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Education as a partial remedy for the economic pressure of population ageing

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Abstract

Purpose – Population ageing will bring economic challenges in the future. The purpose of this paper is to examine whether increased educational level could mitigate the consequences of population ageing on economic sustainability, measured as the gap between labour income and consumption.

Design/methodology/approach – Using the National Transfer Accounts (NTA) methodology, the authors decompose labour income and consumption by age and educational level (low, medium and high) and compare obtained age profiles with those calculated conventionally. In addition, using the population projections by age and educational level, the authors project both profiles to 2060 for selected EU countries and assess future economic sustainability.

Findings – The results show that the highly educated have a significantly higher surplus for a longer period then those with lower and medium education. Therefore, the improved educational level of individuals will have a substantially positive impact on labour income in the future—on average by about 32% by 2060 for all EU countries included. However, as the better educated also consume more, higher production does not fully translate into improved economic sustainability, but the resulting net effect is still positive at about 19%.

Originality/value – The authors present for the first time an NTA by education for 15 EU countries and show the importance of including education in the analysis of the economic life cycle. The authors also show that increased educational level will mitigate the consequences of population ageing on economic sustainability in the future.

Keywords Labour income, Consumption, Educational level, Population ageing, Economic sustainability

Paper type Research paper

1. Introduction

The welfare system provides a wide range of basic services, from education and health care to long-term care and pensions. The net recipients of these services tend to be children and the elderly, who are a dependent part of the population, and they are financed predominantly by the

JEL Classification — I25, J11, J18

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working age population, who produces more than they consume. However, economies are facing rapid population change that is causing the share of the working age population to deteriorate. This process is driven by two main factors: low fertility and increasing life expectancy, resulting in a rapidly ageing population. For the European Union, the median age of the population is projected to increase from 43.7 years in 2019 to 48.2 years in 2050. By 2050, there will be fewer than 2 people of working age (people aged 20 to 64) for every person aged 65 and older (Eurostat, 2020). The fact that in the future the workforce will be smaller and older raises concerns about its ability to support the needs of the elderly (Bloom *et al.*, 2015).

Conventionally, economic sustainability has been studied using various age dependency ratios (or their inverse, the age support ratio) based only on the number of individuals of a certain age to estimate the pressure that population ageing exerts on economic sustainability. For example, the old-age dependency ratio shows the number of older people aged 65 and over relative to the working age population (usually defined as aged 20 to 64). On the other hand, the total age dependency ratio captures the total number of economically dependent individuals (individuals under age 15 plus individuals aged 65 and older) relative to the working age individuals (defined as aged 15 to 64) (UN DESA Population Division, 2019). Conventional age dependency and support ratios, however, do not give information about labour income and consumption at a given age. A research step in this direction was taken by the National Transfer Accounts (NTA) project. By disaggregating labour income, consumption, transfers and asset-based reallocations by age, NTA, which are comparable across countries, provide information on how age affects individuals' economic behaviour over the economic life cycle (UN, 2013). This allowed for the calculation of the share of total labour income in total consumption in a given year and resulted in an NTA support ratio, which is a more accurate measure of economic sustainability (Lee *et al.*, 2014; D'Albis and Moosa, 2015).

Nevertheless, many authors argue that dependency and support ratios based only on age still do not reflect true dependency (e.g. Loichinger *et al.*, 2017; Marois *et al.*, 2020). Although age is one of the most important determinants of individuals' economic behaviour (UN, 2013), this behaviour is strongly influenced by social and demographic factors other than age, such as educational level, gender and others. Highly educated individuals, for example, invest longer in their education, and their earnings are lower in the early stages of their career than the earnings of individuals with medium education. However, the growth of their earnings is much steeper than that of the less educated, resulting in significantly higher total earnings over a lifetime (Tamborini *et al.*, 2015; Bhuller *et al.*, 2017). Moreover, participation in the labour force in Europe is positively correlated with educational attainment. This is particularly pronounced at older ages, implying that individuals with higher education also retire later (Loichinger and Prskawetz, 2017). Yet, depending on the country, highly educated individuals may face employability issues early in their careers (ILO, 2020). Strong vocational education can ease the transition from school to work. However, because of technological change, gains in youth employment attributable to vocational education may be offset by lower adaptability and employment later in life, especially in countries that emphasize apprenticeship programs (Hanushek *et al.*, 2017).

Furthermore, the decline in fertility has led to higher investment in human capital per child, especially in their health and education (Lee and Mason, 2010; Prettner *et al.*, 2013). Educational attainment in high-income countries has therefore increased substantially since the 1960s. Each cohort has achieved higher levels of education than the previous one, leading to higher levels of education in the workforce as a whole (Heckman and Jacobs, 2010). Based on the Ben-Porath model (1967), Hansen and Strulik (2017) have provided empirical evidence that the increased life expectancy in the 1970s has led to an increase in higher education between the 1960 and 2000s. Young individuals are expecting more healthy years and are therefore more likely to invest in education (Cervellati and Sunde, 2013; Sánchez-Romero *et al.*, 2016; Strulik and Werner, 2016).

Moreover, higher levels of education among workers have a positive effect on productivity (Lebedinski and Vandenberghe, 2014; Kampelmann *et al.*, 2018). Crespo Cuaresma *et al.* (2014) found that the higher productivity of the better educated, as well as their ability to innovate and adapt to technology, can explain the growth of GDP per worker. Vandenberghe (2017) found that highly educated, older and more experienced workers contribute to total factor productivity growth. Furthermore, Kotschy and Sunde (2018) estimated the joint effect of age and education on macroeconomic performance using extended development accounting models and found that human capital can mitigate the negative effects of population ageing. We study similar questions, but with the aim of contributing to a more accurate measurement of the economic support ratio.

By applying the NTA methodology, we create for the first time an economic life cycle for 15 European Union (EU) countries, disaggregated by age and educational level and compare it to the existing economic life cycle, disaggregated by age only. We multiply the obtained profiles by the projections of population size by age and education and obtain the projections of total labour income and total consumption by 2060 in each of the countries. In this way, we were able to estimate the effect of education on economic sustainability, which is measured as the gap between total consumption and total labour income in an economy. Our results show that the surplus created in the economic life cycle by the increasing number of better educated individuals has a positive impact on reducing the gap between total labour income and consumption by 2060, thereby mitigating the negative effects of population ageing. A sensitivity analysis in which we applied the declining wage premium in the calculation of labour income for high education shows similar conclusions.

Our paper complements recent NTA work that considers other dimensions besides age as important determinants of individual behaviour over the life cycle, such as gender (e.g. Hammer *et al.*, 2020), immigration status (e.g. Tofoska Apostolova *et al.*, 2022), and in particular, education. Hammer (2015) disaggregated the NTA for Austria by age and education level for 2010, Renteria *et al.* (2016) and Abio *et al.* (2017) for Spain and Mexico and Abio *et al.* (2021) by education and family type for Spain, the United Kingdom, Austria and Finland. However, our goal, in addition to analysing other countries, is to measure the impact of changes in educational attainment on economic sustainability.

This paper is organised as follows. Section 2 presents both conventional NTA and NTA by education, as well as the data used for the analysis. Section 3 presents the results of adding education to the conventional NTA methodology in constructing the economic life cycle and the role of education in economic sustainability. Section 4 presents the conclusions.

2. Methodology and data

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

2.1 Conventional NTA

The conventional NTA methodology, as well as the definitions required to construct the NTA are described in detail in the UN (2013) manual. For the specifics of the European NTA see Istenič *et al.* (2016). The basic NTA identity shows that the difference between individuals' consumption and labour income must equal the sum of net transfers and asset-based reallocations. Net transfers are calculated as the difference between transfer inflows (transfers received) and transfer outflows (transfers given), while asset-based reallocations are the difference between asset income and savings (Lee and Mason, 2011), as shown in Equation (1):

$$\underbrace{C(i) - YL(i)}_{\text{Life cycle deficit}} = \underbrace{\tau^{+}(i) - \tau^{-}(i)}_{\text{Net transfers}} + \underbrace{YA(i) - S(i)}_{\text{Asset-based reallocations}} \quad (1)$$

where $C(i)$ denotes consumption, $YL(i)$ labour income, $\tau^{+}(i)$ transfer inflows, $\tau^{-}(i)$ transfer outflows, $YA(i)$ asset income and $S(i)$ savings by age i.

Individuals who earn more than they consume have a life cycle surplus and are usually in their prime working years. Children and the elderly consume more than they earn and therefore have a life cycle deficit. Under the basic NTA identity, this deficit must be covered by the net transfers they receive and/or by asset-based reallocations, which can be either public or private. Public transfer inflows include expenditure on education, health, pensions and other factors and mainly meet the consumption needs of children and the elderly. Public transfer outflows are predominately financed by the workforce in the form of taxes and compulsory contributions on labour, in addition to indirect taxes and other taxes. NTA also estimates private transfers that occur between different households and private transfers within the households, whereby the latter are much larger, in particularly parents financing the consumption needs of their children. Private and public asset-based reallocations include income earned in capital and financial markets, including rents, interest, dividends and corporate shares, for example (Lee and Mason, 2011; UN, 2013).

To obtain the per-capita averages, called "age profiles" in NTA, economic flows by age must be tracked at the individual level. Two main categories of NTA identity are labour income (*YL*) and consumption (*C*), which are also the focus of our research. Total labour income consists of the gross earnings of employees, including employers' social contributions and the labour income of the self-employed. Estimates for all categories of labour income are based on data from the 2011 European Union Statistics on Income and Living Conditions (EU-SILC) survey, where labour income data refer to 2010.

Total consumption is composed of public and private consumption. According to the NTA methodological framework, total public consumption includes public consumption (1) on education, (2) on health and (3) other than education and health (UN, 2013). Estimates of public consumption by age are based on many different, mainly administrative, data sources. Estimates of public consumption on education are made by combining data on public spending on education with age-specific enrolment data. The estimate of public health consumption, on the other hand, is based on one-year age profiles provided by the Ageing Working Group (AWG) for 2012, which were then adjusted to 2010 aggregate values. Public consumption expenditure other than education and health can be either individual or collective consumption. Individual public consumption depends on the age of the individual and is allocated accordingly, while collective consumption includes the consumption of public goods and is thus divided equally among all individuals. On the other hand, the subcategories of private consumption mainly use the 2010 Household Budget Survey (HBS). In the HBS, data on consumption are collected only at the household level, so different allocation rules must be applied to estimate consumption of each individual. Estimates of individual expenditure on education are based on the number of individuals in a household enrolled in a given level of education. Estimates of individual health expenditures are obtained by regressing household health expenditures on the number of household members in a given 10-year age group. The coefficients obtained are used as relative proportions to allocate total household consumption among household members. A household's private expenditure other than education and health is allocated at the individual level using the equivalence scale. The conventional NTA profiles for the 15 EU countries included in our analysis were previously estimated by Istenič *et al.* (2016).

2.2 NTA by education

The construction of the NTA profiles by education is very similar to the construction of the conventional NTA profiles and result in age- and education-specific NTA profiles that must be consistent with the conventional NTA profiles. In other words, the per capita age- and education-specific NTA profiles multiplied by the age- and education-specific population size, must be equal to the total conventional NTA values in the base year. Since the conventional NTA profiles were created for 2010, to create the NTA by education, we first need data on the population by age and educational level for 2010 as well. To do so we use 2011 census data from the Census Hub (Eurostat). Although the census data are for 2011 and not 2010, we assume that age strongly influences the educational level and that this influence remains the same from 2010 to 2011. We take the 2011 education-specific proportions for each age group and multiply them by the total population in each of the age groups in 2010. The Census Hub data use 1997 International Standard Classification of Education (ISCED) (see Appendix 1) for education levels, which we further combine into three main groups: low (ISCED 0–2), medium (ISCED 3–4) and high (ISCED 5–6). To construct the NTA by education, we use the conventional NTA approach described above but consider educational level in addition to age.

The estimate of total labour income by three levels of education based on the 2011 EU-SILC is the same as for the conventional NTA but considers educational level in addition to age. As with conventional NTA, the consumption of the NTA by education consists of public and private consumption, divided into the same three subcategories. Public expenditure on education is distributed to individuals who aim for a certain level of education. Because data on those aiming for education was not available at the aggregate level, we estimated it from the EU-SILC survey and made two assumptions. The first assumption was that everyone enrolled in a particular educational programme would complete it [1]. The second was that anyone enrolled in or completing a higher education programme must also have completed all lower education programmes. We applied the same principles to estimate private consumption of education, but we used the HBS as the data source. The HBS served as the data source for estimating private consumption for health and private consumption other than education and health. We estimated education-specific private health expenditure by regressing household health expenditures on the number of individuals in each of the 10-year age groups, which were further divided into three education groups (low, medium and high). Public expenditure on health could not be divided by educational groups as AWG data do not contain this information. For private consumption other than education and health, we used the equivalence scale, which does not directly account for the educational level but still reflects the age and educational composition of a household. While collective private consumption is distributed uniformly among individuals of different ages and educational levels, the individual part of private consumption other than health and education was estimated as age- and education-specific.

2.3 Projections and assessment of future economic sustainability

To project total labour income and consumption in selected EU countries, we combine the obtained NTA age and education profiles with the population projections of the Wittgenstein Centre for Demography and Global Human Capital (WIC) by age and education (European Commission, Joint Research Centre, 2018). We use only the Medium (SSP2) scenario, which is considered the most likely path for each country and focus on the period up to 2060, by which time population ageing will be most pronounced. First, we had to make sure that the two data sets match. Population projections are available by 5-year age groups to 100+ years, but we summarise the highest age groups up to 80+ to match available NTA age profiles. Synchronising educational levels between WIC and NTA by education is more challenging (see Appendix 1 for a detailed linkage of the WIC and NTA by education data to ISCED categories). The NTA by education and WIC data sets differ in the allocation of the ISCED 4

("post-secondary, non-tertiary" education) category. NTA follows Eurostat's approach and considers ISCED 4 as part of the medium education category, whereas WIC considers it as part of the "post-secondary education" category. Since neither data set contains data on the population size of those with the ISCED 4 level, we could not simply rearrange the categories to match. Therefore, we used the data from the Eurostat's 2011 Census Hub, which contains information on the share of the ISCED 4 in the total population, to extract it from the WIC "post-secondary education" category and add it to the "upper secondary" category. By rearranging the WIC categories, we were able to match the NTA data by education for 2010. We assumed that the proportion of the ISCED 4 category would remain constant to 2060.

In Figure 1, we show the share of the population with a high level of education by 2060. According to projections for population size, the share of the highly educated is expected to increase strongly in all countries included in our research: 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).

To analyse future economic sustainability, we compare projections for total labour income and total consumption. Technically, we obtain them by multiplying the NTA age profiles of labour income and consumption for 2010 by the WIC projections of population size by age. We repeat the procedure with NTA by education profiles and WIC projections of population size by age and education to determine the impact of education on future economic sustainability. We assume that the 2010 NTA age patterns of labour income and consumption remain unchanged in the future. Since we only compare total consumption to total labour income, the results would be the same if we assumed that both the age profiles of labour income and consumption grow at a selected annual growth rate. However, we also test whether our results are sensitive to the decline in the wage premium for the highly educated, and consequently, to the decline in their labour income.

To determine the extent to which rising consumption levels are covered by labour income, we present two indicators. The first indicator is the conventional NTA support ratio (see, e.g. Prskawetz and Sambt, 2014). This ratio shows the impact of age structure on labour income and consumption in an economy, holding constant all other factors that might affect labour income and consumption. Summing the product of age-specific labour income and population size (total labour income) over the product of age-specific consumption and

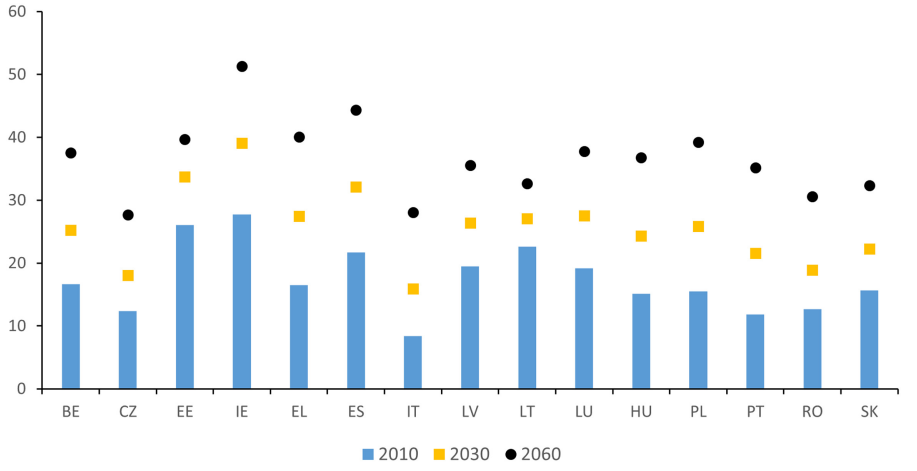

Figure 1.
Share of population with higher education among the total population (%)

Source(s): WIC (2018), authors' calculations

population size (total consumption), we obtain the conventional NTA support ratio (Equation (2)):

$$SR(NTA)_{conv} = \frac{\sum_i n_i yl_i}{\sum_i n_i c_i} \quad (2)$$

where n_i denotes the number of individuals, yl_i labour income per capita, c_i the consumption per capita in age group i (i = 0–4, 5–9, 10–14, . . ., 80+). In the second case, we determine the NTA by education support ratio. This support ratio takes into account the labour income and consumption of each age group and educational level (Equation 3):

$$SR(NTA)_{edu} = \frac{\sum_{i,j} n_{i,j} yl_{i,j}}{\sum_{i,j} n_{i,j} c_{i,j}} \quad (3)$$

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 educational level j (j = low, medium, high).

3. Impact of education on the economic life cycle and economic sustainability

To show the impact of education on the economic life cycle, this section presents education-specific age profiles of labour income and consumption compared to conventional age profiles. To gain better insight into the impact of education on population ageing, we project the obtained age profiles to 2060 and perform a sensitivity analysis to test the results.

3.1 Conventional NTA and NTA by education profiles

For the first time, we have compiled the comparable NTA profiles by education for 15 EU countries in 2010. These countries complete the list of EU countries for which this analysis is possible. Figure 2 shows average labour income and consumption under both the conventional NTA approach and the NTA by education for 2010 for all 15 EU countries included in our analysis combined.

To make the NTA results comparable across countries, we divided all age profiles by the average value of conventionally calculated NTA labour income in the 30–49 age group for each of the countries. The average of all 15 countries shows that the conventionally calculated labour income reaches positive values only at the age of 15. From that point on, labour income increases, forming a bell-shaped curve, before declining again in old age, when people retire. Total consumption, on the other hand, begins to increase at young age, then decreases at working age and increases slightly in old age. The increase in total consumption at young age is due to increased expenditure on education. At older age, total consumption increases mainly due to higher expenditure on health care. However, the age at which labour income falls below consumption also crucially depends on the retirement age in the country. For economic sustainability, it is important to observe by how much and for how long labour income exceeds consumption. This is the age range at which individuals can finance their own consumption and the surplus they generate is transferred to the economically dependent population through transfers and asset-based reallocations. Therefore, retirement age is one of the reasons why the length of this age range varies quite a bit across the countries we included in analysis. Figure 3 shows four selected countries that best illustrate these differences [2].

In the conventional NTA, labour income exceeds consumption on average for all 15 countries between the ages of 27 and 57. In Greece, however, the situation is quite different. They experience the surplus in a much shorter age range, from age 32 to 54, which is only 23 years. The shorter range of the life cycle surplus can be partly explained by the lower retirement age

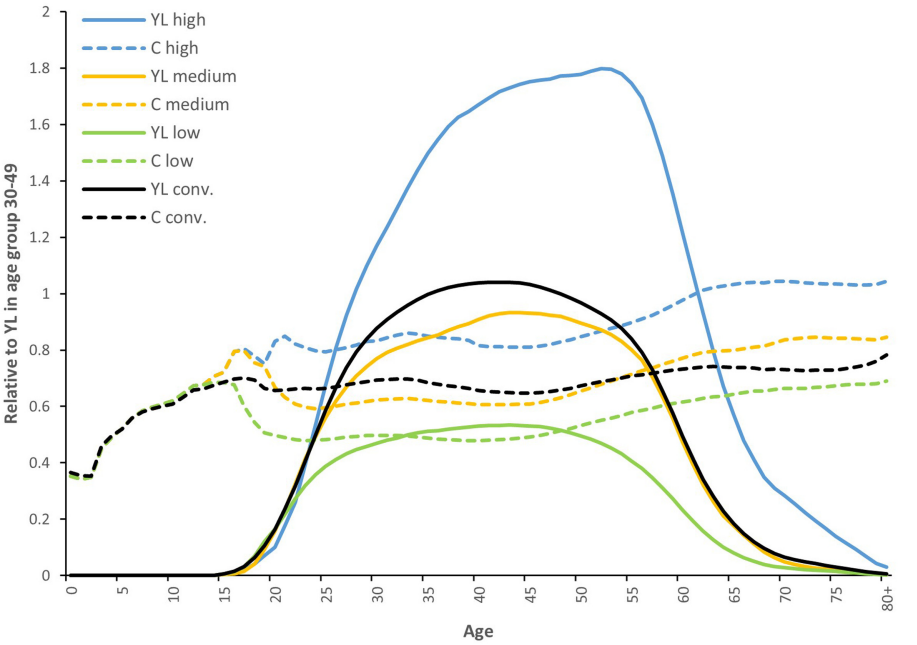

Figure 2.
Labour income (YL) and consumption (C) by age – conventional NTA and NTA by education, average for 15 EU countries in 2010

Note(s): "conv" = conventional NTA, "low" = ISCED 0-2, "medium" = ISCED 3-4, "high" = ISCED 5 or more

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

than in other countries. According to OECD (2011), the retirement age in Greece in 2010 was 57 for both women and men. By comparison, in Slovakia, it was also 57 for women but 62 for men. In Italy, it was 59, in Belgium and Luxembourg 60, and the highest was in Spain, Portugal and Ireland at 65 for both women and men. In addition to low retirement age in Greece, its labour income does not significantly exceed consumption in the surplus area, which means that Greece could face significant problems when it comes to financing the dependent population.

The NTA by education (see Figure 2 for the average of 15 countries) shows that better educated people earn more, but as a direct consequence they also consume more. However, the differences in consumption between educational levels are much smaller than the differences in labour income. In the case of low educational level, labour income does not exceed consumption at any point in the economic life cycle in 4 countries (Lithuania and Greece in Figure 3, but also the Czech Republic and Slovakia). On the other hand, highly educated people enter the workforce later, after having invested heavily in their education. However, they experience a steeper increase in labour income and a significantly higher life cycle surplus then individuals with medium and lower education. They also work the longest, which means they are able to finance their own consumption over a longer age span. In Lithuania, for example, the highly educated experience the life cycle surplus for 33 years (from age 28 to 60), while the low educated experience no surplus at all and the medium educated experience it for only 10 years (from age 30 to 32 and again from age 39 to 45). In Lithuania, then, ensuring economic sustainability depends almost exclusively on the highly educated. In Belgium, by contrast, labour income covers consumption more evenly across educational groups. The low educated receive the surplus for 32 years (from age 23 to 54), the

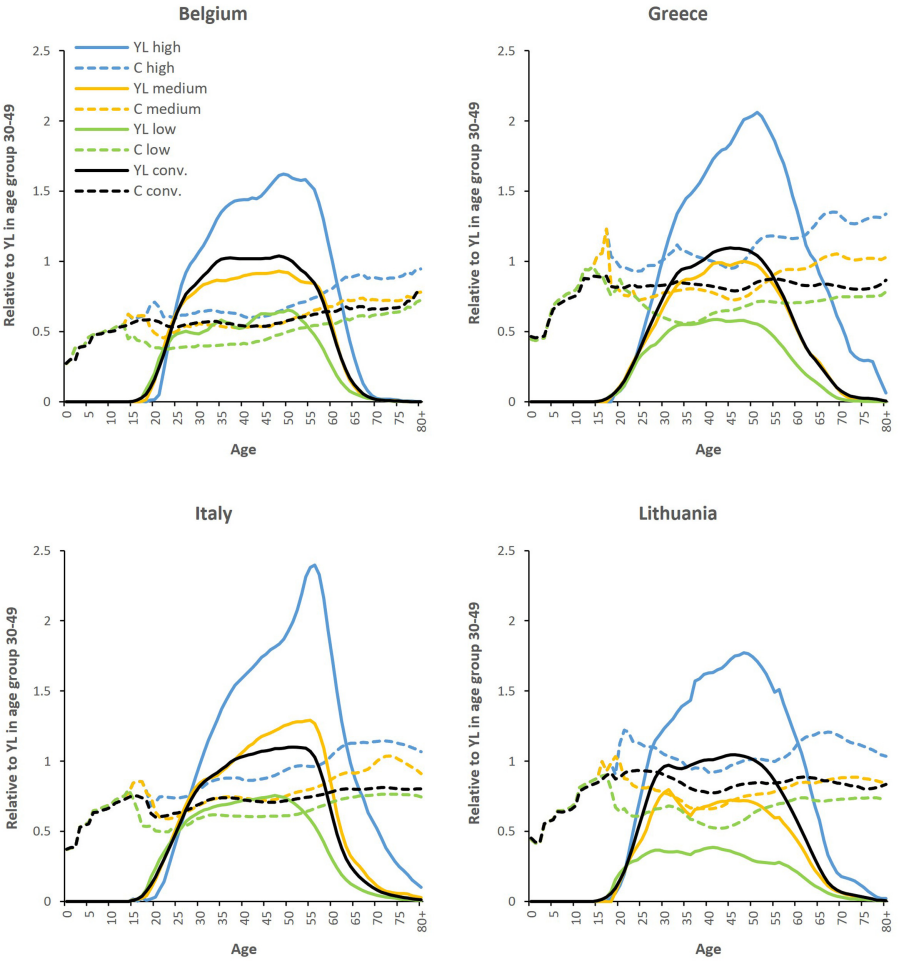

Figure 3.
Labour income (YL) and consumption (C) by age – conventional NTA and NTA by education, four selected EU countries in 2010

Note(s): "conv" = conventional NTA, "low" = ISCED 0-2, "medium" = ISCED 3-4, "high" = ISCED 5 or more

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

medium educated for 36 years (from age 23 to 58) and the highly educated for 37 years (from age 25 to 61). However, the total surplus accumulated by the highly educated in Belgium is still significantly higher than the surplus of the low and medium educated.

3.2 Projections of conventional NTA and NTA by education

To look more closely at the positive impact of high education on long-term economic sustainability, we show the change in conventionally calculated labour income and consumption from 2010 to 2060 and then compare it to the change in projected labour income and consumption by education level (Table 1). In the conventionally calculated case, total consumption and labour income through 2060 depend only on changes in population size and the age distribution of the population. Total consumption in each country varies from a 33% decrease in Romania to an 82%

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*

Table 1. Projected impact of improved educational level on total labour income and total consumption for 15 EU countries

Note(s): 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. $C_{edu}/C_{conv} = \left(\frac{I_{Cedu}}{I_{Cconv}} \times 100\right) - 100$

For the projections of other countries please contact the authors.

Source(s): EU-SILC 2011, HBS 2010, Eurostat database, WIC (2018), authors' calculations

increase in Luxembourg by 2060, and total labour income is projected to decrease by 52% in Romania and increase by 40% in Luxembourg. In comparison, total consumption, calculated by education level is projected to decrease by 17% in Romania by 2060, while total labour income is also projected to decrease, but by 35%. In Luxembourg, total consumption is projected to increase more than in the conventional case by 2060, by 98%, but this increase is also accompanied by an increase in labour income by 77%. The difference due to the inclusion of educational level in the calculations is most apparent when comparing the changes in labour income and consumption in 2060 (compared to 2010) in the conventional NTA with the NTA by education. On average, total labour income by education increases 32% more than the conventional labour income by 2060. However, since the highly educated also consume more, total consumption by education also increases, but only by an average of 13% more than the conventional one. The net effect is positive (19%). Comparing conventional NTA and NTA by education, Portugal, for example, is projected to have the highest increase in labour income by education, 74% higher than the increase in conventionally calculated labour income. This is not surprising as the share of highly educated individuals in Portugal is projected to increase the most by 2060. Moreover, the difference in labour income between those with high education and those with medium and low education was already significantly larger in 2010 compared with other countries. However, this is also followed by the highest increase in consumption by education (32%), compared to conventional projections. Greece (41%), Italy (40%) and Poland (38%) follow Portugal as the countries with the largest difference in total labour income when education is considered. These are also the countries projected to have the highest increase in highly educated population by 2060 (Figure 1).

A smaller gap between the change in total labour income and consumption by education by 2060 in Table 1 means that a higher share of total consumption is covered by total labour income than in the conventional case. Therefore, a smaller share of consumption must be

financed by transfers or asset-based reallocations, which helps maintain economic sustainability. In most countries, despite differences in the economic life cycle by education, the gap is likely to narrow when educational level is taken into account (for a more detailed comparison of four selected countries, see Appendix 2).

To examine the future impact of education on economic sustainability, we project both the conventional NTA support ratio and the NTA support ratio by education through 2060. We observe the extent to which changing shares in educational levels mitigate a decline in the labour income to consumption ratio in the future.

As Table 2 shows, NTA by education support ratio remains significantly higher than that of conventional NTA through 2060. The total labour income of conventional NTA covers less than half of total consumption in Greece and less than 75% in Estonia by 2060, with most of the included countries having support ratios between 55 and 65%. Such low support of total labour income to total consumption puts very high pressure on economic sustainability. In the case of NTA by education, however, support ratios decline much less from 2010 to 2060, with about 70% or more of total consumption remaining covered by labour income in most countries. The only country not projected to experience a decline in education support ratio is Portugal, where the highly educated had a much higher life cycle surplus in 2010 than those with low and medium education. Moreover, the share of highly educated in Portugal is projected to increase significantly by 2060 (Figure 1), despite the decline in total population size. In general, since we leave per capita labour income and consumption at 2010 levels, the increase in the support ratio by education is due to the higher labour income generated by the increased share of highly educated individuals. However, as more people attain high educational levels, we would expect this educational level to be valued less than it is now. Therefore, we test our results by applying the declining wage premium for high education in the future in the next subsection.

	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

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

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

* 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(s): EU-SILC 2011, HBS 2010, Eurostat database, WIC (2018), authors' calculations

Table 2. NTA support ratios (1) by age only $SR(NTA)_{conv}$ and (2) by age and education $SR(NTA)_{edu}$

3.3 Sensitivity analysis

The value of a higher level of education is measured by the wage premium that this level brings compared to a medium level. In our case, the future increase in the number of individuals obtaining a high level of education brings the largest difference in the NTA by education support ratio compared to the conventional support ratio. Therefore we used OECD (2019) data on wage premiums for higher education in our sensitivity analysis, with data being 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, we assume that this change is the same as between these years, with the average wage premium for high education in the countries in our analysis falling by an average of 4.95% over this approximately 10-year long period. Thereafter, we assume that the wage premium will continue to decline by 2.475% points every 5 years throughout the projection period until 2060. As the labour income of highly educated individuals declines, we assume that their consumption premium also gradually declines to the consumption level of those with medium education. To account for the decline in consumption, we calculate the relative change in labour income affected by the declining wage premium for high education. We then apply the obtained relative change in labour income to the consumption of the highly educated to obtain the consumption of the highly educated affected by the declining wage premium. Figure 3 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 declining wage premium to labour income and declining consumption of the highly educated (see Figure 4).

When the declining wage premium for high education is considered, total labour income and consumption levels are still significantly higher than in the conventional case where only the age

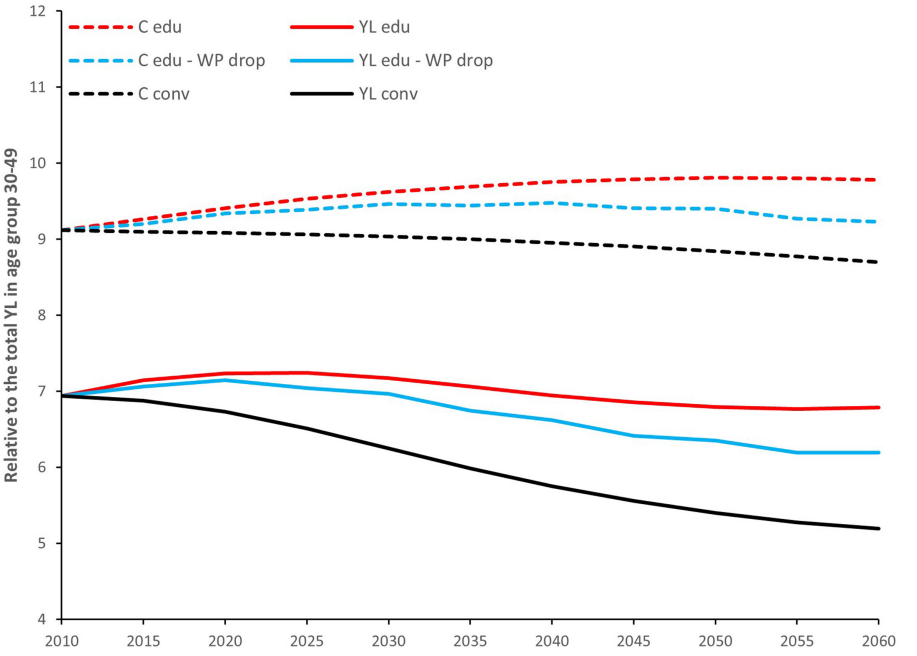

Figure 4.
Sensitivity analysis of projections of total labour income (YL) and consumption (C) levels to 2060, unweighted average for all EU countries included

Note(s): "conv" = conventional NTA, "edu" = NTA by education, "edu – WP drop" = NTA by education with applied declining wage premium (WP) for highly educated

Source(s): EU-SILC 2011, HBS 2010, Eurostat database, WIC (2018), authors' calculations

structure is considered. Similarly, the gap between total labour income and consumption remains smaller than in the conventional case. Therefore, even when the declining wage premium for high education is considered, high education in the total population is projected to have a positive effect, meaning that better education could mitigate the negative consequences of population ageing.

4. Conclusion

As Europe's population ages, economic sustainability depends on the support provided by the life cycle surplus that the working age population creates to meet the life cycle deficit of the dependent population, children and the elderly. The conventional NTA, which provides comparable information on how much people earn and consume at each age, reveals large differences in the size and length of the life cycle surplus among the 15 European countries analyzed. However, it also reveals their common problems. Due to unfavourable changes in age structure, all countries are projected to have significant problems with the ability of total labour income to support the total consumption of its population by 2060. European countries have already adopted a number of pension reforms to partially alleviate this problem, but age-related public expenditures are still expected to continue to increase (EC, 2018). Therefore, additional measures are needed, such as increasing the educational attainment of the population.

This paper adds educational level to the conventional NTA. The calculated NTA by education shows that highly educated individuals have a significantly longer and larger life cycle surplus than individuals with medium and low education. This also shows that the life cycle surplus of the highly educated is the main source of support for the life cycle deficit of the dependent population in a majority of countries.

The projections of total labour income and total consumption by education show that the gap between the two is smaller than in the conventional case in all countries studied except Romania. The effect of education varies by country as it depends on the differences in the economic life cycle between different levels of education and the projected increase in the share of the highly educated in the total population of each country. Nevertheless, the average total labour income for 15 countries analysed is projected to increase by 19% more than total consumption when educational level is included in the analysis. The results show that education has a positive impact on economic sustainability even if we apply the diminishing wage premium for high education, which clearly implies that education can be seen as a partial remedy to mitigate the effects of population ageing. Moreover, our results clearly indicate that future NTA outcomes projecting the NTA support ratio should take into account changes in the educational attainment of individuals in addition to changes in the age structure of the population.

Our projections assume that the age- and education-specific profiles of labour income and consumption from 2010 do not change during the projection period. Although we draw macro conclusions in this paper, our results are often based on micro data from surveys, adjusted in a way that, multiplied by the projected population size, they match the aggregate controls – most frequently the data from the System of National Accounts. Therefore, the results depend on how well individuals included in surveys represent the total population. Given these limitations, our results should not be interpreted as forecasts, but rather a calculation exercise that provides insight into the positive impact of education in mitigating the pressure of population ageing on economic sustainability.

Policymakers should consider promoting high levels of education in Europe, along with policies that encourage people to stay longer in employment, as the main solution for maintaining economic sustainability in the future. This is even more true if we consider that, according to the NTA, public and private spending on education are treated as consumption and not as investment that has a positive impact on economic growth in the long run. We should also keep in mind that public spending on health is not disaggregated by education

level, which means that public spending on health for the highly educated is expected to be even lower in the future than projected in this paper.

Notes

1. We could make this assumption because education level is used here to estimate consumption of public education. When individuals enrol in a given level of public education, the cost of their education has already been incurred, regardless of whether they complete the enrolled programme or not.
2. For the age profiles of other countries please contact the authors.

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Appendix 1

Classification of educational levels according to ISCED, WIC and NTA

For the decomposition of NTA by educational level, we used the ISCED classification. ISCED 1997 consisted of 7 educational levels, while the ISCED 2011 (valid since 2014) consisted of 8 categories. The only difference between the two was in the high education category. This category in ISCED 2011 was divided into 4 categories instead of 2, namely ISCED 5–8 instead of ISCED 5–6 (UNESCO Institute for Statistics, 2012). For a comparison of the classification of educational level by ISCED, WIC and NTA, see Tables A1 and A2.

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(s): UNESCO Institute for Statistics (2012)

Table A1. ISCED and NTA by education classification

Appendix 2

Total labour income and total consumption for four selected countries to 2060

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
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(s): WIC (2018)

Table A2. WIC classification of education

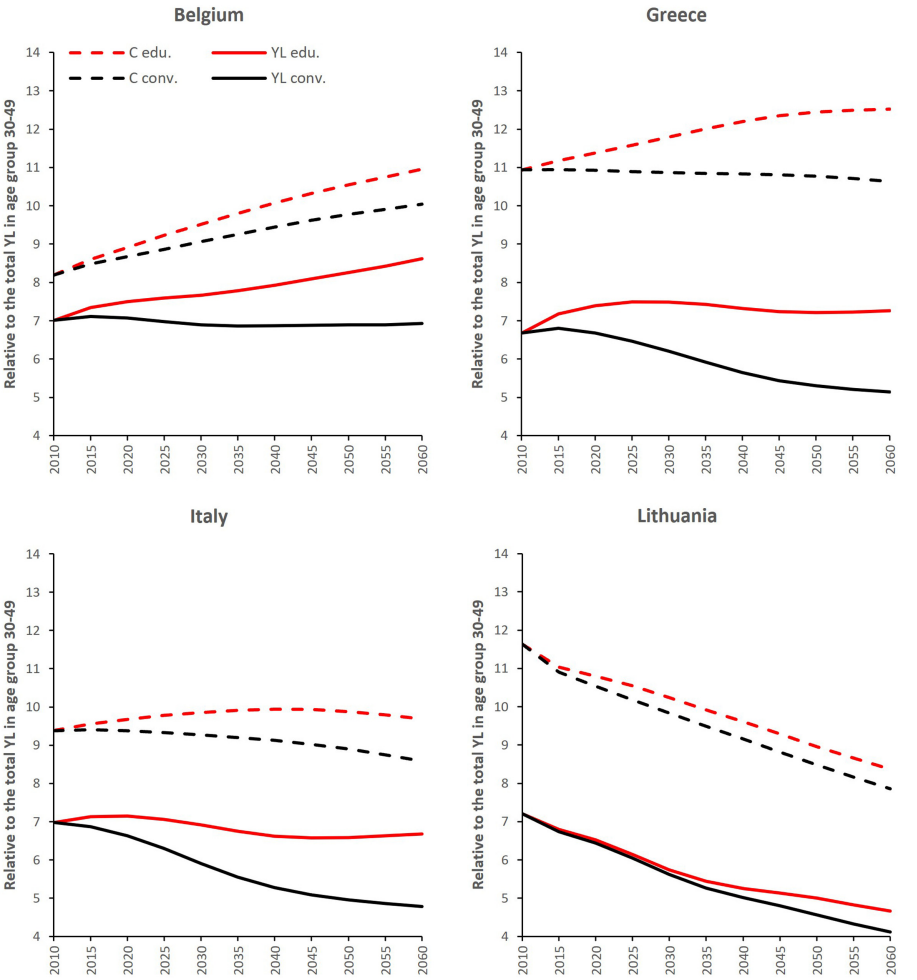

Figure A1.
Projections of total labour income (YL) and total consumption (C) for four selected EU countries to 2060

Note(s): "conv" = conventional NTA, "edu" = NTA by education

Source(s): EU-SILC 2011, HBS 2010, Eurostat database, WIC (2018)

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