UNIVERSITY OF LJUBLJANA
SCHOOL OF ECONOMICS AND BUSINESS

EMA KELIN

PRODUCTION, CONSUMPTION AND TRANSFERS BY EDUCATIONAL LEVEL

DOCTORAL DISSERTATION

Ljubljana, 2023

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AUTHORSHIP STATEMENT

The undersigned Ema Kelin, a student at the University of Ljubljana, School of Economics and Business, (hereafter: SEB), author of this written final work of studies with the title Production, consumption and transfers by educational level, prepared under supervision of Jože Sambt, PhD and co-supervision of Tanja Istenič, PhD.

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ACKNOWLEDGEMENTS

I would like to thank my supervisors, Jože Sambt and Tanja Istenič, for their time, patience and guidance on this journey. The knowledge I received from them is an irreplaceable part of my future research steps.

I would also like to thank my committee members, Daša Farčnik, Irena Ograjenšek and Concepció Patxot. Their perspectives and constructive comments have contributed greatly to the quality of this work.

However, this thesis is not only consisted of these pages, but also of challenges where the help of many people has been invaluable. I have been incredibly fortunate to start this journey with my fellow PhD students and friends Peonare, Danijela and Ezgi, whose tremendous help and encouragement has motivated me to keep going even on the most difficult days. I am also grateful to my second-year colleagues, Ivana and Antonija, for all the challenging but unforgettable moments we have shared together. A special thanks goes to my dear friend Antonija for the endless discussions during our long hours in the library and for the boundless support she gave me when I needed it most. I also thank my mentor Ana and my faculty colleagues for all the advice, comments, discussions and willingness to help whenever I needed it. They made key moments in this journey much easier and less stressful.

Finally, I would like to thank my family, my parents Dragutin and Mirjana and my brother Krešimir. Many of the challenges on this journey could only be overcome thanks to the strong safety net they provided me. Their love, understanding, tolerance and many hours of conversation have been instrumental in completing this work. I dedicate this thesis to them.

This document uses data from Eurostat, Cross-sectional EU-SILC UDB, 2011. We herewith acknowledge data provision for EU-SILC by Eurostat and the European Commission, respectively. The responsibility for all conclusions drawn from the data lies entirely with the authors. This document also uses data from Eurostat, Household Budget Surveys (HBS) 2010. We herewith acknowledge data provision for HBS by Eurostat and the European Commission, respectively. The responsibility for all conclusions drawn from the data lies entirely with the authors. We also gratefully acknowledge the national teams of Ageing Working Group for providing us the data on health and long-term care expenditures. This document also uses data from Croatian Bureau of Statistics, Household Budget Survey 2014. We herewith acknowledge data provision for Croatian HBS 2014 by Croatian Bureau of Statistics. The responsibility for all conclusions drawn from the data lies entirely with the authors.

SUMMARY

The economic behaviour of individuals depends crucially on their age. Children and the elderly, whose consumption exceeds their labour income, depend on support of the working-age population, which produces more than it consumes. However, European economies are affected by population ageing caused by lower birth rates and higher life expectancy. As a result, the share of the elderly population has increased and the share of the working-age population has decreased. With a smaller share of the working-age population having to support an increasing share of the dependent population, the economic growth and sustainability of European economies are at risk.

Population ageing has made the study of production, consumption and reallocation of resources over the life cycle more important than ever. By introducing the age dimension into the System of National Accounts (SNA), the National Transfer Accounts (NTA) project developed a methodology to produce comparable age profiles of labour income and consumption over the life cycle across countries. The NTA enabled the estimation of intergenerational transfers and age-specific asset-based reallocations, which are crucial to ensure economic well-being of the dependent population.

However, the NTA methodological framework not only included the age dimension in the SNA, but also provided a framework for the inclusion of other demographic dimensions, such as gender. In this way, also age- and gender-specific estimates of unpaid work have been added to the NTA analysis to provide a more detailed and accurate approach to life cycle research. Besides age and gender, which are the most important characteristics of individuals, educational level is also a very important source of population heterogeneity. More importantly, a change in the educational level of the population can cause a change in micro- and macroeconomic performance.

This study shows the impact of educational level on the economic life cycle of individuals in three ways. First, using data for Croatia for 2014, I analyse the impact of educational level on intra-household monetary transfers by age. For the first time, these transfers are calculated and presented in two-dimensional input-output matrices. The results confirm that intra-household transfers are primarily downward-directed, regardless of educational level, from older transfer givers to younger transfer recipients, especially those still in school. Educational level, however, affects the value of transfers given. Consistent with the downward direction of intra-household transfers, the results show that, on average, highly educated individuals give the highest value of intra-household transfers to the low-educated aged 0–19 and low-educated individuals give them the lowest value. This age group of transfer recipients consists mainly of children attending either primary or secondary school. The same is true for medium-educated transfer recipients aged 15–29, which also includes individuals who are still pursuing higher education.

Second, using and adapting the National Time Transfer Accounts (NTTA) methodology, I analyse the effects of educational level on the production and consumption of unpaid work within households, using data for several EU countries. Time spent on unpaid work generally increases with age and peaks around retirement age, regardless of the individual's educational level. However, educational level does affect the prioritisation of the type of unpaid work. The results show that low-educated individuals spend the most time and highly educated spend the least time on unpaid housework other than childcare. In terms of unpaid work, highly educated, however, priortise childcare by spending substantially more time on it than medium- and low-educated.

Third, in the analysis I compare the labour income and consumption profiles disaggregated only by age with the profiles disaggregated by age and education for 15 European countries in 2010. The results show that education affects the age profile of labour income much more than the age profile of consumption. The labour income of highly educated individuals is much higher than the labour income of low- and medium-educated individuals. Although consumption is also affected by educational level, the differences between the consumption profiles of the three education levels are much smaller. As a result, the highly educated have a much higher life cycle surplus during their working-age than low- and medium-educated individuals.

Combining age profiles of conventional NTA and NTA by education with population projections by age and educational level, projections of total labour income and consumption by 2060 are obtained. The ability of total labour income to support total consumption of selected EU countries is used to measure the degree of economic sustainability of these economies. The results show that the expected increase in education levels in Europe will have a positive impact on economic sustainability. The total labour income of the NTA by education is projected to increase by an average of 19% more than total consumption in the countries studied. These results also suggest that education could partially mitigate the negative effects of population ageing caused by the increasing share of elderly people and the decreasing share of the working-age population in Europe.

Keywords: labour income, consumption, intergenerational transfers, economic life cycle, education, unpaid work

POVZETEK

Ekonomsko vedenje posameznikov je v veliki meri odvisno od njihove starosti. Otroci in starejši, katerih potrošnja presega njihov dohodek iz dela, so odvisni od podpore prebivalstva v delovni starosti, ki proizvede več kot potroši. Evropska gospodarstva se soočajo s staranjem prebivalstva, ki je posledica nizke rodnosti in vse daljše pričakovane življenjske dobe. Posledično se delež starejših zvišuje, delež oseb v delovni starosti pa znižuje. Vedno manjši delež oseb v delovni starosti mora tako podpirati vedno večji delež ekonomsko odvisnih posameznikov, kar ogroža gospodarsko rast in ekonomsko vzdržnost gospodarstev v Evropi.

Zaradi staranja prebivalstva je bolj kot kadarkoli prej pomembna analiza proizvodnje, potrošnje in prerazporejanja virov skozi življenjski cikel. Z uvedbo dimenzije starosti v Sistem nacionalnih računov (SNA) je bila v okviru projekta Računi nacionalnih transferjev (NTA) razvita metodologija za razporejanje dohodka iz dela, potrošnje in drugih ekonomskih kategorij po starosti. NTA je omogočil izračunavanje medgeneracijskih transferjev in starostno specifičnega prerazporejanja iz naslova sredstev, ki predstavljajo ključni vir za zagotavljanje ekonomske blaginje odvisne populacije.

Metodološki okvir NTA v SNA ne uvaja le dimenzije starosti, ampak tudi dodatne demografske spremenljivke, npr. spol. Z vpeljavo dimenzije spola pa se je v analizo začelo vključevati tudi starostno-specifične vrednosti neplačanega dela, ločenega po spolu, kar je omogočilo podrobnejši in natančnejši pristop k raziskovanju ekonomskih tokov med posameznimi starostnimi skupinami. Poleg starosti in spola, ki sta ključni demografski značilnosti posameznikov, je pomemben vir heterogenosti populacije tudi stopnja izobrazbe. Pomembneje, spremenjena izobrazbena struktura prebivalstva lahko vodi do sprememb v mikro- in makroekonomski uspešnosti.

Študija prikazuje vpliv stopnje izobrazbe na ekonomski življenjski cikel posameznikov na tri načine. Najprej analiziram vpliv stopnje izobrazbe na vrednost starostno-specifičnih transferjev znotraj gospodinjstev za Hrvaško v letu 2014. Ti transferji so prvič izračunani in predstavljeni v dvodimenzionalnih input-output matrikah. Rezultati potrjujejo, da so transferji znotraj gospodinjstev usmerjeni predvsem navzdol, ne glede na stopnjo izobrazbe, od starejših (ki transferje dajejo) k pretežno mlajšim, šolajočim (ki transferje prejemajo). Stopnja izobrazbe pa vpliva na vrednost danih transferjev. Rezultati kažejo, da največ transferjev prejemajo nizko izobraženi v starosti 0–19 let in da jih v povprečju največ prejemajo od visoko izobraženih posameznikov, najmanj pa od nizko izobraženih posameznikov. To starostno skupino prejemnikov transferjev sestavljajo predvsem otroci, ki so v procesu izobraževanja v osnovni ali srednji šoli. Podobno velja tudi za srednje izobražene prejemnike transferjev v starosti 15–29 let, kamor sodijo tudi posamezniki, ki so vključeni v visokošolsko izobraževanje.

Z uporabo in prilagoditvijo metodologije Računov nacionalnih transferjev časa (NTTA) nato analiziram učinke stopnje izobrazbe na proizvodnjo in potrošnjo neplačanega gospodinjskega dela na podlagi podatkov za več držav EU. Na splošno se čas, namenjen neplačanemu delu, s starostjo povečuje in doseže vrh okoli upokojitvene starosti, ne glede na stopnjo izobrazbe posameznika. Stopnja izobrazbe pa vpliva na to, kateri vrsti neplačanega dela dajejo posamezniki prednost. Rezultati kažejo, da neplačanemu gospodinjskemu delu (brez časa, porabljenega za varstvo otrok) največ časa namenijo posamezniki z nizko stopnjo izobrazbe, najmanj pa posamezniki z visoko stopnjo izobrazbe. Pri neplačanem delu visoko izobraženi dajejo prednost varstvu otrok in za to porabijo bistveno več časa kot srednje in nizko izobraženi.

Nazadnje v analizi primerjam profile dohodka iz dela in potrošnje, razčlenjene le po starosti, s profili, razčlenjenimi po starosti in stopnji izobrazbe za 16 evropskih držav v letu 2010. Rezultati kažejo, da izobrazba na starostni profil dohodka iz dela vpliva precej močneje kot na starostni profil potrošnje. Dohodek iz dela posameznikov z visoko stopnjo izobrazbe je bistveno višji od dohodka iz dela posameznikov z nizko in srednjo stopnjo izobrazbe. Čeprav stopnja izobrazbe vpliva tudi na potrošnjo, pa so razlike v starostnih profilih pri treh stopnjah izobrazbe precej manjše. Posledično se visoko izobraženi v svoji delovni starosti soočajo z znatno višjim presežkom življenjskega cikla kot nizko in srednje izobraženi.

S kombinacijo tradicionalno izračunanih rezultatov NTA in rezultatov NTA po stopnji izobrazbe, upoštevajoč projekcije prebivalstva po starosti in spolu, dobimo projekcije skupnega dohodka iz dela in skupne potrošnje do leta 2060. Sposobnost, da s celotnim dohodkom iz dela financiramo celotno potrošnjo, kaže na stopnjo ekonomske vzdržnosti izbranih evropskih gospodarstev. Rezultati kažejo, da bo pričakovano zvišanje izobrazbene ravni v Evropi pozitivno vplivalo na ekonomsko vzdržnost. Predvideva se, da se bo celotni dohodek iz dela povečeval po povprečni stopnji, ki je za 19 % višja od skupne potrošnje v preučevanih državah. Ti rezultati tudi kažejo, da bi izobrazba lahko ublažila negativne učinke staranja prebivalstva, ki ga povzročata naraščajoči delež starejših in padajoči delež oseb v delovni starosti v Evropi.

Ključne besede: dohodek, potrošnja, medgeneracijski transferji, ekonomski življenjski cikel, izobrazba, neplačano delo

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AGENTA	Ageing Europe: An application of National Transfer Accounts (NTA) for explaining and projecting trends in public finances
AWG	Ageing Working Group
BE	Belgium
COICOP	Classification of individual consumption by purpose
CZ	Czech Republic
EE	Estonia
EL	Greece
ES	Spain
ESSPROS	European System of Public Transfer Inflows in Cash by Purpose
ESA	European System of Accounts
EU	European Union
EU-SILC	European Union Statistics on Income and Living Conditions
GDP	Gross domestic product
HAF	Harmonised Aggregate Files
HBS	Household Budget Survey
HEF	Harmonised Episode Files
HU	Hungary

IE	Ireland
ISCED	International Standard Classification of Education
ISCO-08	International Standard Classification of Occupations for 2008
IT	Italy
LCD	Life cycle deficit
LCS	Life cycle surplus
LT	Lithuania
LU	Luxembourg
LV	Latvia
MTUS	Multinational Time Use Study
NPISH	Non-profit institutions serving households
NTA	National Transfer Accounts
NTTA	National Time Transfer Accounts
OECD	Organisation of Economic Cooperation and Development
PL	Poland
PO	Portugal
RO	Romania
ROW	Rest of the world
SES	Structure of Earnings Survey
SK	Slovakia
SNA	System of National Accounts
US	United States
VET	Vocational education and training
WIC	Wittgenstein Centre for Demography and Global Human Capital

1 INTRODUCTION

This dissertation focuses on examining the impact of education on paid and unpaid work, consumption and transfers within the economic life cycle, as well as the broader implications for economic sustainability.

1.1 Disseration's research area

Economic growth reduces poverty, increases the standard of living and the general prosperity of nations. It depends on the economic value created by the labour force (Adams, 2003; Roemer & Gugerty, 1997). Apart from the surplus-generating working-age population, the human life cycle begins and ends with the period of dependency. Children and the elderly have higher consumption needs relative to their production, so their well-being depends largely on flows of economic resources from the working-age population with a production surplus (R. Lee, S.-H. Lee, & Mason, 2008; R. Lee & Mason, 2011b).

In the 20th century, many countries experienced the effects of the demographic dividend: Economic growth as a result of the increasing proportion of the population of working-age and the decreasing proportion of the dependent population (Bloom et al., 2003a; Lindh & Malmberg, 1999). However, because of the low birth rate, the proportion of the working-age population began to decline, and because of longer life expectancy, the proportion of the elderly population began to increase. The process of population ageing has led to a shift in the age distribution in favour of the elderly in many countries, especially in high-income countries (UN DESA Population Division, 2001). For the European Union (EU), the median age of the population is projected to increase from 43.7 years in 2019 to 48.2 years in 2050. In 2050, there will be fewer than two persons of working-age (20–64 years) for every person aged 65 and older (Eurostat, 2020).

The rising proportion of elderly people increases consumption needs, mainly in the form of pensions, but also in the form of health care and long-term care, which must be financed by public transfers or asset-based reallocations (e.g. disposal of assets accumulated in the past). The nature and extent of this support depends on the institutional system of each country. In Europe, for example, these needs are typically financed through public transfers based on the social contributions of currently active workers (Loichinger et al., 2017). The fact that the labour force will be smaller and older in the future raises concerns about its ability to meet the needs of older people (Bloom et al., 2015).

Therefore, population ageing has focused attention on how people produce, consume, transfer and save resources at a given age. Because individuals' economic behaviours related to employment, consumption, transfers received or paid and saving change with age (Bloom et al., 2007; Hamermesh, 1985; Spijker & Macinnes, 2013; UN, 2013), previous studies have focused on the different dimensions of population ageing to identify and understand the

effects of population ageing and future population trends (Lutz, Crespo Cuaresma, et al., 2008).

The effects of individual production, consumption and reallocation of resources have been analysed for some time in the context of generational economics, but the method for obtaining comprehensive and comparable data on the reallocation of resources across age groups was developed only recently with the National Transfer Accounts (NTA) project. By introducing the age dimension into the System of National Accounts (SNA), the NTA methodology enables the construction of profiles that provide information on the level of production and consumption by age (UN, 2013). It also enables the measurement of economic flows between different age groups by closing the gap between consumption and production of individuals at different ages. These flows refer to intergenerational transfers and asset-based reallocations. Calculating the NTA thus means creating a standardised dataset of age profiles that reveal the characteristics of economic behaviour at each age and can be compared across countries (D'Albis & Moosa, 2015; UN, 2013).

Depending on the institutional framework, transfers in different countries differ not only in terms of their amount, but also in terms of the direction in which these transfers flow, with the direction of transfers depending, among other factors, on the country's level of development. Due to population ageing, transfers in industrialised countries flow from the younger to the older, while in developing countries, transfers flow from the old to the young (R. Lee & Donehower, 2011). This is particularly true for public transfers (health care, long-term care, pensions, etc.). In contrast, private transfers, which consist of transfers between or within households, the latter also being one of the main contributions of the NTA methodology, show a strict downward direction in all societies (R. Lee & Mason, 2011b).

Transfers are an important tool for reducing inequality, ensuring the well-being of the population of all ages, and consequently economic growth (Miller et al., 2014). Because it is based on the SNA, previous NTA research on transfers has focused mainly on asset-based reallocations and monetary transfers given and received through the market, government, between or within families (e.g., Hammer, Istenič, & Vargha, 2018; R. Lee & Donehower, 2011; R. Lee & Mason, 2011b; Rentería, Scandurra, Souto, & Patxot, 2016; Zannella, 2015). Calculating monetary transfers provided a better picture of intergenerational dependence and future growth potential.

However, not all transfers are monetary. There is also economic value produced in the household (e.g., cooked meals, clean house) and intended for household consumption. This value is also transferred, mainly within the household, and it is measured in time. In all countries, it is women who provide most of this household production, and therefore the economic value of their production has often been underestimated (Miranda, 2011). However, the extension of the SNA to include household satellite accounts has made it possible to capture household production that is not sold on the market (European Commission, 2003). As mentioned earlier, household production includes all products and

services such as cooking, cleaning, childcare, and others that are produced and consumed within (and in some cases between) households. Household production is captured by the time use surveys, which record the time individuals spend on their daily activities (Centre for Time Use Research, 2020). The introduction of the age dimension into household production leads to the creation of the National Time Transfer Accounts (NTTA) (Donehower, 2014). To measure the non-market part of the economy, time spent on different activities is usually monetized to combine with the monetary values of the NTA. By combining monetary and time production and consumption, the NTA, combined with the NTTA, allows for a comprehensive analysis of transfers (Vargha, Šeme, et al., 2017).

The NTTA extension of the NTA shows that the NTA has provided a framework for including other demographic dimensions besides age in the study of the economic life cycle and related resources, such as the gender dimension. However, an individual's economic life cycle is determined by economic activity and the mechanisms and institutions present in the particular economy (R. Lee & Mason, 2010, 2011b). One of the most important factors affecting economic activity is the educational level of the individual (Barro & Lee, 2013).

The inclusion of the educational dimension in the study of the impact of population characteristics on the economy has become particularly important in the era of population ageing. Age and gender are typically characteristics that are considered key to population dynamics; educational attainment is key to otherwise uncaptured population heterogeneity (Lutz et al., 1998; Lutz, Goujon, et al., 2008). The impact of education on macroeconomic performance and economic growth has long been debated. Although models have shown that the inclusion of education as a human capital indicator in production models helps explain economic growth in different countries (Mankiw et al., 1992; Nelson & Phelps, 1966), the results of empirical research provided mixed results, mainly because the measurement of human capital was not detailed enough (D. Cohen & Soto, 2007; de la Fuente & Doménech, 2006). However, recent research has been able to demonstrate the link between higher education and economic growth. Educational expansion has been found to be a necessary condition for long-term economic growth, especially in terms of future macroeconomic performance (Kotschy & Sunde, 2018; Lutz, Crespo Cuaresma, et al., 2008). Education has also been shown in the past to play a key role in economic growth, particularly in terms of the demographic dividend achieved through the increased productivity and innovation of better-educated individuals (Crespo Cuaresma et al., 2014).

Education, especially in terms of productivity, also plays an important role at the micro level. The profitability and productivity of firms depends on the productivity of better educated workers, especially highly educated workers. Highly educated workers have also been shown to maintain higher productivity levels later in their working lives (Kampelmann et al., 2018; Lebedinski & Vandenberghe, 2014). As a result, they tend to stay in the labour market longer, delay retirement and earn higher earnings over their life cycle (Geppert et al., 2019).

Although population ageing is a problem, the good news is that it is accompanied by an increase in educational attainment. In particular, fertility decline leads to higher investment in education per child (Heckman & Jacobs, 2010; Prettner et al., 2013). Similarly, an increase in life expectancy leads individuals themselves to be more willing to spend more time in school because they expect to benefit from investments in education for longer in their lives (Ben-Porath, 1967; Cervellati & Sunde, 2013; Hansen & Strulik, 2017; Sánchez-Romero et al., 2016).

Evidence that education could mitigate the negative effects of population ageing has also drawn attention to the inclusion of the education dimension in the economic life cycle and transfers in the context of NTA research. Using Austrian data, Hammer (2015) fully disaggregated NT(T)A by both age and educational level and showed differences in economic behaviour over the life cycle between three levels of education: Basic, higher secondary and tertiary. However, most NTA research has only partially examined the impact of education on transfers, finding that highly educated individuals use the public transfer system less, but contribute more to (Abio et al., 2017, 2021).

1.2 Aim of the research and research questions

The aim of this research is to disaggregate paid and unpaid work, consumption, and intra-household transfers by educational level and analyse their impact on the economic life cycle.

More specifically, this research focuses on the role of education in three main areas. First, I analyse the NTA for Croatia and further disaggregate it by educational level for the first time. I also use the input-output matrices to estimate exactly who gives monetary transfers to whom, which has not been done before by educational level. Second, I analyse the impact of individual educational level on the production of unpaid work for 9 EU countries: Austria, Bulgaria, Denmark, Spain, France, Hungary, Italy, the Netherlands, and Slovenia. I also analyse the impact of educational level on consumption for 2 EU countries: Italy and Spain. This is the first research that comprehensively analyses the impact of educational level on the type of the household production activity performed. Third, the impact of differences in the economic life cycle between the three levels of education on future economic sustainability is examined for all EU countries for which all necessary data could be retrieved. These are 15 countries: Belgium, Czech Republic, Estonia, Greece, Spain, Ireland, Italy, Lithuania, Latvia, Luxembourg, Poland, Portugal and Romania.

Because educational level affects economic growth, it is the subject of research in the analysis of consumer income and behaviour (Abdel-Ghany & Shrimper, 1978; Carroll & Summers, 1991). The economic life cycle is determined by consumption needs at each age, and labour income is one of the ways to satisfy them (R. Lee et al., 2008; R. Lee & Mason, 2011b). The labour income earned by the highly educated in the paid work tends to be higher, which also allows them to consume more (Abio et al., 2017; Lutz, Crespo Cuaresma, et al., 2008; Perna, 2003). However, labour income is earned mainly by the working-age

population, which has to allocate part of its income to the consumption of children and the elderly through transfers. Like labour income and consumption, transfer flows are affected by many socioeconomic factors (R. Lee et al., 2008). Although educational level is one of these factors, there is little research on the effects of educational level on public (given by the government) or private (given by individuals within or between households) transfers. Most research has focused on the effects of public transfers on educational expansion (Abbott et al., 2018; Turra et al., 2011). Educational attainment has also been used as a proxy variable for income and/or socioeconomic status in research on inequality transfers (Jiménez-Fontana, 2019; Mejia-Guevara, 2015; Miller et al., 2014; Tovar & Urdinola, 2014). However, the impact of educational level on private intra-household transfers has not yet been analysed. In Europe, NTA by education level has been analysed to some extent for Spain, Austria, Finland, and the United Kingdom (UK) (Abio et al., 2017, 2021; Hammer, 2015). However, all previous estimates of NTA by educational level have been constructed by combining different data sources, especially on income and consumption, from several different sources. Therefore, monetary intra-household transfers have been estimated based on imputations of consumption levels in income surveys, using different characteristics of individuals within a household. In my dissertation, I construct the NTA based on the educational level using the relevant data from the same data source for Croatia for the year 2014, which allows me to calculate more accurately monetary intra-household transfers between different age groups disaggregated by their educational level. For the first time, such a study is conducted at the individual level and the transfer flows between age groups are presented in two-dimensional matrices. This leads to the definition of the first research question.

Research question 1: Do the direction and value of monetary intra-household transfers differ considerably between individuals in the same age group but with different levels of education?

During their life cycle, individuals can create value by investing their time to produce either a product or service that can be consumed (R. Lee et al., 2008). Time invested in household production in the form of unpaid work creates value, usually for members of the household. Unpaid work creates goods and services that, if not produced through unpaid work, would have to be purchased in the market (Donehower, 2014). Following the decision not to include unpaid work in the national accounts, it was apparent that the total economic activity of nations would be undervalued. Moreover, since unpaid work is primarily performed by women, the total contribution of women to the economy is not taken into account (Reid, 1934). As a result, most research on household production and unpaid work is gender oriented, particularly in the NTTA (e.g., Rentería, Scandurra, Souto, & Patxot, 2016; Sambt, Donehower, & Verbič, 2016; Šeme, Vargha, Istenič, & Sambt, 2019; Zagheni & Zannella, 2013; Zannella, 2015). However, like paid work, unpaid work is also influenced by the educational level of individuals over the economic life cycle. Therefore, part of the research in the NTTA framework has been extended to include the dimension of education. Zagheni,

Zannella, Movsesyan, & Wagner (2015) for Denmark, France, Austria, Germany, Italy, and Spain, and Jiménez-Fontana (2019) for Costa Rica have shown that education expansion contributes to reducing gender gaps in time spent on unpaid work. Hammer (2015) included age profiles of both production and consumption of unpaid work in his construction of NTA by education for Austria, focusing on two broad groups of activities: Unpaid household work other than childcare and childcare. However, Hammer (2015) does not analyse the effect of education on more specific activities of unpaid work, such as cleaning, cooking, and the like. In my dissertation, using most recent data, I analyse the effect of educational level on the production of unpaid work for 9 EU countries: Austria (2008), Bulgaria (2001), Denmark (2001), Spain (2009), France (2009), Hungary (2009), Italy (2008), the Netherlands (2005), and Slovenia (2000). Because of the peculiarities of estimating the consumption of unpaid work, I use 2002 data for two EU countries: Spain and Italy. These countries complete the list of EU countries for which such an analysis is possible. For the first time, I show the activities in which individuals with a certain educational level specialise. The second question focuses on the relationship between educational level and unpaid work.

Research question 2: How does educational level affect the production and consumption of unpaid work?

Some of the research outside of NTA points to the positive role of educational expansion on macroeconomic performance and mitigating the negative effects of population ageing (Kotschy & Sunde, 2018; Lutz, Crespo Cuaresma, et al., 2008). In the NTA framework, research on the effects of education on the demographic dividend for Spain and Mexico shows that education can offset the negative effects of population ageing (Rentería, Souto, et al., 2016). In my research, I use the NTA by education age profiles and determine the differences in the economic life cycle of different educational levels. I also make projections for total income and total consumption for 15 European countries up to 2060 and comprehensively determine the role of education in maintaining economic sustainability. The third set of questions, therefore, addresses the implications of differences in the economic life cycle of educational levels for economic sustainability in the future.

Research question 3: Does the gap between total income and total consumption remain the same when NTA age profiles are further disaggregated by education? How is education likely to affect economic sustainability?

1.3 Methodology and data

To show whether there is a significant difference in the supply and demand of monetary intra-household transfers across age groups for different levels of education in Croatia, I first need to estimate intra-household transfers. Therefore, for the first time, I construct the NTA by education age profiles for Croatia. To answer my first research question, I conduct an input-output analysis (Leontief, 1986). This analysis has previously been used in the NTTA framework to model intra- and inter-household transfers of time, disaggregated by age and

gender (Dukhovnov & Zagheni, 2015; Zagheni, 2015). The input-output model allows me to represent transfers between groups of different ages and educational levels in a two-dimensional form of input-output matrices. To represent transfer flows in this form, data on consumption, income and educational level must be available for each person in each household. This research route has not been pursued because in most countries income and consumption data are only available in separate data sources, so these data are not available for the same individual. For Croatia, however, the input-output analysis of monetary intra-household transfers is possible for 2014, as the Croatian Household Budget Survey (Croatian HBS) contains both income and consumption data for all household members for that year.

To evaluate the production of unpaid work in my second research question, I use the latest available data from the Multinational Time Use Study (MTUS) (Gershuny et al., 2020) for all EU countries for which data allow such an analysis: Austria (2008), Bulgaria (2001), Denmark (2001), Spain (2009), France (2009), Hungary (2009), Italy (2008), the Netherlands (2005) and Slovenia (2000). The construction of age profiles of consumption of unpaid work is specific because it depends not only on the data of the individual, but on the data of all household members. Therefore, to obtain the best possible age profiles of consumption of unpaid work, I use data from the MTUS for Italy (2002) and Spain (2002), the only two countries for which data on unpaid work are available for all household members. To construct household production and consumption profiles by age and educational level, I use the NTTA method described by Donehower (2014), which I adapt to include the disaggregation of production and consumption of unpaid work by educational level rather than by gender.

To answer my third research question, three steps must be taken to assess economic sustainability as measured by the gap between total labour income and consumption. First, the NTA categories must be disaggregated by age only to obtain the age profiles of conventional NTA, and then by both age and education to obtain the age profiles of NTA by education. This is done for 15 European countries for the year 2010: Belgium (BE), Czech Republic (CZ), Estonia (EE), Ireland (IE), Greece (EL), Spain (ES), Italy (IT), Latvia (LV), Lithuania (LT), Luxembourg (LU), Hungary (HU), Poland (PL), Portugal (PO), Romania (RO), and Slovakia (SK). These countries complete the list of countries for which a decomposition of the NTA by education is possible. In a second step, the obtained age profiles of NTA by education are combined with the global population projections from the Wittgenstein Centre for Demography and Global Human Capital (WIC) (2018) until 2060. The WIC global projections are available by age as well as by age and education, so that both age profiles of conventional NTA and NTA by education can be projected for the future. In the third step, the gap between total labour income and consumption obtained with conventional NTA and NTA by education is compared to estimate the potential impact of increased educational level of the population as a possible remedy for the sustainability of the transfer system.

1.4 Contribution to the field of knowledge

In the first part of my dissertation, in addition to production and consumption, I measure intra-household transfer flows by age group and educational level and determine whether there are differences in the value and direction of these flows depending on the age and educational level of individuals. In this way, I present the model of monetary intra-household transfer flows broken down by an individual's educational level in a two-dimensional form (input-output matrix) for the first time.

In the second part of the thesis, I examine the production and consumption of unpaid work by educational level for all the EU countries for which this is possible for the first time. My comprehensive analysis contributes to the field by establishing links between educational attainment and the type and amount of unpaid work performed and received.

The third part of the thesis presents income and consumption projections for a total of 15 European countries, broken down by educational level. I provide estimates and explanations for the evolution of current and future income and consumption in groups with different levels of education. To assess the impact of education on economic sustainability, I calculate NTA support ratios (the ratio between total labour income and total consumption in an economy). To test the results of the impact of education on projected total labour income and total consumption, I conduct a sensitivity analysis in which I apply the diminishing wage premium for high education for the first time. By including educational levels as the basis for projections of total income and total consumption, policymakers can gain additional information and insight that will allow them to influence and manage future economic growth through public finance and, more importantly, education policies.

In the past, educational level has been used as a proxy variable for income. However, with all three parts of my dissertation, I make an empirical contribution by showing that not only production and consumption, but also monetary and time transfers depend crucially on the educational level of individuals. Moreover, I make a methodological contribution by using input-output matrices to show monetary intra-household transfer flows by age and education. To show the ratio in which total consumption in an economy is covered by total labour income, I present for the first time the NTA support ratio indicators. Finally, I also make a theoretical contribution by showing that the consequences of population ageing for economic sustainability are not as drastic as previous research suggested when educational expansion is taken into account. This result is further supported by a sensitivity analysis that accounts for the declining wage premium for the highly educated, which has not been done before.

Due to population ageing, and the resulting importance of investment in human capital and labour opportunities, education policy is becoming one of the most important government policies. Therefore, the results of this study are useful to policymakers in guiding future growth and development.

1.5 Disseration's structure

This doctoral dissertation consists of five chapters and a Conclusion. Following this Introduction, Chapter 2 presents the theoretical foundations upon which the remainder of the dissertation's analysis is built. It includes the fundamentals of NTA, an overview of NTA methodology and previous contributions to the field of unpaid work and the impact of education on economic performance. Chapter 3 presents the detailed methodology and data used to answer the three main research questions of this dissertation. Therefore, this chapter is divided into three subchapters. First, I show the construction of NTA by education profiles for Croatia in 2014, which are needed for the further construction of the input-output matrices for monetary intra-household transfer flows, also presented in the same chapter. Second, I present the adaptation of the NTTA methodology for calculating the profiles of production and consumption of unpaid work by education. In the third part, I briefly explain the construction of age profiles of conventional NTA and NTA by education for 15 analysed countries. I then explain how obtained age profiles are matched with WIC population projections. Finally, I show the methodology used for total labour income and total consumption projections and the sensitivity analysis that ensures the credibility of the results. Chapter 4 summarises the results obtained in four subchapters. The first subchapter presents the age profiles of conventional NTA and NTA by education for Croatia for 2014 and shows the differences between them. The second subchapter presents input-output matrices of monetary intra-household transfer flows disaggregated by age and education in Croatia in 2014. The third subchapter presents the results of the analysis of the production and consumption of unpaid work disaggregated by age and educational level. The fourth and final subchapter compares conventional NTA age profiles with NTA by education age profiles in 15 EU countries. Projections of these profiles to 2060 show how education will affect future economic sustainability. Chapter 5 discusses the results obtained and provides theoretical, empirical, and practical contributions from the research. It also identifies some of the limitations of the research and discusses possible future research paths. The final chapter presents a conclusion. At the very end, the extended summary of the dissertation is presented in Slovenian.

2 NATIONAL TRANSFER ACCOUNTS

The study of population ageing and its impact requires data and information on how and how much people of different ages earn, consume, transfer and save. These economic activities are based on the economic life cycle of individuals as well as the associated reallocation of resources, which is the focus of the NTA.

2.1 Theoretical foundations of National Transfer Accounts

Already Malthus (1798) recognised the connection between population dynamics and per capita income and stated that population growth affects the economy. However, it was not until the 20th century, and in the face of rapid population growth in the Western world, that economists began to look more closely at the impact of population dynamics on the economy, its growth, and its development. In 1800, the world reached its first billion people, but it took only 123 years to reach the second billion in 1927 and only 32 years to reach the third billion in 1959 (UNFPA, 2011).

This rapid population growth caused thinkers of the time to take a pessimistic view, fearing shortages of food and limited natural resources. Ehrlich (1968), for example, predicted a worldwide famine that would affect millions of people by the 1980s due to rapid population growth. Coale & Hoover (1958) argued that people would face a shortage of adequate space and resources unless fertility was reduced. They also showed that population growth had a negative impact on economic growth. In the late 1960s and early 1970s, concerns about the negative impact of population growth on economies were echoed by many of the relevant institutions. The World Bank (1968) emphasized the economic benefits of slowing population growth as measured by per capita income and called for a focus on population control. The United Nations (1973) emphasized the negative impact of population growth on per capita income, but noted that there was no relationship between population growth and total product. In addition, they argued that rapid population growth would also lead to increased demand for education, health and other forms of consumption. This would put a great strain on the limited resources of developing countries in maintaining existing living conditions. They concluded that less developed countries would benefit from greater income growth and better overall development if there were no rapid population growth. The common denominator for the pessimistic view since Malthus' (1798) work was that population growth occurs in a world with fixed resources.

However, population growth brought other changes than just a growing number of people. Although controlling population growth was the prevailing view at the time, there were thinkers who disagreed. Kindleberger (1967), for example, argued that labour supply growth was the reason for economic growth in Europe after the war. He emphasised that rapid population growth caused the increase in labour supply, which, combined with the shift of labour out of agriculture, made post-war economic growth possible. This was consistent with the work of Boserup (1965), who argued that population growth put pressure on economies to change technically, economically, and socially, leading to their modern development. She argued that resource scarcity would encourage people to innovate more. Kuznets (1967) also found that population growth rates and per capita income were positively correlated and stated that there was insufficient evidence to support the prevailing pessimistic view that population growth negatively affects economic growth. He noted that both population and income growth are not a novelty, but the extreme growth rate is. This extreme growth also led to changes in industrialization and urbanisation. However, Kuznets (1967) argued that

population growth also produced more producers of already established products and more creators of new knowledge and inventions. He further argued that the increased productivity and new knowledge and technology resulting from population growth can offset the scarce natural resources, which the pessimists believed were a key problem. Similarly, Simon (1981) argued that population growth will eventually lead to technological growth because natural resources will become scarcer and people will have to adapt to this situation by processing resources better or finding innovative substitutes. Thus, he referred to human adaptive and innovative capacity as "the ultimate resource".

Although the Western world experienced population growth after World War II, there was also demographic change. Because of the introduction of new medicines and antibiotics, as well as new treatments for various diseases that had previously been fatal to millions of people, population mortality rates declined (Bloom et al., 2003a). However, fertility rates initially remained the same as before the decline in mortality, resulting in a larger but younger population. At this point, economists of the time realized that it was not just the number of people that was changing. The age structure of the population also had a massive impact on the economy and was therefore included in macroeconomic models (Bloom et al., 2003b).

The most notable model that accounts for age structure is the "overlapping generations" (OLG) model, first introduced by Allais (1947) but elaborated in more detail by Samuelson (1958) and Diamond (1965). The OLG model shows the interactions and exchanges between generations living at the same time. Samuelson (1958) introduced a consumption loan model with or without social contrivance of money, which became one of the most important macroeconomic models (Blanchard, 2018). It became the basis for social security systems, pension systems, business cycles, government debt studies, etc. (Diamond, 2009; R. Lee, 2021) In this consumption loan model, Samuelson (1958) considered for the first time the demographic structure in which generations overlap indefinitely into the future. In its simplest form, it considers two generations, the young and the old. The young generation has more of the perishable commodity than it needs, and the old generation has that commodity less than it needs. However, as the young generation grows older, it too will have less of the perishable commodity than it needs. Therefore, it is better for everyone if the young generation gives some of its perishable commodity to the old generation and in return receives the same from the young generation when it grows older. Of course, for this to happen, the young generation must believe that it can get the same from the next generation when it itself grows older. Thus, some sort of social contract is required. Samuelson (1958) suggests that this exchange may be based on the social contrivance of money. By having one generation pass on the surplus of a commodity to the generation that does not have it, Samuelson (1958) introduces intergenerational transfers for the first time.

Diamond (1965) extended Samuelson's (1958) simple consumption loan model by adding capital to the equation. Consumption optimality can be achieved either through money, as in Samuelson's (1958) model, through government debt, or through savings by younger

generations for their own old age. In Diamond's (1965) model, economies exist indefinitely, but individuals do not. Since individuals seek to maximize their own utility during their lifetimes, they are therefore motivated to save at younger ages to finance their own consumption in old age.

Diamond's (1965) last conclusion is related to the life cycle model, first introduced by Modigliani & Brumberg (1954). The life cycle model, which builds on consumer choice theory, assumes two periods in the life of a household: a working period in which income is higher than consumption needs, and a later, non-productive period in retirement in which income is lower than consumption needs. Despite the existence of these two periods, Modigliani & Brumberg (1954) argued that individuals make their consumption decisions regardless of their income at any age. People save when their income is higher and borrow when it is lower than their consumption. Therefore, consumption at any age is constrained by the resources available over a lifetime or, in other words, by the average income over a lifetime. Although the life cycle model is a micro-based model, it also has macroeconomic implications. Individual savings for retirement also affect national savings, which in turn affect national income growth, especially in the context of population growth, where more young people save than older people spend (Deaton, 2005).

During the period of major population changes, both OLG and life cycle models focused attention on the impact of the changing age structure on the economy. In particular, they addressed the importance of meeting the high consumption needs of older generations either through the income they themselves saved at a young age or through the surplus income of the currently younger generation in the form of intergenerational transfers. The OLG and life cycle models gained more importance in the 1980s, when economists became aware that the ageing of the population in industrialised countries has economic consequences (Bos & Weizsacker, 1989; R. Lee, 1980; Mason, 1988).

The life cycle consists of individuals with increased consumption at a young age, increased production at a working-age, and again increased consumption at old age. Depending on how many individuals belong to each generation in the economy, the relative weights are given to each of the life cycle stages. If the growth rate of the population changes, the age distribution also changes, and so do the weights given to each of the stages (R. Lee, 1980). R. Lee (1980) also shows that the individual and the social budget constraints are identical in both the consumption loan model and the model with capital when the population consumes only the direct returns to its labour. However, both the individual and society are affected by the change in the population growth rate. From society's perspective, a change in the population growth rate also changes the relative number of givers and recipients of intergenerational transfers. From the individuals' perspective, rapid population growth increases the interest rate, which allows them to consume more if they consume later than they earn. Therefore, when society accumulates capital and the population growth rate is high, society must save more to keep the capital-labour ratio optimal.

Based on this work and the work of other authors mentioned above, R. Lee (1994) provided the accounting framework for intergenerational transfers. He considered them in the context of other age reallocations, capital and credit. With this work, R. Lee (1994) provided the conceptual foundations for the NTA project, which later involved scholars from many countries around the world. These foundations include the economic life cycle, intergenerational transfers and saving.

2.1.1 Economic life cycle

The economic life cycle is determined by the difference between income and consumption. A life cycle surplus (LCS) occurs when income is higher than consumption, while a life cycle deficit (LCD) occurs when consumption is higher than income (R. Lee & Mason, 2011b). LCS and LCD can be described at both the individual and aggregate level, but the individual level is in the focus of the NTA.

The economic life cycle at the individual level shows how much an individual earns and consumes at each age during his or her lifetime. There are three main stages characterised by consumption needs and earning capabilities: young age or childhood, working-age, and old age or retirement. In addition to age, the economic life cycle depends on many other factors: biological, social, demographic, political etc. (UN, 2013). All these factors affect the choices individuals make and shape their economic behaviour throughout the life cycle. Economic behaviour is characterised by high dependency at young and old ages. At these ages, consumption needs exceed the individual's income capacity, making him or her dependent on working-age individuals, whose income exceeds consumption needs (R. Lee, S.-H. Lee, & Mason, 2008)

Although there are three important stages in the economic life cycle, at the beginning of life cycle research, childhood was often neglected. In the early OLG models of Samuelson (1958) and Diamond (1965), only two generations were considered: Workers and retirees. It was similar with the early life cycle models such as that of Modigliani & Brumberg (1954). Childhood was often considered as the consumption of parents. However, modelling with only one dependency period in the life cycle instead of two can lead to misleading results as it ignores some of the basic demographic characteristics. For example, a child's consumption affects saving, which is one of the central activities of the economic life cycle (Mason, 1988). This is discussed in more detail in the next section.

2.1.2 Transfers

Children and the elderly, a population with a life cycle deficit, are unable to cover their consumption through their own income. Therefore, this deficit must be covered either by transfers from the working population or, in the case of the elderly, also by personal savings (R. Lee et al., 2008; R. Lee & Mason, 2011b).

Intergenerational transfers were first mentioned by Samuelson (1958) in his OLG model. However, the focus on only two generations in this model ignores not only child dependency, but also changes in labour force participation, entry age into the labour force and retirement age, as well as shifts in age-related mortality. This is highlighted by Arthur & McNicoll (1978) who suggested that the focus of such research should be on the life cycle of the individual, broken down by age. They noted that economic behaviour in terms of production and consumption varies according to age and that production and consumption patterns are not identical. When consumption is higher than production, the difference is made up by transfers from those who produce to those who consume. Building on the age-specific approach to economic behaviour, Willis (1988) recognised the need to include family (or intra-household) and public transfers in the accounting system.

The generational accounting system was developed by Auerbach, Gokhale, & Kotlikoff (1991). Generational accounting shows the present value of the fiscal burden in the form of taxes imposed by the present generation on future generations. This work not only provided the framework for accounting, but also demonstrated the importance of tracking the public transfer system that also affects future generations.

R. Lee & Miller (1994) introduce generational accounting and follow up on the research of Willis (1988) by pointing out the high demand for wealth in old age. They distinguish between real wealth and transfer wealth, where real wealth is physical or human capital and transfer wealth is the present value of future transfers that are expected to be made minus transfers that must be made. If there were no net intergenerational transfers, the demand for wealth could only be satisfied by capital accumulation. Previously, Kotlikoff & Summers (1981) had demonstrated that intergenerational transfers actually account for most of the total capital accumulation in the US, which underlines the need to pay more attention to the study of intergenerational transfers.

2.1.3 Capital accumulation or savings

Early models consisting of only two generations (workers and retirees), such as Samuelson's (1958) OLG model, can lead to misleading results, especially with regard to savings behaviour. Savings or capital accumulation, together with transfers, are the means by which the consumption of the dependent parts of the population is secured.

Feldstein (1974) showed that in the US, the expansion of the public pension system reduces personal savings. Mason (1981) extended the life cycle model to include the timing of household saving. He found that the timing of household saving depends on both the interest rate and public pension programmes. In his later research on aggregate saving, Mason (1988) showed that the decline in fertility and the slowdown in population growth contributed to the improvement in living standards and increased the share of national income used for capital accumulation and aggregate saving. Countries in Asia with low dependency ratios also had higher savings rates, confirming the findings of Feldstein (1974).

Savings and intergenerational transfers are, however, intertwined. Kotlikoff (1988) has examined the motivation for saving in more detail and found that one of the most important motivators is intergenerational altruism, more specifically the will to generate intergenerational transfers. If there is a decline in the transfer system, for example, due to the rapid ageing of the population and thus fewer transfer producers and more transfer recipients, aggregate saving in turn increases (R. Lee et al., 2003).

These two contributions to the study of savings and intergenerational transfers became even more evident when populations in poor countries began to grow rapidly and populations in high-income countries began to age. They highlighted the importance of studying intergenerational transfers for policy making, which eventually led to the creation of the NTA.

2.2 Overview of National Transfer Accounts

The methodological framework of NTA is similar to generational accounting (GA), with the important addition of private transfers and reallocations resulting from interaction with capital and financial markets (R. Lee & Miller, 1994). In this way, the NTA measures transfer systems comprehensively and provides a better picture of the functioning of a country's welfare system. The picture, however, is only complete when private transfers are added to public transfers, as they show that private institutions can offset fiscal policies (D'Albis & Moosa, 2015). Recent research has further linked the GA and the NTA. For example, the NTA has been used to more accurately assess the long-term sustainability of the public sector (e. g. Hammer, Istenič, & Vargha, 2018). Further, R. Lee, McCarthy, Sefton, & Sambt (2017) introduced the Full Generational Accounts (FGA) which, in addition to public transfers, include the private transfers and bequests received by a generation over its lifetime and compare the position of future newborns with the position of current newborns, that is, what will the current generation leave to the next generation (R. Lee et al., 2017).

The NTA provides an accounting framework for identifying economic flows between individuals of different generations. Their aggregate values are consistent with the values of national accounts, provided by the SNA. The SNA provides an internationally agreed-upon standard framework for measuring economic activity. It also provides information on the level of assets and liabilities of an economy at specific points in time, as well as on the interconnectedness of the economy with the rest of the world (ROW) (UN, EC, IMF, OECD, 2009). The results of this accounting are comprehensive, consistent, and integrated accounts that can be used to analyse the overall performance of an economy.

The NTA is consistent with the SNA in all its concepts, so that a macroeconomic analysis based on both sources is possible. The values provided by the SNA are used as macro controls for the NTA component. However, there are also many differences between the NTA and the SNA. The focus of the NTA is on the individual, while other institutions are

considered as intermediaries (UN, 2013). The SNA focuses on the following institutional units: non-financial corporations, financial corporations, government units, non-profit institutions serving households and households (NPISH) and ROW. These sectors are considered as the total economy (UN, EC, IMF, OECD, 2009). The NTA is also based on these sectors, but they are aggregated into the private sector (non-financial corporations, financial corporations, NPISH and households) and the public sector (government units and ROW). The SNA also does not capture intra-household flows as the NTA does. Therefore, intra-household transfers are one of the most important estimates provided by the NTA (UN, 2013). Intra-household transfers account for about 90% of total private transfers. Private transfers represent a large share of the national economy, about 25% of GDP in Western countries and about 40% in Southeast Asia. They are important because they enable individuals who receive them to consume more than they earn. In the case of intra-household transfers, this is particularly true for children up to the age of 20, who receive large transfers from older household members (R. Lee & Donehower, 2011). The NTA introduces the age dimension into the SNA, enabling the analysis of the economic life cycle. By showing how individuals of different ages earn, consume, transfer and save resources, the economic life cycle reveals the economic behaviour at each age (R. Lee et al., 2008).

2.2.1 The NTA perspective on the economic life cycle

Models such as the OLG model and life cycle theory models developed to study generational flows and generational economic activity relied only on flows between aggregated cohorts (D'Albis & Moosa, 2015). They used generations as the unit of analysis. The total population was divided into either the young and old generations in two-generation models or the young, working-age and retired generations in the case of three-generation models.

Even though later models captured three generations (Cox & Stark, 1996; Wrede, 1998), much information is lost in such a broad definition of the unit of analysis, as economic activity itself varies greatly within the three generations. For example, the economic activity of young people who are at the beginning of their careers is very different from the economic activity of people who are still working but close to retirement. Nevertheless, both belong to the same working-age generation.

The NTA, on the other hand, shifts the perspective in examining economic flows from the aggregate level of generations to the individual level, distinguished by each age. Everything produced at a certain age or received from someone else is considered an inflow for that age, while everything consumed or given away to someone else is considered an outflow. The age and individual perspective allows us to track economic flows at a much deeper level, between individuals of different ages and not just between different generations (R. Lee & Mason, 2011b).

However, it is not easy to keep track of all the flows for each age. In compiling the accounts, the NTA relies on data collected by different institutions. Therefore, it is difficult to break

flows by age and individual. For example, the institutional data that the NTA uses to compile the accounts are in many cases collected for a household and not for each household member (UN, 2013). Furthermore, it is difficult to attribute the consumption of public goods to an individual, as public goods can be consumed by anyone. Some flows from one person to another of different ages pass through institutions (e.g. pensions). All these aspects show that a specific methodology is needed to track all flows by age (R. Lee et al., 2008).

The NTA tracks flows by age at the individual level, and the age profiles obtained, when aggregated, must match the aggregated amounts available in the national accounts. The construction of an NTA age profile is based on three types of data: population data, national accounts data and data on age-specific economic flows (UN, 2013).

Population data come either a national statistical office, The United Nations Population Division or, in European cases, Eurostat. These data must capture the population by a single age, they must include representatives of the total population (e.g. students, nursing home residents, etc.), and they must be adjusted for data collection problems such as undercounting of certain age groups (Istenič et al., 2016; UN, 2013).

National accounts serve as the basis for compiling NTA aggregate controls, which are then supplemented by data on government revenues and expenditures or reports on public programmes such as education and health. To build the age profiles of public consumption, various administrative records are added, which may cover some of the public programmes such as education, pensions or health expenditure by age (Istenič et al., 2016). The final data needed to construct the age-specific per capita NTA profiles are usually microdata in the form of various household surveys such as the Labour Force Survey, the Household Expenditure Survey or similar. Household surveys used for NTA profiling should include information on the age, gender and schooling or work status of all household members, as well as on labour and asset income income, cash transfers, private expenditure and inter-household transfers. These data are later classified into NTA categories, which are discussed in more detail in the next sections. Household surveys are also complemented by various administrative records that may cover some of the public programmes such as education, pensions, or health expenditures by age. Usually, several data sources must be used to construct the age-specific per capita NTA profiles. If the individual data are available, these data are used. If only household data are available, the total amount applicable to the household must be allocated to each household member (Istenič et al., 2016; UN, 2013).

After deciding which household survey to use as the basis for building the NTA age profiles, the main NTA variables can be created. The next step is to merge the micro-level NTA data with sources outside the micro-survey, such as estimates of public education or health consumption by age. The final step is to include national-level data. After smoothing (using Friedman's Super Smoother) and adjusting with the aggregate controls based on the SNA data, the final NTA age profiles are obtained (Istenič et al., 2016; UN, 2013).

2.2.2 The NTA flow identity

The basic NTA identity shows that all inflows into the age group x must be equal to the outflows (UN, 2013):

$$\underbrace{Y^l(x) + \tau^+(x) + Y^k(x) + Y^{p+}(x)}_{Inflows} = \underbrace{C(x) + \tau^-(x) + Y^{p-}(x) + S(x)}_{Outflows} \quad (1)$$

where inflows consist of labour income $Y^l(x)$, transfer inflows $\tau^+(x)$, capital income $Y^k(x)$ and property income inflows $Y^{p+}(x)$. The outflows consist of consumption $C(x)$, transfer outflows $\tau^-(x)$, property income outflows $Y^{p-}(x)$ and savings $S(x)$. The identity must hold at both the per capita and aggregate levels.

However, the NTA is mainly concerned with the economic life cycle, which shows economic behaviour at each age. This behaviour is characterised by the quantity consumed and the quantity produced through labour (R. Lee et al., 2008). The rearranged terms of the basic NTA identity show the age-specific economic life cycle, with labour income and consumption being the most important categories (R. Lee & Miller, 1994; UN, 2013):

$$\underbrace{C(x) - Y^l(x)}_{Life\ cycle\ deficit} = \underbrace{\tau^+(x) - \tau^-(x)}_{Net\ transfers} + \underbrace{Y^A(x) - S(x)}_{\substack{Asset-based \\ reallocations}} \quad (2)$$

where asset income is equal to the sum of capital income and property income, $Y^A(x) = Y^k(x) + Y^{p+}(x) - Y^{p-}(x)$.

The economic life cycle is represented on the left-hand side of the Equation (2) by the difference between consumption $C(x)$ and labour income $Y^l(x)$ at a given age x. It shows how much of the age-specific per capita consumption is covered by labour income. If consumption is higher than labour income, there is a life cycle deficit. This is usually the case for children and the elderly, who are unable to finance their own consumption and therefore rely on support from the working-age population. The labour income of the working-age population usually exceeds their own consumption, which means they have a life cycle surplus. They have more resources than they need (Mason, R. Lee, Thung, Lai, & Miller, 2009).

The difference between consumption and labour income is equal to the sum of net transfers and asset-based reallocations. In the case of the dependent population, which has a life cycle deficit, the difference between consumption and labour income is equal to the transfers and asset-based reallocations it receives from the working-age population to cover its deficit. The life cycle surplus of the working-age population, on the other hand, is equal to the transfers and asset-based reallocations it gives to those in need of assistance to cover their consumption (Mason et al., 2009). Therefore, there are three main components that form the basic NTA identity: life cycle deficit, net transfers and asset-based reallocations. They are presented in the next subsections.

2.2.3 Life cycle deficit in the NTA

The life cycle deficit is determined by consumption and labour income at a given age x. The profiles of consumption and labour income are the main categories of the NTA. Consumption within the economic life cycle includes public and private consumption. According to the NTA methodological framework, both public and private consumption are divided into three main categories depending on the purpose: (1) consumption of education, (2) consumption of health, and (3) consumption other than education and health (UN, 2013). Education and health are categories that tend to vary most with age and are therefore analysed separately (UN, 2013). Labour income consists of earnings (i.e. gross wages/salaries including employer's social contributions) and self-employment income.

2.2.3.1 Public consumption

Public consumption refers to the consumption of various public services. It has a redistributive and (total) consumption equalising function between different age groups. This is especially true for high-income countries, where it tends to have a high share in total consumption (R. Lee et al., 2008; Thung, 2011).

Public consumption can be either individual or collective public consumption. In the case of individual public consumption, it is possible to identify the exact beneficiaries of a particular public programme, while in the case of collective public consumption, the general public benefits (Istenič et al., 2016; UN, 2013). To construct NTA age profiles, public consumption by age also needs to be estimated. To achieve this, data on public consumption usually come from a variety of administrative data. In the case of the European NTA, data from various EU organisations were used (Istenič et al., 2016).

Spending on education can be classified as both consumption and investment. Like public consumption in general, public consumption of education (and health care) tends to have a higher share of total consumption in high-income economies (Thung, 2011). However, in the NTA framework, spending on education is only considered as consumption.

Public consumption of education can be either formal or informal consumption of education. Formal consumption of education includes government spending on children's schooling, while informal consumption of education includes consumption of other forms of general or adult education (UN, 2013). Public consumption of education is estimated by combining data on public education expenditure with age-specific enrolment data (Istenič et al., 2016; UN, 2013). The enrolment data are disaggregated by age and educational level. The number of educational levels considered depends on the availability of data. Usually, at least three levels of education are considered, but in the case of the European NTA, for example, they are: (1) pre-primary, (2) primary, (3) secondary, (4) post-secondary, non-tertiary, and (5) tertiary. These levels were distinguished using the International Standard Classification of Education (ISCED) (UNESCO Institute for Statistics, 2012).

There are three main steps in constructing the age profile of formal public education consumption. First, public education expenditure data must be used to estimate the cost per enrolled student at each level of education. Second, the number of enrolled students is calculated for each level od education and age. The final step is to determine the average public consumption of education by age. This is done by multiplying the number of students determined in the second step for each level and age by the unit cost from the first step. The same is done for informal public consumption of education. The sum of all levels of education for each age gives total the public consumption by age, which, when divided by the population size by age, gives the per capita consumption of public education (Istenič et al., 2016; UN, 2013).

Public health care can be provided directly by the government, purchased by individuals and then later reimbursed through various public programmes, or health care can be used collectively, for example through various prevention programmes. As mentioned earlier, public health consumption is much higher in high-income economies than in low-income economies. This is particularly true for older people (Thung, 2011). Public consumption of health provided by the government is usually recorded in government data that can be matched with patient information in administrative records. If these are not available, proxies may be used. Health services purchased by individuals that are subsequently reimbursed are included in the Household Expenditure Survey and can be estimated using methods for estimating private health consumption. Finally, collective public health care consumption is allocated equally across all ages (UN, 2013). In the case of the European NTA for 2010, estimates of public health consumption are based on one-year age profiles provided by the Ageing Working Group (AWG) for 2012, which were then adjusted to the 2010 aggregate values (Istenič et al., 2016).

Public consumption expenditures other than education and health can be divided into two categories: individual and collective consumption. Individual public consumption depends on the age of the individual and can be divided accordingly. Collective consumption includes the consumption of public goods, such as public administration services or public infrastructure, and is therefore divided equally among all individuals (UN, 2013).

2.2.3.2 Private consumption

There is a close connection between private consumption and public cash transfers such as pension programmes, unemployment benefits and the like. More precisely, public cash transfers, together with labour income, increase private consumption and thus indirectly affect the economic life cycle (R. Lee et al., 2008).

Private consumption is the consumption of goods and services purchased in the private sector. Data on private consumption usually come from the Household Budget Survey. These data are in many cases available only at the household level and not available for each household member. In these cases, intra-household allocation rules must be applied since

the objective of the NTA is to obtain estimates of individual private consumption. As with public consumption, private consumption of education and private consumption of health are analysed separately because they vary considerably by age. All other private consumption is marked as private consumption other than education and health (UN, 2013).

Private consumption of education is mainly measured using data from expenditure surveys, which often include consumption of tuition, fees, books and other materials, etc. Informal education expenditure is also included in this category. The allocation of education expenditure to household members in schooling depends on the available data (UN, 2013).

The European NTA used the Household Budget Survey (HBS) to calculate the age profiles of private consumption of education. The HBS contains detailed information on household expenditure on five levels of education: pre-primary education, primary education, secondary education, post-secondary non-tertiary education and tertiary education. Therefore, the unit cost of education for each household member was obtained by simply dividing the education expenditure for each level by the household members enrolled in that level. Education expenditure that could not be distinguished by educational level was allocated equally to all household members enrolled in any level of education (Istenič et al., 2016).

The ability to estimate private consumption of health depends heavily on the availability of data. This process is quite complex, as the world's economies have very different health care systems. In some cases, for example, health insurance premiums are paid by employers and are therefore not included in the surveys. In other countries, health care costs are paid by the individual, who is later reimbursed by the national health care system. Furthermore, in most cases it is very difficult to determine the age of the person who has used the health services or paid the health insurance premium, as it is usually not reported. This is a problem because the focus of the NTA is on determining the age profile of the individual's economic activity. Therefore, the NTA has developed several methods to allocate the private consumption of health, depending on the availability of data (UN, 2013).

If the survey of health expenditure by age is available, the individual private consumption of health can be determined directly from the survey. If this is not the case, a regression approach (without a constant term) can be used, depending on data availability. One of the options is also to use the iterative method, where the household’s health expenditure is divided equally among all household members. This is then considered as the average private consumption of health for the available age groups. The resulting age profiles are used as an equivalence scale in the next iteration, which in turn produces a new age profile. The process is repeated for each household analysis, assuming that the per capita age profile eventually converges to the actual age-specific profile of private health expenditure (UN, 2013).

In the case of the European NTA, estimates of individual health expenditure were obtained by regressing household health expenditure on the number of household members in a given

10-year age group. The coefficients obtained were then used as relative proportions to distribute the total household consumption among the household members (Istenič et al., 2016).

Household's private consumption other than education and health is allocated to the individual level using the equivalence scale. According to the equivalence scale, the consumption of adults aged 20 and over in a household is constant and equal to 1.0. For children under 4, it is assumed that their consumption is equal to 0.4 of the adult's consumption. Children between 4 and 20 years are assumed to have a linear increase in consumption from 0.4 to 1.0 of adult consumption. Using this method, the estimated age profile of private consumption other than education and health does not show how a given household allocates its consumption. However, it still reflects the variation in consumption between age groups (UN, 2013).

2.2.3.3 Labour income

Labour income, generated mainly by the working-age population, is the main source of economic sustainability for a population. In low-income countries, the population usually enters the labour force at a very young age, but their income is still low. In high-income countries, on the other hand, older people can afford more leisure time and therefore have little motivation to continue working. In the era of population ageing, when the working-age population is shrinking, labour income and economic behaviour have become more important for young and older people. For young people in low-income countries, expanding education should increase their income (S.-H. Lee & Ogawa, 2011).

Due to its role in meeting the consumption needs of both working-age and dependent population, labour income is an extremely important profile within the NTA. It includes income from employees and income from self-employment (S.-H. Lee & Ogawa, 2011; UN, 2013). Labour income consists of earnings (i.e. wages or salaries paid as compensation for work performed by the individual and as employers' social contributions) and labour income from self-employment. Earnings are usually estimated from survey data and are generally available at the individual level. However, some surveys do not include data on employers' social contributions, so it must be assumed that these account for a constant share of wages and salaries (UN, 2013). Data on labour income from self-employment are sometimes obtained from survey data, as in the case of the European NTA. In this case, the EU-SILC survey provided data on both earnings and income from self-employment for each person (Istenič et al., 2016).

2.2.4 Net transfers

According to the basic NTA identity, the deficit in the economic life cycle must be covered by net transfers and/or asset-based reallocations, which are explained in the next section.

Transfers are economic flows that do not involve explicit quid pro quo, which means they are motivated by the exchange itself. The transfer giver does not expect anything in return from the person to whom he or she gives the transfers (R. Lee & Mason, 2011c). However, there may be an implicit quid pro quo, in the form of indirect reciprocity that links exchange and altruism. Children observe their parents providing support to older people. As adults, they continue this practise by supporting their own parents, with the expectation that they will be supported by their children, when they themselves grow old (Arrondel & Masson, 2006; R. Lee & Mason, 2011c). In the NTA, net transfers are the difference between transfer inflows (transfers received) and transfer outflows (transfers given). Both transfer inflows and transfer outflows can be public or private (UN, 2013).

2.2.4.1 Public transfers

Public transfer inflows are flows that are mediated by the government. They include both in-kind and in-cash transfers. Public in-cash transfers are transfers of money received from the government, such as public pensions. Public in-kind transfers are equal to the public consumption and can therefore be consumed individually (e.g. public health care) or collectively (e.g. street lighting, etc.). Although some public transfers can be consumed collectively, all public transfers within the NTA are allocated to an individual (Miller, 2011).

Public transfer inflows are analysed according to their purpose and as such are divided into four main categories: (1) education, (2) health, (3) pensions, and (4) other. In the European NTA, the category of other public transfer flows is further subdivided into unemployment, family and children, housing, other social protection and other benefits. For the European countries, cash transfers are reported at the individual level and are available from the EU-SILC (Istenič et al., 2016).

Under the NTA, flows from the private to the public sector are considered public transfer outflows. These flows mainly finance public transfer inflows, public asset income, or public saving. Public transfer outflows are mainly paid by working-age people in the form of taxes and compulsory contributions on labour as well as indirect taxes and other taxes. In Europe, public transfer outflows usually do not cover public transfer inflows and public interest payments, so the difference must be covered by dissaving, which is part of the public asset-based reallocations (Istenič et al., 2016)

2.2.4.2 Private transfers

Private transfers can occur as inter-household transfers between different households or intra-household transfers within the same household (UN, 2013). Inter-household transfers include direct transfers from one household to another (e.g. alimony payments), indirect transfers mediated by the non-profit institutions serving households (e.g. donations) and private transfers to and from ROW. Inter-household transfers are estimated from survey data

and must match net private transfers to and from ROW as this information is available in the SNA (UN, 2013). In the European NTA, these transfers are reported at household level and treated as given to the head of household (Istenič et al., 2016). Intra-household transfers are transfers between members of the same household. Therefore, intra-household transfer inflows must equal the intra-household transfer outflows, which means that net intra-household transfers at the aggregate level are zero (UN, 2013).

One of the most important contributions of the NTA methodology is the ability to make estimates of private intra-household transfers (e.g. adults financing their children's consumption) and to make these estimates comparable across many countries. Individuals finance their private consumption through labour income earned in the market and public cash transfers (net of taxes paid). If they are unable to finance all their consumption, the remaining part is usually financed by private intra-household transfers. Therefore, household members who have a life cycle surplus are assumed to finance the consumption of household members who have a life cycle deficit. If the sum of labour income and public cash transfers of all household members is not sufficient to finance the total consumption of a household, the remaining part is financed in two ways. Either it is financed by the asset income, which belongs only to the household head, or the household head has to borrow resources from other households to cover the total consumption needs of a household (R. Lee & Donehower, 2011; R. Lee & Miller, 1994). Intra-household transfers are much more common than inter-household transfers. About 90% of all private transfers are intra-household transfers, while inter-household transfers account for only about 10% (R. Lee & Donehower, 2011).

2.2.5 Asset-based reallocations

Assets are economic resources that can be reallocated over time. Asset-based reallocations, together with transfers, are used to finance the life cycle deficit. However, the extent to which assets are used to meet the consumption needs of the elderly, for example, varies from country to country. In some countries, assets are hardly used, while in others they cover almost 70% of the consumption needs of the elderly (Mason et al., 2011).

Asset-based reallocations correspond to the difference between asset income, defined as the sum of capital and property income and savings. Asset income includes resources that could be used for consumption, so the generation of additional asset income is an inflow. The same applies to negative saving or dissaving. Positive saving, on the other hand, is considered an outflow. Asset-based reallocation can also be either public or private (UN, 2013).

2.2.5.1 Public asset-based reallocations

Public asset-based reallocations are closely linked to public transfer deficits or surpluses. When public transfer inflows are insufficient to cover public transfer inflows, a deficit occurs. The government must make up this deficit by issuing asset-based reallocations.

Public asset income is composed of the government's net operating surplus and net property income. The net operating surplus is the difference between the gross operating surplus and the consumption of fixed capital. Net property income is the difference between public property income inflows and public property income outflows, which are estimated by using the corresponding public transfer age profiles (UN, 2013).

2.2.5.2 Private asset-based reallocations

Private asset-based reallocations are the difference between private asset income and savings. They are also one of the mechanisms for the shift of economic resources across age and time when an individual's preferred consumption differs from the trend in individual labour income. For example, individuals who are early in their careers may generate resources by taking on debt. They invest in their education by paying their tuition fees, or they want to buy a house (UN, 2013).

The first component of private asset-based reallocations, private asset income, is divided into two categories: (1) capital income and (2) property income. Capital income includes is the return on capital held by households (owner-occupied housing), capital income of corporations and unincorporated enterprise income (Istenič et al., 2016; UN, 2013). In the European NTA, owner-occupied housing is estimated by using the imputed rents age profile. Capital income of corporations is estimated by using the age averages of asset income available in EU-SILC survey. Unincorporated enterprise income is estimated by the age profile of the income from the self-employment (Istenič et al., 2016). Property income inflows include flows generated from financial assets, of which the most important are interest, dividends and rents. Property income outflows consist of interest expenditure of households and interest outflows of corporations. Property income is then obtained by subtracting property income outflows from inflows. The important feature of property income is that its inflows and outflows must always be balanced (UN, 2013). In the European NTA, property income data, just like private asset income, is also taken from the EU-SILC (Istenič et al., 2016).

The second component of private asset-based reallocations are savings. Individuals generate inflows when they acquire debt or dispose assets they have, and they generate outflows when they dispose debt or accumulate additional assets (UN, 2013). Private saving is equal to private disposable income minus consumption. However, in the European NTA only the household head owns asset income, and all other household members use the potential surplus they may create to give transfers to all the other household members. Therefore, private saving (or dissaving if negative) is only possible for the household head (Istenič et al., 2016).

2.3 Unpaid work

By breaking down national accounts by age, NTA provides a comparable framework for studying intergenerational reallocations. It provides information on how people at a given age produce, consume, save and transfer resources (R. Lee & Mason, 2011a). Although the NTA provides information on how individuals produce goods, this analysis only considers the production that is recorded in the national accounts. This is the production that is sold and valued in the market. However, people also produce goods and services that have economic value but are not sold on the market. Cooking meals, cleaning the house or gardening are all production activities that, if they were not performed by individuals, would have to be bought on the market. These activities performed by household members that are not sold on the market constitute household production and are referred to as non-market activities or unpaid work (Donehower, 2014).

2.3.1 Should household production count?

The economic performance of nations around the world is measured using national accounts, which aim to capture economic activity within an economy and provide an overview of economic processes (UN, EC, IMF, OECD, 2009). However, one of the problems has always been the definition of economic activity. Any activity that uses scarce resources to achieve a monetary or non-monetary result can be considered economic (Quah, 1992). However, individuals engage in various activities that lead to physical outputs (e.g. various products) or to a particular experience (e.g. services). Moreover, some of these activities are performed in the market and others are performed outside the market. Due to the complexity and problems that would otherwise arise, only activities that take place in the market have been included in the national accounts. Non-market activities were only considered in exceptional cases. For example, a self-built house or a self-sewn dress could be included in the national accounts by assigning a market value to these products. However, household production, which consists of cooking, cleaning, childcare and similar household activities, is not part of the national accounts (Miranda, 2011; Stiglitz et al., 2009).

The need to include household production in national income has been discussed since the first half of the 20th century. Somewhat earlier, Marshall (1890) noted that people who perform only household work earn income as do people who perform these activities as part of their occupation. Reid (1934) further argued that not including household production makes national accounts incomplete and undervalues the economic contribution of women, who are usually the main producers of unpaid household work. On the other hand, men are usually the main producers of paid work.

However, except in some cases, household production was not included in the national accounts for several reasons. First, there was the problem of how to accurately measure household production, i.e. how to collect data on household production. Second, the definition of household production was not easy, as it is difficult to distinguish whether some

activities are leisure or work. Third, sometimes several activities take place at the same time, so it is difficult to quantify them. Fourth, household production needs to be valued in order to compare it with market production (Quah, 1986). Over the years, economists have proposed different ways to solve these problems, which are discussed below.

2.3.1.1 Measuring the household production

Gross domestic product (GDP), the commonly used measure of economic activity, mainly captures market output. GDP growth is often considered the best indicator of economic growth. This means that economic growth is mainly indicated by growth in market output. However, growth in market output may be the result of a decline in the production of unpaid work, which means that overall well-being has not improved (Stiglitz et al., 2009).

Although most activities of unpaid household production take place within the household, their impact on well-being goes much further. Not only do they enable higher levels of current consumption, but they also affect future well-being. For example, time invested in childcare is an investment in the well-being of a future generation. The same is true for unpaid work done outside the household. For example, the well-being of the community benefits from unpaid volunteer work (Miranda, 2011).

The first problem with the inclusion of household production in national accounts was therefore the question of how to measure intra-household production. In their discussion of whether household work should be included in the national accounts, Kuznets, Epstein & Jenks (1941) pointed out the problem of the lack of data on household production, which led them to conclude that only those activities that have a market value should be included in the compilation of the national accounts. The problem of the lack of data on intra-household activities was attempted to be solved by measuring the time required to perform a given activity of household production. Although there have been partial versions of this since the 1930s, the first properly designed and harmonised time use study, covering 12 countries was funded by UNESCO and conducted by Alexander Szalai (1972) in the mid-1960s. Time use was recorded in the form of diaries kept by individuals over a period of time. The importance of the harmonised time use studies was, among other things, that they made it possible to measure intra-household production activities in units of time that were comparable between countries.

2.3.1.2 Definition and quantification of household production

The second problem is the definition of household production, which should be included in national accounts. Household work consists of activities that have both economic value (e.g. unpaid work) and do not (e.g. leisure). Sometimes the distinction between these activities is not clear (Quah, 1992). For example, teaching a child to write might be considered childcare, but a parent might also enjoy teaching a child, which should then be considered leisure for a

parent. The boundary between these activities is usually drawn by the "third party" criterion. This criterion is used to classify a particular activity as unpaid work based on whether it is possible for a person to pay a third party to perform the activity and still receive a benefit from it (Reid, 1934).

Besides the definition of household production, the third problem is the quantification of the housework (Quah, 1992). Some activities can be performed simultaneously by one household member. For example, a person may cook and take care of a child at the same time, thus performing the activities of cooking and childcare at the same time. Therefore, the problem of recording such activities arises. If both activities are recorded separately, the total time spent on all activities would exceed 24 hours in one day. Usually, only the activity that the diarist reports as the main activity is recorded and the secondary activity is not taken into account (Chadeau, 1992). However, some surveys indicate whether there was a secondary activity.

2.3.1.3 Valuing the household production

The problems in quantifying household production led to the fourth problem in including household production in national accounts: the valuation of household production. The main issue here is whether to value inputs or outputs. There are two main methods of assigning a value to household production: the output approach and the input approach (Chadeau, 1992).

The output approach evaluates the results that a particular production activity has produced in the household. For example, a result of cooking is a cooked meal. According to the output approach, the value of cooking would be determined by the value of the cooked meal. The input approach values the inputs used for a particular production activity. In the example of cooking, the input approach would value the time invested in the activity of cooking. However, both approaches have their advantages and disadvantages.

The advantage of the output approach is that the value it gives is not affected by differences in the productivity of a person performing the activity. For example, the same meal would likely be prepared faster by a 30-year-old than by a 75-year-old, as labour productivity depends on age, but would be valued equally under the output approach (Vargha, Gál, et al., 2017). However, the drawback is that there is usually no data on the quantity of household goods and services produced. Moreover, the output approach assumes that there is a substitute in the market for the goods and services produced by households. The value of this market substitute is then attributed to the product of unpaid work in the household (Chadeau, 1992).

The input approach is much simpler and allows for comparability because it assigns a monetary value to labour inputs. However, the same meal prepared by a person who takes more time to prepare is valued more highly, which means that economies of scale are also not taken into account. Preparing five meals does not require five times as much time, but

five meals would cost five times as much in the market. Therefore, the input approach may undervalue labour (Vargha, Šeme, et al., 2017). Nevertheless, the input approach is more commonly used due to data availability and thus simplicity.

2.3.2 Household Satellite Accounts

Although the need to include unpaid household production in national accounts has long been debated, comparable time-use surveys, first conducted in the 1960s, have shown the extent of household production. The 1993 revision of the national accounts allowed for the creation of satellite accounts that enabled the integration of household production into the national accounts' framework. The idea behind the satellite accounts was to use alternative concepts that can complement and add additional dimensions to the national accounts framework (UN, EC, IMF, OECD, 1993).

After several years of work, the European Commission (2003) made a proposal for a methodology to construct household satellite accounts, which were then constructed for many European countries. The first comprehensive survey conducted for 25 EU countries (all EU countries in 2012, except for Malta) estimated that total value of unpaid family care work in EU ranges from a minimum of 17.0% to a maximum of 31.6% EU GDP, depending on the applied methodology. Childcare alone accounted for 2.5–5.4% of EU GDP (Giannelli et al., 2012). Miranda (2011) made comparative accounts for Organisation for Economic Co-operation and Development (OECD) countries that showed the importance of the contribution of unpaid work to societal well-being. Her estimates showed that unpaid work accounts for between one-third and one-half of all economic activities valued by traditional measures. Several research findings have shown that analysing data on time use, and thus on unpaid work, can give a better picture of the true size of the economy.

Household satellite accounts provide insight into the extent of unpaid work in a given economy and show socio-economic differences in the performance of paid and unpaid work. However, they only provide an aggregate measure of unpaid work and therefore ignore the age dimension. Therefore, the NTA further developed unpaid work by age.

2.3.3 Allocation of unpaid work by gender

The study of unpaid work showed the extent to which work done in the household is not valued. However, it also confirmed the specialisation of work and its division by gender. Although the total time women and men devote to work is roughly equal, women devote more time to unpaid work and men to paid work (Miranda, 2011). On average, women worldwide spend 3 to 6 hours per day on unpaid work, while men spend only 0.5 to 2 hours per day. This means that, on average, women spend 2 to 10 times more time on unpaid work than men. Although the amount of time spent on unpaid work varies by region and income,

women perform more than men in all regions (Ferrant et al., 2014). This has several consequences.

More time spent on unpaid work means that women cannot spend as much time on paid work as men. Women's labour force participation is negatively correlated with the amount of time women spend on unpaid care work. This is also true for countries where the gender gap in education is decreasing, assuming that women are responsible for unpaid work in these countries. Moreover, in countries where men participate more in unpaid work, female labour force participation is higher (de Laat & Sevilla-Sanz, 2011). However, when responsibility for unpaid work is high, women are more likely to opt for part-time paid employment, employment with poorer conditions, or employment that is below their skills or education, leading to a widening of the gender wage gap. Even when they do participate in the labour market, women tend to earn less than average, which translates into wider gender gaps in labour outcomes (Ferrant et al., 2014).

In recent decades, women have started to participate more in the labour force, leading them to postpone childbearing until later in life, as it is difficult to navigate between a higher level of paid work and the same level of unpaid work as before (Bianchi, 2011). In countries where men participate more in unpaid work, women can increase their labour force participation at high fertility rates. However, this is not the case for women with higher wages. They participate more in the labour force, but at lower fertility rates (de Laat & Sevilla-Sanz, 2011).

The gender dimension of unpaid work clearly affects the economic life cycle of individuals, both men and women. As the value of unpaid work is not taken into account in national accounts, this was the reason to add it to the economic life cycle of the individual.

2.3.4 Inclusion of unpaid work in NTA

The introduction of household satellite accounts, and thus the inclusion of household production in the national accounts, opened the door for it to be included in the NTA as well. The focus of the NTA is on the economic life cycle of an individual and allows for the capture of flows between different generations by disaggregating the national accounts by age. As the NTA is based on the SNA, they could therefore only capture flows of money between individuals of different ages and/or generations. However, the inclusion of household production in the SNA allowed for a more detailed specification of the production account even within the NTA. Since all work - paid and unpaid - is strongly influenced by gender, the inclusion of unpaid work in the production account also allows the gender dimension to be taken into account in the NTA.

The first NTA to include unpaid work was conducted in Thailand and showed that most transfers take place within households, with women being the main providers of time transfers or unpaid work for most of their lives (Phananiramai, 2011). Following this

research, Donehower (2014) developed a comprehensive methodology for valuing unpaid work and added it to the NTA, which enabled for the creation of what is known as the National Time Transfer Accounts (NTTA). As men are the main providers of paid work, which is already reported in the national accounts, the NTTA add unpaid work, which is mainly performed by women, to the production account.

The NTTA methodology measures the unpaid work by analysing time use surveys. It takes into account all activities that could earn a wage if performed in the market. Therefore, the household production of unpaid work includes activities such as cooking, cleaning, childcare, caring for the elderly, volunteering and other. Household management and care activities are mostly done by adults, which makes them the main producers of unpaid work. Adult household members also consume general househwork (such as a clean house or a cooked meal). Children, on the other hand, are the main consumers of unpaid work, as they consume childcare in addition to the general housework. Childcare is a specific activity of unpaid work because it is heavily concentrated at a particular stage of life, namely the childbearing age. As in the NTA, therefore, individuals of working-age remain net givers, while children and the elderly are net recipients of resources (Donehower, 2014; Vargha, Šeme, et al., 2017).

This was shown by Dukhovnov & Zagheni (2015), who used the American Time Use Survey and found that most care transfers are from parents to children. This is followed by care transfers from grandparents to grandchildren, while transfers from the working-age population to the elderly were less common. A significant proportion of transfers take place between spouses within the same generation.

Hammer, Prskawetz, & Freund (2015) considered similar topics in their cross-country comparison of the role of age and gender in market and non-market production activities. Their comparison included Austria, Finland, France, Germany, Hungary, Italy, Slovenia, Sweden and the UK. They found that in all countries studied, women performed a large share of unpaid work for men living in the same household. In addition, the working-age population generally performed a large share of unpaid work for other generations, especially for their children. Although older people perform a large share of unpaid work, the goods and services produced are mainly consumed by themselves. As unpaid work mostly consists of simpler tasks such as cleaning or gardening, this work is generally valued less than paid work. As a result, in most countries the total output of working-age men is higher than the total output of women. However, the situation is different in Spain and Slovenia, where working-age women produce more than men. The reason for this, unfortunately, is that women spend significantly more time on production activities than men, thus compensating for the lower value placed on unpaid work. Across all age groups, women perform more unpaid work than men, highlighting gender inequality. However, the extent of inequality varies from country to country. Within Europe, for example, gender inequality is greatest in southern Europe, where the gap between women's and men's time production during the life cycle is widest (Zagheni & Zannella, 2013).

The inclusion of unpaid work in the economic life cycle of individuals also provides important information for policy makers. Based on their research findings for Slovenia, Sambt, Donehower, & Verbič (2016) suggest that Slovenian policies should promote improvements in gender equality in total workload. They found that women in Slovenia spend on average about one hour less on paid work but two hours more on unpaid work than men. This is even more pronounced between the ages of 30 and 50, which means that policies should aim to provide childcare services or flexible working arrangements.

Looking at the historical patterns of unpaid work in EU countries by age since the 1970s, Šeme, Vargha, Istenič & Sambt (2019) found that over time, women spent more time in paid work and less time in unpaid work activities. Conversely, over time, men began to spend more time in unpaid work then in the past. However, there were other changes in the economic life cycle than just changes in the shares of unpaid work. Analysis of historical NTTA profiles of unpaid work showed that total household production (consisting of housework and care activities) peaked over time in older age groups. The peak in household production tends to be caused by caring for young children, suggesting that people have postponed parenthood over time. Moreover, this effect was found to be more pronounced among women. In addition, per capita consumption of childcare increased substantially, suggesting that more was invested in children's human capital over time. Over time, women transferred less, and men transferred more unpaid work to children than in the past. The direction of the transfer of unpaid work has remained the same: from women to men.

The study of unpaid work by age and gender provides useful information for the design and implementation of various public policies. Most authors point to the need to create policies, such as kindergartens or more flexible work arrangements, to help women between the ages of 30 and 50 to balance work and family life (Kluge, 2014; Rentería, Scandurra, Souto, & Patxot, 2016; Sambt et al., 2016). Such policies would allow women to participate more in the labour force. Increasing women's market production benefits the transfer system and can reduce the economic dependency of the elderly (Hammer et al., 2015). In addition, labour force participation allows women to maintain the protection of the paid labour market (Rentería, Scandurra, et al., 2016)

This is especially important for the highly educated women. Since the highly educated women can receive higher wages for their paid work, the opportunity cost of unpaid work is higher for them than for the low- and the medium-educated women. This is also the reason why the gender gap in the production of unpaid work is smaller in the households of the highly educated. With the expected expansion of high education levels in Europe, the gender gap in the household production of unpaid work is also expected to narrow in the future (Zagheni et al., 2015).

2.4 Effects of education on population dynamics and economic performance

The standard of living of a population within a given economy increases with economic growth. However, economic growth is also affected by the characteristics of the population. Since they are responsible for the emergence of many different demographic patterns, gender and age are considered two key characteristic dimensions of population processes (Preston et al., 2001). Gender is an essential characteristic because it is crucial for studying fertility and thus population growth or decline. Age, on the other hand, allows us to determine an individual's position in the life cycle, i.e. whether a person is in school, in the labour force or retired. Both characteristics allow for a broad spectrum of population research.

However, there are several characteristics that can contribute to the study of population processes. One of these is the level of education, an important indicator of observable population heterogeneity. For example, lower fertility tends to be associated with higher education among women. Therefore, education is capable of changing population dynamics, mainly in terms of population size (Lutz & KC, 2011).

2.4.1 The role of education in macroeconomic performance

Changes in population size have been shown to have affected the performance of many economies in the second half of the 20th century. Rapid economic growth resulting from a favourable change in the age structure of a population is known as the first demographic dividend. The share of the population of working-age is higher than the share of the dependent population. Bloom & Williamson (1998) were the first to empirically demonstrate this effect, finding that about 30% of rapid economic growth in East Asia is due to age structure. Subsequent research has shown that the mechanisms by which the demographic dividend is achieved are savings, labour supply and human capital (Bloom, Canning, & Fink, 2010; Bloom, Canning, & Sevilla, 2003). Kelley & Schmidt (2005) distinguish between two main effects of the demographic dividend: the productivity effect, which is seen as growth in output per working-age person, and the translation effect, which shows growth in output per capita.

Research into its mechanisms and effects allowed for a more in-depth study of the demographic dividend. Crespo Cuaresma, Lutz, & Sanderson (2014) focus on the mechanism of human capital and show that the demographic dividend comes not only from changes in the age structure, but also from increases in educational level. The empirical evidence is that the age structure affects economic growth only through translational effects: as the share of the working-age population in the total population increases, output per capita also increases. On the other hand, better educated individuals with a greater ability to innovate and adopt new technologies, as well as their higher productivity, also induce the growth in output per working-age person and thus affect economic growth through the productivity effect. Growth in output per worker is determined by two factors. As the structure of the population changes from a young to an ageing population, there are more

individuals who own more assets acquired during their lifetime. Also, as individuals have a longer life expectancy, they tend to save more (Sánchez-Romero et al., 2017). These findings were particularly important for Europe, where the labour force is expected to become older on average by 2053. The shift towards older ages is also accompanied by a shift towards tertiary education (Loichinger, 2015), suggesting that growth can be sustained due to the effect of increased productivity.

Before there was empirical evidence, the potential impact of education as a key factor of the effect of population dynamics on economic growth was discussed theoretically for decades. The Nelson-Phelps hypothesis was the first theory to propose considering human capital as an input in the production process and to highlight the significant role that education can play in economic growth (Nelson & Phelps, 1966). Building on the standard Solow model, Mankiw, Romer & Weil (1992) showed that the addition of human capital as a factor of production can explain income differences across countries.

However, some of the later studies showed no relationship between changes in educational attainment and economic growth. For example, using the Cobb-Douglas production function, Benhabib & Spiegel (1994) found that the accumulation of human capital represented in growth rates had no effect on economic growth. However, they found that human capital showed positive effects when it was included in levels to the total factor productivity growth model. Human capital in levels affected the rate of domestic technological innovation. In addition, the stock of human capital facilitated the adoption of foreign technologies. The combination of innovativeness and technology adaptation has shown that growth rates can vary. This happens especially in the more innovation-oriented economies due to of differences in the level of human capital stock. Furthermore, it is likely that a country with a higher stock of human capital will overtake the innovation leader country and become the new innovation leader. This position will be maintained as long as the advantage in human capital stock is maintained. Pritchett (2001) turns away from productivity and focuses on the contribution of education to economic growth. He finds that this contribution is much lower than expected and varies widely across the countries studied. He also found three possible reasons for his findings. First, if the institutional environment is poor, the expansion of schooling may be in the wrong areas, which in turn imposes costs but does not add value, thus lowering economic growth. Second, if the supply of educated workers increases while the demand for them remains the same, the marginal returns to education may fall quickly. Third, additional years of schooling do not necessarily create additional human capital if the quality of education is not good. Although empirical research on the demographic dividend has confirmed the substantial impact of education on economic growth, the issues raised by Pritchett (2001) remain important in promoting educational expansion.

Since the conclusion that there is no or only a weak relationship between education and economic growth is at odds with economic theory, further research has shown that the contradictory results may be due to inadequate measurement of human capital (e.g. the use

of data covering only years of schooling) or poor quality of the data used (D. Cohen & Soto, 2007; de la Fuente & Doménech, 2006). Lutz et al. (2008) show that education is a necessary condition for long-run economic growth by using the dataset augmented by educational attainment and age, which additionally takes into account differential mortality and four educational categories whose definition remains consistent over time. The joint effect of age structure and human capital was further investigated by Kotschy & Sunde (2018). The stock of human capital has a positive effect on macroeconomic performance, but this effect depends on the age structure of the population. Although population ageing reduces the potential of economic growth, especially in old societies, human capital can mitigate the effects of population ageing. Kotschy & Sunde (2018) also confirmed that the expansion of education is crucial for the future macroeconomic performance of economies.

Growth is affected differently by education in different countries. In developed countries, for example, the key is technological innovation driven by tertiary education. In developing countries, on the other hand, the focus is on technology adoption, which is driven by secondary education (Crespo Cuaresma & Mishra, 2011). Vandenbussche, Aghion, & Meghir (2006) point out the importance of the comparability of workers' skills and the distance of the economy from the technology frontier for overall productivity growth. Lower levels of education are more important in economies far from the technological frontier where technology is imitated, while higher levels of education are more important in countries where technological innovation takes place.

It has been shown that economic growth forecasts can be significantly improved if education is included as a dimension alongside age. At this stage, however, it is important to observe how education affects the labour force and how demographic changes affect the expansion of education.

2.4.2 Effects of demographic changes on education

Demographic changes have shaped the second half of the 20th century. One of the consequences is that educational attainment in high-income countries has risen substantially since the 1960s. Each cohort has achieved a higher level of education than the previous one, leading to higher educational attainment of the labour force as a whole (Heckman & Jacobs, 2010). The educational expansion was primarily a consequence of higher life expectancy (Hansen & Strulik, 2017).

One of the basic models of labour economics, the Ben-Porath (1967) model, shows that higher life expectancy encourages people to invest in higher levels of education because they are able to benefit longer in their lives from the higher income that this level brings. This model also suggests that high investment in formal education is associated with high investment in on-the-job training. Investment in human capital does not end when formal education ends, but is also associated with an increase in earnings. Earnings increase throughout the duration of employment, but more slowly with age. Higher earnings as a

result of higher educational level allow workers to consume more over their lifetime, and fewer hours of work allow them to enjoy more leisure time at the same time.

Many concepts of Ben-Porath (1967) model were later confirmed by different studies. Hansen & Strulik (2017) found evidence to support this claim by examining the decline in mortality rates in the US as a result of the cardiovascular revolution in the 1970s. They found that increased life expectancy led to the rise in higher education between the 1960s and 2000. Cervellati & Sunde (2013) studied theoretically and empirically life expectancy, schooling and labour supply over the life cycle. They concluded that the reason for the increase in schooling was the decline in working-age mortality rates rather than longevity. Moreover, their empirical results for the US from 1840 to 1930 showed that the benefits of schooling increased despite the decline in labour supply. This implies that a decline in working-age mortality can lead to both an increase in schooling and a reduction in hours worked. Sánchez-Romero, d′Albis, & Prskawetz (2016) confirmed that the decline in working-age mortality leads to higher investment in human capital. Moreover, the decline in mortality in the post-retirement years not only leads to higher investment in human capital, but also to later retirement. Higher human capital, which is a consequence of the decline in mortality, also leads to an increase in lifetime income (Strulik & Werner, 2016).

Moreover, not only does increased life expectancy encourage individuals to attain higher levels of education, but better educated individuals and their children then have lower mortality rates and a lower prevalence of disability (KC & Lentzner, 2010). However, the benefits of better education on health and mortality are not evenly distributed across the life cycle. The positive effect of better education on health is most evident between the ages of 45 and 60. However, the impact of education on mortality rates reduction is the most pronounced after age 60 (Kaestner et al., 2020). Better health and longer life expectancy have thus initially led to better education, but better education has also led to better health, especially at older ages.

However, although the expansion of education can have a positive effect on the older population, it can cause problems early in the life cycle through a decline in fertility. Better educated women have fewer children, largely because they are more knowledgeable about and have access to birth control, and because they usually want fewer children (Bongaarts, 2010; Cleland & Rodriguez, 1988). The reasons of highly educated to have fewer children are twofold. First, by having fewer children they can offer their children a better quality of life, which is important for better educated women. Lower fertility leads to higher human capital investments per child, especially in their health and education (R. Lee & Mason, 2010; Prettner et al., 2013). Second, the opportunity costs of leaving the labour market for maternity leave are higher for better educated women than for less educated ones (Becker, 1993). Therefore, women achieving secondary or higher levels of education may lead to a decline in population growth (J. E. Cohen, 2008).

2.4.3 Education and productivity

As the population ages and the working-age population shrinks, one of the solutions to ensure economic sustainability could be to increase labour productivity. By raising the educational level of individuals, population ageing leads to an increase in the quality of the stock of human capital. Human capital is the stock of skills, knowledge and other attributes that increase people's productivity. It thus includes people's health and education, where education includes both the stock of education and the flow of education. The stock of education is the result of previous educational flows and is therefore usually measured by the amount of formal education a person has received. The flow of education includes investment in human capital in the form of formal and informal education, on-the-job learning and work experience in general (Lutz & KC, 2011; OECD, 2022c). Although population ageing is shrinking the working-age population, the level of human capital levels is increasing at the same time.

The relationship between investment in human capital and productivity has long been debated. Lucas (1988) argued that on-the-job training and learning-by-doing during working life are at least as important for productivity as initial schooling in building the stock of human capital. Mincer (1958) argued that productivity increases with work experience and thus with age, but only up to the point where biological decline sets in and negatively affects productivity. This is especially true for jobs that require speed, learning, and problem-solving skills, while productivity remains high at older ages for jobs where experience and verbal skills are crucial. Despite the decline in productivity, earnings continue to rise into old age, which can lead to a decline in corporate profits, especially in times of population ageing and technological advances (Skirbekk, 2004, 2008). Nevertheless, some research shows that older and more experienced workers contribute positively to total factor productivity (TFP) growth. The same is true for workers with higher education, while this is not the case for workers with medium education (Vandenberghe, 2017).

At the micro level, a higher level of education of workers had a positive effect on productivity. Productivity at the firm-level depends mainly on the marginal productivity of highly educated workers. However, the higher productivity of highly educated workers is also associated with higher labour costs (Lebedinski & Vandenberghe, 2014). However, the research conducted in Belgium on education, productivity and wages has shown that education has a stronger impact on productivity than on labour costs. Regarding the wages of highly educated and low-educated workers, the differences between them increase with the age of the workers. However, as workers age, highly educated workers stop being underpaid and low-educated workers stop being overpaid for the work they do. The gender-disaggregated results show that women's education has an even stronger positive effect on their productivity than on their wage costs. Moreover, the overall profitability of the firm, estimated as the difference between productivity and wages, increased when less educated workers were replaced by better educated ones (Kampelmann et al., 2018).

2.4.4 Highly educated and the labour market

People are willing to invest in their education because they expect a higher income resulting from a better-quality job. They also usually expect that they will have no problems finding a job. However, depending on the country, this is not always the case. In low-income countries, skilled jobs may be scarce, which means that highly skilled people are more likely to be unemployed than highly skilled people in high-income countries. In low-income countries, people with a low level of education are more likely to be employed than highly skilled people. In high-income countries, the opposite is true: people with a low level of education often have difficulty finding employment. The same is true for the duration of unemployment: in low-income countries, it takes longer for highly educated individuals to find employment, while low-educated individuals stay unemployed longer in high-income countries (ILO, 2020).

In terms of employability at the beginning of working life, the orientation of the educational programme can be a decisive factor. According to UNESCO Institute for Statistics (2012), the orientation of educational programmes can be either general or vocational. General education provides literacy, numeracy, and general skills, competencies, and knowledge. Its aim is usually to prepare learners for more advanced educational programmes, sometimes at the higher ISCED education levels, or to provide a foundation for lifelong learning. However, this programme is not designet to prepare learners for employment in a specific occupation and it does not usually lead directly to a qualification relevant to the labour market. Vocational education and training (VET), on the other hand, focuses on developing skills and competences required for a specific occupation. These programmes may include some components, such as apprenticeships, that are work-related, and as such they usually lead to a labour market relevant qualification (UNESCO Institute for Statistics, 2012). Strong VET programmes can therefore facilitate the transition from school to work and are often seen as the solution to youth unemployment. On the other hand, it is often assumed that general education provides people with knowledge and the ability to adapt to new technologies, while skills acquired in VET can quickly become obsolete. Therefore, gains in youth employment attributable to VET may be offset by lower adaptability and employment later in life, especially in countries that emphasise apprenticeship programmes (Hampf & Woessmann, 2017; Hanushek et al., 2017)

Highly educated people may take longer to find jobs in low and low-to-middle income countries, but when they do, they tend to find better quality jobs (Eurofound, 2012; ILO, 2020). First, highly educated workers are more likely to find paid employment, even in low-income countries where paid employment is not the norm as it is in high-income countries. In high-income countries, there are also differences in the structure of pay between educational levels. In the US, for example, there is a difference between salaried jobs, which guarantee a fixed income each month and thus offer more security, and hourly jobs, which depend on the hours worked (Brenan, 2017). Hourly wage jobs can therefore be unstable and have unpredictable schedules. Salaried jobs are usually taken by highly educated

individuals. Two-thirds of salaried workers have a least a college degree. In contrast, about 80% of hourly employees have less than college degree (Brenan, 2017). Thus, in low-income countries, highly educated workers enjoy much better working conditions than people with basic education. This is closely related to the formality of jobs. Informal jobs are not part of countries' labour legislation, which means that they usually do not offer social protection or access to labour rights (e.g. sick leave). Informal workers can work in the informal sector as well as hold informal jobs in the formal sector. In both high-income and low-income countries, highly educated people have better access to formal jobs. In low-income countries, their working conditions are also much better than those of workers with little or no education (ILO, 2020). An important component of quality jobs is fringe benefits such as pension provision, health insurance or paid time off. Although the provision of fringe benefits to all workers has declined over time, the less educated workers are the most affected, especially with regard to health insurance (Farber & Levy, 2000; Kalleberg, 2011). Moreover, in the US, for example, better educated workers are more likely to have paid time off, such as vacation, sick leave or parental leave than less educated workers (Glynn et al., 2016).

In all countries, regardless of national income, the better educated also work more. The average weekly working hours of the highly educated are higher than those of the medium- and the low-educated. Moreover, the share of the highly educated working overtime (more than 40 hours per week) is higher than that of the medium- and the low-educated (OECD, 2021b). On the other hand, the share of workers working part-time is highest among the low-educated (ILO, 2020). Given the differences in hours worked and the fact that less educated workers often work part-time, hourly wages need to be compared when analysing earnings. Hourly wages of highly educated workers are much higher than hourly wages of workers with low education (OECD, 2022b). In some low-income countries, such as Kenya, Namibia and Rwanda, the earnings of highly educated workers are 5–10 times higher than those of low-educated workers (ILO, 2020).

By investing longer in their education, highly educated people also earn a wage premium during their working lives. This now happens immediately after they enter the labour market. By this time, the medium-educated have already worked in the market for several years. Therefore, the earnings of highly educated individuals in the early stages of their working lives are lower than the earnings of medium-educated individuals (Bhuller et al., 2017). However, the earnings of highly educated individuals increase much more than the earnings of low-educated individuals. This leads to a higher total income of highly educated individuals over their life cycle (Tamborini et al., 2015; Bhuller et al., 2017).

Another aspect affected by education is the length of employment within an economic life cycle. The level of education affects the retirement age and retirement in general. Although population ageing is increasing the number of retirees, the positive news is that employment rates of older people have increased substantially since 2000, from 44% in 2000 to 62% (OECD average) of people aged 55–64 in 2020 (OECD, 2021c). The increase in employment

rates can be attributed to higher life expectancy and higher levels of education (Geppert et al., 2019). Although the increase in employment rates occurred among workers of all educational levels, it was higher among the medium-educated (17%) than among low-educated and highly educated individuals (13%) (OECD, 2021c). Nonetheless, increasing life expectancy and educational attainment are likely to continue to be the most important factors behind the rise in employment rates among those aged 55 and over (Geppert et al., 2019). This is particularly important because the pace of ageing is projected to be considerably high until 2060, when it is expected to slow down (OECD, 2021c).

2.4.5 Education trends and economic consequences in the future

In Europe, the demand for labour has shifted towards skilled labour and this is expected to continue in the future (Gunderson & Oreopoulos, 2010; Heckman & Jacobs, 2010). Moreover, low-skilled occupations are threatened by automation: there is a risk that their jobs will be replaced by technology in the next 5–15 years. In OECD countries, the jobs of about 40% of workers with lower secondary education are at risk of automation, while this applies to less than 5% of workers with tertiary education (OECD, 2017b). Moreover, employment levels in tertiary education seem to recover much faster after the unexpected shock of the pandemic. After the COVID-19 crisis, employment levels of individuals with highly education were above pre-crisis levels in the first quarter of 2022, while employment levels of low- and medium-educated individuals had not recovered by that time. Many jobs for highly educated individuals remained intact during the pandemic, as they were not as affected by the frequent lockdowns (OECD, 2022d). The share of highly educated individuals in the sectors most affected by the COVID-19 lockdowns - hospitality, construction and retail - is low. In the UK, for example, it is less than 25%. On the other hand, jobs in information and communications, financial services and other professional services, which predominantly employ individuals with higher education, could be done remotely, allowing workers to keep their jobs. In the UK, 55–70% of workers in these sectors have a tertiary education degree (Allas et al., 2020).

However, labour supply depends on population trends and labour force participation, which is characterised by age, gender and educational level (Loichinger, 2015). Due to population ageing, labour supply is expected to shrink. In the EU, however, it is difficul to project population trends in terms of labour force size because of uncertainties related to migration and policies that may be introduced in the future to address this issue (Bijak et al., 2007). However, it is expected that gender and educational levels could strongly influence labour supply in the EU and mitigate the decline in the labour force, a negative effect of population ageing. Better educated people have a higher labour force participation rate. Moreover, the general increase in educational attainment in recent years has coincided with the labour force participation rate. This is particulary true for female workers (Balleer et al., 2014; Thévenon, 2014). In projecting labour force participation up to 2053, Loichinger (2015) found that the EU labour force is projected to be older, better educated and have a higher share of women

than today. In the EU, women are already equally or better educated than men in most countries. Although the male labour force is projected to be larger than the female labour force by 2053, a higher proportion of the female than the male labour force will have tertiary education in all EU countries. Aditionally, as people live longer, the retirement age is expected to increase for both genders in most high-income countries, thus lengthening the time spent in the labour market in the individual life cycle. This effect is compunded by the fact that already now, highly educated individuals tend to retire later (Hartlapp & Schmid, 2008).

However, an increasing share of workers with higher education may also have some negative effects on the labour market. With technological change, the demand for skilled workers increases and the demand for unskilled workers it decreases. Low-skilled workers could then be threatened with unemployment and thus become dependent on the welfare state. This could put additional pressure on the labour force, which already faces increasing demand for transfers from older people (Heckman & Jacobs, 2010). Despite ongoing concerns that technological progress could negatively impact employment opportunities for low-skilled workers, the OECD (2019) considers a decline in employment unlikely. While technological change has led to the disappearance of some jobs, it has also led to the creation of new jobs, resulting in an increase in employment in OECD countries. Nevertheless, jobs appear to be less stable (i.e. not permanent), especially for low-educated workers (OECD, 2019).

Moreover, the likelihood of being underemployed (i.e., working fewer hours than they would actually like) is higher among low-skilled workers (Valletta et al., 2020). Underemployment is generally higher among young workers, but it has increased by 80% among young male workers with low education and almost doubled among male workers with low education of prime working-age in the OECD from 2006 to 2017. Over the same period, the risk of underemployment has varied for women across OECD countries, but has been much higher than for men in all countries from the start. Women are still more likely to be underemployed than men, although the risk of underemployment has worsened more for men than for women (OECD, 2019).

However, the rising demand for skilled labour may also lead to an increase in wages for skilled workers, increasing income inequality between the better and less educated (Acemoglu & Autor, 2011). Several studies suggest that the increase in wage inequality occurs at the very top of the wage distribution (Mincer, 1996; Piketty & Saez, 2003). This was confirmed by Lemieux (2006), who also showed that the increase in wage inequality between 1973 and 2005 was indeed due to the substantial increase in the wage premium attributed to post-secondary education. It also showed that other characteristics such as labour market experience, primary and secondary education, and the position of workers with primary and secondary education did not play a significant role in explaining the wage structure during this period. However, the share of high-paying jobs in OECD countries did not grow as fast as the share of high-skilled occupations between 2006 and 2017. Moreover, young people with medium education were the group most pushed into low-paid

employment. This is the result of the job polarisation that has taken place in Europe, with an increase in the share of professional and managerial jobs on the high-income side and personal service jobson the low-income side. All this has happened at the expense of manufacturing and routine office jobs, which tend to be held by medium-educated individuals (Goos et al., 2009). In many countries, even highly educated young people face the likelihood of finding low-paid employment (OECD, 2019). By analysing the US labour market, Beaudry, Green, & Sand (2016) show that after 2000, demand for occupations with high cognitive skills, such as managerial, professional and technical occupations, began to decline after increasing in the 1980s and 1990s. They also show that this shift in demand pushed high-skilled workers into low-skilled jobs, which indirectly affected low-skilled workers who were then exchanged with high-skilled workers and pushed out of employment.

Moreove, the job polarisation and the increasing share of tertiary educated individuals have led to a decline in the wage premium for tertiary education relative to secondary education in most OECD countries. Between 2006 and 2016, it declined by about 3.3 percentage points on average, with 40% of this change mainly due to job polarisation (OECD, 2019). Wages in high-skilled occupations have remained relatively stable over the aforementioned period. However, as their numbers increased, not all highly educated workers were able to find high-skilled employment. Therefore, they had to find employment in medium- and low-skilled occupations, which led to a downgrading of skills (Beaudry et al., 2016), which in turn led to an increase in the wage premium within these occupational groups (OECD, 2019; Valletta, 2016).

2.4.6 Education in NTA

The comprehensive impact of education on the life cycle of individuals has also been explored in the context of NTA. However, these impacts have remained limited and partial under the NTA. Originally, educational attainment was not used as a separate dimension in the NTA analysis, but as an indicator of socio-economic status. Following the methodology similar to the NTA, Miller et al. (2014) constructed the National Inequality Accounts and used the educational level of the head of household as an indicator of socio-economic status and access to economic, social and political resources. Educational level of head of the household was used as an indicator of access to primarily economic resources in NTA research on public transfers and inequality. The impact of socio-economic status on intergenerational transfers in Colombia was analysed by Tovar & Urdinola (2014) using the educational level of the household head as a proxy for poverty. Although both analyses show inequality between educational levels, Tovar & Urdinola (2014) find that the educational level of the household head is not sufficient as a proxy for poverty, but performs better when it is enhanced with additional information such as a household's living conditions and educational level of other adult household members.

The first complete decomposition of the NTA by both age and educational level was carried out for Austria for the year 2010 by Hammer (2015). In this case, not only was the educational level of the household head taken into account, but full calculations were performed for the three main educational levels: basic, higher secondary and tertiary education. This made it possible to show the differences in economic behaviour within age groups and to illustrate that the life cycle of individuals with different levels of education can look quite different. Education determines not only total labour income and consumptionlevels, but also the length of the life cycle and the amount of monetary transfers made and received (Hammer, 2015).

Abio, Patxot, Rentería, & Souto (2017) added education to the study of intergenerational transfers in Spain, showing the crucial role of education in sustaining the Spanish welfare state in times of population ageing. They disaggregated the NTA by the educational level of the household head, defined as the person within a household who earns the most. They found substantial differences in the life cycles associated with different educational levels. Highly educated individuals earn more, but they also consume more: about 50% more than low-educated individuals. However, they also pay higher taxes and thus contribute more to the public transfer system. They also receive more transfers in the form of pensions, but are less dependent on them, mainly due to higher income over the life cycle and staying in the labour market longer (Abio et al., 2017, 2021).

The effect of education combined with the effect of gender on time transfers has been studied for Costa Rica by Jiménez-Fontana (2019) and Zagheni, Zannella, Movsesyan, & Wagner (2015) for Denmark, France, Austria, Germany, Italy and Spain. Jiménez-Fontana (2019) finds that highly educated women in Costa Rica spend significantly less time on unpaid activities than women without a high school education. However, this difference is not observed in the time men spend on unpaid work. Zagheni et al. (2015) also observe differences in the time spent on unpaid work by men and women with different levels of education in Denmark, France, Austria, Germany, Italy and Spain. They find that men spend similar amounts of time on unpaid work regardless of their educational level, while women do less unpaid work the higher their level of education, with the differences being greatest in Southern Europe.

By further disaggregating NTA age profiles by education, Renteria, Souto, Mejia-Guevara, & Patxtot (2016) deciphered the effects of age and education on the demographic dividend in Spain and Mexico. The age effect represents the impact of changes in the population age structure and the education effect represents changes in the composition of the population by educational level on economic growth. They showed that the education effect was larger than the age effect in the demographic dividend in these countries, implying that the expansion of education contributed more to the demographic dividend than the beneficial changes in the age structure. Moreover, their results suggest that higher levels of education could help to offset the negative effects of ageing on the support ratio. They therefore conclude that the positive effects of the demographic dividend could be enhanced by an

expanding educational attainment. Similarly, Prskawetz & Hammer (2018) found that higher education levels in Austria lead to lower employment-based and consumption- and income-based dependency ratios, making it easier for the economy to cope with the increasing dependency needs of older people.

3 DATA AND METHODOLOGY

This chapter is divided into three parts, corresponding to the three main objectives of my dissertation. The first part uses the NTA method to construct the age profiles of labour income and consumption, needed to estimate intra-household transfers. The first part also uses input-output matrices to examine the impact of education on intra-household transfers given and received. Such an analysis not only makes it possible to estimate the amount received or given by an average person of a given age and education level, but also provides information on from whom these transfers are received or to whom they are given. The analysis is based on the Croatian Household Budget Survey 2014, which provides data on income and expenditure of the same households in only one survey. In the second part, the NTTA method is applied to identify differences in the production and consumption of unpaid work among individuals with different educational backgrounds in several European countries. By extending the NTA methodology with the dimension of education, the last part shows how education affects the economic life cycle in several EU countries for which all the necessary data to estimate NTA by educational level were available. By projecting the NTA age profiles into the future, the last part also shows the impact of education expansion on future economic sustainability.

3.1 Intra-household monetary transfer flows by age and education

To represent the flows of total private transfers by age and education within a household, I use the input-output matrices. For this purpose, however, the private transfers within a household must first be calculated. To calculate them, I use the NTA methodology, following the European NTA manual (Istenič et al., 2016), but with some minor adjustments resulting from the fact that the Croatian Household Budget Survey is used as the main source of data and serves as a source of information for both individual income and household consumption, which is generally not the case for the European NTA estimates.

3.1.1 Croatian Household Budget Survey 2014

The focus of the first part of the research is on monetary intra-household transfers, which are one of the main estimates of the NTA methodological framework. They are estimated by comparing an individual's disposable income with his or her level of private consumption, assuming that an individual deficit is covered by household members who have a surplus or

by asset-based reallocations if the total household surplus falls short of the total household deficit. It follows that the main categories for estimating intra-household transfers are disposable income and private consumption, where disposable income consists of individual's current income in the form of labour income, public cash transfers net of taxes and social contributions paid, and net inter-household transfers (UN, 2013). However, in the case of the harmonised European NTA, these variables are estimated using separate data sources. More specifically, the income-related variables are estimated from the European Union Statistics on Income and Living Conditions (EU-SILC) 2011 survey, while the age profiles of private consumption are estimated from the Household Budget Survey (HBS). In this way, the age-specific values of private consumption are imputed into the income survey (Istenič et al., 2016), which means that the resulting estimates are only rough estimates of the private transfers given and received by individuals.

However, as mentioned previously, the Croatian HBS allows for more precise estimates of intra-household transfers, as all required variables can be retrieved from only one survey. Unlike most other European countries, the Croatian Bureau of Statistics collected data on individual income and household consumption in the same survey until 2014. As of 2017, the methodology has changed. Earnings are now reported only at the household level, while individual expenditure is broken down in more detail (Croatian Bureau of Statistics, 2019). Individual earnings are reported in the separate survey "Statistics on Income and Living Conditions", which is mandatory at EU level. In Croatia, it was only introduced in 2010 to comply with Eurostat methodology and EU regulations (Croatian Bureau of Statistics, 2020). These changes to the methodology of data collection on individual income and household consumption from 2017 are the reason why the Croatian HBS 2014 is used for this analysis.

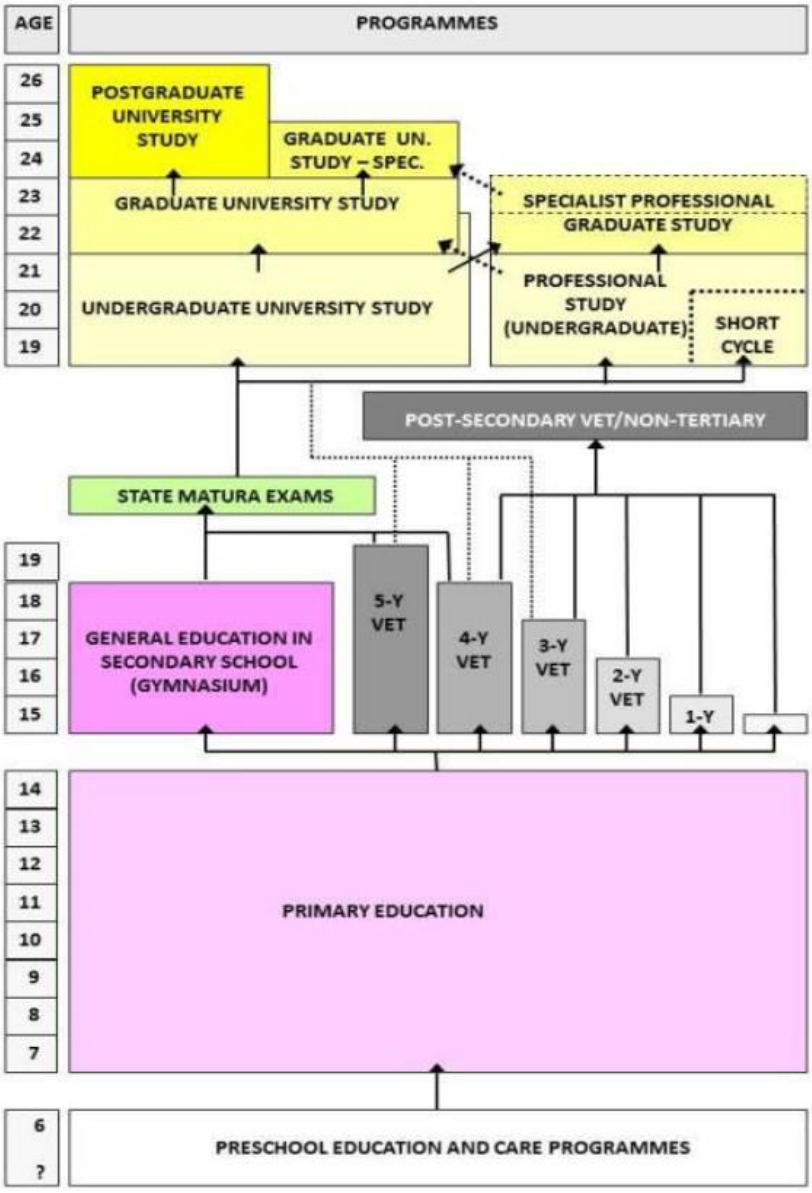
The structure of household consumption in the Croatian HBS 2014 is determined by the international Classification of Individual Consumption by Purpose (COICOP) in the 2013 version. Following this classification, the Croatian HBS collects data on individual consumption in 12 main categories: (1) Food and non-alcoholic beverages, (2) Alcoholic beverages and tobacco, (3) Clothing and footwear, (4) Housing and energy consumption, (5) Furnishings, household equipment and the routine maintenance of the house, (6) Health, (7) Transport, (8) Communication, (9) Recreation and culture, (10) Education, (11) Restaurants and hotels and (12) Miscellaneous goods and services.

Survey data were collected for all 12 months of 2014 and the results represent annual consumption levels. All results are expressed in Croatian kuna (HRK), the national currency valid in 2014. A total of 5831 individuals were interviews in a random sample of 2029 households. In addition to earnings reported at the individual level and consumption reported at the household level, the Croatian HBS contains information on many household and individual characteristics, such as the number of persons living in the same household, the relationship of the respondent to the head of the household, the gender of the respondent, marital status, employment status (e.g. whether a person is employed or self-employed,

studying, on maternity leave, etc.), whether a person works in the public or private sector, full- or part-time, and the like.

However, for this study, the most important demographic information was the age and educational level of the respondent. Unfortunately, age is only given in form of 5-year age groups (0–4, 5–9, ..., 75–79, 80+), so a detailed breakdown of income, consumption, transfers and savings by one-year age groups, as normally done in the NTA, is not possible. However, one-year age groups are most important for determining age profiles at a young age, when children are still in school. For example, in the Croatian HBS, which uses 5-year age groups, the 5–9 age group includes children not in school, children attending pre-school, and children attending primary school, which would complicate the estimation of public and private consumption of education and thus their overall consumption. Fortunately, the Croatian HBS contains two variables describing the level of education: one shows the completed level and the other the aiming level for individuals still in the education system. Both educational variables describe the level of education according to the ISCED 2011 classification, as shown in Table 1 (in subsection 3.1.2). In the analysis, both education variables are used, as for some NTA variables (such as private consumption of education) the aiming and not completed level of education has to be considered. Thus, despite the 5-year age groups, the available information allows for a more accurate estimate.

Figure 1: Croatian education system



Source: Ministry of Science, Education and Sports & Agency for Science and Higher Education (2014)

The levels of the Croatian education system and the age at which students are enrolled in each level are shown in Figure 1. Primary education in Croatia lasts 8 years and is compulsory for all children aged 6–15 (Ministarstvo znanosti i obrazovanja, n.d.-a). However, children entering primary school are either 6 or 7 years old, depending on the month in which they were born. The school year starts at the beginning of September each year and includes all children who turned 6 between 1 April of the previous year and 1 April of the school year of enrolment. However, in rare cases, if there are medical reasons, the enrolment of children in primary school can also be approved one year later. There is also the possibility of early enrolment for children who have turned 6 by the 31 August of the school year od enrolment, but only if the child passes an examination before a committee of

experts that determines the child's psychophysical condition and readiness for school (Ministarstvo znanosti i obrazovanja, n.d.-b). Secondary school is not compulsory and can take 1–5 years, depending on the programme. However, the most common programmes are either four-year general education programmes, four-year vocational education programmes or three-year vocational education programmes. Generally, children attending secondary school are between 15 and 18 years old, although some of the children may be 14 or 19 years old, depending on the age at which they enrolled in primary school.

Tertiary education consists of undergraduate (bachelor's degree), graduate (master's degree), and postgraduate programmes. Undergraduate programmes usually last 3 years, followed by 2-year graduate programmes. There are only a few four-year undergraduate programmes followed by a one-year graduate programme, and a few programmes, mainly in law and medicine, that do not have a bachelor's degree but last five or six years and lead directly to a master's degree. Both undergraduate and graduate programmes can take the form of general or vocational education. General education programmes prepare students to develop and apply scientific, artistic, and professional innovations. Vocational education programmes, on the other hand, prepare students for direct participation in the labour market (Eurydice, n.d.).

3.1.2 Construction of the Croatian NTA by education

The first step in constructing the Croatian NTA to calculate private intra-household transfers by age and education is to calculate the NTA aggregate values. To make the aggregate controls, population data are first needed. Since census data are the most accurate and reliable, it seemed to be the best choice to use the 2011 census data from the Census Hub (Eurostat, 2022b) to construct the Croatian NTA. Although these data are available for 2011 and not for 2014, age is assumed to have a strong influence on educational level and this influence remains the same from 2011 to 2014. The 2011 education-specific proportions are taken for each age group and multiplied by the total population in each of the age groups in 2014. Educational levels in the Census Hub data are classified according to the 1997 International Standard Classification of Education (ISCED) (UNESCO Institute for Statistics, 2012), which are then divided into three main categories for this analysis: low (ISCED 0-2), medium (ISCED 3-4) and high (ISCED 5-6).

Just as in other European countries, NTA aggregate values must be consistent with the European System of Accounts (ESA). Therefore, the ESA sector accounts (Eurostat, 2022d; Refinitiv, n.d.) form the basis for calculating the aggregate values of the main NTA categories, such as asset and labour income, private and public transfers, private and public consumption, and savings, which then serve as aggregate controls in the compilation of the age- and education-specific NTA profiles. The detailed calculation of NTA aggregate values is described in Istenič et al., (2016), but the following paragraphs provide some basic

information on the estimates of aggregate controls needed for the estimation ofintra-household transfers.

The ESA only provides the value of gross mixed income, which includes both the return on labour and the return on capital of unincorporated companies, while the macroeconomic aggregate for earnings can be calculated directly. Using two-thirds of gross mixed revenue, the total value of self-employment labour income is estimated. As mentioned earlier, the NTA definition of consumption includes both private and public consumption, which are further broken down into private or public consumption for health, education, and other purposes. The COICOP is used to determine the macro controls for the subcategories of private consumption, as the ESA does not provide aggregate values for the subcategories of private consumption.

Flows mediated by government, such as public pensions, unemployment benefits, family and children's allowances etc., are referred to as public transfer inflows and are estimated by combining ESA data with the European System of Public Transfer Inflows in Cash by Purpose (ESSPROS). Public transfer outflows, which include taxes, social contributions and other income paid to government, are used to assess flows of economic resources from the private sector (individuals or businesses) to the public sector. Public transfer outflows are distinguished in the NTA according to their source, i.e. the taxable activity. Thus, a distinction is made between taxes on income from assets, wages and consumption, as well as between social contributions made by seniors and those made by employers and employees. Based on data from the Directorate-General for Taxation and Customs Union (TAXUD) of the European Commission (European Commission TAXUD, 2022), the aggregates of public transfer outflows are estimated.

Private transfers consist of inter-household transfers and intra-household transfers. The NTA excludes capital transfers like bequests, as it only refers to *inter vivos* transfers. Private transfers between households can be direct (such as alimony payments and gifts) or indirect (through the non-profit organizations that assist households, e.g. donations). Net private transfers from ROW are defined as the difference between inter-household transfer inflows and outflows at the aggregate level. The NTA methodology's estimates of intra-household private transfers are one of its most important contributions. Since intra-household transfers only include transfers between members of the same household, their aggregate value is zero. As a result, inflows and outflows of intra-household transfer are identical at the aggregate level. The estimation of aggregate controls for Croatia thus follow the European NTA approach, but with some minor modifications, following the fact that ESA standards have changed over time. Istenič et al. (2016) describe the calculation of NTA aggregate values using ESA 1995, while ESA 2010 was used to calculate Croatia’s NTA for 2014. Due to changes in methodology, the ESA 2010 does not include the category “GNP based fourth own resource”, which existed in the ESA 1995 and was originally part of the category “Miscellaneous current transfers” in the ESA sector accounts. Instead, the ESA 2010 includes a new category called “VAT and GNI-based EU own resources”, which is recorded

as a category of "Other current transfers" but separately from "Miscellaneous current transfers" (Eurostat, 2014; Eurostat & European Commission, 2013). Therefore, the new category had to be included in the calculation of aggregate public transfers within NTA.

After calculating the NTA aggregate values, the survey data must be prepared. First, two new education variables are created, according to the purpose of the analysis: one indicating the highest level of education attained and the other indicating the highest aiming education. I distinguish between three main levels of education, both completed and aiming, as shown in Table 1. In Croatia, none of the educational programmes lead to qualification in the ISCED 4 category, and this level does not exist in Croatia.

Next, the head of household had to be identified. According to the NTA, the head of household receives and gives all inter-household transfers and is the only one in the household who owns asset income and saves or dissaves. Although the survey already indicated a head of household, the NTA defines the head of household using the criterion of the main earner (i.e. the individual with the highest income within the household, where income is composed of labour income and cash transfers received) (Istenič et al., 2016; UN, 2013).

Table 1: ISCED and NTA by educational classification

Levels of education	**ISCED 2011**	**Levels of NTA by education**
Early childhood education ('less than primary' for educational attainment)	ISCED 01	Low education
	ISCED 02	
Primary education	ISCED 1	
Lower secondary education	ISCED 2	
Upper secondary education	ISCED 3	Medium education
Post-secondary non-tertiary education	ISCED 4	
Short-cycle tertiary education	ISCED 5	High education
Bachelor's or equivalent level	ISCED 6	
Master's or equivalent level	ISCED 7	
Doctoral or equivalent level	ISCED 8	

Source: UNESCO Institute for Statistics (2012)

After defining the variables that are a prerequisite for constructing the NTA by education, I was able to start constructing the age- and education-specific NTA profiles. The construction of these profiles fully follows the European NTA methodology described in Istenič et al. (2016) and briefly presented in this dissertation in subsection 2.2 with an additional disaggregation of the obtained NTA age profiles by education. However, I highlight in

particular the adjustments that had to be made due to the specificities of using the Croatian HBS.

Although the main goal of this dissertation is to measure transfers received and paid within the household, where an estimate of public consumption is not necessary, in this dissertation I additionally present the LCD estimates for Croatia, as the LCD estimate (the difference between total consumption and labour income) tends to be also one of the main age profiles of the NTA.

3.1.2.1 Labour income age profile based on Croatian HBS

The first age profile to be constructed is the labour income profile, which according to the NTA can be composed of: (1) earnings from dependent work, (2) self-employment income, and (3) employers' social contributions. Table 2 shows which variables from the Croatian HBS were used to construct the age- and education-specific labour income profile.

The Croatian HBS reports only net income and not gross income, which is normally used in the NTA. It also does not include information on employers' social contributions. However, aggregate controls for all these categories are available at the gross level. Since employers' social contributions depend on wages paid, their distributions match. Therefore, I equate employers' social contributions with net income received and adjust them to the aggregate controls to estimate their values. In doing so, I follow the NTA manual (UN, 2013). I also adjust net income to the aggregate controls to correct for the unavailability of gross income information. Since the income categories in the survey data are reported at the individual level, the age profile of labour income is calculated as a weighted average of the subcategories that make it up.

Table 2: Croatian HBS variables used for labour income age profile

NTA category	**Croatian HBS variables**
Earnings from dependent work	Net income from paid employment – in cash
	Net income from paid employment – in kind
	Income from student's or pupil's work through students' or pupils' employment agency
	Net income from occasional work – in cash
Income from self-employment	Net income from self-employment and agriculture – in cash
	Net income from self-employment and agriculture – in kind
Employers' social contributions	No data

Source: Croatian HBS (2014)

3.1.2.2 Public consumption age profile based on Croatian HBS

As already mentioned, total consumption consists of public consumption and private consumption. Public consumption further consists of public consumption for (1) education, (2) health and (3) other public consumption. To estimate public expenditure on a particular level of education, it would be most useful to use data on individuals enrolled in that level. Data on those enrolled in a particular educational level were not available and could only be estimated from the EU-SILC survey, using two assumptions. The first assumption is that everyone enrolled in a particular educational programme will complete it. The second assumption is that everyone enrolled in or completing a higher education programme must also have completed all lower education programmes. Public expenditure on health could not be broken down by educational levels because the AWG data do not contain this information. The calculation of public consumption of education, health and public consumption other than education and health fully follows the methodology of the European NTA described in Istenič et al. (2016) with the minor exception that 5-year age groups are used to match the Croatian HBS data. The procedure was also described in subsection 2.2.3.1.

3.1.2.3 Private consumption age profile based on Croatian HBS

Similar to public consumption, private consumption is composed of private consumption of (1) education, (2) health and (3) other private consumption, as shown in Table 3. Since private consumption in the Croatian HBS is only reported at the household level, certain allocation rules must be applied to distribute household expenditure among household members.

For private expenditure on education, expenditure on pre-primary, primary, secondary and tertiary education is allocated to household members enrolled in education programmes according to the educational level in which they are enrolled. For the estimation of private consumption for education, the same principles are applied as for public expenditure on education, except that the Croatian HBS is used as the data source. Unit expenses are assumed to be the same for each household member enrolled in a particular level of schooling, regardless of age. In addition, education, which cannot be defined by educational level, is attributed to all household members who are enrolled in formal education programmes and are between 5 and 60 years old. They are identified as those most likely to spend on education. Health expenditure is assigned to household members by regressing health expenditure on the number of household members by age and educational level. For this purpose, 10-year age groups are used in the regression analysis without a constant term, and then further divided into three educational groups: low, medium and high education. The obtained regression coefficients are then used as an equivalence scale for the allocation of health expenditure among household members.

Table 3: Croatian HBS variables used for private consumption

NTA category	Croatian HBS variables
Private consumption of education	Pre-primary and primary education
	Secondary education
	Tertiary education
	Education not definable by level
Private consumption of health	Health
Other private consumption	Food and non-alcoholic beverages
	Alcoholic beverages, tobacco and narcotics
	Clothing and footwear
	Housing, water, electricity, gas and other fuels (less Imputed rentals for housing)
	Furnishings, household equipment and routine household maintenance
	Transport
	Communication
	Recreation and culture
	Restaurants and hotels
	Miscellaneous goods and services

Source: Croatian HBS (2014)

Other private consumption is further divided into (1) private consumption for housing and (2) other consumption. These two categories of other private consumption are distinguished for methodological purposes of estimating intra-household transfers. Private consumption for housing normally includes "Imputed rentals for housing"; however, as this particular variable is not available in the Croatian case, the category "Housing, water, electricity, gas, and other fuels" is used. Like private consumption for housing, other private consumption is assigned to household members using Deaton's (2019) modified equivalence scale, assuming that children in the 0–4 age group consume 0.4 of adult consumption. A person considered an adult here is 20 or more years old. For children aged 5–20 years, their share of an adult's consumption is assumed to increase linearly with the adult share as they approach age 20. This means that the equivalence scale only distinguishes by age, but not also by educational level. Even though this is true, there are still differences by educational level as we capture differences in household structure by educational level.

3.1.2.4 Public transfers based on Croatian HBS

Public transfers consist of public transfer inflows and public transfer outflows. Public transfer inflows consist of public transfers in-cash and public transfers in-kind (that equal public consumption). Since public transfers in-cash are received directly from the government, they are reported in the survey data. The relationship between the NTA and Croatian HBS categories is shown in Table 4.

Table 4: Croatian HBS variables used for public transfer inflows

NTA category	Croatian HBS variables
Public education	Scholarships and awards received for education
Social protection - pensions	Old-age pensions
	Survivors' benefits
	Disability benefits
Health	Sickness benefits
Unemployment	Unemployment benefits
Family and children	Family/children related allowances
Housing	No data
Social protection – in kind	Social protection – in kind
Miscellaneous social protection – in cash	Social protection – in cash

Source: Croatian HBS (2014)

In the Croatian HBS, sickness benefits consist of benefits for sick leave of more than 42 days, benefits for physical impairments, care services for others, employment of disabled persons. Family/child allowances include all family-related income, such as child allowance, maternity leave, income for newborn equipment and childcare. Social protection often includes various housing allowances. However, the Croatian HBS did not define this variable. Similar to labour income, the age profiles of public transfers in-cash are calculated as age- and educational level-specific (weighted) averages.

Outflows of public transfers include taxes, social security contributions, and other current transfers. As mentioned above, public transfer outflows are distinguished according to their source, i.e. the activity that is being taxed. Taxes therefore consist of taxes on asset income, taxes on labour income, and taxes on consumption. Social contributions further consist of contributions paid by pensioners and contributions paid by employers and employees. According to the NTA methodology (UN, 2013), the age profiles of the subcategories of public transfers are based on the previously calculated profiles, for example taxes on asset income are estimated using the age profile of asset income, while taxes on consumption are

estimated using the age profile of private consumption. Since the estimation of all other age profiles, except from the estimation of the age profile of asset income has already been described, Table 5 only shows the variables used to estimate the age profile of asset income.

Table 5: Croatian HBS variables used for public transfer inflows

NTA tax category	Croatian HBS variables
Asset income, profit and capital gains	Net income from renting business premises and movable property (vehicles, boats, etc.)
	Net income from renting real estate (room, apartment, house, vacation house, garage) and land
	Net income from interest on savings, dividends, profit shares, patents, copyrights, bonds and other securities

Source: Croatian HBS (2014)

3.1.2.5 Private inter-household transfers

Private transfers consist of inter-household transfers, that happen between households, and intra-household transfers that happen within a household. The Croatian HBS contains data on the private inter-household transfer inflows, but no information on private inter-household transfer outflows.

Private inter-household transfer outflows are borrowed from the calculation for the Slovenian NTA (Istenič & Sambt, 2019) and adjusted to the 2014 aggregate values for Croatia. The variables for inter-household transfers in the Croatian HBS are presented in Table 6. All inter-household transfers are assumed to flow to and from the household head to be consistent with the calculations for all other European NTA.

Table 6: Croatian HBS variables used for private inter-household transfer inflows

NTA category	Croatian HBS variables
Private inter-household transfer inflows	Alimony received, support received from persons who are not members of the household
	Cash gifts received from persons who are not members of the household
	Net income from interest on savings, dividends, profit shares, patents, copyrights, bonds and other securities

Source: Croatian HBS (2014)

3.1.2.6 Private intra-household transfers

Private intra-household transfers are also calculated using the European NTA methodology and then further disaggregated by educational level. The basic description was given above; however, for more details see Istenič et al. (2016). Intra-household transfers by educational level are estimated in the same way as intra-household transfers by gender in the European

NTA, replacing the variable gender by educational level. Within a household, private transfer inflows must equal private transfer outflows. This allows the construction of the input-output matrices to track flows by age and educational level.

3.1.3 Construction of the input-output matrices of intra-household monetary transfers by education

Since intra-household transfers are transfer flows within a household, the existing NTA methodology could only provide a rough estimate of these flows. This is because it combines two different data sources and therefore simply does not have the data on earnings and consumption of the same household. Since data from the same household are usually not available, it was also not possible to show from whom to whom transfers flow in a household. However, this information is important because if intra-household transfer flows are shown by the age of a transfer giver and a transfer recipient, it is possible to see the direction of transfers and at what age the burden of transfer outflows is highest for the transfer givers. Including the educational level of transfer givers and transfer recipients in the intra-household transfer analysis makes it possible to analyse whether there are differences in the age of highest burden of transfer outflows between transfer givers with different educational levels. In addition, differences in investment in children and in monetary support for older transfer recipients can be identified.

Originally, the input-output model was used to show that the output of one industrial sector can be an input to another industrial sector. Since the output of one sector can be an input to several sectors, the input-output model shows the interdependent relationship between different sectors. It is usually represented by an input-output matrix in which the rows represent the outputs of different sectors and the columns represent the inputs to different sectors. The model focuses on changes in demand, which then cause changes in all sectors supplying the sector where demand has changed (Leontief, 1986). Dukhovnov & Zagheni (2015) and Zagheni (2015) used the input-output model to show the flows of intra- and inter-household time transfers of unpaid work between different age groups. In their versions, the sectors of the original input-output model were replaced by the age groups, the outputs by the time transfer outflows of the transfer givers and the inputs by the time transfer inflows to the transfer recipients. They also disaggregated their input-output matrices by gender to identify differences in given and received flows in this dimension as well. I adapt the methodology of Dukhovnov & Zagheni (2015) and Zagheni (2015) and apply it to monetary intra-household transfer flows disaggregated by age and educational level.

Once the private intra-household transfer inflows and outflows have been calculated for each household member using the NTA methodology, the input-output matrices can be constructed. The total transfer inflows must equal the total transfer outflows within household. Since I was interested in the impact of education on the value of transfers given and received, the matrices had to be constructed by age and educational level. The illustrative

example of the input-output matrix showing the intra-household transfer flows by age and education is shown in Figure 2.

Figure 2: Graphical representation of the input-output matrix of monetary intra-household transfer flows by age and education

			Monetary transfer recipients								
		Edu. level	**Low**			**Medium**			**High**		
	Edu. level	Age group	1st	…	Last	1st	…	Last	1st	…	Last
Monetary transfer givers	**Low**	1st									
		…									
		Last									
	Medium	1st									
		…									
		Last									
	High	1st									
		…									
		Last									

**Notes: Edu. level = educational level*

Source: Leontief (1986), own work

Since the focus of the original input-output model is on demand, the focus of this calculation is on the transfer recipients, i.e. the household members who receive the transfer inflows. Therefore, following the original input-output model, they are represented by the columns. The supply sectors, i.e. the age groups of monetary transfer givers, are represented by rows, as shown in Figure 2. Each cell of the input-output matrix contains a value given by a particular age group of transfer givers, which then serves as a transfer inflow for a transfer recipient. On the other hand, the NTA shows that intra-household transfer inflows must be equal to intra-household transfer outflows, since the demand for intra-household transfers must be satisfied within households, either from the surplus generated by other household members or from the asset-based reallocations held by the household head. The first step was therefore to calculate for each household member the share of demand for transfers in the total transfer outflows of the household. This is done by dividing the transfer inflows of each household member by the total transfer outflows of the household.

In the next step, I assume that each transfer recipient receives the calculated share of the transfer outflows from each of the transfer givers. For example, in a household with two adult transfer givers and two children as transfer recipients, the total intra-household transfer outflow is estimated to be 1000 using the NTA methodology (subsection 3.1.2.6), with the first transfer giver contributing an estimated 200 and the second 800 intra-household transfer outflows. If one child's intra-household transfer inflow estimated with the NTA is 400 (0.4 of the total estimated intra-household transfer outflow) and the other's is 600 (0.6 of the total estimated intra-household transfer outflow), I assume that the first child receives 80 from the first intra-household transfer giver and 320 from the second (0.4*200 + 0.4*800), and the second child receives 120 from the first intra-household transfer giver and 480 from the second (0.6*200+0.6*800).

Intra-household transfer flows are divided into three categories according to the educational level attained: low, medium and high, as shown in Table 1. To better present the results in the subsection 4.1.2, the input-output matrix shown in Figure 2 has been divided into 9 smaller tables, each representing a combination of educational levels of intra-household transfer givers and intra-household transfer recipients. However, each figure in subsection 4.1.2 shows three tables related to a specific educational level of the transfer recipient. Furthermore, the input-output matrices were originally based on 5-year age groups following the Croatian HBS. However, some of the age- and education-specific transfer combinations then contained no observations or were based on too few observations. Therefore, some of the original 5-year age groups were combined to allow the estimation of intra-household transfer flows to be based on more observations. The final age groups selected for the input-output matrices do not cover the same age range. The relationship between the early age groups and the school system is shown in Table 7.

Table 7: Age groups in input-output matrices and the Croatian school system

<table>
<tr><th>Final age groups</th><th>Age</th><th>School system</th></tr>
<tr><td>0–4</td><td>0–4</td><td rowspan="3">Care and preschool programmes</td></tr>
<tr><td rowspan="5">5–9</td><td>5</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td><td rowspan="8">Primary school (ISCED 1-2)</td></tr>
<tr><td>8</td></tr>
<tr><td>9</td></tr>
<tr><td rowspan="5">10–14</td><td>10</td></tr>
<tr><td>11</td></tr>
<tr><td>12</td></tr>
<tr><td>13</td></tr>
<tr><td>14</td></tr>
<tr><td rowspan="5">15–19</td><td>15</td><td rowspan="3">Secondary school (ISCED 3)</td></tr>
<tr><td>16</td></tr>
<tr><td>17</td></tr>
<tr><td>18</td><td></td></tr>
<tr><td>19</td><td>Start of tertiary education (ISCED 5-8)</td></tr>
<tr><td>20–29</td><td>20–29</td><td></td></tr>
<tr><td>30–39</td><td>30–39</td><td></td></tr>
<tr><td>40–49</td><td>40–49</td><td></td></tr>
<tr><td>50–59</td><td>50–59</td><td></td></tr>
<tr><td>60+</td><td>60+</td><td></td></tr>
</table>

Source: Own work

The age groups for the input-output matrices are left as 5-year age groups for ages 0–19, as these age groups also primarily reflect the level of educational programme in which individuals of that age are enrolled. Between ages 20–59, the flows are presented in 10-year

age groups, mainly because this allows me to calculate the transfer flows based on more observations. Although the number of observations in some of the age- and education-specific combinations is still quite small, this allows me to show which age- and education-specific combinations of transfer flows are most common. In the 5-year age over 60, there are far fewer and, in some cases, hardly any observations. Because of the small number of observations and because the NTA age profile shows that the life cycle deficit starts again at about age 60, the 60+ age category was chosen as the last one in this input-output analysis.

For these reasons, the number of observations in each combination (Figures 7, 9 and 11 in subsection 4.1.2) is reported next to each figure showing the input-output matrix of values of intra-household transfer flows received by educational level of intra-household transfer recipients (Figures 6, 8 and 10 in subsection 4.1.2). I also indicate which age groups exchange the most transfers in each combination of education levels.

3.2 The role of education in unpaid work activities

Since in most economies women do most of the household production, analyses of time use usually show gender differences. Here I take a different approach and construct age profiles of household production of unpaid work by education. Educational level has a substantial impact on the economic behaviour of the individual, but also on the economic behaviour of the household (Abio et al., 2017). Therefore, it also influences time production and consumption in the form of unpaid work. Although gender differences in time transfers are well analysed, differences in time transfers can stem from many different socio-economic factors, including educational level. Extending the analysis of time transfers to other socio-economic factors can contribute to the understanding of fertility decisions, the relationship between time use and welfare systems, and thus allow for a rethinking of economic policies that take into account labour issuses within paid work (Zagheni & Zannella, 2013). This is particulary important in the period of the expected expansion of education. Therefore, the age profiles of unpaid work show the differences in the time spent on unpaid work, but also the structure of unpaid work at different levels of education.

3.2.1 The Multinational Time Use Study

The analysis of unpaid housework is based on the Multinational Time Use Study (Gershuny et al., 2020). The MTUS allows the analysis of time spent on different activities in a given day in different countries. Depending on the country, respondents are asked to keep a 24-hour diary for one or more days, in which they must record the duration of all their daily activities, usually in 10-minute time slots. There are two harmonised frames for coding activities: one with 69 activities and one with 25 activities. For the age profiles of household production, I use the latest available MTUS data for Austria (2008), Bulgaria (2001), Denmark (2001), Spain (2009), France (2009), Hungary (2009), Italy (2008), the Netherlands (2005), and Slovenia (2000). Due to data availability, age profiles for unpaid

work consumption are provided for Italy (2002) and Spain (2002). Unfortunately, not all countries recorded the activities using the more detailed coding frame with 69 activities, so I used the coding frame with 25 activities. This also ensured comparability of time spent on activities between countries in my analysis.

In addition, the MTUS version 7 dataset contains both Harmonised Episode Files (HEF) and Harmonised Aggregate Files (HAF). The HEF data show the sequence of activities, called episodes, and also indicate when the activities change or whether a person is doing two or more activities at the same time (e.g. washing dishes and taking care of a child). Apart from the episodes, these data only give age and gender as identifiers. The HAF data, on the other hand, only show the total time spent on a specific unpaid activity on a given day, without indicating the order in which the activities were carried out on that day. However, apart from the time spent on unpaid activities, these data also provide demographic and socio-economic information about the respondent and about the respondent's household. Since the goal of my study is to show differences in total production and consumption across educational levels, the data from HAF are appropriate.

Apart from the year of data collection, there are also differences in the way the time use surveys are conducted. They differ in the number of individuals completing the diary, the age range of respondents, and the number of days the diary had to be completed. These differences are listed in Table 8.

Since the data for each country is different, I had to make some adjustments. First, I estimate age profiles up to age 80 for all countries and include all diarists older than 80 in the 80+ group to ensure comparability of results. The diaries are kept for only one day in Austria, Spain, Hungary and Italy, and for several days in Bulgaria, Denmark, France, the Netherlands and Slovenia. In the surveys that consider more than one day, each daily observation is treated independently as it shows the daily differences in activities, especially between weekdays and weekends. However, in the MTUS dataset, this difference is taken into account by applying a weighting that applies both to the case where diaries are kept for only one day and to the case where they are kept for several days. This weighting is taken into account in all analyses.

However, it is important to emphasise that estimates by educational level may be less accurate due to the small number of observations in younger and older age groups. For example, since observations are divided into three groups according to educational level, in some countries there are few individuals at older ages who have attained a high level of education. The reason for this is that there used to be far fewer highly educated people than there are today. For example, in 2009, when the last available study on time use was conducted in France, there were 43.15% university graduates in the 25–35 age group in France. However, in 1981, only 15.12% of the same age group had a tertiary degree, which now leads to a smaller number of observations of the highly educated in older age groups (OECD, 2022b).

Table 8: Differences in MTUS diaries between the countries analysed

Country	Year	One or more diarists per household	Diarists age range	No. of diary days per diarist
Austria	2008	1	9–90	1
Bulgaria	2001	All persons aged 10+	10–91	2
Denmark	2001	More, but not all (only 1–2)	16–80	1–2
Spain	2002	All persons aged 10+	10–90	1
	2009	More, but not all	10–90	1
France	2009	1–2	11–85	1–2
Hungary	2009	1	11–84	1
Italy	2002	All persons aged 3+	3–80	1
	2008	More, but not all	3–90	1
Netherlands	2005	1	12–80	7 consecutive days
Slovenia	2000	More, but not all	9–80	2

Source: Gershuny, Vega-Raoun, & Lamote (2020)

Second, since the goal of the analysis is to estimate the production and consumption of unpaid work by educational level, I had to ensure that the variables indicating educational level were consistent for all countries. The MTUS dataset contains two education variables: one indicating the level of education based on the national system and the other indicating the harmonised highest level of education completed. I use the latter because it allows for universal disaggregation of production and consumption by three levels of education: (1) low (incomplete secondary education or less), (2) medium (completed secondary education) and (3) high (above secondary education) (Centre for Time Use Research, 2020). However, in several countries there were a certain number of observations with no indication of educational level. Therefore, I checked the other variables to try to determine the educational level of the individual. The diaries with the number of observations in the survey and the final number of diaries by three educational levels are shown in Table 9.

Table 9 shows that in Austria, 415 diaries out of a total of 8234 were marked "non response" or "not applicable". However, all diarists in this group were between 9 and 14 years old. According to the structure of the Austrian education system (OECD, 2017a), children in this age range can at most enter secondary education, but could not have completed it yet. Therefore, I was able to assign the category "low education" to all 415 diaries. I repeated the same procedure for Bulgaria, as 1064 out of 1070 diarists were without educational qualifications between the ages of 10 and 14, and children in this age range can at most

attend secondary school in the Bulgarian education system. Bulgaria substantially reformed its education system in 2007, 2016 and 2020, but none of the reforms had an impact on the age of secondary school enrolment (Guthrie et al., 2022). In Denmark, 43 diaries did not have an educational level indicated and there was no additional information that would have enabled me to assign these diaries to a specific educational level. In addition, 28 diaries were not labelled as high quality, so I excluded all 43 diaries from the analysis. In France, 392 diaries indicated that the diarists' educational level was not applicable. All diarists were between 11 and 14 years old, which means that according to the French education system, they can be enrolled at most in secondary education (OECD, 2021a). In Italy (2002), national education structure was not translated into harmonised levels, but the documents accompanying the MTUS results allowed the construction of harmonised levels. Table 9 shows only the final harmonised educational levels. In Italy (2009), 1121 diaries indicated that the educational level was not applicable to the diarists. All diarists were between 3 and 5 years old, so they could be assigned the category "low education". In Slovenia, Spain (2009), Hungary and the Netherlands, the educational level was indicated in all diaries.

Table 9: Diaries by educational level in the MTUS datasets of the analysed countries

Country	**Year**	**Total diaries**	**Harmonised educational levels**			
			Low	**Medium**	**High**	**Non response/Not applicable**
Austria	2008	8234	1815 (2230)	4918	1086	415 (0)
Bulgaria	2001	14714	5313 (6377)	6177	2154	1070 (6)
Denmark	2001	6617 (6574)	196	4032	2346	43 (0)
Spain	2002	46774	17260	20974	8410	130
	2009	19295	7290	4212	7793	-
France	2009	27903	9165 (9557)	12695	5651	392 (0)
Hungary	2009	8390	5220	1761	1409	-
Italy	2002	51206	18130	29625	3451	-
	2008	40944	24157 (25278)	12096	3570	1121 (0)
Netherlands	2005	15428	4494	5733	5201	-
Slovenia	2000	12273	7214	3770	1289	-

**Notes: Numbers in brackets show the final number of diaries at each educational level, after all the changes to datasets described in main text have been done*

Source: Gershuny, Vega-Raoun, & Lamote (2020)

3.2.2 Estimation of production and consumption of unpaid work by education

In estimating the production and consumption of unpaid work within households, I used the NTTA methodology, described in Donehower (2014). First, all daily activities are divided into five major activity groups: (1) paid work, (2) education, (3) unpaid work, (4) personal care, and (5) leisure (Donehower, 2014; Sambt et al., 2016). Paid work results in income derived from either paid employment or self-employment. The income is recorded in national income. Unpaid work, on the other hand, includes activities such as cooking or cleaning that would be included in national income if they were performed for wages. Activities that can be classified as unpaid work are often determined using the "third party criterion", i.e. whether it is possible to pay a third person to perform the activity and still benefit from it (Reid, 1934). Clearly, education, personal care (e.g. sleeping, eating) and leisure activities benefit only the person who performs them. In order to analyse unpaid work, I have therefore divided it into ten categories, which are listed in Table 10.

Table 10: Grouping of MTUS unpaid household activities

Activity	**MTUS 25-activity variables**	**Description**
Cooking, washing up	*foodprep*	Food preparation, cooking, dishwashing
Cleaning	*cleanetc*	Cleaning, doing laundry, other regular housework
Maintaining home/vehicle	*maintain*	Maintain home and/or vehicle, re-fuel
Gardening	*garden*	Gardening, forage
Pet care	*petcare*	Pet care, including walking dogs
Shopping	*shopserv*	Purchasing goods and consuming services
Commuting	*commute*	Travelling to or from work or education facility
Childcare	*pkidcare*	Physical, medical and routine childcare
	ikidcare	Playing with child (including sports), reading to child, teaching child
Elderly care	*eldcare*	Looking after adults in need of help or care
Volunteering	*volorgwk*	Voluntary, civic or organisational acitivities

Source: Gershuny, Vega-Raoun, & Lamote (2020)

While dividing daily activities into the groups of paid work and education is straightforward, it is more difficult to decide whether a particular activity should be part of the group of unpaid work, leisure or personal care. For example, a person may enjoy walking the dog, playing with the child or gardening and therefore these activities could be considered leisure and not unpaid work. However, following Donehower (2014), in such cases I apply the principle that all activities for which someone else can be paid should be considered unpaid work. Even if parents enjoy taking care of or playing with their children, if they were unable

to do so, they would have to hire someone to do it in their place. It is therefore important to highlight which daily activities belong to the personal care and leisure groups. Personal care activities include sleeping, eating and self-care in general. Leisure includes a wide range of activities such as religious activities or meditation, travelling for leisure, sports or exercise, watching television or listening to the radio, reading, writing emails, texting, playing computer games, going to the cinema, museum, or to watch sports and many more. After defining personal care and leisure, I create education-specific age profiles of the five major daily activities (paid work, education, unpaid work, personal care and leisure) for each country and year included in my analysis, and then estimate the time spent producing unpaid work broken down by age and educational level.

Estimation of the consumption of unpaid work is different. Since the consumption of unpaid work is not directly observed, according to the NTTA and the methodology proposed by Donehower (2014), for consumption age profiles to be as accurate as possible, data on the time use and production of unpaid work by all household members should be available. In this way, it would be possible to calculate total household production and then allocate it among all household members based on the type of activity and age (e.g. a cleaned house is consumed equally by all household members, while childcare is consumed only by children). However, with MTUS version 7 this was not possible for all countries included in my analysis, as the time use surveys are not conducted in the same way in all countries (the main differences between the MTUS datasets for each country are listed in Table 8). However, it was possible to do this for Spain in 2002 and Italy in 2002. In Spain, all household members except young children under 10 completed the time use surveys, while in Italy, all persons above 3 years completed the survey. For these countries, I added the production of all household members to get the total household production. Since childcare is only consumed by children, I subtracted it from the total household production to get the total production of housework consumed equally by all household members (Donehower, 2014). Therefore, each household member consumes an equal share of the housework production. However, as mentioned earlier, children also consume time devoted to childcare in addition to housework. Therefore, the total time devoted to childcare in a household is divided by the number of children in the household. The share of childcare consumed obtained in this way is then added to the share of the housework consumed for all children under 18. After assigning consumption values to all individuals, I create the consumption profiles and disaggregate them by age and educational level. All production and consumption profiles were smoothed using Friedman's Super Smoother.

3.3 The effect of education on the economic life cycle and on the economic sustainability[1]

To analyse the potential impact of education expansion in the future, total labour income and consumption are projected to 2060 based on the age profiles of conventional NTA and NTA by education. Therefore, this analysis is carried out in several steps.

First, the age profiles of conventional NTA and the NTA by education are constructed for the year 2010. This year was chosen due to data availability. Using the constructed age profiles of conventional NTA (section 3.3.1) and the NTA by education (section 3.3.2) showing labour income and consumption for the year 2010, the differences between economic life cycles disaggregated by age only and by age and education can be analysed. In the second step (section 3.3.3), these profiles are matched with the WIC population projections (Wittgenstein Centre for Demography and Global Human Capital, 2018) by age and by age and education so that they can be combined. In the third step (section 3.3.4), the NTA profiles are multiplied by the WIC population projections, resulting in projections of total labour income and total consumption with and without taking into account educational levels. This enables the calculation of the NTA support ratio, which is used as one of the indicators of economic sustainability. In the last step (section 3.3.5), the sensitivity analysis of the projections of total labour income and consumption by education level takes into account the possibility that the wage premium for tertiary education decreases.

3.3.1 Conventional NTA profiles

Conventional NTA profiles are per capita averages that require tracking economic flows by age at the individual level. Two main categories of NTA identity are labour income (YL) and consumption (C). Since the focus of this part of the research is on economic sustainability, defined as the gap between total labour income and total consumption within a country, labour income and consumption are also the key measures.

The category of total labour income includes the gross earnings of employees, which also include employers' social contributions, and the labour income of the self-employed. All categories of labour income are estimated using data from the EU-SILC 2011 survey, with labour income data referring to 2010. Total consumption is composed of public and private consumption, both of which consist of consumption (1) of education, (2) of health and (3) other than education and health (UN, 2013).

The sources of estimates of public consumption by age are several, mainly administrative, data sources. First, estimates of public consumption of education are based on public education expenditure data, which are then combined with age-specific enrolment data.

[1] The content of this subsection was published in co-authorship with my supervisors in: Kelin, E., Istenič, T. & Sambt, J. (2023). Education as a partial remedy for the economic pressure of population ageing. *International Journal of Manpower*, 44(9), 37-54. https://doi.org/10.1108/IJM-03-2022-0126

Second, public consumption of health is estimated using Ageing Working Group (AWG) 2012 one-year age profiles, which are then adjusted to 2010 aggregate values. Finally, public consumption expenditure other than education and health can be further divided into individual and collective consumption. Depending on age, individual public consumption is also divided by age. Collective consumption, on the other hand, is the consumption of public goods and therefore cannot be divided by age, but is distributed equally among all individuals.

In contrast, the estimation of all three subcategories of private consumption is based on the HBS 2010. In the HBS, data on consumption are only collected at the household level, which must then be allocated to all individual household members. As already mentioned in the previous subsections, this allocation therefore requires the application of different allocation rules to estimate the consumption of each individual. Individual expenditure on education is estimated based on the number of individuals in a household enrolled in a particular level of education. Individual health expenditure is estimated by regressing household health expenditure on the number of household members in a given 10-year age group. The coefficients obtained from the regression are then used as relative proportions to allocate total household consumption of health among household members. Private consumption other than education and health of the household is allocated at the individual level using the equivalence scale. The conventional NTA profiles for the 15 EU countries included in this analysis were previously estimated by Istenič et al. (2016).

3.3.2 NTA by education age profiles

The construction of age profiles of NTA by education is very similar to the construction of age profiles of conventional NTA. The goal of NTA by education is to obtain age- and education-specific NTA profiles, which means that both educational level and age are taken into account in their construction. The constructed NTA profiles by education must be consistent with the conventional NTA profiles. To ensure this consistency, the age- and education-specific NTA profiles per capita, multiplied by the age- and education-specific population size, must be equal to the aggregate values of the conventional NTA.

Since the age profiles of conventional NTA are created for 2010, the population data by age and educational level must also be for 2010. The population data used are from the census in 2011, retrieved from the Census Hub (Eurostat, 2022b), following the same procedure as in subsection 3.1.2. The only exception is that the 2011 data have been adjusted to 2010 levels, instead of 2014 levels, as in the case of Croatia.

The construction of the NTA by education is the same as the construction of the conventional NTA described above, taking into account three main levels of education in addition to age. The two main surveys used to construct NTA profiles, EU-SILC for labour income and HBS for consumption, contain information on both the age and education of the individual. Therefore, as with conventional NTA, the estimate of total labour income by the three main

educational levels is based on EU-SILC 2011, with the difference that in addition to age, educational level is also taken into account. As with the conventional NTA, the consumption of the NTA by education consists of public and private consumption, which are divided into the same subcategories. Public and private consumption by education is done in the same way as in the construction of the Croatian NTA by education presented in subsections 3.1.2.2 and 3.1.2.3.

3.3.3 WIC data and matching the WIC and NTA data

The idea behind the NTA-based projections of total labour income and consumption in selected EU countries is to project age profiles of both conventional NTA and NTA by education. Total labour income and consumption can then be obtained by multiplying age-specific labour income and consumption levels by the population size of the respective age group. For this purpose, it is important to ensure that the NTA profiles match the population size data in terms of age groups and educational level. The population size projections are from WIC and are available up to the year 2100 (Wittgenstein Centre for Demography and Global Human Capital, 2018). However, due to data availability for their construction, the NTA age profiles were constructed for the year 2010. Therefore, the projection focuses on the 50-year period after the NTA profiles, i.e. until 2060, when population ageing is expected to be most pronounced.

WIC population projections are available for five scenarios: (1) Medium (SSP2), (2) Rapid Development (SSP1), (3) Stalled development (SSP3), (4) Medium – Zero Migration (SSP2 – ZM) and (5) Medium – Double Migration (SSP2 – DM). The population projections used here are limited to the basic Medium (SSP2) scenario, which is considered the most likely path for each country. It assumes medium fertility, medium mortality, medium migration, and the Global Education Trend scenario (GET), which takes historical education trends and extends them into the future.

In addition to the various scenarios, WIC population projections are available by age and by age and educational level. In terms of age, all WIC projections are available by 5-year age groups from 0–4 to 100+. The highest age groups are summarised in the 80+ age group as this corresponds to the NTA age profiles. On the other hand, the NTA labour income and consumption profiles were originally created for each age, but are converted to the 5-year age groups to match the WIC population projections. The WIC population projections, which include information on both age and educational level, have seven categories of educational levels, based on ISCED 2011 and are shown in Table 11.

Table 11: WIC classification of education

Level of education (by WIC)	Highest level of education attained (by ISCED 2011):
No education	No level and Grade 1 of ISCED 1 not completed
Incomplete primary	Incomplete ISCED 1
Primary	Completed ISCED 1 and incomplete ISCED 2
Lower secondary	Completed ISCED 2 and incomplete ISCED 3
Upper secondary	Completed ISCED 3 and incomplete ISCED 4, 5 or 6
Post-secondary	Completed ISCED 4, 5, 6, 7 or 8
Short post-secondary	Completed ISCED 4 or 5
Bachelor	Completed ISCED 6 and incomplete ISCED 7
Master and higher	Completed ISCED 7 or 8

Source: Wittgenstein Centre for Demography and Global Human Capital (2018)

Synchronising educational levels between WIC and NTA by education is more challenging than synchronising by age. The two data sets differ in the allocation of ISCED 4 category ("Post-secondary, non-tertiary education"). As shown in Table 11, the WIC does not distinguish between ISCED 4 as a separate category of educational level but groups it together with ISCED 5 in the same category labelled "Short post-secondary education". This category is part of the post-secondary category, the WIC version of higher education, together with "Bachelor" and "Master and higher". On the other hand, the NTA by education data are compiled according to the Eurostat concept which distinguishes between three main educational levels: (1) low, (2) medium and (3) high. The classification of ISCED and NTA education categories is shown in Table 12.

According to the NTA, the ISCED 4 educational level is classified as medium education, while according to the WIC it belongs to the category "Post-secondary education", which mainly includes the categories of higher education. Since neither the WIC nor the NTA dataset contains data on the population size of those educated exclusively at ISCED 4 level, it was not possible to simply rearrange the categories to make them compatible.

Therefore, to make them compatible, the ISCED 4 category was extracted from the WIC category "Post-secondary education". For this purpose, data from Eurostat's Census Hub 2011 were used. These data contain information on the size of the population belonging to each of the ISCED categories separately. The calculation of the ISCED 4 share extracted from the WIC category "Post-secondary education" made it possible to add it to the cateogry "Upper secondary". This restructuring of the WIC categories achieved consistency with the 2010 NTA data. For the population size projections, it is assumed that the share of the ISCED 4 category remains constant for all years until 2060.

Table 12: ISCED and NTA by education classification

Levels of education	**ISCED 2011**	**ISCED 1997**	**Levels of NTA by education**
Early childhood education ('less than primary' for educational attainment)	ISCED 01	-	Low education
	ISCED 02	ISCED 0	
Primary education	ISCED 1	ISCED 1	
Lower secondary education	ISCED 2	ISCED 2	
Upper secondary education	ISCED 3	ISCED 3	Medium education
Post-secondary non-tertiary education	ISCED 4	ISCED 4	
Short-cycle tertiary education	ISCED 5	ISCED 5	High education
Bachelor's or equivalent level	ISCED 6		
Master's or equivalent level	ISCED 7		
Doctoral or equivalent level	ISCED 8	ISCED 6	

Source: UNESCO Institute for Statistics (2012)

3.3.4 Projections and assessment of future economic sustainability

Economic sustainability is defined here as the difference between total labour income and total consumption. It is important because it shows the ability of the population of a certain economy to support its own consumption. As mentioned earlier, economic behaviour in terms of both labour income and consumption depends on the educational level of the individual. Therefore, the impact of the increase in educational attainment on future economic sustainability is assessed here in three ways.

First, total labour income and total consumption are projected to 2060. Technically, the projections are obtained by multiplying the NTA age profiles of labour income and consumption for 2010 by the WIC projections of population size by age. The same procedure is repeated to combine the age profiles of NTA by education and the WIC projections of population size by age and education. It is assumed that the NTA age structure of labour income and consumption for 2010 will remain unchanged in the future. Since this analysis only compares total consumption and total labour income, the results would be the same if both the age profiles of labour income and consumption are assumed to grow at a selected annual growth rate.

The second way is to measure the relative changes in total consumption and total labour income separately in the case of both conventional NTA and NTA by education. Table 24 shows the relative changes in total consumption in 2060 compared to 2010 in the conventional NTA case as follows (Equation (3)):

$$C_{conv} = I_{Cconv} - 100 \quad (3)$$

where I_{Cconv} is a fixed base number calculated as (Equation (4)):

$$I_{Cconv} = \frac{C_{conv}(2060)}{C_{conv}(2010)} \times 100 \quad (4)$$

and $C_{conv}(2010)$ is the value of total consumption in 2010 and $C_{conv}(2060)$ is the value of total consumption in 2060.

The same procedure is repeated for total labour income in the case of conventional NTA and total consumption and total labour income in the case of NTA by education. Finally, the relative changes in total consumption in the case of NTA by education from 2010 to 2060 are compared with the relative changes in total consumption in the case of conventional NTA for the same time period (Equation (5)):

$$C_{edu}/C_{conv} = \left(\frac{I_{Cedu}}{I_{Cconv}} \times 100\right) - 100 \quad (5)$$

where I_{Cedu} and I_{Cconv} are fixed base indices calculated using the Equation (4).

The third way to assess economic sustainability is to calculate the indicators that show the extent to which the rising consumption levels are covered by labour income. The first indicator is the conventional NTA support ratio (see e.g. Prskawetz and Sambt, 2014). Holding constant all other factors that might affect labour income and consumption, this ratio shows the impact of the age structure on labour income and consumption in an economy. Summing the product of age-specific labour income and population size (total labour income) over the product of age-specific consumption and population size (total consumption), yields the conventional NTA support ratio (Equation (6)):

$$SR(NTA)_{conv} = \frac{\sum_i n_i yl_i}{\sum_i n_i c_i} \quad (6)$$

where n_i denotes the number of individuals, yl_i the labour income per capita and c_i the consumption per capita in age group i (i = 0–4, 5–9, 10–14, …, 80+). In the second case, the NTA by education support ratio takes into account the labour income and consumption of each age group and educational level (Equation (7)):

$$SR(NTA)_{edu} = \frac{\sum_{i,j} n_{i,j} yl_{i,j}}{\sum_{i,j} n_{i,j} c_{i,j}} \quad (7)$$

where $n_{i,j}$ denotes the number of individuals, $yl_{i,j}$ the labour income per capita, $c_{i,j}$ consumption per capita in age group i (i = 0–4, 5–9, 10–14, …, 80+) and the educational level j (j = low, medium, high).

By distinguishing between educational levels in both population size and labour income and consumption, the latter support ratio takes into account the shares of population size in each educational level group. Although the per capita labour income and consumption profiles are decomposed by both age and education, they are assumed to remain at 2010 levels throughout the projection period. Only the population size changes during the projection period.

3.3.5 Sensitivity analysis

Holding per capita labour income and consumption constant in future periods is a strong assumption. If the shares of educational levels change, the wage premia for those levels may also change. The wage premium is the value that one level of education brings compared to a lower level of education. Of the three main educational levels in this analysis, the high educational level is likely to increase the most. However, as more and more people reach a high level of education, the wage premium for this level of education is expected to decrease over time. To account for this, it was important to additionally analyse the projections of total labour income and consumption, taking into account the declining wage premium for high education.

OECD (2019) provides data on wage premiums for higher education, with data available for 2007–2016 for Greece, Portugal, and Latvia, 2007–2015 for Italy, 2006–2017 for Ireland and Luxembourg, and 2006–2016 for other countries. Following the OECD approach, this change had to be assumed to remain the same in the future as it was between these years, with the average wage premium for higher education in the countries studied falling by an average of 4.95% over this period of about 10 years. The wage premium was then assumed to decline by 2.475 percentage points every 5 years throughout the projection period to 2060. As the labour income of highly educated individuals declines, their consumption premium should also gradually decline to the consumption level of those with medium education. Therefore, the calculated relative change in labour income affected by the declining wage premium for high education was applied to determine the consumption of highly educated individuals affected by the declining wage premium.

4 RESULTS

This section is divided into four parts. In the first subsection (subsection 4.1), the NTA age profiles of labour income and consumption by educational level are constructed for Croatia. These age profiles are a prerequisite for the estimation of intra-household transfer flows by educational level, which is part of the second subsection. The second subsection (subsection 4.2) also provides a more in-depth analysis of the intra-household transfer flows, with estimates of flows by age and educational level presented in the form of input-output

matrices. The third subsection (subsection 4.3) shows the impact of education not only on the time spent on the various activities of production of unpaid work, but also on the consumption of unpaid work. Finally, subsection 4.4. presents the impact of education on economic life cycles in the 15 EU countries and examines the implications of education expansion for future economic sustainability.

4.1 Labour income, consumption and life cycle deficit by education

The aim of subsection 4.1 is to decompose NTA age profiles of labour income and consumption by education in order to observe the effect of education on these two variables over the life cycle. Table 13 gives a brief overview of subception 4.1. and provides the main definitions needed to understand the results presented, the data sources, the methodology and the outcomes of this part of the research. Table 14 shows the NTA subcategories used to estimate the age profiles of labour income and consumption.

Table 13: Overview of subsection 4.1

Country studied	Croatia (2014)	
Definitions	NTA age profiles studied	Age-specific averages of labour income and consumption. Their structure is shown in detail in Table 14.
	Economic life cycle	Shows economic behaviour (labour income and consumption) over an individual's life cycle
	Life cycle deficit	Positive value of consumption (C) less labour income (YL); opposite is life cycle surplus
Data sources	Main	Household Budget Survey for Croatia for 2014
	Supplementary	AGENTA, AWG, Eurostat, UNESCO
Educational level – completed (by ISCED 2011)	Low	ISCED 0-2
	Medium	ISCED 3-4
	High	ISCED 5-8
Methodology	NTA methodology	An accounting framework for comprehensive tracking economic flows across age groups; results are the age profiles
	NTA by education	An accounting framework for comprehensive tracking economic flows across age groups, further disaggregated by educational level; results are the age profiles by educational level
Outcomes	Educational level has a massive effect on the economic life cycle. Therefore, highly educated in Croatia have: (1) the latest entry on the labour market, (2) the steepest increase in their labour income at the start of the career, (3) the highest and the longest life cycle surplus during the working-age, (4) the latest peak in labour income in age group 45–49 and (5) high labour income even in years before the retirement. On the other hand, the low-educated do not have a life cycle surplus at any point of the life cycle.	

Source: UN (2013), Deaton(2005), Modigliani & Brumberg (1954), own calculations

Table 14 shows how the two main NTA age profiles, labour income and consumption, are constructed. Table 14 shows which subcategories are used to construct these two age profiles, the methods used to estimate each NTA subcategory and where the data for each subcategory come from.

Table 14: Structure of the NTA variables needed to construct the life cycle account of the Croatian NTA

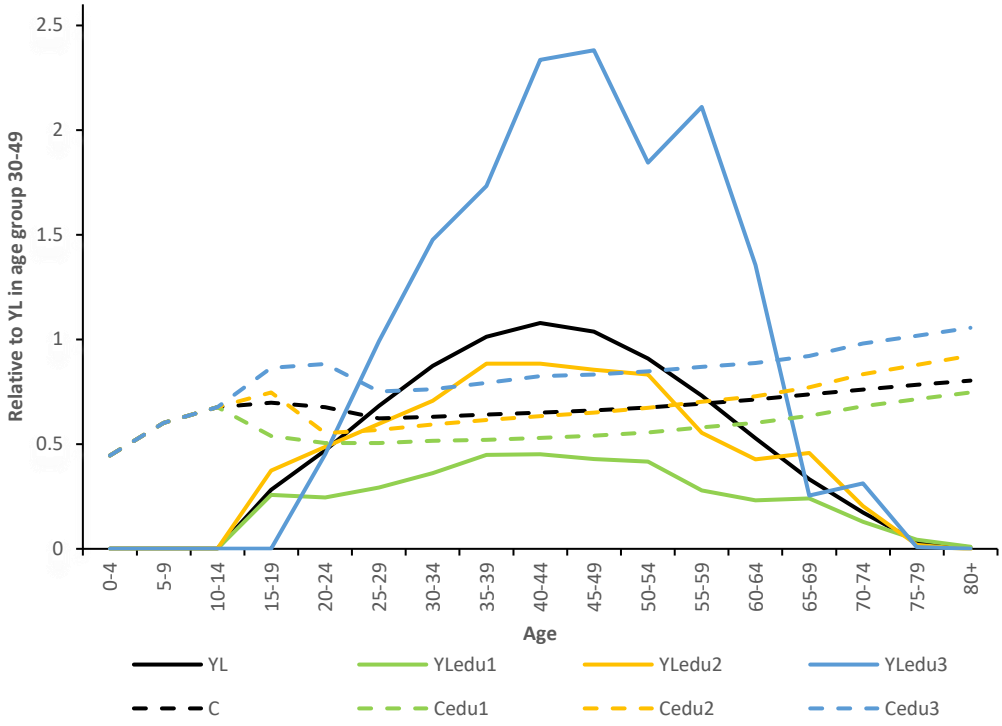
Variable Name			Variable description	Methods used	Data source
YL			**Labour income**	Weighted average of the YLE and YLS	
	YLE		Labour income, earnings		HBS
	YLS		Labour income, self-employment		HBS
C			**Consumption**		
	CF		Private consumption		
		CFE	Private consumption, education	Allocation by edu. level (aiming)	HBS
		CFH	Private consumption, health		HBS
		CFX	Private consumption, other than education and health		HBS
	CG		Public consumption		
		CGE	Public consumption, education	Allocation by edu. level (aiming)	Eurostat, UNESCO
		CGH	Public consumption, health	Allocation by regression	AGENTA, AWG
		CGX	Public consumption, other than education and health	Allocation by equivalence scale	
		TGSOAII	Public transfers, social protection - pensions, in-kind		HBS
		TGSUII	Public transfers, social protection - unemployment, in-kind		HBS
		TGSFII	Public transfers, social protection - family and children, in-kind		HBS
		TGSHII	Public transfers, social protection - housing, in-kind		HBS
		TGSDII	Public transfers, social protection - sickness and disability, in-kind		HBS
		TGSXII	Public transfers, social protection - miscellaneous, in-kind		HBS
		TGXII	Public transfers, other consumption, in-kind		HBS

Source: Abio et al. (2021), Istenič et al. (2016), UN (2013), own calculations

The economic life cycle shows the economic activity in the market. It is represented by two main age profiles: labour income and consumption. Figure 3 shows the age profiles of labour income and consumption in Croatia in 2014. The profiles are presented (a) as a conventional NTA by age only and (b) further disaggregated by educational level. In addition, the values of labour income and consumption are normalised to the per capita labour income of the conventional NTA in the age group 30–49. This is a standard NTA way of presenting age profiles, which ensures comparability across countries and over time (UN, 2013).

Figure 3 shows that the age profile of labour income of the conventional NTA has a typical bell shape. Children who attend primary school do not receive labour income, but those who do not continue their education or do student work can enter the labour market at age 15. The age profile of labour income of the conventional NTA peaks in the 40–44 age group and then begins to decline with age. The age profile of consumption of conventional NTA shows that consumption is quite stable over the life cycle but increases slightly with age after the end of schooling (after the age of 24) for most individuals.

Figure 3: Age profiles of labour income (YL) and consumption (C) of conventional NTA and NTA by education - Croatia 2014



**Notes: edu1 = low education (ISCED 0–2), edu2 = medium education (ISCED 3–4), edu3 = high education (ISCED 5 or more); age profiles normalised to conventional YL in the age group 30–49 = 76,444.10 HRK (≈10.151,94 EUR)*

Source: Croatian HBS (2014), Eurostat, own calculations

However, the age profiles of the NTA by education provide more information, particularly in relation to labour income. The earnings of low-educated are lower than those of medium-educated and highly educated throughout the life cycle. The peak of their earnings is already reached in the 35–39 age group. The age profile of labour income of medium-educated has a similar shape as that of low-educated. Although they too reach the peak of their earnings in the 35–39 age group, the earnings of medium-educated are higher than those of low-educated at all ages. Although the highly educated enter the labour market later in the life cycle, their labour income is much higher than that of the medium-educated, and especially the low-educated. After the highly educated enter the labour market, their earnings increase much faster than those of the medium- and low-educated. Their earnings peak in the 45–49 age group, but remain high in the 55–59 and 60–64 age groups, which represent the pre-retirement age in Croatia. The high labour income in these age groups is the result of higher wages received by the highly educated compared to the wages of the low- and medium-educated, but also the result of higher employment rates compared to low- and medium-educated individuals in the same age groups (Table 15).

Table 15: Employment rate by age and educational level in Croatia in 2014

Edu. level by NTA	Edu. level by ISCED11	Age									
		15-19	**20-24**	**25-29**	**30-34**	**35-39**	**40-44**	**45-49**	**50-54**	**55-59**	**60-64**
Low	**ISCED 0-2**	1.1	17.2	29.5	44.2	53.9	59.1	51.0	50.5	29.0	16.6
Medium	**ISCED 3-4**	17.8	31.2	64.1	74.0	76.0	73.5	69.8	65.6	48.1	21.5
High	**ISCED 5-8**	-	34.4	68.9	84.8	91.0	93.4	85.5	87.0	81.7	47.0

Source: Eurostat (2022b)

As shown in Table 15, in 2014, in the 55–59 age group, 81.7% of the highly educated were employed, while this was true for 48.1% of the medium-educated and only 29.0% of the low-educated. Although employment rates in the 60–64 age group are much lower for all three educational levels, they are still much higher for the highly educated (47.0%) than for the medium-educated (21.5%) and the low-educated (16.6%). The high employment of the highly educated, even in the 55–59 and 60–64 age groups, can be partly explained by the nature of their jobs, which tend to be less physically demanding than the jobs of the other two educational levels (Abio et al., 2017). However, the main difference stems from the fact that years of work are one of the conditions for retirement, along with age. As the highly educated enter the labour force later, they also meet the requirements for retirement later. The large differences between educational levels in employment rates are also observed in all other age groups. Therefore, the highly educated in Croatia have the highest employment rate throughout their working-age, which is also reflected in higher labour income.

A higher labour income enables the highly educated to also consume more than the medium- and low-educated (Figure 3). However, the differences in the age profiles of consumption

between educational levels are much smaller than the differences in labour income. This can be attributed to the progressivity of the tax system and the higher propensity to save of the highly educated (Revoredo & Morisset, 1995). All three age profiles of consumption show the same shape, namely a slight increase with age, starting with the 25–29 age group. The largest differences in the age profiles of consumption between the three educational levels are found at the beginning of the life cycle, during the schooling ages. All three age profiles show the same level of consumption in the 0–14 age group, with 14 being the age at which primary education usually ends. Secondary education (or medium education according to the NTA) ends in the 15–19 age group, and higher education programmes end for most individuals in the 20–24 age group.

During the school years, consumption differences mainly result from public and private consumption of education. Both the age profiles of public and private consumption of education in this analysis are constructed on the basis of the level of education aimed rather than the level of education completed. This means that the 15–19 age group includes both those enrolled in the medium level of education and also those enrolled in the high level of education. High level of education (university) is typically enrolled in at age 18 or 19. Thus, in the 15–19 age group, the age profiles of consumption increase for both those with medium and high levels of education. In the 20–24 age group, the age profile of consumption of the medium-educated decreases, as shown in Figure 3. The age profile of consumption of the highly educated remains high, partly due to the fact that they continue their studies at this age and thus have high public and private consumption of education. As shown in Figure 1, all programmes of high education in Croatia can be completed earliest in the 20–24 age group. This is also reflected in the age profile of consumption of highly educated, as their consumption decreases in the 25–29 age group. As mentioned earlier, the age profiles of consumption of all three educational levels increase in later stages of working-age. The analysis has also shown that the increase in consumption after the age of 65, when most individuals in Croatia are retired, is mainly due to higher consumption of public health.

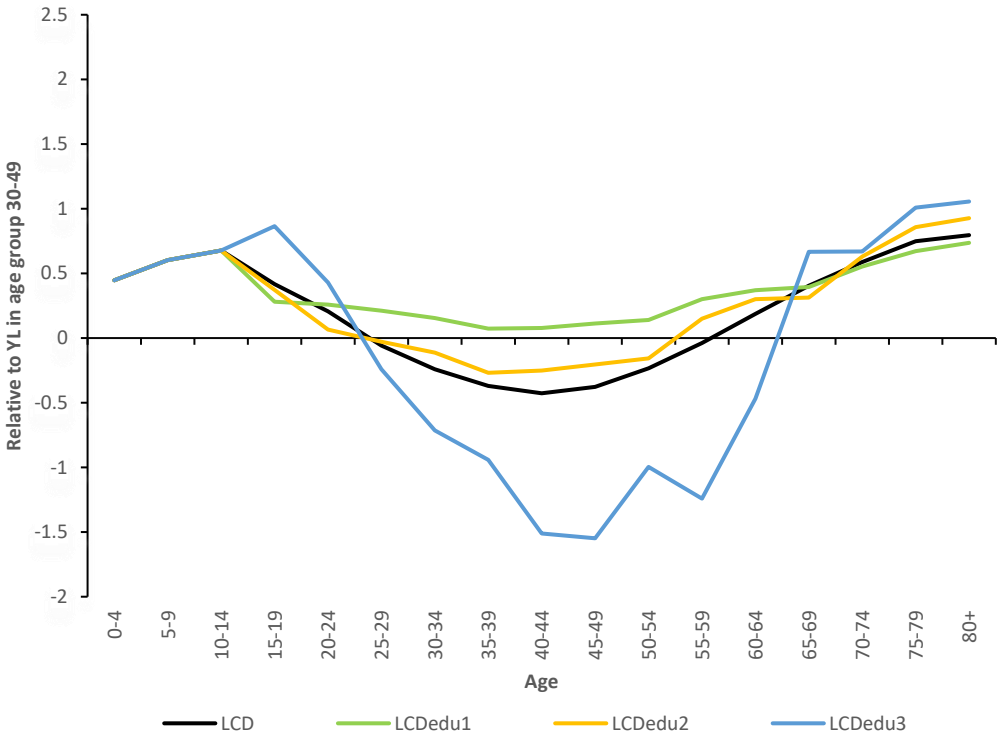
For the transfer system of an economy, it is important how individuals finance their own consumption. Individuals whose labour income is higher than their consumption have a life cycle surplus, while individuals whose consumption is higher than their labour income have a life cycle deficit. The life cycle deficit represented by the conventional NTA and the NTA by education is shown in Figure 4.

In Croatia, as in other countries, the life cycle deficit estimated with the conventional NTA is observed for young and older people. The conventional NTA life cycle surplus starts around the age of 26 and lasts until around the age of 58. This means that it lasts for about 33 years, slightly longer than the EU average where the life cycle surplus lasts between ages 27 and 57 (i.e. 31 years) (Istenič et al., 2016).

A breakdown of NTA profiles by education shows that the low-educated in Croatia do not have a life cycle surplus at any point in their life cycle. This means that even at working-

age, their consumption has to be covered by the surplus generated by those with medium and especially high levels of education, who have the life cycle surplus. However, the surplus generated by highly educated individuals is much higher and lasts over a longer age span than the surplus generated by medium-educated individuals. The surplus for individuals with medium and high levels of education starts around the age of 26. For the medium-educated, it lasts until age 55, and for the highly educated, it lasts on average 10 years longer, until age 65. Therefore, the highly educated in Croatia can support their own consumption the longest. They are also able to finance dependent individuals more intensively, as the magnitude of their life cycle surplus is much larger than that of the other two educational groups.

Figure 4: Life cycle deficit (LCD) for Croatia 2014 – conventional NTA and NTA by education



**Notes: edu1 = low education (ISCED 0–2), edu2 = medium education (ISCED 3–4), edu3 = high education (ISCED 5 or more); age profiles normalised to conventional YL in the age group 30–49 = 76,444.10 HRK (≈10.151,94 EUR)*

Source: Croatian HBS (2014), Eurostat, own calculations

Thus, apart from the ability to finance one's own consumption, the life cycle surplus is also a basis for giving resources to others who cannot finance their own consumption, either in the form of public or private transfers. The transfer recipients are therefore mainly children and the elderly who cannot finance their own consumption. In addition to public transfers received from the government, individuals also receive private transfers, from individuals in

other households in the form of inter-household transfers or from individuals within the same household in the form of intra-household transfers. As mentioned earlier, intra-household transfers account for about 90% of all private transfer flows and are the focus of further research (R. Lee & Donehower, 2011).

4.2 Intra-household monetary transfers by age and education

The aim of subsection 4.2. is to estimate the direction and value of intra-household monetary transfer flows between household members by age and educational level. The estimation of intra-household monetary transfers by age and education is an extension of the estimation of labour income and consumption by education. Table 16 provides a brief description of the definitions, data sources, methodology and outcomes of the estimation of intra-household transfers.

Table 16: Overview of subsection 4.2

Country studied	Croatia (2014)	
Definitions	Intra-household monetary transfers	Economic flows (in Croatian kunas) between a transfer giver and a transfer recipient of a given age and educational level. For their estimation it is necessary to construct the transfer account. NTA subcategories necessary for the construction of transfer account are shown in Table 17.
Data sources	Main	Household Budget Survey for Croatia for 2014
	Supplementary	Eurostat
Educational level – completed (by ISCED 2011)	Low	ISCED 0-2
	Medium	ISCED 3-4
	High	ISCED 5-8
Methodology	Input-output matrix	Each cell represents a value of monetary transfer flow between two household members of given ages and educational levels: transfer givers are in rows and transfer recipients are in columns.
Outcomes	Educational level does not affect the direction of intra-household monetary transfer: they always flow from parents (and even grandparents) towards children. However, educational level affects the value of transfers given to children. On average, highly educated give the highest intra-household transfers to children in school, while the low-educated give the lowest.	

Source: UN (2013), Deaton(2005), Modigliani & Brumberg (1954), own calculations

Table 17 shows the NTA variables recquired to construct the age profiles of intra-household transfers. It also briefly shows the methods and data used to estimate each subcategory. Some of the subcategories are estimated based on the age profiles shown in Table 14.

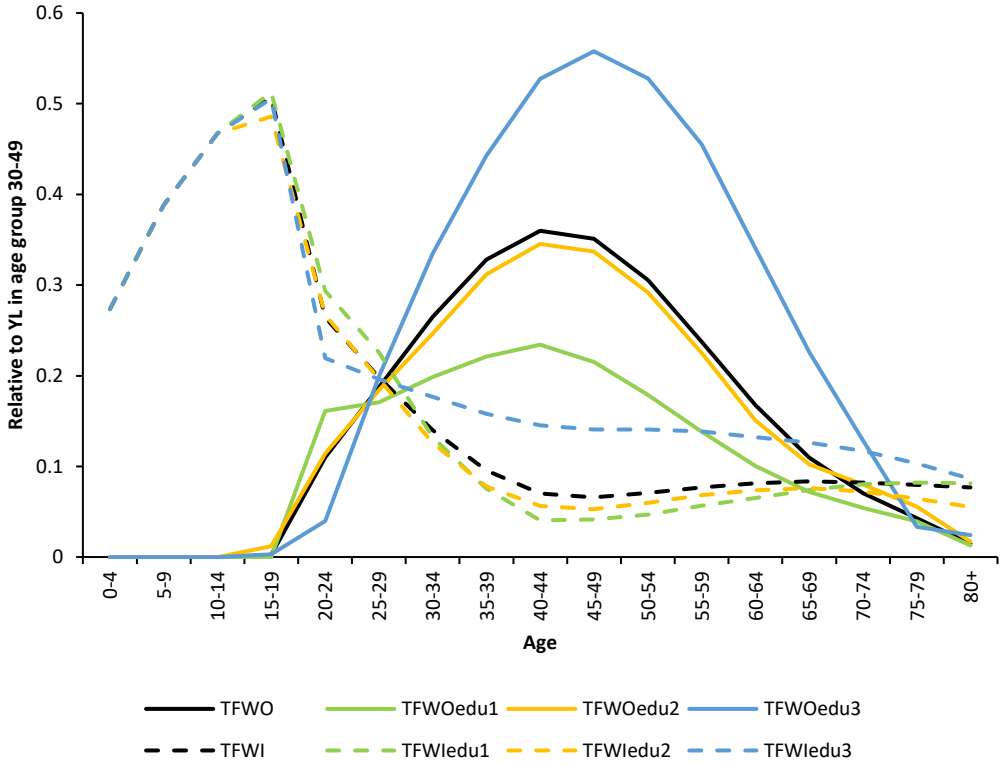
Table 17: Structure of the NTA variables needed to construct the transfer account of Croatian NTA

Variable Name			Variable description	Methods used	Data source
TG			Net public transfers	TGI-TGO	
	TGI		Public transfer inflows	Weighted average of the TGIC and TGII	
		TGIC	Public transfer inflows, in-cash		
		TGEIC	Public transfer inflows, education, in-cash		HBS
		TGHIC	Public transfer inflows, health, in-cash		HBS
		TGSOAIC	Public transfer inflows, pensions, in-cash		HBS
		TGSUIC	Public transfer inflows, unemployment, in-cash		HBS
		TGSFIC	Public transfer inflows, family and children, in-cash	Allocated to the household head	HBS
		TGSHIC	Public transfer inflows, housing, in-cash	Allocated to the household head	HBS
		TGSXIC	Public transfer inflows, other social protection, in-cash	Allocated to the household head	HBS
		TGXCI	Other public transfer inflows, in-cash	Assumed uniform distribution	
		TGII	Public transfer inflows, in-kind	TGII=CG	CG
	TGO		Public transfer outflows	Weighted average of the TGF, TGP and TGX	
		TGF	Taxes		
		TGFYA	Taxes on asset income		HBS
		TGFYL	Taxes on labour income	Obtained from:	YL
		TGFC	Taxes on consumption	Obtained from:	CF
		TGFX	Taxes, other than on asset and labour income, consumption	Assumed uniform distribution	
		TGP	Social contributions		
		TGPYL	Social contributions on labour income	Obtained from:	YL
		TGPPEN	Social contributions on pensions	Obtained from:	TGSOAIC
		TGX	Other current transfers	Assumed uniform distribution	
TF			Private transfers		
	TFB		Private inter-household transfers	Allocated to the household head	HBS
	TFW		Private intra-household transfers	Indirect estimation based on YL, TGIC, TGFYL, TGFC, TGP, TGX, TFB, CF and CFR	NTA

Source: Abio et al. (2021), Istenič et al. (2016), UN (2013), own calculations

Net intra-household transfers are calculated as the residual between individual disposable income and private consumption (excluding consumption of housing, i.e. imputed rents). At the aggregate level, intra-household transfer inflows correspond to intra-household outflows. However, there are large age differences between recipients and givers of this type of transfers. The age profiles of intra-household transfer flows are shown in Figure 5.

Figure 5: Intra-household transfer inflows (TFWI) and outflows (TFWO) profiles for Croatia 2014 – conventional NTA and NTA by education



**Notes: edu1 = low education (ISCED 0–2), edu2 = medium education (ISCED 3–4), edu3 = high education (ISCED 5 or more); age profiles normalised to conventional YL in the age group 30–49 = 76,444.10 HRK (≈10.151,94 EUR)*

Source: Croatian HBS (2014), Eurostat, own calculations

Children receive substantially more intra-household transfers than other age groups, with children aged 15–19 receiving the highest intra-household transfers. Both age profiles of intra-household transfer inflows of low- and medium-educated individuals reach the minimum value during their working-age. Low-educated individuals receive the lowest intra-household transfers in the 40–44 age group and the medium-educated in the 45–49 age group, before increasing in the older age groups. However, the age profile of intra-household transfer inflows for the highly educated is different. It remains much higher than the age profiles of intra-household transfer inflows of low- and medium-educated even at working-age and reaches its lowest levels at old age. The age profiles of the intra-household transfer

outflows show that the highly educated also give the highest transfers. Their intra-household transfer outflows are higher than their intra-household transfer inflows for the longest time, namely from the age of about 26 to the age of about 73. The low- and medium-educated have lower intra-household transfer inflows than the highly educated, but their intra-household transfer outflows are also much lower. Although the low-educated enter the labour market much earlier than the medium-educated and especially the highly educated, their intra-household transfer outflows do not exceed their inflows until they are about 29 years old. Their inflows become higher again already at the age of about 66.

While the conventional NTA allows us to measure the size of intra-household transfer inflows and outflows, it lacks information on from whom these transfers are received or given. Intra-household transfers flow between all members of a household, for example, from a parent to a child, from a working-age child to an older parent, from a spouse to a spouse (R. Lee & Donehower, 2011). As the Croatian HBS 2014 includes each household member's labour income and household consumption with all other relevant information in the same survey, it allows estimating the direction, including the size, of these intra-household transfer flows using input-output matrices.

The input-output matrices in Figures 6–11 are presented according to the educational level of the recipient of the intra-household transfer: low (ISCED 0–2), medium (ISCED 3–4) and high (ISCED 5–8). The educational levels in these matrices refer to the completed level of education. This means that transfers received by a recipient aged 15–19 who is attending the secondary school (and thus aiming for the medium educational level) are found in the 15–19 age group of low-educated transfer recipients. Similarly, the transfers received by a 20-year-old university student are found in the 20–24 age group of medium- educated transfer recipients.

Furthermore, the age groups shown in the input-output matrices do not cover the same age ranges. The main reason for this is that the original 5-year age groups provided too few observations for the estimation of intra-household transfers. The details of the merging of the original 5-year age groups and the selection of the final age groups in the input-output matrices are explained in subsection 3.1.3 and Table 7. However, even after merging age groups, some still provided too few observations, so I do not report values for intra-household transfer flows estimated on the basis of fewer than 5 observations. Therefore, the input-output matrices of intra-household transfer flows to recipients at each educational level in Figures 6, 8 and 10 are supplemented by the matrices in Figures 7, 9 and 11 that report on the number of observations in each age- and education-specfic combination. In order to make the matrices showing the value of intra-household transfer flows received by individuals of each educational level comparable with each other, but also with the NTA age profiles shown earlier in subsection 4.1 and also later in subsection 4.4, all transfer flows are normalised to the per capita labour income of the conventional NTA in the 30–49 age group.

Figure 6: Monetary intra-household transfer flows to low-educated transfer recipients

Flows from low to low educated

Transfer recipients

Transfer givers / Age	0-4	5-9	10-14	15-19	20-29	30-39	40-49	50-59	60+
15-19									
20-29	0.258	0.352			0.057				
30-39	0.135	0.168	0.166	0.172	0.040	0.022	0.042	0.040	0.083
40-49	0.141	0.213	0.251	0.243	0.090	0.037	0.029	0.109	0.094
50-59	0.079	0.112	0.148	0.182	0.059	0.020	0.030	0.030	0.066
60+	0.060	0.112	0.129	0.141	0.088	0.010	0.013	0.013	0.054
AVG	**0.114**	**0.168**	**0.185**	**0.202**	**0.067**	**0.021**	**0.028**	**0.034**	**0.061**

Flows from medium to low educated

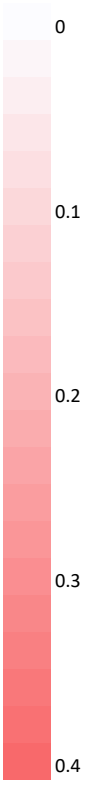
Transfer recipients

Transfer givers / Age	0-4	5-9	10-14	15-19	20-29	30-39	40-49	50-59	60+
15-19									
20-29	0.180	0.310		0.295			0.008	0.017	0.052
30-39	0.136	0.185	0.206	0.207	0.052	0.023	0.049	0.036	0.060
40-49	0.170	0.224	0.257	0.269	0.115	0.023	0.027	0.027	0.095
50-59	0.075	0.116	0.179	0.228	0.045	0.016	0.028	0.025	0.071
60+	0.037	0.053	0.070	0.117		0.006	0.012	0.011	0.052
AVG	**0.126**	**0.185**	**0.219**	**0.243**	**0.068**	**0.020**	**0.026**	**0.025**	**0.068**

Flows from highly to low educated

Transfer recipients

Transfer givers / Age	0-4	5-9	10-14	15-19	20-29	30-39	40-49	50-59	60+
15-19									
20-29									
30-39	0.133	0.178	0.219	0.193				0.016	0.073
40-49	0.164	0.227	0.264	0.292					0.093
50-59	0.055		0.257	0.292				0.026	0.055
60+		0.204							0.043
AVG	**0.135**	**0.193**	**0.253**	**0.283**				**0.022**	**0.063**



**Notes: low education = ISCED 0–2, medium education = ISCED 3–4, high education = ISCED 5 or more; transfer flows are normalised to conventional YL in the age group 30–49 = 76,444.10 HRK (≈10.151,94 EUR)*

Source: Croatian HBS (2014), own calculations

In all countries, private transfers flow downwards, from adults to children in school, usually by their early twenties (R. Lee & Donehower, 2011). Figure 6 shows the value of intra-household transfers given by individuals with three different levels of education to low-educated transfer recipients. Since the input-output matrices are constructed according to the completed educational level of the transfer recipient, Figure 6 shows that most intra-household transfer flows are directed to children who are still in school. More specifically, these are mainly intra-household transfers to children attending primary school (recipients

aged 0–14) or to children who have completed it and are attending secondary school (recipients aged 15–19). The dark red cells show that children aged 0–19 receive the highest transfers compared to working-age transfer recipients or low-educated older individuals, regardless of the educational level of the transfer giver. In most cases, these transfers amount to up to 20–30% of the average labour income of those aged 30–49, the age group with the highest labour income in the life cycle (shown in Figure 3).

However, there are some peculiarities in intra-household transfers given by givers with different levels of education. Transfers that account for more than 20% (of the average labour income of those in the 30–49 age group) are given to children by two age groups of low-educated transfer givers: those aged 20–29, and those aged 40–49. More precisely, low-educated aged 20–29 give the highest transfers to children aged 5–9 (35.2%), which is the age group where children attend kindergarten and where primary school starts. They also give high transfers (25.8%) to young children aged 0–4. The low-educated aged 40–49 transfer more than 20% to the 5–19 age group, which mostly covers the age when children attend primary and secondary school (in Croatia usually ages 7–18). However, the highest transfers by the low-educated aged 40–49 are given to slightly older children aged 10–14 (25.1%) and 15–19 (24.3%).

The medium-educated aged 20–49 transfer more than 20% (of the average labour income of those in the 30–49 age group) to children. More specifically, the medium-educated aged 20–29 transfer the most to children aged 5–9 and 15–19, and the medium-educated aged 30–39 to children aged 10–19. Nevertheless, the medium-educated aged 40–49 are the main transfer givers of this educational level. They give transfers of 20% or even more to children in three age groups (5–9, 10–14, 15–19).

Transfers above 20% are also given by highly educated transfer givers aged 40–49 to children aged 5–19, which also makes them the main transfer givers of the highly educated. However, highly educated older than 49 still give higher transfers to children than the low- and medium-educated. The highly educated aged 50–59 give over 25% to children aged 10–14 and almost 30% to those aged 15–19. Moreover, the highly educated aged 60+ also give high transfers (20.4%) to children aged 5–9. The fact that the highly educated continue to give higher transfers at older ages is not surprising, as the highly educated continue to earn high incomes at ages 50–59 and 60+ (shown by the NTA age profile of labour income by education in Figure 3). However, the fact that the older highly educated give high transfers to children may also indicate that the highly educated have children later in life. It is therefore beneficial to look at the number of observations on which each estimate is based. This is shown in Figure 7.

Figure 6 shows only the values of intra-household transfer flows that could be estimated from 5 or more observations. The number of observations in each combination of age and educational level of transfer givers and transfer recipients (including combinations with less

than 5 observations), shown in Figure 7, can provide insight into the most common combinations for intra-household transfer flows.

Figure 7: Number of observations for monetary intra-household transfer flows to low-educated transfer recipients

Flows from low to low educated

Transfer recipients

Transfer givers	0-4	5-9	10-14	15-19	20-29	30-39	40-49	50-59	60+
15-19									
20-29	8	8	2	4	6	1	3	4	1
30-39	26	47	37	17	11	75	9	20	23
40-49	11	23	33	52	14	12	91	18	38
50-59	33	27	14	35	17	21	21	223	61
60+	16	18	16	16	8	17	14	32	259

Flows from medium to low educated

Transfer recipients

Transfer givers	0-4	5-9	10-14	15-19	20-29	30-39	40-49	50-59	60+
15-19		1		1	1			2	
20-29	20	15	3	12	4	1	9	22	19
30-39	153	232	175	52	9	54	8	62	80
40-49	49	102	177	223	8	14	65	12	110
50-59	50	47	44	101	10	13	13	156	116
60+	26	20	17	23	3	10	9	38	153

Flows from highly to low educated

Transfer recipients

Transfer givers	0-4	5-9	10-14	15-19	20-29	30-39	40-49	50-59	60+
15-19									
20-29	2		1	4			1	3	2
30-39	80	61	17	8		2		12	17
40-49	18	24	43	47			3		9
50-59	5	4	19	34	2	2	1	20	16
60+	3	5	2	3	2	1	1		16

**Notes: low education = ISCED 0–2, medium education = ISCED 3–4, high education = ISCED 5 or more*

Source: Croatian HBS (2014), own calculations

Figure 7 shows that intra-household transfers given by the highly educated aged 30–39 are mainly directed to children aged 0–9. Transfers given by those aged 40–59 are directed to children aged 10–19. Transfers of the medium-educated aged 30–39 are mainly directed to children aged 10–14, and transfers from those aged 40–49 are directed to children aged 5–19. Medium-educated transfer givers aged 50–59 mainly direct their transfers to children aged 15–19. Although these figures are not directly comparable, as I do not use the age groups of the same sizes and they depend on population size, these frequencies nevertheless imply that the highly educated have children later than the medium-educated. However,

because of their higher labour income, the highly educated can also transfer more to their children, even if they are older.

Figure 8: Monetary intra-household transfer flows to medium-educated transfer recipients

Flows from low to medium educated

Transfer recipients

Transfer givers	15-19	20-29	30-39	40-49	50-59	60+
15-19						
20-29		0.078			0.015	
30-39		0.063	0.039	0.066	0.032	0.100
40-49	0.257	0.121	0.053	0.041	0.105	0.144
50-59	0.229	0.072	0.035	0.041	0.037	0.084
60+	0.208	0.046	0.009	0.009	0.013	0.054
AVG	**0.238**	**0.082**	**0.034**	**0.037**	**0.037**	**0.075**

Flows from medium to medium educated

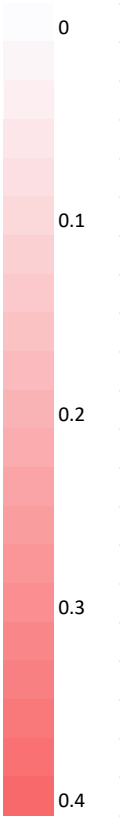
Transfer recipients

Transfer givers	15-19	20-29	30-39	40-49	50-59	60+
15-19						
20-29	0.215	0.092	0.017	0.011	0.016	0.044
30-39	0.275	0.064	0.027	0.036	0.052	0.082
40-49	0.259	0.126	0.061	0.037	0.110	0.124
50-59	0.202	0.089	0.031	0.023	0.038	0.086
60+	0.375	0.062	0.009	0.007	0.015	0.045
AVG	**0.248**	**0.099**	**0.030**	**0.033**	**0.042**	**0.063**

Flows from highly to medium educated

Transfer recipients

Transfer givers	15-19	20-29	30-39	40-49	50-59	60+
15-19						
20-29		0.097		0.006	0.014	0.044
30-39		0.082	0.029	0.056	0.040	0.068
40-49	0.309	0.128		0.029	0.070	0.124
50-59	0.222	0.110	0.036	0.015	0.029	0.064
60+		0.069	0.008	0.008	0.012	0.044
AVG	**0.266**	**0.107**	**0.026**	**0.028**	**0.031**	**0.058**



**Notes: low education = ISCED 0–2, medium education = ISCED 3–4, high education = ISCED 5 or more; transfer flows are normalised to conventional YL in the age group 30–49 = 76,444.10 HRK (≈10.151,94 EUR)*

Source: Croatian HBS (2014), own calculations

However, Figure 7 shows that intra-household transfer flows are very common from the low- and medium-educated to elderly aged 60+, which seems to be less common among the highly educated transfer givers. This does not necessarily indicate that the highly educated are less

likely to support older individuals with low level of education (presumably their parents), but could indicate that they are less likely to live in the same household. Moreover, transfers between low-educated transfer givers and low-educated transfer recipients are common in the same age group. These are mainly transfers between spouses (R. Lee & Donehower, 2011).

Figure 8 shows the intra-household transfer flows to medium-educated individuals. The highest transfers (over 20% of the average labour income of those aged 30–49) are given by transfer givers of all three educational levels to children aged 15–19. The 15–19 age group with medium level of education consists of children (transfer recipients) who have completed secondary education and entered the labour market or have entered tertiary education after the completing secondary education.

The medium-educated aged 20–29 also receive high transfers from individuals at all three educational levels, but these transfers are not as high as the transfers to the medium-educated aged 15–19 (Figure 8). The 20–29 age group receives the highest transfers from transfer givers aged 40–49, about 12–13%, regardless of their educational level. Looking at the average value given to age groups that include transfer recipients who are still in school, we see that highly educated transfer givers of all ages give the highest transfers and low-educated give the lowest transfers to the transfer recipients in both 15–19 and 20–29 age groups. Moreover, transfer givers aged 40–49 of all three educational levels give transfers higher than 12% to the medium-educated transfer recipients aged 60+. This makes those in the 40–49 age group the main transfer givers to the medium-educated.

However, Figure 9 shows that regardless of the educational level of transfer giver, intra-household transfers between individuals in the same age group are the most common. Although they are the most common, Figure 8 shows that the value of these transfers is relatively low, usually less than 5%. Interestingly, the most frequent transfers were made to medium-educated transfer recipients aged 20–29 by transfer givers aged 50–59, regardless of their educational level. However, the value of transfers given was highest among the highly educated (11.0%) and lowest among the low-educated (7.2%) (Figure 8), again reflecting their level of earned labour income at this age (Figure 3).

Figure 9: Number of observations for monetary intra-household transfer flows to medium-educated transfer recipients

Flows from low to medium educated

Transfer recipients

Transfer givers / *Age*	15-19	20-29	30-39	40-49	50-59	60+
15-19		2				
20-29	3	33	2	2	9	2
30-39	3	21	107	14	20	18
40-49	32	75	11	71	10	12
50-59	19	109	77	12	95	24
60+	14	35	36	27	16	71

Flows from medium to medium educated

Transfer recipients

Transfer givers / *Age*	15-19	20-29	30-39	40-49	50-59	60+
15-19		2				
20-29	6	72	7	18	29	10
30-39	5	39	404	39	66	73
40-49	75	185	64	427	52	49
50-59	29	191	70	64	498	61
60+	5	30	50	22	55	307

Flows from highly to medium educated

Transfer recipients

Transfer givers / Age	15-19	20-29	30-39	40-49	50-59	60+
15-19						
20-29	1	13	1	8	15	6
30-39	1	15	73	11	39	45
40-49	21	43	4	73	11	12
50-59	20	97	13	13	114	23
60+	2	20	21	6	19	95

**Notes: low education = ISCED 0–2, medium education = ISCED 3–4, high education = ISCED 5 or more*

Source: Croatian HBS (2014), own calculations

The intra-household transfer flows towards the highly educated recipients are shown in Figure 10. Few intra-household transfer flows were available for the combination of low-educated transfer givers and highly educated transfer recipients. Unsurprisingly, highly educated recipients receive less transfers from the low-educated, as they also have low incomes and thus less income available. Moreover, the consumption of the highly educated is higher than the consumption of the low- and medium-educated, making it even more difficult for the low-educated, who generally have low income, to support the consumption of the highly educated. Since the input-output matrices of intra-household transfers to the highly educated do not show transfers given to children, the average transfers given to the

highly educated aged 60+ are highest (about 8%) in case of medium-educated and highly educated transfer givers.

Figure 10: Monetary intra-household transfer flows to highly educated transfer recipients

Flows from low to highly educated

Transfer recipients

Transfer givers	*Age*	**20-29**	**30-39**	**40-49**	**50-59**	**60+**
	20-29					
	30-39		0.038			
	40-49	0.066				
	50-59	0.054	0.033			
	60+					0.035
	AVG	**0.059**	**0.036**			**0.035**

Flows from medium to highly educated

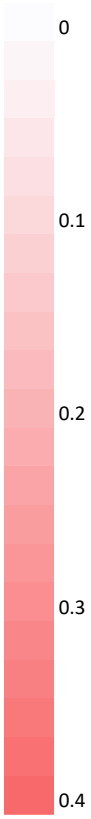
Transfer recipients

Transfer givers	*Age*	**20-29**	**30-39**	**40-49**	**50-59**	**60+**
	20-29	0.057			0.010	
	30-39	0.048	0.041		0.085	0.126
	40-49	0.110	0.105	0.054	0.073	0.198
	50-59	0.056	0.034	0.037	0.044	0.111
	60+	0.027	0.013		0.021	0.052
	AVG	**0.061**	**0.041**	**0.051**	**0.047**	**0.081**

Flows from highly to highly educated

Transfer recipients

Transfer givers	Age	**20-29**	**30-39**	**40-49**	**50-59**	**60+**
	20-29	0.060				0.059
	30-39	0.043	0.035	0.015	0.098	0.110
	40-49		0.052	0.034		0.184
	50-59	0.057	0.019	0.021	0.037	0.087
	60+	0.036	0.016		0.016	0.066
	AVG	**0.052**	**0.034**	**0.031**	**0.039**	**0.078**



**Notes: low education = ISCED 0–2, medium education = ISCED 3–4, high education = ISCED 5 or more; transfer flows are normalised to conventional YL in the age group 30–49 = 76,444.10 HRK (≈10.151,94 EUR)*

Source: Croatian HBS (2014), own calculations

As can be seen in Figures 6 and 8, it is the highly educated who, on average, give the highest intra-household transfers to low- and medium-educated transfer recipients over the life cycle. In old age, however, they receive more transfers than low- and medium-educated older individuals (Figure 10). Moreover, Figure 11 shows that the most frequent transfers were between the medium-educated and highly educated transfer givers and highly educated

transfer recipients in the same age group, again showing that regardless of educational level, intra-household transfers are rarely directed upward.

Figure 11: Number of observations for monetary intra-household transfer flows to highly eduated transfer recipients

Flows from low to highly educated

Transfer recipients

Transfer givers / *Age*	**20-29**	**30-39**	**40-49**	**50-59**	**60+**
20-29	3				
30-39	2	16		1	1
40-49	7		1		2
50-59	8	11	1	3	1
60+	2	2	0	1	6

Flows from medium to highly educated

Transfer recipients

Transfer givers / *Age*	**20-29**	**30-39**	**40-49**	**50-59**	**60+**
20-29	20	1		5	3
30-39	17	104	3	9	20
40-49	23	14	33	7	5
50-59	68	33	7	55	17
60+	13	28	2	7	67

Flows from highly to highly educated

Transfer recipients

Transfer givers / Age	**20-29**	**30-39**	**40-49**	**50-59**	**60+**
20-29	21	1		3	5
30-39	13	151	8	7	18
40-49	4	7	74	4	7
50-59	35	7	6	120	11
60+	16	12	4	10	116

**Notes: low education = ISCED 0–2, medium education = ISCED 3–4, high education = ISCED 5 or more*

Source: Croatian HBS (2014), own calculations

In summary, regardless of educational level, intra-household transfers are directed downward, from adults to children, just as in the general case of private transfers (R. Lee & Donehower, 2011). In addition to transfers given to children, transfers between individuals in the same age group (mainly between partners) are also very common. These transfers take place between individuals older than 30 years, which is the working-age for all educational levels. Since individuals of working-age have the highest labour income, they tend to transfer more to their children who are still in school. Regardless of educational level, intra-household transfer givers aged 40–49 are under the most pressure.

However, there are also some differences in intra-household transfers given by individuals with different levels of education. Because they have higher labour income, on average, the highly educated give the highest intra-household transfers, especially to transfer recipients who are still in school. This is also the case for the highly educated transfer givers aged 50–59, which is not the case for the low- and medium-educated. However, the highly educated also receive higher intra-household transfers in old age.

Although intra-household transfers represent flows of resources within the household, they are a reflection of market-based economic activity in the form of labour income and consumption. To complete the picture of the economic activity that happens within households, it is therefore crucial to include the household production and consumption of unpaid work.

4.3 The role of education in unpaid work activities

The aim of subsection 4.3. is to construct age profiles of the production and consumption of unpaid work by education in order to observe differences in time devoted to unpaid work activities between individuals of different educational levels. Table 18 provides a brief overview of this subsection.

Table 18: Overview of subsection 4.3

Countries studied	For production of unpaid work	Austria (2008), Bulgaria (2001), Denmark (2001), Spain (2009), France (2009), Hungary (2009), Italy (2008), Netherlands (2005) and Slovenia (2000)
	For consumption of unpaid work	Spain (2002), Italy (2002)
Definitions	Unpaid work	Work performed off the market, usually within households, which produces goods and services that would otherwise have to be bought in the market. Sometimes it is also referred to as household production. It is measured as value of time invested in performing a certain unpaid work activity.
	Housework other than childcare	Activity of unpaid work consisted of (1) cooking and washing up, (2) cleaning, (3) maintaining home/vehicle, (4) gardening, (5) pet care, (6) shopping, (7) commuting, (8) elderly care, (9) volunteering
	Childcare	Activity of unpaid work consisted of (1) physical, medical and routine childcare and (2) playing with a child, reading to a child, teaching a child
Data sources	Main	Multinational Time Use Study (MTUS)
	Supplementary	Eurostat
Educational level – completed (by MTUS)	Low	Incomplete secondary education or less
	Medium	Completed secondary education
	High	Above secondary education
Methodology	NTTA methodology	Construction of age profiles (i.e. per capita averages) of household production and consumption of unpaid work that results in estimation of time transfers.
Outcomes	Educational level affects production more than if affects consumption of unpaid work. Regardless of educational level, the age profile of production of unpaid work follows a similar pattern of unpaid work – it increases towards the old age and peaks around the retirement age. However, educational level affects the age profile of production in terms of the type of the unpaid activity performed. In most countries analysed, the low-educated prioritise housework other than childcare (cooking, cleaning, maintaining home/vehicle etc.). Of three educational levels, they devote the most time to these activities, while highly educated devote the least time to them. On the other hand, the highly educated prioritise childcare over the life cycle. In comparison with medium- and especially low-educated, highly educated devote the most time to childcare.	

Source: Centre for Time Use Research (2020), Donehower (2014), own calculations

In addition to work and all economic activities in the market, individuals also work outside the market. This work is not paid and mostly takes place in the households. Just as the individuals' market activity is primarily determined by labour income and consumption, unpaid work in households is determined by household production and consumption, usually measured in time. As shown in the NTA age profiles for Croatia (Figure 3), the educational level of the individual has a large effect on labour income and a somewhat smaller effect on

consumption. How much time people spend on household production also depends on how much time they spend on paid work. Therefore, it can be expected that the educational level also affects the production of unpaid work as well.

In contrast, the consumption of unpaid work itself does not depend on the educational level. Regardless of the educational level, people need to consume meals, a clean house and other products and services produced in households. Therefore, consumption of unpaid work depends on total household production, which is then divided among all household members (as mentioned in subsection 3.2.2). Consequently, it still reflects the effect of education (Zannella, 2015). This shows that the differences in unpaid work between individuals with different educational levels can best be identified through an analysis of household production. Therefore, the analysis of household production of unpaid work is highlighted throughout the section 4.2. In addition, because of the importance of household production of unpaid work, the most recent MTUS data available are used for the analysis.

4.3.1 Household production of unpaid work

As mentioned earlier, the household production of unpaid work depends on the time spent on paid work in the market. In order to analyse the relationship between the time spent on paid work and the time spent on unpaid work, it is first necessary to determine and group time spent on daily activities. According to the NTTA (Donehower, 2014; Sambt et al., 2016), which was developed to add unpaid work to the NTA, all daily activities can be grouped into five main categories: (1) paid work, (2) education, (3) unpaid work (household production), (4) personal care, and (5) leisure. The sum of all these categories must be 1440 minutes, which covers all 24 hours of a day.

Table 19 shows the average time spent on each category of daily activity for all adults aged 18 and over in 9 EU countries: Austria (2008), Bulgaria (2001), Denmark (2001), Spain (2009), France (2009), Hungary (2009), Italy (2008), the Netherlands (2005) and Slovenia (2000). Children under 18 are not included in this table as they are mostly consumers rather than producers of unpaid work. All categories of daily activities are divided by three levels of education (originally available with the MTUS datasets): (1) low (incomplete secondary education or less), (2) medium (completed secondary education) and (3) high (above secondary education) (Centre for Time Use Research, 2020). The estimate of unpaid work takes into account the level of education completed.

In almost all countries studied, the low-educated devote more time to unpaid work than the medium-educated and the highly educated although the amount varies from country to country. The low-educated spend the most time on unpaid work in Bulgaria (5 hours and 12 minutes) and the least in Denmark (3 hours and 33 minutes). On the other hand, the amount of time spent on the production of unpaid work varies much less between countries for those with medium, and especially for those with high levels of education.

Table 19: Average time in minutes spent on daily activities, age 18+

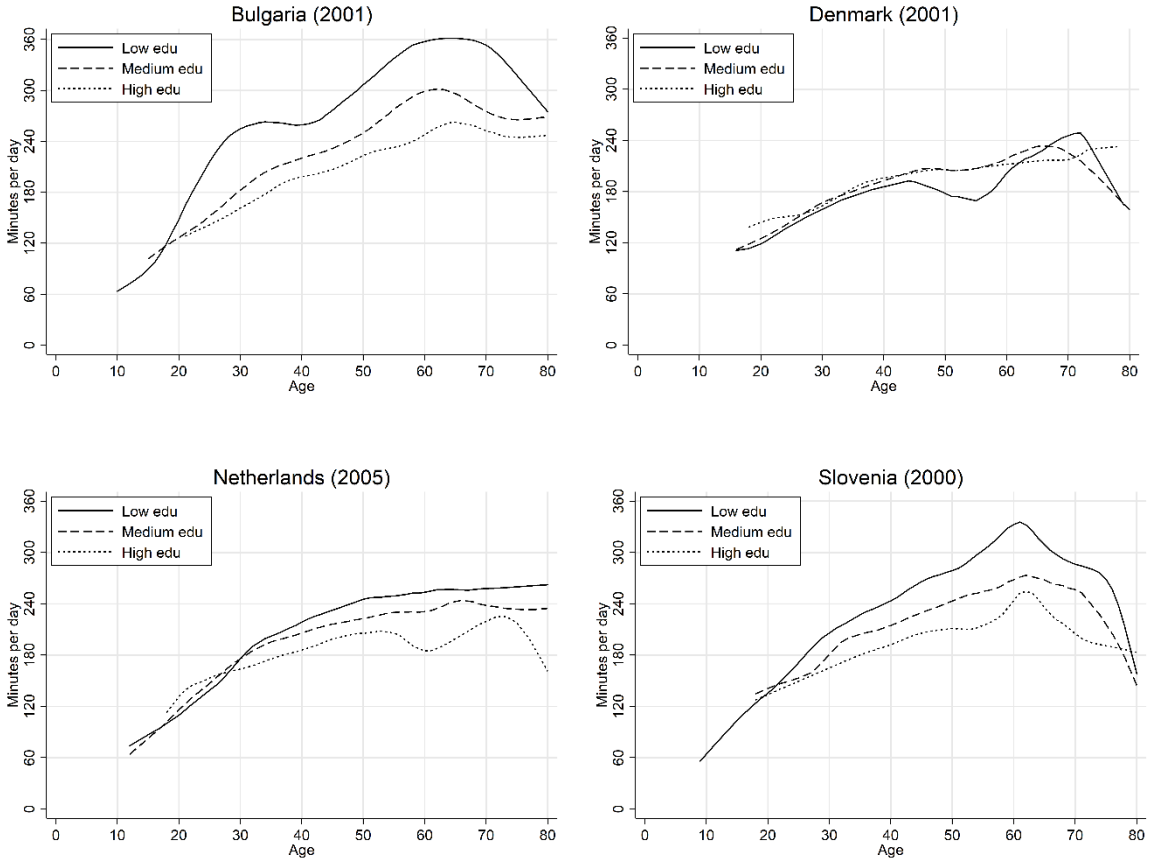
Country	Year	Educational level	Paid work	Education	Unpaid work	Personal care	Leisure
Austria	2008	Low	101.65	16.71	252.21	693.04	376.40
		Medium	209.04	18.8	209.89	631.87	370.40
		High	254.16	15.4	209.85	618.01	342.57
Bulgaria	2001	Low	70.89	0	312.07	752.61	304.44
		Medium	204.12	0	238.27	681.86	315.75
		High	211.42	0	228.59	675.97	324.02
Denmark	2001	Low	84.92	48.55	213.46	685.98	407.10
		Medium	210.95	17.21	219.31	630.88	361.64
		High	225.35	39.54	217.3	611.85	345.95
Spain	2009	Low	90.54	5.52	239.81	704.71	399.42
		Medium	171.61	15.15	237.4	663.02	352.83
		High	209.14	29.75	218.03	644.91	338.18
France	2009	Low	75.08	3.4	251.67	710.28	399.57
		Medium	177.49	11.8	236.42	675.27	339.02
		High	223.31	11.02	225.8	657.2	322.67
Hungary	2009	Low	167.3	22.26	217.07	689.23	344.14
		Medium	193.16	24.71	214.57	676.93	330.63
		High	195.68	12.85	230.89	667.8	332.78
Italy	2008	Low	124.71	7.07	257.2	695.08	355.93
		Medium	211.7	29.15	217.12	648.59	333.43
		High	239.17	22.06	209.47	639.68	329.63
Netherlands	2005	Low	124.92	9.23	248.04	666.99	390.81
		Medium	172.32	29.82	227.02	649.23	361.61
		High	217.94	27.38	214.49	628.6	351.59
Slovenia	2000	Low	158.6	13.02	264.39	647.08	356.90
		Medium	194.41	31.72	223.39	608.51	381.96
		High	232.48	11.13	232.6	581.63	382.16

Source: Gershuny, Vega-Raoun, & Lamote (2020), own calculations

The medium-educated spend the least time on production of unpaid work in Austria (3 hours and 30 minutes) and the most in Bulgaria (3 hours and 58 minutes). The highly educated in Austria also spend the least time (3 hours and 30 minutes) and the highly educated in Slovenia spend the most time (3 hours and 52 minutes) on production of unpaid work. Thus, the medium-educated and the highly educated spend similar amounts of time on unpaid work in most parts of Europe, while the time spent by the low-educated varies from country to country.

The Croatian NTA presented in Figure 3 and the NTA by education for 15 other EU countries presented in Figures 18–21 show that the low-educated earn the lowest income throughout the life cycle and thus contribute the least to economic value creation in the market. However, Table 19 shows that their contribution outside the market is much higher and therefore not captured in official statistics. The economic value of paid work over the life cycle is included in the NTA age profile of labour income, but this is not the case for unpaid work. To fully capture the economic flows between age groups, the age profiles of household production of unpaid work need to be considered.

Figure 12: Total production of housework other than childcare by age and education (countries of MTUS 2000–2005)



Source: Gershuny, Vega-Raoun, & Lamote (2020), own calculations

In order to analyse the household production of unpaid work over the life cycle as age- and education-specific profiles in the standard NTTA way, following Hammer (2015) and Sambt et al. (2016), I divided unpaid work in the household into two main categories: (1) production of housework other than childcare and (2) childcare. Childcare is analysed as a separate category for several reasons. First, childcare in my analysis covers a wide range of different activities, from medical and physical care to playing with and teaching a child. A person hired in the market to provide childcare on this scale would need to be better educated and earn more than a person hired to do most other housework. Second, most people have their children between the ages of 20 and 40, so childcare activities are heavily concentrated at this time in the life cycle. Therefore, in order to eliminate the strong influence of childcare on the total amount of unpaid work during this period, the time spent on housework (other than childcare) is analysed separately.

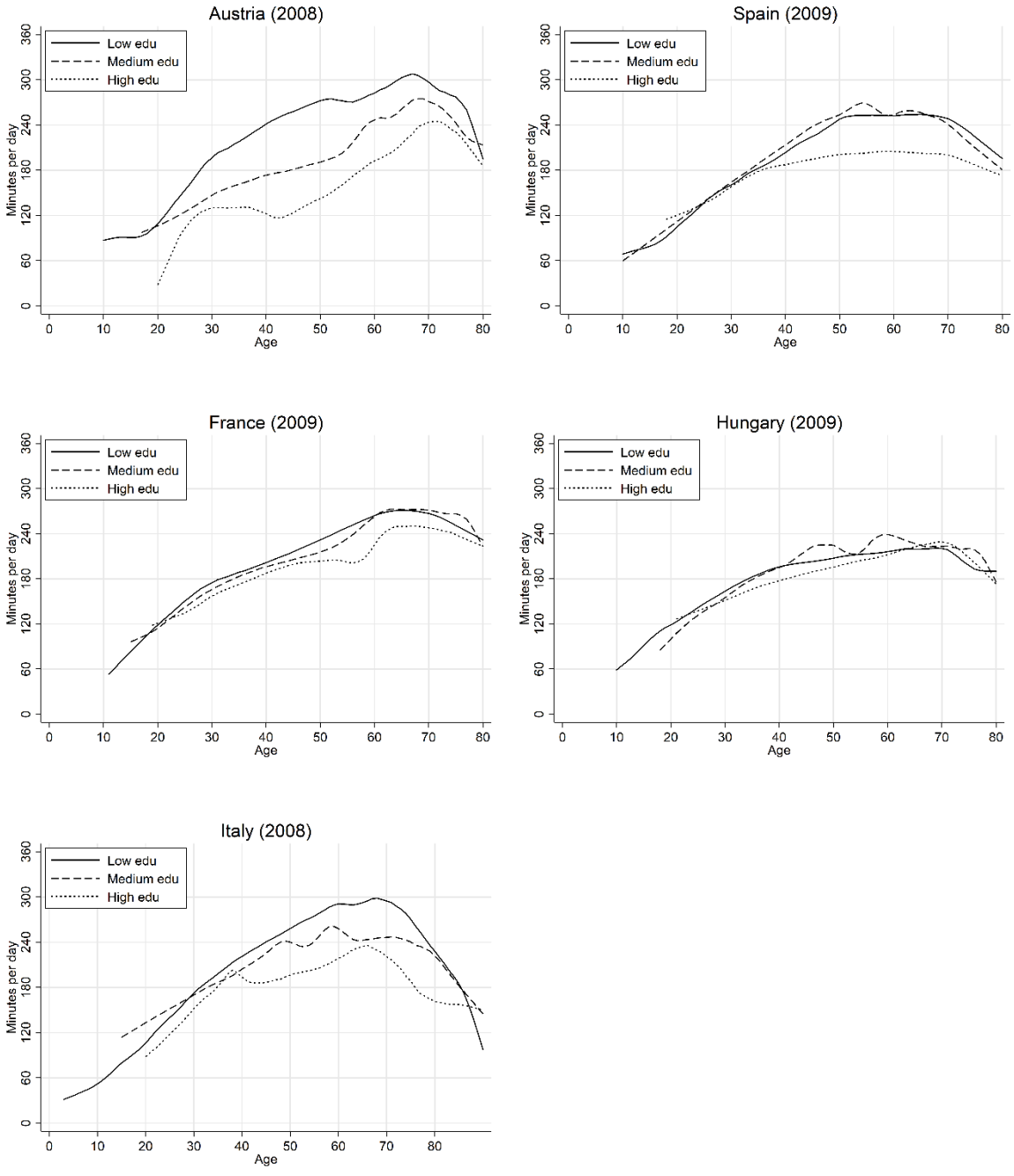
Figures 12 and 13 show education-specific age profiles ofproduction of all housework other than childcare, which includes the following activities: cooking and washing up, cleaning, maintaining home or vehicle, gardening, pet care, shopping, commuting, elderly care and volunteering (Table 10). All individuals who participated in the survey and their completed educational level are considered (Tables 8 and 9). The age profiles are presented in two separate groups of countries. For comparability reasons, the first group, shown in Figure 12, consists of countries whose last time use survey was conducted in the period 2000–2005, and the second group, shown in Figure 13, consists of countries whose last time use survey was conducted in the period 2008–2009.

The age profiles presented in Figures 12 and 13 show some similarities, but also some differences in the time spent on the total production of housework other than childcare, between countries and educational levels. Regardless of country and educational level, time spent on production of housework other than childcare increases with age and generally peaks around retirement age. When individuals stop working in the market and retire, they have more time for unpaid housework, which is reflected in the age profiles.

There are, however, differences between educational levels in terms of the amount of time spent on production of housework other than childcare. In all countries, highly educated individuals spend less time on unpaid work other than childcare than low- and medium-educated individuals during most of the life cycle and especially in working-age. There are two main reasons for this. First, households can divide paid and unpaid work among household members through specialisation by education in such a way that the household as a whole is better off than if the work was equally divided (Hammer, 2015). According to the SES 2006 and SES 2010, the earnings of individuals with high levels of education are significantly higher than that of medium-educated and especially low-educated individuals in all countries studied (Eurostat, 2022b). Therefore, household members who earn higher incomes from their paid work have higher opportunity costs for paid work and vice versa for those low-educated. This may encourage the highly educated to specialise in paid work and thus earn a higher income for the household. Secondly, it is also more profitable for the

highly educated to spend more hours on their paid work and hire help on the market for services that are normally performed in the household (e.g. cleaning, gardening, car repair).

Figure 13: Total production of housework other than childcare by age and education (countries of MTUS 2008–2009)



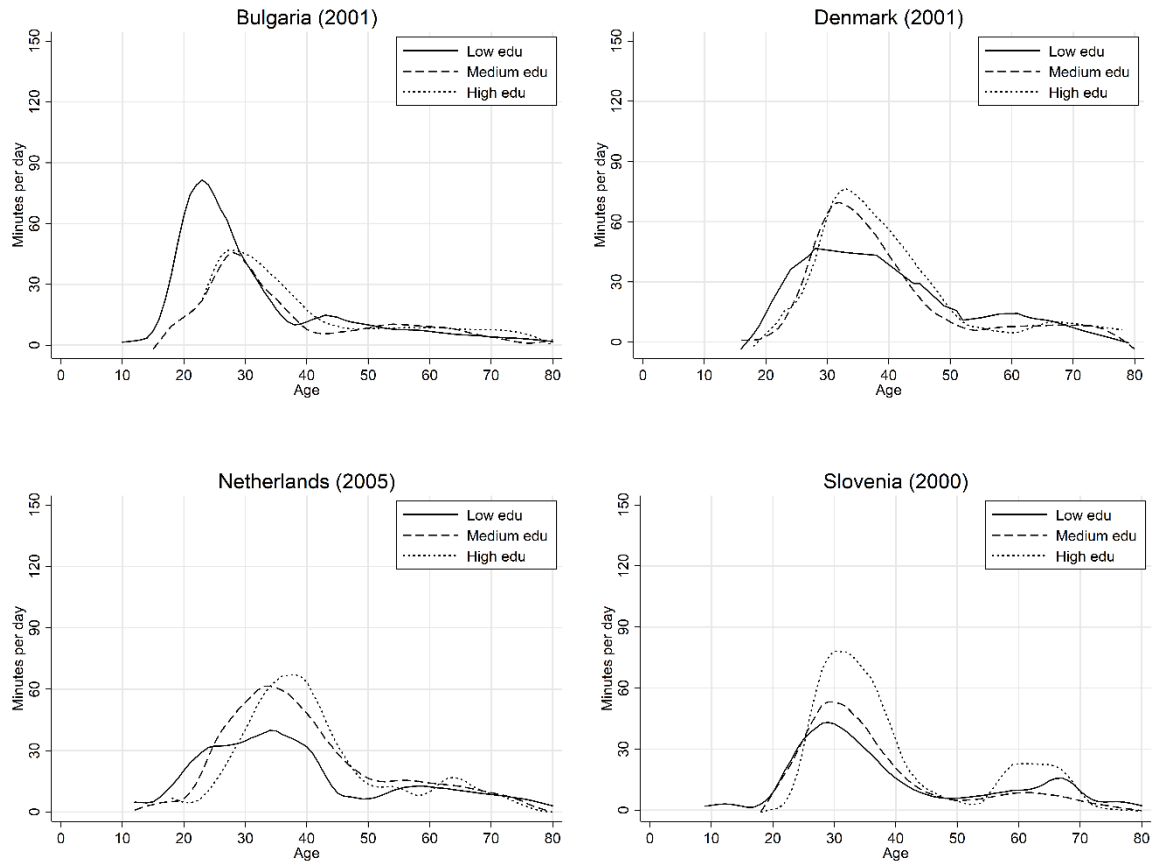
Source: Gershuny, Vega-Raoun, & Lamote (2020),own calculations

The age profiles of the production of housework other than childcare also show that the time spent on it during most of the life cycle varies strongly by educational level in Bulgaria, Austria, Slovenia and Italy. In contrast, in France, Hungary, Spain and the Netherlands, time

spent on housework is similar for individuals with low and medium levels of education, while it is lower for individuals with high levels of education over most of the life cycle. This is also reflected in their earnings. According to the SES 2006 and 2010, the earnings gap between low- and medium-educated individuals in these countries is much smaller than the earnings gap between medium-educated and highly educated individuals (Eurostat, 2022b).

As mentioned earlier, the highly educated may specialise in paid work because of their higher earnings, which means that they do more paid work but less unpaid work in a day. Accordingly, the smaller gap between the earnings of low- and medium-educated individuals could explain the similarities in the age profiles of production of housework other than childcare between the two. In Denmark, on the other hand, the production of housework other than childcare is very similar for the medium-educated and the highly educated over most of the life cycle. In Denmark, only around the retirement age (ages 56–70) do the highly educated spend less time on this task than the medium-educated.

Figure 14: Childcare production by age and education (countries of MTUS 2000–2005)



Source: Gershuny, Vega-Raoun, & Lamote (2020), own calculations

Although the age profiles of the production of housework other than childcare show that among educational levels, the highly educated generally spend the least time on it over the

life cycle, this is different for childcare. Figures 14 and 15 show the age profiles of childcare by educational level. As mentioned earlier, for comparability reasons, countries are divided into two groups according to the year in which the survey was conducted. The first group consists of countries whose last time use survey was conducted in 2000–2005 and is shown in Figure 14; the second group consists of countries whose last time use survey was conducted in 2008–2009 and is shown in Figure 15. The age profiles are presented according to the level of education completed (Centre for Time Use Research, 2020).

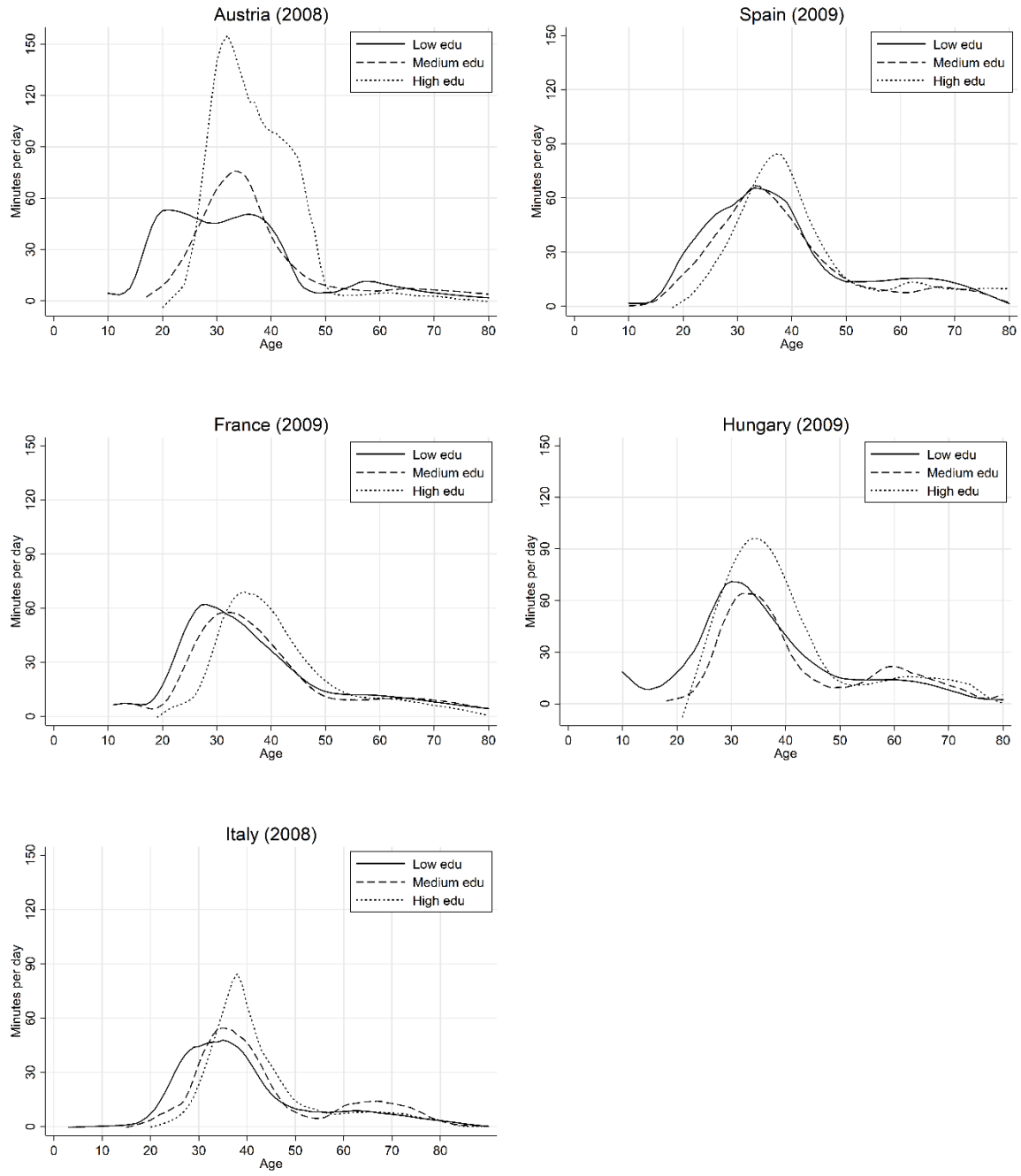
The age profiles of childcare by education presented in Figures 14 and 15 show that time spent on childcare is mainly concentrated between the ages of 20 and 40, which is observed in all countries. Moreover, in all countries, the first profile to increase is that of the low-educated. This is because the low-educated women have children at the earliest age. The average age at first birth in Europe is 27.0 years for low-educated women, 29.5 years for medium-educated women and 31.0 years for highly educated women (D'Albis et al., 2017). The age profile of highly educated individuals is shifted to the right, which means that highly educated have children at the latest age. This is also supported by the fact that parents of young children are the ones who spend the most time on childcare (Hammer, 2015), which explains high levels of childcare in the late thirties and early forties in most countries.

Although in most countries the age profiles of childcare start to increase earliest among the low-educated and latest among the highly educated, there are some exceptions. In Bulgaria and Denmark, the age profiles of childcare of medium-educated and highly educated individuals overlap at the beginning. In Hungary, the age profile of childcare of the highly educated starts to increase before the age profile of the medium-educated. However, the estimates for Hungary between ages 23 and 27 years are based on a total of only 5 observations, which is too few for strong conclusions.

In all observed countries, the peak values show at what age the average time spent on childcare is highest for each education level. For high education, the peak is reached between 30 and 40 years, except in Bulgaria, where the peak is already reached in the late twenties. Compared to the other countries, Austria has an unusually high peak in childcare among the highly educated. Comparing data from the MTUS with data from the Austrian Microcensus 2009, Hammer (2015) found that the share of the highly educated aged 30–45 with children under 2 years seems to be overrepresented in the MTUS, which would imply that more highly educated individuals have young children than in reality. In most countries, however, the age profiles of childcare of the highly educated are narrower at their peak than the age profiles of low- and medium-educated individuals. This implies that the highly educated have young children in a narrower age range. This is supported by D'Albis et al. (2017), who show that highly educated women in Europe are the latest to have children, but are also more likely to become mothers at the end of childbearing age, which they set at the age of 45. This means that although they start having children later, they "catch up" and overtake low- and medium-educated women by the age of 45. Conversely, the age profiles of

childcare of the low-educated are flatter, which implies that they have young children at a wider age range, which in turn is confirmed by the earlier average age at first birth.

Figure 15: Childcare production by age and education (countries of MTUS 2008–2009)



Source: Gershuny, Vega-Raoun, & Lamote (2020), own calculations

In addition to the peak in younger age groups, there is another, much smaller increase in childcare in older age groups in most countries. This is the age of caring for grandchildren. The largest increase in time spent caring for grandchildren is in Slovenia. There, individuals

of all education levels spend time on childcare around retirement age, but the time of the highly educated is most pronounced (Sambt et al., 2016).

Table 20: Average time in minutes spent on daily activities, age 18+

Country	Year	Educ. level	Childcare	Cook, wash up	Clean	Maintain	Garden
Austria	2008	Low	16.32	66.53	81.46	7.52	20.82
		Medium	25.35	45.82	58.17	10.12	14.09
		High	57.06	38.88	47.04	8.99	11.00
Bulgaria	2001	Low	14.42	91.58	62.53	64.43	48.26
		Medium	15.55	71.6	46.91	28.07	26.62
		High	19.15	74.41	48.09	17.18	14.22
Denmark	2001	Low	12.97	40.39	41.54	21.55	13.75
		Medium	22.38	49.45	44.79	17.56	11.64
		High	37.31	42.9	42.12	11.17	5.75
Spain	2009	Low	20.02	72.12	71.83	7.73	11.88
		Medium	30.54	60.47	65.7	6.44	6.48
		High	39.56	49.07	48.51	4.36	3.57
France	2009	Low	14.72	69.72	70.11	18.6	22.03
		Medium	23.79	50.26	58.82	17.7	16.33
		High	33.37	43.91	54.13	10.52	9.48
Hungary	2009	Low	26.39	76.36	38.62	25.86	1.45
		Medium	24.49	73.17	38.92	16.16	1.06
		High	47.26	70.21	40.74	14.16	1.71
Italy	2008	Low	14.85	77.54	81.2	3.77	16.28
		Medium	24.46	52.75	58.54	2.49	6.01
		High	30.55	46.79	50.44	1.91	4.00
Netherlands	2005	Low	17.09	69.92	41.68	21.55	12.74
		Medium	26.39	52.43	40.03	15.18	7.17
		High	31.28	40.89	31.45	14.37	5.63
Slovenia	2000	Low	14.00	77.02	54.43	36.88	39.55
		Medium	20.53	57.59	48.65	20.03	27.19
		High	36.13	53.14	50.88	14.07	24.19

Source: Gershuny, Vega-Raoun, & Lamote (2020), own calculations

Although the peaks among the highly educated suggest that time spent on childcare is concentrated between the ages of 20 and 40, it is difficult to identify which individuals with which level of education spend the most time on childcare based on the age profiles alone. Therefore, the average daily time in minutes spent on childcare is presented in Table 20 and compared to the time spent on four other main housework activities: cooking and washing up, cleaning, maintaining care and/or vehicle and gardening. Table 20 includes all individuals of adult age (ages 18–80).

Table 20 can be used to identify whether individuals with the same level of education give priority to the same unpaid activities, regardless of the country in which they live. The analysis of time spent on other housework activities shows significant differences between educational levels. In almost all countries, the low-educated spend the most time on all housework activities other than childcare. In most countries, for example, the low-educated spend on average 70 minutes or more per day on cooking and washing dishes.

The only exception is Denmark, where the low-educated spend only about 40 minutes per day cooking and washing dishes, while medium-educated and highly educated spend more time per day doing so. The highly educated spend on average 40 to 50 minutes per day on cooking and washing dishes in most countries. The exception is Bulgaria, where the highly educated spend on average about 70 minutes per day on this. In Bulgaria, the low-educated spend even more time on this activity, about 90 minutes per day.

Although the time spent on each of the other activities (cleaning, maintaining and gardening) is highest among the low-educated and the lowest among the highly educated in most countries over the life cycle, some of the activities seem to be more country-specific than others. In Italy and Spain, for example, people spend little time maintaining their homes or vehicles. The time spent on this ranges from about 2 minutes in Italy and 4 minutes in Spain for people with high levels of education to about 4 minutes in Italy and about 8 minutes in Spain for people with low levels of education. On the other hand, in Bulgaria, a relatively large amount of time is spent on this activity: from about 17 minutes for the highly educated to 65 minutes for the low-educated. In Hungary, individuals of all educational levels spend less than two minutes per day on gardening, while individuals in Slovenia spend between 24 minutes (highly educated) and almost 40 minutes (low-educated) on it.

As shown in Table 20, highly educated individuals spend the most time on childcare in all the countries studied. In most countries, the highly educated spend on average more than 30 minutes per day to childcare over the life cycle. The only exception is Bulgaria, where the average time spent on childcare among the highly educated is only about 19 minutes per day, and all three educational levels spend similar amounts of time on childcare. The fact that the highly educated spend more time on childcare could either be due to the fact that they have more children or that they devote more time to each child. In order to analyse the time spent on childcare, Table 20 needs to be complemented by Table 21, which shows the share of

women with one child, two and three or more children, broken down by women's educational level.

Table 21: Share of women with children, by educational level and number of children in EU27 in 2021

Edu. level by ISCED 2011	**1 child**	**2 children**	**3 children or more**
ISCED 0-2	51.30	32.32	16.38
ISCED 3-4	54.65	34.96	10.39
ISCED 5-8	47.31	41.88	10.81

Source: Eurostat (2022c)

In most countries listed in Table 20, the highly educated spend twice or almost twice as much time per day on childcare as the low-educated. Table 21 shows that while highly educated women who have children are slightly less likely to have only one child than medium- and low-educated women, they are most likely to have two children, not more. Furthermore, while low-educated women are more likely to have one child, they are also more likely to have three or more children. Therefore, the number of children that by women of a certain educational levels have does not determine the amount of time that individuals of that educational level spend on childcare. This indicates that better educated devote more time to their children then the less educated.

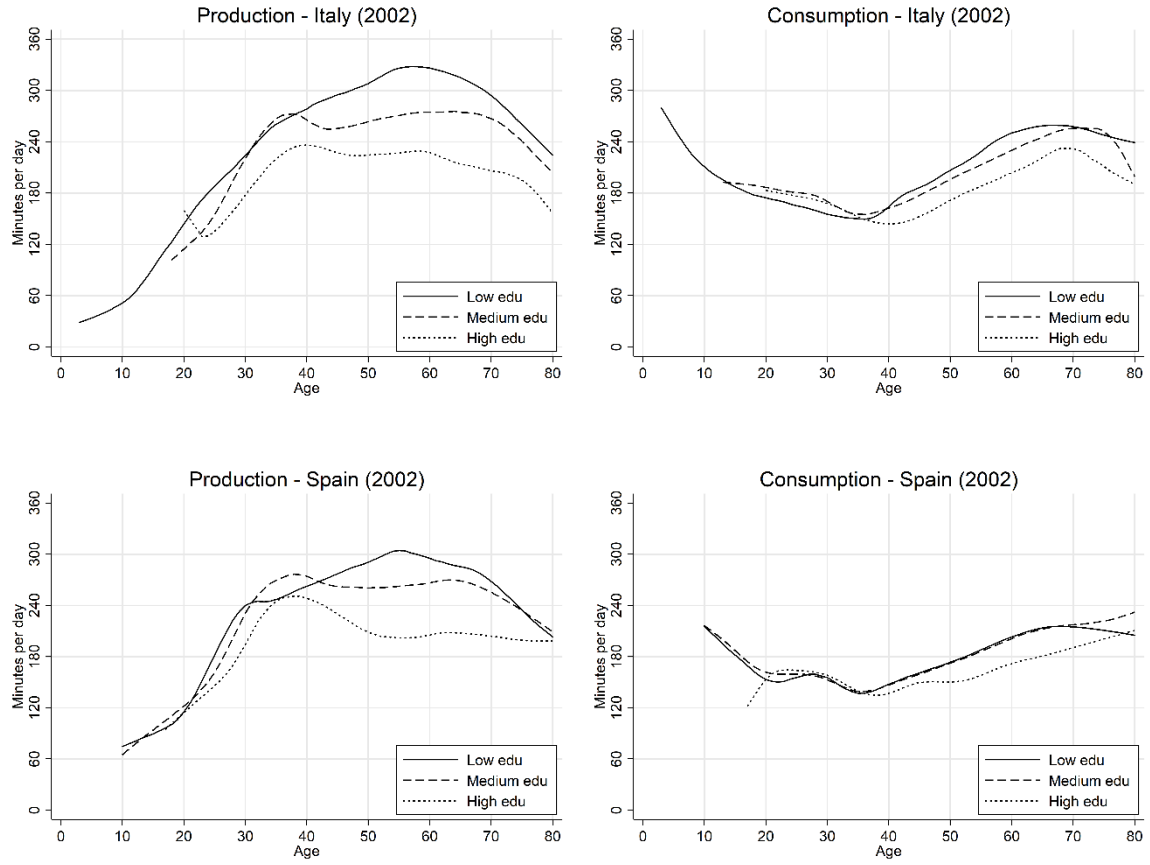
In summary, the analysis of the production of unpaid work shows that over the life cycle, highly educated individuals spend the least amount of time on housework, which consists of cleaning, cooking, gardening and similar activities, while low-educated individuals spend the most time on these activities. Although they spend more time on their paid work over the life cycle, highly educated still devote the most time to childcare among the three educational levels.

4.3.2 Consumption of unpaid work

As mentioned earlier, according to the NTTA, consumption of unpaid work depends on the household production of unpaid work and can best be calculated if data on the time spent on household production of unpaid work are available for all household members (Donehower, 2014). To obtain the age profiles of consumption, all production of unpaid work except childcare within the household is divided among all household members. Data on household production for all household members were only available in the MTUS data (Gershuny et al., 2020) for Italy (2002) and Spain (2002), so the full construction of age profiles of consumption was only possible based on these data. As more recent MTUS data (Gershuny et al., 2020) were used for the analysis of household production of unpaid work in subsection 4.2.1 (2008 for Italy and 2009 for Spain), the obtained age profiles of consumption of unpaid

work are complemented in Figure 16 by the age profiles of production of unpaid work for 2002.

Figure 16: Comparison of total household production and consumption by age and education



Source: Gershuny, Vega-Raoun, & Lamote (2020), Vargha, Šeme, Gal, Hammer, & Sambt (2017), own calculations

Figure 16 compares education-specific age profiles of total household production with education-specific age profiles of consumption of unpaid work. The age profiles of consumption of individuals at all three levels of education have a similar shape. Moreover, the differences between individuals with different educational levels in terms of time consumed are much smaller than the differences in terms of time produced. This is partly because I do not observe consumption by age and educational level directly, but estimate it based on the production of unpaid work. Based on NTTA, I assume that consumption of total housework other than childcare is consumed equally by all household members (Donehower, 2014). However, this type of estimation does not produce results that are substantially different from the NTA results. The age profiles obtained by NTA for Croatia in Figure 3 and the age profiles obtained for 15 other EU countries in Figures 18–21 also show that educational level affects consumption much less than production (in the form of labour income) in the market.

In both countries, the levels of consumption of unpaid work are lowest in the mid-thirties among the low- and medium-educated. The lowest levels of consumption of unpaid work among the highly educated are reached a few years later: around age 40 in Italy and age 38 in Spain. The age at which the consumption of unpaid work is lowest for all educational levels coincides in both countries with the age at which production of childcare is highest (Figure 15). Therefore, most of the unpaid work produced at these ages is consumed only by children. After age 40, when individuals again spend more time on production of housework other than childcare, their consumption also starts to increase. However, for the rest of the life cycle, the consumption of unpaid work remains lower for the highly educated for the low- and medium-educated.

4.4 The effect of education on the economic life cycle and on the economic sustainability[2]

The aim of subsection 4.4 is to show the effect of education on economic sustainability by projecting age profiles of conventional NTA and NTA by education into the future, taking into account the increasing share of elderly, but also the increasing share of the highly educated. Table 22 gives a brief overview of subsection 4.4. The study of the effects of education on the economic life cycle is extended in this subsection from Croatia to 15 other EU countries. The key NTA variables of interest are again labour income and consumption.

[2] The content of this subsection was published in co-authorship with my supervisors in: Kelin, E., Istenič, T. & Sambt, J. (2023). Education as a partial remedy for the economic pressure of population ageing. *International Journal of Manpower*, 44(9), 37-54. https://doi.org/10.1108/IJM-03-2022-0126

Table 22: Overview of subsection 4.4

Countries studied	Western EU (Ireland, Belgium and Luxembourg), Southern EU (Portugal, Spain, Italy and Greece), Baltic EU (Estonia, Latvia and Lithuania) and Central and Eastern EU (Poland, Czech Republic, Slovakia, Hungary and Romania)	
Definitions	NTA age profiles studied	Age-specific averages of labour income and consumption Their structure is shown in detail in Table 23.
	Economic life cycle	Economic behaviour (labour income and consumption) over an individual's life cycle
	Life cycle deficit	Positive value of consumption (C) less labour income (YL); opposite is life cycle surplus
	Total labour income	NTA age profiles (i.e. per capita averages) of labour income multiplied by the age-specific projections of population size obtained from WIC
	Total consumption	NTA age profiles (i.e. per capita averages) of consumption multiplied by the age-specific projections of population size obtained from WIC
Data sources	For NTA age profiles	EU-SILC (2011), HBS (2020), AWG, Eurostat, WIC (2018)
	For total labour income and consumption projections	NTA age profiles, age- and education-specific projections of population size from WIC (2018)
Educational level – completed (by ISCED 1997)	Low	ISCED 0-2
	Medium	ISCED 3-4
	High	ISCED 5-6
Methodology	NTA methodology	An accounting framework for comprehensive tracking of economic flows across age groups. Economic flows are shown as age profiles (i.e. age specific averages).
	NTA by education	An accounting framework for comprehensive tracking economic flows across age groups, further disaggregated by educational level. Economic flows are shown as age profiles by educational level (i.e., age- and education-specific averages)..
	NTA support ratio	Ratio between total labour income and total consumption.
Outcomes	The outcomes of this subsection confirm that all five effects of educational level found in subsection 4.1 for the highly educated in Croatia also hold for 15 other EU countries. Education expansion (the increased share of the highly educated) is shown to have a positive effect on economic sustainability by 2060 by creating higher total labour income to support total consumption. The results hold even when the declining wage premium for the highly educated is taken into account.	

Source: Istenič et al. (2016), UN (2013), own calculations

Like Table 14 for Croatia, Table 23 shows how the NTA profiles of labour income and consumption are constructed for all 15 EU countries studied in this subsection. Table 23 also

shows the methods and data sources used to estimate each subcategory needed to construct the age profiles of labour income and consumption.

Table 23: Structure of the NTA variables needed to construct the life cycle account of Croatian NTA

Variable Name				Variable description	Methods used	Data source
YL				**Labour income**	Weighted average of the YLE and YLS	
	YLE			Labour income, earnings		EU-SILC
	YLS			Labour income, self-employment		EU-SILC
C				**Consumption**		
	CF			Private consumption		
		CFE		Private consumption, education	Allocation by edu. level (aiming)	HBS
		CFH		Private consumption, health		HBS
		CFX		Private consumption, other than education and health		HBS
	CG			Public consumption		
		CGE		Public consumption, education	Allocation by edu. level (aiming)	Eurostat, UNESCO
		CGH		Public consumption, health	Allocation by regression	AGENTA, AWG
		CGX		Public consumption, other than education and health	Allocation by equivalence scale	
			TGSOAII	Public transfers, social protection - pensions, in-kind		EU-SILC
			TGSUII	Public transfers, social protection - unemployment, in-kind		EU-SILC
			TGSFII	Public transfers, social protection - family and children, in-kind		EU-SILC
			TGSHII	Public transfers, social protection - housing, in-kind		EU-SILC
			TGSDII	Public transfers, social protection - sickness and disability, in-kind		EU-SILC
			TGSXII	Public transfers, social protection - miscellaneous, in-kind	Assumed uniform distribution	
			TGXII	Public transfers, other consumption, in-kind	Assumed uniform distribution	

Source: Abio et al. (2021), Istenič et al. (2016), UN (2013), own calculations

The constructed age profiles of NTA by education for Croatia in subsection 4.1.1 show that education substantially affects the level of labour income, while its impact on consumption remains much lower throughout the life cycle. As a result, the highly educated have a high life cycle surplus. Apart from earning more throughout the life cycle than low- and the medium-educated individuals, the highly educated in Croatia have high labour income even at pre-retirement age. Higher disposable income also allows the highly educated adults to give higher intra-household transfers to their children who are still in school, suggesting that they also invest more in their children. These two positive effects, high labour income even in late working-age and higher investment in children, are important at a time when the population is getting older on average and fewer children are being born.

To examine whether the positive effects of education on the economic life cycle are generally present, this part extends the NTA by education to 15 EU countries. By calculating total labour income and total consumption in each of the 15 countries, it also analyses the impact of the gap between them on economic sustainability, especially in the future.

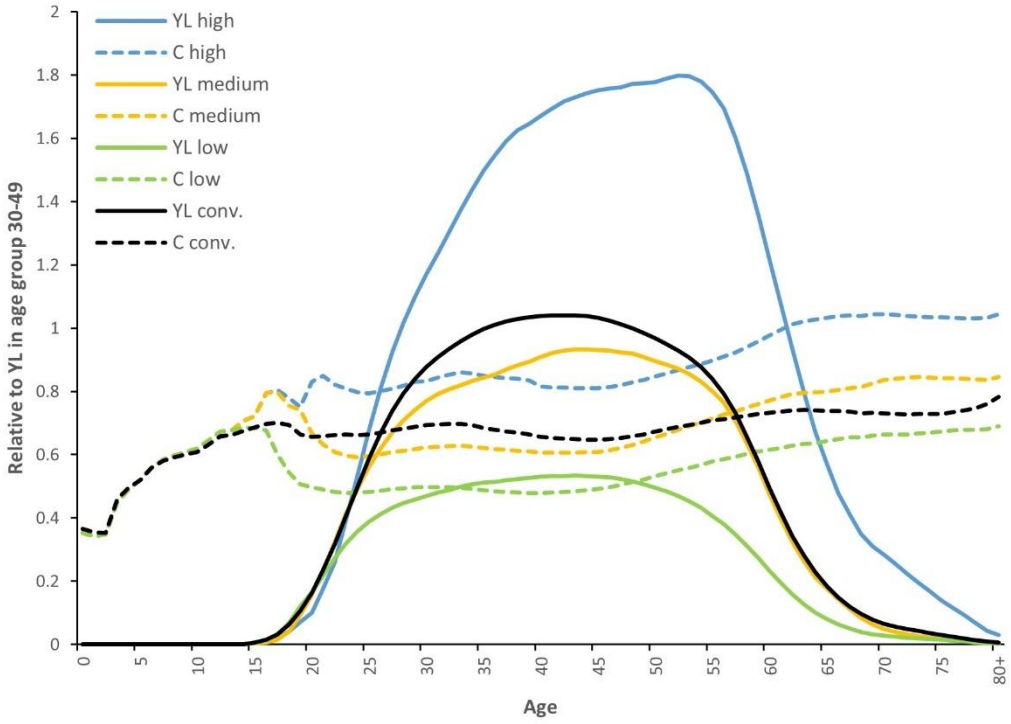
4.4.1 Conventional NTA and NTA by education profiles

In order to observe the impact of education on the economic life cycle, as in the Croatian case, the age profiles of conventional NTA are compared with the age profiles of NTA by education for all 15 EU countries for which this was possible. Due to their socio-economic differences and to ensure their comparability, the countries are divided into four groups: Western EU (Ireland, Belgium and Luxembourg), Southern EU (Portugal, Spain, Italy and Greece), Baltic EU (Estonia, Latvia and Lithuania) and Central and Eastern EU (Poland, Czech Republic, Slovakia, Hungary and Romania).

Since the effect of education is observed by comparing the age profiles of conventional NTA with the age profiles of NTA by education, all age profiles for each country are normalised to the average value of the country's conventional labour income in the 30–49 age group. This further ensures the comparability of the NTA results between all countries, but also with the results previously obtained for Croatia. To better understand the differences in the economic life cycle between three educational levels at the EU level, the age profiles of labour income and consumption are calculated as averages for 15 EU countries and presented in Figure 17.

The age profile of labour income of the conventional NTA is equal to 0 until the age of 15, which means that children of this age have no income of their own in the 15 EU countries analysed. From the age of 15, labour income increases. The increase in labour income is strongest between the ages of 20 and 26, after most individuals of all educational levels have entered employment. As work experience increases, labour income also continues to rise, forming a bell-shaped curve before declining again as people retire. Again, the sharpest decline occurs between the ages of 60 and 65, which are the retirement ages in most EU countries.

Figure 17: Age profiles of labour income (YL) and consumption (C) of conventional NTA and NTA by education, average for 15 EU countries in 2010



**Notes: conv = conventional NTA, low = ISCED 0–2, medium = ISCED 3–4, high = ISCED 5 or more*

Source: EU-SILC 2011, HBS 2010, Eurostat database, authors' calculations

In contrast, consumption of conventional NTA increases substantially from age 3 to 18. As these are the ages at which European children reach low and medium levels of education, this consumption consists mainly of consumption of education. Consumption then decreases slightly at working-age, especially between 35 and 55, and increases slightly again at retirement age. At older ages, total consumption increases mainly due to higher expenditure on health care.

The age profiles of NTA by education have a very similar shape to the conventional NTA profiles, but also reveal the effect of education on the economic life cycle. Over the life cycle, the labour income of the highly educated is much higher than the labour income of those with low and medium levels of education. Although it begins to rise at the latest point in time, it remains significantly higher at older ages. Moreover, the peak of the bell-shaped curve of labour income is much later than the peak of the low- and medium-educated. Both low- and medium-educated workers reach the peak of their income at age 43, while for the highly educated workers the peak of labour income is reached at age 52. After that, however, the decline in labour income is much steeper than for the low- and medium-educated- but remains at a much higher level at older ages.

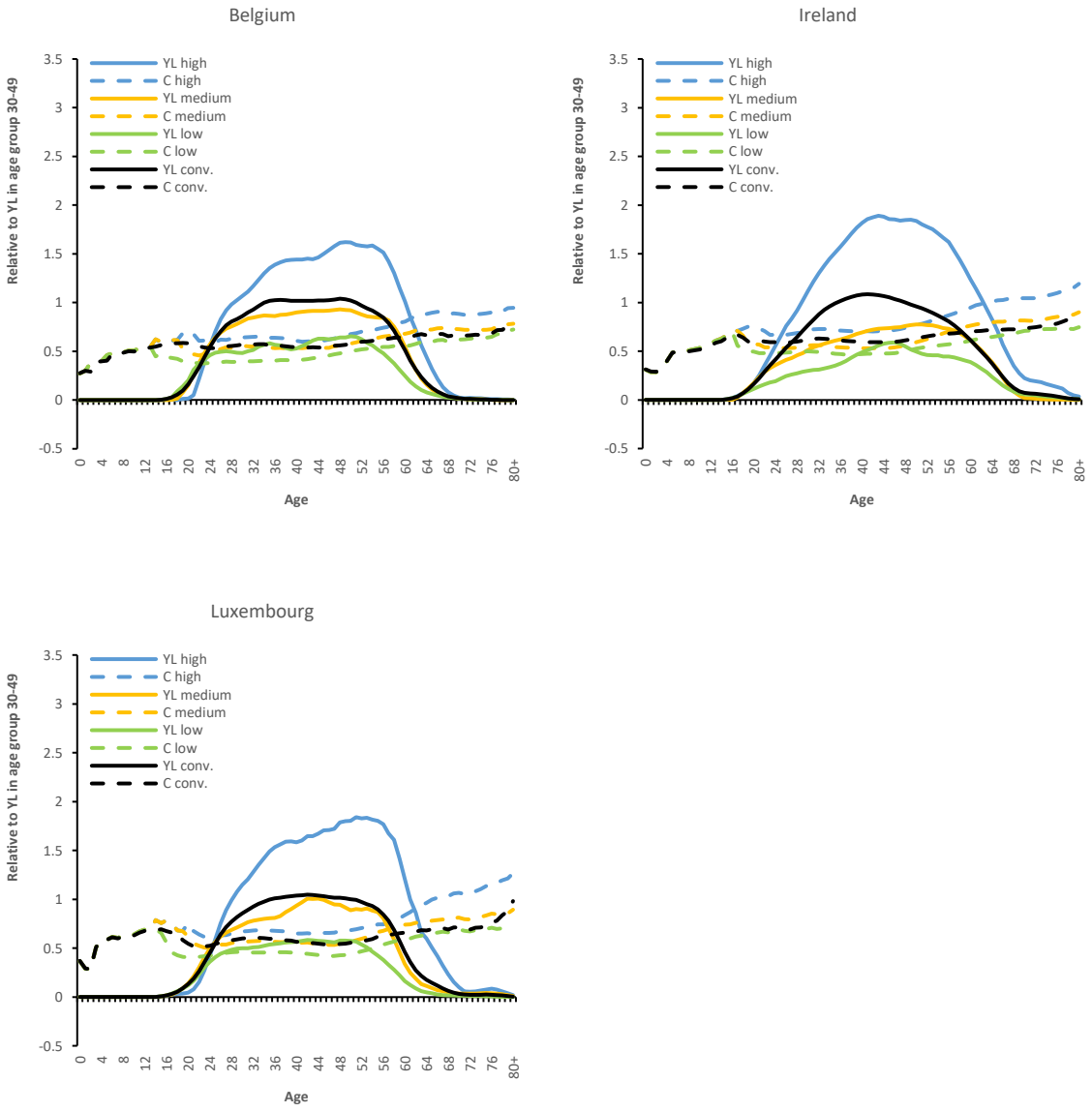
Although the age profiles of consumption of all three educational levels have the same shape for most of economic life cycle, but at different consumption levels, there are some differences around the age of entry into the labour market. Consumption levels drop considerably after age 16 for the low-educated and after age 19 for the medium-educated. For the highly educated, there is a decline after entering the labour market at age 21, but it is much smaller than for the other two educational groups. After being at a low level at working-age, consumption increases again at old age for all three educational levels. Consumption of the highly educated is highest throughout the life cycle.

For economic sustainability, however, it is important to observe the duration of the life cycle surplus, i.e. the age span in which the age profile of labour income exceeds the age profile of consumption. During this period, individuals are not only able to finance their own consumption, but the surplus they create can be given to the dependent population in the form of transfers and asset-based reallocations. As Figure 17 shows, although the low-educated are the first to enter the labour market and have the lowest consumption throughout the life cycle, they begin to generate surplus at age 33, and they only have it until age 48. Therefore, even at working-age, their consumption must be financed by asset-based reallocations or transfers from the other two educational groups. The medium-educated have a life cycle surplus of 15 years (ages 26–55) and the highly educated of 20 years (ages 26–61), which is longer than the low-educated. Although the highly educated have the highest consumption levels, they also have a much higher surplus than the medium- and especially the low-educated. Consequently, they can finance their own consumption the longest, but their surplus is also the main source of transfers to those who depend on them.

The age at which the age profile of labour income is again lower than the age profile of consumption is the age at which individuals begin to have a life cycle deficit. While the age at which this occurs depends on the educational level of the individual, it also depends on the retirement age. Even within the EU, the retirement age differs from country to country and therefore also affects the length of the life cycle surplus (Figures 18–21).

The conventional NTA age profiles of labour income and consumption presented in Figure 3 show that the common life cycle surplus of the 15 EU countries spans between the ages 27 and 57 (Figure 17). In Greece, however, the life cycle surplus is much shorter and smaller (Figure 19). It is recorded for only 23 years, namely for ages 32–54. The retirement age in Greece in 2010 was only 57 for both women and men (OECD, 2011), which can partly explain such a short age span where labour income exceeds consumption. Countries with a low retirement age in 2010 include Slovakia (57 years for women but 62 years for men), Italy (59 years for both men and women), Belgium and Luxembourg (60 years for both men and women). In contrast, Spain, Portugal and Ireland had the highest retirement age in 2010 (65 years for both women and men). Interestingly, despite the lower retirement age, Belgium is the country with the longest life cycle surplus (35 years) obtained as the difference between the age profiles of labour income and consumption of the conventional NTA.

Figure 18: Age profiles of labour income (YL) and consumption (C) of conventional NTA and NTA by education in 2010 (Western EU countries)

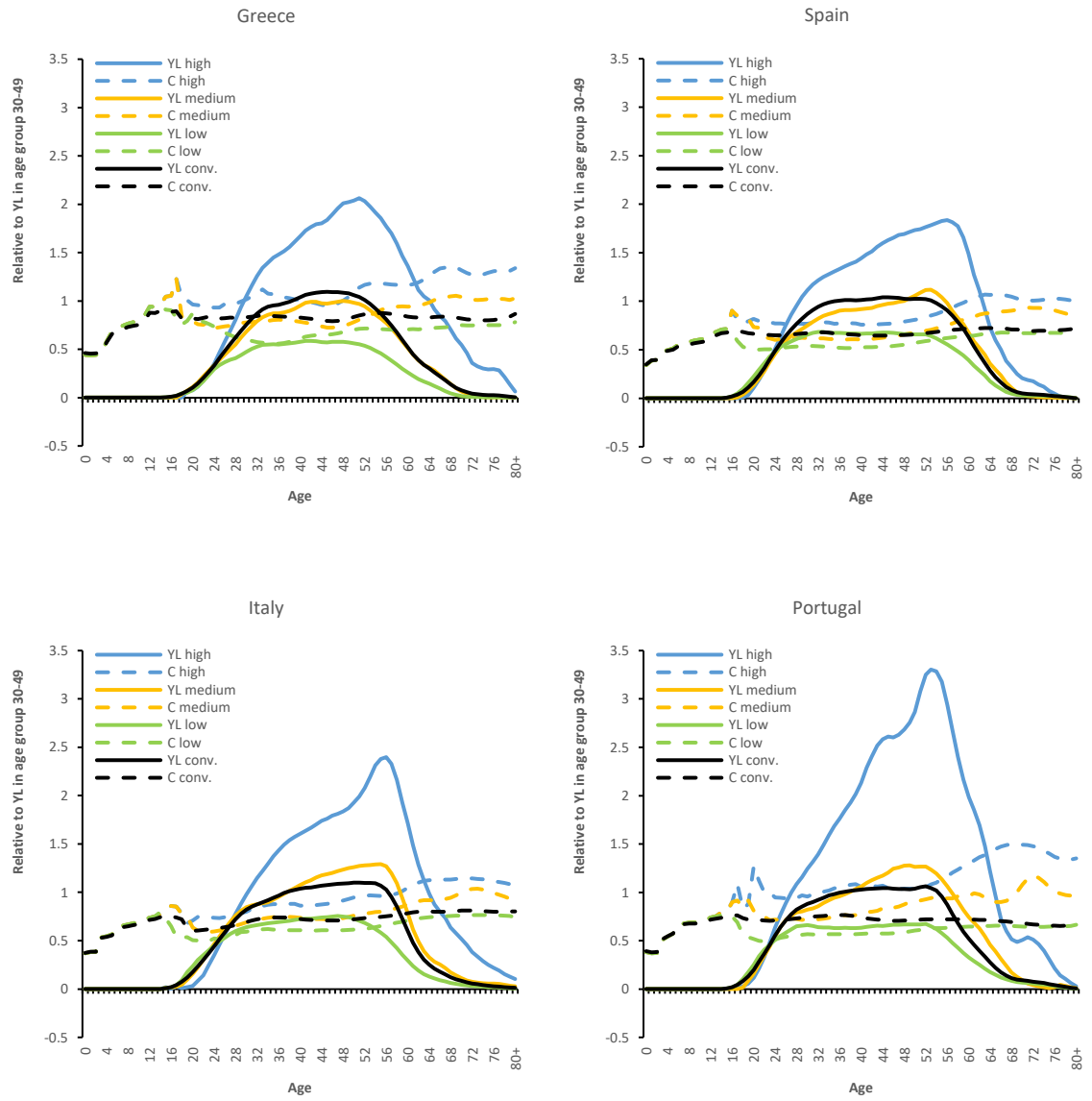


**Notes: conv = conventional NTA, low = ISCED 0-2, medium = ISCED 3-4, high = ISCED 5 or more*

Source: EU-SILC 2011, HBS 2010, Eurostat database, authors' calculations

The NTA by education age profiles of labour income and consumption averaged across 15 EU countries and presented in Figure 17, show that highly educated individuals have a much longer and higher life cycle surplus. As in the Croatian case, this is a consequence of much higher labour income earned by the highly educated even at older ages and a small difference in consumption levels over the life cycle compared to the low- and the medium-educated. Although life cycles by educational level vary from country to country, some countries show similar patterns.

Figure 19: Age profiles of labour income (YL) and consumption (C) of conventional NTA and NTA by education in 2010 (Southern EU countries)



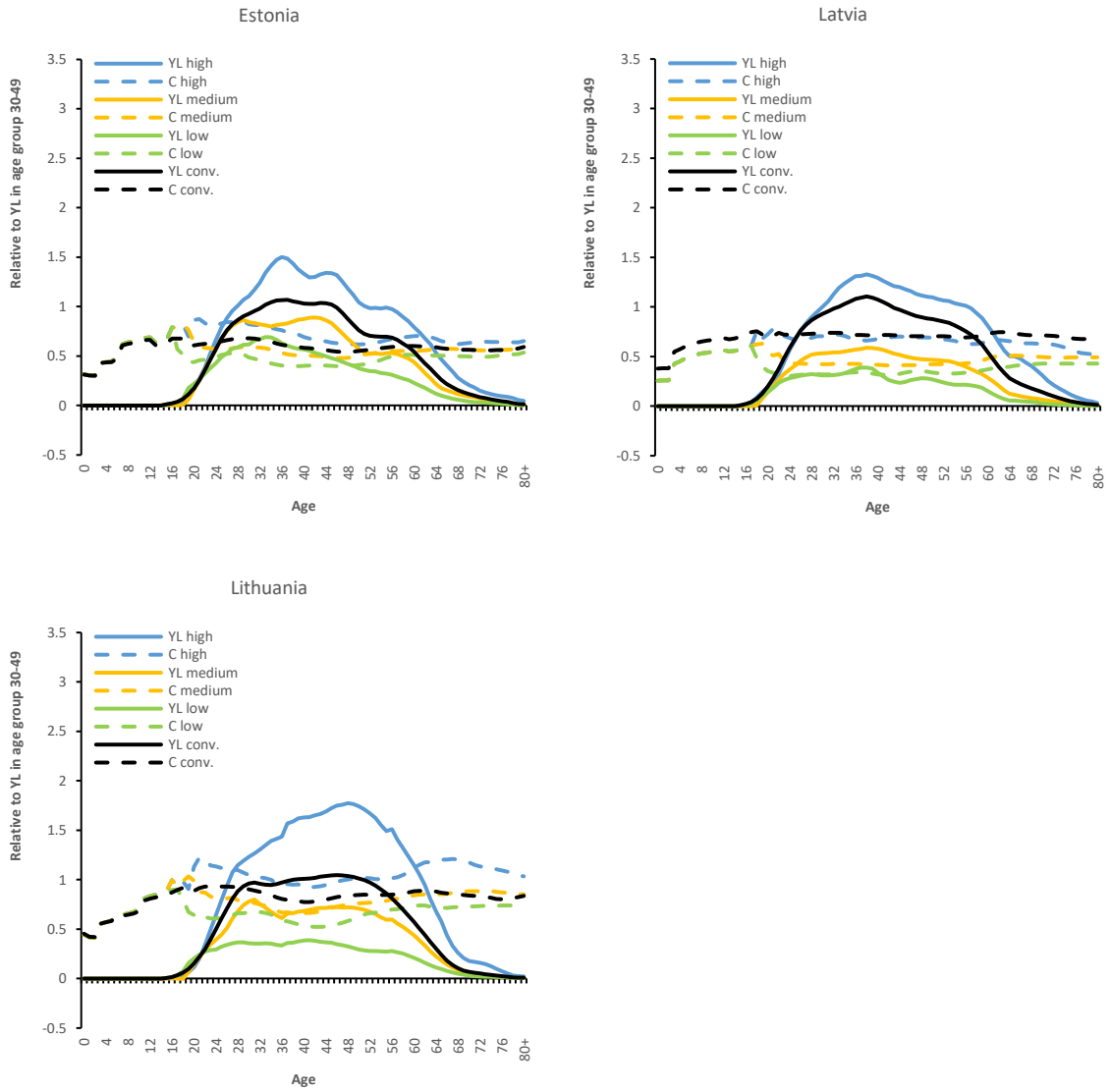
**Notes: conv = conventional NTA, low = ISCED 0-2, medium = ISCED 3-4, high = ISCED 5 or more*

Source: EU-SILC 2011, HBS 2010, Eurostat database, authors' calculations

Among the low-educated, the age profile of labour income is lower than the age profile of consumption at every age of the economic life cycle in four countries: Greece (Figure 19), Lithuania (Figure 20), Czech Republic and Slovakia (Figure 21). In other countries, it barely exceeds it and only for a short time: Ireland for 7 years (Figure 18), Latvia for 7 years (Figure 20), Hungary for 10 years (Figure 21) and Romania for 11 years (Figure 21). In these countries, the low-educated are almost entirely dependent on transfers from the highly educated. The case of Lithuania stands out, where the transfer givers are almost exclusively

the highly educated (Figure 20). There, the life cycle surplus of the highly educated individuals extends over 33 years (from age 28 to 60), while it exists for only 10 years (at ages 30–32 and 39–45) for the medium-educated. Moreover, in Lithuania, labour income does not exceed consumption of the low-educated at any age, which means that they have a life cycle deficit even at working-age.

Figure 20: Age profiles of labour income (YL) and consumption (C) of conventional NTA and NTA by education in 2010 (Baltic EU countries)



Notes: conv = conventional NTA, low = ISCED 0-2, medium = ISCED 3-4, high = ISCED 5 or more

Source: EU-SILC 2011, HBS 2010, Eurostat database, authors' calculations

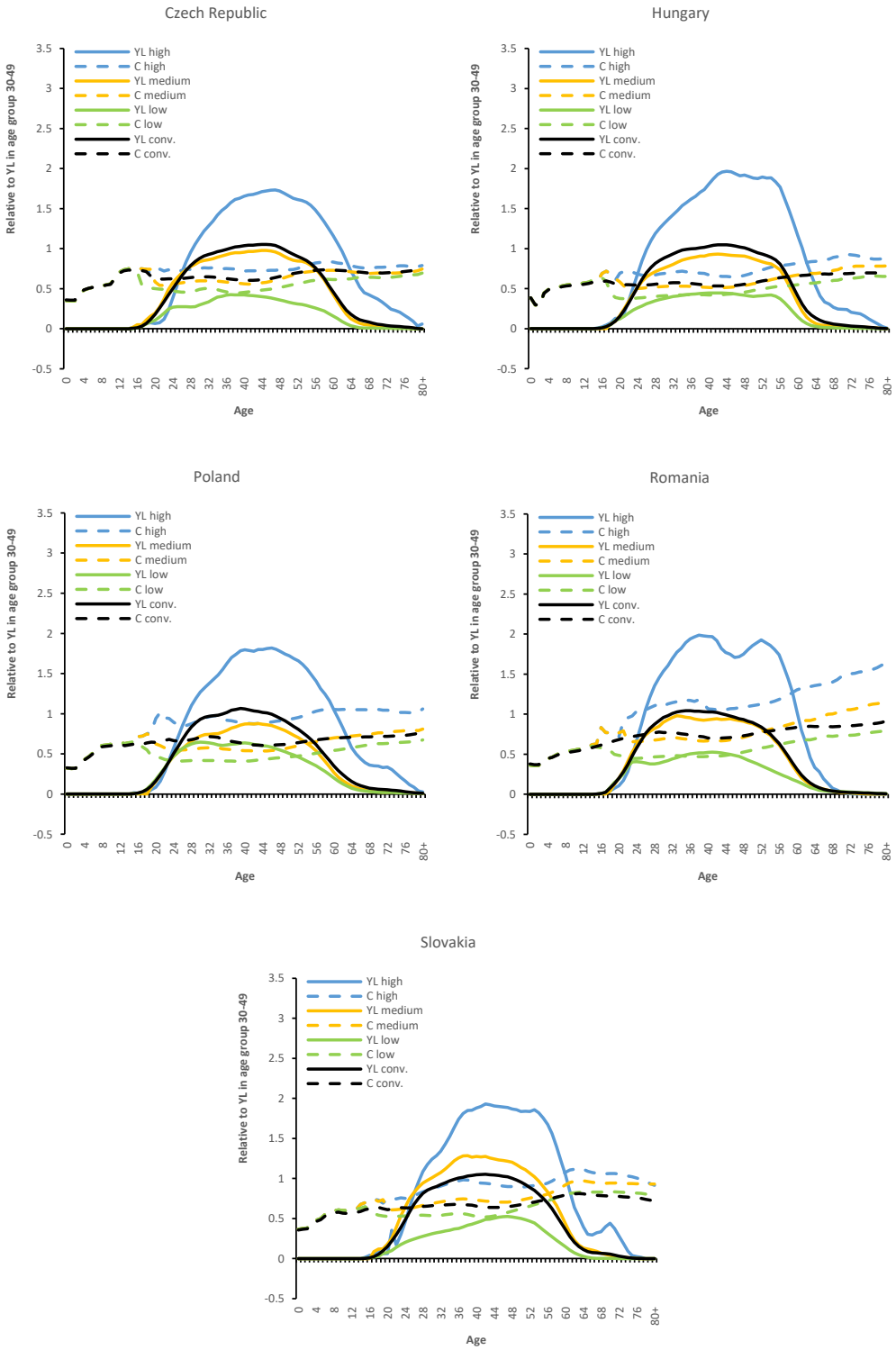
In Belgium, on the other hand, labour income covers the consumption of the different educational groups more evenly (Figure 18). The life cycle surplus of the low-educated spans

32 years (ages 23–54), that of the medium-educated spans 36 years (ages 23–58), and that of the highly educated spans 37 years (ages 25–61). This also explains why the Belgian life cycle surplus is the longest in the conventional NTA, despite the lower retirement age. However, the total surplus accumulated by the highly educated in Belgium is still much higher than the surplus of the low- and medium-educated.

Although highly educated individuals enter the labour force later, after having invested heavily in their education, their labour income increases more than that of the medium- and the low-educated in all countries studied. Their investment in education is covered by the higher wage premium and thus the higher labour income they receive compared to people with medium level of education. The considerably higher labour income also ensures them a significantly higher life cycle surplus than the low- and medium-educated. As their life cycle is the longest, they can finance their own consumption over a longer age span. In most countries, their labour income is still higher than their consumption even in their early sixties. The only exceptions are Poland, Romania and Slovakia, but even there, consumption of the highly educated does not exceed their labour income until they reach age 60 (Figure 21).

In the EU, the financing ofconsumption of the dependent parts of the population, children and the elderly, depends largely on the life cycle surplus generated by the highly educated. In some countries, especially in Eastern Europe, the highly educated also support the working low-educated. On this basis, the following sections analyse the future impact of increasing the share of the highly educated in the EU in times of population ageing.

Figure 21: Age profiles of labour income (YL) and consumption (C) by age of conventional NTA and NTA by education in 2010 (Central and Eastern EU countries)



**Notes: conv = conventional NTA, low = ISCED 0-2, medium = ISCED 3-4, high = ISCED 5 or more*

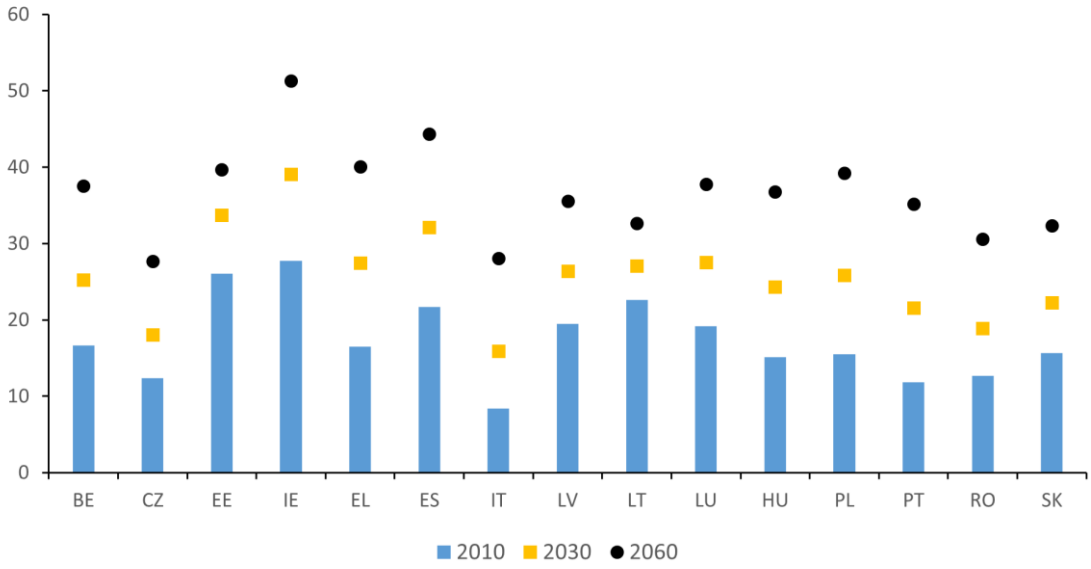
Source: EU-SILC 2011, HBS 2010, Eurostat database, authors' calculations

4.4.2 Projections of total labour income and total consumption constructed within the conventional NTA and NTA by education

Increased life expectancy means that people are living longer after they retire. Because of the life cycle deficit caused by increased consumption of - usually - health care and long-term care and the lack of labour income, they need the support of those who have a life cycle surplus. However, population ageing brings with it another factor: low fertility. As the population is expected to have more elderly and fewer people of working-age in the future, maintaining economic sustainability and the transfer system in general is likely to become a problem.

However, as shown in Figure 22, the number of the highly educated in Europe is projected to increase in all 15 EU countries included in subsection 4.3.1. The countries where the share of the highly educated in the total population is expected to increase the most compared to 2010 are Portugal (23.69 percentage points), Ireland (23.55 percentage points) and Greece (23.55 percentage points).

Figure 22: Projected share of the highly educated in the total population



Source: Wittgenstein Centre for Demography and Global Human Capital (2018), own calculations

The previous results of the NTA by education have revealed some interesting specifics of those with high levels of education. First, as mentioned earlier, the age profiles of labour income and consumption of the conventional NTA and the NTA by education show that better education leads to higher labour income and a life cycle surplus over the life cycle. Most importantly, it ensures high levels of income even at pre-retirement ages, which means that the highly educated can support their own consumption needs for longer. Moreover, the higher income allows them to transfer more to their children. Apart from money, the highly educated adults also devote more time to their children than those with low and medium

education. With both money and time, they invest more in their children, which is a good basis for ensuring that their children also receive a high education.

Given the positive effects that high education has for those who complete it, both in and out of the market, and given the projected education expansion, the question naturally arises as to whether the positive effects of education can be sustained in the future. Therefore, in this part, age profiles of conventional NTA and NTA by education are projected to show how the positive impact of high levels of education on the economic life cycle also affects long-term economic sustainability. The obtained NTA profiles are combined with the respective population sizes. Total labour income and consumption of the conventional NTA then depend only on changes in population size and the age distribution of the population until 2060. Apart from age, the changes in the case of NTA by education also depend on the changing shares of the three main levels of education.

First, the effects of education are assessed separately for both labour income and consumption. The change in total labour income and consumption of conventional NTA is presented from 2010 to 2060 and then compared with the change in projected total labour income and consumption of NTA by education (Table 24).

Table 24 shows that, among the countries studied, the two countries on the opposite side are Romania and Luxembourg. In Romania, the total consumption of conventional NTA is projected to decrease by 33% by 2060. In contrast to Romania, total consumption in Luxembourg is projected to increase by 82% by 2060. Although the changes in total consumption in the two countries appear to be a completely different response to population trends by 2060, the picture is not complete until the total labour income is added. Total labour income is projected to decrease by 52% in Romania, while it will increase by 40% in Luxembourg. Therefore, total consumption is still expected to be higher than the total labour income in both countries. However, total labour income and consumption of NTA by education in Romania in 2060 show more favourable results, as total consumption is projected to decrease by 17% and total labour income by 35%, which is less than in the case of conventional NTA. In Luxembourg, total consumption is projected to increase by 98% and total labour income by 77% in 2060, more than in the case of conventional NTA. Although both countries also have a deficit in the case of NTA by education, this deficit is projected to be much smaller than in the conventional NTA case.

To see what difference the addition of educational level as a dimension in the calculations makes, it is best to compare the change in total labour income and consumption from 2010 to 2060 in the conventional NTA with the change in the NTA by education. Table 24 shows that the average total labour income of the NTA by education for all 15 countries increases by 32% more than the total labour income of the conventional NTA by 2060. As higher labour income enables them to do so, the highly educated also consume more. This is reflected in the average total consumption of NTA by education of all countries, which also increases. However, this increase is much smaller, only 13% more than in the case of

conventional NTA. The net effect is 19%, which illustrates the positive impact of educational expansion on changes in total labour income and consumption.

Table 24: Projected impact of improved educational level on total labour income and total consumption for 15 EU countries

Country	Relative change in consumption *(C)* and labour income *(YL)* between 2010 and 2060 (in %)				Comparing both changes (in %)	
	C_{conv}	YL_{conv}	C_{edu}	YL_{edu}	C_{edu} / C_{conv}	YL_{edu}/ YL_{conv}
Belgium	23	-1	34	23	9	24
Czech R.	-5	-30	-1	-14	5	23
Estonia	-9	-22	-3	-15	6	9
Ireland	33	2	50	39	12	37
Greece	-3	-23	14	9	18	41
Spain	5	-26	21	-1	15	33
Italy	-8	-31	3	-4	13	40
Latvia	-24	-34	-18	-20	8	21
Lithuania	-32	-43	-28	-35	7	13
Luxembourg	82	40	98	77	9	26
Hungary	-17	-35	-8	-11	11	36
Poland	-15	-39	0	-15	17	38
Portugal	-23	-42	2	2	32	74
Romania	-33	-52	-17	-35	23	37
Slovakia	-10	-37	-3	-24	8	20
				Average	**13**	**32**

Notes: C_{conv}, YL_{conv}, C_{edu}, YL_{edu} are relative changes in total *C* and *YL* calculated based on a fixed base index number: eg. $C_{conv} = I_{Cconv} - 100$ where $I_{Cconv} = \frac{C_{conv}(2060)}{C_{conv}(2010)} \times 100$

C_{edu} / C_{conv}, YL_{edu}/ YL_{conv} are relative changes calculated based on the ratio of fixed based indeces: eg. $C_{edu}/C_{conv} = \left(\frac{I_{Cedu}}{I_{Cconv}} \times 100\right) - 100$

Source: EU-SILC 2011, HBS 2010, Eurostat database, Wittgenstein Centre for Demography and Global Human Capital (2018), own calculations

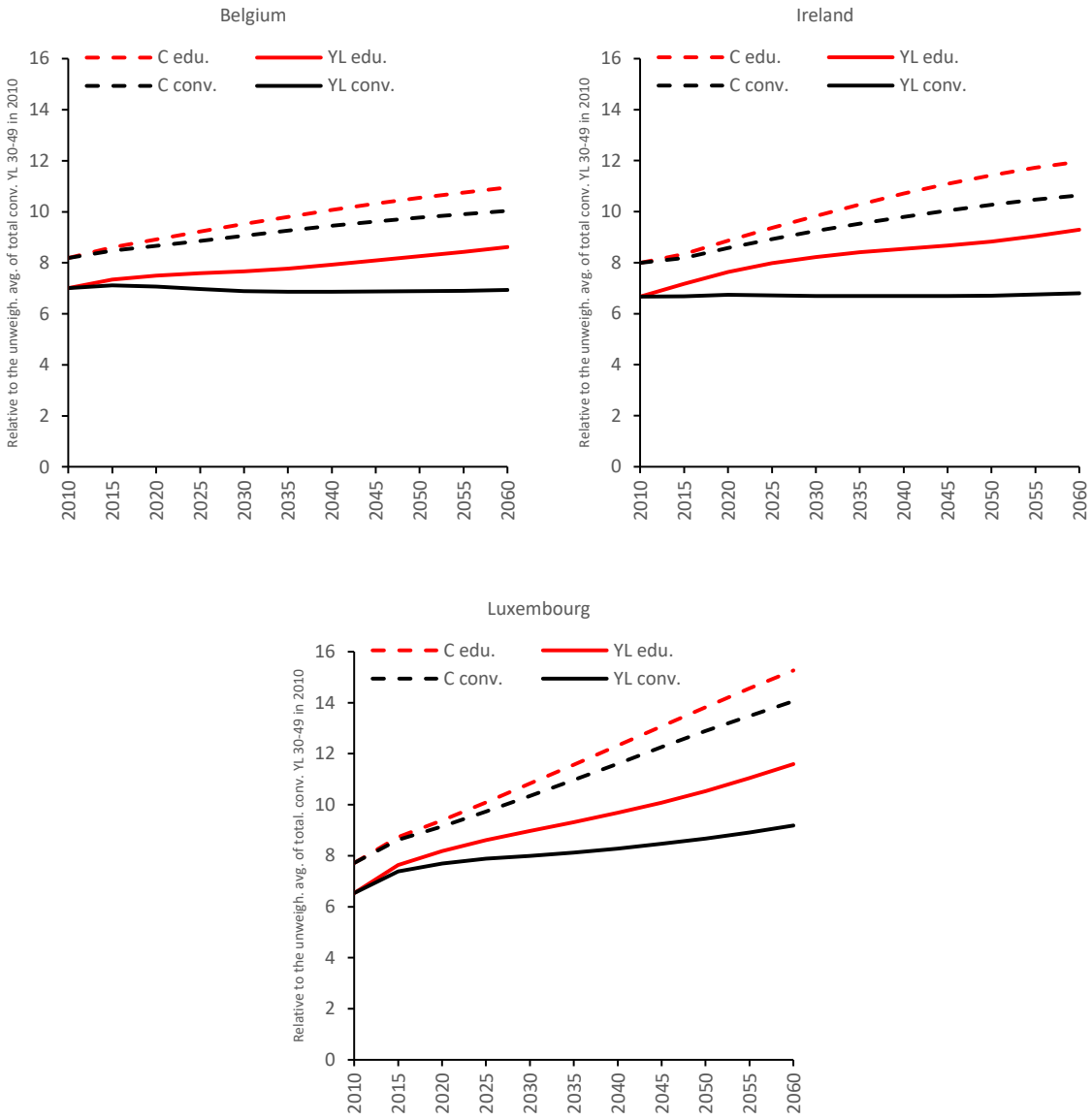
Comparing the projected changes in total labour income and consumption of the conventional NTA with that of the NTA by education shows that the total labour income of NTA by education is by far the highest in Portugal. It is 74% higher than the increase in the total labour income of the conventional NTA. Such a high increase in the case of NTA by education in Portugal can be attributed to two factors. First, the difference in labour income

between the highly educated and the low- and the medium-educated shown in Figure 19, which served as the basis for the projections, was already considerably larger in 2010 compared to other EU countries. Second, this difference in labour income is also accompanied with the large increase in the share of the highly educated by 2060, shown in Figure 22. Countries such as Greece (41%), Italy (40%) and Poland (38%) also show a substantial increase in total labour income when education is taken into account, which can also be attributed to the higher share of the highly educated in 2060 (Figure 22). However, the higher increase in total labour income in the case of NTA by education compared to the increase in the case of conventional NTA is also followed by a 32% increase in total consumption in the case of NTA by education compared to the conventional NTA projections, which is also the highest among all countries.

Figures 23–26 show the gap between total labour income and total consumption in the case of conventional NTA and NTA by education from 2010 to 2060. If the gap between total labour income and consumption in the case of NTA by education is smaller than the gap between total labour income and consumption in the case of conventional NTA, education expansion is expected to have a positive effect on future economic sustainability. It can be seen that in 2060 a higher share of consumption is covered by total labour income, which is a consequence of the higher share of highly educated.

Although the age profiles of labour income and consumption of NTA by education presented in Figures 23–26, which serve as the basis for these projections, show large differences in the duration and size of the life cycle surplus, total labour income and consumption also depend on population size. Even though the population size is projected to decrease, the share of the highly educated in the population is projected to increase. Thereofore, by 2060, the gap between total labour income and consumption in the case of NTA by education is likely to either remain the same or become smaller than in the case of conventional NTA.

Figure 23: Projections of total labour income (YL) and total consumption (C) of conventional NTA and NTA by education to 2060 (Western EU countries)



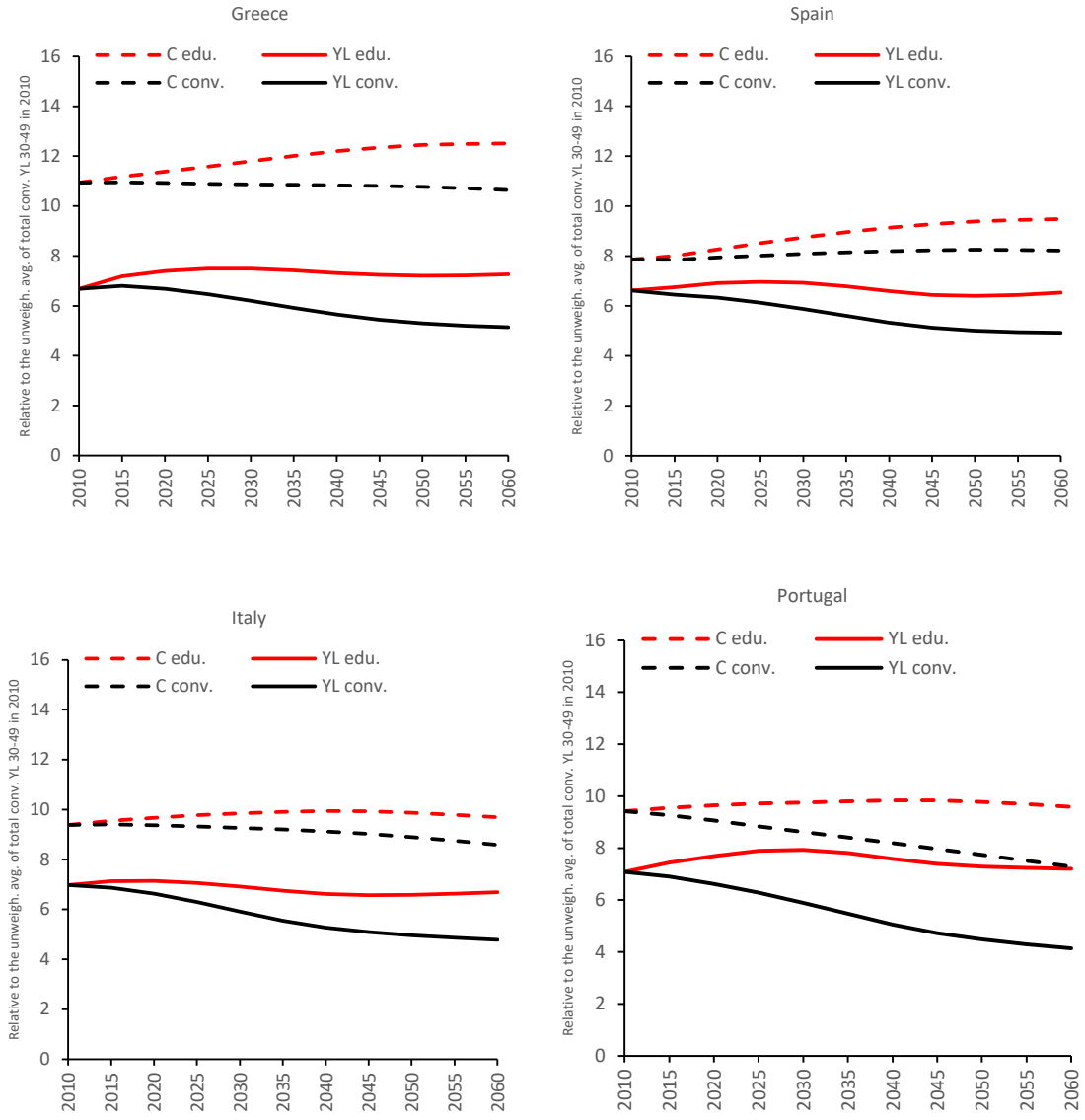
**Notes: conv = conventional NTA, edu = NTA by education*

Source: EU-SILC 2011, HBS 2010, Eurostat database, Wittgenstein Centre for Demography and Global Human Capital (2018), own calculations

Figure 23 shows that while total consumption in the case of NTA by education is projected to increase more than in the case of conventional NTA, the increase in labour income is much higher in all three Western EU countries analysed. Although the gap between total labour income and consumption in the case of NTA by education is projected to be larger than in 2010, it is still expected to be much smaller than the gap projected in the case of conventional NTA.

In contrast to the Western EU countries, the Southern EU countries presented in Figure 24 are not all expected to be affected by education expansion in the same way. For example, the gap between the total labour income and total consumption in 2060 is expected to be quite small for Portugal, but quite large for Greece.

Figure 24: Projections of total labour income (YL) and total consumption (C) of conventional NTA and NTA by education to 2060 (Southern EU countries)



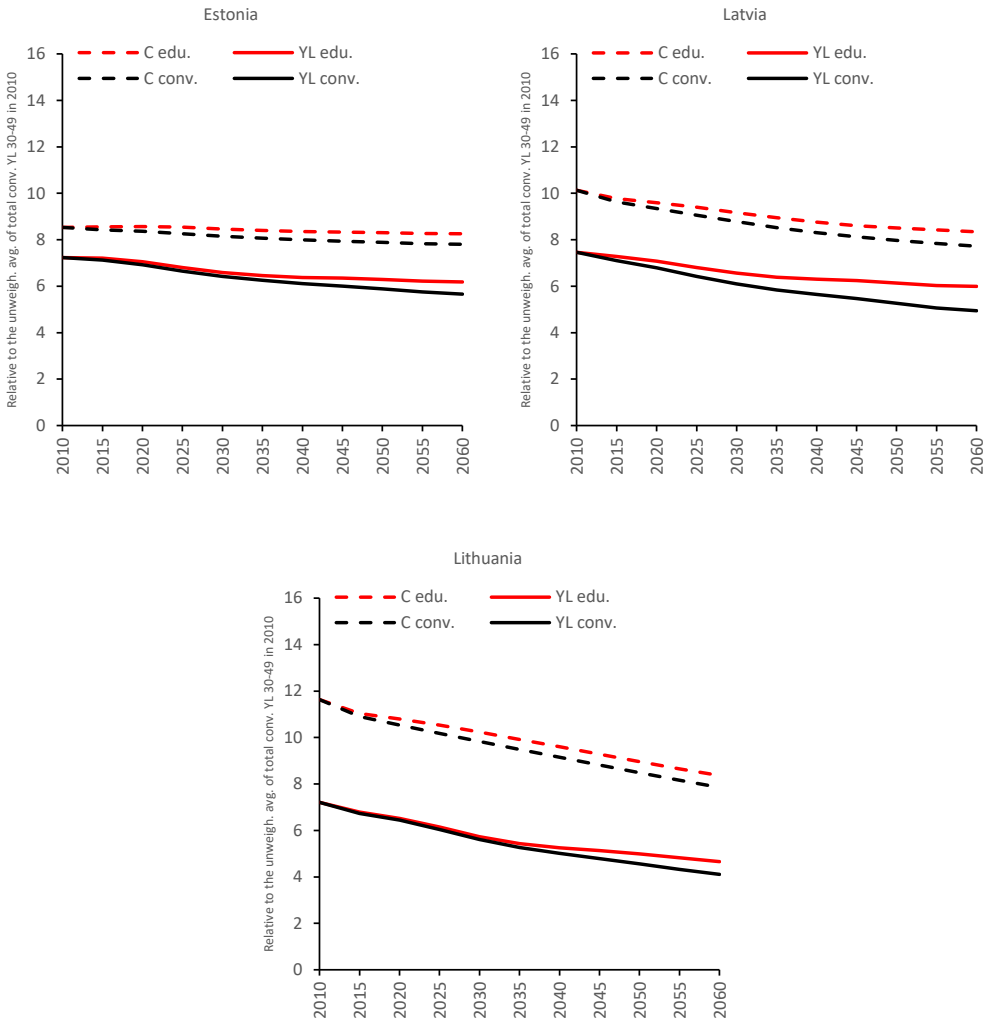
**Notes: conv = conventional NTA, edu = NTA by education*

Source: EU-SILC 2011, HBS 2010, Eurostat database, Wittgenstein Centre for Demography and Global Human Capital (2018), own calculations

As mentioned earlier, the total labour income of NTA by education in Portugal in 2060 is expected to be much larger than in the case of conventional NTA, due to the current large differences in labour income between the educational levels. On the other hand, the gap

between total labour income and consumption was already large in Greece in 2010. Although it is expected to widen in both cases by 2060, the gap is somewhat smaller in the case of the NTA by education than in the case of conventional NTA.

Figure 25: Projections of total labour income (YL) and total consumption (C) of conventional NTA and NTA by education to 2060 (Baltic EU countries)

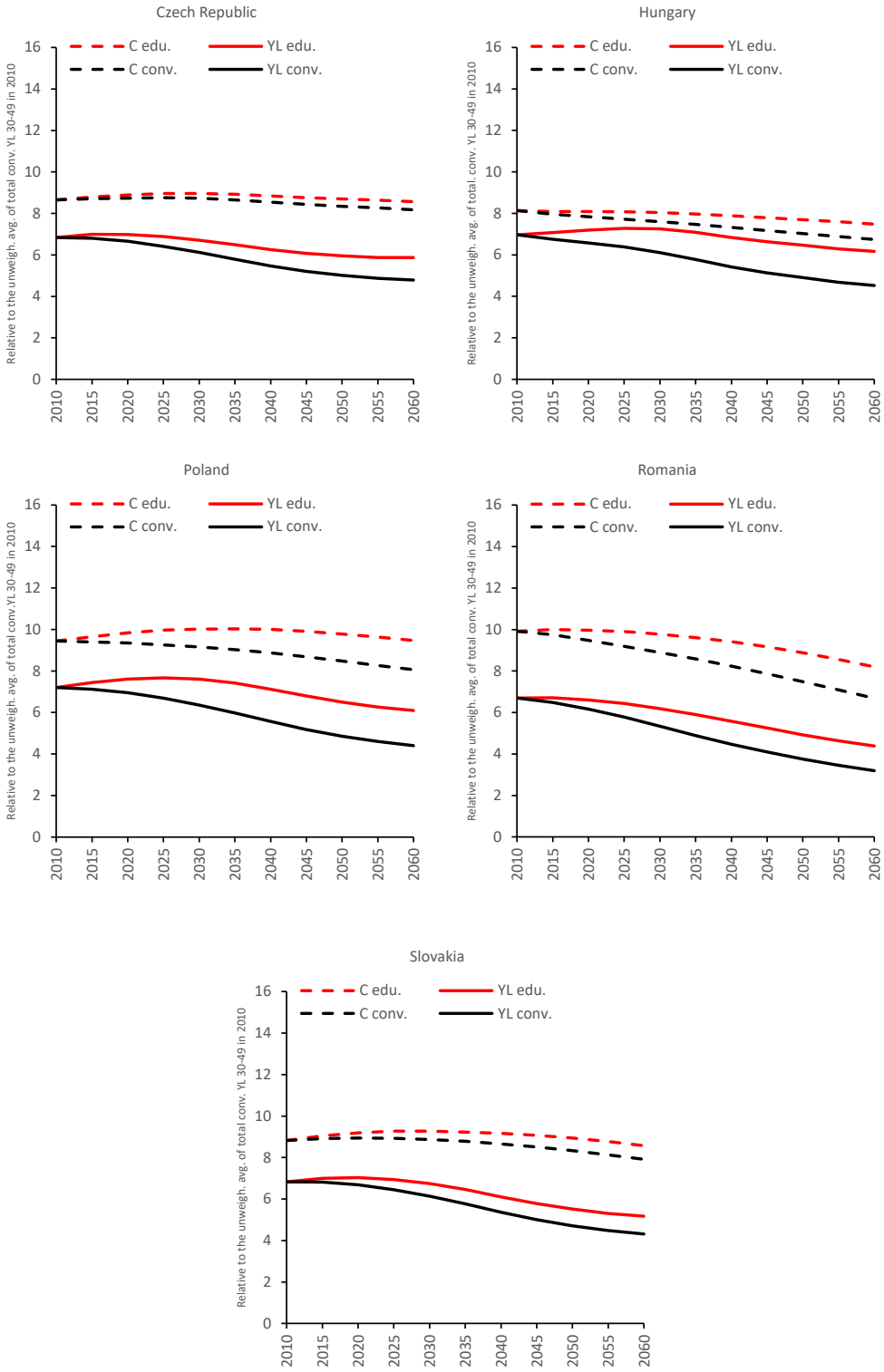


**Notes: conv = conventional NTA, edu = NTA by education*

Source: EU-SILC 2011, HBS 2010, Eurostat database, Wittgenstein Centre for Demography and Global Human Capital (2018), own calculations

The differences between conventional NTA and NTA by education are projected to be smallest in the group of Baltic EU countries (Figure 25). The only country projected to have a visibly smaller gap in the case of NTA by education in 2060 is Latvia, mainly due to the increase in total labour income of NTA by education.

Figure 26: Projections of total labour income (YL) and total consumption (C) of conventional NTA and NTA by education to 2060 (Central and Eastern EU countries)



**Notes: conv = conventional NTA, edu = NTA by education*

Source: EU-SILC 2011, HBS 2010, Eurostat database, Wittgenstein Centre for Demography and Global Human Capital (2018), own calculations

Small differences between conventional NTA and NTA by education are also observed in Slovakia and the Czech Republic, which are part of the Central and Eastern EU countries (Figure 26). The largest effect of education is expected in Hungary, where the gap between the total labour income and total consumption is considerably smaller in the case of NTA by education than in the case of conventional NTA.

However, to quantify the impact of education on economic sustainability, two support ratios were calculated: the conventional NTA support ratio and the NTA support ratio by education are projected to 2060 (Table 25). Both NTA support ratios show the extent to which total labour income is able to support the total consumption needs in a country. A comparison of the two support ratios shows the extent to which education expansion can mitigate a decline in the ratio of labour income to consumption attributable to population ageing.

Table 25: NTA support ratios 1) by age only SR(NTA)conv and 2) by age and education SR(NTA)edu

	Conventional NTA support ratio – *SR(NTA)conv*				NTA support ratio by education – *SR(NTA)edu*				Difference between *SR(NTA)conv* and *SR(NTA)edu*		
Country	2010	2020	2040	2060	2010	2020	2040	2060	2020*	2040	2060
Belgium	**0.86**	0.82	0.73	0.69	**0.86**	0.84	0.79	0.79	-0.03	-0.06	-0.10
Czech R.	**0.79**	0.76	0.64	0.59	**0.79**	0.79	0.71	0.69	-0.02	-0.07	-0.10
Estonia	**0.85**	0.83	0.76	0.73	**0.85**	0.82	0.76	0.75	0.01	0.00	-0.02
Ireland	**0.83**	0.79	0.68	0.64	**0.83**	0.86	0.80	0.78	-0.08	-0.11	-0.14
Greece	**0.61**	0.61	0.52	0.48	**0.61**	0.65	0.60	0.58	-0.04	-0.08	-0.10
Spain	**0.84**	0.80	0.65	0.60	**0.84**	0.84	0.72	0.69	-0.04	-0.07	-0.09
Italy	**0.74**	0.71	0.58	0.56	**0.74**	0.74	0.67	0.69	-0.03	-0.09	-0.13
Latvia	**0.74**	0.73	0.68	0.64	**0.74**	0.74	0.72	0.72	-0.01	-0.04	-0.08
Lithuania	**0.62**	0.61	0.55	0.52	**0.62**	0.60	0.55	0.56	0.01	0.00	-0.03
Luxembourg	**0.85**	0.84	0.71	0.65	**0.85**	0.87	0.79	0.76	-0.03	-0.07	-0.11
Hungary	**0.86**	0.84	0.74	0.67	**0.86**	0.89	0.87	0.82	-0.05	-0.13	-0.15
Poland	**0.76**	0.74	0.63	0.55	**0.76**	0.77	0.71	0.64	-0.03	-0.08	-0.10
Portugal	**0.75**	0.73	0.62	0.57	**0.75**	0.80	0.77	0.75	-0.07	-0.15	-0.18
Romania	**0.68**	0.65	0.54	0.48	**0.68**	0.66	0.59	0.53	-0.01	-0.05	-0.06
Slovakia	**0.77**	0.75	0.62	0.55	**0.77**	0.76	0.67	0.60	-0.02	-0.05	-0.06

Notes: $SR(NTA)_{conv} = \frac{total\ YL\ by\ age}{total\ C\ by\ age} = \frac{\sum_i n_i yl_i}{\sum_i n_i c_i}$

$SR(NTA)_{edu} = \frac{total\ YL\ by\ age\ and\ educational\ level}{total\ C\ by\ age\ and\ educational\ level} = \frac{\sum_{i,j} n_{i,j} yl_{i,j}}{\sum_{i,j} n_{i,j} c_{i,j}}$

* For 2010 there are actual values, to which NTA age profiles are adjusted, therefore by definition there is no difference between *SR(NTA)conv* and *SR(NTA)edu*.

Source: EU-SILC 2011, HBS 2010, Eurostat database, Wittgenstein Centre for Demography and Global Human Capital (2018)own calculations

As shown in Table 25, the NTA by education support ratio remains considerably higher than that of conventional NTA in 2060 in all countries analysed. The conventional NTA support

ratio shows that total labour income covers between 55% and 65% in most countries. However, in Greece and Romania, it is projected to cover less than half of total consumption. In terms of economic sustainability, this means that these two countries are projected to be the most affected by population ageing. In the case of the NTA by education, however, the pressure of population ageing is projected to have less of an impact on economic sustainability. Although support ratios still decline in this case between 2010 and 2060, they do so to a much lesser extent. Labour income is projected to cover about 70% or even more of the remaining total consumption in most countries.

With per capita labour income and consumption left at 2010 levels, the increase in the support ratio by education is generally due to higher labour income generated by the increased share of highly educated individuals. In addition, the highly educated have the highest labour income later in their working years, which means that the shift in the average age of the population towards an older age has a positive effect on the total labour income of the highly educated. Thus, the results suggest that despite the decline in the total population and the shift towards an older age of the population, the higher proportion of highly educated individuals could mitigate these consequences of population ageing.

4.4.3 Sensitivity analysis

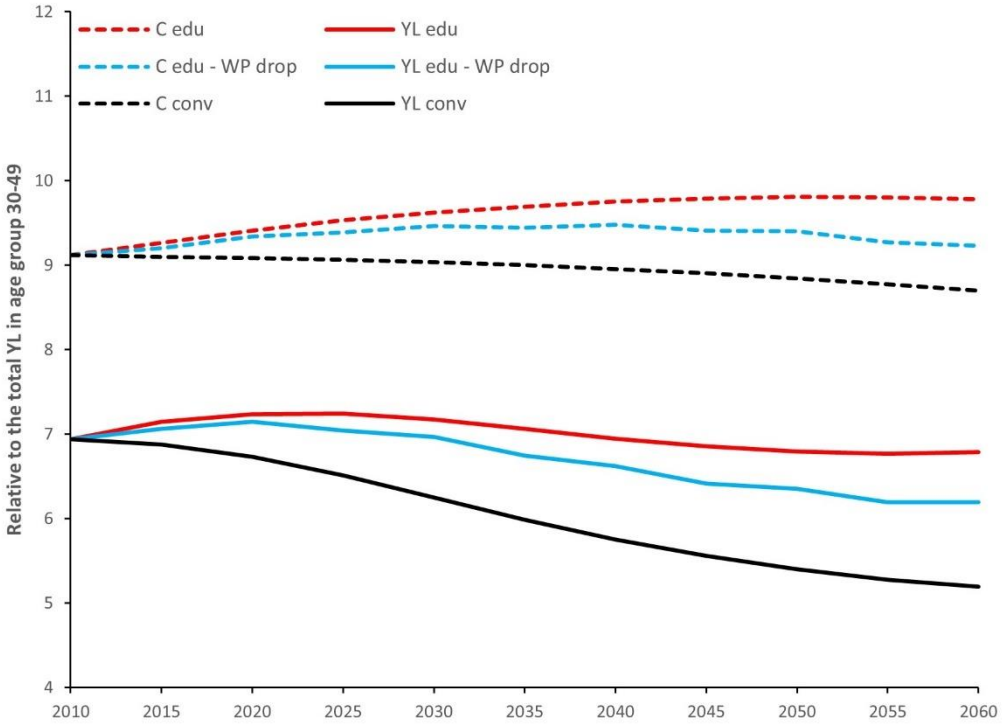
The proportion of highly educated people in the EU is projected to increase by 2060. However, as more and more people reach a high level of education, the value of that educational level would be expected to decline. Therefore, the projection results indicating the positive impact of education expansion on economic sustainability are further tested by applying the declining wage premium (decline by 2.475 percentage points every 5 years) for high education. The calculation of the declining wage premium is explained in subsection 3.3.5.

Figure 27 shows total labour income and consumption calculated (1) in the conventional way, (2) with NTA by education, and (3) with NTA by education, applying the diminishing wage premium to labour income and diminishing consumption of the highly educated. The results are shown for the average of all 15 countries combined.

In the case of the applied wage premium on total labour income and consumption of NTA by education (Figure 27), since the wage premium is assumed to decline by additional 2.475 percentage points every five years, its effect becomes larger toward the end of the projection period. Nevertheless, despite the declining wage premium for high education, total labour income and consumption still stay on much higher levels in 2060 than in the case of the conventional NTA, which considers only the age structure. The projections of total consumption in the case of a declining wage premium take into account the fact that a reduction in labour income also reduces consumption opportunities. Therefore, total consumption also decreases, but the gap between total labour income and consumption still remains smaller than in the case of the conventional NTA.

Even if the wage premium for high levels of education declines, the expansion of high levels of education is still projected to have a positive effect on the ability of labour income to support consumption. This - in turn - suggests that better education could mitigate the negative effects of population ageing that threaten economic sustainability in the future.

Figure 27: Sensitivity analysis of projections of total labour income (YL) and consumption (C) levels to 2060, unweighted average for all EU countries included



**Notes: conv = conventional NTA, edu = NTA by education, edu – WP drop = NTA by education with applied declining wage premium*

Source: EU-SILC 2011, HBS 2010, Eurostat database, Wittgenstein Centre for Demography and Global Human Capital (2018), own calculations

5 DISCUSSION

The study of economic behaviour over the life cycle, i.e. how individuals of a given age produce, consume and transfer resources, is of paramount importance in the era of population ageing. Currently, high-income economies facing population ageing can no longer count on the benefits of the demographic dividend as a tool for economic growth and thus economic sustainability. Instead, they must turn to other solutions, because in the future the demographic impact on economic growth and sustainability will be substantially negative. Previous literature has indicated that expanding education can be one of the solutions for

improving economic performance in times of population ageing. This thesis comprehensively analyses the impact of education on the production and consumption of resources both in the market and outside the market. It also examines the impact of education on intra-household monetary transfers, which account for a considerable portion of intergenerational private transfers. These transfers play an important role in meeting the consumption needs of the economically dependent population - children and the elderly. In addition, this thesis projects the observed effects of education on the economic life cycle into the future to identify possible future effects on economic sustainability. The first subsection of this chapter discusses the findings and theoretical implications of this thesis and links them to existing research. These implications serve as the basis for the practical implications for policymakers, educators, and companies, which are in the focus of the second subsection. The third and final subsection of this chapter discusses limitations and possible future research directions.

5.1 Theoretical and empirical implications

This research's comprehensive approach to the impact of education on the economic life cycle has extended many of the earlier findings and provided some new insights. It shows that the highly educated enter the labour market latest, after having invested heavily in their high education. Using a different approach to the dataset from Norway, Bhuller et al. (2017) found that the highly educated therefore earn less in the early stages of their careers than the medium-educated, who have already worked in the market for a few years at that point. Here, however, the NTA age profiles by education reveal that this is only true for some EU countries, such as Belgium, the Czech Republic, Italy or Slovakia. In other countries, such as Estonia, Hungary, Ireland, Latvia, Lithuania, Poland or Portugal, the highly educated earn as much as or more than the medium-educated when they enter the labour market. While Bhuller et al. (2017) found that the highly educated start with lower wages than the medium-educated, Bhuller et al. (2017) also showed that they experience a steep increase in their labour income. The NTA by education age profiles presented here show that the steeper increase in labour income of the highly educated compared to that of the medium- and the low-educated indeed occurs in all countries studied.

The NTA age profiles by education also show that, both in the case of Croatia and in all the other 15 EU countries studied, the steep rise in labour income at the beginning of the career of the highly educated is also followed by the largest and longest life cycle surplus. This is because the labour income of the highly educated is considerably higher than that of the low- and the medium-educated and because the differences in consumption levels between educational levels are much smaller for the entire economic life cycle. There are a few reasons why the labour income of the highly educated is much higher than the labour income of the others. First, the highly educated work more working hours than the medium- and the low-educated. The analysis of unpaid work in this study found that the medium- and especially the low-educated spend more time on unpaid work, while the highly educated

spend more time on paid work on average over their life cycle. This is also supported by the OECD (2021b) findings that the highly educated work more hours per week. Second, the highly educated invest heavily in their education before entering the labour market and consequently they receive a large wage premium throughout the life cycle relative to the wages of the medium-educated (ILO, 2020; OECD, 2019, 2022b). Third, research to date has found a positive effect of higher education on worker productivity. For example, some previous discussions have questioned whether high wages for older workers are justified as their biological decline can also lead to a decline in their productivity (Skirbekk, 2004, 2008). However, Vandenberghe (2017) has shown that high wages for the older highly educated workers are justified as they positively contribute to total factor productivity growth. Moreover, highly educated are not more productive only at older ages. Previous research has shown that highly educated workers are generally more productive than the low- and the medium-educated and that they are the largest contributors to firm-level productivity (Lebedinski & Vandenberghe, 2014).

Another important determinant of the life cycle surplus of the highly educated is the duration of the age span in which individuals earn more labour income than they consume. The longest life cycle surplus in all countries studied indicates that the highly educated work longer and retire later than the low- and the medium-educated. Moreover, the age profiles show that the highly educated in the EU not only stay in the labour market the longest, but also reach the peak of their labour income just before retirement, which provides a good basis for meeting their own consumption needs in retirement. Because of increasing life expectancy, the highly educated are motivated to stay longer in the labour market. They expect to have more time after retirement to enjoy the benefits of higher earnings over the course of their working lives (Geppert et al., 2019; Strulik & Werner, 2016).

However, this study has also highlighted the problem of the extremely low, and in some cases even non-existent, life cycle surplus of the low-educated. In some countries, such as Croatia, the Czech Republic, Greece, Lithuania and Slovakia, the labour income of the low-educated does not exceed their consumption at any point in their life cycle This means that they have a life cycle deficit throughout their whole life cycle. In other countries, such as Hungary, Ireland, Latvia, and Romania, the low-educated have a life cycle surplus only for a short period, about 10 years or less. Another problem is that even in countries where they have it, the life cycle surplus of the low-educated leaves very little potential for transferring resources to children and the elderly. As a result, the low-educated also largely depend on the welfare system, which is already under pressure from the increased consumption needs of larger numbers of older individuals.

Furthermore, ILO (2020) shows that the share of part-time workers is highest among the low-educated, which also leads to lower average labour income. Apart from the low wages the low-educated may receive in the labour market, another demotivating factor for participation in the labour market may be a high number of low-quality jobs offered. As previous research has shown, there is a higher share of jobs for the low-educated that have

poor working conditions, such as lack of social protection or fringe benefits (ILO, 2020; Kalleberg, 2011). Because of these conditions and low wages, the low-educated may not be motivated to participate in the labour market. Instead, as this research shows, they specialise in unpaid work.

With the education expansion, all these issues may become even more prominent, mainly because of the job polarisation, resulting from the increasing number of professional jobs requiring high education on the one hand and personal service jobs requiring low education on the other (Goos et al., 2009). Job polarisation is a problem because it can push the medium-educated into the low-paying occupations. This also means that low-educated workers in low-skilled occupations may be replaced by better educated workers, and thus pushed out of employment entirely. As a result, job polarisation may lead to medium-educated workers having a smaller and shorter life cycle surplus, and low-educated workers having a life cycle deficit throughout their economic life cycles. In this scenario, more people would become dependent on the transfer system, in addition to children and the elderly. Although my results suggest that the expansion of education has a positive effect on economic sustainability, it is still important to consider the issue of job polarisation.

In addition to the threat of job polarisation, the jobs of the low-educated are also threatened by the automation, which is expected to occur in the coming years as technology advances (OECD, 2017b). The highly educated are those who drive technological innovation in high-income economies near the technological frontier, while the medium-educated tend to be those responsible for technology adoption in developing countries (Crespo Cuaresma & Mishra, 2011; Vandenbussche et al., 2006). Jobs of the low-educated, which tend to be simple production work or simple service-oriented are also more vulnerable to unexpected shocks, either of technological or otherwise, as illustrated by the COVID-19 pandemic (OECD, 2022d).

Another important aspect to consider when discussing the impact of education on the economic life cycle is health. Advances in health in the second half of the 20th century have led to increased life expectancy, which is one of the drivers of population ageing. But increased life expectancy is also one of the reasons why individuals are willing to invest more in their education. Investments in education and health are the basis for building human capital (World Bank, 2018). In Europe, investments in education and health are usually supported by the public transfer system. However, parents also invest in their children's human capital primarily through private transfers (Hammer et al., 2020; R. Lee & Donehower, 2011). Because children usually live with their parents, these transfers flow within households. The fact that intra-household monetary transfers flow mainly from parents to children is also confirmed by this research for Croatia. Moreover, as shown by the input-output matrices, the highly educated pass on higher values of monetary intra-household transfers to their dependent children in school than the low- and the medium-educated. By transferring higher values to their children, the highly educated also invest more in children's education, but also in their health. However, the highly educated not only

give more monetary transfers to their children, but also devote more time to them through childcare over their life cycle. Among other activities, childcare in this analysis includes medical care for child, suggesting that highly educated parents devote more time to childcare, and thus more time to their children's health. As noted by KC & Lentzner (2010), this clearly has a positive effect on children's health. However, better education also has a positive impact on the working-age population. This positive impact is especially seen in the years before retirement (Kaestner et al., 2020), as it translates into higher productivity levels than those of less educated. Consequently, a positive impact on health also has a positive impact on labour income, which is much higher for the highly educated than for the medium- and the low-educated before retirement.

These findings on the impact of education on the economic life cycle are extremely important for the future economic sustainability of European economies, especially since the European population is projected to become much older, but also better educated by 2060. This research emphasizes that economic sustainability depends on the ability of an economy's total labour income to support its total consumption. Looking only at the age dimension, this support is projected to decline atrongly by 2060. However, when education is taken into account, total labour income is projected to increase much more relative to total consumption, so the total consumption levels are better supported. The good news is that these results hold even when the declining value of higher education is taken into account, meaning that education expansion should continue to have a positive impact on future economic sustainability.

5.2 Practical implications

This research has shown that expanding education is an important factor in mitigating the consequences of population ageing and improving future economic sustainability. However, for this to happen or for the impact of education to be further expanded, there are some implications for policymakers at all levels, educators and companies that should be considered.

In many of the countries studied, the low-educated have no life cycle surplus at all, or they have it for only a short period of time. Job polarisation could push more low-educated workers out of employment and reduce labour income for the medium and highly educated, making them more dependent on the public transfer system. The public transfer system depends on the life cycle surplus generated by the working-age population, with the highly educated being the largest contributors. By lowering their wage premium, job polarisation could cause their life cycle surplus to become smaller and thus insufficient to cope with the increasing pressure of population ageing, pushing more people into unemployment, inactivity on the labour market or low-paid employment. Job polarisation can be managed if education policies are carefully planned and if the education programmes are able to meet labour market needs in a timely manner.

To achieve this, one of the most important changes that policymakers should consider and then implement is improving the quality of higher education. The quality of higher education is of paramount importance because of technological change and the key role that higher education plays in fostering the technological innovation. It can be improved primarily through increased investment in high education. Although the quality of higher education is crucial for long-term growth (European Investment Bank, 2018), investment in higher education in the EU22 currently amounts to 1.3% of GDP, below the OECD average (1.5% of GDP) (OECD, 2022a).

With technological change, jobs of the low-educated are threatened by automation. Therefore, policymakers and educators should not only focus on higher education programmes, but also consider promoting programmes that could improve the skills of those who finished with the formal schooling. Lifelong learning and on-the-job training activities have been shown to be beneficial for increasing human capital and are important tools for increasing technology adoption among of the low-educated (European Investment Bank, 2018; Smit et al., 2020). This can also lead to higher earnings and employability, which could also motivate the low-educated to stay longer in the labour market. Increasing and expanding their participation in the labour market will also increase the life cycle surplus of the low-educated.

As discussed earlier, the short and low life cycle surplus of the low-educated, if any, is a problem because it makes them dependent on the transfer system. However, policymakers could adopt policies that would ensure better working conditions and better overall quality of employment for the low-educated. This could lead to an increase in the life cycle surplus of the low-educated for three reasons. First, it could motivate them to stay longer in the market. Second, it could motivate them to spend more time on paid work in the market rather than replacing it with unpaid work at home. Third, it could increase their productivity on the workplace.

In addition, there are a number of policies that should be considered by both policymakers and companies. As this research has shown, a large amount of time is spent on unpaid work, especially at prime working-age. At this age, childcare is the main activity of unpaid work, leading to conflict between family and work that can result in postponing the decision to have children and start a family or, if there are no suitable facilities, giving up work to care for the children (Zannella et al., 2019). This conflict primarily affects women, regardless of their educational level. In terms of population ageing, the only solution is to reconcile both sides – family and work. Therefore, policymakers should consider promoting facilities such as kindergartens and school programmes that allow for longer and/or more flexible childcare. Furthermore, it would be beneficial for working parents if such facilities were located close as possible to their workplace, as this would shorten their daily commute. This is also why larger companies should consider offering some form of private kindergarten to their employees. Providing more kindergartens and schools with high-quality programmes would

be the especially important for highly educated parents who prioritise childcare over other unpaid work activities and would make it much easier for them to balance family and work.

Another solution to family-work balance could be to promote part-time employment to those workers who wish to do so. This type of employment could also be important in encouraging elderly to stay longer in the labour market, thus extending their life cycle surplus. In addition, previous research has shown that better health of highly educated workers in the later stages of their working lives allows them to maintain high levels of productivity in the pre-retirement age (Sánchez-Romero et al., 2016). Therefore, length of the life cycle surplus in general can be further extended with continued improvements in health. Regular medical checkups not only ensure the health of the working population but are also a way to prevent many serious issues that can occur at the old age, when usually the consumption of healthcare increases. Policymakers should promote health policies and companies should ensure that the health of the working-age population is monitored through regular annual general medical examinations.

Although many of the issues mentioned in this subsection are already initiatives that the EU is working on, there is still a need to pay more attention to them. In addition, the right policies need to be put in place to ensure that educational outcomes meet the needs of the European labour market. However, this is an issue that policymakers, educators, and companies need to work on together.

5.3 Limitations and future research

The NTA provides a comprehensive overview of economic behaviour over the life cycle. Together with the information on education, the NTA shows how educational level of individuals affects the production (measured with labour income) and consumption change over the life cycle. However, apart from the valuable information that it provides on transfers, the NTA method also has some limitations. This subsection acknowledges the limitations of this research and provides guidelines for future research. First, I will discuss the general limitations of the NTA method and then focus on the limitations of the present research.

The first limitation of NTA in general, and thus of NTA by education, is that it reflects individual's economic behaviour only in a particular year for which all the data are available. Therefore, the NTA does not track a given individual throughout his or her life cycle, but rather provides a snapshot of the life cycle of different individuals in a given year based on cross-sectional data. This allows us to identify the transfer potential and intergenerational transfer flows at a given point in time, but it gives us only a rough estimate on how the economic behaviour of working-age individuals will be affected when they reach the age of the older generation.

The life cycles of individuals change over time, also due to different policies and requirements that apply during the large span of the life cycle. Therefore, individuals who are of working-age today may eventually experience a life cycle surplus or a life cycle deficit of a different duration and magnitude than it is indicated for their educational level. This is not only the limitation of NTA and NTA based projections, but also of NTTA, which focus on the analysis of unpaid work over the life cycle.

Consistent with the limitations of the NTA in general, the monetary intra-household transfer flows presented in the input-output matrices within this research also show snapshots of the transfer flows between household members of certain ages and educational levels in a given year. Although they do not track the same parent and child through different stages of child's schooling, they still show well the private transfers between partners and between parents and children. However, the input-output matrices focusing only on intra-household monetary transfers do not provide complete information on private transfers from the individuals of working-age to the elderly because many older family members do not live in the same household with their children. These transfer flows are captured by the inter-household transfers. Therefore, future research focusing on private transfers to the elderly should supplement the data used to estimate the intra-household monetary transfers with data on inter-household transfers.

The data used to estimate monetary intra-household transfer flows in this research came from the Croatian HBS for 2014. It was selected because it shows income and consumption in the same survey, providing a rare opportunity to better estimate monetary intra-household transfers by both age and education. However, the inclusion of both dimensions in the research, which is based on the survey of 5831 observations from 2029 households, comes at a cost. For each observation, the received and given transfers had to be estimated, and then further disaggregated by both age group and educational level, yielding many possible combinations of transfer flows. Even after merging some age groups, the final input-output table of intra-household monetary contained 360 age- and education-specific combinations. Therefore, some of the age-education combinations could not be reported because they contained either very few or no observations. Future research should consider supplementing the estimation of intra-household monetary flows with additional datasets, such as EU-SILC or some other national-level datasets with bigger sample sizes.

Adding the information from other datasets would allow for addition of other dimensions, such as gender, that would shed light on how education also affects gendered potential to transfer resources. The focus of this research was on comprehensive analysis of the impact of education on the economic life cycle and its contribution to future economic sustainability. However, some previous research indicated that higher female labour force participation will be one of the critical factors in mitigating the consequences of population ageing on economic sustainability (e.g. Balleer et al., 2014; Loichinger, 2015). Due to sample size limitations, the gender aspect has not been included in this research; however, it would be desirable to obtain an even more accurate picture of effects of educational

expansion. Women around the world are the main producers of unpaid work, and this research has shown the huge differences in the age profiles of unpaid work of different educational levels. Furthermore, Zagheni et al. (2015) have shown that education mostly affects the levels of production of unpaid work for women, while the levels of production of unpaid work for men remain very similar throughout the life cycle regardless of their education. Therefore, the educational differences in total unpaid work probably mostly reflect these differences in women's age profiles of unpaid work. Consequently, education is also expected to affect women's NTA age profiles differently than men's NTA age profiles. Given that the proportion of women in the EU who attain tertiary education is higher than that of men (Eurostat, 2022a), future research should consider the gender and educational effects of educational expansion together.

This research has shown huge differences in the life cycle by education. The differences are both in the levels of life cycle surplus and the duration of their life cycle surplus. As presented in chapter 4, the duration of this surplus depends directly on the individual's activity in the labour market. This topic is only briefly addressed in this research but should be considered to a much greater extent in future research, particularly because of the impact that education has on labour force participation at older ages.

The limitation of this research is also that the production and consumption of unpaid work are expressed only in units of time. This research has shown that the highly educated prioritize paid work, while the low-educated prioritize unpaid work. Therefore, the total value of work produced by the low-educated is underestimated in the NTA framework when the dimension of education is not taken into account. To obtain a comprehensive picture of the impact of education on total production and consumption, the age profiles for the production and consumption of unpaid work obtained by using the NTTA methodology should be expressed in monetary terms and added to the NTA age profiles. The same procedure should be extended to the analysis of private transfers, adding the monetized time transfers of unpaid work to the estimated private monetary transfers. Therefore, future research should consider combining the NTA and NTTA age profiles, as this would allow full comparability of the value created and transferred by individuals at each educational level.

Finally, this research focuses only on the effects of level of education - on production, consumption and transfers. However, as discussed in the previous subsection, the impact of education is closely related to various other dimensions, including gender, family type etc. Previous research has shown that education also affects productivity, workers' potential for innovation, and their willingness to learn on the job. None of these effects were considered in this research, but they represent important relationships that should be analysed in the future. By demonstrating the impact of education on labour income and transfers, as well as on economic sustainability in an ageing population, this research has emphasized the importance of these relationships. Future research that could analyse one of these pathways

would be a valuable contribution to further investigate the impact of education on the economic life cycle and economic sustainability.

CONCLUSION

The aim of this research is to analyse the role of educational level on production, consumption and transfers in monetary and non-monetary terms and how these effects impact future economic sustainability. More specifically, this research focuses on the role of education in the three main areas listed below.

First, I examine the impact of education on intra-household transfer flows between different age groups. I present for the first time the NTA and the NTA by education for Croatia. I also provide a detailed estimate of intra-household transfers – I not only measure their size at different ages and for different educational levels, but also provide estimates of to whom the transfers are given or from whom they are received. This is made possible through the use of input-output matrices. The study is conducted for Croatia for the year 2014, as suitable data for such a study (i.e. income and consumption related variables in the same survey) are rarely available.

Second, I analyse for the first time the impact of individuals' educational levels on household production of unpaid work for 9 EU countries (Austria, Bulgaria, Denmark, Spain, France, Hungary, Italy, the Netherlands and Slovenia) and consumption for 2 European countries (Italy and Spain). Although unpaid work is not officially considered an economic value-adding activity, it greatly influences and explains individuals' activity in the market. It has a significant impact on the economic life cycle of individuals and is therefore important in explaining the education-specific behaviour of individuals at any age.

Finally, I look at the impact of education on the economic life cycle of individuals for 15 EU countries (Belgium, Czech Republic, Estonia, Ireland, Greece, Spain, Italy, Latvia, Lithuania, Luxembourg, Hungary, Poland, Portugal, Romania, and Slovakia) and examine its impact on future economic sustainability. Due to the ageing of the population and the increasing share of the highly educated, some of the previous research has examined the impact of improved level of educational attainment in the economy on macroeconomic performance. However, I contribute by examining this issue from an NTA perspective based on the number of different countries - a path that has not been explored before.

The focus of each of the three aforementioned areas of this study was captured through a corresponding research question. The answers to each of the three research questions are listed below.

Research question 1: Do the direction and value of monetary intra-household transfers differ considerably between individuals in the same age group but with different levels of education?

Intra-household transfers are transfer flows within a household. Their direction and value depend on the labour income and consumption of the individual. As labour income and consumption change considerably over the life cycle, the age of the individual is also an important factor in determining individuals' ability to give and their need to receive intra-household transfers. Intra-household transfers primarily help the dependent population – children and the elderly – to close the gap between their consumption needs and the income they receive. Individuals with a life cycle surplus, i.e. with an income that exceeds their consumption, are the ones who are able to give transfers. In Croatia, the life cycle surplus estimated with the conventional NTA in 2014 is generated on average by persons aged from about 26 to about 58 years who belong to the working-age population.

Since the focus of this part of the study is to determine whether intra-household monetary transfers differ by educational level, it was necessary to first analyse labour income and consumption by educational level. The NTA profile of the low-educated in Croatia shows that the low-educated do not achieve a life cycle surplus at any age. This indicates that their ability to transfer income is negligible, or more precisely, an average individual with a low educational level receives (public and/or private) economic flows throughout their life cycle to cover their estimated (public and private) consumption. The medium-educated have a life cycle surplus at ages 26–55, but the highest positive difference between labour income and consumption is obtained by the highly educated. Their labour income is much higher than the labour income of medium-educated and especially low-educated individuals. However, the differences in consumption levels between individuals with different levels of education are not so large. Therefore, the life cycle surplus of the highly educated lasts the longest, roughly from age 26 to age 65, which means that the Croatian transfer system is highly dependent on them. The highest and longest-lasting surplus allows the highly educated to give intra-household transfer of a higher value.

The study of intra-household transfers shows that the level of education does not affect the direction of transfer flows. Intra-household transfers flow mainly to transfer recipients with low and medium levels of education aged 0–19. Higher values are also transferred to medium-educated recipients in the 20–29 age group, which also includes individuals who are pursuing tertiary education. The highest values within a household are thus transferred downwards, from parents to children, regardless of their educational level. This is followed by the values transferred from grandparents to grandchildren. Although individuals older than 60 years receive slightly higher transfers than other age groups of adults, they still transfer higher values to children who are in school than the values they receive themselves. On the other hand, individuals aged 30–59 generally receive the lowest values of intra-household transfers. This is broadly consistent with the period of life-cycle surplus

calculated by the conventional NTA, where labour income is higher than consumption, implying that these individuals mainly cover their own consumption.

However, the educational level of the transfer givers affects the value of the transfers given. Low-educated individuals aged 0–19, which includes individuals pursuing secondary education, receive on average the lowest transfer inflows from low-educated individuals and the highest from highly educated individuals. The same is true for medium-educated transfer recipients aged 15–29, which include individuals pursuing tertiary education. On average, the highest transfers are made by the highly educated to the 15–19 age group with low and medium levels of education, i.e. to the children attending secondary school or just starting their university studies. Although transfers to children in school generally increase with age and educational level that children are aiming for, the low-educated on average transfer considerably less than the medium-educated and the highly educated in most younger age groups.

Apart from intra-household transfers to children in school, most transfer flows occur between transfer givers and transfer recipients of the same age group (usually spouses or partners) in the same household. The only exceptions are flows from highly educated individuals to low-educated individuals and vice versa, where this could not be observed.

In addition to the market, value is also created through the investment of time in work within households. Although this work is not paid, it is still affected by the educational level of individual performing it. This is the focus of the second research question.

Research question 2: How does the level of education affect the production and consumption of unpaid household work?

Unpaid work mainly takes the form of unpaid household work and caring for others in the household. It is a source of paid and received time transfers. Like market production and consumption and monetary transfer flows, unpaid work is strongly influenced by age and educational level. Time spent on unpaid work is inversely related to labour income earned through paid work. This research has shown that people with low levels of education spend more time on unpaid work in the household than people with medium and high levels of education. This is true for all countries studied, with the exception of Denmark and Hungary.

Further analysis of unpaid work, broken down into childcare and housework other than childcare, shows that the production of housework other than childcare generally increases with age in all countries and for all educational levels. It peaks around retirement age, when individuals spend more time in their homes, but then declines after age 70. However, there are still differences between individuals with different levels of education in terms of amount of time spent on housework other than childcare, with the low-educated spending the most and the highly educated least time on this activity.

Highly educated individuals spend less time on unpaid work other than childcare than low- and medium-educated individuals during most of their life cycle in all countries. However, there are differences between countries. In Bulgaria, Austria, Slovenia and Italy, the amount of time spent on unpaid housework other than childcare starts to vary considerably between educational levels as already at the age of 20 and remains different until old age. In other countries, such as France, Hungary, Spain and the Netherlands, low- and medium-educated individuals spend similar amounts of time on housework. The amount of time spent on housework by highly educated individuals is much lower from the beginning and increases much more slowly until old age. This is also reflected in their earnings from paid work, for which the highly educated spend more time. The earnings of the highly educated are much higher than those of the low- and medium-educated.

There are also significant differences between educational levels in the amount of time spent on housework. The low-educated spent the most time on different activities of housework other than childcare. In most countries, except Denmark, they spend about 70 minutes or more per day on cooking and doing the dishes. In all countries studied, except Bulgaria, the same activities take only about 40 to 50 minutes.

However, there is one unpaid activity for which the highly educated spend significantly more time compared to the low- and the medium-educated: childcare. In all countries surveyed, highly educated workers spend an average of almost 40 minutes per day on childcare over the course of their live cycle, which is on average about 133% moree than the low-educated and about 65% more than the medium-educated. The only exception is Bulgaria, where the highly educated spend an average of 19 minutes on childcare.

Although childcare is an activity that is mainly concentrated between the ages of 20 and 40 among individuals of all educational levels and in all countries, the low-educated have children earliest and the highly educated have them latest. Another difference is that a high proportion of those with high levels of education have young children at about the same age, while those with low levels of education have children at a wider age range.

Caring for children has a substantial impact on meeting their consumption needs, not only in terms of monetary transfers, but also in terms of time devoted to them (caring for them, preparing meals etc.). Both children and the elderly are not able to cover their needs with their own income. They rely on support from the life cycle surplus of the working-age population. The extent to which the consumption needs of the dependent population are met is crucial for ensuring economic sustainability. This is the focus of the third research question.

Research question 3: Does the gap between total income and total consumption remain the same when NTA age profiles are further disaggregated by education? How is education likely to affect economic sustainability?

The conventional NTA examines how much people earn and consume at each age, resulting in comparable age profiles across countries. The analysis conducted in this study shows how the size and length of the life cycle surplus created varies across the 15 European countries studied. However, it also shows that all countries are expected to face problems with total labour income being able to cover the total consumption of their populations by 2060 due to population ageing. Although many European countries have already introduced numerous pension reforms, additional measures need to be taken. This study shows that increasing the educational level of the population could be a partial solution.

The age profiles of NTA by education show that in most countries it is mainly the highly educated who support the consumption needs of the dependent population. Their life cycle surplus is much longer and larger than that of people with medium and low levels of education. This is projected to have positive impact on the gap between total labour income and total consumption. The gap is smaller in the case of NTA by education than in the case of conventional NTA in all countries analysed except Romania. Apart from the impact on the economic life cycle, the impact of education also depends on the projected share of highly educated individuals in the future. Although it varies from country to country, the effect of education is reflected in the projected increase in the average total labour income for the 15 countries analysed, which is 19% higher than total consumption compared to the conventional NTA projections. However, as more and more people attain higher education, this level of education is expected to be less valued in the future than it is today. Nevertheless, the positive impact of education on maintaining economic sustainability remains, even if the wage premium for high education declines in the coming years. This leads to the clear implication that education can partially offset the effects of population ageing.

This study of the effects of educational attainment on production, consumption and transfers has some limitations. In the study of intra-household transfers, the number of observations in some of the transfer age groups is too small. Some of these groups even contain no observations at all. As data availability dictates, further research could focus on extending the methodology to obtain more coherent results. Moreover, this study is limited to intra-household transfer flows only. However, older family members may live in separate households. Transfers to these family members are mainly covered by inter-household transfers.

In the second part of the study on differences in unpaid work by education, the data are considered as they are available in the MTUS. No adjustment is made other than using the weights already available in the surveys. I should point out that the number of observations in some age groups was very low. In addition, countries have different methodologies and different starting ages for their time use surveys.

The third part of the study on the impact of educational level on future economic sustainability uses the strong assumption that the age- and education-specific profiles of

labour income and consumption do not change from 2010 to 2060. Moreover, these NTA profiles used as the basis for the projections are based on results obtained from survey microdata while the final conclusions are given for the macro perspective. Although the NTA results are adjusted to aggregate controls (in this case to the ESA) these results should not be interpreted as projections, but as a calculation exercise that gives insight into the positive impact of a higher share of the highly educated on mitigating the pressure of population ageing on economic sustainability.

Despite these limitations, the results of this study demonstrate the importance of educational level in the economic life cycle of individuals and its role in future economic sustainability. Regardless of educational level, intra-household transfers are directed downwards and provide for the consumption of the children. However, highly educated individuals invest the most in children, both in terms of money transfers and time spent on childcare. Little is transferred within households to the elderly, the other dependent part of the population. Older people are mainly dependent on the public transfer system, which is a problem in times of population ageing.

The public transfer system, in turn, depends on the labour income of the working-age individuals. With significantly higher incomes and the highest life cycle surplus, the highly educated contribute most to the maintenance of the public transfer system. The surplus generated by the highly educated is likely to be the key to securing public transfers for the elderly, who receive limited transfers from their own households, and thus to reducing the support ratio, which is rising due to population ageing. Therefore, to maintain economic sustainability in time of population ageing, policymakers should consider promoting high levels of education in Europe, together with policies aimed at keeping people in the labour market longer and thus financing their own consumption for longer.

The results of this study also offer further research opportunities. The first part of this study, which analysed the direction and value of monetary intra-household transfers given and received across educational levels, could extend the analysis to the structure of intra-household transfers. Such an analysis could shed light on whether individuals with different educational level prioritise transfers for education, health or other needs. Moreover, the first part of this study is limited to intra-household transfers, and many older individuals live in different households than their children and grandchildren. To get a clearer picture of the total transfers received by the elderly, the study could be extended to include estimated inter-household transfers.

This research has also shown the impact of educational level on the household production of unpaid work. Future research in this area could also consider estimating the market value of the household production and consumption of unpaid work, which would then make it possible to assign a monetary value to the intra-household time transfers. Extending the input-output matrices of intra-household monetary transfers to include the estimated value

of intra-household time transfers would give a better insight into investment in children andthus human capital by educational level.

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APPENDIX

Appendix 1: Summary in Slovenian language / Daljši povzetek disertacije v slovenskem jeziku

Prozivodnja, potrošnja in transferji po izobrazbenih ravneh

Gospodarska rast zmanjšuje revščino ter povečuje življenjski standard in splošno blaginjo prebivalstva. Odvisna je od ekonomske vrednosti, ki jo ustvari delovna sila (Adams, 2003; Roemer & Gugerty, 1997). Življenjski cikel človeka se poleg presežka, ki ga ustvarja delovno sposobno prebivalstvo, začne in konča z obdobjem odvisnosti. Otroci in starejši imajo večje potrebe po potrošnji v primerjavi s svojo proizvodnjo, zato je njihova blaginja v veliki meri odvisna od tokov ekonomskih virov delovno sposobnega prebivalstva s presežkom proizvodnje (R. Lee et al., 2008; R. Lee & Mason, 2011b).

V 20. stoletju so številne države izkusile učinke demografske dividende, tj. gospodarske rasti kot posledice vse večjega deleža delovno sposobnega prebivalstva in zmanjševanja deleža vzdrževanega prebivalstva (Bloom et al., 2003a; Lindh & Malmberg, 1999). Vendar pa se je kasneje zaradi nizke rodnosti začel zmanjševati delež delovno sposobnega prebivalstva, zaradi daljšanja življenjske dobe pa povečevati delež starejšega prebivalstva. Proces staranja prebivalstva je v mnogih državah, zlasti v državah z visokim dohodkom, povzročil premik v starostni porazdelitvi v smeri starejših (UN DESA Population Division, 2001). Za Evropsko unijo (EU) naj bi se povprečna starost prebivalstva povečala s 43,7 leta v letu 2019 na 48,2 leta v letu 2050. Leta 2050 bosta delovno sposobni manj kot dve osebi (20–64-letni) za vsako osebo, staro 65 let in več (Eurostat, 2020).

Naraščajoči delež starejših povečuje potrošniške potrebe, predvsem v obliki pokojnin, pa tudi v obliki zdravstvenega varstva in dolgotrajne oskrbe, ki jih je treba financirati z javnimi transferji ali prerazporeditvami sredstev (npr. odtujitev akumuliranih sredstev iz preteklosti). Narava in obseg te podpore sta odvisna od institucionalnega sistema posamezne države. V Evropi se na primer te potrebe običajno financirajo z javnimi transferji na podlagi socialnih prispevkov trenutno aktivnih delavcev (Loichinger et al., 2017). Dejstvo, da bo delovna sila v prihodnosti manjša in starejša, vzbuja pomisleke o njeni zmožnosti izpolnjevanja potreb starejših (Bloom et al., 2015).

Glede na navedeno je pomembno, kako ljudje določene starosti vire proizvajajo, porabljajo in prenašajo ter kako z njimi varčujejo. Ekonomsko vedenje posameznikov, povezano z zaposlovanjem, potrošnjo, prejetimi ali plačanimi transferji in varčevanjem, se s starostjo spreminja (Bloom et al., 2007; Hamermesh, 1985; Spijker & Macinnes, 2013; UN, 2013). Da bi prepoznale in razumele učinke staranja prebivalstva in prihodnje trende prebivalstva, so se prejšnje študije osredotočile na različne razsežnosti staranja prebivalstva (Lutz et al., 2008).

Učinki individualne proizvodnje, potrošnje in prerazporeditve virov se že nekaj časa analizirajo v kontekstu generacijske ekonomije, vendar je bila metoda za pridobivanje celovitih in primerljivih podatkov o prerazporeditvi virov med različnimi starostnimi skupinami razvita šele pred kratkim s projektom Računi nacionalnih transferjev (NTA). Z uvedbo starostne dimenzije v Sistem nacionalnih računov (SNA) metodologija NTA omogoča izgradnjo starostnih profilov, ki zagotavljajo informacije o stopnji proizvodnje in potrošnje po starosti. Poleg tega omogoča merjenje ekonomskih tokov med različnimi starostnimi skupinami, katerih namen je zapolniti vrzel med potrošnjo in proizvodnjo posameznikov v različnih starostih. Ti tokovi se nanašajo na medgeneracijske prenose in prerazporeditve virov. Izračun NTA tako pomeni ustvarjanje standardiziranega nabora podatkov o starostnih profilih, ki razkrivajo značilnosti ekonomskega vedenja v vsaki starosti in jih je mogoče primerjati med državami (D'Albis & Moosa, 2015; UN, 2013).

Ekonomski življenjski cikel na ravni posameznika kaže, koliko posameznik zasluži in porabi v posamezni starosti v svojem življenju. Obstajajo tri glavne stopnje, za katere so značilne potrošniške potrebe in zmožnosti zaslužka: mladost ali otroštvo, delovna doba in starost ali upokojitev. Poleg starosti je ekonomski življenjski cikel odvisen od mnogih drugih dejavnikov: bioloških, socialnih, demografskih, političnih itd. (UN, 2013). Vsi ti dejavniki vplivajo na odločitve posameznikov in oblikujejo njihovo ekonomsko vedenje v celotnem življenjskem ciklu. Za ekonomsko vedenje je značilna visoka odvisnost v mladosti in starosti. Pri teh starostih potrošniške potrebe presegajo posameznikovo dohodkovno zmožnost, zaradi česar je odvisen od delovno sposobnih posameznikov, ki imajo presežek dohodka nad potrošniškimi potrebami (R. Lee et al., 2008).

Razlika med potrošnjo in dohodkom od dela v vsaki starosti je enaka vsoti neto transferjev in prerazporeditev sredstev. V primeru vzdrževanega prebivalstva, ki ima primanjkljaj v življenjskem ciklu, je razlika med potrošnjo in dohodkom od dela enaka transferjem in prerazporeditvam sredstev, ki jih za pokrivanje svojega primanjkljaja prejme od delovno aktivnega prebivalstva. Po drugi strani pa je presežek delovnega prebivalstva v življenjskem ciklu enak transferjem in prerazporeditvam sredstev, ki jih dajejo tistim, ki potrebujejo pomoč, da pokrijejo svojo potrošnjo (Mason et al., 2009).

NTA je omogočil povsem nov način merjenja tokov prenosa virov med generacijami. To je privedlo do oblikovanja standardiziranega nabora podatkov in starostnih profilov, ki razkrivajo značilnosti ekonomskega vedenja v vsaki starosti in jih je mogoče primerjati med državami (D'Albis & Moosa, 2015).

Transferji v posameznih državah se glede na institucionalni okvir razlikujejo ne le po višini, temveč tudi po smeri, v katero tečejo, pri čemer je smer transferjev odvisna, med drugim, tudi od stopnje razvitosti države. Zaradi staranja prebivalstva se v industrializiranih državah transferji pretakajo od mlajših k starejšim, v državah v razvoju pa od starejših k mlajšim. To še posebej velja za javne transferje (zdravstvo, dolgotrajna oskrba, pokojnine itd.). Nasprotno je z zasebnimi transferji, ki so sestavljeni iz transferjev med gospodinjstvi in

transferjev znotraj gospodinjstev. Transferji znotraj gospodinjstev kažejo striktno smer navzdol v vseh družbah in so tudi eden glavnih prispevkov metodologije NTA (R. Lee & Mason, 2011b).

Transferji so pomembno orodje za zmanjševanje neenakosti, zagotavljanje blaginje prebivalstva vseh starosti in posledično gospodarske rasti. Ker je temeljila na SNA, se je prejšnja raziskava NTA o transferjih osredotočala predvsem na prerazporeditve virov in denarne transferje, dane in prejete prek trga, vlade, med ali znotraj družin. Izračun denarnih transferjev je zagotovil boljšo sliko medgeneracijske odvisnosti in potenciala prihodnje rasti.

Razširitev SNA na satelitske račune gospodinjstev je omogočila zajem proizvodnje gospodinjstev, ki se ne prodaja na trgu. Gospodinjska proizvodnja vključuje vse izdelke in storitve, kot so kuhanje, čiščenje, varstvo otrok in druge, ki so proizvedeni in porabljeni znotraj (in med) gospodinjstvi. Proizvodnja gospodinjstev je zajeta z raziskavami o porabi časa za vsakodnevne dejavnosti posameznika. Uvedba starostne razsežnosti v proizvodnjo gospodinjstev je privedla do priprave Računov nacionalnih transferjev časa (NTTA). Za merjenje netržnega dela gospodarstva se čas, porabljen za različne dejavnosti, običajno monetizira v kombinaciji z denarnimi vrednostmi NTA. Združevanje denarne in časovne proizvodnje in potrošnje NTA v kombinaciji z NTTA omogoča celovito analizo transferjev. V vseh državah so ženske tiste, ki opravijo večino gospodinjske proizvodnje, zato je bila ekonomska vrednost njihove proizvodnje pogosto podcenjena. Raziskave o prenosu časa so zato skoraj neizogibno vključevale razsežnost spola.

NTA je tako zagotovil okvir za vključitev drugih demografskih razsežnosti poleg starosti v študijo ekonomskega življenjskega cikla in s tem povezanih virov. To je pomembno, saj je ekonomski življenjski cikel posameznika določen z gospodarsko dejavnostjo ter mehanizmi in institucijami, ki so prisotne v posameznem gospodarstvu (R. Lee & Mason, 2010, 2011b). Eden najpomembnejših dejavnikov, ki vplivajo na ekonomsko aktivnost, je stopnja izobrazbe posameznika (Barro & Lee, 2013).

Vključevanje izobrazbe v proučevanje vpliva populacijskih značilnosti na gospodarstvo je v dobi staranja prebivalstva postalo še posebej pomembno. Starost in spol sta tipični značilnosti, ki veljata za ključni pri populacijski dinamiki, izobrazba pa je ključna za sicer nezajeto populacijsko heterogenost (Lutz et al., 1998; Lutz, Goujon, et al., 2008).

O vplivu izobrazbe na makroekonomsko uspešnost in gospodarsko rast se že dolgo razpravlja. Čeprav so modeli pokazali, da vključitev izobrazbe kot indikatorja človeškega kapitala v modele proizvodnje pomaga razložiti gospodarsko rast v različnih državah (Mankiw et al., 1992; Nelson & Phelps, 1966), so rezultati empiričnih raziskav dali mešane rezultate, predvsem zato, ker merjenje človeškega kapitala ni bilo dovolj podrobno (D. Cohen & Soto, 2007; de la Fuente & Doménech, 2006). Nedavne raziskave so pokazale povezavo med visokošolsko izobrazbo in gospodarsko rastjo. Ugotovljeno je bilo, da je dvig izobrazbene ravni nujen pogoj za dolgoročno gospodarsko rast, zlasti v smislu prihodnje

makroekonomske uspešnosti (Kotschy & Sunde, 2018; Lutz, Crespo Cuaresma, et al., 2008). Pokazalo se je tudi, da je imela izobrazba ključno vlogo pri gospodarski rasti v preteklosti, zlasti pri demografski dividendi, ki je dosežena s povečano produktivnostjo in inovativnostjo bolje izobraženih posameznikov (Crespo Cuaresma et al., 2014).

Izobrazba, predvsem z vidika produktivnosti, ima pomembno vlogo tudi na mikroravni. Dobičkonosnost in produktivnost podjetij je posebej odvisna od produktivnosti bolje oz. visoko izobraženih delavcev. Dokazano je tudi, da visoko izobraženi delavci ohranjajo višjo raven produktivnosti pozneje v svojem poklicnem življenju (Kampelmann et al., 2018; Lebedinski & Vandenberghe, 2014). Posledično ostanejo na trgu dela dlje, odložijo upokojitev in v svojem življenjskem ciklu zaslužijo več (Geppert et al., 2019).

Te ugotovitve so še posebej pomembne v času staranja prebivalstva, ki potegne za seboj tudi dvig izobrazbe v ekonomiji. Zmanjšanje rodnosti vodi do večjih naložb v izobraževanje na otroka (Heckman & Jacobs, 2010; Prettner et al., 2013). Podobno, podaljševanje pričakovane življenjske dobe povzroči, da so posamezniki sami bolj pripravljeni preživeti več časa v šoli, saj pričakujejo, da bodo imeli koristi od naložb v izobraževanje dlje v življenju (Ben-Porath, 1967; Cervellati & Sunde, 2013; Hansen & Strulik, 2017; Sánchez-Romero et al., 2016).

Dokazi, da bi lahko izobrazba ublažila negativne učinke staranja prebivalstva, so pritegnili pozornost k vključevanju razsežnosti izobrazbe v ekonomski življenjski cikel in transferje tudi v okviru raziskav NTA. Hammer (2015) je na podlagi avstrijskih podatkov v celoti razčlenil NT(T)A tako po starosti kot po stopnji izobrazbe, pri čemer je pokazal razlike v ekonomskem vedenju v življenjskem ciklu med tremi ravnmi izobrazbe: osnovno, srednješolsko in visokošolsko. Večina raziskav NTA je sicer le delno preučevala vpliv izobrazbe na transferje, vseeno pa se je izkazalo, da visoko izobraženi posamezniki manj uporabljajo sistem javnih transferjev, a k njemu prispevajo več (Abio et al., 2017, 2021).

Namen te raziskave je analizirati vlogo izobrazbe v proizvodnji, potrošnji, denarnih transferjih in neplačanem delu ter njen vpliv na prihodnjo ekonomsko vzdržnost. Raziskava se osredotoča na vlogo izobrazbe na treh glavnih področjih.

Najprej analiziram vpliv izobrazbe na tokove transferjev znotraj gospodinjstev med različnimi starostnimi skupinami. Stopnja izobrazbe vpliva na gospodarsko rast in je zato predmet raziskav pri analizi dohodka in vedenja potrošnikov (Abdel-Ghany & Shrimper, 1978; Carroll & Summers, 1991). Ekonomski življenjski cikel določajo potrošniške potrebe v posamezni starosti, dohodek od dela pa je eden od načinov za njihovo pokrivanje (R. Lee et al., 2008; R. Lee & Mason, 2011b). Dohodek od dela, ki ga visoko izobraženi zaslužijo s plačanim delom, je običajno višji od drugih izobrazbenih skupin. To visoko izobraženim omogoča tudi večjo potrošnjo (Abio et al., 2017; Lutz, Crespo Cuaresma, et al., 2008; Perna, 2003). Dohodek od dela zasluži le delovno sposobno prebivalstvo, ki mora del svojega dohodka s transferji nameniti za potrošnjo otrok in starejših. Tako kot na dohodek od dela

in potrošnjo tudi na transferje vplivajo številne družbenoekonomske sile (R. Lee et al., 2008). Čeprav je izobrazbena raven eden od teh dejavnikov, obstaja le malo raziskav o vplivu izobrazbene ravni na javne (ki jih daje vlada) ali zasebne (ki jih dajejo posamezniki znotraj ali med gospodinjstvi) transferje. Večina raziskav se je osredotočila na učinke javnih transferjev na dvig izobrazbene ravni (Abbott et al., 2018; Turra et al., 2011). Dosežena izobrazba je bila uporabljena tudi kot približna spremenljivka za dohodek in/ali socialno-ekonomski status v raziskavah o transferjih in neenakosti (Jiménez-Fontana, 2019; Mejia-Guevara, 2015; Miller et al., 2014; Tovar & Urdinola, 2014). Vpliv ravni izobrazbe na zasebne transferje znotraj gospodinjstev pa še ni bil analiziran. V Evropi je bil NTA glede na stopnjo izobrazbe do neke mere analiziran za Španijo, Avstrijo, Finsko in Združeno kraljestvo (Abio et al., 2017, 2021; Hammer, 2015), vendar so bile vse dosedanje ocene izdelane s kombiniranjem različnih virov podatkov o dohodku in potrošnji. Posledično so bili denarni transferji znotraj gospodinjstev ocenjeni le na podlagi imputacije ravni potrošnje v anketah o dohodku z uporabo različnih značilnosti posameznikov v gospodinjstvu. To je prva študija, v kateri so transferji znotraj gospodinjstev izračunani in ne zgolj ocenjeni. Poleg tega so denarni transferji znotraj gospodinjstev prvič razčlenjeni glede na starost in izobrazbo v input-output matrikah, kar omogoča sledenje tokovom virov med posamezniki določene starosti in ravni izobrazbe. Študija je bila zaradi redke dostopnosti ustreznih podatkov za tovrstne raziskave izvedena za Hrvaško za leto 2014. Anketa o porabi hrvaških gospodinjstev za leto 2014 vsebuje podatke o dohodkih in potrošnji vseh članov gospodinjstva, kar omogoča sledenje transfernih tokov med njimi.

Prvič analiziram tudi vpliv ravni izobrazbe posameznikov na proizvodnjo in potrošnjo neplačanega gospodinjskega dela za devet držav EU. Čeprav neplačano delo uradno ne velja za aktivnost z dodano vrednostjo, močno vpliva in pojasnjuje aktivnost posameznika na trgu. Po odločitvi, da se neplačano delo ne vključi v nacionalne račune, je bilo očitno, da bo skupna gospodarska aktivnost držav podcenjena. Poleg tega, ker neplačano delo opravljajo predvsem ženske, skupni prispevek žensk v gospodarstvu ni upoštevan. Posledično je večina raziskav o gospodinjski proizvodnji in neplačanem delu usmerjenih na spol.

Vendar pa tako kot na plačano delo tudi na neplačano delo vpliva raven izobrazbe posameznika v ekonomskem življenjskem ciklu, zato so nekatere raziskave v okviru NTTA zajele tudi izobrazbo. Zagheni et al. (2015) za Dansko, Francijo, Avstrijo, Nemčijo, Italijo in Španijo ter Jiménez-Fontana (2019) za Kostariko so pokazali, da dvig izobrazbene ravni prispeva k zmanjšanju razlike med spoloma v času, namenjenem neplačanemu delu. Hammer (2015) je v svoji konstrukciji NTA glede na izobrazbo za Avstrijo vključil tako profil proizvodnje kot potrošnje neplačanega dela, pri čemer se je osredotočil na dve široki skupini dejavnosti: neplačano gospodinjsko delo razen varstva otrok in varstvo otrok. Ni pa analiziral vpliva izobrazbe na bolj specifične dejavnosti neplačanega dela, kot so čiščenje, kuhanje in podobno. Poleg tega časa, porabljenega za neplačano delo, ni denarno ovrednotil in tako ni pokazal, koliko bi bilo to neplačano delo vredno, če bi se vštelo v nacionalni dohodek. Zato ostaja analiza neplačanega dela po stopnjah izobrazbe nepopolna. V doktorski

nalogi z najnovejšimi možnimi podatki analiziram vpliv stopnje izobrazbe na proizvodnjo neplačanega dela za devet držav EU: Avstrija (2008), Bolgarija (2001), Danska (2001), Španija (2009), Francija (2009), Madžarska (2009), Italija (2008), Nizozemska (2005) in Slovenija (2000). Zaradi posebnosti ocenjevanja porabe neplačanega dela uporabljam podatke iz leta 2002 še za dve državi EU: Španijo in Italijo. Te države dopolnjujejo seznam držav EU, za katere je takšna analiza mogoča. Prvič prikazujem dejavnosti, v katerih se specializirajo posamezniki z določeno stopnjo izobrazbe.

Na koncu obravnavam vpliv izobrazbe na posameznikov ekonomski življenjski cikel in preučujem njegove posledice za prihodnjo ekonomsko vzdržnost. Zaradi staranja prebivalstva in vse večjega deleža visoko izobraženih so nekatere dosedanje raziskave preučevale vpliv višje stopnje izobrazbe na makroekonomsko uspešnost. Nekatere raziskave zunaj NTA kažejo na pozitivno vlogo višje izobrazbe pri makroekonomski uspešnosti in blaženju negativnih učinkov staranja prebivalstva (Kotschy & Sunde, 2018; Lutz, Crespo Cuaresma, et al., 2008). V okviru NTA raziskava o vplivu izobrazbe na demografsko dividendo za Španijo in Mehiko kaže, da lahko izobrazba izravna negativne učinke staranja prebivalstva (Rentería, Souto, et al., 2016). S preučevanjem tega vprašanja z vidika NTA se podajam na pot, ki doslej še ni bila raziskana. Natančneje, NTA uporabljam po izobrazbenih profilih in ugotavljam razlike v ekonomskem življenjskem ciklu treh različnih stopenj izobrazbe. To se izvaja za 15 evropskih držav: Belgijo, Češko, Estonijo, Irsko, Grčijo, Španijo, Italijo, Latvijo, Litvo, Luksemburg, Madžarsko, Poljsko, Portugalsko, Romunijo in Slovaško. Te države dopolnjujejo seznam, za katere je možna razčlenitev NTA po izobrazbi.

Pridobljeni NTA po izobrazbenih profilih so združeni s projekcijami svetovnega prebivalstva Wittgensteinovega centra za demografijo in globalni človeški kapital (WIC) do leta 2060. Poleg tega sem zagotovila projekcije skupnega dohodka in skupne potrošnje za 15 evropskih držav do leta 2060 in celovito opredelila vlogo izobrazbe pri ohranjanju ekonomske vzdržnosti. Ekonomska vzdržnost se meri kot razlika med dohodkom od dela in potrošnjo. Kot dodaten indikator razlik v projekcijah prihodnje ekonomske vzdržnosti uporabljam NTA razmerje podpore. Rezultati so testirani z analizo občutljivosti.

Posameznikov življenjski cikel, tj. koliko posameznik zasluži in porabi v vsaki starosti, prav tako določa posameznikovo sposobnost dajanja transferjev znotraj gospodinjstva in njegovo ali njeno potrebo po njihovem prejemanju. Transferji znotraj gospodinjstev pomagajo vzdrževanemu prebivalstvu, otrokom in starejšim predvsem pri zmanjševanju razlike med njihovo potrošnjo in prejetimi dohodki. Posamezniki s presežkom življenjskega cikla, torej dohodkom, ki presega njihovo potrošnjo, so tisti, ki so sposobni dajati transferje. Na Hrvaškem presežek življenjskega cikla, ocenjen s konvencionalnim NTA v letu 2014, na splošno ustvarijo osebe, stare od 26 do približno 58 let, ki so del delovno sposobnega prebivalstva.

Poleg starosti, ki določa posameznikovo stopnjo odvisnosti, na dohodek od dela in na raven potrošnje močno vpliva izobrazba. NTA profil nizko izobraženih na Hrvaškem kaže, da ti v

nobeni starosti ne dosežejo presežka v življenjskem ciklu. To pomeni, da je njihova sposobnost prenosa dohodka nizka. Srednje izobraženi imajo presežek v življenjskem ciklu v starosti 26–55 let, vendar največjo pozitivno razliko med dohodki od dela in potrošnjo dosegajo visoko izobraženi. Njihovi dohodki od dela so veliko višji od dohodkov od dela srednje in predvsem od dohodkov od dela nizko izobraženih posameznikov. Poleg tega presežek visoko izobraženih v življenjskem ciklu traja najdlje, okvirno od 26. do 65. leta, kar pomeni, da je hrvaški transferni sistem zelo odvisen od njega. Najvišji in najdlje trajajoči presežek omogoča visoko izobraženim, da dajo večje vrednosti transferjev znotraj gospodinjstva.

Študija transferjev znotraj gospodinjstev je pokazala, da stopnja izobrazbe ne vpliva na smer transfernih tokov. Transferji znotraj gospodinjstev so namenjeni predvsem prejemnikom transferjev z nizko in srednjo stopnjo izobrazbe, starim od 0 do 19 let. Višje vrednosti se prenašajo tudi na srednje izobražene prejemnike v starostni skupini 20–29 let, kamor sodijo tudi študenti. Tako se največje vrednosti znotraj gospodinjstva prenašajo navzdol, od staršev k otrokom, ki se šolajo, ne glede na izobrazbeno stopnjo staršev. Sledijo vrednosti, prenesene s starih staršev na vnuke. Čeprav so starejši od 60 let deležni nekoliko višjih transferjev kot druge starostne skupine odraslih, še vedno prenašajo višje vrednosti na otroke, ki se šolajo, od vrednosti, ki jih prejemajo sami. Vendar je ta študija omejena na transferje znotraj gospodinjstev in veliko starejših posameznikov ne živi v istem gospodinjstvu kot njihovi otroci in vnuki. Za jasnejšo sliko skupnih transferjev, ki jih prejmejo starejši, je treba raziskavo razširiti na medgospodinjske transferje.

Po drugi strani pa posamezniki v starosti 30–59 let praviloma prejemajo najnižje vrednosti transferjev znotraj gospodinjstev. To je v veliki meri skladno z obdobjem presežka v življenjskem ciklu, izračunanim s konvencionalnim NTA, kjer je dohodek od dela višji od potrošnje, kar pomeni, da ti posamezniki večinoma pokrivajo lastno potrošnjo.

Vseeno pa stopnja izobrazbe dajalcev transferjev vpliva na vrednost danih transferjev. Nižje izobražene osebe v starosti 0–19 let, kamor sodijo tudi srednješolci, prejemajo v povprečju najnižje transferne prilive od nižje izobraženih oseb, največje pa od visoko izobraženih oseb. Enako velja za srednje izobražene prejemnike transferjev, stare od 15 do 29 let, kamor sodijo tudi študenti. V povprečju najvišje transferje opravijo visoko izobraženi, in to osebam v starosti 15 do 19 let, z nizko in srednjo stopnjo izobrazbe. Ta starostna skupina vključuje dijake in študente. Poleg transferjev znotraj gospodinjstev, namenjenih otrokom v šoli, so najpogostejši tokovi transferjev med dajalci in prejemniki transferjev iste starostne skupine med zakonci v istem gospodinjstvu. Izjema so le transferji visoko izobraženih k nizko izobraženim in obratno, kjer tega ni bilo mogoče opaziti.

Neplačano delo poteka predvsem v gospodinjstvih in je vir prenosa časa. Tako kot tržna proizvodnja in potrošnja ter tokovi denarnih transferjev tudi na neplačano delo vplivata starost in stopnja izobrazbe. Čas, porabljen za neplačano delo, je tesno povezan s časom, porabljenim za plačano delo. Ta raziskava je pokazala, da osebe z nizko stopnjo izobrazbe

porabijo več časa za neplačano delo v gospodinjstvu kot osebe s srednjo in visoko stopnjo izobrazbe. To velja za vse proučevane države z izjemo Danske in Madžarske.

Nadaljnja analiza neplačanega dela, razdeljenega na varstvo otrok in gospodinjska dela razen varstva otrok, je pokazala, da se proizvodnja gospodinjskih del razen varstva otrok povečuje s starostjo v vseh državah in stopnjah izobrazbe. Vrhunec doseže okoli upokojitvene starosti, ko posamezniki preživijo več časa v svojih gospodinjstvih, nato pa se po 70. letu zmanjša. Še vedno pa obstajajo razlike med posamezniki z različnimi stopnjami izobrazbe v količini časa, ki ga porabijo za gospodinjska dela razen varstva otrok.

Posamezniki z visoko stopnjo izobrazbe večino svojega življenjskega cikla v vseh državah porabijo manj časa za gospodinjsko delo razen varstva otrok kot posamezniki z nizko in srednjo stopnjo izobrazbe. Vendar pa med državami obstajajo razlike. V Bolgariji, Avstriji, Sloveniji in Italiji se količina časa, porabljenega za neplačano gospodinjsko delo razen varstva otrok, začne močno razlikovati med stopnjami izobrazbe že pri 20 letih in ostane različna do starosti. V drugih državah, kot so Francija, Madžarska, Španija in Nizozemska, ljudje z nizko in srednjo stopnjo izobrazbe porabijo podobno količino časa za gospodinjska dela. Količina časa, ki ga visoko izobraženi posamezniki porabijo za gospodinjska dela, je že od začetka precej nižja in se do starosti povečuje precej počasneje. To se odraža tudi v njihovih zaslužkih od plačanega dela, za katerega visoko izobraženi porabijo več časa. Zaslužki visoko izobraženih so precej višji od zaslužkov nizko in srednje izobraženih.

Velike razlike med stopnjami izobrazbe so tudi v količini časa, porabljenega za gospodinjska opravila. Tisti z nizko stopnjo izobrazbe so večino časa namenili drugim gospodinjskim opravilom. V večini držav, razen na Danskem, porabijo približno 70 minut ali več na dan samo za kuhanje in pomivanje posode. Enake dejavnosti trajajo le približno 40 do 50 minut v vseh proučevanih državah razen v Bolgariji.

Obstaja pa ena neplačana dejavnost, za katero visoko izobraženi porabijo bistveno več časa kot nizko in srednje izobraženi: varstvo otrok. V vseh anketiranih državah visoko izobraženi delavci v življenju v povprečju porabijo 30 minut na dan za varstvo otrok. Edina izjema je Bolgarija, kjer so visoko izobraženi za varstvo otrok v povprečju porabili približno 19 minut.

Čeprav je varstvo otrok dejavnost, ki je v glavnem koncentrirana med 20. in 40. letom starosti med posamezniki vseh izobrazbenih stopenj in v vseh državah, imajo posamezniki z nizko izobrazbo otroke najbolj zgodaj, tisti z visoko izobrazbo pa najpozneje. Druga razlika je v tem, da ima visok delež tistih z visoko stopnjo izobrazbe majhne otroke približno iste starosti, medtem ko imajo tisti z nizko stopnjo izobrazbe otroke zelo različnih starosti. To se potem kaže tudi v času, porabljenem za varstvo otrok, saj varstvo majhnih otrok zahteva več časa kot varstvo starejših otrok.

Skrb za otroke pomembno vpliva na zadovoljevanje njihovih potrošniških potreb, ne le z vidika denarnih nakazil, ampak tudi z vidika časa, ki se jim posveti. Otroci, pa tudi starejši, svojih potreb ne morejo zadovoljiti z lastnimi prihodki. Zanašajo se na podporo presežka

delovno sposobnega prebivalstva v življenjskem ciklu. Obseg, v katerem so izpolnjene potrošniške potrebe odvisnega prebivalstva, je ključnega pomena za zagotavljanje gospodarske vzdržnosti.

Konvencionalni NTA preučuje, koliko ljudje zaslužijo in porabijo v vsaki starosti, kar ima za posledico primerljive starostne profile po državah. Analiza, izvedena v tej študiji, kaže, kako se razlikujeta velikost in dolžina presežka v življenjskem ciklu, ustvarjenega v 15 proučevanih evropskih državah. Vendar pa tudi kaže, da se bodo vse države do leta 2060 zaradi staranja prebivalstva predvidoma soočile s težavami v zvezi z zmožnostjo skupnega dohodka od dela, da zadosti skupni potrošnji njihovega prebivalstva. Čeprav so številne evropske države že uvedle ustrezne pokojninske reforme, je treba sprejeti dodatne ukrepe. Ta študija kaže, da bi dvig izobrazbene ravni prebivalstva lahko predstavljal delno rešitev.

Profili NTA, razčlenjeni po stopnji izobrazbe, kažejo, da so v večini držav predvsem visoko izobraženi tisti, ki podpirajo potrošniške potrebe vzdrževanega prebivalstva. Njihov presežek življenjskega cikla je veliko daljši in večji kot pri ljudeh s srednjo in nizko stopnjo izobrazbe. Predvideva se, da bo to pozitivno vplivalo na vrzel med skupnim dohodkom od dela in skupno potrošnjo. Vrzel je v primeru NTA manjša kot v običajnem primeru v vseh analiziranih državah razen v Romuniji. Poleg vpliva na ekonomski življenjski cikel je učinek izobrazbe odvisen tudi od predvidenega deleža visoko izobraženih posameznikov v prihodnosti. Zato se učinek izobrazbe, čeprav se razlikuje glede na državo, odraža v predvidenem 19-odstotnem višjem povečanju povprečnega skupnega dohodka od dela za 15 analiziranih držav glede na skupno potrošnjo v primerjavi s konvencionalnimi projekcijami NTA. Ker pa bo več ljudi pridobilo visokošolsko izobrazbo, se pričakuje, da bo ta stopnja izobrazbe v prihodnosti manj cenjena kot zdaj. Pozitiven vpliv izobrazbe na ohranjanje ekonomske vzdržnosti ostaja tudi po tem, ko se bo v prihodnjih letih znižal pribitek na visoko izobrazbo. To vodi do jasne implikacije, da lahko izobrazba delno izravna učinke staranja prebivalstva.

Ta študija o učinkih dosežene izobrazbe na proizvodnjo, potrošnjo in transferje pa ima tudi nekatere omejitve. Pri študiji transferjev znotraj gospodinjstev je število opazovanj v nekaterih starostnih skupinah transferjev premajhno. Za nekatere od teh skupin sploh ni bilo podatkov. Glede na razpoložljivost podatkov bi se lahko nadaljnje raziskave osredotočile na razširitev metodologije za pridobitev bolj skladnih rezultatov. Poleg tega je bila ta študija omejena le na transferje znotraj gospodinjstev, vendar lahko starejši družinski člani živijo v ločenih gospodinjstvih. Transferji tem družinskim članom so v glavnem pokriti s transferjem med gospodinjstvi. Zato bi lahko z vključitvijo transferjev med gospodinjstvi input-output analiza zagotovila boljši vpogled v razlike v transfernih tokovih do starejših družinskih članov z različnimi stopnjami izobrazbe.

V drugem delu raziskave o razlikah v neplačanem delu po izobrazbi so bili upoštevani podatki, kot so bili dostopni v MTUS. Izvedena ni bila nobena prilagoditev, razen uporabe uteži, ki so že bile na voljo v raziskavah. V nekaterih primerih je bilo število opazovanj zelo

majhno in zato težko primerljivo z drugimi profili. Poleg tega imajo države različne metodologije in različne začetne starosti raziskav. Čeprav je bilo to poudarjeno v metodološkem poglavju te naloge, bi lahko nadaljnje raziskave usmerili v iskanje poti za premagovanje teh razlik.

V tretjem delu študije o vplivu stopnje izobrazbe na prihodnjo gospodarsko vzdržnost je bila uporabljena močna predpostavka, da se starostni in izobrazbeni profili dohodka in potrošnje dela od leta 2010 do leta 2060 ne spremenijo. Poleg tega profili NTA, ki se uporabljajo kot podlaga za projekcije, temeljijo na rezultatih, pridobljenih iz mikropodatkov, končni sklepi pa so podani za makro perspektivo. Čeprav so rezultati NTA prilagojeni agregatnim kontrolam, v tem primeru ESA, teh rezultatov ne bi smeli razlagati kot projekcije, temveč kot izračun, ki daje vpogled v pozitiven učinek povečanega deleža visoko izobraženih pri blaženju pritiska staranja prebivalstva na gospodarsko vzdržnost.

Kljub omejitvam rezultati te študije kažejo pomen izobrazbe v ekonomskem življenjskem ciklu posameznikov in njeno vlogo pri prihodnji ekonomski vzdržnosti. Ne glede na stopnjo izobrazbe so transferji znotraj gospodinjstev usmerjeni navzdol in skrbijo za potrošnjo otrok. Največ v otroke vlagajo visoko izobraženi posamezniki, tako z vidika denarja, ki jim ga nakažejo med šolanjem, kot z vidika časa, ki ga porabijo za varstvo otrok. Malo se znotraj gospodinjstev prenese na starejše, drugi vzdrževani del prebivalstva. Starejši so odvisni predvsem od javnih transferjev, kar je v času staranja prebivalstva problem.

Sistem javnih transferjev je odvisen od dohodkov iz dela delovno sposobnih generacij. Visoko izobraženi z bistveno višjimi dohodki in najvišjim presežkom življenjskega cikla največ prispevajo k ohranjanju sistema javnih transferjev. Presežek, ki ga ustvarjajo visoko izobraženi, bo verjetno ključ do zagotavljanja javnih transferjev za starejše, ki jih ne prejemajo iz lastnega gospodinjstva, in s tem do zmanjševanja podpornega deleža, ki se zaradi staranja prebivalstva povečuje.

Za ohranitev ekonomske vzdržnosti v času staranja prebivalstva bi morali oblikovalci politik poleg ukrepov za daljšo prisotnost na trgu dela in s tem daljšim financiranjem lastne potrošnje razmisliti tudi o spodbujanju visoke stopnje izobrazbe v Evropi.