaggregated by income quintile for selected European countries. In Chapter 5, Gemma Abio, Tanja Istenič, Ció Patxot and Guadalupe Souto explore how family type influences such transfers, relying on data from Spain. Together, these chapters provide and illustrate a comprehensive framework for analysing economic transfers and inclusion over the life course.

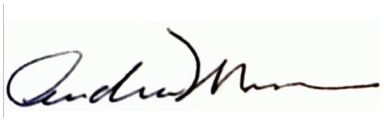
The *National Inclusion Accounts Manual* is intended for use by researchers, statistical offices and policymakers who seek to understand how age-related economic activities and resource transfers are distributed across individuals and groups within populations. It is also a resource for those aiming to expand the NTA framework to include additional dimensions of social and economic variation. By analysing economic transfers from the perspective of both age and other individual or group characteristics, the NTA-I framework provides a foundation for a more comprehensive and equitable approach to understanding the generational economy.



John Wilmoth, Director UN
DESA Population Division



Ronald Lee, Emeritus Professor
University of California, Berkeley



Andrew Mason, Emeritus Professor
University of Hawaii at Manoa

Chapter 1: Background, theory and uses of NTA-I

1.1 Introduction

Global populations have been changing rapidly in the first 25 years of the twenty-first century. Two thirds of the world's population lives in countries where fertility is below the replacement level of 2.1 births per woman. The rate of global population growth is slowing, and already the population in many countries is declining. The main population projections, including those of the United Nations, agree in foreseeing global population decline starting between the 2060s and 2080s. Of course, there is tremendous diversity across the globe in levels and trends in fertility, mortality and migration, leading to very different demographic futures. Associated with these changes are major changes in the population age distribution. For some countries, these changes will provide demographic dividends as the proportion in the working ages swells. In others, they will bring an end to their demographic dividends and usher in the start of population ageing. In still others, population ageing will continue and reach levels never seen before. Further, there is also great heterogeneity within individual countries.

Population is the substratum of society and economy. Members of a population are linked together in a network of social connections reflecting family and friendship ties of love, support and obligation. More indirectly, they are connected by economic interactions within markets as they buy and sell their labour, goods and services. Still more indirectly, they are bound together by governments at all levels, bringing public sector benefits but also imposing responsibilities such as taxes.

The nature of these links varies with the ages of those connected. Parents support young children, but adult children may support their older parents. Young adults may borrow in financial markets indirectly from older working age adults who are saving for retirement or from older persons who derive income from their investments. Older persons may also get support from public pensions that are funded by the taxes of workers, and both older persons and workers pay for the public education of children through taxes.

Changing population age distributions alter the relative numbers of children, workers and older persons, sometimes stressing and stretching this network of connections, but other times relaxing and strengthening it. Effects ripple through families, markets and the public sector.

The National Transfer Accounts project (NTA) was developed to measure, describe, chart and project these linkages and the ways they are affected by changing population age distributions, over demographic transitions and through the future of population ageing. To do so, it first measures and describes in a comprehensive way the labour income generated at each age and the amount consumed at each age, and then subtracts consumption from labour income to find the gap between them. This gap, called the "life cycle deficit", refers to the net amount needed to provide for consumption in excess of labour income. This amount may be positive in childhood when consumption exceeds labour income, negative in working ages when consumption is less than labour income, or again positive in old age when consumption again exceeds labour income. The life cycle deficit is then filled, either: through net private transfers, such as parents supporting children; through net public transfers, such as publicly provided education, healthcare or pensions in excess of taxes and contributions; or through asset income in excess of savings. NTA measures these various kinds of flows that fill the gaps or reallocate the surpluses. The quantitative descriptions of flows by age within families, the market and the state are of great interest in themselves.

The original version of NTA focused on heterogeneity across ages within a society, although other dimensions of heterogeneity such as gender are also vitally important. It did not include domestic production in the form of care work done within the household such as child or elder care, cooking, cleaning, shopping and household management. Without including these, it would not be possible to study economic contributions by gender. In order to include

gender differences in NTA, unpaid family labour is included based on time use survey data. The resulting system of extended NTA accounts that include time is called National Time Transfer Accounts (NTTA).

Heterogeneity also shows up in the form of differences in socioeconomic status. NTA and NTTA have been extended to now estimate accounts separately for different social groups, for example by educational attainment, income, parental or household status, or geographic region, and this extension to incorporate socioeconomic heterogeneity is the focus of this manual.

One reason for constructing NTA by socioeconomic status is to assess the current degree of inclusion and inequality. This can include: how large the economic inequalities are in a country today from a life course and intergenerational perspective; how these have been changing over time when multiple NTA for a country are available; and the role of public programmes in relation to these inequalities. For some outcomes, it may also be possible to use NTA to assess progress towards meeting the SDGs.

These inequalities can first be assessed by examining the distribution at each age of relevant economic outcomes like labour income, total income, consumption and asset income. In practice, it is often more useful to calculate and examine differences in averages for socioeconomic categories. These may be defined by income or educational attainment, urban or rural residence, race or ethnicity, immigration status or any other factor that is available in the individual-level data and that is economically or socially relevant. When NTA are available at more than one date, it is possible to examine trends in inequality by any of these measures. It is also useful to see the public programme benefits received on average in each of these categories and taxes paid, as well as whether benefits go mainly to lower- or upper-status groups, the net benefits received or given by each group, how the age patterns of programme receipt vary by age across the different groups, whether programmes are equalizing or exacerbating inequalities, and, if policies have changed between two NTA years, how these changes have affected inequality.

Another main reason for constructing NTA by socioeconomic status is to deepen, extend and improve the use of NTA for projecting the economic impact of projected changes in population age distributions and other demographic variables. These projections are based on the changing proportion of the population that has some key characteristic. In traditional NTA, this characteristic is age, which is the basis for the familiar measures of support ratios, demographic dividends and the negative dividends associated with population ageing. NTA can, however, also be disaggregated in other ways. The prime example is to integrate projections by educational status with projections of the population, using NTA by socioeconomic status to calculate the economic implications. This can also be done for other variables.

The scope and reach of NTA have been greatly expanded by these extensions to now shed light on inequality, inclusion, redistributive aspects of public programmes and variations in the economic life cycle across socioeconomic groups. This chapter will discuss these new directions and the uses to which the new measures may be put in characterizing inclusion and exclusion and in projecting the economic impacts of demographic change including fiscal sustainability.

1.2 Background to transfers and support systems

Transfers are central to NTA, so this section will begin by considering their basic nature. Transfers are like gifts. They are money or other resources that are given from one person to another with no obligation that it be paid back. This distinguishes them from trades, exchanges or loans in which something is given to another person with the understanding that it or something else of similar value will be given back in return at that time or later. Exchanges are part of a market economy, while transfers are social and occur outside the market.

1.2.1 Intergenerational transfers

Transfers are fundamental to human existence. In fact, people literally could not live without them, since children are born helpless. Even in hunter-gatherer societies, children did not become nutritionally self-sufficient until the age of 18 or 20 (Kaplan, 1994; Hooper and others, 2015), although in agricultural societies, self-sufficiency was achieved earlier by about five years. Children everywhere depend on their parents, grandparents and other relatives and unrelated adults for shelter, food, care and instruction (Lee, 2020). The large brains of humans are not fully developed until their mid-20s, and the growth of brains requires very heavy caloric investment. A wide web of support, stretching beyond the parents alone, is necessary because the parental or nuclear family experiences a life-cycle squeeze when the family dependency ratio peaks ten or fifteen years after childbearing begins (Lee and Kramer, 2002). So, provision for the needs and development of children is the first need for intergenerational transfers. In all populations, for all of human history until recent decades, there was a net flow of resources downwards from adults to children. Because of the young population age distributions before the demographic transition, this was even true in those societies where there was a strong cultural tradition of adult children supporting their older parents (Lee, 2020).

There is, however, a second important need for intergenerational transfers: support of older persons. In the far past, this was not the case. Older persons in hunter-gatherer societies continued to produce a surplus which they transferred to their children and grandchildren until near the end of their lives (Hooper and others, 2015; Lee, 2020). With the development of agriculture and property rights over land, a kind of retirement emerged in which older persons greatly reduced their work on the land, leaving it to their adult children and grandchildren. But full-blown retirement apparently emerged in the United States of America and Europe in the late nineteenth or early twentieth centuries (Costa, 1998), facilitated by developing financial markets and by the development of public pensions. As a result of the widespread decline in labour supply by older persons, the increase in consumption by older persons relative to younger adults, and the ageing of the population, there are now many countries in which the direction of net transfer flows has shifted from being downwards to children to flowing upwards to older persons (Lee, 2020). This shift will no doubt intensify in the coming decades as populations age further.

1.2.2 Transfers as social insurance against risks

While intergenerational transfers address well-known and foreseeable life cycle deficits, many kinds of transfers, both public and private, have a quite different goal: to serve as a safety net for temporary misfortunes or to help those who are chronically poor. Humans have evolved with empathy for the problems experienced by others and a willingness to share. As with intergenerational transfers, this is a necessary component of human nature. Without it, a hunter-gatherer who fell sick or broke a leg might well have starved to death, and such a loss would have endangered their children's lives and represented a loss to their group. Equally important, hunters had highly variable success. Hunters in African groups obtained any meat on only 20–30 per cent of days, and a Hadza hunter obtained big-game meat on only 3 or 4 per cent of days, based on studies of contemporary groups (Hill and Hurtado, 2009). Sharing meat among families in the group was a necessary part of their strategy. Going beyond this risk-sharing behaviour, food sharing also smoothed out some of the variability in the long-term abilities of hunters, making living and raising children more possible for those less skilled.

We humans have inherited from this distant past our sympathy and empathy for those who are sick, disabled or less successful economically. We have strong self-interest, but we also have altruistic feelings and to some degree act accordingly. We no longer live in relatively small groups of close kin and friends, but our private generosity extends to charitable acts benefiting anonymous strangers as well as those we know. It is equally striking that we create public programmes that provide a safety net for those in need and support them through our taxes (Lee, 2012).

These two strands of altruistic behaviour, generational transfers and helping the unfortunate, are an important part of our lives. GDP (roughly "primary income") is received by individuals as labour income or as asset income, yielding

the primary income distribution. NTA data show that around 50 per cent of GDP is transferred from the individual who receives it to someone else of a different age (Lee and Donehower, 2011), leading from the primary distribution of income to the secondary distribution. In countries with lower per capita incomes, a higher proportion of these transfers takes place through the family, while in higher income countries, a larger proportion takes place through the public sector. This can be seen in table 1.1, where private transfers as a share of total transfers rise from 41 per cent in the highest income region to 76 per cent in the lowest income region.

Table 1.1
Total, private and public transfers as a share of GDP (US$) in four regions, 2000

Average (Region)	GDP per cap.	(Region) TotTr/ GDP	PrivTr/GDP	PubTr/GDP	Priv/Tot
Western Industrial	26,000	60%	25%	36%	41%
East Asia	21,000	59%	36%	23%	60%
Latin America	9100	50%	32%	18%	64%
Southeast Asia	4000	52%	40%	12%	76%

Note: GDP is PPP-adjusted US$ (2000). Averages are unweighted for NTA countries in each region included in Lee and Donehower (2011). Aggregate transfers, total, private or public, are measured as the sum of transfers received in each country's total population. The percentages are calculated for each country. The averages of these percentages within each region are given in the table.

1.3 Measuring socioeconomic status in NTA

1.3.1 Data sources

There is obvious interest and importance in estimating measures of economic inequality and their changes over time. This might seem to be a straightforward undertaking, but it is not (Chetty and others, 2022). One of the key questions is whether to use survey data, which are typically subject to misreporting and errors of recall, or to use administrative data such as tax records, which may be more accurate but which exclude some kinds of market income and public transfers. Some analyses, like Piketty's (2014) book *Capital in the Twenty-First Century*, use tax data to focus on measures of wealth inequality. Other analyses focus on inequality in labour income, while still others look at consumption. All of these are important dimensions of inequality.

NTA provides what might be the most comprehensive measure of inequality in income and consumption, with full control for the age distribution of the population. NTA is comprehensive because it includes all public transfers as well as interhousehold and intrahousehold private transfers. NTA does, however, have some weaknesses in that the surveys from which it draws its data are subject to misreporting and may disproportionately miss income and wealth at the top end of the income distribution. Furthermore, many of the private transfers estimated by NTA cannot be observed directly and must be derived from imputations which at best may be adequate on average but can be noisy at the individual and household levels.

Some recent articles highlight the different conclusions that can be reached using different measures (Wan, Gustafsson and Wang, 2024; Auten and Splinter, 2024). Auten and Splinter's 2024 analysis of the trend in real income of the bottom 50 per cent of the United States of America's income distribution from 1960 to 2019 is particularly telling. It shows that using income as reported in taxes, real household after-tax income for the bottom 50 per cent has hardly changed since 1960, while, if after-tax per capita income plus public transfers is used instead, this group's per capita real income has risen by about two thirds from 1979 to 2019. To understand such results more fully, it is important to also consider the changing population age distribution, particularly population ageing, and changes in net public

and private transfers by age. For example, it would be useful to know whether rising real incomes of the lower 50 per cent are largely due to the rising generosity of public pension benefits and increasing costs of public healthcare for older persons while incomes stagnated for younger ages. It is important to break all these results down by age.

1.3.2 Dimensions and measurement of SES

There is a large and deep literature on the conceptualization and measurement of socioeconomic status (SES). Here, the discussion will focus on more practical matters of measurement. Because there are so many kinds of questions that NTA may be used to address, some aspects of the methods will also vary according to the purpose of the estimates. To better understand the use of public transfers as a safety net for short-term distress such as unemployment, temporary disability or recent loss of a spouse or partner, then the measure of SES should reflect short-term variations in circumstances, such as current labour income, or perhaps the deviation of current labour income from what might have been expected for the individual's age, gender and education. If the object is to understand the economic life cycle, intergenerational flows and how public transfers are related to lifetime socioeconomic status, then another measure may better reflect lifetime status, with educational attainment being the most obvious. Again, if the goal is to understand net public transfers to childless couples, then of course it is necessary to use measures of parental status, while to understand urban versus rural inequalities, an analyst must distinguish the inhabitants of urban and rural areas. The possibilities are limited only by the richness of the surveys on which the NTA estimates are based.

1.3.3 Education measures

Education is a useful measure because it is quite stable over the adult lifetime from around age 25, so it is suitable for questions related to the long term and is not subject to short term variation or shocks. However, it also has problems. First, children and young adults have not yet completed their education so their educational attainment at time of survey is a poor measure. For this reason, it is common practice to use the education of the household head to assign educational status to members of the household. Rosero-Bixby (2024) uses the highest education in the household after cohort adjustment (explained below). Amarante and others (2024) use the education of each individual age 25 and above, and those under 25 are assigned their mother's education level (individual education is necessary if the Wittgenstein Centre projections of educational attainment are to be used). Another variation on this approach is to use the average education of all the adults in a household. These options should be carefully considered in relation to the national context and the goals of a study.

As Tovar and Urdinola (2014) point out, educational status can exaggerate inequality by focusing attention on high attainment groups that may represent only a tiny sliver of the population. They propose and apply a Multidimensional Quality of Life Index that includes education of household head and average education of others in household, as well as other indicators of quality of the home. Indicators that would be directly influenced by transfers are excluded. Their analysis is then based on quartiles of this index. This appears to be a good way to look at NTA by SES, but it would be difficult to project forward for future years.

Another problem for analysis of changes over time or international comparisons is the selectivity on other characteristics of those with different educational attainment. For example, in many developing countries, educational attainment of adults was typically very low some decades ago, and in such cases, low educational attainment such as not completing third grade tells us very little about the abilities and family background of an individual. Over time, as the average attainment of birth cohorts rose, those in the cohorts that had not completed third grade became more adversely selected for other characteristics that might make them less economically successful in life. At the same time, cohort members completing higher levels such as secondary school become less positively selected. Mejía-Guevara (2015) finds that the proportion of the Mexican population in the lowest education category fell in a single decade (1994 to 2004) from 50 to 36 per cent, while the proportion in the highest category rose from 19 to 31 per

cent. Changes of this sort can distort comparisons over time of inequality by educational attainment for outcomes like labour income or consumption, making their meaning and interpretation unclear.

This problem of selectivity is related to the problem raised by Tovar and Urdinola (2014), presented above. One way to address it is to construct educational quantiles (for example, dividing into the bottom 20 per cent, 20–40 per cent, and so on up to 80–100 per cent) rather than using absolute levels of education. The economic and social meaning of a 25-year-old having a secondary school degree is different than it would be for a 60-year-old having the same degree. For this reason, the quantiles should be constructed separately for each age group or birth cohort. Using educational quantiles minimizes the problem of changing selection but it is unfortunately useless for projections, since the quantile distribution does not change as the level of education in the population rises. This means, for example, that with the quantile measure, changes over time in educational attainment cannot be related to productivity growth, which is a serious limitation. However, with quantiles, changes over time in the sensitivity of outcomes to place in the educational distribution can be measured, which is useful.

Additional problems occur when education is used in projections and simulations. Education is projected by age for individuals, for example by the Wittgenstein Centre. At baseline NTA, individual labour income can be observed in relation to individual education. When projections are done using education, they must be done for individuals, as education by household head is unavailable. For this reason, it is necessary to use individual education of each adult age 25 or over (or perhaps above a younger age cutoff in some countries). This is done by Rentería and others (2016 and 2024), Choo and Gee (2024) and Oosthuizen (2024). So far as projecting the effect of rising educational attainment in the future, the inability to use quantiles might lead to an overstatement of the gains as selectivity changes.

Many papers have used educational attainment to define status groups for the population, including Rosero-Bixby (2024), Mejía-Guevara (2015), Turra and Quieroz (2005), Miller and others (2014), Hammer (2015) and Donehower and others (2021). Education is measured in different ways for different purposes, as discussed elsewhere. Results are generally quite consistent. Labour income profiles are several times higher for those in the top education category than those in the bottom, as expected, and consumption varies similarly. Because education is a good indicator of lifetime SES, these results are also good measures of disparities in lifetime labour income and consumption. Patterns of use of public education are described elsewhere, but in some cases higher education groups show a preference for private education and healthcare. Pension payments are higher for higher education groups. As discussed in a later section, NTA by education can be linked to data from other sources on educational attainment over time, enabling a whole range of new applications and projections.

1.3.4 Income measures

Measures based on income have an obvious appeal. One problem, however, is that income changes over the life cycle and may change from day to day or month to month, as people experience unemployment, illness and other setbacks that may be temporary (transitory income shocks). This makes income useful for observing the effectiveness of public and private transfers in softening the impacts of such shocks but also limits its usefulness for examining the consequences of longer-term differences in income, transfers and other aspects of economic behaviour. Another problem is that income is itself affected by public and private monetary transfers. These sources of income could be deleted, but had they not received these transfers, people would probably have worked different amounts, consumed different amounts and behaved differently in other ways.

Fewer NTA studies have used income to define status for reasons discussed earlier, but it is not uncommon. Recent examples are Kim (2023) for the Republic of Korea, Hammer and others (2023) for countries of the European Union and Abrigo and others (2016) for the Philippines.

1.3.5 Parental status and living arrangements

Many measures included in the relevant surveys can be used to define categories and estimate the relevant variables within them. One example is parental status. NTA may also differ between individuals with different living arrangements. For example, Tung and Lai (2011) found that older persons in China, Taiwan Province of China living with their children relied primarily on intrahousehold transfers. Those living with only a spouse or grandchildren relied mainly on their own resources. Those living alone relied on public transfers. These results are somewhat similar to those found for the Republic of Korea, where Kim (2023) and Kim and Lee (2025) find that older persons living in high income extended family households receive support almost entirely from family transfers, while those living in extended-family, low-income households receive support almost entirely from public transfers. This pattern intensified from 2010 to 2016. Older persons in high-income nuclear households funded consumption mostly from asset-based reallocations, while low-income ones funded consumption mostly from public transfers. This pattern also intensified from 2010 to 2016.

Hammer and Prskawetz (2022) give a detailed analysis of intrahousehold transfers by parental status in Austria (whether childless, or by age of the youngest child) by age and by whether retired. This study also demonstrates the flexible use of microfiles to define and examine categories relevant to the purpose at hand.

Vanhuysse and others (2023) analyse not only the net taxes (taxes minus benefits) paid by non-parents and parents (which are greater for non-parents) but also the costs of the market goods transferred to children and the value of parental time spent raising children. With this framework, they find that parents make very much larger net contributions than non-parents and conclude that European governments unwittingly tax the reproduction on which they depend.

1.3.6 NTA for subnational regions

Individuals can also be grouped according to where they live, a different sort of SES variable. Subnational regions may be defined as rural versus urban or by different geographical areas of a country. Subregions may be associated with large economic differences and variations in fertility, mortality, age distributions and migration patterns. NTA can help identify differences that could be targets of government policy, so subnational NTAs can be useful. There have been quite a few studies along these lines. An early study by Mejía-Guevara (2010) estimated NTA for Mexico in 2004 by urban versus rural residence as well as by subregion and found stark differences. Li and others (2011) estimated public transfers by urban versus rural residence in China for 1995 and 2002, and Maliki (2011) estimated NTA separately for poor and non-poor people in rural and urban areas in Indonesia, with particular emphasis on their public and private old-age support systems. Eleven countries in Central and West Africa have done subnational NTA under the auspices of CREG, the Consortium Régional pour la Recherche en Economie Générationnelle directed by Latif Dramani (personal communication), and Nigeria has also prepared its own subnational NTA estimates (Olasehinde and others, 2024). Abrigo and others (2016) estimated NTA for the Philippines for urban and rural subgroups, each classified by high, medium or low income, at several dates and then decomposed the source of changes in the support ratio between population age distribution changes and changes in subgroup age profiles for 1991 through 2011.

1.4 Implementing measures of SES in NTA

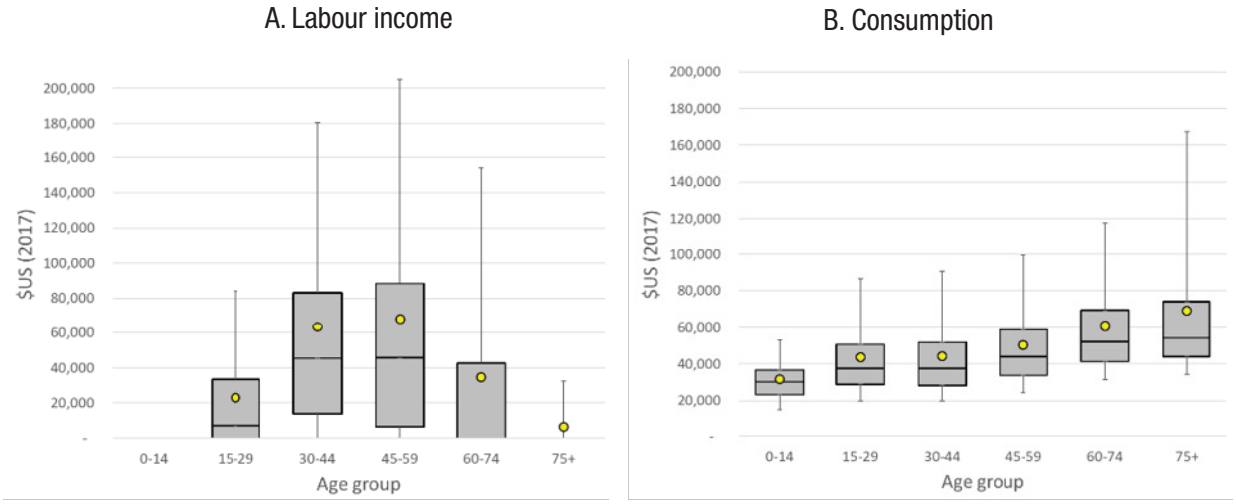
1.4.1 Microfiles: NTA for individuals

NTA from the start has been built on a foundation of estimates at the individual and household level based on surveys as well as administrative data. In this report, these original individual level data sets are referred to as "microfiles". Microfile data are no doubt subject to greater errors at the individual level than when they are averaged over individuals in groups, since individual errors tend to cancel out on average. Similarly, the finer the disaggregation of the population into groups, the greater the risks of errors and biases in group averages due, for example, to differences in reporting biases by socioeconomic categories and to fewer observations in the categories to be averaged.

Despite the greater possibility of error in microdata, it is interesting to examine dispersion at the individual level while controlling for age and possibly gender. It is straightforward to do so for labour income, for which there are direct measures, but for consumption, asset income or other NTA variables it is typically necessary to rely on indirect measures based on strong assumptions which may introduce further errors at the individual level even when they are reasonably accurate on average. While absolute levels of dispersion may be distorted by the measurement errors mentioned above, they are less likely to be an issue for comparisons over time in the same country.

Dispersions of this sort for labour income and consumption by age for the United States of America in 2017 are shown in figure 1.1, panel A, and for consumption in figure 1.1, panel B, as box and whisker plots. The yellow dot is the average at each age and the dark line toward the middle of each box is the median. The top and bottom of the box bound the upper 75 per cent and lower 25 per cent of each distribution, and the vertical lines (whiskers) extend to the 95 and 5 per cent bounds. Figure 1.1 shows that there was not much increase in median labour income over 25 years, while average labour income for those aged above 30 did increase, most strikingly at ages 60–74. Clearly the upper tail of the distribution increased, as the top labour income rose substantially (except for younger workers). In figure 1.1, panel B, consumption has much lower dispersion both across age and within each age. As with labour income, the average level rose more than the median, and the upper tail grew disproportionately as seen from the upper whiskers. While these distributions give us limited insight about what factors lie behind them or how policy might alter them, they are descriptively interesting and valuable.

Figure 1.1
Distribution of individual labour income and consumption within age groups, United States of America, 2017



Note: Each box is bounded by the twenty-fifth and seventy-fifth percentiles of the distribution in the age group, with the median shown in the middle. The whiskers show the fifth and ninety-fifth percentiles. Units are in real dollars, 2017 basis. For labour income, data are not collected for ages 0–14. Age group means are plotted with yellow dots.
Source: Donehower and others (2021).

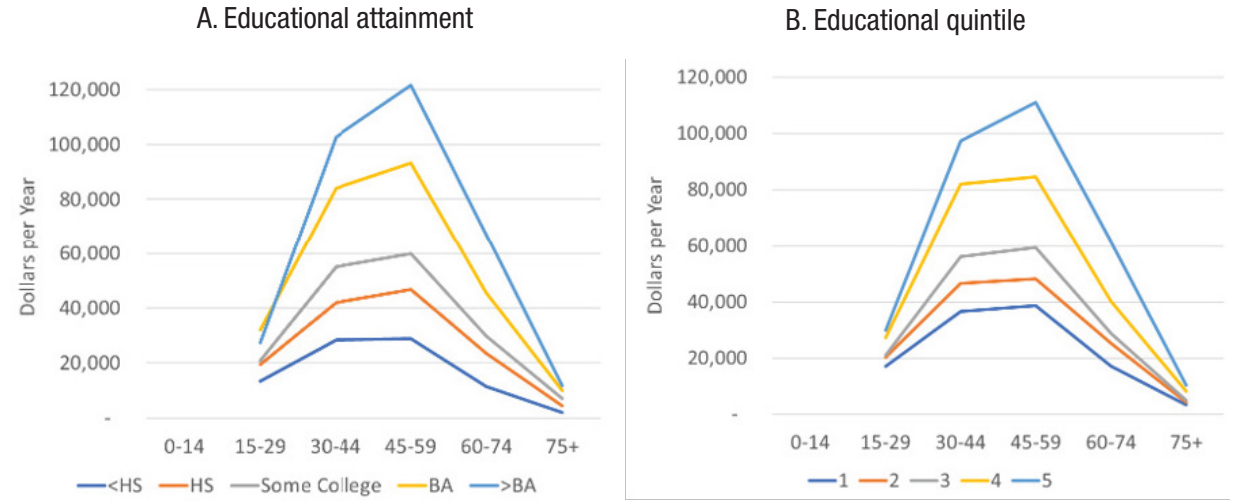
1.4.2 Averaging micro NTA for SES groups

To gain insight, it is useful to average these microdata within SES categories. In standard NTA, these micro estimates are averaged across individuals at each age to form population level averages, or "age profiles". But the microdata can be averaged by other categories besides age, for example by age and gender, by age, gender and education, by parental status, by income, by urban-rural residence, by region of the country, or by other comparisons that could be suggestive and more easily understood. It could also be possible to analyse the microdata using regression methods, although this has not yet been done, and it is not clear whether it would be a useful approach.

There are many reasons for estimating NTA by gender. Men and women have different healthcare needs and life expectancies, and public transfers may not be structured to recognize contributions of adults who work outside the labour market, for example in raising children, preparing meals or other kinds of home production. Standard NTA does not include these activities. If NTA is calculated separately for men and women, it misses a great deal of women's work, making it appear that in most countries women do little work and receive large transfers from males. For this reason, it seems pointless to do NTA by gender unless it also includes at-home care work using time-use surveys. This is done in National Time Transfer Accounts (NTTA), which for developing countries have been estimated as part of the Counting Women's Work project. This manual focuses on other dimensions of inequality.

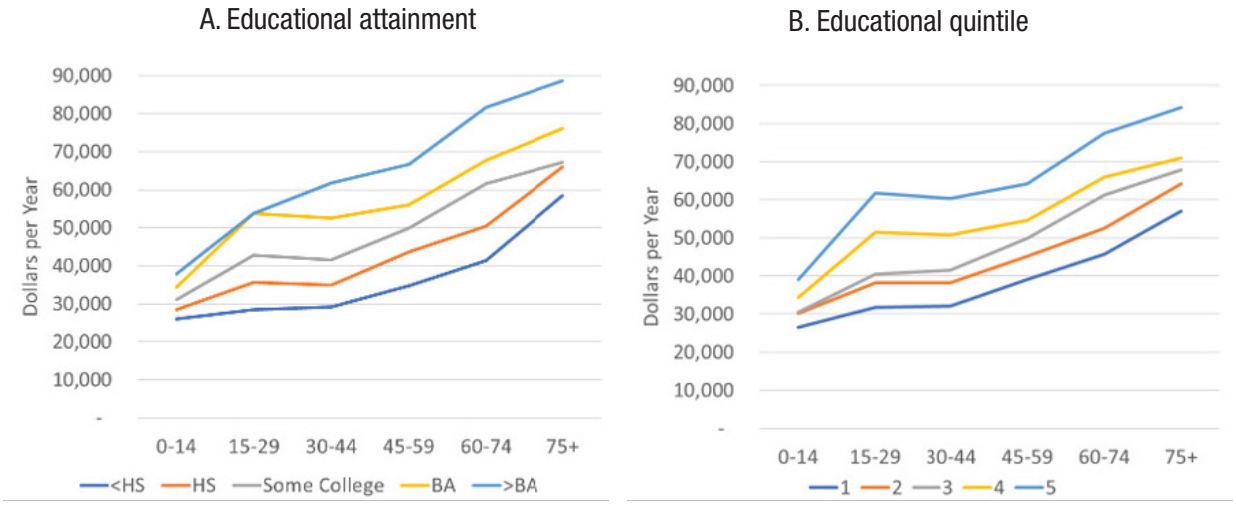
Figure 1.2 shows labour income for the United States of America in 2018, with averages across individuals at each age within categories defined either by education of the head of household in which they live (panel A), or by the head of household's educational quintile (e.g. bottom 20 per cent, …, top 20 per cent; panel B). The differences shown in panel B for education quintiles are smaller than those in panel A for educational attainment levels, because the quintile measures reduce the effects of selectivity as discussed earlier. Figure 1.3 shows similar results for consumption, and again the differences across quintiles are smaller than those for attainment levels.

Figure 1.2
Average labour income by educational attainment group in 2018 (US$), United States of America



Source: Donehower and others (2021).

Figure 1.3
Average consumption by educational attainment group in 2018 (US$), United States of America



Source: Donehower and others (2021).

1.4.3 Problems in estimating NTA for SES groups

Because reporting on surveys is often inaccurate, and to achieve consistency of NTA with aggregate national accounts, the first round of NTA estimates is always adjusted so that when multiplied by baseline population data and summed it exactly matches national accounts aggregates. The totals to be matched are called "control totals". While these are available at the national level, they are generally not available for SES subgroups, however defined. In that instance, the same adjustment factors must be used for all SES groups, even though reporting quality may vary across groups.

A different problem is that in some countries, not all necessary information (e.g. labour income and consumption) is available in a single survey. In this case, there must be imputation across surveys, which poses additional problems. Imputation may get group averages right but is more questionable for individual data in the microfiles.

Estimates of some NTA components are not based on individual data but on administrative data. Examples are public education and publicly funded healthcare spending. It may be possible to impute administrative data to micro files by using survey data. For example, surveys may report whether household members are enrolled in public school.

1.5 Measuring inequalities

As discussed earlier, it is possible to analyse the distribution of many economic outcomes in the microfiles distinguishing only by age, as illustrated in figure 1.1. The data could also be rescaled to show proportional or logarithmic variations. Gini coefficients can be calculated to describe the amount of inequality at each age. When NTA for more than one date are available, it is possible to determine whether inequality had been rising or falling for each outcome. This would be useful and important information but would not show what was driving the inequality, and so could not help guide policies to reduce inequality. For this reason and others, it is helpful to introduce measures of SES, such as education or others to be discussed below, and then to consider the distribution of income or other outcomes across averages within these status groups. An earlier section discussed the advantages and disadvantages of some measures of SES including education of household head or income. Here some studies using these and other measures will be briefly reviewed.

1.5.1 What outcome to analyse

The advantages and disadvantages of using educational attainment or quantiles of educational attainment for SES have already been discussed. There are also many possible outcomes to be studied, such as labour income, total income, consumption, asset income, pension benefits, costs of public healthcare usage and private transfers. Wan and others (2024) consider the extent to which some of these outcome measures are correlated over the period 1988 to 2018 in China, finding that the increase in income inequality in China has ended recently, but that inequality in consumption and wealth has continued to grow. Despite these divergent trends, the three outcomes are all highly correlated. This finding suggests that it is important to consider more than one outcome when looking at trends in inequality, since these trends can differ.

1.5.2 How to measure dispersion

Kim (2023) measures within-group inequalities by age using the variance of log income or consumption and the coefficient of variation for groups defined by both high- and low-income level and further classified by extended or nuclear living arrangements. For Peru, Olivera (2024) analyses changes in income distribution between 2007 and 2019 and the role of both changing population age distribution and changing educational attainment over that period, finding interesting patterns of change.

Rosero-Bixby (2024) calculates pseudo-Gini coefficients by age in Ecuador, based on differences in various outcomes across quartiles of the highest adjusted educational attainment of all members of a household, not necessarily the household head or even an adult. The education of each individual in the household is first adjusted by subtracting the average level of educational attainment in that birth cohort. The Gini coefficients are “pseudo” because they measure inequality only across the education quartiles but not within them or for characteristics not associated with the education quartiles. The coefficients are calculated for eleven different outcomes, including labour income, consumption, public and private education, public and private health expenditures, public pension benefits and taxes, leading to many important findings. One of these is that the new “neo-socialist” government in Ecuador that introduced new policies with the goal of reducing inequalities did indeed accomplish a substantial reduction

in inequalities. Another finding regarding education is typical of Latin America and may be characteristic of other parts of the developing world: at younger school ages, lower quartiles use public education more heavily than higher quartiles, but at older school ages, the higher quartiles use public education for tertiary education more heavily than the lower quartiles. This pattern continued after the government reforms but became weaker. A third important finding is that retirement pensions and asset income are highly unequal, and these inequalities rise with age, leading Rosero-Bixby to suggest that population ageing will exacerbate income inequality. Rosero-Bixby's paper is presented here in some detail because it introduces several new methods and approaches. The measurement of education is also innovative, and the study shows comparative results for more widely used measures and also examines the effect of public programme changes on inequality, as will be described below.

1.6 Public transfers, SES and inequality

1.6.1 What public transfer systems do: "Robin Hood" versus "Piggy Bank"

Differences in economic circumstances of individuals give rise to private and public transfers, whether these differences arise from life cycle stage, temporary misfortune or lifetime conditions. The first gives rise to intergenerational transfers that redistribute over the life cycle, while the second two give rise to redistributive transfers to alleviate poverty, according to Barr (2001), who refers to the former as the "Piggy Bank" function (in relation to public transfers) and the latter as the "Robin Hood" function. Standard NTA is all about the "Piggy Bank" function, while this manual emphasizes the "Robin Hood" function or combined "Piggy Bank" and "Robin Hood" functions. In this manual, the two functions are often referred to as "intergenerational" and "redistributive".

In practice, the two kinds of transfers interact in interesting and important ways. People in different SES groups may have different shapes for their economic life cycles, for example starting work earlier or later and retiring earlier or later, with different numbers of children to support. The end of life may come sooner for the poor than for the rich. Consequently, different SES groups may have somewhat different age patterns of life cycle deficits and intergenerational transfers. These variations in the shape of the economic life cycle by SES are of great interest in themselves, but it is also important to see how public transfers differ by SES.

Some studies have investigated overarching patterns in public transfer systems in Europe. These analyses could be usefully extended to other countries and regions and might help guide policymakers as they shape growing welfare states. Vanhuysse and others (2021) carried out a conceptually deep and careful analysis of microdata from 22 European countries to find patterns in public transfers, asking whether welfare states in Europe primarily redistribute income to alleviate poverty (the "Robin Hood" model) or smooth consumption over the life cycle (the "Piggy Bank" model). They used a composite measure of SES that includes education, occupation and home ownership, concluding that "European welfare states are primarily inter-age reallocation machines", i.e. "Piggy Bank" systems.

Hammer and others (2023) studied the trade-off between the two kinds of redistribution systems. They analyse data from 28 European countries, defining economic status quartiles based on "equivalized" household income. They find that in northern European countries there is strong redistribution to lower income households but limited public pensions whereas in southern European countries there is weak redistribution to lower income households but strong redistribution to pensioners.

In line with the "Piggy Bank" function, public pension transfers typically provide higher benefits to higher status groups, sometimes in proportion to lifetime earnings. But some public pension programmes may also have a redistributive or "Robin Hood" function which moderates or reverses that proportionality of benefits to prior earnings. Other public programmes may be entirely for redistributive purposes. Still others may offer equal benefits to all groups, such as public education or publicly provided healthcare, although the groups may differ widely in their uptake of the benefits

offered. Also, the picture for gross benefits, meaning the value of benefits received, can look very different from the picture for net benefits, meaning the value of benefits received minus the taxes or contributions paid.

1.6.2 Public transfers and SES

The pioneering paper on this topic was by Turra and Queiroz (2005), referring to Brazil in 1996, which found a number of results that continue to hold not only for Brazil but also for many other countries in Latin America and perhaps elsewhere. One is the pattern described by Rosero-Bixby above: lower status groups use public education more heavily for their children at younger ages, perhaps through secondary school, while higher status groups pay for private education for their younger children. After secondary school, the children of higher-status groups attend public universities while those of lower-status groups enter the labour market. Differences of this sort may help to perpetuate SES differences from generation to generation. Bucheli and González (2024) find high private spending by the top education group throughout education in Uruguay. As for healthcare, use is inversely related to status, with the highest status groups hardly using public healthcare at all and the lowest status groups using it most heavily. Pension benefits, both gross and net, flow overwhelmingly to the highest status groups.

Shen and others (2018) estimate public transfers for education, healthcare and pensions by per capita income quartile in China in 2010. Public spending is heavily skewed toward older persons on a per capita basis, and the top income quartile receives four times the benefits of the bottom quartile.

Abrigo (2023) finds that the public healthcare system in the Philippines is "propoor", both in benefits and contributions, in a study that defines socioeconomic status using educational attainment categories. Benefits are measured in different ways, but the use of "transfer wealth" (net present value of expected benefits received minus taxes paid) as an outcome variable is an interesting innovation in this paper.

1.6.3 Public policy and reduced inequality

When NTA are available for at least two years and there is a policy change between them, it may be possible to assess the effect of the change on inequality. Rosero-Bixby (2024) describes public policy changes that occurred between the switch from a neoliberal regime in 2006 to what he calls a neo-socialist government committed to reducing inequality. These changes included an increased minimum wage and protections for workers, increased pension coverage, new conditional cash transfers, increased health insurance and health facilities, and both increased taxes and increased total public transfers. The effects of these policy changes can be seen in the increased progressivity of public transfers, reduced inequality in wages and consumption, and a decrease in the full (as opposed to "pseudo") Gini index from .52 to .46. Because the pension system is highly regressive, however, he expects that population ageing may lead to increasing inequality overall in the future.

Feng and others (2019) find that although public transfers in China go mainly to higher income groups, the expansion of government programmes from 2010 to 2014 raised the public benefit share of the lower income groups and contributed to a narrowing of inequality over that period.

1.6.4 Public pensions

The National Academies of Sciences, Engineering, and Medicine of the United States of America (NASEM, 2015) finds that, in some countries, many lower-income workers are in the informal sector and therefore do not qualify for public pension benefits, while higher-income workers are more likely to qualify. In other countries, informal sector workers are covered by "non-contributory" public pensions whether or not they contributed to the pension system during their working years. Further, in some countries public pensions are proportional to earlier earnings, whereas in others lower-income groups receive proportionately higher pensions. For example, in the United States of America,

the benefit level is progressive in the sense that those with lower lifetime covered earnings receive a proportionately higher benefit than those with higher earnings. Sometimes lower-income groups have lower life expectancy and so receive pension benefits for fewer years than higher income groups, which can make what are intended to be progressive public programmes for older persons less so or even regressive.

When Piketty's (2014) *Capital in the Twenty-First Century* was published in English translation, it generated enormous interest and called international attention to growing inequality, particularly in wealth. Wealth, in the sense of property and other assets, brings power to its owners and can be transmitted from generation to generation through inheritance. Yet, for most people, public pensions are also a kind of wealth. If the pensions are "pay-as-you-go" (PAYGO), meaning not backed by assets, then they are a form of transfer wealth, defined as the present value of expected future transfer benefits minus future transfer contributions. This concept is most familiar in the context of pension wealth, but it applies to all kinds of transfers including publicly funded healthcare and long-term care, public education, private transfers for costs of raising children and family assistance for support of older persons. Some public pensions are funded through accumulated assets and, like PAYGO pensions, these represent wealth but not transfer wealth. Rather, both the asset wealth and the pension transfer wealth are forms of pension wealth. Pension transfer wealth is of great importance and can substitute for life cycle savings. Pension transfer wealth is very substantial throughout the high-income countries and is increasingly important in middle-income countries with public pensions, meaning that taking it into account could dramatically alter the picture of wealth inequality and its trends (Barr, 2001; Catherine and others, 2025). This is true even though transfer wealth is not heritable and does not convey power.

Both proportional and progressive pension benefits can have an equalizing effect on the distribution of wealth, though it is stronger with progressive benefit rules. This is because asset holdings typically rise more than in proportion to labour income. For example, in the United States of America, labour income is five times greater for those with more than a tertiary education than for those with less than a secondary degree, while asset income is 21 times greater. For this reason, even pension benefits proportional to earnings can reduce wealth inequalities.

A non-NTA study in the United States of America by Catherine and others (2025) used actual data on wealth and pension benefits over three decades to study the roles of asset wealth and pension wealth in inequality. They found that, if pension wealth is included, the wealth share at the top of the wealth distribution has not changed over the past three decades, whereas it did increase in estimates based on asset wealth alone. Pension wealth in the country more than quintupled between 1989 and 2019. NTA data do not include asset wealth, but it does include asset income. From asset income, asset value can be approximately estimated by dividing it by the average rate of return on assets. For example, in the United States of America, this average real rate of return has remained close to 5 per cent per year for decades as can be calculated from national accounts. The study by Catherine and others provides a possible model for comparing inequality based on estimated assets to a measure that adds pension wealth. Wealth inequality is not, however, a main topic of focus in this manual.

1.6.5 NTA and the fiscal impacts of immigration and emigration

International migration is an important topic for both receiving countries and sending countries. Receiving countries are concerned about the fiscal impact of immigrants, their social and economic assimilation, and how they affect the earnings and employment of the domestic population. Sending countries want to know about how the brain drain will affect their economy, the possible loss of the emigrants' human capital, resulting from the sending country's investment in their public education, and possible future remittances by those emigrants. NTA can help address all these questions except for the impact of immigration on employment and earnings, as is discussed briefly below.

When the necessary information on immigrant status is included in the surveys used to estimate NTA it can be included in microfiles. It is then possible to estimate NTA by immigrant status, for example by whether an individual

is foreign-born ("first generation immigrant"), native born to foreign-born parents ("second generation immigrant"), or neither. Often immigrant status can be cross-classified by educational attainment and age when the immigrant entered the country as well as current age and education. NTA age profiles can be estimated for these immigrant status categories, for example for labour income, consumption, taxes paid and public benefits received. The age profiles for labour income by detailed immigrant status can then be used to see how labour income by age and education at time of immigrant arrival compare to the same for second generation immigrants and the rest of the population. It may also be possible to analyse the degree of convergence of immigrant labour income to that of the rest of the population, controlling for age, duration in the country and education.

Studies in the United States of America have carried out such estimates and comparisons based on methods similar to NTA (Smith and Edmonston, 1997; NASEM, 2017). Both studies used detailed dynamic accounting projections and age-cohort demographic projections to estimate and analyse the fiscal impact of immigration. These studies found (using the preferred set of assumptions) that immigrants were initially a net fiscal cost to state and local governments but were a larger net benefit at the federal level, when all origins, education levels and ages of immigrants were combined, with the long-term effect fiscally beneficial overall. Much of the benefit derived from the children and later descendants of the immigrants, and the impacts depended on the level of education and age of the arriving immigrants.

Work on the impact of emigration on the sending country has begun with a pioneering study for Mexico of the impact of emigration to the United States of America (Mejía-Guevara and Vega, 2013), taking into account the cost of the human capital lost to emigration as well as the value of the remittance flows back to Mexico.

The use of NTA to study the costs and benefits of migration to both sending and receiving countries is not a focus of this manual, but is mentioned here because it seems likely to be an important use of NTA in the future. As of 2026, an NTA working group has been developing and testing methods based on simpler data requirements with the goal that these could be used by many or most countries with NTA.

1.7 Projections and simulations for growth and sustainability based on SES subgroups

An important strength of NTA for policy purposes and economic projections is that it draws out the implications of projected demographic change in a transparent way, building on the NTA age profiles, typically for labour income and consumption. Most NTA projections are designed to show the economic impact of population change, other things being equal. They tell us what would happen if the NTA base age profiles remained unchanged while the population changed rather than attempting to forecast the real future in which other variables also change. NTA can be used to make more comprehensive forecasts, but that is a separate process and not the focus of this manual.

The "support ratio" is a simple and intuitive measure of the effect of population age distribution on per capita income, while the "demographic support ratio" is the ratio of the population in the working ages (often taken to be ages 20–64) to the number of consumers, which is the total population. This ratio tells us how many consumers each person in the working ages must provide for. The "economic support ratio" (ESR) is based on the NTA age profiles for labour income and consumption. Rather than counting every individual age 20–64 as working age, for a given year t the population at each age is multiplied by the baseline labour income at that age and sum across ages to get so-called "effective labour" for that year, denoted L_t. This is also the projected total labour income for that year, all other things being equal. L_t is measured in efficiency units such that one unit of labour at age x earns labour income $y_l(x)$, so L is both the supply of labour and total labour income. Rather than counting every member of the population as an equal consumer, the so-called "effective consumers", denoted N_t, are calculated in a similar way, weighting the population age distribution by the baseline age profile of consumption for each year. Then the ESR_t is the ratio of effective labour to effective consumers $ESR_t = L_t / N_t$.

1.7.1 Simple analytics of the economic support ratio and demographic dividend

Economic output, Y, is simply output per unit of labour Y/L times labour L. So Y/N, income per effective consumer, equals the productivity of labour, Y/L, times the amount of labour, L, divided by N:

(1.1) $$(Y/N) = (Y/L)\ (L/N)$$

In words, output per effective consumer equals the economic support ratio times the productivity of labour (output per worker). The support ratio translates productivity per unit of labour into output per effective consumer.

This also results in:

(1.2) $$Gr(Y/N) = Gr(Y/L) + Gr(L/N)$$

The rate of growth (Gr) of the ESR is the "demographic dividend" which, if negative, may be interpreted as the cost of population ageing.

Growth rate of Income per Effective Consumer = Demographic Dividend + Productivity growth rate

Or, to get aggregate consumption C per effective consumer N, the formula $C=(1-s)Y$, where s is the proportion of Y saved, can be used to get:

(1.3) $$C/N = (1-s)\ (Y/L)\ (L/N)$$

(1.4) $$Gr(C/N) = Gr(1-s) + Gr(Y/L) + Gr(L/N)$$

This is the intuitive appeal of the ESR. It also merges well with a neoclassical growth model with $Y=AF(L,K)$, where K is the capital stock and A is the level of technology. With constant returns to scale, this can be rewritten $Y=LAf(k)$, where k is capital per unit labour, K/L. Then the productivity of labour is $Y/L=Af(k)$ (see Cutler and others, 1990). The ESR reflects economic dependency inversely. When the ESR is rising, as in the demographic dividend phase, it adds to the effect of productivity growth, and when it is falling, as with population ageing, it subtracts from the effect of productivity growth.

With this background, it is now possible to consider how incorporating educational attainment enriches projections of changing age distributions and economic growth.

1.7.2 Incorporating educational attainment in projections

This use of NTA age profiles can be augmented in an important way by using NTA by SES in addition to age. A leading example is educational attainment. Projections of educational attainment are carried out by some organizations, notably the Wittgenstein Centre (2023). Educational attainment can be translated into labour income using the NTA baseline age-education labour income profile. This step is simplest if the age-education labour income profile is expressed using the same education categories as the Wittgenstein Centre. The changing labour income profiles can then be applied to the population projections in the usual way. Because average labour income is higher for individuals with more education, a rising level of education results in a rising age profile for average labour income. A similar calculation can be done for the age profile of consumption. Some NTA studies have done this, following the approach in the pioneering paper by Rentería and others (2016). Another study by Prskawetz and Hammer (2018) takes a similar approach.

There are two ways to interpret the results of these calculations. The first, emphasized in the study by Rentería and others, is to consider the effect on the demographic dividend. The second, which may be more important, is the effect on the rate of growth of labour income. Rising educational attainment raises the productivity growth rate in equation 1.2 rather than affecting the demographic dividend, which is still defined in terms of the baseline age profiles of labour income and consumption.

1.7.3 How educational attainment affects the demographic dividend

The term "demographic dividend" has been used in different ways. In a preceding section, it was defined as the rate of change of the support ratio due to changing population age distribution, and the support ratio was in turn defined based on the baseline age profiles of labour income and consumption. In Rentería and others (2016), it has a different meaning because it reflects changes in age profiles from year to year due to changing education, as well as changing population age distribution. Aggregate effective labour income L and consumption N can be calculated as outlined above to reflect educational attainment as well as population age distribution. These are designated as EdL and EdN, respectively. The ratio EdL/EdN is the "education augmented economic support ratio", or $EdSR$. The rate of change of the $EdSR$ is the "education augmented demographic dividend", or $EdDD$. Rentería and others (2016) report these various components in their table 1, using a different terminology and notation.

The standard demographic dividend tells us at what rate the changing population age distribution would change labour income per effective consumer if the age profiles of labour income and consumption were unchanged at baseline levels. Of course, these age profiles are not expected to remain unchanged in the future, and one of the forces expected to change them is rising educational attainment. The $EdDD$ differs from the ordinary demographic dividend DD because it incorporates this effect of rising educational attainment. It tells us whether population ageing and rising educational attainment would generate an aggregate life cycle surplus or deficit if everyone earned labour income and consumed according to their baseline education-specific profiles.

Note that this incorporates the education effect on both labour income and on consumption. If changing education raises labour income, it will tend to raise the $EdSR$. If changing education raises consumption, that will tend to reduce the $EdSR$. The balance of these changes determines whether education makes the $EdSR$ rise or fall. Naturally, higher education groups with higher labour income also have higher consumption. If age-specific consumption profiles rose at the same rate as labour income profiles when educational attainment increases at baseline, then there would be zero effect on the ratio EdL/EdN and the $EdDD$ would equal the DD. Still, consumption at every age would be rising. In practice, the consumption of higher education groups is generally lower relative to their labour income, most likely because they pay proportionately more taxes, so these groups generate a large surplus. In some cases, the top education group may be the only group with a surplus in the working ages.[1] As educational attainment rises and the population shifts toward the higher and highest education groups, the aggregate surplus rises and the $EdDD$ is positive. Prskawetz and Hammer (2018) find that taking education into account reduces the projected cost of population ageing for Austria.

In table 1.2, the columns headed "Effect of education on L and N, constant age distribution" show the effect of changes in educational attainment on the growth rate of aggregate labour income and aggregate consumption over spans of 45 to 65 years in the past, holding population age distribution constant. In every case, the boost to growth rate in labour income is at least .8 per cent per year greater than the boost to consumption, and in most cases substantially more. From this, it can be seen that the $EdSR$ will be larger than the standard ESR, and higher education will lead to a greater life cycle surplus. This is confirmed by the columns headed "Demographic Dividend Measures".

[1] See figure 5 in Rentería and others (2016) for Mexico and Spain; figure 1.3 in Rentería and others (2024); and figure 4 in Oosthuizen (2024) for South Africa, in which negative values of the life cycle deficit indicate a surplus.

1.7.4 How rising educational attainment raises the growth rate of income

As discussed above, a key part of the analyses reported in these studies and summarized in table 1.2 is the effect of changing educational attainment on the growth of labour income. Because the share of labour income in total income is generally quite stable, these will translate approximately into effects on the growth rate of total income. The effects are substantial, ranging from about 1 per cent per year over 65 years in South Africa to about 3 per cent per year in Singapore. The full effect, combining productivity growth due to education with the standard demographic dividend, as expressed in equation 1.2 above, is given in the last column showing the growth rate of output Y per effective consumer N based on the original baseline consumption age profile.

This rapid growth in labour income is a very impressive economic achievement which is much larger than the size of the first demographic dividend in per cent per year. It is, however, closely related to the second demographic dividend in that declining fertility and lower proportions of children in the population facilitate increased investment in education per child and also are motivated in part by the desire to be able to afford such investments in children's education.

These calculations are all based on past data, but similar calculations have been made for projected future changes in education. For example, Rentería and others (2024) present these for 19 European countries. Under the medium education projections from the Wittgenstein Centre, most European countries begin with productivity gains of 2 to 3 per cent per year, which then decline toward 1 per cent per year in 2080, with much variation in this pattern (as can be inferred from figure 9).

This use of the NTA data by educational attainment is valuable in quantifying its impact on economic growth and in quantifying its ability to generate an economic surplus which will help to offset the rising costs of population ageing.

Table 1.2
Impact of changing population age distributions and changing educational distributions on various growth rates

	Demographic dividend measures		*Effect of education on* L *and* N*, constant age distribution*		*Effect of age on* YI *and* C		*Equation (1.2) Age and Education*
Country, dates	$Gr(ESR)$	$Gr(EdSR)$	$Gr(EdL)$	$Gr(EdN)$	L	C	$Gr(Y/N)$
South Africa, 1950–1990	0.11	0.82	1.12	0.3	0.05	-0.06	1.35
Mexico, 1970–2015	0.56	1.76	2.75	1.59	1.74	1.20	3.31
Spain, 1970–2015	0.38	1.53	1.87	0.73	0.75	0.37	2.25
Singapore, 1970–2020	0.41	2.38	3.13	1.62	1.24	0.87	3.54

Source: For Spain and Mexico, Rentería and others (2016), table 1. For South Africa, Oosthuizen (2024), table 1, recalculated here as weighted average of 1950–1990 and 1990–2015 and with changed sign for effects on consumption. For Singapore, Choo and Gee (2024). The last column shows the growth rate of output per effective consumer as the sum of the ordinary demographic dividend $Gr(ESR)$ and the growth of labour productivity due to rising education $Gr(EdL)$.

The role of population age distribution versus education in the demographic dividend is a controversial topic. For example, an article by Lutz and others (2019) titled "Education rather than age structure brings demographic

dividend" interprets "demographic dividend" more broadly as the effect of demographic change on economic growth, where demographic change refers to "all characteristics of people that are typically collected in a census". The article assesses the impact of demographic change through a comparative international panel regression study in which the role of education is found to be greater than that of the share of the population in the working ages (the demographic support ratio discussed earlier). For the purposes of this manual, this measure of the support ratio is deficient because it weights all consumers equally in the denominator of per capita income and weights all people aged 20–64 equally as producers in the numerator. It is hard to know how important this is for their results, although Rentería and others (2016) find that the growth rate of GDP per capita (weighting consumers equally) is 1.35 per cent per year faster than the growth rate of GDP per effective consumer from 1970–2015 in Mexico, while in Spain the two measures are almost equal.

An important question is whether rising education of parents is causing falling fertility or if a desire to invest more in each child's education causes falling fertility and rising education. It is also possible that both are caused by other factors such as rising incomes. For many purposes, however, the exact cause and effect is not important. It seems clear that an exogenous increase in education would bring lower fertility, and an exogenous decrease in fertility would bring increased education. There is a close empirical association between the two (Mason and others, 2016). What Lutz and others (2019) analyse is a simplified and schematic version of the "first demographic dividend" representing the pure age distribution effect. The results in table 1.2 are certainly consistent with the results in Lutz and others (2019) and are consistent with what one would expect, namely that the first demographic dividend is of limited size and duration and is eventually reversed by the rising dependency of population ageing, whereupon it turns negative. Education is a powerful driver of economic growth and does not reverse in this way. Its effects on the level of output are sustained even if the growth-boosting effect is projected to decline over the course of this century. But there is also arguably a "second demographic dividend" (Mason and Lee, 2006) which includes other changes brought on by the changing population age distribution, notably rising investment in human capital per child and rising capital per worker.

1.7.5 Incorporating other dimensions of SES in projections

If projections exist for other dimensions of SES by age, or if such projections can be generated, then NTA classified by these dimensions could be used to refine and deepen projections using methods similar to those for education. Such other dimensions include urban or rural residence, residence in subregions of a country, and immigration status. Some other dimensions might be more difficult to project forward, such as parental status, household living arrangements and income. These could be very informative in the base period and yet be less useful for projection.

The basic strategy for such projections is to draw out the consequences of changing population composition with respect to the dimension under consideration. Standard NTA does this extensively with respect to the dimension of age, and newer work has done so based on age and educational attainment as described above. With each new candidate dimension, however, it matters whether the projected new members of a category, such as a larger proportion achieving higher educational attainment, will have the same outcomes as described in the NTA baseline category or if those changing statuses will be self-selected on other characteristics. The question of whether those members of the population who remain in a lower category will have the same characteristics and outcomes as those who have left the category to achieve a higher level arises even in the case of age because as mortality falls, survival to the higher ages is less selective based on socioeconomic background, although this effect is probably quite small.

The problem is bigger for other dimensions. The problem for educational attainment, for which the lower categories become more adversely selected and the upper categories become less positively selected over time, is discussed above. In this case, the use of the baseline NTA may overstate the favourable effects of educational progress. Regarding rural to urban migration, the question arises as to whether a migrant from a rural area will become

like the average urban resident after moving to a city. In the case of international immigration to the United States of America, careful analyses have been undertaken for the process of educational and labour force assimilation of immigrants both within generations by length of time since arrival and also between generations considering educational transition probabilities (Smith and Edmonston, 1997; NASEM, 2017). These show that the process of economic assimilation is lengthy and not immediate.

Another question is whether a change of status is as permanent as it would be for education. For immigrant status, the possibility of return migration must be considered, as it similarly must be for rural-urban migration.

1.7.6 Projections and simulations based on subgroups to improve projections of fiscal sustainability for public programmes

Standard NTA age profiles for taxes and other contributions paid versus the costs of benefits received have been extensively used in projections to assess the fiscal sustainability of public programmes (e.g., Miller and others, 2011; Cai and others, 2018). NTA for subgroups of the population can be used to deepen and refine such calculations. Amarante and others (2021) incorporate education in their analysis of net public transfers in Uruguay and project the public sector budget using the Wittgenstein Centre's education projections along the lines of Rentería and others (2016). They find that rising educational attainment in future years should generate a substantial fiscal surplus. So far, there has only been limited use of this approach, but it appears to be a valuable approach that is worth replicating in other countries.

The most elaborate application to date is for the fiscal effects of immigration in the United States of America, for which there were detailed studies by Smith and Edmonston (1997) and NASEM (2017). These studies were not based explicitly on NTA methods, but the estimation and use of the age profiles is very similar to NTA. Detailed analyses quantified the economic impact on the public sector of immigration to the country, taking a forward-looking longitudinal approach.

A related project (Mejía-Guevara and Vega, 2013) used the Mexican NTA to estimate the economic impact on Mexico of emigration to the United States of America, balancing the export of costly human capital on the one hand and the acquisition of remittance income flows among other costs and benefits on the other. This is a promising topic for development.

1.8 Conclusions

With some countries at an early or middle stage of the demographic transition, and others toward the end and experiencing population ageing, NTA offers welcome insights into the economic consequences for families, the public sector and markets. Individual-level NTA estimates already exist in microfiles, which are the first step in constructing national-level estimates. Drawing on these, various dimensions of SES can be added to standard NTA to greatly deepen and extend the kinds of analysis that can be done and the uses to which NTA may be put. Policy analysts can see whether public transfers are reaching their intended targets and whether the progressivity or regressivity of public programmes matches the intent of the programmes. The level and trends of inequality can be assessed, and pockets of poverty for specific groups can be identified for targeting. Projections can be made of future growth as affected not only by the changing population age distributions, but also by the way projected educational change will affect growth rates and fiscal sustainability. New measures of the education-enhanced demographic dividend can be constructed. Extending the measurement and analysis of NTA by socioeconomic status is an important next step for all countries that have completed standard NTAs.

Chapter 2: NTA-I Methodology

2.1 Review of basic NTA methodology, with adjustments for NTA-I

This chapter presents the methodology for constructing National Transfer Accounts by additional characteristics (NTA-I), extending the standard NTA framework beyond age to incorporate socioeconomic, demographic and household dimensions. The chapter has three closely related objectives. First, it provides a detailed, operational description of the methods required to estimate NTA-I in a way that is fully consistent with aggregate national accounts and with single-group NTA age profiles. Second, these methods are implemented and vetted using recent data from the United States of America, allowing the user to assess data requirements, identify practical challenges, and highlight lessons learned in applying the framework. Third, the chapter illustrates a set of tools for summarizing, visualizing and interpreting NTA-I results, reflecting the fact that NTA-I produces rich micro-level information that cannot be adequately conveyed using age profiles alone. Together, these elements are intended to support both rigorous estimation and effective communication of NTA-I results in comparative and policy-relevant research.

2.1.1 Overview

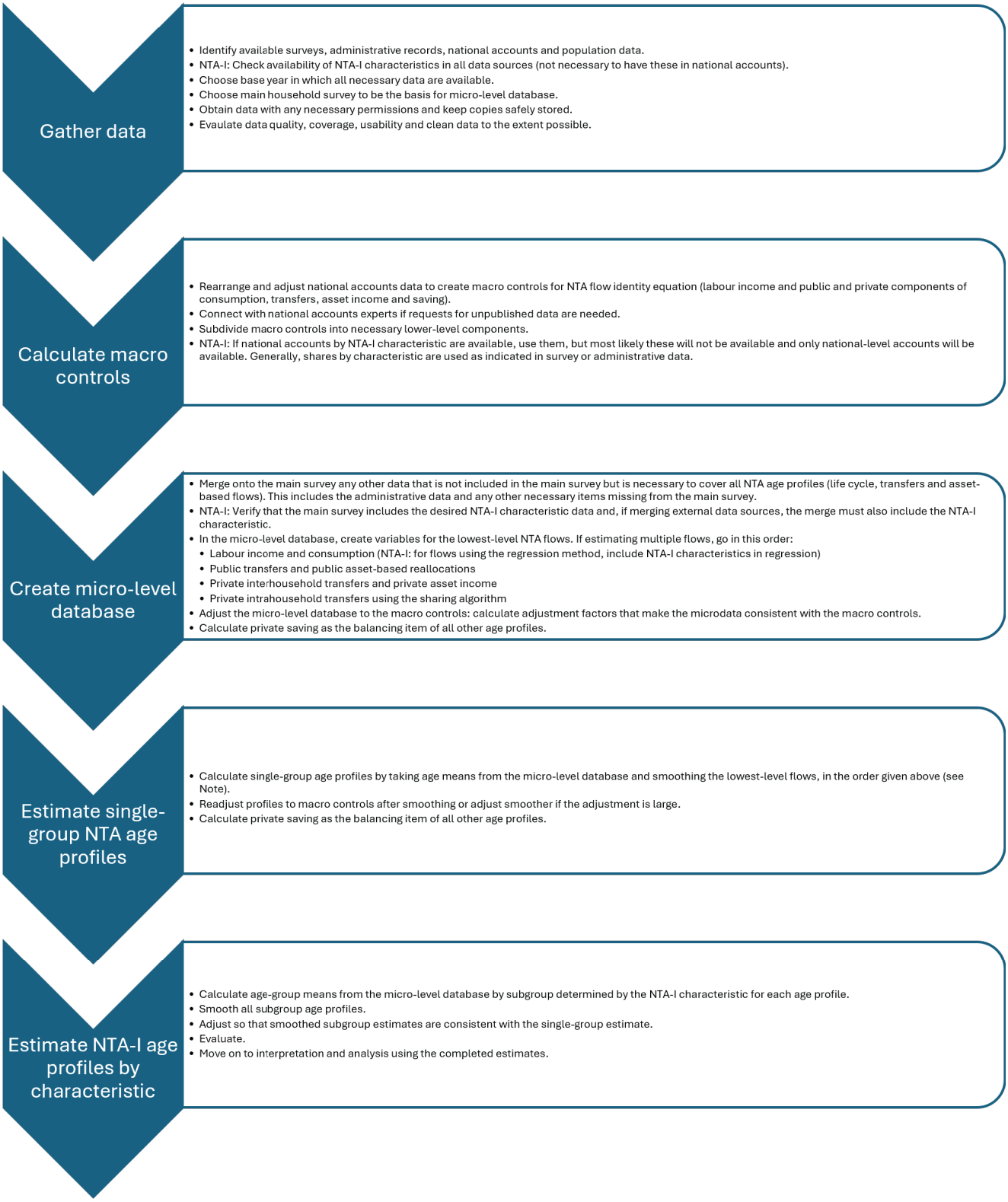
The methods build on the first NTA manual, *National Transfer Accounts Manual: Measuring and Analysing the Generational Economy* (United Nations, 2013), summarized briefly here. First, analysts gather data, which may include: national accounts data that track total current flows in the economy; survey data on economic life that indicate how households and individuals participate in those flows; administrative data that capture economic transactions not observable at the household level (mainly flows facilitated by governments); and population data that provide an accurate picture of the population by age. Second, national accounts data are arranged and adjusted to give national-level totals of how people produce, consume, share and save resources through both the public and private sectors. Third, survey and administrative data are used to calculate average age patterns of economic flows, including consumption, production, government-based transactions and private transfers between households. Fourth, these age patterns are adjusted to match national-level totals, producing age profiles that show the average value by age of each flow. Finally, components of the generational economy that are not measured directly –most notably private transfers within households and individual-level private saving – are calculated using methods unique to the NTA framework.

Each of these steps is reviewed in greater detail – noting where procedures differ from those described in the first NTA manual – in order to estimate NTA by subgroups, such as socioeconomic status, geographic region or any other important attribute available in survey and administrative data. The shorthand "NTA-I" is used to distinguish these estimates from those made with the earlier NTA methodology, with the "I" denoting the "inclusion" of important attributes of a population. Estimating NTA-I makes it possible to examine how the generational economy functions differently across groups and how households, labour markets and governments shape economic outcomes in group-specific ways.

NTA-I is also used to examine distributional features of NTA age profiles, providing a useful supplement to agespecific means by allowing analysis of medians, dispersion and other distributional measures. The use of NTA-I results for distributional and subgroup analysis is discussed later in this chapter, but first, section 2.1 reviews the construction of single-group NTA estimates, followed by section 2.2, which explains how those estimates are disaggregated by NTA-I characteristics.

The discussion in this section is not intended to replace the first NTA manual, and readers who are new to NTA research should consult that volume in detail. In particular, the conceptual foundations presented in chapter 2 of the

Figure 2.1
Suggested workflow for calculating NTA and NTA-I



Note: This sequence assumes that researchers will calculate a complete set of single-group NTA age profiles and then subsequently calculate a complete set of NTA-I age profiles. Alternatively, researchers may go profile by profile, calculating single-group and NTA-I by characteristic for labour income, consumption and other components.

first NTA manual are not repeated here and provide essential framing for the NTA framework. This manual assumes that readers are already familiar with the basic concepts, terminology and accounting structure of NTA.

This review begins with figure 2.1, which illustrates suggested workflow for calculating NTA-I. This is a modification of figure 3.1 in the first NTA manual, but it includes the steps necessary to estimate NTA-I and changes the order of some steps to facilitate NTA-I calculations alongside single-group NTA.

2.1.2 Data

The first step in calculating NTA and NTA-I estimates is to assess the availability of the necessary data sources for calculating NTA in a year and whether they include enough detail to allow NTA-I estimates to be produced alongside NTA. NTA and NTA-I can be calculated for multiple years or only one year. Typically, researchers will start with one base year for their country and then add base years as the project continues, either updating with more recent estimates as time goes on or working back to fill in historical estimates as data allow.

This section reviews the four main types of necessary data – population estimates, national accounts, household economic surveys and administrative data – and discusses how to evaluate whether each type is sufficient for the purpose. In some instances, substitutions or workarounds are discussed where the ideal data source is not available. This information is also discussed in section 3.1.2 of the first NTA manual, "Data requirements".

Population estimates

Population data by age may come from a country's national statistical office (NSO), or from international organizations such as the United Nations Department of Economic and Social Affairs (DESA). Population estimates by age are necessary for constructing the base-year NTA and NTA-I estimates, while population projections for future years are useful for forecasting analyses conducted after the base-year estimates have been completed.

Estimates are usually produced in increments of single years for age groups from 0 through 90+ years of age. Some countries have population estimates that do not have sufficient detail up to age 90 and so must have a younger eldest age group. Some countries have more detail and produce estimates up to, for example, 100+. The resident population should be used, taking care to include any non-household or hard-to-measure populations such as students, military personnel or other persons in institutional settings.

The quality of the population data should be assessed for any measurement issues such as age heaping or underreported age groups. This can be done with simple plots of population by age or by comparing estimates from national statistical offices with estimates from other sources. If problems arise, researchers should discuss with the NSO which data sources are the best to use, or whether corrected estimates can be obtained.

For NTA-I, it is helpful if there is also population count data for the additional NTA-I characteristic. For example, if the characteristic is a subnational geographic level, it matters whether the NSO produces population estimates by age for each subnational geographic entity. Or, if the estimates are being done by sex, if the NSO has population counts by age and sex. If the NTA-I characteristic is a socioeconomic status indicator like education or income, it is less likely that population counts will be available by these subgroups. In that case, the distribution of population by characteristic within each age group will have to come from survey sources, under the assumption that the survey is a good representative sample of persons in the population.

National accounts and other aggregate data

As with population data, national accounts (NA) data will typically be produced by a group within the NSO. Most countries produce NA following the United Nations System of National Accounts (SNA), which results in an organized set of tables of national-level aggregates by different types of entities (firms, governments and households). Currently,

NTA records only those aggregates in the "flow account", which covers the earning and consumption, transfer and saving of resources within a single year.

For most NTA-I characteristics, NA by that NTA-I characteristic will not be available, as it is not necessary to have this degree of detail in NA. Instead, the survey or administrative data are used to determine the overall shares of the aggregates by NTA-I characteristic. In adjusting single-group NTA age profiles to the macro control using one multiplicative factor, it is assumed that whatever error is being corrected with the macro control adjustment is not correlated with age. Similarly, when the survey or administrative data shares determine how the macro control is divided by the NTA-I characteristic, it is assumed that the error is also not correlated with the characteristic.

In some cases, the NSO may have produced NA by an NTA-I characteristic. This might be the case if the characteristic is a subnational geographic level, or if it is gender and the NSO produces a detailed study based on gender budgeting principles. If such data are available, they can be used to maintain consistency with NSO NA results.

It is very important to understand a country's system for producing NA to know which agency is in charge, what the publication schedule is and who can be contacted with questions or requests. Many countries publish NA using their own tables and also contribute to harmonized NA databases maintained by organizations like the United Nations or the OECD. The first NTA manual provides more detailed information on accessing these international databases.

For some purposes, national-level aggregates for public tax and benefit programmes may not be available in NA but may be available in government budget documents or expenditure reports.

Household survey microdata

The household survey is at the heart of NTA estimates, providing the detailed age-incidence indicators for many economic flows. Most countries have at least one nationally representative household survey that is conducted annually or at longer intervals and used to calculate important economic indicators like unemployment, inflation, household saving, labour force participation and other major macroeconomic indicators.

Surveys with the following qualities are useful for NTA:

- Richness: the survey includes variables of interest (all types of income, consumption, public programme participation, individual-level characteristics and a complete household roster by age including a designation of who is considered the household head). For NTA-I, the survey must have an indicator of the NTA-I characteristic of interest.
- Reliability: the variables are measured as accurately as possible.
- Validity: the data set is representative of the entire national population. If any particular subgroups such as institutionalized persons or rural residents are not represented, this should be noted. If the survey oversamples particular subpopulations, survey weights must be used to produce accurate, nationally representative statistics.

There can be many problems in using survey data, and it is not always possible to identify issues in the data set. However, some basic diagnostics can be used to evaluate the quality of the data:

- Check the age distribution against population count data from an external source:
    - Is there age heaping at ages that end with five or zero?
    - Are there fewer children than expected in the survey data set?
- Evaluate survey items for issues:

- Are there some items important to NTA estimates, such as labour earnings, that have a high degree of missing data because people refused to answer?
- Are there outliers that seem like miscodes?
- Are some financial flow items topcoded? If so, what does that mean for calculations of mean values? Some surveys provide a topcode value for income variables above a certain level, which can be used to produce more accurate means and distributions.

In some cases, data cleaning techniques can be used to increase accuracy. Eliminating outliers is one example. Another is using external specialized surveys that may provide more accurate data that can be merged onto the main survey (there is more information about this in the section on creating the micro-level database below).

Administrative data

Monetary flows that are not managed through households will typically not be included in household surveys. This is frequently the case for publicly provided goods and services. Publicly provided or subsidized healthcare and education are obvious cases of this. When the government is providing the service, households may not be able to give an accounting of how much they have consumed. Reports on age-specific expenditures and enrolments or survey data on enrolment in or access to a publicly provided resource can be combined with administrative data on total spending to estimate age-specific values.

Administrative data by the NTA-I characteristic is needed. If that is not available, researchers need to state clearly that this particular flow does not include data that differentiates by the NTA-I characteristic. Plan administrators may have unpublished data on spending by the NTA-I characteristic, even if a full matrix of spending by NTA characteristic and age is not available.

2.1.3 Creating NTA macro controls from NA data

In gathering NA data, the first step is to become familiar with the country's publication schedule. Typically, the organization that produces NA, usually the NSO, will have a regular schedule for publishing early estimates. Those estimates may then be updated for greater accuracy as more data become available. It is important to revise estimates periodically using the most accurate NA available at any given time.

Once the full set of NA estimates published in a country has been gathered, the next step is to estimate the high-level macro controls that represent the major components of the flow equation:

$$\underbrace{C(x)-Y^{l}(x)}_{\text{Lifecycle Deficit}}=\underbrace{\underbrace{\tau^{+}(x)-\tau^{-}(x)}_{\text{Net Transfers}}+\underbrace{Y^{A}(x)-S(x)}_{\text{Asset-based Reallocations}}}_{\text{Age Reallocations}}$$

where $C(x)$ is consumption, $Yl(x)$ is labour income, τ^{+} and τ are transfer inflows and outflows respectively, $Y^{A}(x)$ is asset income, and $S(x)$ is saving (or dissaving if the value is negative).

Some flow equations also have public and private components. The first NTA manual gives details on how the flow equation is a rearrangement of an accounting equation that separates inflows from outflows, or "sources" and "uses" in the SNA framework. Table 2.1 gives a brief summary of the calculation of the major aggregates required to construct the NTA flow equation, using components from NA as they are named in the SNA framework. The NTA abbreviations are also provided.

Table 2.1
Calculating flow equation components from NA aggregates using the SNA framework

NTA Macro Control	Calculation from SNA components
Consumption, Private (CF)	Final Consumption Expenditures of Private Sectors [1] LESS any private consumption expenditures that should be reclassified as public if they are similar to "voucher" programmes paid for by the government but provided by private entities LESS Indirect Taxes Less Subsidies on Products [2]
Consumption, Public (CG)	Final Consumption Expenditures of the Public Sector [1] PLUS any private consumption expenditures that should be reclassified as public if they are similar to "voucher" programmes paid for by the government but provided by private entities
Labour Income, Earnings (YLE)	Compensation of Employees (domestic plus net from the Rest-of-World) PLUS Labour's share of Indirect Taxes Less Subsidies on Production [2]
Labour Income, Self-Employment (YLS)	Two thirds of Gross Mixed Income [3]
Transfers (T)	Disposable Income LESS National Income (DI and NI can be expressed as either gross or net of consumption of fixed capital [4]; the difference will be the same)
Asset Income, Private (YAF)	Gross Operating Surplus of Private Sectors PLUS one third of Gross Mixed Income PLUS Capital's share of Indirect Taxes Less Subsidies on Production [2] PLUS Net Property Income from Rest-of-World to Private Sectors [5] LESS Consumption of Fixed Capital by Private Sectors [1,4]
Asset Income, Public (YAG)	Gross Operating Surplus of Public Sector [6] LESS Consumption of Fixed Capital by Public Sector [1,4] PLUS Net Property Income from Rest-of-World to Public Sector [5]
Saving, Private (S)	Gross Saving of Private Sectors LESS Consumption of Fixed Capital of Private Sector [1,4]
Saving, Public (S)	Gross Saving of Public Sector LESS Consumption of Fixed Capital of Public Sector [1,4]

Note: The numbers in square brackets in table 2.1 refer to the explanations provided in the corresponding numbered paragraphs below.

[1] The SNA system tracks flows by different sectors that represent different institutional arrangements in the economy. The SNA sectors include: Corporations (sometimes broken out by financial and non-financial), General Government (sometimes broken out by various levels of organization in federal systems), Households, Non-Profit Institutions Serving Households (NPISH) and Rest-of-World (RoW). In the NTA system, flows are tracked only at the individual level, but separate accounts are mediated through the private and public sectors. In practice, this means grouping SNA flows for Corporations, Households and NPISH into the private sector, while General Government represents the public sector.

[2] The SNA system distinguishes taxes in terms of whether they are directly assessed on income or wealth versus indirectly on production or products. NTA reclassifies some of these taxes compared to where they are in SNA accounting to reflect the NTA preference to report flows at "basic" prices rather than "market" prices. For consumption, this means taking out indirect taxes like VAT and sales taxes that consumers pay for but are not part of the value of what they are consuming. Instead, NTA reclassifies these as a tax consumers pay and includes its value in public transfers. For labour income, NTA adds back production taxes that employers pay to reflect them as part of what workers earn, but also accounts for them as taxes that the workers pay even though the actual transaction is implemented by employers. In the case of subsidies, this is like a negative indirect tax on consumption.

[3] In the SNA system, Gross Mixed Income (GMI) is understood to be the income accruing to businesses that are wholly owned by households and do not keep a separate set of financial accounts to distinguish between the inputs and earnings of the household members versus the business. This is in contrast to Gross Operating Surplus (GOS), which is intended conceptually to be the income accruing to incorporated businesses in which accounting separates the income that is paid out in the form of Compensation of Employees rather than the income that is owed to the owners of the business. In some countries, GMI is not reported separately from GOS, and there is one total GOS reported that includes GMI. To separate out GMI, researchers can request a special tabulation from national accountants. If that is not available, researchers can use United Nations or OECD databases to tabulate the share of GMI in GOS+GMI from peer countries in terms of region, economic development, and other structural features.

[4] In the SNA system, Consumption of Fixed Capital (CFC) reflects depreciation of physical capital assets over the period. Gross amounts in SNA are those that include CFC, while net amounts have CFC taken out. Therefore, the difference between two net flows should be the same as the difference between two gross flows. Either approach may be used, depending on how a country's NA are reported.

[5] Net Property Income is income generated by the ownership of financial assets (such as dividends and interest) or non-produced non-financial assets (such as land). This definition does not include rental income from buildings on the land.

[6] For most countries, Gross Operating Surplus of General Government is very close to the CFC of the General Government Sector, resulting in a Net Operating Surplus that is zero or quite small. This reflects the fact that government is generally understood to be providing services free of charge (apart from taxes used to pay for those goods or services). As a result, standard accounting practice equates any operating surplus generated by government activities to the level of CFC for the sector. While many countries hold significant ownership stakes in corporations (such as resource extraction companies or airlines) that generate profits, the SNA system classifies these entities with the corporate sector and records their flows in the private sector, within returns passed to taxpayers through taxes and property income payments.

Once the major components of the flow equation have been calculated, available detailed data can be used to subdivide the major aggregates into lower-level macro controls. As long as the major aggregates are kept consistent, the flow equations will continue to balance. The first NTA manual discusses how to further refine macro controls down to the lowest level of specificity for which data are available to identify a separate age profile. More detailed SNA tables may sometimes be available, such as detailed breakdowns of Final Consumption Expenditures, which will allow researchers to isolate health or education spending from other consumption. There may also be government budget documents to specify detailed taxation and benefit programmes within a country. As mentioned above, it is not necessary to separate macro controls by the NTA-I characteristic.

2.1.4 Age profiles

To review, an NTA age profile is a schedule of age-specific average flow amounts, based on a directly observed or proxy indicator or model of the age incidence of that flow derived from a household survey or government report, smoothed over age and adjusted to be consistent with aggregate amounts as measured in NA. The following sections will detail the steps in estimating single-group NTA age profiles, noting where additional steps need to be taken to be able to produce NTA-I estimates by characteristic after the single-group estimates have been completed.

Creating the micro-level database

To estimate a complete set of NTA age profiles, the first step is to create a micro-level database that contains all necessary information merged into a single data set. To begin, the analyst identifies the main survey source which

should be the nationally representative survey as described in the previous section. This survey should include the following:

- A complete household roster with ages specified for all members and an indicator of household headship.
- As much of the necessary information on economic flows as possible (including income sources, consumption, taxes paid, public benefits received and private transfers given and received by the household).
- A variable for the NTA-I characteristic for all individuals in the survey.

Once this main survey source has been identified, any flow indicators that are not included in the survey are merged into the main survey from external sources. There may be several reasons why a particular flow is not included in the main survey. Flows that come from government programmes are often excluded because households do not pay for these benefits out of a household budget, and therefore household members typically do not know their full value. The consumption of publicly provided healthcare is a good example here. Households generally do not observe the full cost of their healthcare consumption because they do not pay it out of pocket. Instead, administrative data from government sources are used on public healthcare programmes that report expenditures on beneficiaries by age and by the NTA-I characteristic of interest.

Another reason for merging data into the main survey arises when a separate data source provides more detailed or higher-quality information for a particular flow. This may be the case for some types of income or expenditure for which a specialized survey measures that flow more accurately than an item included in the main survey. Finally, some countries' survey systems do not cover income and expenditures within the same survey. In such cases, merging multiple surveys is necessary for calculating some components of the NTA system, particularly intrahousehold transfers, which are estimated using a model based on other NTA flows rather than measured directly. Merging data in this way should take advantage of as many details as are available in both the main survey and the external source. Age must be included on both sides of the merge, and to calculate NTA-I by another characteristic, both sides must also have that characteristic.

The objective is to merge estimates from the external source into the main survey at the highest feasible level of specificity. The least specific approach is to rely on mean values by age and NTA-I characteristic and merge only those two dimensions. This approach is adequate for most age profiles but can lead to underestimation in some components of the interhousehold transfer algorithm and is therefore appropriate only for calculating NTA-I age profiles, not for producing the full distribution of any flow by age. A more specific approach could be a fully hot deck-like matching procedure by age, NTA-I characteristic and as many other characteristics as can be found in both the main survey and the external source. Depending on data availability, some profiles may allow a basic merge using only age and the NTA-I characteristics, while others may support a more detailed, higher-quality match. All such methodological choices should be documented in any reports presenting the results.

Specifics on indicators of age incidence

An indicator of age incidence is used in NTA to disaggregate an aggregate value as measured by the macro control and disaggregate it by age. The indicator may be a financial flow that has a direct relationship to the flow measured by the macro control, a proxy for the flow when it cannot be measured directly, or an unobserved flow that is imputed based on a modelled relationship among other NTA variables. The following examples illustrate the distinctions between direct, proxy and modelled measures:

- Direct measures: Earnings from a paid job are usually directly measured in surveys, and each individual who answers the survey item reports a financial flow that is a highly correlated indicator of labour earnings as defined in the corresponding macro control. Out-of-pocket healthcare consumption is another example of a flow that is often directly measured in consumption or expenditure surveys. The household is able to account for that consumption accurately and in the same financial metric as the macro control. The macro

control adjustment adjusts for survey noise and perhaps an additional adjustment needed for time periods, if the survey item does not ask about a whole year's worth of expenditures.

- Proxy measures: Sales, consumption, or VAT-type taxes are not often available in survey data because most households do not keep detailed records on how much tax they pay for each purchase. Instead, the overall level of private consumption is used as a proxy, with the resulting age profile adjusted to the macro control so that it aggregates to the total level of sales, consumption or VAT taxes in the national accounts. This approach assumes that sales tax is a constant proportion of all consumption. An alternative is to use a private measure of consumption that reflects the features of a country's tax system. Another common proxy measure for age incidence is public programme participation. When detailed information on individual benefits from programmes such as public education or a public healthcare service is unavailable, enrolment rates can be used as a proxy. This assumes that all individuals consumed the service equally, which may be a reasonable assumption for public education, but not necessarily public health. Later sections discuss alternatives if data allow.
- Modelled measures: Intrahousehold transfers cannot be measured directly or through proxy. Estimates are constructed using estimates of the consumption of individuals and their resources as described in the first NTA manual. Public asset income and saving are also estimated based on age profiles of taxes that are not earmarked for specific programmes. Finally, private saving is estimated as the balancing item. Private saving is by definition equal to labour and asset income, less consumption and net transfers.

NTA procedures for assigning age incidence differ also depending on whether the flow can be measured at the individual level or the household level. When the flow is measured in survey or administrative data for individuals, the age incidence is straightforward. In this case, the means by age group are taken as given. In cases in which the measurement is available only at the household level, as is almost always the case for consumption in terms of total household purchases, it would be very difficult for any survey respondent to accurately break down those purchases among the individual household members. Household consumption is allocated using sharing rules, or the use of equivalent adult consumer (EAC) weights to apportion the household-level amount to household members. Details on EAC weights can be found in the first NTA manual, section 5.3.2 under the heading "Private consumption other than education and health", but put briefly, the EAC weights are 0.4 for children aged 0 to 4 and 1.0 for adults aged 20+, with the weight rising linearly from 0.4 at age 4 to 1.0 at age 20. In effect, this assumes that children consume less than adults and approach the adult level of consumption by age 20. With a full household roster, an EAC weight value can be assigned to each member based on their age, and these can be used as shares to allocate the household-level amount to each household member.

This assumption applies to general goods shared within the household such as food, utilities and housing, but the resulting EAC weights are not applicable to education and healthcare, as younger persons are the main consumers of education and older persons generally consume much more healthcare than children. Instead, regression methods are used for these NTA age profiles. The regression estimated is the relationship between the household amount of these services consumed and the household structure by age. The regression coefficients on the age groups are then used as weights to allocate the household amount, just like EAC weights but with a data-driven process generating the weights. The regression equations are all specified in section 5.3.2 of the first NTA manual. The regression equations for NTA-I include the NTA-I characteristics as regressors.

Adjusting NTA age profiles and the micro-level database to macro controls

Once all age-incidence estimates are in place, the macro control adjustment can be made. The individual NTA age data are aggregated into means, employing survey weights to calculate aggregates. The ratio of the macro control to the unadjusted aggregate is a scaling factor that, when multiplied by the unadjusted profiles, yields adjusted age profiles, with adjustment applied separately for each low-level NTA age profile. Low-level adjusted NTA age profiles

are then summed up to equal the higher-level age profiles. The equations are given in section 3.3.1 of the first NTA manual and are repeated here for reference:

a:	age a, single years ranging from 0 to ω
$N(a)$:	population count, age a
X:	macro control (i.e. national total, all ages combined)
$x(a)$:	per capita age pattern, age a
$\tilde{x}$:	per capita NTA age profile, age a
$\tilde{X}$:	aggregate NTA age profile, age a

Scale Factor Calculation: $\theta = X \,/\, \sum_{a=0}^{\omega} x(a)N(a)$

Apply Scale Factor:

$$\tilde{x}(a) = \theta x(a)$$

$$\tilde{X}(a) = \tilde{x}(a)N(a)$$

Smoothing

The final step in producing the NTA age profile is to smooth over age in order to reduce noise generated by sampling. NTA methodology uses a cross-validation weighted smoother with weights used to reflect the number of observations in each age mean. The survey weights will have already been used to calculate the age means, so they do not need to be used again here. Instead, the weighted smoother makes it possible to give more weight to age groups with more observations and thus lower variance in the estimate. Two examples of implementing the smoother in statistical software are "supsmu" in R and "supsmooth" in Stata. Only the lowest-level components of the data are smoothed, and smoothed data are then aggregated to obtain higher-level profiles.

Caution must be exercised with smoothing to avoid accidentally eliminating "real" features of the age pattern, such as legitimate peaks, valleys, elbows and zeros. Additionally, any false negative values encountered in the data should be replaced with zeros. The first NTA manual's section 3.3.1 and Appendix B have more information on this process.

Smoothing introduces small differences with the overall aggregate level of each NTA flow compared to its macro control. As part of the process of reviewing the quality of the age profiles, the aggregated smoothed profiles should be compared to the macro control. A 1–2 per cent difference from the macro control should be a matter of concern that may require further adjustment.

2.2 NTA-I methodology

2.2.1 Overview

The previous section describes the steps involved in creating a set of smoothed single-group NTA age profiles and a micro-level database, both of which have been adjusted to be consistent with macro controls. This section presents methods for creating NTA-I, a set of NTA age profiles by characteristic, consistent with the single-group NTA age profiles and aggregate data. First, means by age and by the NTA-I characteristics are calculated from the micro-level database for the lowest-level NTA flows, creating a set of unsmoothed NTA-I age profiles for each flow. This set is consistent with macro controls because it is calculated from microdata that have been adjusted to be consistent with those controls. Second, the NTA-I age profiles by characteristic are smoothed, consistent with the smoothing that was done for each NTA flow. Third, a set of age-specific adjustment factors are calculated and applied to each set

of NTA-I age means to achieve consistency with the smoothed single-group NTA age profile for each low-level flow. Finally, low-level flows are added up by characteristic to create any higher-level flows.

The following sections detail methodological aspects of creating NTA-I characteristics, review in more detail the process for completing the steps just outlined, discuss special cases when different procedures are needed, and finally identify some good practices for reviewing estimates.

2.2.2 The basics: creating NTA-I

Groups

This section addresses some of the methodological issues involved in creating the subgroup indicators used for any set of NTA-I age profiles and proposes categories for any given indicator to promote comparability across the NTA network. With so many possible cross-cutting characteristics, this is not always possible or even the main goal of the research. Individual analysts will have their own research needs to consider when creating and analysing any set of NTA-I age profiles. However, a great strength of the NTA approach has always been harmonization across research groups and the opportunity for cross-country comparison. To this end, for each type of characteristic described here, a minimum comparative set of characteristics is given. For any given research need, more detailed characteristics or a different characteristic may be necessary, but researchers can ensure future comparability with estimates from other countries by following the minimum comparative characteristics.

Sex and gender

Conceptually, the difference between sex and gender is reasonably well defined. Sex refers to biological differences between men and women that do not change over time or across place, although the biological realities can be more complicated than just two distinct categories. By contrast, gender is a socially expressed category in which attributes, norms and social interactions are mapped onto being male or female.

In the practice of social statistics, such a clean distinction is not possible. NTA researchers are users of data produced by survey statisticians, governments and the individuals who answer surveys, and as such are subject to the interpretation of categories in the data sources by those who produced them. Because the estimates reflect socioeconomic realities, it is appropriate to refer to this category as gender while acknowledging that surveys often ask about sex and that the data often do not have any detailed information on gender expression. Even for those data sources that may have more detailed information on gender, there will likely be such a small sample of categories other than male and female that a full NTA age profile for additional categories is not possible. This may change in future data collection efforts.

For comparative purposes, NTA here refer to this category as "gender" and include only the two categories of male and female.

A final important note when considering NTA-I by gender is the possibility of also including the value of unpaid care work as estimated in National Time Transfer Accounts (NTTA). NTTA is a methodology to estimate the age profile of production, consumption and transfers of unpaid care work using time use surveys and valuing that time by an imputed wage. The estimation of NTTA is encouraged in any country where there is available time use data, but it is especially important to consider adding this piece when producing NTA-I by gender due to the gendered nature of economic accounting. National accounts, on which NTA are based, include the value of market labour only, while NTTA includes work for pay but also unpaid work when it produces goods for household use. In the case of unpaid service work for household use, such as care and domestic work, the value of those services is not included in NA and therefore also not included in NTA. This unpaid care and domestic service work is the kind of labour that women traditionally specialize in, and indeed, when examining time use data, men are seen to be doing more market labour than women and women more unpaid care and domestic service work than men at almost all ages

in almost all countries. What this means for NTA-I by gender is that much of women's contributions to the economy, to households, to social reproduction and to intergenerational support will not be counted if NTTA by gender is not included with NTA-I by gender. If there is no time use data available in a country to allow for the estimation of NTTA, researchers can include NTTA estimates from regional neighbours to make this important point. At a minimum, any reports should highlight the gendered measurement aspect of leaving unpaid care and domestic service work out of NA and NTA and point out that there are tools to address this error.

Education

One of the original motivations for developing the NTA-I methodology was to understand how NTA age profiles differ by socioeconomic status, and thus understand if the generational economy is functioning differently for persons with access to more or fewer resources. Education is one of social science's most durable indicators of socioeconomic status, as it reflects the level of investment that the state, families and the individual have made in a person's productivity. The productivity enhancement provided by education is reflected in earnings over time and across age, thus making the link between educational attainment and access to resources. NTA-I age profiles by education are discussed extensively in chapter 3 below, while some general empirical issues are raised here.

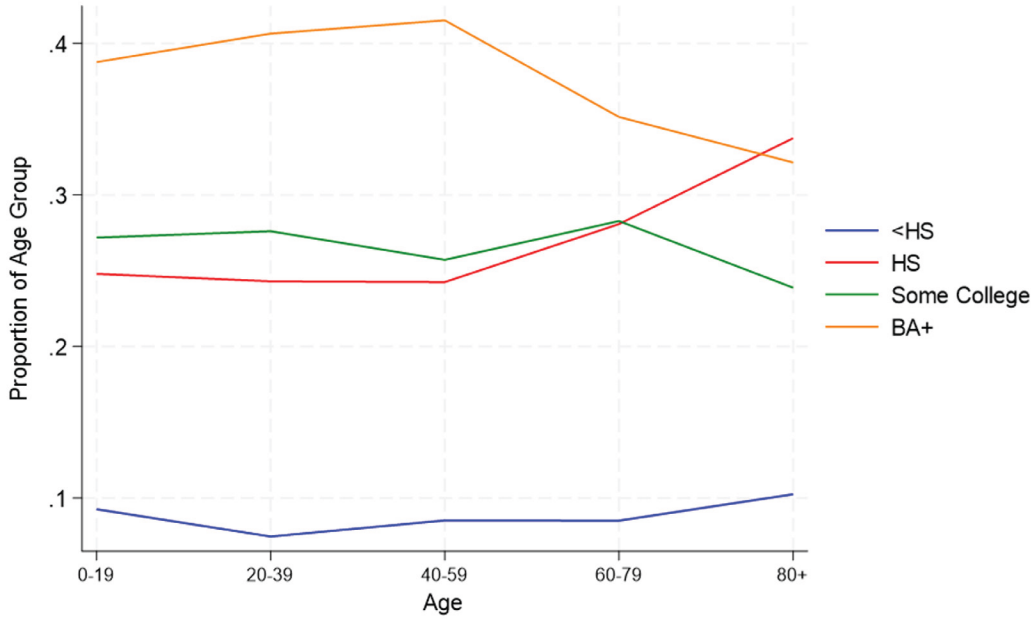
A common practice is to use the highest level of schooling completed as a measure of educational attainment. Unfortunately, this ignores the fact that the quality of education can vary a great deal from place to place and over time, but within a given place and time it does still indicate relative human capital investment. There are additional considerations, however, because children who have not yet completed their education will not have educational attainment that is relevant for understanding their access to resources. This is also an issue for adults in the household in that some persons may have very low educational attainment but be sharing a household with highly educated persons, and thus their personal educational attainment is not a good indicator of access to resources. For this reason, it is also common to use the education of the household head instead of the education of the individuals. In this way, the whole household has the same educational attainment indicator, reflecting the role of the household in sharing resources. Chapter 3 discusses cases in which this may not be an appropriate method and suggests other methods.

Designating categories of education can be a complex problem. Some research projects may have a clear set of categories designated by available survey data or by a policy-relevant measure in which the categories are already set. If this is not the case, however, in the interest of comparative research across the NTA network, it is recommended to use a group of categories that is likely to be available in survey data with a number of categories that is sufficient to capture variation in educational distributions but not so numerous as to impede cross-country comparison and result in sample sizes that are too small for some categories.

For comparative purposes, NTA-I by education can be classified into three categories for schooling: 0–5 years; 6–12 years; and 13 or more years. These categories can be roughly translated in terms of school level to: has not completed primary education; has completed primary or secondary education; and has completed post-secondary education. Many research purposes require more detail than just three categories, but if researchers subdivide those three groups to get more detail, they can still combine categories consistent with the three groups for comparison.

Finally, although this manual has thus far centred around only absolute levels of education, there may be research questions for which relative measures are more appropriate. For example, sorting household heads by education and evaluating educational level in terms of percentiles of the total distribution of education of household heads may give a more even distribution of persons across categories than absolute measures. In contexts where educational expansion has been very rapid over time, these distributions may also need to separate out certain cohorts and take distributions within those cohorts.

Figure 2.2
Distribution of education of household head, by age group



Source: Current Population Survey, Annual Social and Economic Supplement, 2023

Figure 2.2 shows data from the United States of America where the distribution by age is relatively stable from ages 0 to 59. Those in age groups older than 60, however, are more likely to be living in households where the highest education level is high school or less. This reflects both the current increasing educational attainment among younger generations and the strong prevalence of nuclear households. Parents and minor children share households, while older persons are much more likely to be living as married couples only or alone.

Income

Separating households by income is a direct way to assess socioeconomic status and access to resources, and is important for both research and policy since many social protection programmes are targeted at households by some measure of household income. Income is best assessed at the household level because the household is the major locus of sharing and intergenerational support in the private sector. Focusing on individual earnings instead may make sense for some research questions, but when assessing intergenerational support and resource access, household measures are most relevant.

Chapter 4 below discusses alternative definitions of household income, showing how resource availability changes when considering labour income, labour income after public transfers and disposable income, with a detailed discussion of what the different definitions mean and how their results differ. Comparative analyses should focus on measures that indicate the resources available to each individual in the household. For this purpose, per capita labour and asset income is appropriate. Ranking this level for all individuals and taking percentiles is preferred because it allows researchers to set aside methodological issues of currency differences and purchasing power. Quintiles are commonly used to strike a reasonable balance between having either too many categories, which provides too much detail and may be poorly estimated or hard to interpret, and too few categories, which may be well estimated without providing much insight.

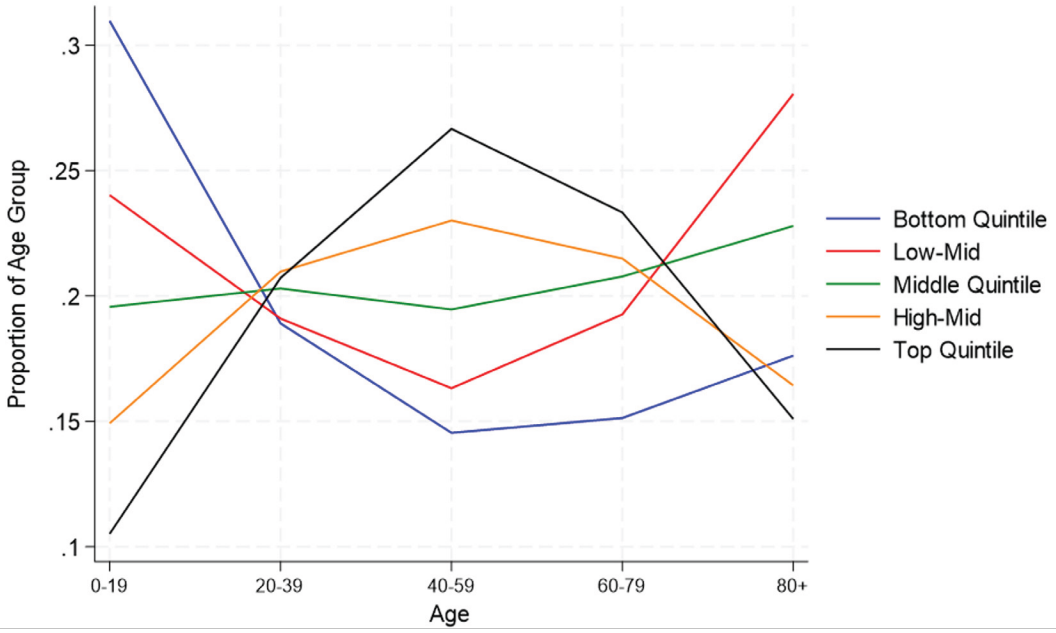
For comparative purposes, the recommended measure is per capita primary income (labour plus asset income) classified by quintiles.

Subnational geography

Subnational categories may include states or provinces, aggregations of these units, urban and rural areas, and similar classifications. In some countries, a strong federal system may exist where subnational levels of geography are as important as, or even more important than, the national level for policymaking, monitoring and analysis. In this case, making subnational NTA-I a part of NTA research is essential for making NTA estimates available to policymakers.

Definition of these geographies is usually not a problem because it is important for the functioning of the nation to have information at this level. Where researchers will be challenged, however, is that sample sizes may be insufficient. One way researchers can address this is to use broader age profiles. Another is to group geographic units. This is suboptimal in that it eliminates important regional diversity, but it can also be an encouragement to national statistics offices to increase survey sample sizes overall or institute oversampling in smaller areas.

Figure 2.3
Distribution of household per capita income quintiles, by age group



Source: Current Population Survey, Annual Social and Economic Supplement, 2023

Figure 2.3 shows that children live in households with lower per-person income than all other age groups. This reflects the fact that children share households with more people than any other age group, so per-person income is lower. The age group of their parents also includes those with no children, so their income quintile groups are more mixed. The oldest age groups, while making up a relatively low proportion of the bottom quintile, are relatively more numerous in the middle and lower-middle quintiles than younger adults.

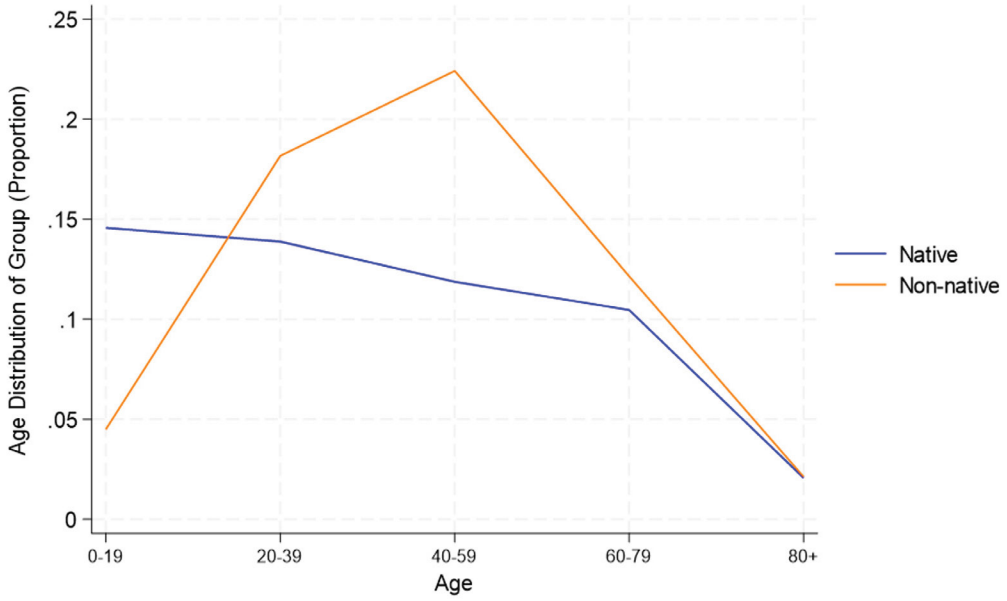
Household structure

Because so much of NTA research is about understanding patterns of family support across age groups, it often makes sense to separate out estimates by household type because so much sharing and support takes place within the household. Chapter 5 below shows how households are an important characteristic in determining patterns of public and private transfers.

There are many ways to classify households, but NTA emphasizes typologies that focus research on sharing within households and on those who live alone and are thus outside of household support systems. Creating typologies that are detailed enough to capture important trends, but not so detailed that sample sizes are insufficient and unreliable, is challenging. Chapter 5 describes a typology with 12 different household types and addresses the small sample size problem by grouping ages. This is appropriate for the purposes of that chapter, but for NTA comparative purposes, a different balance is recommended. Again, specific research purposes may necessitate more or different categories, but if there is a way to make them consistent with the comparative suggestion below, cross-country comparative research will be enhanced.

For comparative purposes, NTA-I by household type will include the following categories: living alone, couple only (married or cohabiting), single parent with children, partnered couple with children, other family, and other nonfamily.

Figure 2.4
Age distribution of native-born vs non-native-born persons



Source: Current Population Survey, Annual Social and Economic Supplement, 2023

Nativity

Migration is an important policy topic in many countries. Countries that receive many migrants may want to understand how those immigrants are impacting labour markets, public transfer systems and many other aspects of their economies. Because migrant flows are often very different by age compared to the total populations of sending or receiving countries, the age dimension of the NTA framework reflects that demographic reality and provides more accurate inputs to modelling exercises.

As with many characteristics, defining immigration status in a way that is maximally accurate and comparable across countries can be difficult. It needs to be determined whether the data support the ability to distinguish temporary migrants from permanent ones, or recent migrants from those who arrived in the country of migration decades earlier. This may be possible in some countries, but comparability with those with less rich data sources will be impossible. The easiest category to identify in many data sources is native-born persons compared to nonnative-born persons.

For comparative purposes, NTA encourages two categories for this characteristic: native-born persons and those who were not native-born.

Figure 2.4 illustrates a different way to look at group distributions, focusing on the age distributions of two different groups in the population: native-born persons and those who were not native-born. Non-native-born persons are much more concentrated in the working ages than native-born persons. This reflects migration dynamics where the primary objective for many migrants is work opportunities.

Others

NTA research teams may have many other characteristics of interest. Groups have made estimates based on race or ethnic groups, immigrant generation, urban vs. rural residents, and migrants sorted by countries of origin. All of these are possible, so long as they are accurately measured in survey and administrative data and there are relevant theoretical or policy questions to be explored.

Table 2.2
Example of microdata structure

Year	*weight*	*hhid*	*pernum*	*age*	*sex*	*household income quintile*	*education attainment of hh head*	*consumption*	*labour earnings*	*self-employment income*
2023	1623	1	1	66	2	2	2	63,861	-	-
2023	1582	1	2	68	2	2	2	67,424	-	-
2023	1616	2	1	52	2	3	2	94,711	-	-
2023	1840	2	2	51	1	3	2	73,312	49,527	-
2023	1355	3	1	78	2	2	2	89,694	-	-
2023	1363	4	1	65	1	5	3	242,327	72,748	-
2023	1309	4	2	68	2	5	3	101,969	61,319	-
2023	1361	5	1	74	2	2	1	50,248	-	-
2023	1244	5	2	74	1	2	1	45,522	3,104	63,602

If a characteristic is not available in every part of the construction of the micro-level database, results can still be estimated, but researchers must be very clear in documenting which parts of the NTA flow accounts are not able to detect differences by an NTA-I characteristic. For groupings which are highly politically sensitive in a given context, complete observation of the characteristic is recommended to avoid misleading results. In the absence of complete observation in these cases, estimations cannot be completed.

Table 2.2 presents an illustrative example of the microdata structure used in NTA-I. Each row represents an individual and includes basic household and person identifiers (year, household ID and person number), along with demographic characteristics such as age and sex. The table also reports selected NTA-I indicators derived from the microdata, including household income quintile and the educational attainment of the household head. These indicators are followed by key NTA variables at the individual level, such as consumption, labour earnings and self-employment income.

From microdata to NTA-I: creating subgroup NTA-I age profiles and adjustment for consistency with NTA

Section 2.1 above describes methods used to create the micro-level database that supports building NTA-I estimates. To review, the main adjustments needed to create the micro-level database for estimating NTA alone versus NTA and NTA-I are as follows:

- Confirm that all survey and administrative data include the desired set of NTA-I characteristics.
- Combine data into a single micro-level database, including NTA-I characteristics to the extent possible.
- In the process of creating the lowest-level NTA flow variables, making sure to include the NTA-I characteristics for any variables that use the regression method to estimate individual-level distributions of household-level amounts from surveys.

Assuming these steps were followed in the creation of the micro-level database, and that single-group NTA age profiles have also been estimated, only a few additional steps are required to create NTA-I estimates. Note that single-group age profiles are constructed first and used as the reference for the NTA-I estimates. Thus, NTA-I estimates are adjusted to be consistent with the single-group NTA estimates.

The profiles are treated in this way because the single-group NTA estimates have larger sample sizes than any NTA-I and, thus, are estimated with lower variance. The NTA-I estimates are more accurate if estimated with reference to NTA age profiles than if each category age profile is estimated by itself. For some research purposes, the consistency between NTA and NTA-I will not be of great importance, and this step can be left out, as in some of the applied work in later chapters. For overall consistency across the NTA network, however, this step to harmonize NTA with NTA-I is encouraged.

To begin the NTA-I estimation, age-specific means are first calculated for each NTA flow by age and by the NTA-I characteristic. This means that instead of just estimates for each of 91 age groups (in the case of single year estimates for ages 0 to 90+), creating NTA-I for 5 education categories requires calculating specific means for 91 age groups across 5 education groups, yielding a total of 455 means. As with single-group NTA, any required survey weights should be applied to ensure that the resulting statistics are representative of the underlying sampling frame.

Second, each NTA-I category age profile is smoothed over age. The same smoother used for single-group NTA is applied, with adjustments as necessary to ensure consistency with the smoothed NTA age profile. In the example of the five education groups, this involves smoothing five separate age profiles over age for each NTA flow.

Third, a set of age-specific adjustment factors is calculated for each NTA flow to ensure that the NTA-I estimates are consistent with the single-group NTA smoothed profile. Recall that in the process of creating the micro-level database, a single adjustment factor was applied to each age group for the NTA age profile. The NTA-I adjustment is

different, with a series of adjustment factors calculated for each age group for each flow. The intuition underlying these age-specific adjustment factors is to first calculate the overall single-group average value at each age implied by the unadjusted NTA-I estimates, and then rescale the age-specific NTA-I values so that their average equals the corresponding value from the NTA profile value.

In mathematical notation, let a index age, and c index one of the NTA-I subgroups where cmax is the total number of categories of the NTA-I characteristic. Let $\tilde{x}(a)$ be the smoothed, single-group NTA age profile for any low-level flow, adjusted to agree with the macro control as noted previously (the notation is the same as that given above for single-group macro control adjustment in section 2.1.4). Let $x(a,c)$ represent the set of smoothed age means for group c of the NTA-I subgroups, not adjusted except to the extent that it was created from macro-adjusted microdata.

$N(a)$ is the population count at age a. For some types of subgroups, an external source of data for $N(a)$, the population counts by age and subgroup will be available, which will be indicated by $N(a,c)$. This will often be the case when gender or subnational geography is the NTA-I characteristic, and less commonly for immigration status or any race or ethnic division. It will be very rare for socioeconomic status indicators. In cases in which an external $N(a,c)$ is not available, the analyst should instead use $W(a,c)$, which is the total survey weight for age group a in category c, and $W(a)$, which is the total survey weight for age a.

In cases in which an external population count $N(a,c)$ is available:

$$\theta(a) = \frac{\tilde{x}(a)}{\left(\sum_{c=1}^{cmax} N(a,c)x(a,x)\right) \Big/ N(a)} \quad : \quad \text{adjustment factor, age } a$$

$$\tilde{x}(a,c) = \theta(a)x(a,c) \quad : \quad \text{per capita NTA-I age profile, age } a\text{, group } c$$

In cases where an external population count by age and group is not available, $W(a,c)$ and $W(a)$ are substituted in the equation for the adjustment series in place of $N(a,c)$ and $N(a)$.

The series of adjustment factors does not need to be saved as was done for the macro-control adjustment factors, but they can be useful to review to test the assumption that the errors adjusted for in the macro control adjustment do not have strong patterns by age.

2.2.3 Evaluation

The first NTA manual details many recommended ways to evaluate estimates for both internal and external validity. Assessing internal validity involves checking that the methods have been followed properly, meaning making sure the calculations have been done correctly. Assessing external validity means ensuring that the age profiles make sense and compare reasonably well with any other research that is roughly assessing the same patterns.

Researchers should apply the principles of internal and external validity to NTA-I as well. This involves following all of the NTA checks, but adding a few specific ones relevant to NTA-I:

- Relative positions of NTA-I age profiles appear to be as expected. For example, higher education groups are earning higher levels of labour income, as expected. If not, researchers should check the calculations. This can also apply to subnational geographies. If some areas are known as higher income areas, NTA-I estimates would likely be expected to show the same pattern.

- Patterns in NTA-I estimates are consistent with categories in absolute terms. For example, when estimating NTA-I by household type, if one of the categories is persons living alone, those households should have zero intrahousehold transfers according to the nature of the category.
- In cases where no population data by category is available, survey data weights should give reasonable population distributions by age and category.

Researchers may come up with other ways to double-check estimates for consistency, accuracy and reasonableness before moving on to analysis of results, as described below.

2.2.4 Implementation, vetting and practical lessons

The NTA-I methods described in this chapter were implemented and vetted using recent microdata for the United States of America. This implementation served two purposes. First, it provided a systematic check on the internal consistency of the procedures outlined above, ensuring that NTA-I estimates could be produced in a way that remained fully consistent with aggregate NA and with single-group NTA age profiles. Second, it revealed a number of practical issues that arise when applying the framework to real-world data – issues that are not always apparent from methodological descriptions alone. This subsection summarizes several general lessons that emerged from this process and are likely to be relevant in other country contexts.

A first lesson concerns **data sufficiency versus ideal data availability**. In practice, few countries possess household surveys, administrative records and population data that align perfectly with NTA-I requirements. The example from the United States of America confirmed that NTA-I can be constructed using imperfect but carefully evaluated data sources, provided that researchers are explicit about data limitations and apply consistent adjustment procedures. In particular, when population counts by age and subgroup are unavailable, survey weights can serve as a reasonable substitute, but they require careful scrutiny to ensure that implied population distributions are plausible.

Second, the vetting process highlighted the importance of **diagnostic checks throughout the estimation workflow**. Simple diagnostics, such as comparing age distributions in survey data with external population estimates, examining the prevalence of zero or top-coded values, and reviewing the age patterns of key flows before and after macro adjustment, proved essential for identifying coding errors, data anomalies or unintended consequences of smoothing. These checks are especially important for NTA-I because subgroup estimates are based on smaller samples and are therefore more sensitive to noise.

Third, some components of the NTA framework are inherently **more sensitive to methodological choices** than others. In the United States of America implementation, labour income profiles by subgroup were generally robust, reflecting strong signal-to-noise ratios in survey earnings data. By contrast, asset-based reallocations and private saving were more sensitive, owing to their reliance on residual calculations, household headship assumptions and the allocation of asset income within households. These sensitivities do not invalidate the estimates, but they underscore the importance of careful documentation and cautious interpretation, particularly when comparing subgroups.

Fourth, the implementation experience reinforced the need for **consistency between single-group NTA and NTA-I estimates**. Treating single-group NTA age profiles as the reference point for NTA-I adjustment improved the stability of subgroup estimates and reduced the influence of sampling variation at older ages and in smaller groups. While some applied analyses may relax this constraint for specific research purposes, the vetting exercise confirmed that harmonizing NTA-I profiles with single-group NTA profiles is a useful default for comparative work.

Finally, the United States of America implementation made clear that **presentation and interpretation choices are an integral part of the methodological process**. NTA-I produces rich micro-level information that can easily overwhelm readers if results are presented only as tables of age-specific means. The vetting process therefore extended beyond estimation to the exploration of alternative ways to summarize and visualize results, such as distributional tables, histograms, box-and-whisker plots and funding-share triangle graphs. These tools proved valuable not only for communication, but also for internal validation, helping to identify unexpected patterns that warranted further investigation.

Taken together, these lessons suggest that NTA-I is best understood as an integrated workflow rather than a set of isolated procedures. Successful implementation depends not only on following the formal steps described earlier in this chapter, but also on iterative checking, informed judgment and thoughtful presentation of results. The next section illustrates several approaches to summarizing and visualizing NTA-I estimates that emerged as particularly useful and that may be adapted to other country settings.

2.3 Analysing NTA-I data

Estimating NTA-I produces a micro-level data set with multiple dimensions – age, characteristics and economic flows – that cannot be adequately summarized by conventional age profiles alone. As a result, methodological choices do not end with estimation; they extend to how results are summarized, visualized and interpreted. This section illustrates a set of tools for presenting NTA-I results that are consistent with the underlying accounting framework while making distributional patterns and group differences transparent. The examples draw on recent data from the United States of America and are intended to be illustrative rather than exhaustive, highlighting approaches that researchers may adapt for comparative analysis and policy communication.

This section illustrates methods that can be used to summarize NTA-I data. The NTA-I database, as explained above, is individual level data comprised of NTA economic variables: consumption, labour income, transfers, asset-based reallocations and their components. Individuals are identified by their age, sex and other indicators such as educational attainment, household type and place of residence.

NTA-I data can be analysed using econometric tools. However, the tools discussed here emphasize tables and charts that summarize NTA-I variables, the distribution of NTA-I variables and cross-tabulations of NTA-I and available indicators. Age is a feature of all analysis presented here.

NTA analysis measures two important sources of variation – age and sex – using the aggregate and mean per capita flow. NTA-I makes it possible to explore diversity more fully. Some of the methods presented below are designed to analyse the distribution of an NTA variable, determining: to what extent the typical person, as measured by median, differs from the mean; how many people or what proportion of a population or age group meet a particular benchmark; whether members of a population are experiencing similar economic experiences; how the experience in one country differs from another; and how those experiences change over time. Determining these requires NTA-I data and methods presented here, helping to address the application of NTA-I to many different situations.

A related extension of NTA-I data are to analyse the economic circumstances of different groups, helping to answer questions such as: how those who are more educated differ from those who are not; whether some regions of a country are more prosperous than others, and how the economic circumstances of members of one region differ from those of another; how economic outcomes vary with living arrangements; and whether the shift to smaller households, for example, would have economic consequences.

The applications presented in the remainder of this chapter are organized by presented results for four economic variables: consumption, labour income, healthcare spending and support systems. The methods used are delineated below:

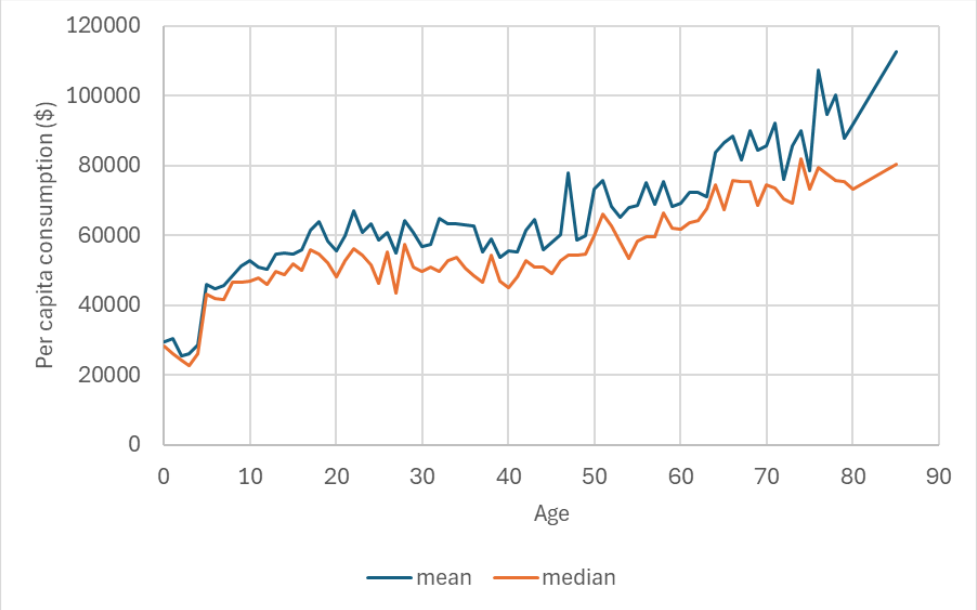
Consumption	Age profiles: mean vs median Distributional table: cross-classifications of NTA variables Bar chart: population by age and consumption groups
Labour income	Distributional table: labour income by age and labour income groups Summary measures
Healthcare spending	Distributional table: total health consumption Bar chart: private funding as percentage of the total Distributional table: population by age and out-of-pocket healthcare spending Histogram: out-of-pocket spending by age and spending percentiles Box and whisker plot: out-of-pocket healthcare spending, means, medians and selected percentiles
Support systems	Consumption funding shares: triangle graphs

2.3.1 Mean and median age profiles: consumption

Consumption is one of several ways to assess standards of living and measure inequality. Among the advantages of using consumption are that it can be used to measure standards of living at any age and that it reflects all resources that provide support to people at all ages. Because the distribution of consumption can be estimated at any age, it obviates the need to use equivalence scales (see chapter 4 on this point).

A simple but useful extension to NTA is to estimate both the mean and the median age profiles of equivalent consumption. These age profiles were estimated using consumption and population weights and the Stata statistical package, and Excel was used to construct the plot. Note that Excel is not used to construct the mean and the median because it does not generate weighted means and medians.

Figure 2.5
Consumption by age, mean and median, United States of America, 2023



2.3.2 The distribution table: consumption by age and consumption groups

The distribution table summarizes an NTA variable using a 5 x 5 classification of age and consumption groups. Quintiles are used to classify age into five groups with an equal span of 20 years each: 0–19; 20–39; 40–59; 60–79; and 80+ years of age (the 80+ age group has an age span that may be more than 20 years). Using quintiles is advantageous because it avoids variations across age in population and aggregate consumption that reflect variation in the age span. There are many instances, however, in which the choice of age categories will be guided by different considerations.

The NTA variable, consumption, is also classified into five groups using absolute values (US$) that are selected based on relative values (percentiles), rounded to the nearest $1,000 as shown in table 2.3. For a single distributional table, the choice of absolute versus relative values is of no importance. For comparison of countries or years, however, the choice is critical.

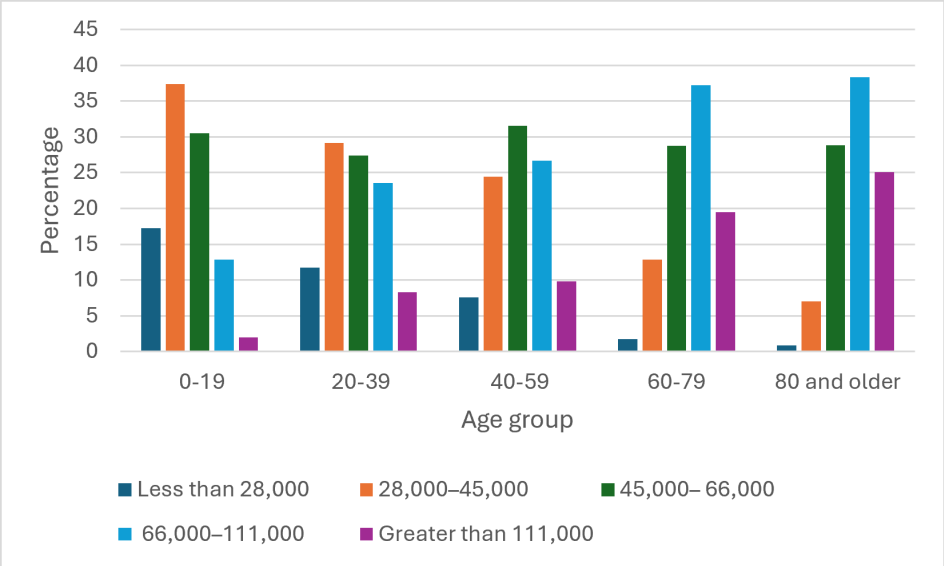
Table 2.3
Joint distribution of consumption by age and consumption groups, United States of America, 2023

Consumption group ($)	*Consumption group (Pct)*	*All ages*	*0-19*	*20-39*	*40-59*	*60-79*	*80+*
	Population (1000s)						
Less than 28,000	Less than 10	32,172	14,106	10,496	6,302	1,161	107
28,000-45,000	10-35	86,437	30,563	26,107	20,271	8,593	904
45,000-66,000	35-65	98,539	24,924	24,589	26,155	19,158	3,713
66,000-111,000	65-90	83,498	10,506	21,094	22,152	24,803	4,943
Greater than 111,000	Greater than 90	33,449	1,639	7,423	8,158	12,999	3,231
All	All	334,095	81,737	89,708	83,038	66,714	12,897
	Aggregate consumption (millions of $)						
Less than 28,000	Less than 10	713,036	306,784	232,912	144,236	26,761	2,344
28,000-45,000	10-35	3,216,308	1,136,993	961,083	755,575	327,423	35,234
45,000-66,000	35-65	5,391,034	1,334,359	1,341,855	1,432,216	1,072,778	209,827
66,000-111,000	65-90	6,956,247	853,678	1,749,703	1,852,349	2,076,389	424,129
Greater than 111,000	Greater than 90	5,310,355	235,316	1,119,627	1,264,253	2,052,168	638,990
All	All	21,586,980	3,867,129	5,405,180	5,448,628	5,555,518	1,310,525
	Per capita consumption ($)						
Less than 28,000	Less than 10	22,163	21,748	22,191	22,889	23,041	22,006
28,000-45,000	10-35	37,210	37,201	36,814	37,274	38,105	38,990
45,000-66,000	35-65	54,710	53,538	54,572	54,759	55,995	56,508
66,000-111,000	65-90	83,310	81,258	82,948	83,619	83,715	85,799
Greater than 111,000	Greater than 90	158,759	143,609	150,834	154,970	157,871	197,795
All	All	64,613	47,312	60,253	65,616	83,273	101,612

The table is comprised of three panels: the population, i.e. the number of individuals, belonging to each cell; the aggregate value of the NTA variable for each cell; and the per capita value equal to the aggregate value divided by the number of individuals. The table also includes entries that summarize the distribution. Table 2.3 is a distributional table constructed from the United States of America 2023 microdata, and the distribution data in table 2.3 can be applied in many ways using standard tools.

Figure 2.6 is based on the percentage distribution, i.e. the share of the population of each age group belonging to one of five consumption groups. The percentage in the lowest consumption group and in the lower middle group decline by age and are smaller at older ages. Note that the percentages reflect the choice of percentile groups. By definition, about 10 per cent of the population belongs to the lowest and highest consumption groups. As a consequence, the shares for those age groups are smaller than for other age groups. An alternative representation of these data could be as a histogram, as discussed below.

Figure 2.6
Population by age and consumption groups, United States of America, 2023



Source: Consumer Expenditure Survey, 2023

2.3.3 Distributional table II, bar charts, and line graphs: labour income by age and labour income groups

Many of the same tools used to analyse consumption can be applied to the analysis of labour income. The age classification used for consumption is also used here. The distribution of labour income, however, is very different from the distribution of consumption. Many individuals do not have any or have negligible labour income. For those who do have some, the distribution is skewed towards higher values. About half of all individuals have less than $5,000 in labour income, which is the breakpoint used to define the lowest category. The next three groups are based on approximately 15 percentile ranges while the top range is approximately the top 5 per cent of all individuals. A point of emphasis is that all members of the population are included in the classification where other studies may not include the child population (see chapter 4, for example).

Table 2.4
Labour income by age and labour income group, United States of America, 2023

Labour income groups	*Percentiles*	*All ages*	*0-19*	*20-39*	*40-59*	*60-79*	*80+*
	Population (1000s)						
less than 5000	Less than 50	167,340	77,183	19,034	16,394	42,546	12,183
5,000 to 42,000	50 to 65	49,164	4,035	23,730	13,725	7,365	309
42,000 to 83,000	65 to 80	52,147	389	23,986	20,485	7,124	162
83,000 to 179,000	80 to 95	48,841	113	18,324	23,377	6,861	167
greater than 179,000	95 and greater	16,604	17	4,635	9,057	2,819	76
All groups		334,095	81,737	89,708	83,038	66,714	12,897
	Labour income (billions of $)						
less than 5000	Less than 50	15.2	8.1	7.3	-0.3	0.2	-0.3
5,000 to 42,000	50 to 65	1,167.3	61.7	575.2	355.0	168.4	7.1
42,000 to 83,000	65 to 80	3,249.2	22.7	1,483.5	1,290.5	442.2	10.2
83,000 to 179,000	80 to 95	5,827.6	12.5	2,129.0	2,835.3	829.9	20.8
greater than 179,000	95 and greater	5,606.5	6.6	1,487.1	3,087.3	999.4	26.2
All groups		15,865.7	111.7	5,682.1	7,567.8	2,440.1	64.0
	Per capita labour income						
less than 5000	Less than 50	91	105	386	-17	5	-21
5,000 to 42,000	50 to 65	23,743	15,288	24,238	25,864	22,863	22,960
42,000 to 83,000	65 to 80	62,308	58,422	61,849	62,995	62,072	63,072
83,000 to 179,000	80 to 95	119,317	110,929	116,192	121,290	120,962	124,172
greater than 179,000	95 and greater	337,665	394,111	320,817	340,879	354,556	343,387
All groups		47,488	1,366	63,340	91,137	36,575	4,963
Mean		47,488	1,366	63,340	91,137	36,575	4,963
Median		4,717	_	46,294	65,009	_	_

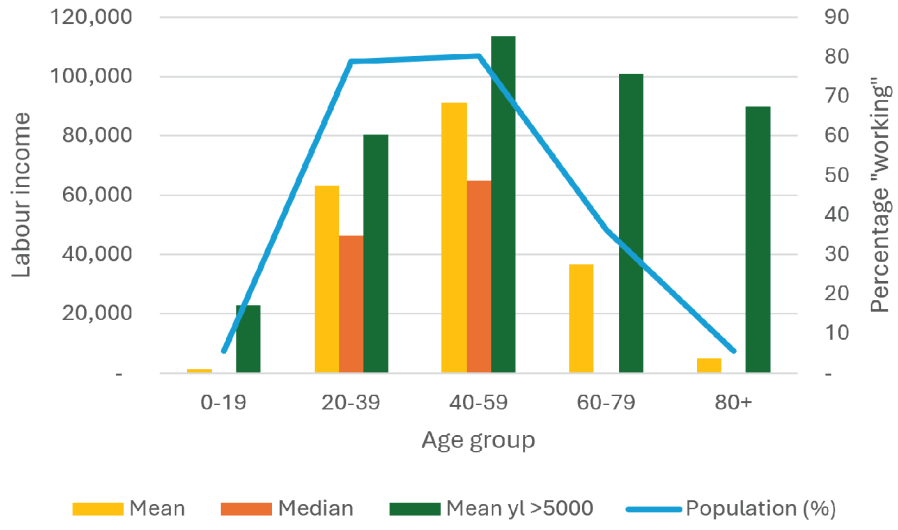
Note: The percentiles are approximations.

The distribution of labour income reveals some important features. First, about half of the population of the United States of America, 167 million, had no or negligible labour income, defined here as less than $5,000. It comes as no surprise that the proportion working, defined in this way, varies by age group with the vast majority of those under 20 and over 80 essentially not working. Close to 80 per cent of those in the 20–39 or 40–59 age groups had more than $5,000 in annual labour income, and about one third of those in the 60–79 age range had more than $5,000.

Standard summary measures are not readily interpreted when applied to labour income. The median values are zero for those under 20 or over 60 years of age. Table 2.4 improves the representation of labour income through the selection of breakpoints of 50, 65, 80 and 95 for the group of those with no or negligible labour income, providing more detail for those with labour income.

Figure 2.7 presents some simple analysis of the components of labour income. First, the mean rises substantially between the 20–39 and 40–59 age ranges because labour income is higher for those who are working, and the proportion working does not change over this age span. Second, those at older ages have much lower labour income, primarily because they are much less likely to be working. Average labour income of those who are working declines with age after reaching the 40–59 peak, but it is relatively high even for those in their 80s who are working and is higher, in fact, than for those working in the 20–39 age range. "Working" refers to having labour income in excess of $5,000 per year.

Figure 2.7
Summary of labour income, United States of America, 2023



Source: Current Population Survey, Annual Social and Economic Supplement, 2023.

2.3.4 Distribution table and bar charts: health spending by age and health spending groups

In the United States of America, health spending is high, variable and allocated across individuals through complex public and private systems. Analysis of NTA-I microdata can be used to look more deeply at health consumption and to illustrate further components useful for analysing other NTA-I variables.

Age is an important source of variability in health spending that can be explored by NTA data or NTA-I microfiles. The distribution table provides detailed information about how health spending varies with age and health spending groups (table 2.5). Age groups are classified using quintiles with cut points at the 10th, 35th, 65th and 90th percentiles used to classify consumption. The table consists of three panels: the first panel has the estimated population belonging to each cell, based on the microdata and population weights; the second, the aggregate health consumption panel, provides estimates of total health spending by the individuals belonging to each cell; and the third provides estimates of per capita values, which can be calculated by dividing the aggregate health consumption values by the population values. The final row in the distribution table is the median spending on health by age group.

The distribution data can be used in a variety of ways, with two applications identified here. The first application is to compare the means and the medians. For those below age 80, the median value is less than the mean value by 20 per cent or less. For the oldest age group, the median is only 55 per cent of the mean. Spending is very high for some individuals who are 80 and older.

The second application is to analyse the relative importance of private and publicly funded resources devoted to healthcare. Distribution tables for private and publicly funded health spending, not shown, were constructed with an identical structure to table 2.5. The tables differ only in that total and per capita private and publicly funded consumption are estimated. The same age distributions and cut points are employed as used in table 2.5. One purpose of the analysis is to determine the public and private shares of health consumption by age and health consumption spending. The private shares, in percentage terms, are reported in figure 2.8, with the public shares equal to 100 minus the private shares.

Spending percentiles have a clear effect on funding shares that holds across most age groups. For those with healthcare spending of less than $2,000 per year who fall approximately in the lowest 10th percentile, private funding constitutes about 40 per cent of total spending, with the public sector funding the rest. For the lower-middle and middle levels of spending, at $2,000–$12,000, private spending plays the most important role, with private spending funding between 60 and 90 per cent of healthcare consumption for most age groups. Children have a distinctive pattern, with lower- and middle-level healthcare spending depending less on private and more on public funding. The private sector was less important, and the public sector more important, when spending exceeded the 65th percentile, or $12,000 per year. The effects of age for the higher spending groups are somewhat mixed. Older persons depend heavily on the public sector when their total spending falls in the $12,000–$23,000 range, and when spending is in the 90th percentile, in excess of $23,000, all age groups, especially children, are heavily dependent on the public sector.

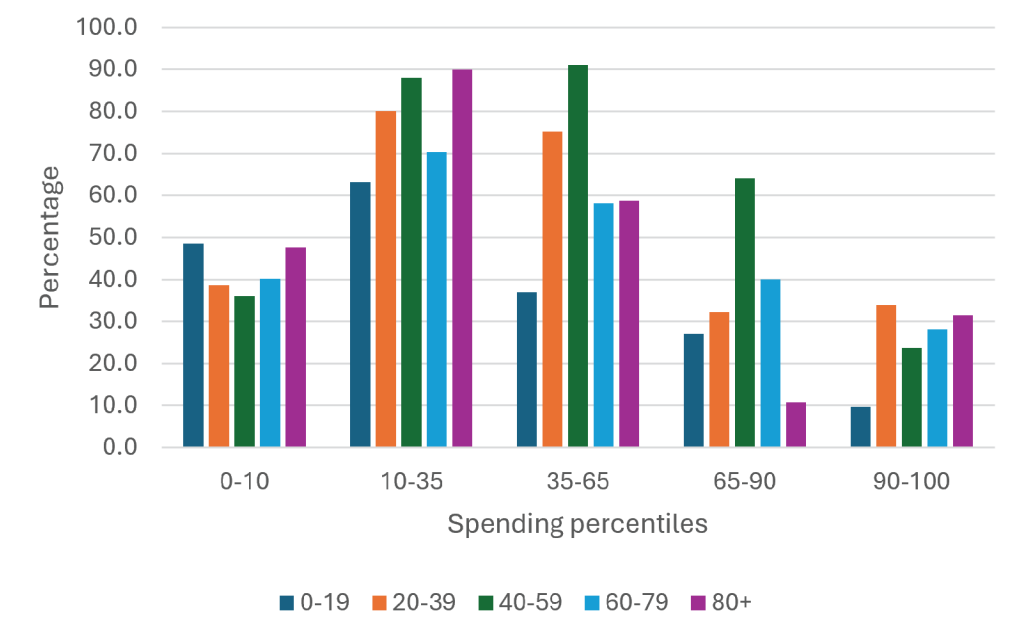
Table 2.5
Distribution of health consumption by age, United States of America, 2023

Health cons group ($)	Group (pct)	All ages	0-19	20-39	40-59	60-79	80+
	Population						
Less than 2,000	0-10	32,634,057	10,085,534	13,349,556	7,025,581	2,079,525	93,861
2,000-6,000	10-35	87,029,687	44,913,545	30,962,665	10,156,546	932,452	64,479
6,000-12,000	35-65	99,448,464	20,765,350	33,530,025	35,481,955	9,527,056	144,078
12,000-23,000	65-90	79,693,262	4,484,022	10,395,008	21,556,255	37,577,261	5,680,716
Greater than 23,000	90-100	35,289,407	1,488,969	1,470,699	8,817,417	16,598,176	6,914,146
All groups	All	334,094,877	81,737,420	89,707,953	83,037,754	66,714,470	12,897,280
	Aggregate health consumption						
Less than 2,000	0-10	27,687	9,921	10,734	5,272	1,675	85
2,000-6,000	10-35	363,755	183,045	129,247	47,336	3,817	308
6,000-12,000	35-65	878,993	162,141	286,859	331,637	97,058	1,299
12,000-23,000	65-90	1,292,404	66,345	164,523	328,034	628,263	105,240
Greater than 23,000	90-100	1,515,916	47,983	42,964	318,603	655,554	450,812
All groups	All	4,078,755	469,435	634,327	1,030,882	1,386,367	557,744
	Per capita health consumption						
Less than 2,000	0-10	848	984	804	750	805	910
2,000-6,000	10-35	4,180	4,076	4,174	4,661	4,094	4,784
6,000-12,000	35-65	8,839	7,808	8,555	9,347	10,188	9,015
12,000-23,000	65-90	16,217	14,796	15,827	15,218	16,719	18,526
Greater than 23,000	90-100	42,957	32,226	29,213	36,133	39,496	65,201
All (mean)	All	12,208	5,743	7,071	12,415	20,781	43,245
Median		8,633	4,732	6,057	10,487	17,148	24,004

2.3.5 Histograms: out-of-pocket healthcare spending

Employer-provided health insurance is important in the United States of America and protects many individuals from the economic effects of health shocks, although private insurance is often subject to deductibles or co-payments that limit protection. Many individuals also do not have private health insurance, with many relying on publicly funded healthcare programmes, such as Medicare and Medicaid, which have their own restrictions. Because some individuals have no coverage or incomplete coverage from these programmes, out-of-pocket (OOP) healthcare spending can be important. An analysis of OOP spending provides additional ways of analysing NTA-I.

Figure 2.8
Private as a percentage of total healthcare spending, United States of America, 2023



Source: Medical Expenditure Panel Survey, National Nursing Home Survey and Current Population Survey, Annual Social and Economic Supplement, 2023.

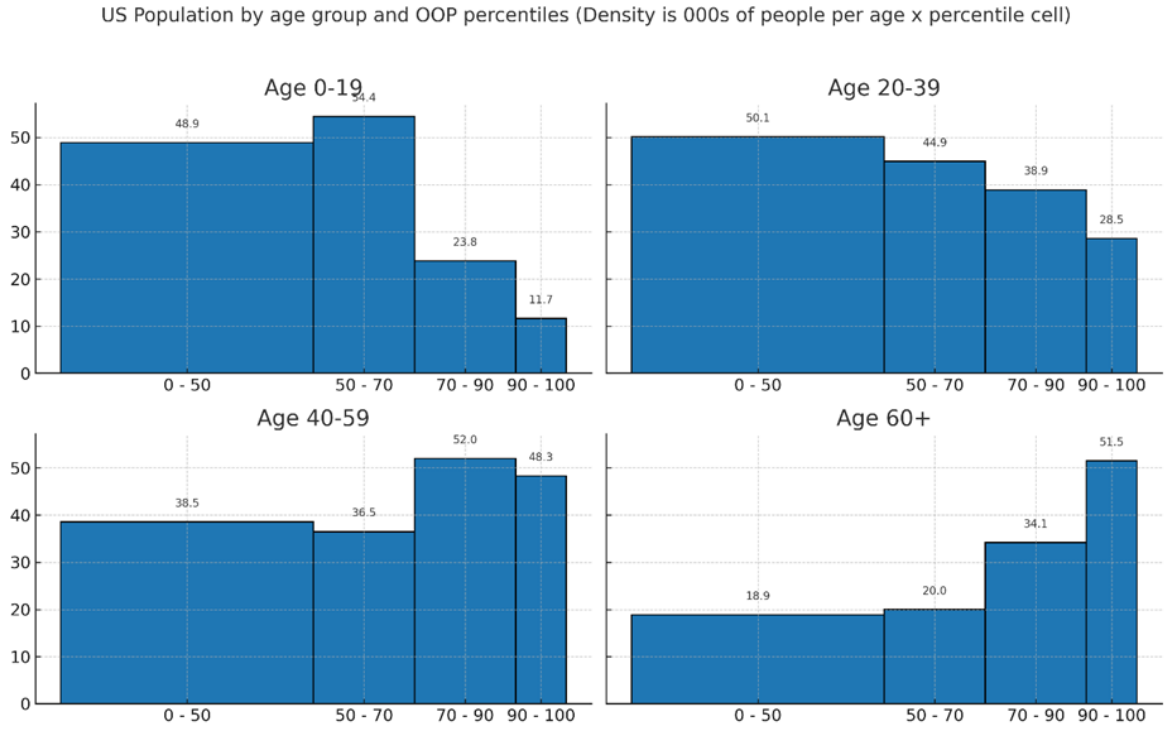
Table 2.6 shows the population classified by age and per capita OOP spending percentiles in the upper panel and the population age distribution. The table is organized in a way that differs from those presented above, in part to illustrate that the distribution table can take many forms. The OOP groups and the age groups are transposed, and only four age groups and OOP percentile groups are used.

Table 2.6
Population by age and OOP percentiles

		NTA Group (percentile)				
		0–50	50–70	70–90	90–100	All
		Number (millions)				
Age group	0–19	48.9	21.8	9.5	2.3	82.5
	20–39	50.1	18.0	15.6	5.7	89.4
	40–59	38.5	14.6	20.8	9.7	83.6
	60+	28.3	12.0	20.5	15.4	76.2
	All	165.8	66.3	66.3	33.2	331.7
		Per cent				
Age group	0–19	14.7	6.6	2.9	0.7	24.9
	20–39	15.1	5.4	4.7	1.7	26.9
	40–59	11.6	4.4	6.3	2.9	25.2
	60+	8.5	3.6	6.2	4.7	23.0
	All	50.0	20.0	20.0	10.0	100.0

An effective visualization is rendered using a histogram that is different from the standard bar graph used above. The width of each bar is proportional to the range of the data and the height is equal to the density of the variable. The area of each bar is proportional to the number of persons belonging to each age by percentile group.

Figure 2.9
A histogram illustrated: out-of-pocket health spending by age and percentile, United States of America, 2023

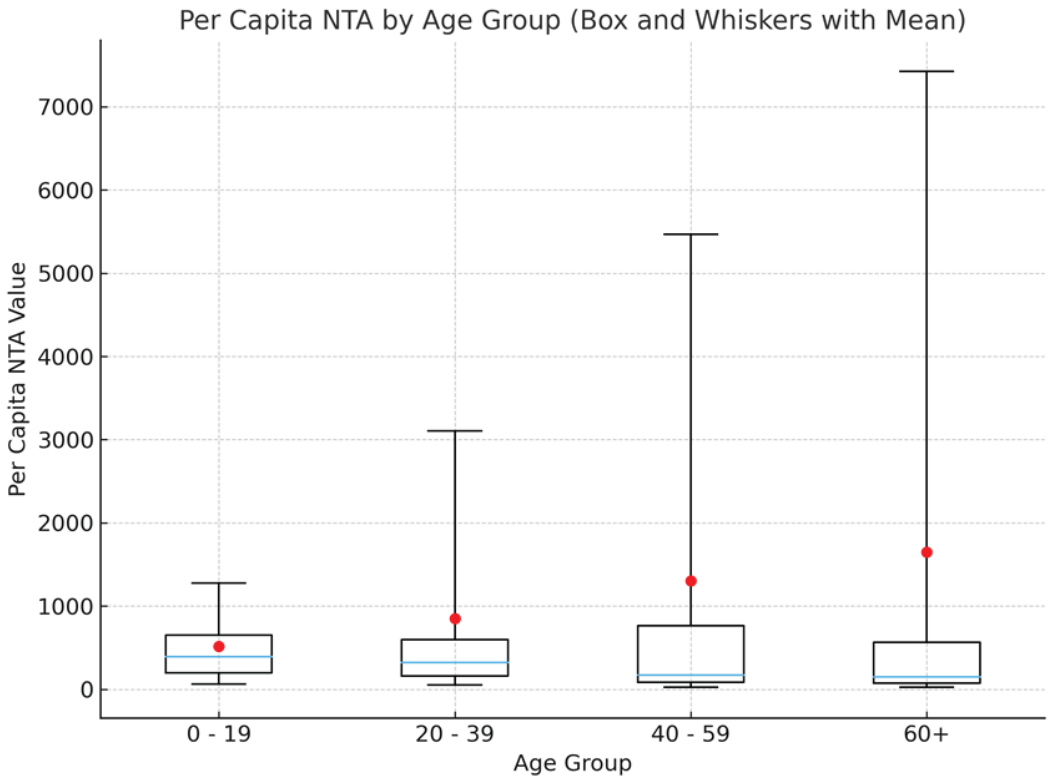


Source: Medical Expenditure Panel Survey, National Nursing Home Survey and Current Population Survey, Annual Social and Economic Supplement, 2023

2.3.6 Box and whisker graphs: means, medians and percentiles revisited

A line graph is an effective way to represent means, medians and percentiles that vary by age. Mean and median line graphs were used to display per capita consumption by age in figure 2.5 above, while a more detailed distributional plot could add age profiles of spending percentiles. A box and whisker plot is an alternative approach that provides important distributional data and eliminates distractions seen in noisy graphs.

Figure 2.10
Distribution of OOP healthcare spending by age, United States of America, 2023



Note: Mean, median, interquartile range, and 5th and 95th percentiles.

Figure 2.10 shows the distribution of per capita OOP healthcare spending by age group. For each age group, the box captures the interquartile range (25th to 75th percentile), the horizontal line inside the box indicates the median (50th percentile), and the whiskers extend to the 5th and 95th percentiles. The red dot marks the mean value. Together, these elements allow for comparison of central tendency, spread and skewness across age groups.

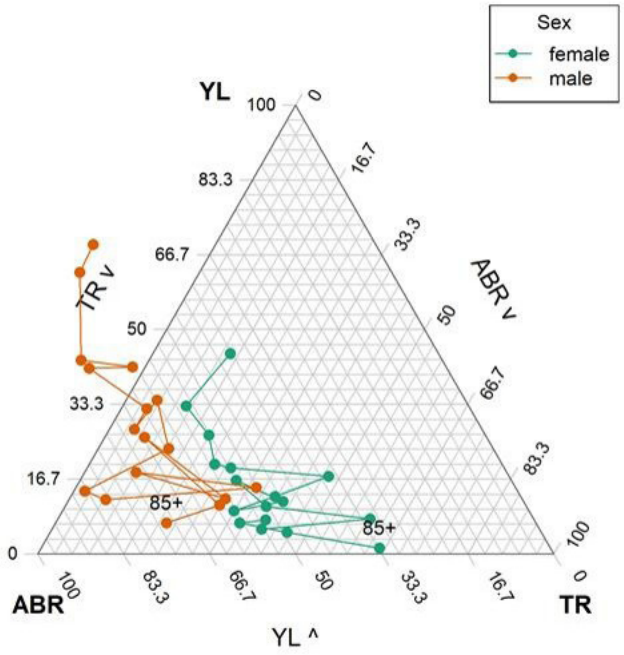
2.3.7 Ternary (triangle) graphs: funding consumption

Consumption by children and older persons can be summarized as the shares funded by three sources: labour income, transfers and asset-based reallocations. Children depend very heavily on transfers, with labour income and asset-based reallocations playing a role only when young people are in their late teens or early twenties. At older ages, all three funding sources are important. Labour income is important for young older persons but declines sharply with age. Transfers and asset-based reallocations fill in the gap between consumption and labour income in ways that vary greatly across countries and over time.

The results below show the sources of consumption funding for older persons by age and sex in the first set of results, and by educational attainment in the second.

Figure 2.11

Shares of consumption funded by labour income (YL), transfers (TR) and asset-based reallocations (ABR), by age and sex, adults 65 and older, United States of America, 2023



A ternary or triangle graph for women and men is provided, showing funding shares by single years of age from 65 to 85+. The "80" age group represents values for those aged 80–84. For both sexes, the labour income share drops very sharply for those in their late sixties. Asset-based reallocations are more important than transfers except in a few cases. Transfers rise slowly in importance with age.

A multi-faceted gender gap is apparent in the data. Labour income funds a higher share of consumption for men at all ages. Asset-based reallocations are a greater share of consumption for men than for women at all ages. Women, on the other hand, depend more heavily on transfers.

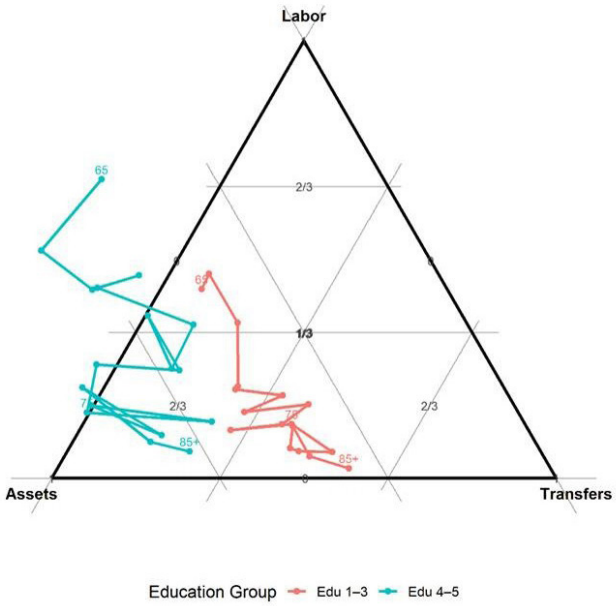
The gender gap in reallocations is somewhat ill-defined because of difficulties in allocating asset income among members of the same household. Asset income is assigned to the household head, who is often male. Some portion of the consumption of non-head household members is funded through intrahousehold transfers from the head to non-head members, who are more frequently female. This is an issue that would benefit from further study.

Analysis of consumption components reveals significant differences by educational attainment. Five educational groups available in the data have been combined into two education groups in figure 2.12: "Edu 1–3" consists of all those with less than a bachelor's degree; and "Edu 4–5" consists of all those who have completed some tertiary education. Estimates are for single years of age for 65 to 80 and age groups for those aged 80–84 and 85+.

The results show that labour income is a greater share of consumption for the more educated group. This is particularly apparent among younger age groups of older persons but also holds at more advanced ages.

Figure 2.12

Shares of consumption funded by labour income, transfers and asset-based reallocations, by age and education, adults 65 and older, United States of America, 2023



The most educated rely more heavily on asset-based reallocations, while the less educated rely more heavily on transfers. Even the less educated, however, rely heavily on asset-based reallocations. Only at the oldest ages are transfers more important than asset-based reallocations for the less educated.

Chapter 3: National Transfer Accounts by Educational Attainment

3.1 Introduction

The common motivation behind estimating NTA by educational attainment is that including population diversity enhances the understanding of age profile accounts and resource reallocations due to the difference in consumption patterns, sources of support and demographic characteristics across educational groups. NTA estimates by educational attainment provide additional insights into the distribution within age groups and improve the accuracy of simulations or projections.

In some studies, estimates by educational attainment are also driven by the possibility of including socioeconomic status inequality analysis in the NTA. These studies have examined resource redistribution between groups (Abio and others, 2017; Bucheli and González, 2024; Comelatto, 2020; Hammer, 2015; Miller, 2014; Rosero-Bixby, 2024) and, in some cases, trends over time (Mejía-Guevara, 2015; Mejía-Guevara and Rivero, 2024; Olivera, 2024). Their findings indicate that the most highly educated individuals are crucial for providing resources to the least educated members of the population.

An important discussion in these studies is why an educational variable should be chosen over other indicators of standards of living, such as income, consumption or any other multidimensional index of well-being. One advantage of education as an indicator is that it does not fluctuate with macroeconomic cycles or cyclical risks, making it a suitable proxy for reflecting lifetime socioeconomic status (Abio and others, 2017). However, education may not be the best option if the aim is to reflect short-term phenomena. For example, in a study for Colombia, Tovar and Urdinola (2014) concluded that a multidimensional quality of life index better captured the poor population. That said, education shapes several socioeconomic aspects, such as wages, economic and employment conditions, and access to public services, often making it a comprehensive proxy of well-being (Mejía-Guevara, 2015). Unlike income, education is exogenous to the economic flows to be studied (Rosero-Bixby, 2024; Mejía-Guevara, 2015), and reports on education are usually more reliable than income reports.

Another reason for including NTA estimates by education is that they are helpful in analysing whether educational improvements can help mitigate the effects of ageing (Amarante and others, 2021; Choo and Gee, 2024; Oosthuizen, 2024; Rentería and others, 2016; Rentería and others, 2024). There are policy-related reasons for this motivation, as education can serve as a tool to address the challenging effects of ageing. In addition, ageing threatens the sustainability of public finances and exacerbates redistributive tensions, particularly in countries with high inequality and decreasing demographic dividends (Amarante and others, 2021). Studies show that investment in education appears to be a valuable public instrument to counteract the potential adverse effects of ageing, including economic and fiscal support ratios and the social and political tensions associated with public redistributive actions.

3.2 Literature review

Table 3.1 outlines studies that have estimated the NTA system by educational attainment. Most studies motivated by analysis of inequality argue that the educational variable should represent the socioeconomic status shared by all household members and, in most cases, use the household head's educational attainment. Studies focusing on the combined effect of education and ageing are more likely to use a variable reflecting individual education. These studies are summarized in the rest of this section, showing how the accounts vary across the life cycle for different groups and how educational expansion interacts with the ageing process.

Table 3.1
Studies reporting NTA estimations by educational attainment

Authors	Countries	Reported Accounts	Educational variables	Years of estimation	Purpose
Abio and others (2017)	Spain	All systems except TG+	HH education, 3 groups	2006	Inequality by education
Amarante and others (2021)	Uruguay	TG	IN education, 4 groups	2013	Ageing, educational and population size change effects on TG 2015–2050
Bucheli and González (2024)	Uruguay	YL, C, LCD and TG	HH education, 4 groups	2013	Inequality by education among children
Choo and Gee (2024)	Singapore	YL, C and LCD	IN education, 4 groups	2013	Ageing and education al change effects on SR 1970–2020
Comelatto (2019)	Argentina	YL, C, LCD and TG	HH education, 3 groups	2016	Inequality by education
Hammer (2015)	Austria	All systems	IN education, 3 groups	2010	Inequality by education
Mejía-Guevara (2015)	Mexico	YL, C, TG, TF and AR	HH education, 4 groups	1994 and 2004	Analysis of changes
Mejía-Guevara and Rivero Fuentes (2024)	Mexico	YL and C	HH education, 4 groups	1994, 2004 and 2014	Analysis of changes
Miller and others (2014)	Chile	C	HH education, 4 groups	2007	Inequality by education
Olivera (2024)	Peru	YL	HH education, 4 groups	2007 and 2019	Analysis of changes
Oosthuizen (2024)	South Africa	YL, C and LCD	IN education, 3 groups	2015	Ageing and education al change effects on SR 1950–2100
Prskawetz and Hammer (2018)	Austria	C, YL and LCD	IN education, 3 groups	2010	Ageing and educational change effects on SR
Turra and Queiroz (2005)	Brazil	YL, C, LCD, TG and TF	HH education, 4 groups	1996	Inequality by education
Rentería and others (2016)	Mexico and Spain	YL, C and LCD	IN education, 4 groups	2004 (Mexico) and 2006 (Spain)	Ageing and education al change effects on SR 1970–2100
Rentería and others (2024)	19 European countries	YL, C and LCD	IN education, 3 groups	2010	Ageing and education al change effects on SR 1950–2080
Rosero-Bixby (2024)	Ecuador	YL, C, LCD and TG	Quartile of the most educated household mem ber (education relative to birth cohort)	2006 and 2011	Inequality by education
Spielauer and others (2022)	Spain, Austria, Finland and UK	YL, C, LCD, TG and TF	IN education, 3 groups	2010	Inequality by education
Tovar and Urdinola (2014)	Colombia	YL, C, TG and TF	HH education, 4 groups	2008	Inequality by education

Notes: YL: Labour Income; C: Consumption; TG: Public Transfers; TG+: Public Transfers inflows; TF: Private Transfers; SR: Support Ratio
HH: household head; IN: individual

All of these studies indicate that per capita income and consumption increase with education. When it comes to the life cycle deficit (LCD), three common aspects emerge: deficits in childhood and old age are more pronounced for the highest- than the lowest-educated group; the surplus increases with education; and the age range of the surplus is higher for the highest- than the lowest-educated group. The least educated group sometimes shows no life cycle surplus (Rentería and others, 2024), which may be related to the choice of the education threshold. Indeed, it is possible that, at least in some countries, there is a sufficiently low threshold so that the least educated group has no surplus at any age.

Studies that report public transfer account estimates show that per capita outflows (taxes and contributions) are positively related to educational attainment. Regarding inflows, the amount is lower for the highly educated group than the least educated group among children, and the opposite is true for older ages. The net result shows that children are net recipients of public transfers when they belong to the lowest educational group, and the net benefits decrease with education. Additionally, studies in Uruguay using different educational variables indicate that children in the highly educated group are net contributors (Amarante and others, 2021; Bucheli and González, 2024), but this result may depend on the threshold used to define educational groups as mentioned for the life cycle deficit pattern. Individuals are net public contributors during working ages, and the contribution amount increases with education. An exception is the least educated group in the United Kingdom, which is a net receiver even during working ages (Spielauer and others, 2022). Net transfers become favourable again at older ages, and as in childhood, net benefits decrease with education. The Colombian case is an exception to these general patterns, where net benefits increase with education at younger and older ages (Tovar and Urdinola, 2014). Also, Spielauer and others (2022) found that the highly educated receive the highest net benefits in Austria and Finland at very old ages.

Limited research is available on private reallocations by education, and the existing findings are heterogeneous. For instance, Abio and others (2017) found that private transfers to children in Spain increase with economic status. Similar findings are reported by Turra and Queiroz (2005) for Brazil, Tovar and Urdinola (2014) for Colombia, and Spielauer and others (2022) for Spain, Austria, Finland and the United Kingdom. However, Hammer (2015) did not find this relationship in Austria before age 20. In old age, these studies indicate that the highly educated group is a net receiver in Spain, while in Colombia, all groups are net receivers; meanwhile, in Austria and Brazil, all groups are net givers. In the multi-country study by Spielauer and others (2022), net private transfers are near zero in old age. The discrepancies between studies may be due to different estimation methods. Income assets increase with education in the three studies that report estimations (Abio and others, 2017; Hammer, 2015; Mejía Guevara, 2015).

The studies examining the effect of intergenerational educational change do not follow the same methodology but share a common general strategy. They start by estimating NTA by individual education for a single year. Then, they use population projections to simulate the economic or fiscal support rate over several years. Finally, they use different decomposition techniques to assess whether increasing education levels can mitigate the adverse effects of ageing. In some cases, these studies analyse the historical path of the demographic dividend and the role of education in it. In contrast, others explore the potential effect of educational expansion on future trends.

All of these studies, which cover different demographic stages, found that the estimated demographic dividend based on the average country profile differs when considering multiple profiles and concluded that education positively affects the growth of the economic support ratio. It is important to note, however, that incorporating educational differences may imply a deviation from the core concept of a demographic dividend, which is related to population change only (Oosthuizen, 2024).

In Singapore, where there is a declining fertility rate alongside economic growth and expansion of education, Choo and Gee (2024) found that the increase in schooling prevented the support ratio from declining despite the negative effect of the population age structure. In South Africa, where the demographic dividend is waning, Oosthuizen (2024) concluded that rising educational attainment contributes to an increase in the demographic dividend, and future

expansions may outweigh the adverse effects of population ageing. Rentería and others (2016) compared Mexico and Spain and found that the positive impact of education is more substantial for Mexico, which has a less accelerated ageing process than Spain. Prskawetz and Hammer (2018) estimated different definitions of dependency rates in Austria and concluded that increasing levels of education would lead to higher numbers of employed individuals and a lower economic dependency ratio. Rentería and others (2024) found a similar result for 19 European countries; most of these countries and the simulations of their future paths, using different scenarios, indicated a negative growth rate in economic support ratio rates by 2020. However, positive – but declining over time – educational effects remain. Finally, a study by Amarante and others (2021) analysed the effect of education expansion on public accounts in Uruguay, arguing that economic ageing may threaten fiscal sustainability and exacerbate redistributive tensions in the context of high levels of inequality. This study concluded that education expansion would mitigate pressures on public resources, outweighing the adverse effects of demographic changes.

3.3 Methodology

Estimates by educational attainment are consistent with the aggregate values and population size by age of the NTA system. They follow the United Nations' general guidelines for NTA system methodology (United Nations, 2013), so the same detailed databases used for NTA system estimation should be used. The general method involves estimating the age profile within each educational group and adjusting the aggregate value by education to ensure consistency with the NTA system. It is important to note that the detailed databases, usually constructed from household data, must allow for the identification of education. This section addresses specific issues related to estimating NTA by educational group.

3.3.1 Constructing the age profile by education

The starting point is to have estimates of the NTA system that satisfy the following identity at both the aggregate level and for each age:

$$C - YL = (TG_{+} - TG_{-}) + (TF_{+} - TF_{-}) + (YA - S)$$

where YL is labour income, C is consumption, TG is public transfers (the sign plus indicates inflows and the sign minus outflows), TF is private transfers, YA is income assets, and S is savings.

For any account, if X is the aggregate value, a is age, $x(a)$ is the smooth per capita value for age a, and P is the population, estimates ensure that:

$$X = \sum_{a} X(a) \quad and \quad X(a) = x(a)\, P(a)$$

The total value for each age is the sum of the aggregate values of educational groups, given E educational groups ($e=1, \ldots, E$):

$$X(a) = \sum_{e=1}^{E} X(a,e) \quad and \quad X(a,e) = x(a,e)\, P(a,e)$$

The first step in creating age profiles by education is to calculate the per capita (smooth) values for each subgroup separately, using the same micro database and following the same method used for the average (as outlined in United Nations, 2013). If the smooth per capita value obtained with the individual database is represented as $\tilde{x}(a,e)$, the aggregate value for age a and education e is:

$$X(a,e) = X(a)\, \frac{\tilde{x}(a,e)\, P(a,e)}{\sum_{e=1}^{E} \tilde{x}(a,e)\, P(a,e)}$$

The NTA smooth per capita value for age a and education e is:

$$x(a,e) = \frac{X(a,e)}{P(a,e)}$$

The procedure ensures that, for each NTA account, the average value aligns with the sum of the educational group value, weighted by the group's population share. It is important to note that the population distribution by education may vary across different databases used to estimate the smooth per capita values. As a result, the share of the total value of groups within ages may not necessarily match the microdata and the NTA estimates.

3.3.2 Choice of educational group and population size

Population size by group

Sources of information on population by age to estimate the NTA system are censuses, official institutions' projections and organizations' estimations. It is rare for these sources to provide the population size of educational groups. Therefore, once the educational thresholds are defined, a micro database is necessary to determine the distribution of the educational groups within ages. This procedure ensures that, for each age, the NTA population is equal to the sum of the NTA population by education.

When more than one source of information is available, and there are no strong arguments for choosing one over the others, conducting a sensitivity analysis of the results would be reasonable.

Education variable at the household or individual level

Working with an educational variable at the household or the individual level is a matter of the researchers' choice, and the option is related to the study's objective, as outlined in section 3.2.

When addressing socioeconomic inequality, the most common choice is to use education at the household level so that all household members share the same standard of living and belong to the same group. However, it is debatable which household members' education best represents socioeconomic status.

The educational attainment of the household head is the most used indicator. This choice relies on the traditional role of the household head as the primary provider and thus responsible for the household's well-being. However, in many countries, the household's funding combines income provided by several household members, making the choice of the household head's education debatable. This issue becomes critical when there are severe educational differences among household members. Differences between couple members are likely smaller than those between members of different generations. Therefore, criticism of using household head education is more relevant in countries with a high incidence of multigenerational households. For example, the oldest person may be designated as the head of an extended family, while the income supporting the standard of living for all members may come from working-age adults who are more educated. An alternative to the education of the household head is to use the level of the most educated member, as in Rosero-Bixby (2024), or the average education of the adults in the household.

When studying the impact of educational changes, researchers are more likely to use individual education. The challenge of implementing this option is that the population comprises individuals who have completed their education investment and others who are still studying and whose future educational attainment is unknown. The question to be answered is how to deal with those still enrolled in the educational system, who are mainly the youngest population.

One option is to use the level of education acquired at the time of observation, as in Hammer (2015). In this case, the youngest population is mostly in the same group (the least educated). Rentería and others (2015) and Oosthuizen (2024) opt not to disaggregate the youngest group and to treat it with a single age profile identical to the average, while Amarante and others (2021) introduce heterogeneity among the enrolled population by assigning them their mother's education on the understanding that it is the best approximation of their expected education.

Educational thresholds and number of groups

The choice of the number of groups and threshold depends on the country's relevant thresholds and data availability and the number of cases needed to estimate profiles with individual data. When the sample size is small, disaggregating by age and educational attainment can result in few cases in some groups. This can lead to imprecise average value estimates for those subgroups, causing wider confidence intervals and unwanted fluctuations in the age profiles of the NTA accounts.

This difficulty arises even in cases where the sample size of the micro database is not small, but rapid educational changes lead to significant differences in educational achievement among different age groups. In such cases, a low educational threshold may be appropriate for elders but may mean few cases for youth. Conversely, a high threshold may lead to a tiny sample size among elders. Therefore, the choice of educational thresholds and the number of groups should be a compromise between using a representative cut-off for the entire population and ensuring enough cases in all age groups.

A solution proposed by Miller (2024) is grouping, at least for some cohorts. Alternatively, Rosero-Bixby (2024) uses quartiles of a relative education indicator that ensure similar age/educational group sizes. This study rescales years of education as deviations from the mean value within each birth cohort, resulting in an "indicator neutral to age". Household members are then assigned based on the most educated individual according to the neutral indicator, and four groups are created based on the quartiles of this distribution.

It is worth noting that interpreting the results can be challenging when using absolute educational thresholds in countries with rapidly expanding education systems. It may be helpful to consider an indicator of the education related to the birth cohort to address this issue, as discussed in Rosero-Bixby (2024).

3.3.3 Other issues

Underreporting of income

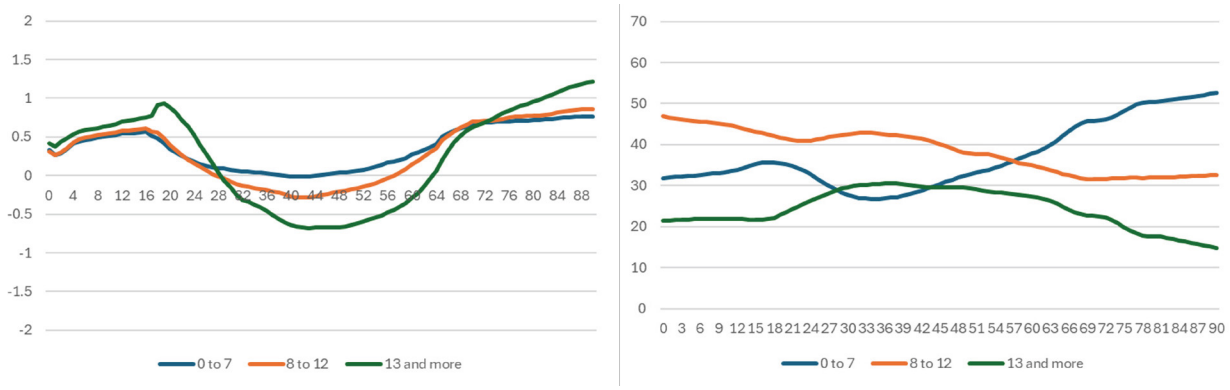
The estimates provided by NTA are based on survey data. One of the drawbacks of surveys is that income and consumption are often underreported. In general, underreporting and missing information are associated with higher incomes. Therefore, underreporting is not as relevant in the average NTA estimates as when estimating by education. Indeed, it is likely that the underestimation of income and consumption has a greater incidence among the most educated group. Thus, inequality would be underestimated when analysing the differences between educational groups. One way to deal with this problem is to use administrative records to adjust survey data, as in the inequality literature, before estimating the age profile. Previous work on NTA estimates is not known to have adjusted for misreporting.

Figure 3.1
Life cycle deficit and population structure by age and household head education, Argentina, Mexico and Uruguay

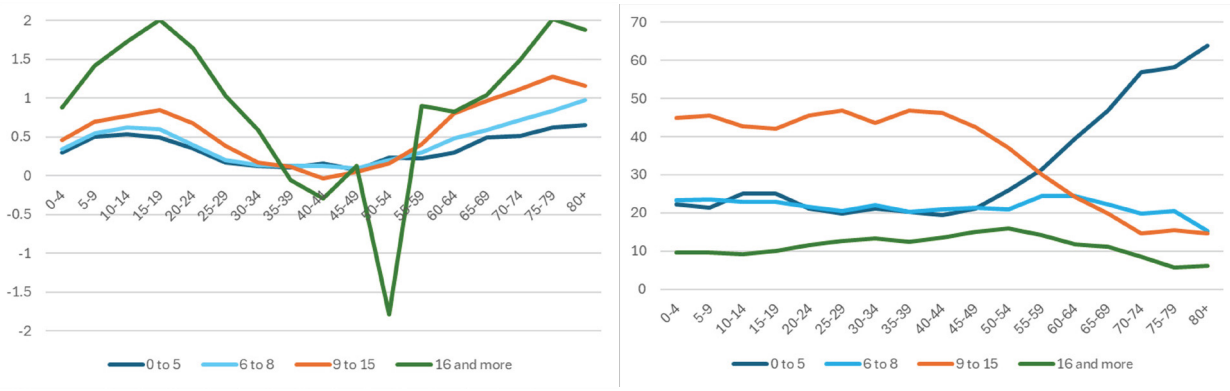
Life cycle deficit (normalized by mean labour income of age 40–49) by groups of schooling years

Share of educational groups within ages (percentage)

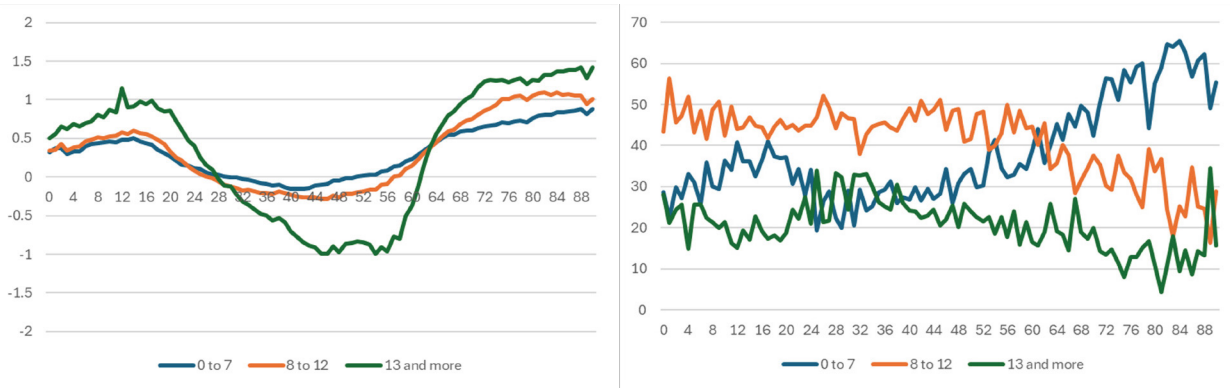
Argentina



Mexico



Uruguay



Sources: Argentina: Comelatto (2019); Mexico: Mejía-Guevara and Rivero Fuentes (2024); Uruguay: authors' elaboration.

The role of the household head

In the NTA methodology, household heads play a unique role in that they own all assets, save or dissave, receive or give interhousehold transfers, and centralize intrahousehold transfers. They receive surplus inflows from non-head members and give outflows to non-head members with deficits. It is important to note that household members belong to the same group when a household-level education variable classifies the population but not when individual education is used. Thus, it is assumed that the household head makes flows between educational groups in the latter case that are not in the former case. In this context, it seems reasonable to wonder about the genuineness of flows based on the assumption of the different household members' roles. Future work could perform sensitivity analyses of other assumptions, for example, that all adult household members own assets and can save or dissave, as in Hammer (2015).

Estimates of individual in-kind public benefits

Following the NTA guidelines, the first step in estimating in-kind public benefits included in public transfer inflows is to calculate the individual public benefit as the unit cost of public programmes and assign it to beneficiaries identified in the microdata set. In the case of educational services, the guides advise considering educational levels separately. Regarding healthcare, programmes may be regarded as separate, while the imputation of collective services value assumes that each consumes the same amount. Analogously, health collective services, the rest of public services spending – such as national defense – are also equally divided among the entire population.

These broad guidelines and the unit cost estimation practice make it clear that the differences between beneficiaries stem from being or not being covered by a programme and the per capita cost of the programme. Using the unit cost of the programme, it is assumed that the benefit is the same for all beneficiaries. However, heterogeneity may be relevant, and it is not known in advance what bias its effect will introduce. For example, a food programme in public schools may be allocated more intensively in areas with higher poverty rates or, on the contrary, the choice of better (and more expensive) teachers in more advantaged neighbourhoods could create a pro-rich bias.

Consequently, efforts to distinguish between beneficiaries of the same programme should not be neglected when there is a distributive concern in the study.

3.4 Applications

This section aims to show empirically some of the results and issues that have been discussed throughout this chapter.

First, the results for Argentina estimated by Comelatto (2019), for Mexico by Mejía-Guevara and Rivero Fuentes (2024), and for Uruguay are compared in terms of the LCD by age and educational level, using the education of the head of the household to classify all household members. Figure 3.1 shows the per capita LCD for Argentina, Mexico and Uruguay by education and age, as well as the share of the groups within each age range. In the case of Mexico, there are four groups determined by years of schooling of the household head: between 0 and 5 years; between 6 and 8 years; between 9 and 15 years; and 16 or more years. For Argentina and Uruguay, there are three groups: between 0 and 7 years; between 8 and 12 years; and 13 or more years. The decision to use the same thresholds for these two countries is based on the fact that they have undergone similar ageing processes and have similar age and educational structures.

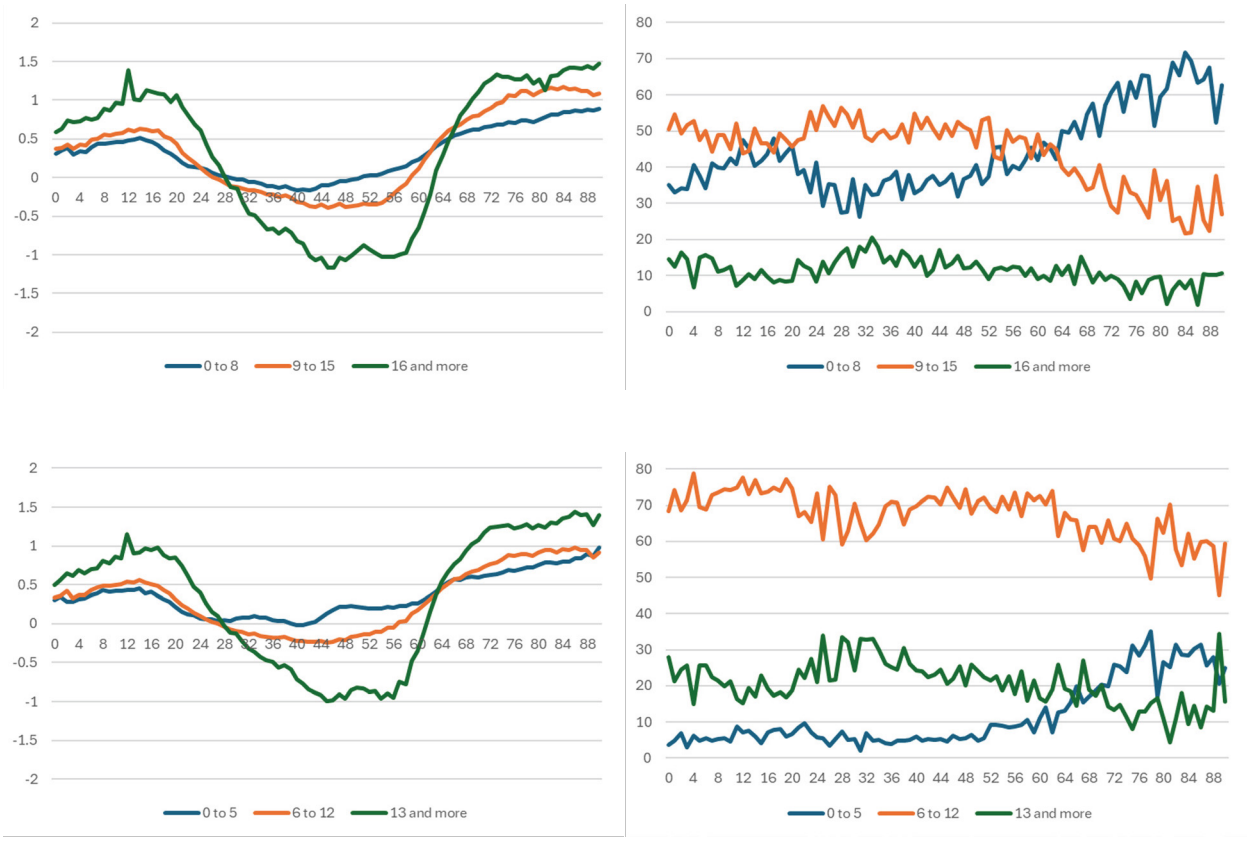
As described in section 3.2, in the three countries, the per capita deficits in childhood and old age are greater for the most educated group than for the least educated group. In turn, the surplus in the working ages and its age range increase with level of education, with a rise in the age at which the second deficit stage begins. There are two distinctive patterns: in the case of Mexico, the most educated group is the only one with a surplus, while in Argentina, the least educated group has practically no surplus at any age. The rest of this section seeks to empirically assess whether the results are sensitive to some methodological options using the Uruguayan case.

Figure 3.2

Life cycle deficit and population structure by age and household head education, Uruguay, alternative cut-offs

Life cycle deficit (normalized by mean labour income of ages 40–49) by groups of schooling years

Share of educational groups within ages (percentage)



Source: Authors' elaboration.

Figure 3.2 shows the LCD and the share of groups within ages using alternative cut-offs of the household head's education. The curves at the top aim to illustrate the effect of raising the educational threshold of at least 16 years of schooling to isolate the most educated population, and at the bottom, the purpose is to focus on the least educated by decreasing the lowest educational threshold (5 years of schooling or less).

As described in section 3.2, in the three countries, the per capita deficits in childhood and old age are greater for the most educated group than for the least educated group. In turn, the surplus in the working ages and its range age increase with level of education, with a rise in the age at which the second deficit stage begins. There are two distinctive patterns: in the case of Mexico, the most educated group is the only one with a surplus, while in Argentina, the least educated group has practically no surplus at any age. The rest of this section seeks to empirically assess whether the results are sensitive to some methodological options using the Uruguayan case.

Figure 3.2 shows the LCD and the share of groups within ages using alternative cut-offs of the household head's education. The curves at the top aim to illustrate the effect of raising the educational threshold of at least 16 years of schooling to isolate the most educated population, and at the bottom, the purpose is to focus on the least educated by decreasing the lowest educational threshold (5 years of schooling or less).

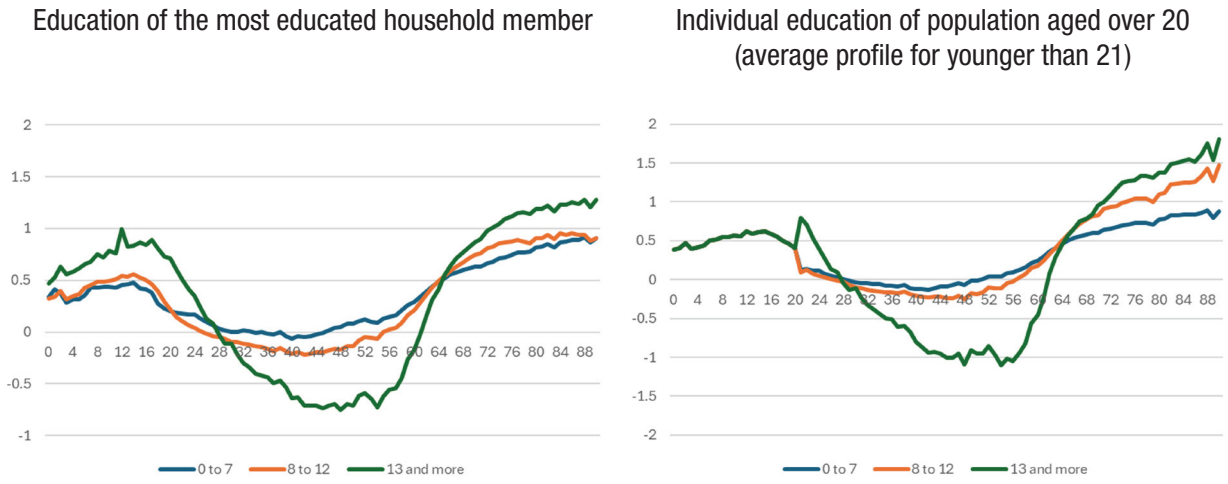
The raw picture of the LCD at the top of figure 3.2 does not present relevant changes compared to figure 3.1. Thus, comparing countries does not appear sensitive to the most educated definition used in the Uruguayan case. However, it is noticeable that the curve for the most educated group differs for older people. Note that figure 3.2 shows in the upper right that the most educated group is small in size, particularly in the older age group. Thus, it is possible that when looking to isolate the most educated among the highly educated, the small sample size produces variabilities at old ages due to imprecise estimates.

On the other hand, the LCD by education presented at the bottom of figure 3.2 looks slightly different than the LCD shown in figure 3.1. The most remarkable change is that in this alternative classification, the lowest educated group has virtually no surplus at any age. In addition, it exhibits variabilities at working ages that do not exist in figure 3.1. Once again, the small population size of this group in middle age may be responsible. This shows that LCD findings are sensitive to the cut-off used to identify the lowest educated, while population size likely introduces undesired effects on the profile.

Figure 3.3 presents the LCD by age using the cut-offs used in figure 3.1 but with different educational variables. On the left, the population is classified by the educational attainment of the most educated household member. This results in some people belonging to the lowest education group in figure 3.1 moving to a higher education group, while movements between the middle and upper groups depend on the case under study. The size of the highest educated group rose more than the middle group. As shown in figure 3.3, the LCD findings are sensitive to using this alternative variable. The lowest educated group has virtually no life cycle surplus at any age. Thus, to capture the lowest socioeconomic level, it is important to consider the possibility that the household head is not the main breadwinner in the household. The contrary seems to be true, however, for the highest socioeconomic level. Indeed, the surplus at working ages is lower in figure 3.3 than in figure 3.1, whereas the deficit gap for older ages is smaller.

Finally, the left side of figure 3.3 shows the LCD by age using individual education. The profile for the population below age 21, when educational attainment is likely incomplete, is the average. The comparison of figures 3.1 and 3.3 suggests that individual education slightly increases the gap between the groups.

Figure 3.3
Life cycle deficit by age and educational groups, Uruguay, alternative educational variables



Source: Authors' elaboration.

3.5 Conclusions

Estimating NTA by educational attainment provides a valuable framework for analysing the intersection of age, socioeconomic status and intergenerational transfers. This approach enhances the understanding of population heterogeneity within age groups and allows for a more accurate assessment of redistribution dynamics and policy impacts, particularly in settings with significant inequality and demographic change.

A key advantage of disaggregating NTA by education is that educational attainment offers a relatively stable and observable proxy for long-term socioeconomic status. Unlike income or consumption, which can fluctuate with short-term macroeconomic conditions or reporting biases, education tends to reflect lifetime opportunities and constraints. It is also strongly associated with a range of well-being dimensions, including employment prospects, income level, health outcomes and access to services. Moreover, as a generally exogenous variable to the economic flows under study, education reduces concerns of endogeneity and facilitates clearer interpretation of the results.

The estimation of NTA by educational groups involves several methodological decisions that can significantly affect the resulting profiles. First, it is necessary to define whether education is measured at the individual or household level. Household-level education is often preferred when the goal is to capture socioeconomic inequality, under the assumption that all household members share a common standard of living. However, the choice of which household member's education best represents that standard – whether the household head, the most educated adult, or an average across members – requires careful consideration, especially in the context of multigenerational households.

Second, researchers must define the number of educational groups and the thresholds that separate them. These decisions must strike a balance between reflecting meaningful differences in educational attainment and ensuring sufficient sample sizes across age and education groups. Rapid educational expansion across generations may require alternative strategies, such as grouping by education relative to birth cohort or constructing indicators that are neutral to age. Failing to ensure adequate sample sizes may result in imprecise or unstable profiles that compromise the reliability of the analysis.

Third, estimating the population distribution by age and educational group typically requires combining census-based age totals with distributions derived from household survey data. This ensures consistency with the total population used in aggregate NTA estimates, while allowing for disaggregation by education. Where multiple data sources are available, conducting sensitivity analyses is recommended to assess the robustness of the estimates.

Finally, constructing the NTA values by age and education requires ensuring that the disaggregated values sum to the aggregate totals by age. This is achieved by first estimating smoothed per capita profiles for each educational group and then scaling them to match the total value by age. This procedure preserves the internal consistency of the NTA framework and ensures comparability across accounts.

NTA estimates by educational attainment provide a powerful tool for understanding economic flows across age and social groups. Their effective use requires careful methodological design, but they offer considerable value for both analytical and policy-oriented applications in the context of demographic change and persistent inequality.

Chapter 4: National Transfer Accounts by Income Quintiles

4.1 Introduction

NTA by income quintiles consist of tools to combine the age-specific analysis of the economy with an income-specific analysis. Disaggregating income, transfers and consumption by income quintiles, in addition to age, improves understanding of the generational economy and how it differs across countries and over time.

This chapter provides the groundwork for standardizing methodology for NTA by income quintiles and presents results for European countries. Doing a similar analysis for many countries within the NTA network improves understanding of differences between countries. The findings for Europe shed light on disparities within and across generations and their relations with country-specific institutional frameworks.

4.1.1 Combining age and income perspectives to analyse the economy

Standard NTA focus on age-specific mean values and contain little information on inequality in the generational economy. Mean values do not capture differences within age groups and do not contain specific information about the population at the bottom or top of the income distribution, although these aspects are of high interest. Consequently, researchers have started to disaggregate NTA by socioeconomic characteristics in addition to age and sex, including disaggregation by income. So far, the use of NTA by income quintiles has focused on three research topics:

1. Dispersion of labour income within age groups: Analysing labour income by quintiles adds information on its dispersion within age groups. This is important for comparing income distributions across countries and for understanding labour income changes over time.
2. Joint distribution of age and disposable income: Studying how the population is distributed by age and quintile of disposable income adds the age dimension to inequality research and highlights the differences in economic opportunities and well-being within and between age groups.
3. The generational economy of rich and poor households: Using NTA by income quintiles allows examination of how variations in disposable income relate to paying and receiving transfers, consumption and saving among different households.

4.1.2 A toolbox for comparative analysis of the economy by age and income

NTA by income quintiles integrate the age dimension into inequality research and thus constitute a toolbox for analysing income, transfers, consumption and savings by age and income level. This chapter suggests a standardization of some of these tools to facilitate and promote comparison between countries.

Clearly, comparable results require a common methodology. In NTA, for example, comparability is greatly improved by the combination of microdata and aggregate data from NA. The combined use of microdata and aggregate data captures the distributive information in the microdata and the higher reliability of aggregate data regarding total quantities and facilitates comparisons across countries due to the high standardization of NA data. For NTA by income quintiles, the standardization of income measures is a particularly important part of the methodology. It ensures that the income quintiles in each country are calculated according to the same income measure.

Not only the methodology but also the output needs to be standardized to enable cross-country comparisons. Among the most important outputs of NTA are indicators that provide insight into cross-country and time variations.

In standard age-specific NTA, the most popular indicators are the life cycle deficit and information on how public and private transfers finance it. These indicators are used to compare differences between countries. One of the objectives of this chapter is to describe and establish equally useful indicators for NTA by income quintiles. Examples are the percentage of an age group with no or very low labour income, the share of an age group in the quintile with the lowest disposable household income and the share of public transfers directed to the richest quintile.

Another important output of NTA is visualizations for highlighting specific aspects of the generational economy. In standard NTA, plotting age profiles of labour income and consumption illustrates strong age patterns and highlights childhood and retirement as periods in which consumption exceeds labour income. Percentile plots are similarly intuitive and add many details on the income distribution.

NTA by income quintiles generates a great deal of new information about the generational economy and allows researchers to answer a range of important questions, including how the age-specific dispersion of labour income differs between countries; how strongly age-specific mean values are influenced by the share of the population without labour income, whether age-specific income changes are similar for people with high and low income; whether specific age groups are overrepresented in the richest quintile of the population; where recipients of public transfers fall in the income distribution; and what share of public transfers goes to the highest and lowest income quintiles.

4.2 Literature review

Inequality and differences between rich and poor households are research topics of high interest, and many researchers have tried to improve understanding of heterogeneities by combining age and income perspectives.

4.2.1 Labour income by quintiles

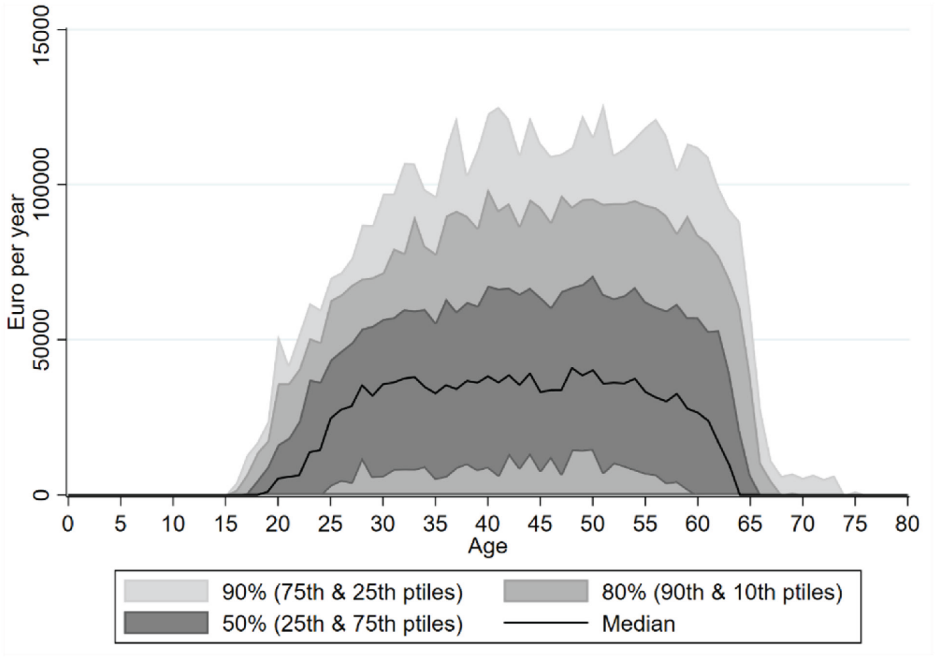
The age and sex-specific mean values in NTA do not contain information about the distribution of labour income within age groups. However, understanding differences between countries and changes over time requires information on the distribution and its change, not only mean values.

The mean values of age-specific labour income are affected by differences in hourly wages as well as labour force participation, unemployment and part-time work. Hammer and others (2022) show that the increasing share of those who do not receive labour income because of unemployment or non-employment is an important explanation for the decline in mean income among the young in Italy and Greece. By contrast, increasing employment rates are an important explanation for increasing mean incomes at age 60 and older. This study used detailed data to identify the reasons for changes in mean income. However, information on the distribution of labour income already reflects these changes and the reasons to a great extent, for example, in the share of the population without labour income. Providing information on the distribution of income within age groups improves understanding of age-specific differences in income and their changes over time.

NTA researchers have been discussing how to best include information on the income distribution within age groups in addition to age-specific means. Lee (2021) presents labour income by percentiles (figure 4.1, reproduced for Germany) and notes that important patterns cannot be easily identified by looking at the age profiles of percentiles. Age profiles for one-year age groups by quintiles for different countries and years contain too much information to be useful for analysis. Identifying changes requires indicators and graphical representations that simplify these complex patterns.

Dispersion measures, such as the Gini index, summarize information on the distribution in a single number. They have been applied to study the age-specific dispersion of labour income. Narayana (2023) uses the Gini coefficient to study inequality within age groups in India, introducing a measure of inequality-adjusted income and consumption by age in which the higher the Gini coefficient, the lower the age-specific values of consumption and income. The study then presents an inequality-adjusted life cycle deficit as the difference between inequality-adjusted consumption and income. This type of research, however, needs further discussion, as it is unclear what an inequality-adjusted life cycle deficit means.

Figure 4.1
Percentiles of labour income by age, Germany, 2019



Source: Lee (2021)

Applying dispersion measures to age-specific income in meaningful ways is generally difficult due to challenges in interpretation and calculation, as they reduce the information captured in the distribution of income too far. For example, a high age-specific Gini coefficient can result from many people having no income or a few having a high income. Furthermore, it is strongly influenced by how well those with high incomes are captured in the data. Using other standard dispersion measures is also challenging when applied to labour income – the quintile share ratio, for example, is not defined when the first quintile is zero due to a high share of the population with no income.

All of this means that focusing on age-specific percentiles in broad age groups is the most promising approach to study income distributions by age without being overwhelmed by the amount of information. For example, an important aspect of the distribution is the percentage of people who do not have labour income, which differs strongly between men and women, between countries and between years. The methodology and results section below introduces percentile plots as a useful tool to describe and analyse the distribution of labour income and its change over time.

4.2.2 Age and inequality: joint distribution of age and income

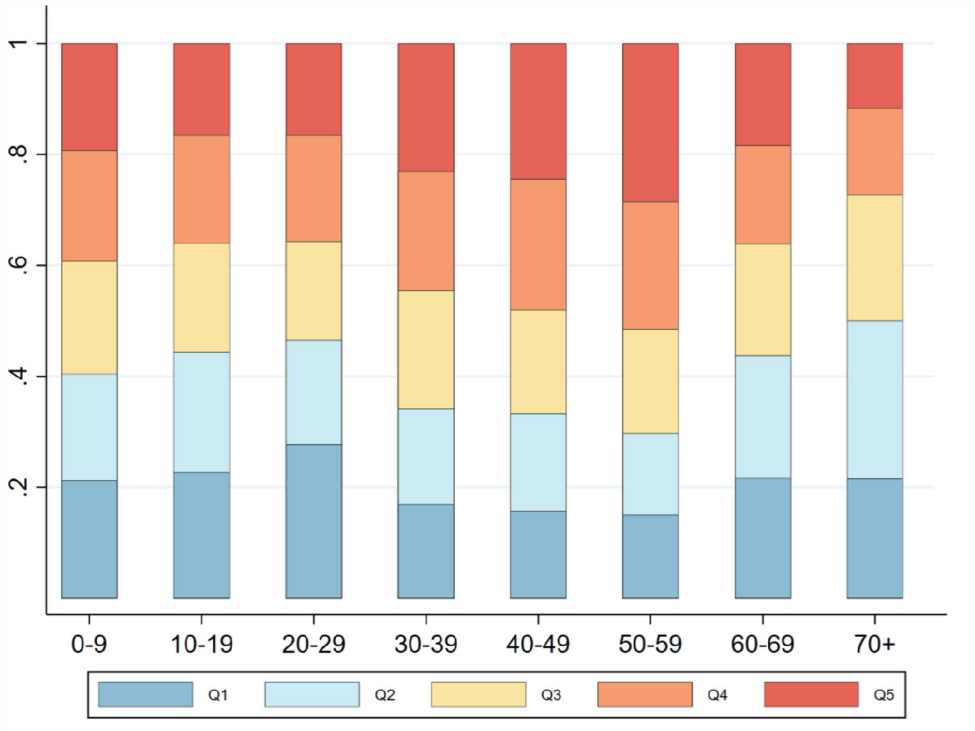
NTA by income quintiles includes methods to integrate the age dimension into inequality research and to analyse the joint distribution of age and disposable income. An intuitive way to show the joint distribution is by plotting the distribution of an age group over income quintiles calculated for the total population. These graphs add details on how the distribution differs between age groups. For example, a high mean income at a certain age may be the effect of a smaller share with no income or a larger share with a high income. Such differences are reflected in the distribution of age groups over income quintiles.

Rosero-Bixby (2004) shows the distribution of the population in Costa Rica by age and income quintiles. A plot of the stacked quintiles for 5-year age groups indicates that a higher share of young and older persons are in the lower income quintiles compared to the population in prime working age. Turra and others (2011) choose a similar graph by stacking age groups for each quintile.

Figure 4.2 shows the distribution of each age group to income quintiles in Germany. The income quintiles are determined according to the equivalised household income, which considers household structure to provide a comparable income-based measure of economic well-being across households. The data show that the age group 50–59 has the highest equivalised income. This result reflects the high average labour income at this age in Germany and the lower share of dependent children compared to younger age groups. Section 4.4 shows that these graphs and the underlying data are useful for studying the joint distribution of income and age and comparing it across countries.

Like NTA, Distributional National Accounts (DINA) aim to integrate distributional information into aggregate data, including some crude information on age. Piketty and others (2018) show that the incomes of the bottom half of the working-age population stagnated between 1979 and 2018 but increased for the population 65 and older. NTAs by income quintiles aim to provide such information for finer age groups and with more detail on the type of income and their distribution for many countries. Analysing the economy by age and income quintiles reveals important patterns and improves understanding of changes over time.

Figure 4.2
Distribution of each age group to quintiles of equivalised household income (OECD modified equivalence scale), Germany, 2019



4.2.3 NTA by quintiles of disposable income

The joint distribution of age and income provides a great deal of information on the organization of the generational economy and its outcome. The biggest contribution of NTA by income quintiles is the study of economic quantities, such as consumption and the payment and receipt of public transfers, by age and by position in the income distribution. Differentiating NTA variables such as income, transfers and consumption by disposable income quintiles shows how these variables differ not only by age but also by income level.

Rosero-Bixby (2004) analysed labour income and consumption by income quintiles for Costa Rica with the remarkable result that labour income was much higher for the highest income quintile than for the lower four income quintiles of the adult population, indicating high inequality. The shape of the consumption age profiles was similar for all quintiles, increasing strongly during childhood (NTA assumption) and peaking at around age 50 and in old age, with a pronounced increase in old age for the highest quintile. A characteristic pattern of NTA by income quintile is the concentration of asset income and payment of taxes in the quintile with the highest primary income.

The plot of the life cycle deficit by income quintile for Costa Rica in the above study nicely shows that the life cycle surplus increases for higher quintiles, but the life cycle deficit in young and old age also grows. Regarding education expenditure in Costa Rica, all income quintiles are relatively similar in public education, but only the highest income quintile spends on private education, which also explains the decrease in public education for this highest income quintile in young ages. The highest income quintile consumes the most public health services in old age and spends considerably more on private health over all ages. Such research is at the core of NTA by income quintiles, and more

similar research for other countries is expected in the years to come. Such research provides valuable insights, even when only one or two variables are analysed by income quintiles.

A particularly interesting NTA quantity that differs by income quintiles is public transfers. NTA highlights that public transfers are redistributed strongly from the working-age population to the population in retirement. However, they are also redistributed between income groups, with large differences in this redistribution between countries. Providing information on transfers by age and income level sheds light on the interplay between intergenerational redistribution and the income situation of households.

Turra and others (2011) combine the distribution of social benefits across income groups with the distribution of these benefits across age groups. They analyse social benefits by disposable income quintiles in Brazil and Chile, distinguishing education, health, family benefits and pensions. The substantial redistribution to the income-rich is remarkable, with the fifth quintile receiving 3.6 times more public transfers than the first quintile. The corresponding value in Chile is 1.5 times higher. They also show utilization rates and payments per beneficiary by age for quintiles 1 and 5. Such a representation allows study of the redistribution across income quintiles or ages and whether this redistribution is based on a higher utilization rate versus a higher payment per beneficiary. As they argue in their analysis, the relation between high public spending on the rich and older persons is partly explained by a high share of older persons in the upper-income groups. Overall, their analysis hints toward regressive pension systems, somewhat progressive health systems and neutral education redistribution. The study highlights that drivers of redistribution can be revealed much better by considering classifications that combine socioeconomic differences with generational differences.

Similar results have also been shown in the case of Europe, where many welfare states redistribute to the population with the highest disposable income. Hammer and others (2023) analyse public benefits directed to the quarter of the population with the lowest and highest equivalised household income, respectively. They distinguish between pensions and other types of public transfers. In southern European countries, many pensioner households are among the top earners because of high pensions, which capture a large share of public pensions. By contrast, there are almost no net public transfers to the quarter with the highest income in Denmark and the Netherlands.

4.3 Methodology

The indicators suggested by Turra and others (2011), Rosero-Bixby (2004) and other researchers provide useful tools for comparative research. To ensure that results from different countries are comparable, these tools must be standardized. In particular, researchers must agree on which income measure should be used to calculate NTA by income quintiles. Although this clearly depends on the research questions, research teams should provide a set of standardized results.

This section describes how NTA by income quintiles can be calculated to ensure comparability across countries and then describes percentile plots as a tool for analysing the age-specific distribution of labour income. Finally, it discusses challenges related to age-specific income analysis and suggest potential solutions.

The calculation of NTA by income quintiles is usually based on a representative household sample with individual information. At a minimum, it needs to contain information on the age of all household members, their income from employment or the household's disposable income. Such income surveys exist for almost all countries.

The NTA by income quintiles for Europe are based on microdata from the EUROMOD tax-benefit simulation model. EUROMOD uses data from EU-SILC and complements it with detailed estimates of taxes and benefits at the individual level. These data have been available for countries of the European Union for several years since 2007 and make it possible to highlight the differences between countries and the changes in recent years.

Methods to introduce distributional information in aggregate data have also been developed by the Distributional National Accounts (Alvaredo and others, 2024) and the OECD-Eurostat Expert Group on Disparities in a National Accounts Framework (Coli and others, 2022; OECD, 2024). The description of the methodologies is an excellent source of information to generate and analyse NTA by income quintiles. Particularly useful are the methods for adjusting microdata to aggregates from NA. In contrast to these approaches, NTA put demographic characteristics at the centre of the distributional analysis. Focusing on demography and income requires specific methods.

4.3.1 Combining microdata and aggregate data from NA

The consistency of NTA with NA is a central feature of the methodology and improves data quality. However, for NTA by income quintiles, the adjustment must be made with care. The population with high asset income is more likely to be underrepresented in survey-based microdata. This is less of a problem for the adjustment of age profiles in standard NTA. If the probability of being captured in the survey depends only on income and not on age, the proportional adjustment of the NTA age profiles suggested in the first NTA manual brings estimates closer to NA and improves their comparability over time and countries. However, the adjustment would bias the income-specific results. In the case of underreporting asset income and underrepresentation of wealthy households, proportional adjustment of the asset income of all households would overestimate its importance for those with moderate asset income and still underestimate income at the top of the distribution.

For those quantities that are well captured in surveys, the adjustment to aggregate data would be carried out directly in the microdata, by multiplying the economic quantity x for an individual i in the survey (x_i) with an adjustment factor (AF_x) based on aggregate data and the survey-based estimate for the total economy:

$$x\_adj_i = x * AF$$

with:

$$AF_X = X_{NA} / \sum_{i=1}^{N} (x_i * WEIGHT_i)$$

where the term X_{NA} represents the aggregate value for the variable x derived from NA (e.g. total labour income or social benefits received by individuals in the country) and x_i the individual values in the survey. The variable $WEIGHT_i$ denotes the number of individuals in the total population that the survey respondent i represents. By adjusting the microdata to NA aggregates, all estimates of mean values are consistent with NA aggregates, including age-specific means and any further disaggregation by age, income group, education and parental status.

In general, wages and salaries are income components that are well covered in survey data. The estimate of total wages and salaries based on survey data is usually close to its equivalent in NA, the "compensation of employees". Some differences may arise because social contributions paid by the employer on behalf of the employee are included in the compensation of employees in NA and NTA but may not be included in survey data. Since employers' social contributions are usually proportional to those paid by the employee, imputation is straightforward and usually delivers good results.

Public benefits are another type of income that is well captured in surveys. However, surveys include only private households. A considerable share of the primary beneficiaries of social benefits, such as older people and people in need of care, may live in collective households such as nursing and retirement homes. Survey-based estimates of age-specific populations should be carefully compared with administrative population data. If there is a gap, the aggregates should be downscaled before a proportional adjustment of microdata to aggregates. Suppose that the population 60 and older is 100,000, and the survey estimate is 95,000. In that case, the survey does not represent the total older population, and a factor of 95/100 should adjust the aggregate of pension and care expenditure.

For income from self-employment, there are larger differences between the survey and NA data (Törmälehto, 2019), in part due to underreporting and underrepresentation of rich households. The concept of self-employment income in surveys and mixed income in NA may also be different, and there are also differences in the definition of households in microdata and the household sector in NA. These differences are difficult to correct and should be carefully evaluated for each country.

Individual-level data should be adjusted to be consistent with aggregate data in NA whenever possible. Because of the high standardization of NA data and the more reliable values for the total economy, adjustments to NA data can improve comparison of the economic situation between countries and analysis of economic changes over time.

Microdata on asset income, however, suffer from underreporting and underrepresentation of high-income individuals. Consequently, there is a considerable discrepancy between the estimates of total asset income from surveys and the corresponding value in NA. Proportional adjustment would overestimate the asset income of households in the middle of the distribution. While there are methods to address this underrepresentation at the aggregate level (Coli and others, 2022), specific methods for adjusting by age need to be developed. If there is a huge discrepancy between the income captured in the survey and the value in NA, it is better to rely on survey data only.

4.3.2 Analysing the dispersion of labour income: percentile plots

One purpose of NTA by income quintiles is to analyse the dispersion of labour income. It is recommended to define labour income in the same way as in NTA, including income of employees including taxes and social contributions and the labour share of self-employment income, assumed to be two thirds of self-employment income.

Labour income can serve as an indicator of economic well-being for the working-age population, as it is the most important source of income. One advantage is its availability at the individual level. For example, if one were researching how economic crises affect young people's income and their ability to rent or buy a home for themselves in southern Europe – where many young adults live with their parents – a measure of household income would reflect the income of their parents. Labour income measured at the individual level highlights the economic position of distinct generations even when they live in the same household.

To analyse the dispersion of labour income, it is recommended to focus on percentiles and differences in them between age groups and countries. To obtain meaningful estimates for each percentile, it is necessary to group the population into broad – at least 10-year – age groups.

Percentile plots are a versatile tool for studying the distribution and dispersion of NTA quantities such as labour income. Income percentiles divide the population into 100 equally sized groups according to income. For example, if the income in the 60th percentile is 30,000 euros, 60 per cent of the population has an income lower than 30,000 euros. Percentile plots provide detailed information about the whole distribution of income and are intuitive and easy to understand.

Standardizing visualizations and indicators makes concepts and results more visible and easier to comprehend. For basic NTA, this includes the age profiles of consumption, labour income and life cycle deficit. Percentile plots of labour income can serve as one tool to highlight the results of NTA by income quintiles by helping to identify differences in the lower and upper parts of the income distribution. The percentiles of labour income can also be used to generate indicators that summarize certain aspects of the income distribution, for example, the share of the population with no labour income in each subgroup or the differences between the first quartile, median and third quartile.

4.3.3 Analysing the distribution by age and disposable income

Research on the two-dimensional distribution of age and income needs to carefully justify the concept of income. If income is interpreted as a measure of well-being, it should capture the economic situation of individuals or households and include all types of income, including social benefits. It may also reflect the household or family size and structure as a proxy for differences in expenses. For example, parents with dependent children require higher income to be equally well-off compared to persons without children because of the transfers they need to make to the children. The exact measure of income needs to be justified by the research question, but it is recommended to use both a measure of household income and of individual income.

Most research that uses income as measure of socioeconomic status and economic well-being is based on equivalised household income (EHI), which assumes that income is shared within the household and adjusts net disposable income of households for household size and structure using an equivalence scale, making the well-being effect of income comparable between distinct types of households. One of the most common equivalence scales is the OECD scale, which weights the first member with 1 (like a single household) and assumes that additional adults require only half the income of a single household to be as well-off. Children below 14 years of age are assumed to require 0.3 income equivalents to enable the same living standard. Equivalised income is consistent with the research of the EG-DNA group of the OECD and is also used by the European Union.

The use of household income rather than individual income has some data-related advantages. Family allowances and asset income are captured in surveys only for the household, not at the individual level. A comparison across countries must be made to ensure that these components are assigned reasonably and similarly in all countries. The NTA approach of assigning these components to the household head may be sufficient for age-specific analysis, but not for gender- or income-specific analysis. A solution between individual and household income would be to assume income sharing within a couple, which solves the problem of assigning family benefits and sharing asset income between partners.

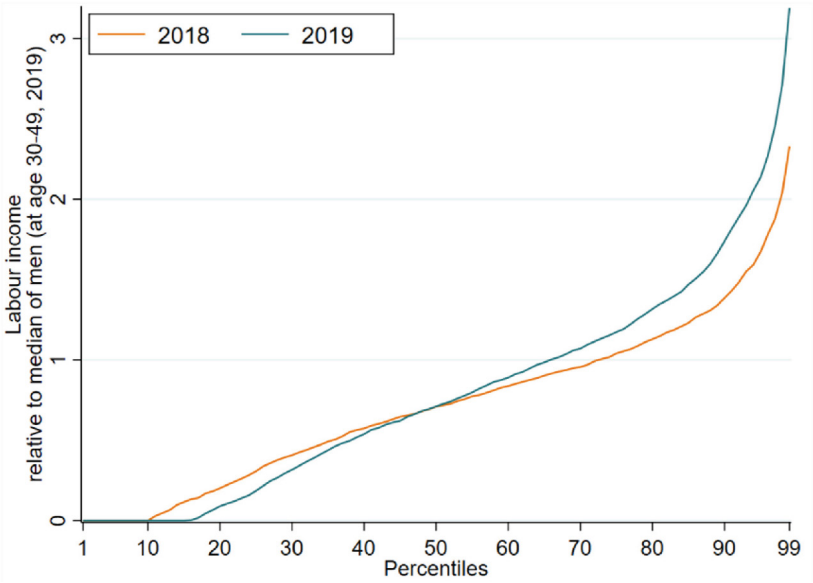
For analysing NTA by income quintiles, it would be more straightforward to use individual income, since the unit of analysis in NTA is the individual, grouped by age. Individual income has the advantage that it reflects opportunities for individual household members, such as the financial ability of the young population to set up their own households and have families and children. This is highly relevant in countries where young adults stay in their parents' household until they reach a higher age, as household income would reflect their parents' income, not their own.

Analysis of the joint distribution of age and income uses equivalised household income, but NTA researchers are recommended to also aim at an analysis of age and individual income. Income components that are given at household level should not be assigned to the household head, but assigned to the person who is most likely to receive the income or shared among all adult members. Family benefits should be shared between the parents.

The income measure for calculating quintiles should only be adjusted to NA aggregates if the survey estimates of the income components are close to the NA value. Otherwise, the quintiles should be formed according to the income available in the surveys and not adjusted to the NA aggregates. It is reasonable to assume that asset income missing at the top does not lead to a reordering of households in the income distribution. Such an approach still allows the analysis of NTA quantities adjusted to NA aggregates, with only quintiles calculated according to the non-adjusted income.

The age-income plots suggested by Rosero-Bixby (2004) enable the comparison of living standards over age groups and can also be used to derive indicators such as the share of the young working age population or the retired population in the highest or lowest quintile.

Figure 4.3
Percentiles of labour income, ages 30–39, Germany, 2018 and 2019



Source: Eurostat; EUROMOD microdata.

4.3.4 Public transfers by income quintile

An important function of public transfers is the support of low-income households. However, most public transfers are independent of age or favour those with high income. For example, in many central and southern European countries, a considerable part of public pension expenditure is directed to the richest quintile.

The analysis of public transfer benefits by age and income quintile gives insight into the different orientation of welfare systems across countries. These differ considerably in how generous they are toward rich retirees. Because support to those with low levels of economic well-being is an important function of public transfers, they should be analysed by quintiles of equivalised income. At the same time, the analysis should also be carried out by individual income, which better reflects differences between generations, even when they live in the same household.

4.3.5 Challenges

Calculation and analysis of NTA by income quintiles requires a thorough sensitivity analysis. The calculation of age profiles is very robust. Changes in sampling and data collection affect all age groups in similar ways, which is not the case for income percentiles. Figure 4.3 shows the percentiles of labour income in Germany in 2018 and 2019. A methodology change can explain the differences, as EU-SILC was integrated in the newly designed microcensus (Eurostat, 2020). Not all changes are as apparent and well-documented as this one, so careful sensitivity analysis is required to avoid an incorrect interpretation of differences across countries or time points.

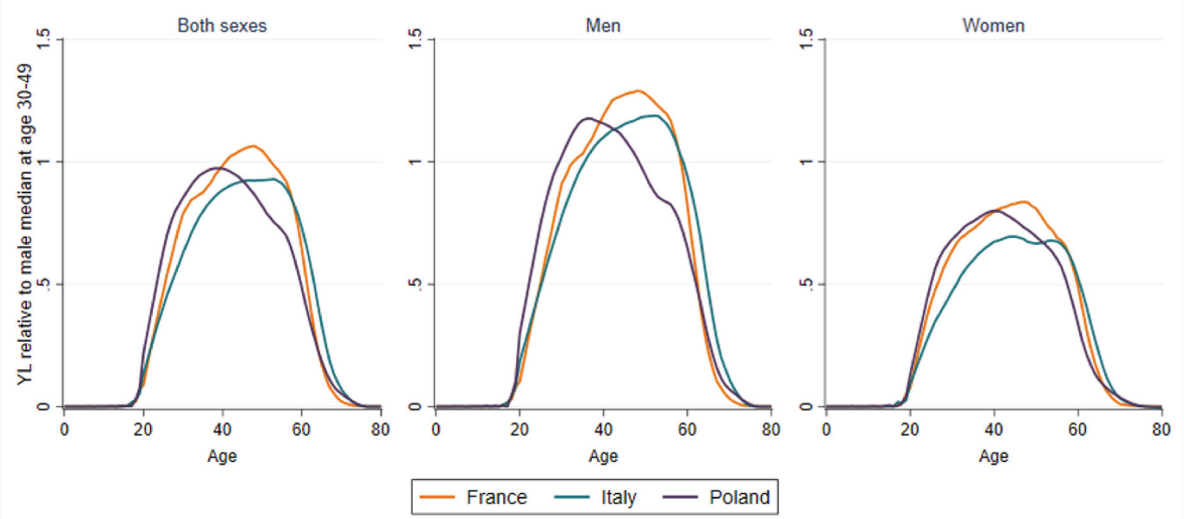
4.4 Applications

NTA estimates by income quintiles for European countries offer insights into the distribution of labour income within age groups, the joint distribution of disposable income and age and the receipt of public benefits by equivalised household income. Specific questions motivate each research topic and its methodology, and the results are discussed in the context of lessons learned from European countries.

4.4.1 Age-specific labour income

Information on the dispersion of labour income within age groups is of great interest when comparing countries or changes in labour income over time, shedding light on the share of the population without labour income and how it differs across countries, whether women's lower income compared to men is an effect of employment rates or lower wages and whether economic crises affect all income groups equally.

Figure 4.4
Age profiles of labour income in France, Italy and Poland, relative to the median of men aged 30–49, 2019



Source: Authors' own calculations based on EUROMOD.

The age profiles of mean labour income reveal interesting differences between countries (figure 4.4). In Poland and other Eastern European countries, labour income peaks at younger ages, around 35–40, while in Western European countries such as France or Italy, the peak of labour income is much later, around age 55. One possible explanation is that in Eastern Europe, young people have benefited more from new economic opportunities and the substantial increase in wages since the accession of the European Union. NTA by income quintiles highlight that is not just the age-specific means that differ but also the age-specific distribution of labour income.

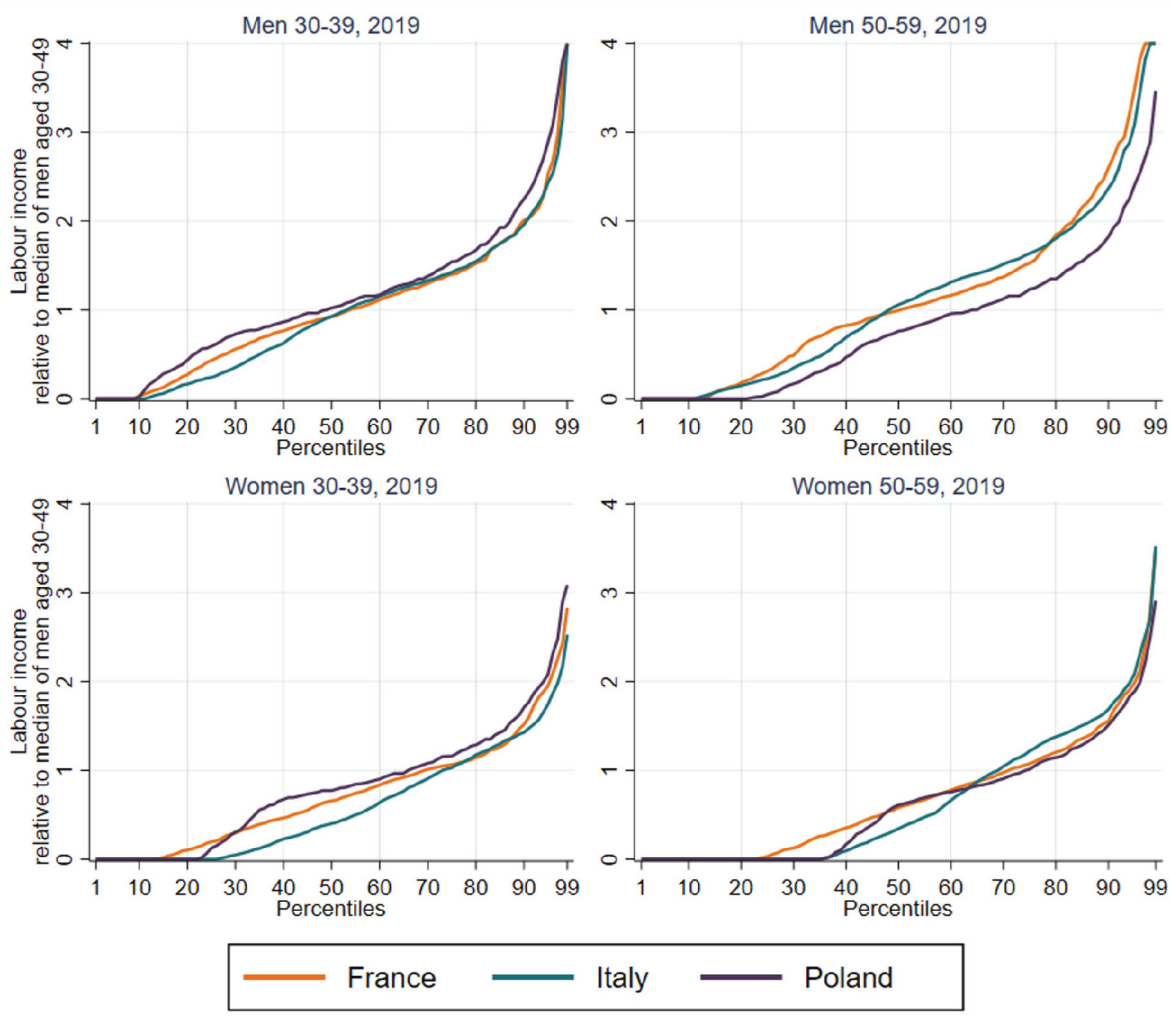
Deeper insights into the cross-country differences of labour income age profiles can be gained by looking at the distribution of labour income within age groups, illustrated by plotting percentiles for different age groups, countries or years. These graphs provide information about the lower and upper tails of the income distribution. To facilitate comparison across countries, labour income is normalized by the median of men aged 30–49 years. Since men in

this age group are typically employed full-time, their median income is a reference point for comparing income levels across countries.

The percentile plots reflect the age-specific differences already captured in the age profiles of mean values. Figure 4.5 compares men and women in Italy, France and Poland at ages 30–39 and 50–59. In Poland, labour income peaks at young ages, around ages 30–39, reflected in the higher income relative to the median of men at ages 30–49. However, the opposite pattern is see at ages 50–59, with much lower income in Poland, especially for men.

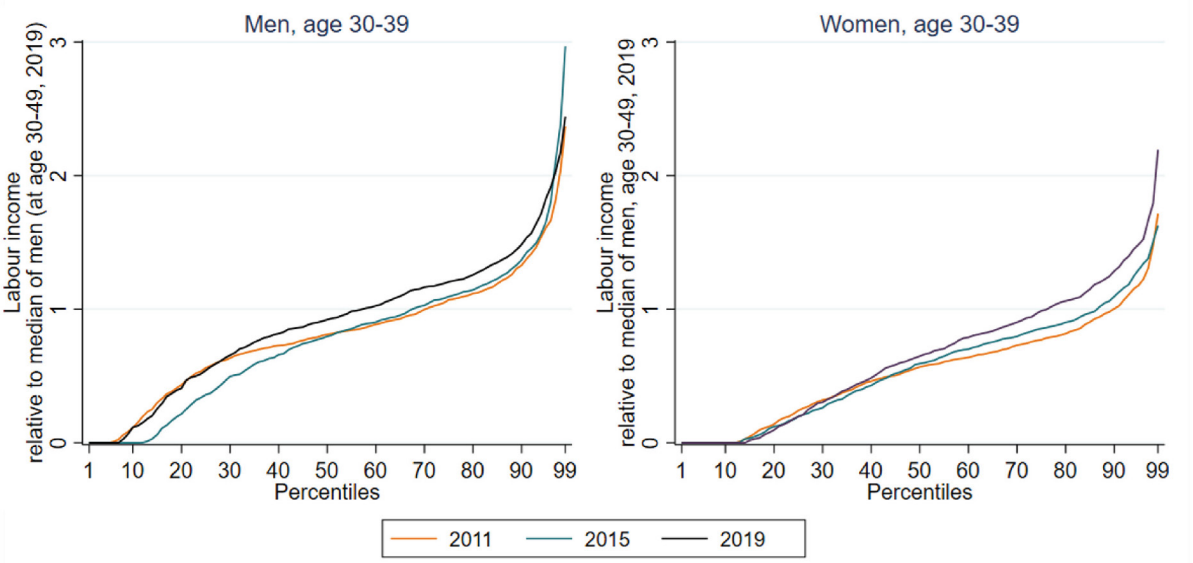
Figure 4.5

Labour income, percentiles by age and sex, relative to the median of men aged 30–49 years, France, Italy and Poland, 2019



Source: Authors' own calculations based on EUROMOD.

Figure 4.6
Labour income, percentiles by year and sex, Sweden, 2011, 2015 and 2019



Source: Authors' own calculations based on EUROMOD.

Percentile plots deliver more information about the distribution and thereby a better understanding of differences across countries. For example, the percentile plots of labour income reflect differences in labour force participation. Italy is characterized by a large share of the population with very little or no labour income. More than 30 per cent of Italian men 30–39 years old had an income of less than half the median at 30–49 years of age, used to normalize results. This pattern reflects the difficulties of the young population in the labour market.

The distribution of labour income within age groups is highly relevant from a gender perspective because the differences between countries are more pronounced for women than for men. In France and Poland, only 30 per cent of women aged 30–39 have a labour income less than half of the median of men, which is well above the 50 per cent found in Italy. This pattern reflects low employment rates and a higher prevalence of temporary or part-time work among women in Italy. France had the lowest share of women without labour income among the three countries, although a larger share of them worked part-time. This is rather uncommon in Poland, where, if a woman works, it is full time, as reflected in a much stronger increase in labour income at the 40th to 50th percentiles compared to France.

The analysis of labour income by percentiles also shows important changes over time (figure 4.6). Incomes of Swedish men with income below the median decreased between 2011 and 2015 but increased again until 2019. Incomes above the median increased between 2011 and 2015 and then even more between 2015 and 2019. Results for Swedish women are more pronounced, with incomes below the median remaining similar in all three years while those above the median increased, especially between 2015 and 2019.

The analysis of multiple countries requires indicators to summarize information. The economic situation of young working-age women aged 30–39 is used here to demonstrate the use of such indicators, by calculating the percentage of this group with a labour income less than half the average income of men aged 30–39. Italy, Austria and Germany have particularly high values (table 4.1), with more than half of women aged 30–39 having a labour income less than half of the male median. In Italy, a large proportion of women do not have labour income due to care responsibilities and the higher unemployment rate. In Germany and Austria, the high rates of part-time work among women result in low incomes compared to men.

Table 4.1
Percentage of women aged 30–39 with labour income of less than half of the male median at age 30–49, 2019

Central and Western Europe	
Austria	54
Belgium	37
Germany	51
France	42
Luxembourg	35
Netherlands	45
Northern Europe	
Denmark	36
Finland	39
Ireland	46
Sweden	41
Eastern Europe	
Czechia	50
Estonia	37
Croatia	39
Hungary	43
Lithuania	40
Latvia	40
Poland	34
Romania	38
Slovenia	30
Slovakia	44
Southern Europe	
Cyprus	43
Greece	49
Spain	45
Italy	55
Portugal	31

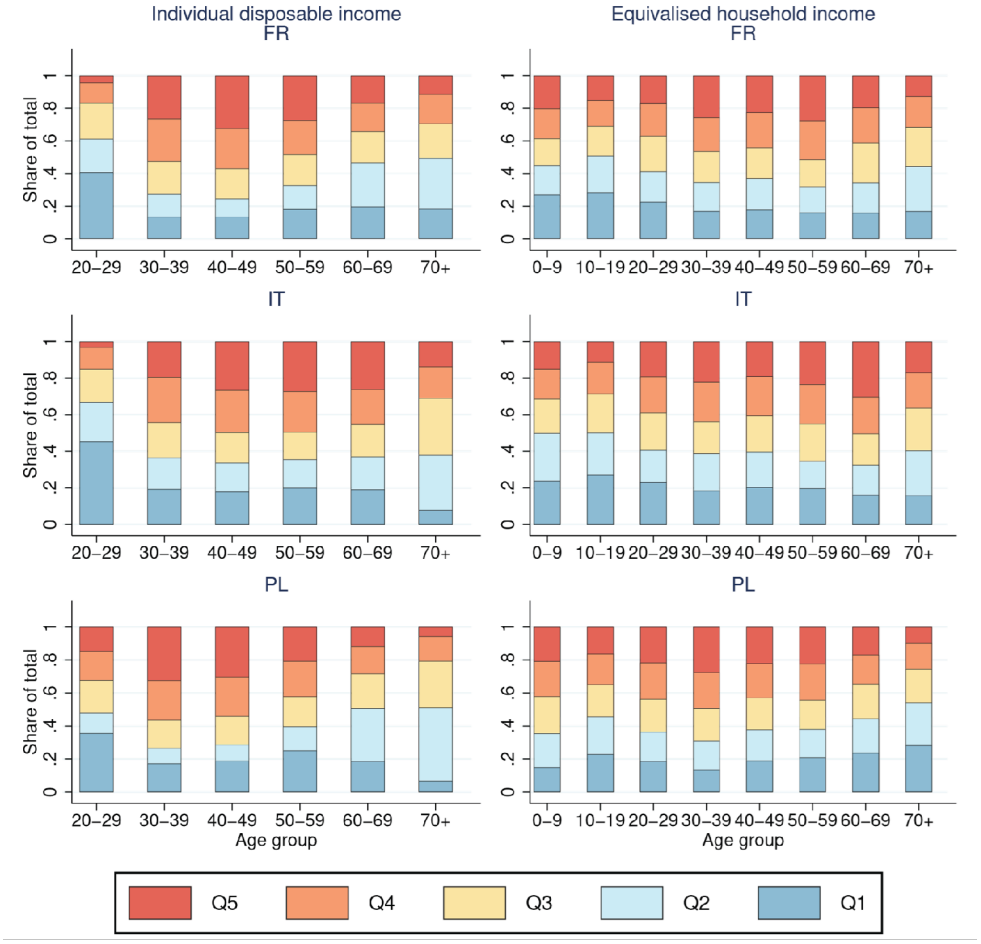
4.4.2 Income distribution among age groups

The ways in which disposable income is distributed among different age groups affect opportunities and economic well-being. While age-specific means provide a general understanding, a comprehensive assessment requires information on the distribution, including whether certain age groups are overrepresented in the richest or poorest quintile, where the young working-age population stands in the income distribution and how these distributions differ across countries. It is also essential to compare these distributions across countries and assess the impact of the financial crisis on the distribution of disposable income.

The results of NTA by income quintiles for Europe in figure 4.7 show the differences in income concepts and differences across countries. The graphs on the left display the outcomes based on individual disposable income, showing that

in Poland, the higher income among young people is attributed to a higher proportion of young people in the highest income quintile (Q5) rather than a low representation in the lowest quintile (Q1). An interesting observation from the distribution of the population aged 70 and older across income quintiles is that in Italy and France, a comparatively larger proportion of older adults falls within the top two income quintiles, whereas in Poland, this proportion is relatively small.

Figure 4.7
Distribution of each age group over income quintiles, France, Italy and Poland, 2019



Household income adjusted for household size and composition (EHI) is a measure of economic welfare. It takes into account the sharing of income within the household and adjusts for the household size and economies of scale. EHI is more evenly distributed across age groups because high disposable income age groups typically share their income with children. In Italy and France, children are most likely to live in households in the first and second quintiles (Q1 and Q2), while in Poland, higher income among the younger working-age population affects this pattern.

The results shown in figure 4.7 allow for comparison of a larger number of countries. For example, the share of the population aged 70 and older in Q5 (figure 4.8) can be used. Europe exhibits a divide between its northeast and southwest. In northern Europe, a relatively small percentage of the oldest population falls into Q5, ranging from 4 per cent in Ireland to 9 per cent in the Scandinavian countries. In Hungary and Luxembourg, this share is 21 per cent.

Table 4.2
Percentage of the age group 70+ in the richest quintile, 2019

Central and Western Europe	
Austria	17
Belgium	6
Germany	12
France	13
Luxembourg	21
Netherlands	8
Northern Europe	
Denmark	9
Finland	9
Ireland	4
Sweden	9
Eastern Europe	
Czechia	4
Estonia	5
Croatia	13
Hungary	21
Lithuania	5
Latvia	7
Poland	10
Romania	8
Slovenia	14
Slovakia	9
Southern Europe	
Cyprus	17
Greece	16
Spain	14
Italy	17
Portugal	18

Enhanced percentile plots

Percentile plots can provide detailed information about the distribution and types of income within specific age groups. Figures 4.8 and 4.9 show the average individual disposable income and its components for each percentile for the age groups aged 30–39 and 70+ in Italy and Poland. The income levels that separate the quintiles are represented as horizontal lines. These lines intersect with the percentile profile of disposable income, providing information on the distribution of different age groups across income quintiles, as shown in figure 4.7.

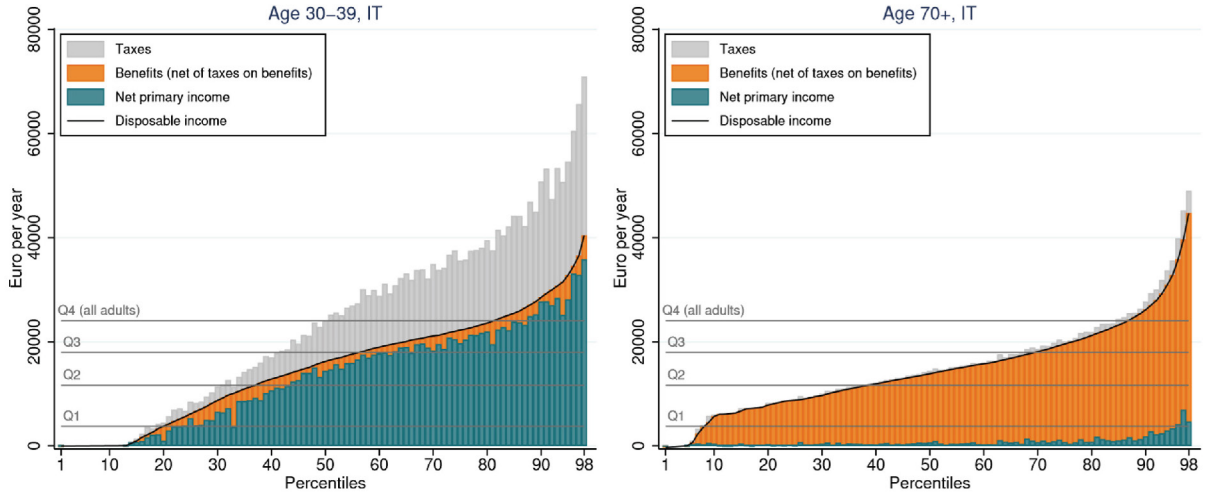
The disposable income of people aged 30–39 in all countries comes from employment, with public benefits playing a minor role and being evenly distributed across all income levels. For those aged 70 and older, income consists almost entirely of public transfers. In Poland, almost all individuals in this age group receive some transfers, whereas in Italy, about 10 per cent of the population receives no or little transfers. Despite this, a higher proportion of the 70+

age group in Italy falls into the two quintiles with the highest income compared to Poland, indicating that transfer benefits relative to the working-age population are higher in Italy.

4.4.3 Public transfers by quintiles of disposable income

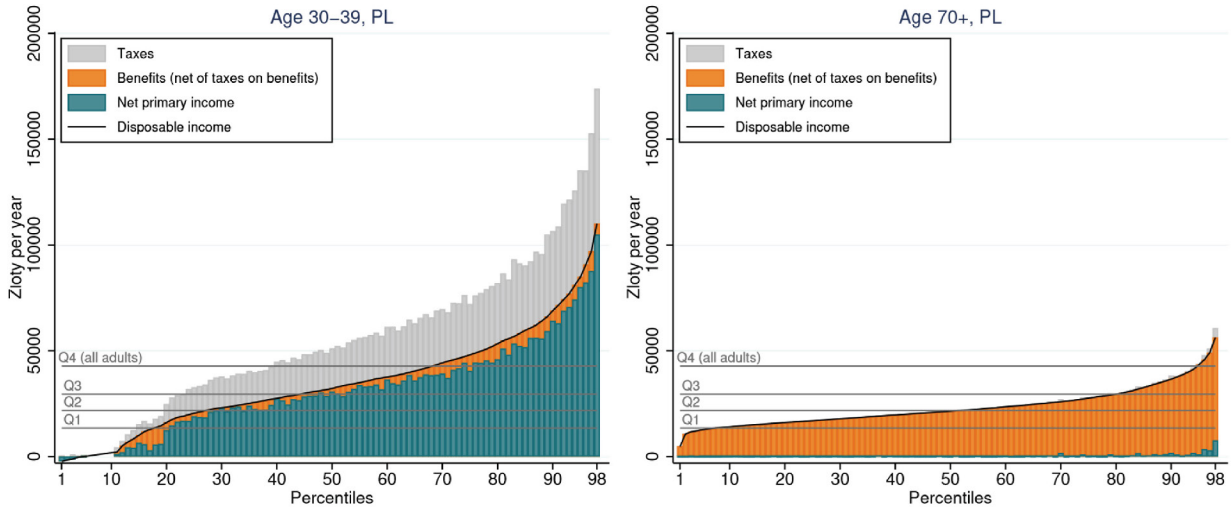
Paying and receiving public transfers is closely related to age and income and differs widely across countries in terms of what part of public transfers goes to high-income households and what the share of public transfers is directed to the poorest quintile.

Figure 4.8
Percentiles of disposable income and its components, age 30–39 and 70+, Italy, 2019



Source: EUROMOD.

Figure 4.9
Percentiles of disposable income and its components, age 30–39 and 70+, Poland, 2019

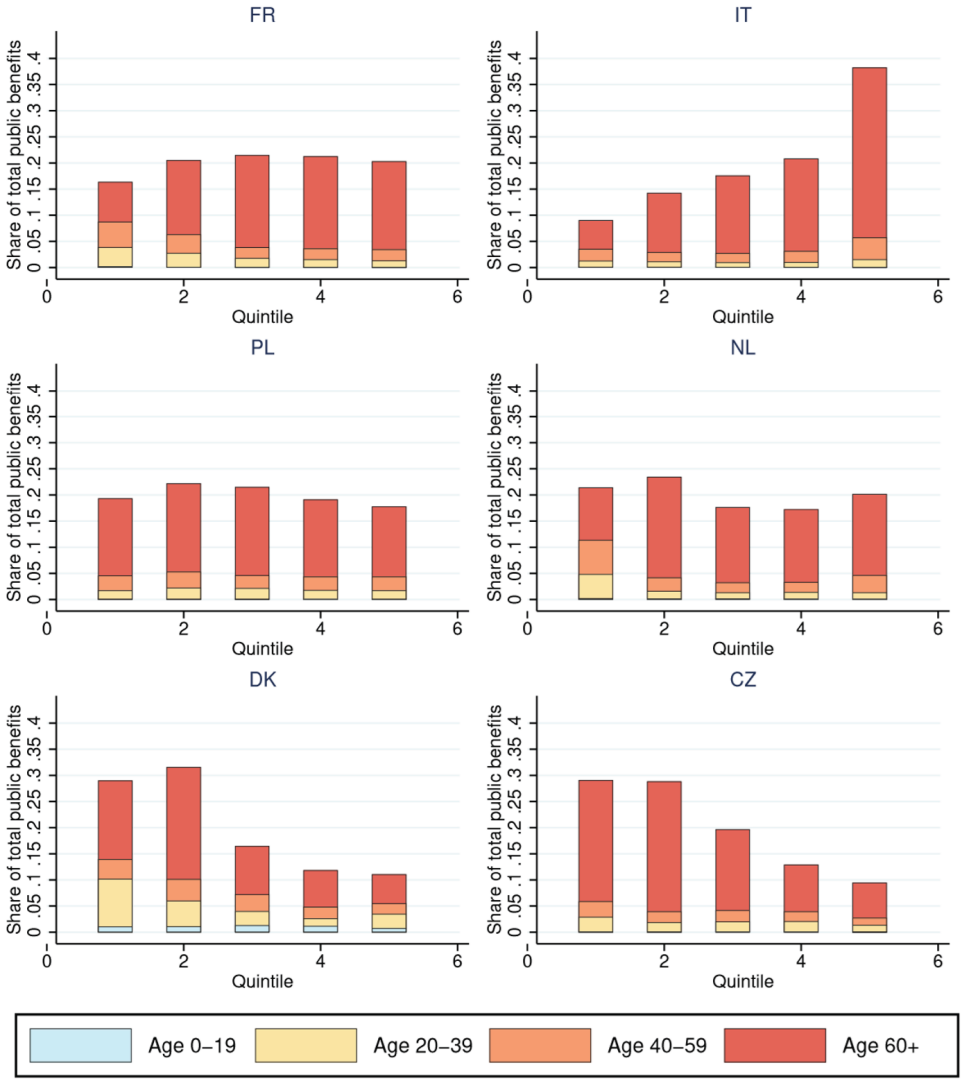


Source: EUROMOD.

Public transfers are often viewed as a primary way to help low-income households, but in many countries, pensions are the most significant benefit programme. If pensions are tied to past earnings and not limited, they end up redistributing money to those with higher income, so it is important to understand how much of the total public transfers go to the groups with the lowest and highest equivalised income.

The distribution of public transfers by income quintile across countries is an interesting research area due to significant differences in the shares received. Figure 4.10 shows the share of public transfers received by each income quintile and the age of the recipients. In Italy, 40 per cent of public transfers go to the wealthiest quintile, and most transfers to all quintiles are pensions for people aged 60 and older. In contrast, in Denmark and Czechia, the majority of public transfers are directed to the quintiles with the lowest incomes. In Denmark, many non-pension transfers go to younger age groups. In France, the Netherlands and Poland, public benefits are equally distributed among all quintiles.

Figure 4.10
Public transfers by quintile of equivalised income and age, France, Poland and Denmark, 2019



Source: EUROMOD.

The allocation of public benefits to the quintile with the highest equivalised income varies across European welfare systems (table 4.3), with low values of less than 20 per cent in northern and many Eastern European countries and the highest values of 30 per cent or more observed in Luxembourg, Hungary, Italy and Portugal.

Table 4.3
Public transfers directed to the quintile with the highest income, 2019

Central and Western Europe	
Austria	26
Belgium	19
Germany	21
France	20
Luxembourg	32
Netherlands	20
Northern Europe	
Denmark	11
Finland	17
Ireland	10
Sweden	18
Eastern Europe	
Czechia	9
Estonia	17
Croatia	24
Hungary	33
Lithuania	17
Latvia	22
Poland	18
Romania	21
Slovenia	20
Slovakia	16
Southern Europe	
Cyprus	39
Greece	28
Spain	29
Italy	38
Portugal	40

4.5 Conclusions

Combining age and inequality dimensions to analyse the economy is a promising research project. NTA by income quintiles consists of valuable instruments for describing the age-specific income distribution and examining differences between countries and changes over time, enabling a much deeper understanding of the generational economy and its change over time.

So far, the disaggregation of NTA by income quintiles has focused on three areas of research: analysing the distribution of labour income within age groups; studying the joint distribution of age and disposable income; and analysing NTA quantities by income level, with a focus on public transfers. This chapter provides suggestions as to how these can be addressed to facilitate comparisons across countries. It describes central concepts and the calculation of income and suggests indicators and visualizations to compare results across countries. Percentile plots are especially helpful for visualizing the age-specific income distribution and the differences between age groups, countries and distinct time points and can also be extended with information on types of income.

In this chapter, NTA by income quintile tools and concepts are applied to European countries, with results revealing large differences across countries and over time. The analysis of labour income by income percentiles highlights differences in the shape of the distribution within age groups, reflecting wages, but also the share of the population outside the labour force and the prevalence of part-time work. The joint distribution of age and income differs considerably across countries; in Eastern European countries, a large share of the young working-age population is found in the highest income quintile compared to other European countries. A particularly striking result is the huge difference across countries in how much governments redistribute to the population with the highest income. While in Portugal and Italy about 40 per cent of public transfer benefits are directed to the quintile with the highest income, this value is only around 10 per cent in Ireland and Denmark.

The results of NTA by income quintiles provide valuable input to the discussion of how to adjust public transfers to an ageing population. If a large proportion of public transfers is directed to the high-income population, the solution looks very different compared to a situation in which public transfers serve to maintain the basic living standard of individuals. Comparison between countries provides information on adapting behaviour and institutions to an ageing population while maintaining generational fairness and protecting those with low income.

Chapter 5: National Transfer Accounts by Family Type

5.1 Introduction

The NTA project has two main objectives. The first is to study the demographic transition and measure how resources are distributed among different age groups. This is achieved by incorporating age into the SNA and leads to the second objective, which is to measure the roles of public and private transfers and asset-based reallocations – the three devices by which resources are reallocated over the life cycle – and offers comprehensive estimates of transfers occurring within a family. This process, along with the breakdown of accounts by gender, leads to the need to measure home production, consumption and the resulting time transfers (NTTA).[2] This chapter goes a step further by disaggregating NTA by family type, a natural extension of the project.

This chapter investigates how income is redistributed within the same generation together with the intergenerational redistribution embedded in standard NTA. As discussed below, this adds a new dimension to income redistribution that has not been widely explored in the literature on inequality.

The estimates provide valuable information for understanding the consequences of changes in family structure during socioeconomic development. Research in social science has been greatly influenced by the demographic transition, leading to new areas of literature. Population economics and family economics are now established as research fields within economics. Family economics examines various family decisions, including interactions between partner formation, fertility, labour market and investment decisions. Population economics addresses macroeconomic effects, as in the Unified Growth Theory, which simultaneously endogenizes long-run fertility and growth trends (Galor and Weil, 2000). There are also growing calls to integrate changes in family structure into dynamic macroeconomic models, including attempts to do so in short-run real business cycle models.[3] Similar efforts to investigate the interplay of economic and demographic development have been taken in various alternative disciplines, including demography, economic history, sociology and political science. In the demography literature, a change in values and needs is posed as one of the drivers of fertility decline. In the sociological literature, Esping-Andersen (2016) calls for a theory to explain the relationship between the maturity of the so-called "women revolution", birth rates and the stability of partner relations. His starting point is that the negative correlations between women's education, fertility and couple stability have weakened in more recent data (Esping-Andersen and Billari, 2015). The tipping point for this sea change appears to coincide with evolving gender roles, characterized by greater participation of men in home production activities.

The NTA estimates by family type offer valuable new data to analyse the wide range of research questions mentioned earlier. More specifically, these data visualize in more detail the incidence of family transfers at the core of the NTA research agenda. Hence, on the one hand, these data can better contribute to the understanding of the interactions between private and public transfers and asset-based reallocations in different countries at different development states, including in what is referred to as the welfare state regime. On the other hand, they can help to understand the role of family arrangements in the size of the gender gap. The "Applications" section below shows some examples, such as measurement of the gender gap in terms of the life cycle explicitly considering the role of family arrangements as in Abio and others (2023). Additionally, the case study in this chapter measures to what extent parents transfer resources to their children despite receiving insufficient compensation from the government. Society primarily supports older adults' consumption, while children depend on private transfers from their parents. This implies a new form of income redistribution from parents to individuals without children, such that, if public pay-as-you-go

[2] NTTA was developed by members of the Counting Women's Work (CWW) project (www.countingwomenswork.org).

[3] See Doepke and Tertilt (2016) for a survey.

transfers are available, having children results in a positive externality for those without children (Bovenberg, 2007). Spielauer and others (2022) use this disaggregation to measure the extent of this externality along the life cycle.[4] This finding suggests a need for welfare policies to take a balanced approach across the life cycle and genders while also considering non-market production, consumption and transfers within the household.

5.2 Literature review

NTA methodology (United Nations, 2013) has become a widely accepted approach for studying the generational economy in a world undergoing the demographic transition. In addition to the standard NTA method, some extensions have been developed to provide more detailed per capita profiles by education level and socioeconomic status (Rentería and others, 2016; Hammer, 2015; Abio and others, 2017).[5]

Another crucial dimension to consider in NTA analysis is the role of family characteristics. Usually, individuals do not live alone but share a household with family members for at least part of their lives. Economic behaviours throughout a person's life cycle (such as work, consumption, saving and transferring resources) depend significantly on the specific household characteristics in which they live.

Some attempts have been made to include family characteristics in NTA analysis by examining characteristics beyond age. For example, Vanhuysse and others (2023) estimated age profiles of public and private transfers for parents and non-parents of working ages in 14 European countries. They based their analysis on the NTA and NTTA profiles provided by the AGENTA project,6 focusing on identifying differences in resource-sharing patterns between parents and non-parents. In Europe, old-age consumption is primarily funded by public transfers from the working-age population, while children rely more heavily on private transfers from their families. Due to this, these authors concentrated on transfers (both public and private) of the working-age population, excluding other NTA flows such as consumption, production and savings. Also, they integrated non-market transfers (NTTA) into the analysis as these are essential for correctly assessing the amount of resources received by children. Their findings underscored the significant effort parents put into sharing resources, with their total net transfers being 1.8 times those of nonparents.

In another recent study, Hammer and Prskawetz (2022) examined private transfers by age, gender and parental status in Austria. The study focused on the patterns of parents and non-parents sharing their private resources through market (NTA) and non-market (NTTA) activities. They found that Austrian parents dedicate around one third of their disposable income to their children, and they spend approximately four hours per day on non-market work. The study did not cover public transfers.

The research conducted by Abio and others (2021a) provided comprehensive NTA age profiles for four European countries: Austria, Finland, Spain and the UK. These profiles were broken down by gender, education and household arrangement. The researchers faced challenges due to the smaller sample size when more dimensions were introduced in the disaggregation. They decided to address the issue by grouping the data into five-year groups for individuals aged 30 and older and using age groups corresponding to the main education levels of the younger individuals (0–3, 4–7, 8–11, 12–16, 17–21 and 22–25). Another challenge was reconciling the cross-sectional nature of the NTA methods with the longitudinal nature of people's lives. Education levels and living arrangements change throughout life, so the researchers had to make assumptions about the education levels of individuals who

[4] Patxot and others (2012) proposed this measurement using standard NTA data in the context of the literature on intergenerational transfers.

[5] The *Journal of the Economics of Ageing* devoted a special issue (Number 27, February 2024) to collect different research papers on extensions of the NTA standard method by socioeconomic status, mainly educational level.

[6] AGENTA was a project with funding from the EU's Seventh Framework Programme aimed at explaining the effects of demographic change on public finances in the EU. Among other outputs, it produced NTA profiles for 25 European countries, and NTTA profiles for another 14, all referring to the year 2010, which are publicly available at https://dataexplorer.wittgensteincentre.org/nta/.

had not yet completed their education due to age. Also, family structure changes during an individual's life cycle, and the profiles based on family characteristics reflect age and cohort effects.

The approach described in this chapter for disaggregating NTA by family characteristics is based on the research by Abio and others (2023).[7] It differs from the method used by Abio and others (2021a) regarding the types of living arrangements considered. In Abio and others (2021a), the breakdown of NTA profiles was explicitly designed for later use in a microsimulation model (see Spielauer and others, 2022 and 2023) focused on individual characteristics, such as partnership and parenthood status, without considering other specific features such as other co-residing members in the household. They identified nine types of individuals, the first two for those aged 0–24 and still in the education system and the rest for adults, defined as aged 17 and older and not enrolled in education. The simultaneous consideration of educational attainment heavily influences this disaggregation. The goal is to distinguish between dependent children aged 0–24, enrolled in the education system and living with their parents, independent children aged 17–24 who are still enrolled in the educational system but have become independent, and those aged 17–24 who have completed their education, irrespective of their household arrangement, who are classified into the adult profiles. On the other hand, adults (17 and older and not enrolled in education) are classified based on partnership (living alone or in a couple), parenthood status (parents or non-parents) and gender (except for single parents), resulting in a total of seven types for each level of education.

These NTA data by gender, education and family characteristics developed for four European countries (Spain, Austria, Finland and the United Kingdom) were later employed in a microsimulation model called microWELT to project the future evolution of key variables such as income, consumption and public and private transfers for current and future cohorts (Spielauer and others, 2022 and 2023).[8] The simulation model projected the net transfers individuals receive over their lifetimes from both the government and their families and calculated the adjustments needed to maintain the financial sustainability of the welfare system. Spielauer and others (2022) found that parenthood was a major factor influencing the interplay between private and public transfers. Parents' private transfers in all the countries analysed were substantially higher than those of childless individuals. Also, in Austria, the welfare state compensated medium educated and highly educated parents through higher public transfers, whereas this is not the case in other countries.

Spielauer and others (2023) examined how future changes in the demographic structure, educational transitions and family structure would impact the financial sustainability of public and private transfers, finding that the interaction between the expansion of education and changes in family structures contributed to alleviating, to some extent, the adverse effects of demographic ageing.

In this chapter, the methodology is designed to analyse NTA by gender and family characteristics without considering education simultaneously. This approach reduces issues related to small observation groups. Also, the family classification follows Abio and others (2023) to include the household characteristics in which the individual lives. Partnership and parenthood status continue to be the main focus, but it is also important to consider the other people who share the same household. For example, differences can be captured between parents who live only with their children and those who live with others in the household, i.e. extended families.

5.3 Methodology

The 2025 United Nations publication *Principles and Recommendations for Population and Housing Censuses, Revision 4* (United Nations, 2025) provides internationally recognized definitions and classifications of families, households and their various types.

[7] Abio and others (2023) also estimate time transfers, adapting the NTTA method accordingly.

[8] See the model platform (www.microwelt.eu).

For cross-country comparison of classification of individuals by living arrangements, it is recommended, as in chapter 2 above, to classify individuals into six categories of living arrangements: living alone, couple only, single parent with children, couple with children, other family and other non-family. As discussed in chapter 1, living arrangements may change over the life course. By contrast, parental status (parent or non-parent), once acquired, generally remains a longer-term characteristic throughout an individual's life.

This section focuses on family type, which is a mixture of parental status, family living arrangement and gender. It explains how to modify the NTA standard methodology to create detailed age and gender profiles while considering family characteristics. The first part covers the necessary changes in data and methodological assumptions, and the second thoroughly explains the adjustments made to the estimation process. Section 5.4 contains a case study from Spain in the year 2010 to illustrate the results. Like the AGENTA estimates for other European countries, the primary sources of microdata are two separate household surveys that provide information on income (EU-Statistics on Income and Living Conditions, EU-SILC) and consumption (Household Budget Survey, HBS).

5.3.1 Data and methodological challenges

There are some challenges to refine the standard NTA methodology by breaking it into family characteristics, primarily related to modifying the method to add more heterogeneity. The most significant change involves adapting assumptions about the household head (see the subsection on "adapting the household head assumption" below). However, other issues exist, such as identifying individuals and acquiring the disaggregated population (as described in the subsection on "data issues" below). These challenges might be exacerbated by the cross-sectional nature of the data used and the irregularity of changes in family structure compared to changes in other characteristics such as age and gender.

Data issues

Defining and identifying specific family characteristics is relevant when dealing with data sets. Besides gender, partnership and parenthood status are also considered, along with co-residing members to identify extended families and other types of household arrangements. Identifying family characteristics in microdata is complex. Initially, the intent was to create profiles for different family types: those without children, those with children living in nuclear families, and those with children and other co-residing members (extended families and other household arrangements). However, this classification poses a challenge when obtaining the age profiles since it is possible to mix young parents with older children, making interpretation difficult. To address this issue, a different approach was used. First, individuals were classified as either parents or those without children, and then further categorized based on whether they live with a partner or not and if they live with others who are not their children or partners (such as parents, grandparents, siblings or non-relatives). It is important to note that parents and children living in the same household are classified into different groups.

Identifying couples and children is straightforward in household surveys, such as in EU-SILC, where variables exist to indicate the couple and the mother and father's identifier within the household. However, determining parenthood is more complex. Usually, surveys can only identify parents when they are co-residing with their children but do not account for individuals with children living with another parent or independently as adults. External information from other surveys can be used to determine whether individuals are parents. For example, the Survey of Health, Ageing and Retirement in Europe (SHARE) provides information on individuals' parenthood status regardless of household composition. However, SHARE only interviews individuals aged 50 and older. Thus, it mainly helps to identify parents of children who have left the parental house, not those with young children living with the other parent. It should be noted, however, that if one member of a couple is identified as a parent in the survey data, the other member is also assumed to be the parent. As a result, the final estimates may miss some biological parents of young children but include others who may not be biological parents but are considered "social" parents (those acting as such in the household).

An imputation procedure has been developed for the case study using SHARE data. This procedure aims to determine the parenthood status of individuals aged 50 and above and impute this information in the main survey (EU-SILC). It involves running a regression analysis using SHARE data, with parenthood status as the dependent variable. Factors considered in determining parenthood status include age (starting age at 50 years and divided into 5-year age groups up to 80+), education level (categorized into three levels), partnership status, individual income and household income (each income divided into quartiles). Weighted logistic regressions are performed separately for men and women. In the case of Spain, only household income could be included in the regressions due to the absence of individual income data. The results of these regressions are then used to predict the probability of being a parent in EU-SILC data for individuals aged 50 and older. This probability is adjusted for observed parents to be very close to 1. Next, childlessness is imputed, taking into account the marginal distributions from Zeman and others (2014) and Kreyenfeld and Konietzka (2017). Abio and others (2021b) provide details on this procedure, which improves considerably the estimation, by capturing differences between parents and childless individuals beyond the age at which children emancipate.

In total, 12 types of individuals are distinguished based on the steps described above (see table 5.1). For each gender and parenthood status, there are three types of individuals depending on whether they live in a couple or with household members other than their partner and children.

Estimating NTA profiles in such detail requires dividing the total population into the same groups. Having national population estimates to support this would be ideal. If detailed estimates are unavailable, an alternative option is to use the distribution observed in the primary household survey for NTA estimations. For the case study in this chapter, the population structure initially observed in EU-SILC for 2010 is corrected by adding parenthood status for people aged 50 and above, based on data from SHARE. The resulting population structure is then adjusted to match the total national population using sample weights, leading to the values presented in table 5.1.

Table 5.1
Population classification according to gender, parenthood and household arrangement, example of data for Spain, 2010

Group number	Type of individual	Prevalence in total population
1	Men_Non parents_Single	2.8%
2	Men_Non parents_Couple	4.0%
3	Men_Non parents_Other (*)	19.6%
4	Men_Parents_Single	1.6%
5	Men_Parents_Couple	18.3%
6	Men_Parents_Other	3.1%
7	Women_Non parents_Single	2.6%
8	Women_Non parents_Couple	3.9%
9	Women_Non parents_Other (*)	16.3%
10	Women_Parents_Single	5.1%
11	Women_Parents_Couple	18.3%
12	Women_Parents_Other	4.4%
	(*) Children are included in this category	

In this case study, two primary living arrangements stand out. The first includes parents living in a couple (with or without their children), making up 36.6 per cent of the total population across both genders (groups 5 and 11). The second major category consists of individuals without children living with others, represented by groups 3 and 9, constituting 35.9 per cent of the population. This category primarily consists of young and adult children residing with their parents. Note that different types of classification can be performed based on the specific goals of the analysis. For example, it may be desirable to obtain distinct age profiles for parents with young children, parents with older children and others.

Many groups result when data are disaggregated into new categories like individual or family types. Not all of them may be represented in the sample across all individual ages. Using age groups instead of creating profiles for each age is more practical. The standard procedure followed in this case study involves using 5-year age groups. However, if it does not provide a representative classification, 10-year age groups could also be used. Note that the age groups defined do not have to be homogeneous. It may be helpful to determine the first age groups differently to account for relevant differences in children's education levels or consumption patterns. For example, the first age group could be from 0 to 2 years of age to account for the differences in consumption of newborns; the second from 3 to 6 years of age; the third from 7 to 12; the fourth from 13 to 17; and the fifth from 18 to 24 years of age, with 5-year groups used from age 25 on.

It is important to check if there are types that are still not represented in the sample for some age groups. In some cases, this will be fine, and nothing has to be done about it. For instance, in the classification presented here there are no children aged 0–16 except for in types 3 (boys) and 9 (girls). This is because children at those ages always live with their parents or other adults caring for them, so they will always be included in types 3 or 9. Hence, for all the different types defined, profiles will start at age group 15–19, whereas for types 3 and 9, profiles will start at age group 0–4. If certain combinations of types and age groups are not represented in the sample used to obtain the disaggregated population, assigning a low-weight value rather than zero is better. This helps to avoid issues in the smoothing procedure. For example, this situation may occur in the case of very young adult ages for single fathers.

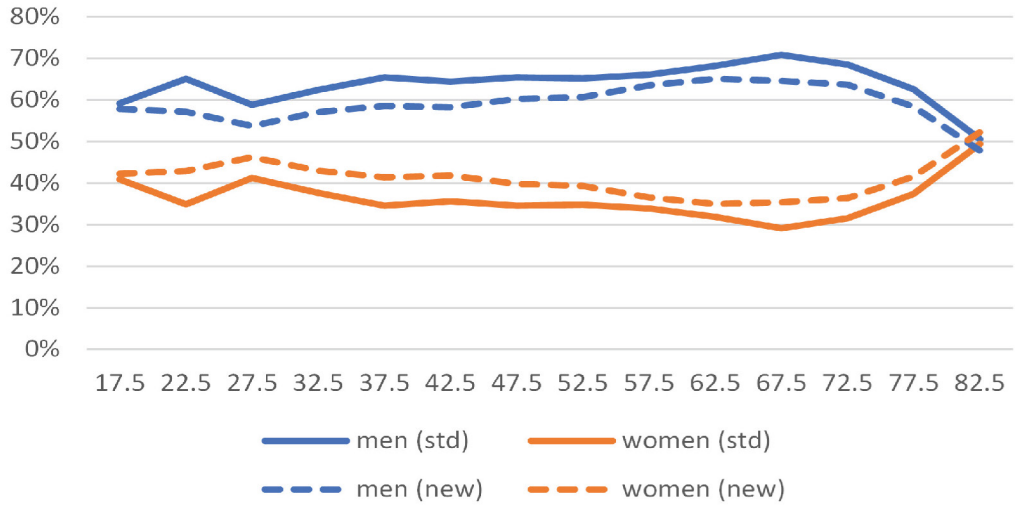
Adapting the household head assumption

Once individuals have been classified and identified in the data, it is meaningful to introduce a methodological change to the standard NTA methodology by adjusting the household head assumption to capture money transfers better and address gender bias more effectively. The current NTA methodology identifies a unique household head as the primary income earner when disaggregating only by age. The household head is responsible for owning the asset income (generally reported at the household level) and saving the remaining resources after all family transfers, and is the default recipient of most household benefits and interhousehold transfers. However, when the data are disaggregated by gender and other socioeconomic characteristics (such as education or income level), it becomes important to consider whether it is convenient to change the household head assumption to reflect the fact that all adults or income earners may play the role of household head.

Therefore, the procedure to estimate intrahousehold transfers is adapted by allowing savings for all adult members of the household with positive income. To that end, the standard procedure is changed by distributing some household benefits that are traditionally assigned to the household head among all adults in the household (two public transfers in cash: housing allowances; and miscellaneous social protection) and then doing the same for interhousehold transfers. Asset income, typically reported at the household level, is attributed to adults as a proportion of their individually reported current disposable income (labour income, pensions and unemployment benefits). Private transfers are computed by redefining disposable income and replacing the role of the traditional household head with a combination of all adult earners in the household, who are assumed to participate in private transfer activities according to the share of their income in total household income. This is done in an attempt to estimate more accurately the private transfers men and women give and receive, with women now being net recipients of private intrahousehold transfers to a lesser extent as their disposable income increases. Overall, this procedure leads to

more consistency, although the results are not much different from those based on the traditional NTA assumption of the household head. The main reason for this is that, under the new assumptions, men still earn significantly more household income than women, as illustrated in figure 5.1, which compares the proportion of household heads by age and gender under the traditional and the new household head assumption. There is a substantial gender gap at practically all ages. Under the new assumption, the percentage of male heads only falls from 64 to 59 per cent.

Figure 5.1
Proportion of household heads by gender, Spain, 2010



5.3.2 Estimation of age profiles

This section outlines the adjustments needed in the estimation method to create age profiles of NTA variables for specific individual or family types. These adjustments are made to the standard NTA method described in Istenič and others (2016) by applying the method initially outlined by the United Nations (2013) and adapting it for use with comparable European data. The variables' definitions and equations remain unchanged, so those documents are referred to in order to avoid repeating information.

In short, the steps to obtain standard NTA are as follows. First, age profiles are derived for income and consumption and the resulting life-cycle deficit. This step is developed using microdata from the household surveys. However, calculating public consumption involves imputing in-kind transfers, typically not captured in those surveys. Next, the data are examined for other public sector variables, such as public cash transfers and taxes. Then, private transfers and private asset-based reallocations are estimated. Private transfers are determined by calculating the surplus or deficit of each household member. Meanwhile, asset-based reallocations are obtained by estimating savings as a residual. Simultaneously, population weights adjust all these data profiles to the SNA.

The steps to obtain the detailed estimates are shown in Appendix 1, focusing on the impact of the methodological extension presented in this chapter. Here, the process is categorized based on the estimation strategy to simplify the explanation. The next subsection addresses changes in the age profile estimations derived directly from the household surveys. The subsection on "profiles calculated from administrative data" discusses profiles obtained from other data sources like administrative data, and the following subsection covers issues that arise with profiles created based on

other profiles or distributed equally among individuals. Lastly, the subsection on "profiles for private intrahousehold transfers" describes the changes necessary to adapt the estimation method for intrahousehold transfers.

Profiles calculated from microdata

As written above, to obtain disaggregated profiles by the family characteristics of the individual from survey data, those characteristics must be present in the survey or imputed from other sources. For Europe, EU-SILC and HBS contain the necessary sociodemographic characteristics of all household members included in the survey (age, gender, having a couple, living with a mother and/or a father). The only exception is the parenthood status for those parents who do not live with their children. How to deal with this limitation has been explained in subsection 5.3.1 above.

Once this information is collected, obtaining specific profiles is relatively straightforward. First, the general profile by age is calculated using the standard methodology. Then, a profile is estimated for each specific type of individual or family by averaging the age and type-specific data previously defined based on individual or family characteristics. Next, the general profile is adjusted to the corresponding aggregate data and the specific profiles considering the population distribution by type. Finally, the profiles are smoothed and readjusted to macro figures.

Age, gender and family-specific profiles

The above subsection on "data issues" describes the different categories of individuals defined based on gender, parenthood status and whether they live with others in the same household. Specific profiles are created for each category by calculating the average by age and other relevant variables unique to each category rather than just using age.

When dealing with variables reported at the household level, the standard procedure is to either assign them to the household head or distribute them among all the adults in the household. As explained above, it is assumed that public cash transfers traditionally assigned to the household head, such as housing allowances and miscellaneous social protection, are received by all adults. Family and Children allowances, another type of public cash transfer, are assigned to parents instead of all adults when possible. Asset income and imputed rents are distributed among adult earners in the household.

Adjusting and smoothing the profiles

After estimating the general and specific age profiles using survey data, these need to be adjusted, smoothed and readjusted to match the macro controls obtained from the SNA. These controls are only available at the aggregate level for the economy without being disaggregated by gender or other characteristics. Therefore, an alternative adjustment process must be applied to the specific profiles to ensure they align with the general profile and macro controls. This alternative procedure is designed based on the gender-specific adjustment method described by Donehower (2013) and Istenič and others (2016).

Here, $x(a,v)$ is used to represent the unadjusted age profile for variable x and $\tilde{x}(a,v)$ to represent corresponding adjusted profile. The adjustment factor $\theta(a)$ is calculated by dividing the adjusted general profile by a weighted average of the type-specific unadjusted profiles:

$$\theta(a) = \frac{\tilde{x}(a)}{\sum_v \frac{x(a,v)\cdot N(a,v)}{N(a)}}$$

where $\tilde{x}(a)$ is the adjusted general age profile, $N(a,v)$ is the population of age a and type v, and $N(a)$ is the population of age a. The adjustment procedure is then implemented as follows:

$$\tilde{x}(a,v)=\theta(a)\cdot x(a,v)$$

The adjustment factor varies by age but does not change across types within the same age group. This means that when each type-specific per-capita age profile is multiplied by the corresponding type-specific population and these are added up for all types within each age group, the result is the aggregate general age profile, which is the product of the per capita general profile by the total population.

It is best to avoid smoothing out grouped age profiles, as both smoothing and age binning aim to reduce noise in the estimates. However, disaggregated profiles can be smoothed since there is a higher likelihood of outliers or noisy patterns due to small samples. It is important to exclude age groups for which the variable takes a zero value or is missing by definition when smoothing. Also, it is important to ensure that smoothed values are replaced only for the relevant ages, leaving the rest with the pre-smoothed value.

Profiles calculated from administrative data

Public consumption includes in-kind public transfers and comprises public education, public health and other forms of public consumption. The first two components are based on administrative data, available by age and gender in Spain and other European countries[9] but not by other individual characteristics such as parenthood status. Therefore, public education and health cannot be differentiated by family type. If administrative data are available at such a level of disaggregation, they should be used to estimate more detailed profiles.

When using external profiles that are not disaggregated by characteristics other than age and gender, it is essential to customize them for specific age groups. Not all ages are relevant to all family types. For example, in the classification proposed here, children younger than 16 can only be in types 3 and 9, as mentioned above. This implies that the profiles will have missing values for ages with no assigned population. However, to avoid problems in the adjustment process, zeros are used instead of missing values, and only after completing the adjustment can the zeros be replaced with missing values.

Profiles created based on other profiles or distributed equally among individuals

Some NTA profiles that cannot be obtained from microdata or administrative data are estimated using previously created profiles. This is the case for most taxes, where the profile of the variable being taxed is used, and for some in-kind public transfers, where the corresponding profile of in-cash transfers is used. In all of these situations, age profiles for different family types must be estimated using the corresponding age profile for each specific type. For example, to get the age profile of taxes on labour income for single men who live alone, the labour income profile of single men who live alone is used and adjusted, along with the other types, to match the general age profile of the total population.

Certain variables, such as collective public consumption, are assumed to be evenly distributed across all individuals, leading to a flat age profile. Specific age profiles for these variables cannot be differentiated and are the same for everyone, and so it is crucial to retain the values of the profile only for the pertinent ages, as mentioned above. The remaining values should be replaced with zeros before adjustment, and any missing values should be addressed after adjustment.

NTA variables obtained as the sum of several components must be estimated at the general level and for each type. For example, public transfer inflows, consisting of all cash and in-kind transfers, should first be calculated for the total population by age and then for each type specified.

[9] See Istenič and others (2016) for details.

Profiles for private intrahousehold transfers

In NTA, intrahousehold transfers are calculated by estimating the resources each household member requires to fund their consumption after their disposable income and consumption needs have been calculated. The sharing rules, which depend on the household head assumption, are explained in detail in the AGENTA NTA manual (Istenič and others, 2016). This subsection explains how the procedure should be adjusted to accommodate the new household head assumption and the disaggregation of the general profiles by types.

Ideally, a micro-level database containing income and consumption variables, along with public taxes, transfers and interhousehold private transfers, would enable accurate estimation of intrahousehold transfers. However, such a comprehensive database is not available in Europe, which limits the implementation of the standard procedure. The necessary adjustments to address this issue are outlined in Istenič and others (2016), where the household structure from EU-SILC is used but with the age profiles of all the variables needed to calculate disposable income and consumption instead of the corresponding microdata from two different surveys.

Regardless of whether all the necessary microdata are available in a single survey, the standard procedure must be adjusted to estimate the variables required to establish the age and specific-type profiles and the new household head assumption. Here, adult members with positive current disposable income are referred to as "household heads".

Intrahousehold transfers are estimated through several steps. First, disposable income is determined for each member of the household. Using the standard method, this income is calculated as the sum of labour income, public cash transfers received and net interhousehold transfers minus taxes paid on products and production:

$$INC=YL+TGIC+TFB-TGFYL-TGFC-TGP-TGX$$

When more than one individual acts as a household head, the definition includes private asset income net of taxes and excludes imputed rents:

$$INC=YL+YAF+TGIC+TFB-TGF-TGP-TGX-YKFH$$

This definition is more reasonable because asset income is not only assigned to a single person in the household but to all adult individuals with positive income.

Second, other variables are defined that are needed to calculate the household shortfall (private current consumption, surpluses and deficits of each household member and for all members combined), and then the household-specific tax rate is computed. All these variables, including disposable income, must be defined for each family type.

Third, intrahousehold outflows are estimated in the standard way for non-household heads. However, for household heads, the procedure has to be modified based on the new assumption, and all variables must be defined explicitly for each type:

a. Calculate the sum of deficits of all household heads.

b. If the household shortfall exceeds the total deficits of all heads, each head is expected to contribute to cover the shortfall (of non-heads) based on their share of headship in the household.

c. All heads will cover the shortfall through asset-based reallocations, considering the proportion of their individually reported current disposable income to the total household income.

Fourth, the method must similarly be adapted to calculate intrahousehold inflows:

a. Determine the share of deficit among the household heads with deficits (they may receive inflows if there is enough surplus in the household).

b. If there is no shortfall, heads with a deficit receive inflows equal to their deficit.

c. If there is a shortfall that is less than the total deficits of the heads, it means that some household members have a surplus that can be transferred to heads with deficits. This surplus is distributed in proportion to the share of one's own deficit in the total deficit of household heads.

Fifth, obtain inflows and outflows by sector. The code must be adapted so that inflows can also be received by heads with a deficit, as long as the household shortfall is lower than the total deficits of heads.

Sixth, intrahousehold transfers should be obtained for savings and durable consumption. Regarding saving inflows, each household head is assumed to receive a fraction of non-head members' aggregate outflows based on their household's share of headship. Similarly, for durable consumption, the same principle applies for distributing outflows among household heads. Each household head is responsible for transferring a portion of the imputed rents of the household to other household members as long as it is more than what they consume of owner-occupied housing services. If this is not the case, the head will receive inflows of durable consumption.

The rest of the procedure to estimate intrahousehold transfers follows the standard method. To obtain detailed profiles, all the steps must be replicated for individuals in each specific family type. It is crucial to ensure that total inflows match the total outflows for the general profiles and for each particular type.

Private transfers (TF) are an interesting category, especially when NTA is broken down by the family characteristics of the individuals. At the aggregate level, private transfers tend to be negligible as they mainly occur within a country's borders, being positive for some age groups and negative for others. However, private transfers are important to redistribute resources between different age groups, particularly parents and their children. By examining NTA profiles based on parenthood status, it is possible to understand how resources are shared privately by different generations living at a given moment.

5.4 Applications

This section presents the main results of the procedure discussed in the previous section for the case of Spain in the year 2010.

To start, profiles directly taken from microdata are charted (see the subsection on "profiles calculated from microdata" above). Labour income (YL) includes work earnings, income from self-employment and employers' social contributions. These profiles are obtained from EU-SILC. Figure 5.2 shows the per capita age profiles of labour income disaggregated by partnership status for childless men and women in Spain. The female profile is significantly lower than the male profile only if they live in partnership. Panel A displays the labour income of single men and women living independently (as depicted in groups 1 and 7, respectively, in table 5.1), while panel B shows the earnings of men and women living in childless couples (groups 2 and 8 in table 5.1). The data indicate that women's labour income is significantly lower when they are part of a couple, and this difference becomes more pronounced as they get older, partly due to cohort effects. On the other hand, men in couples consistently earn more than their single counterparts across all ages.

Private consumption (CF) includes expenditures on education, health and other goods and services. Imputed rents of owner-occupied housing are calculated separately since they must be used to compute intrahousehold transfers. Profiles for private consumption on education and health are obtained applying a regression model in which the gender dimension is taken into account. However, the same regressors are used for other individual characteristics like parenthood or partnership status. The microdata for all private consumption profiles in Spain come from the

HBS. As is commonly observed in standard NTA, differences in private consumption are less pronounced than the disparities in labour income. Analysing living arrangements suggests the cost-saving benefits of economies of scale from living in multi-member households, where expenses are shared. In the present case study, figure 5.3 compares the private consumption profiles of women, distinguishing between mothers and non-mothers, as well as by partnership status. Panel A shows the age profiles for non-mothers, illustrating the potential economies of scale in multi-member households. Panel B compares the age profiles of single mothers and mothers cohabiting with a partner, highlighting smaller differences (as in this case economies of scale are present in both categories), which mainly occur among younger (under 30) and older (55+) age groups, when children are either not yet born or have already moved out of the parental home.

Figure 5.2
Age profiles of labour income (YL) by gender and family arrangement in Spain, 2010 (current euros per capita)

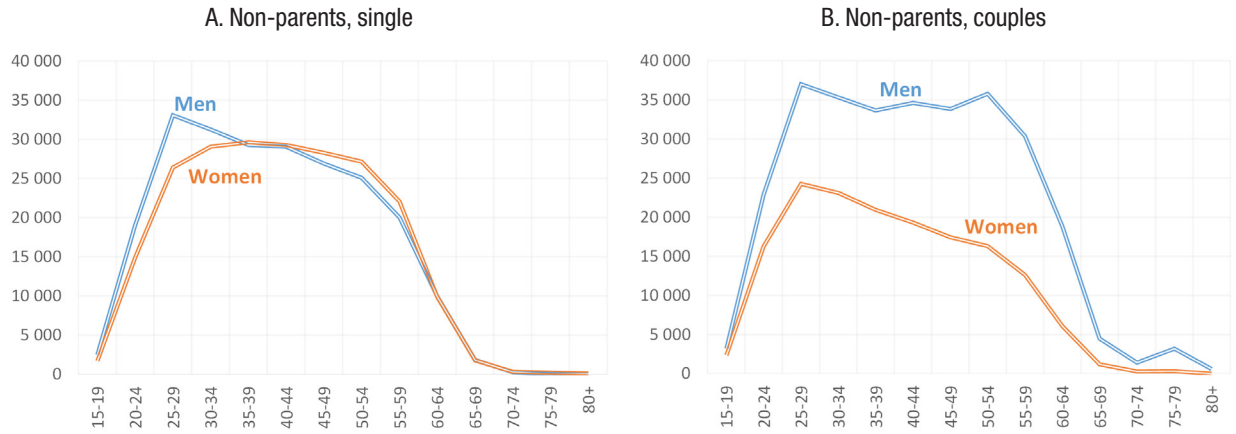
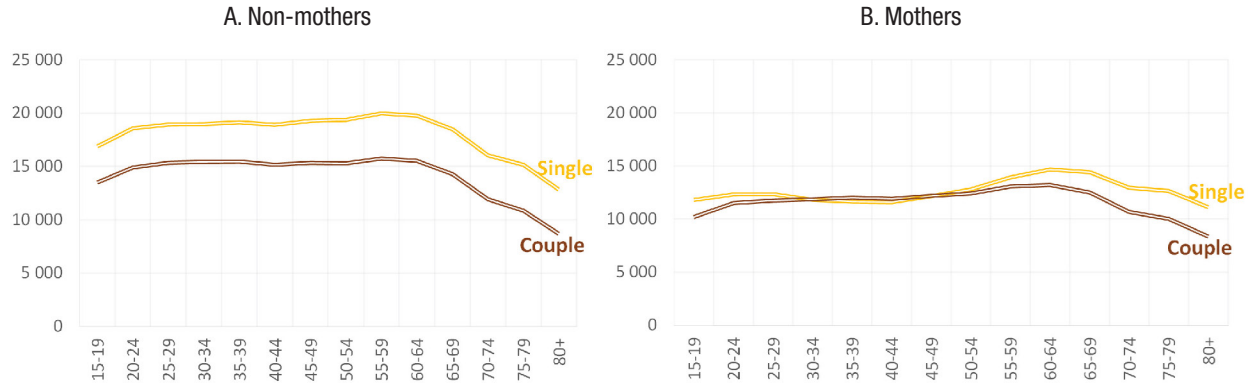


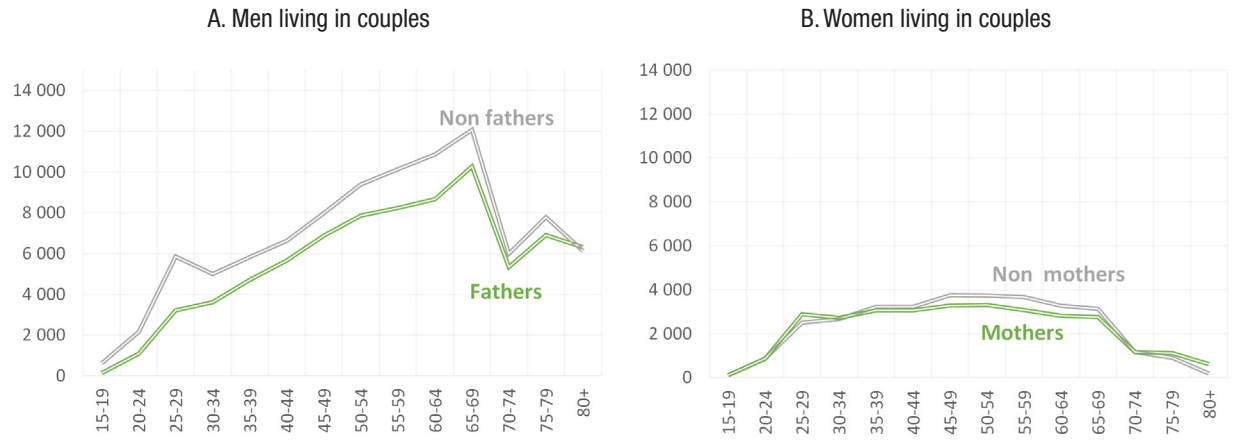
Figure 5.3
Age profiles of private consumption (CF) of women by partnership and parenthood status in Spain, 2010 (current euros per capita)



Public transfers in cash (TGIC) include public education in cash (grants and scholarships), social protection for the older persons (old-age pensions, survivors and disability benefits), public health in cash (sickness benefits), unemployment benefits, social protection for families and children, social protection for housing and miscellaneous social protection. Microdata for all public transfers in cash were obtained from EU-SILC. The first four components are reported for each household member, while the last three are reported at the household level. According to the standard NTA method, public transfers related to family and children are typically distributed among all adults in the household. However, Family and Children cash benefits are distributed among parents and among all adults only if there are no parents in the household.[10] Additionally, housing and miscellaneous cash transfers assigned to the household head in standard NTA are distributed among all adults, irrespective of their income, as they are not necessarily linked to income.

Asset income (YAF) includes capital income and property income (obtained from EU-SILC), encompassing interest, dividends, profits from capital investments in unincorporated businesses and income from the rental of a property or land. Asset income is reported at the household level and distributed among adult earners. This means it is distributed among adults but as a proportion of current disposable income collected by the survey. Figure 5.4 shows the age profiles for individuals living in a couple, comparing parents and non-parents. The results reveal that private asset income is higher for men, specifically for those without children. On the other hand, the differences between mothers and non-mothers are small.

Figure 5.4
Age profiles of private asset income (YAF) by men and women living in couple according to parenthood status in Spain, 2010 (current euros per capita)



Imputed rents, which include returns to capital for owner-occupied housing and are part of asset income, are obtained as a separate profile. They are reported at the household level and distributed among adult household earners. This information is derived from EU-SILC.

Interhousehold transfers are distinguished between inflows (transfers received) and outflows (transfers paid). These functions are calculated from EU-SILC data and reported at the household level. In this instance, they are allocated to all adults in the household.

With respect to the profiles created based on other profiles (see the subsection on "profiles created based on other profiles or distributed equally among individuals" above), figure 5.5 compares total public transfers received (TGI) by

[10] The standard NTA method is followed here. An alternative, more coherent with the aim of capturing age reallocations, would be imputing family and child benefits directly to children, with the result that those resources would not be captured as private transfers.

men and women living in couples, considering whether they have children or not. These transfers include cash and in-kind transfers, but the in-kind benefits (public consumption explained in the subsection on "profiles calculated from administrative data" above) cannot be separated beyond age and gender. Only the portion of public transfers received in cash is estimated based on family characteristics. However, there are significant differences based solely on gender, with women receiving considerably less during retirement ages. The results suggest that the public transfer system provides similar support to parents and non-parents. It is important to note that this result may differ in other European countries with more comprehensive family support policies.

Figure 5.5

Age profiles of public transfers received (TGI) by men and women living in couples according to parenthood status in Spain, 2010 (current euros per capita)

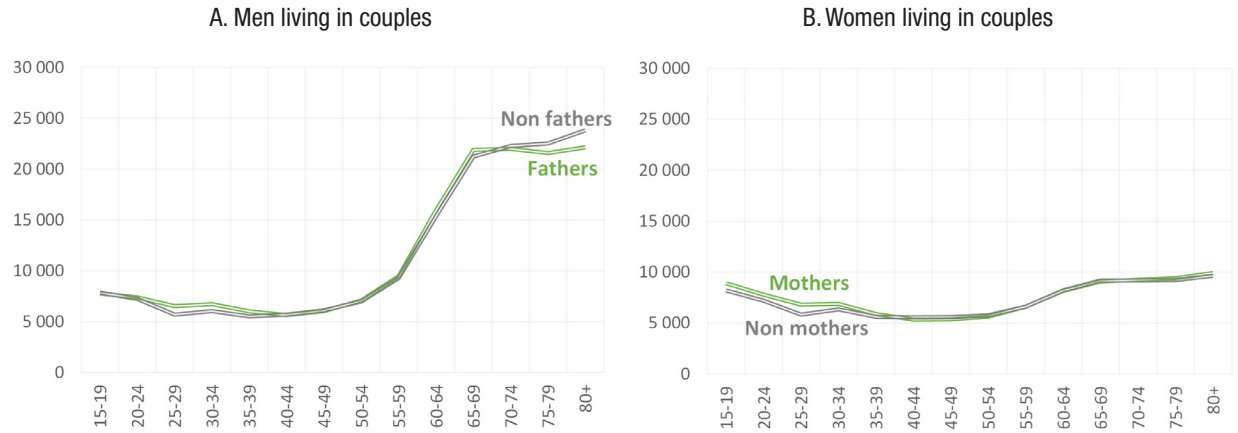


Figure 5.6

Age profiles of private transfer inflows received from other household members (TFWI) by non-parents, Spain, 2010 (current euros per capita)

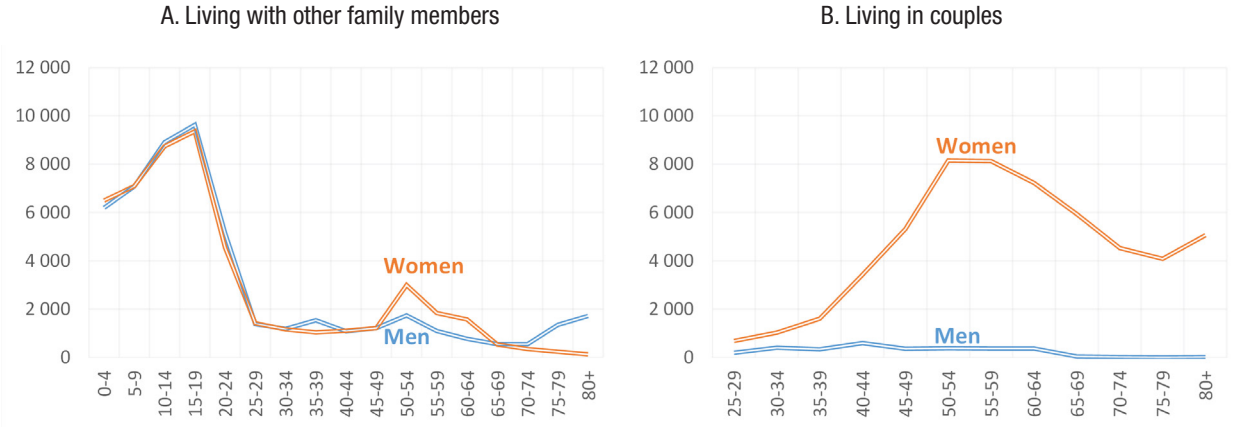
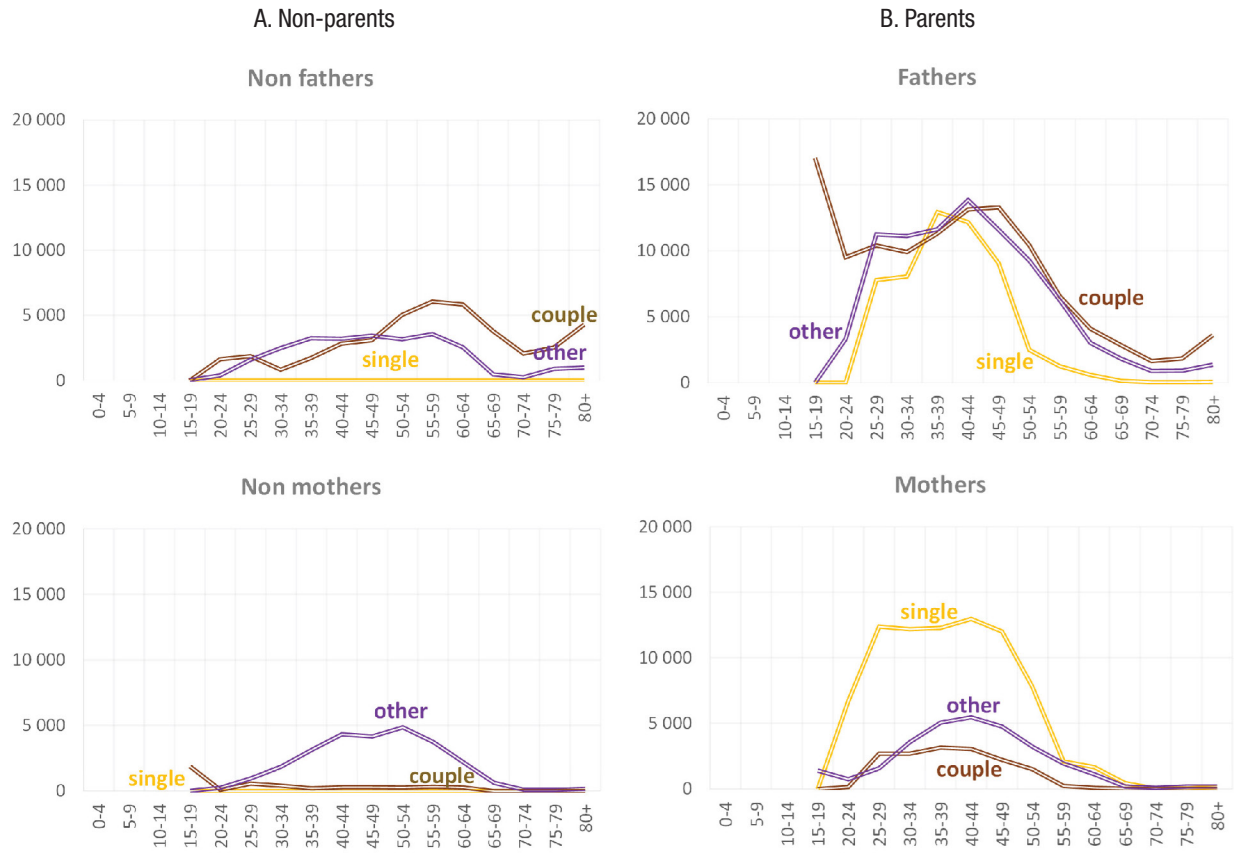


Figure 5.7

Private transfer outflows to other household members (TFWO) by gender, parenthood and living arrangement, Spain, 2010 (current euros per capita)



Figures 5.6 and 5.7 focus on private transfers (see the subsection on "profiles for private intrahousehold transfers" above). Figure 5.6 shows private transfers received from other members of the same household (TFWI) when they are non-parents. Panel A compares the age profiles of private transfers received by individuals in groups 3 and 9 detailed in table 5.1. These groups mainly consist of children living with their parents, and in older ages, adult children living with their parents are mixed with individuals in other household arrangements besides living as a couple. The profiles indicate that private transfers received from parents are increasing until age 20, after which they start to decrease. As expected, there are no gender differences in young ages (parents transfer the same amount to sons and daughters) and these transfers are small in adult ages. In contrast, there are significant gender differences in panel B, showing private transfers between couples who share a household and do not have children. In this case, women are the primary recipients. These results demonstrate the importance of taking into account non-market production and time transfers (NTTA) also disaggregated by family type not included in this analysis.

Figure 5.7 illustrates the age distribution of private transfer outflows within households and identifies the main donors of monetary transfers. Panel A illustrates non-parents, while panel B displays parents, making distinctions based on gender and household arrangements. Not surprisingly, the case study demonstrates that households without children tend to have considerably lower private transfers, with one-person households having none at all. Among parents, men make higher private transfers, aligning with their higher labour income. Also, private transfers decrease after ages 50–55 once children become financially independent.

5.5 Conclusions

This chapter revises existing attempts to further disaggregate NTA estimates by family type, detailing the necessary changes to implement this methodological extension and illustrating it with a case study for Spain. NTA by family type turns out to be a natural extension of standard NTA, which was the first comprehensive methodology to visualize family transfers and observe their role as a crucial mechanism for reallocating resources and providing well-being among individuals. Nevertheless, in standard NTA, family transfers are attributed to a representative agent defined by age, regardless of family characteristics, thus omitting crucial information which could be obtained by disaggregating estimates based on family status.

The results in this chapter confirm the importance of a deeper visualization of transfers occurring in the private sphere, and particularly within families. Moreover, along with chapters 3 and 4 in this manual, they also underscore the importance of considering the combined effects on intragenerational and intergenerational resource redistribution generated by public policies.

Overall, this analysis, which explicitly looks at the role of family transfers as a complementary mechanism for age reallocation (besides the market and government), is crucial to face the ageing process. It helps shed light on the need for a welfare state more balanced in terms of both age and gender. To that end, it is essential to complement monetary family transfers with non-market time transfers, thus also incorporating the NTTA method. This approach will enable a more complete understanding of the gender gap, strongly rooted in the traditional labour division in market and non-market activities between men and women. Further research is currently underway to enhance understanding of the production and distribution of well-being throughout the entire life cycle. On one hand, existing comparable data for EU countries is being integrated with dynamic microsimulation techniques to individualize NTA-NTTA and simulate the full life cycle across different generations. On the other hand, by providing a more detailed assessment of the contribution of public transfers in financing human needs throughout the life cycle, the aim is to contribute to a more comprehensive perspective on welfare policies.[11]

[11] Specifically, in the framework of the Horizon Europe SUSTAINWELL project (2023–27), the dynamic microsimulation model MicroWELT is being extended and applied to eight European Union countries. Moreover, a proposal for a life cycle perspective of welfare policies is being co-created with stakeholders.

Appendix: Detailed steps to estimate NTA disaggregated profiles by family type

0. Preparation of the code and relevant data sets

  0.1 Inserting programme for adjustment

  0.2 Importing and preparing data sets (adjusting household head definition)

  0.3 Defining individual or family types

  0.4 Preparing disaggregated population data

1. Compilation of the labour income age profiles

2. Compilation of the consumption age profiles

  2.1 Private consumption

  2.2 Public consumption

  2.3 Public transfer inflows/other public consumption

3. Adjusting and aggregates of labour income and consumption

4. Taxes and social contributions

5. Public asset-based reallocations

6. Public transfer outflows

7. Public transfer aggregates

8. Private age reallocations

  8.1 Private asset-based reallocations

  8.2 Private transfers

    8.2.1 Private interhousehold transfers

    8.2.2 Private intrahousehold transfers

  8.3 Adjustment and calculation of aggregates for private age reallocations

9. Control and export of data

Note: These steps correspond to the standard NTA procedure. The main changes necessary to adapt the standard methodology to disaggregation by family are underlined, while all the subsequent steps are adapted to these changes.

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