Does education matter? – economic dependency ratios by education

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Abstract

When studying the economic consequences of changes in the age structure of the population, looking at economic dependency ratios provides us with some descriptive and intuitive initial insights. In this paper, we present two economic dependency ratios. The first ratio is based on economic activity status, and relates the number of dependent individuals to the number of workers. The second dependency ratio relates consumption to total labour income. To build up the second ratio, we rely on the recently set up National Transfer Accounts (NTA) for Austria. Simulations of the employment-based dependency ratio with constant age-specific employment rates indicate that the employment-based dependency ratio will increase from 1.23 in 2010 to 1.88 in 2050, based on a population scenario that assumes low mortality, medium fertility and medium migration in the future. The corresponding values for the NTA-based dependency with constant age-specific labour income and consumption are 1.12 in 2010 and 1.49 in 2050. We then compare how the dependency ratio would differ if we accounted for the increasing levels of educational attainment. While the education-specific age patterns of economic activities are kept constant as of 2010, the changing educational composition up to 2050 is accounted for. In Austria, higher educated individuals enter and exit the labour market at older ages and have more total labour income than lower educated individuals. Our simulations of the education-specific economic dependency ratios up to 2050, based on the optimistic projection scenario of low mortality and high educational levels in the future, show that the employment-based ratio will increase to 1.68 and the NTA-based dependency ratio will rise to 1.28. These increases are still considerable, but are well below the values found when changes in the educational composition are not taken into account. We can therefore conclude

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that the trend towards higher levels of educational attainment may help to reduce economic dependency.

1 Motivation

In recent decades, low fertility rates combined with increasing shares of the population surviving to old ages have induced a shift in the age structure of the populations in most industrialised countries towards older ages. Because consumption by elderly people is largely financed through transfers from the working-age population, these developments are putting pressure on the funding of public transfer systems. A second channel for financing consumption at older ages is through asset-based age reallocations, such as the accumulation of capital. The extent to which these different types of reallocations support consumption by older people is determined by the institutional settings of a given country, including its pension system, the organisation of its health and elderly care systems, and its financial and housing markets. Most importantly, the share of the population who are economically active and of working ages plays a central role in the robustness of these systems, since people who are working finance the public transfers through taxes and social security contributions that are linked to their labour income. It is therefore imperative that we gain a better understanding of how the ratio of dependent people to economically active people will change in the future, and of the policy approaches that are likely to facilitate the sustainable development of social security transfer systems, without overburdening the individuals who provide the transfers.

Most of the recent studies on the sustainability of social security systems have focused on two important parameters: the retirement age and the benefits received at older ages. It is often argued that delaying retirement not only decreases the share of dependent people, but increases the contributions paid into the system by the working-age population. We argue in this paper that encouraging higher levels of educational attainment might be a further important investment, as improvements in education may induce various behavioural changes that are conducive to the sustainable development of social security systems. Although higher educated individuals enter the labour market at older ages, they continue working until older ages and have higher levels of productivity and total labour income than lower educated individuals (EUROSTAT 2018). Higher educated individuals might therefore contribute larger transfer amounts at working ages than their less educated counterparts. On the other hand, compared to lower educated people, higher educated people might receive larger transfer amounts at older ages because they have more generous pension benefits and their life expectancy is higher (Philipov et al. 2014).

It is also possible that compared to their lower educated counterparts, higher educated individuals will receive less health and elderly care, given that education is positively related to health behaviour and healthy lifestyles (although these

effects may differ across European welfare states, as shown in Avendano et al. (2009); reduced mortality and disability with higher education is reported in KC and Lentzner (2010)). Whether the changing educational structure alleviates the pressure on social transfer systems caused by demographic ageing will depend on the cost of education and the extent to which higher educational attainment is associated with higher productivity and larger contributions to the transfer system. To gain some initial insight into these mechanisms, we study age- and education-specific economic behaviour like consumption, employment, and labour income. We base our calculations on education-specific data from the Labour Force Survey and National Transfer Account dataset. In a second step, we combine these cross-sectional age and education profiles with education-specific population projections to simulate economic dependency ratios. By taking into account education-specific economic age profiles and increasing educational attainment, we obtain a lower economic dependency ratio than we do in a scenario in which we ignore the educational heterogeneity of economic behaviour and increasing educational attainment.

The paper is structured as follows. We start in Section 2 with a short review of the literature on approaches to measuring economic dependency and examine the role of education in alleviating the challenges associated with an ageing population. In Section 3, we introduce the concept of National Transfer Accounts (NTA), and present age-specific profiles of NTA for Austria in 2010. In Section 4, we discuss labour market and consumption characteristics by age and education. In Section 5, we combine these age- and education-specific profiles with education-specific population projections to simulate future employment-based and NTA-based dependency ratios. In the final section, we discuss our conclusions.

2 Quantifying economic dependency

Economic dependency ratios are indicators that provide aggregate information on the degree of economic dependency in a given society. Unlike demographic dependency ratios that are based on fixed threshold ages, economic dependency ratios take into account that the types and the intensity of economic activities vary across age groups and individuals.

Dependency ratios are built up by defining functions $Dep(x_i)$ and $Sup(x_i)$, which assign to each individual i a value for the degree of its dependency and its ability to support others (Loichinger et al. 2017). The exact value depends on individual characteristics x_i, such as age, employment status, income, and consumption. Dependency ratios are calculated by summing up the dependency measure and the support measure (i.e., the values of the $Dep(x_i)$ and $Sup(x_i)$ functions) over the population of N individuals, and by relating total dependency to total support:

$$Dependency\ Ratio = \frac{\sum_{i=1}^{N} Dep(x_i)}{\sum_{i=1}^{N} Sup(x_i)}. \tag{1}$$

For the demographic dependency ratio, the dependency measure $Dep(x_i)$ takes the value of one for individuals under age 15 or over age 64, and the value of zero otherwise. The corresponding support measure $Sup(x_i)$ takes the value of one if a person is aged 15–64, and of zero otherwise. In Section 5, we will introduce an employment-based dependency ratio as well as a consumption/income-based dependency ratio.

The concept of the economic dependency ratio is closely related to the concept of the economic support ratio. Dependency ratios measure the number of people (or, alternatively, the share of the population) who rely on others, while support ratios measure the capacity of the active population to provide for the dependent population. Both measures take characteristics other than age into account. For instance, Cutler et al. (1990) defined the capacity to provide economic support by weighting the population with its age-specific labour income. They defined the economic dependency as the population weighted by age-specific consumption. In recent years, similar approaches to measuring the economic dependency and the support capability of people have been introduced. Mason and Lee (2006) and, more recently, Mason et al. (2017) used support ratios based on age-specific labour income and consumption (taken from the National Transfer Accounts project) to study the first demographic dividend across countries and time. Several authors have argued that measures of dependency and support based on chronological age are misleading (Sanderson and Scherbov 2013; Shoven 2010; Spijker 2015), and have suggested using prospective age measures that consider the remaining life expectancy. Moreover, Sanderson and Scherbov (2015) and Barslund and von Werder (2016) introduced alternative indicators that take into account health care and pension costs. Since younger cohorts are healthier than older cohorts, it may be assumed that the former are able to work longer than the latter. When such cohort effects are considered in projections of future levels of economic dependency, it appears that the demographic old-age dependency ratio overestimates the impact of the ageing of the population on public finances. Another interesting application that accounts for health improvements is presented in Muszyńska and Rau (2012), who decomposed the old-age dependency ratio into an old-age healthy and an old-age unhealthy dependency ratio.

A comprehensive overview of efforts to quantify economic dependency based on NTA data for 10 European countries is given in Loichinger et al. (2017). They argued that the level of economic dependency is largely determined by the design of the economic life course; i.e., by the age-specific type and intensity of economic activity. The analysis showed that the level of dependency varies significantly depending on which of five different measures of economic dependency is used. In each specific context, the dependency ratio chosen (e.g., a dependency ratio based on consumption and labour market age profiles versus a dependency ratio based on public sector transfers) is determined by the specific question posed.

Kluge et al. (2014) pointed out that increasing dependency ratios are likely to be a burden during a transitional phase spanning the next three decades, but that smaller cohorts will enter retirement in the years that follow. Kluge

et al. (2014) identified five different areas in which population ageing may have positive consequences in the long run (including educational expansion, lower CO_2 emissions, larger intergenerational transfers in the form of bequests, increases in healthy life expectancy, and increases in the share of lifetime spent working). In particular, changes in the educational composition of the working-age population are expected to have positive effects. Higher educational levels are related to higher levels of labour force participation and to smaller gender differences in the labour force participation rates. The authors observed that while the future labour force is likely to be smaller and older, it is also likely to be more productive due to higher human capital levels. Thus, they argued, economic growth can be sustained despite the ageing of the population. Crespo-Cuaresma et al. (2014) also stressed the importance of education for economic growth. They found that the first demographic dividend was largely an educational dividend.

However, the labour force participation rates for a given educational group may change along with the educational composition of the population. Loichinger and Prskawetz (2017) have shown that given the educational expansion and education-specific patterns of economic activity, the labour supply may not decrease as much as expected as the population ages. Labour force projections up to 2053 for 26 EU countries by age, sex, and highest level of educational attainment are presented in Loichinger (2015). The results indicate that in all of the countries considered, educational expansion and education-specific patterns of economic activity are expected to alleviate the decrease in the labour supply due to the ageing of the population.

Loichinger (2015) summarised several micro-economic, sociological, and psychological explanations for the macro-level trend towards increased labour force participation with higher educational attainment. While education represents only one part of an individual's human capital, it affects the person's productivity and health, which are in turn positively related to his or her labour force participation. Moreover, the opportunity costs of not working are greater for individuals with higher levels of education than for their less educated counterparts.

An alternative measure that can be used to gain insight into the future development of the labour force is the concept of working life expectancy at age 50, as elaborated in Loichinger and Weber (2016). Since the mid- to late 1990s, working life expectancy at age 50 has been increasing in most European countries, in line with increases in healthy life expectancy. Because education is positively correlated with life expectancy and labour force participation, there are pronounced educational differences in working life expectancy at age 50.

At the micro level, several recent papers have considered the capacity to work at older ages. Changes in the skills demanded in the labour market resulting from technological and industrial changes may place older workers at a disadvantage. This issue was recently investigated in Gordo et al. (2013). Based on the results of a study on work tasks for Germany, they concluded that older workers are adapting to changes in the demand for skills, and that higher educated workers are adapting to these changing requirements more quickly than lower educated workers. In the

seventh phase of a project on retirement programs around the world, Coile et al. (2016a) examined the extent to which the work capacity of older workers varies depending on their health. Using three alternative methods for measuring health and work capacity, they found that older workers have a greater capacity to work than their current employment levels would indicate. The gains in the capacity to work based on health have been greatest for older people in the higher socioeconomic status groups. For the US, Coile et al. (2016b) found that higher educated women have a greater work capacity than lower educated women. However, no such effect was found for men. Coile (2015) conducted a comprehensive study of the economic determinants of workers' retirement decisions, which include their public and private pension benefits, their wealth and savings, their health and health insurance, and the demand for their labour. Whether the capacity to work leads people to remain employed depends on institutional frameworks, labour demand, and social norms. Manoli and Weber (2016) showed for Austria that there is a rather low labour elasticity at the extensive margin of 0.6. If the severance payment increases, individuals are willing to delay their retirement only modestly, by around 1.25–1.5 years. In sum, these empirical results indicate that in Austria, retirement decisions are not very responsive to financial incentives. The observation that the pension reforms that were enacted in Austria in 2000, 2003, and 2004 did not result in increases in the labour force participation rate of older workers is also discussed in Schmidthuber et al. (2016). To some extent, the tightening of early retirement options led to increases in the number of claims made in other welfare programs, such as unemployment insurance. Schmidthuber et al. (2016) therefore argued that pension reforms need to be complemented by active labour market measures, including lifelong learning programs, flexible employment schemes, and health provisions. It is, however, possible that the combined effects of increasing educational attainment and pension reforms will lead to a stabilisation of the Austrian labour force up to 2030 (Horvath and Mahringer 2014).

In summary, as this short literature review indicates, ageing populations will face pressure to adapt their economic life courses. If, however, the older people of the future are healthier and better educated than the elderly population of today, they may cope well with these challenges. In this paper, we are particularly interested in exploring how educational expansion will affect economic dependency ratios in the future. We base our education-specific characteristics on the National Transfer Accounts data introduced in the next section.

3 National Transfer Accounts (NTA)[1]

The NTA measure how much income each age group generates through labour and through the ownership of capital; how income is redistributed across age groups

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1   This section is based on Fürnkranz-Prskawetz (2015).

through public and private transfers; and how each age group uses its disposable resources for consumption and saving.[2] In particular, the NTA show how children and elderly individuals finance their consumption through age reallocations. These reallocations can be transfers mediated by the public sector, private transfers, and asset-based reallocations. Asset-based reallocations are defined as asset income (i.e., dividends, interest) minus saving. Positive asset-based reallocations can be generated through asset income or dissaving; i.e., the selling of assets by, for example, drawing on privately funded pensions.

The National Transfer Accounts are consistent with the System of National Accounts. The aggregate values (i.e., the values for the total economy) are derived from National Accounts data. The NTA breaks down the National Accounts by age, and thereby introduces information on the relationship between the age of an individual and his or her economic activities. The NTA dataset contains an extensive number of age profiles with age-specific averages of various economic quantities. A detailed introduction to the methodology is given in United Nations (2013) and in Lee and Mason (2011). Details about the Austrian data are provided in Hammer (2014, Chapter 1) and in Sambt and Prskawetz (2011).

Like in the National Accounts, the account identity in the NTA requires that the disposable income in the form of labour income (YL), asset income (YA), public transfer benefits (T_g^+), and private transfer benefits (T_f^+) equals the use of resources for consumption (C), saving (S), and transfer payments (T_g^-, T_f^-). This identity (Equation 2) holds for all individuals, and, consequently, for all aggregates of individuals, such as households, age groups, and the whole economy:

$$YL + YA + T_g^+ + T_f^+ = C + S + T_g^- + T_f^-. \tag{2}$$

Transfer benefits and contributions are recorded from the individual's point of view. Public transfer benefits consist of benefits such as pensions, health services, and child benefits; while the public transfer contributions consist mainly of taxes and social contributions. Public transfers can be in kind, such as public education, health care, and defence; or in cash, such as public pensions and child allowances.

The *life-cycle deficit* is defined as the difference between age-specific consumption and labour income, and can be derived by rearranging Equation 2:

$$C(a) - YL(a) = YA(a) - S(a) + T_g^+(a) - T_g^-(a) + T_f^+(a) - T_f^-(a). \tag{3}$$

The life-cycle deficit at every age can be financed through net public transfers $T_g^+(a) - T_g^-(a)$ and net private transfers $T_f^+(a) - T_f^-(a)$ or asset-based reallocations, defined as the difference between asset income and savings $YA(a) - S(a)$. The ABR is positive at ages at which asset income is greater than savings, and is negative

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[2]   The NTA methodology is being developed in an international project that currently includes about 50 countries. It was initiated by Ronald Lee from the University of California, Berkeley, and by Andrew Mason from East-West Center, Hawaii. For further information, see also www.ntaccounts.org.

at ages at which savings are greater than asset income. How resources are shifted across ages determines the economic consequences of population ageing. Whether population ageing leads to the accumulation of assets or to the expansion of public transfers programs depends on the use of asset-based reallocations (Mason and Lee 2007, p. 130).

Figure 1 presents the NTA cross-sectional age profiles for Austria in 2010. On the x-axis, we plot age by single years; while on the y-axis, we measure the various NTA profiles in euros per capita. As these profiles indicate, at the beginning and at the end of life are periods with a positive life-cycle deficit in which people consume more than they earn. In between these two periods is a period in which individuals generate a life-cycle surplus and earn more than they consume. These three life-cycle stages are common to all societies. However, the length of these phases of life-cycle deficit and surplus, and the ways these phases are financed, differ across countries. Each country's institutional settings, together with the individual norms and behaviour of the population, shape the specific reallocations across ages in that country. Figure 1 shows for Austria that the life-cycle deficit at young ages is financed almost evenly by public and private transfers. In contrast, the life-cycle deficit at old ages is mostly financed through public transfers, while asset reallocations play a small role only. At very high ages, people receive more in public transfers than they consume; thus, asset reallocation becomes negative, leading to positive savings at these ages. At working ages, individuals earn more than they consume, accumulate assets, and generate private and public transfer outflows to the young and elderly dependent population.

4 Labour market characteristics and consumption by education

Hammer (2015) found that there is considerable individual variation in age-specific economic behaviour based on differences in preferences and life circumstances. Significant heterogeneities are observed across educational groups. The education of individuals influences not only their economic opportunities, including their wages and consumption levels, but their socio-economic behaviour as well. For example, compared to lower educated people, higher educated people are more likely to have a healthy lifestyle, to be engaged in non-manual work, and to exit the labour market at a high age. Consequently, the age reallocation of resources differs across educational groups.

Several countries have already investigated the impact of education on income inequality within the NTA framework (e.g., for Chile see Miller et al. (2014), for Colombia see Tovar and Urdinola (2014), and Turra et al. (2011) for Brazil and Chile). Recently, education-specific NTA age profiles have been set up for selected European countries (e.g., Renteria et al. (2016)).

Figure 1:

Overview of the National Transfer Accounts: age-specific income, transfers, and consumption, Austria 2010

Source: Hammer (2014).

In the following, we present selected age profiles of economic characteristics by education for Austria. We distinguish between three levels of education according to the International Standard Classification of Education (ISCED): (1) less than or equal to ISCED 2, including pre-primary, primary, and lower secondary education; (2) ISCED 3, including upper secondary education; and (3) equal to or higher than ISCED 4, including post-secondary and tertiary education.[3] For an overview of the Austrian educational system and its ISCED levels, see https://bildung.bmbwf.gv.at/enfr/school/bw_en/bildungswege2016_eng.pdf.

Table 1 summarises the distribution of the population by age and educational level in 2010 in Austria, as reported in WIC (2015). It clearly shows that the shares of the younger cohorts who are obtaining an upper secondary or tertiary degree are increasing (ISCED 4). Only about 11% of people aged 80+ have completed higher education, while about 33% of people aged 30–39 have earned a post-secondary or tertiary degree.

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[3]   Note that this choice of educational groups differs from the one applied by Hammer (2015) when setting up education-specific NTA. We have chosen to follow the ISCED classification so that we can combine our education-specific age profiles with the human capital projections provided by the WIC data explorer (http://dataexplorer.wittgensteincentre.org/shiny/wic/).

Table 1:
Population by age and educational level (in %), Austria 2010

Age	≤ ISCED 2	ISCED 3	≥ ISCED 4
10–19	52	48	0
20–29	13	49	38
30–39	15	51	33
40–49	18	55	27
50–59	25	53	22
60–69	32	51	17
70–79	51	38	12
80+	55	33	11

Source: WIC (2015).

Higher education is correlated with higher employment rates (Figure 2),[4] except at younger ages. Individuals with lower education (ISCED 3) enter the labour force earlier than individuals with tertiary education (ISCED 4). The group of people with the lowest level of education tends to experience labour market difficulties (i.e., they are less likely to find a job), and are thus the group with the lowest employment rate. Note that Figure 2 plots employment in full-time equivalents; i.e., working 40 hours per week is regarded as full-time employment. The lower employment rates among women shown in Figure 2 are the result of two effects: on average, women work fewer hours per week and are less likely to participate in the labour market than men. Across all educational groups, women work less than 40 hours per week on average. Part-time work is most prevalent among the lowest educational group (with less than level ISCED 2). For all educational groups, the employment rates of females follow an M-shaped pattern, with women having higher employment rates before the onset of childbearing (in their early twenties); and again in their late forties, when they are spending less time on childrearing and care responsibilities. For males, employment rates are hump-shaped, with a maximum at around the ages of 40 to 50. Males in the highest educational group work even more than 40 hours per week on average at their peak employment ages. Men in the lower educational groups have lower employment rates and are less likely to be in full-time employment than their higher educated counterparts. Because part-time work is not common among men, lower educated men generally have low employment rates.
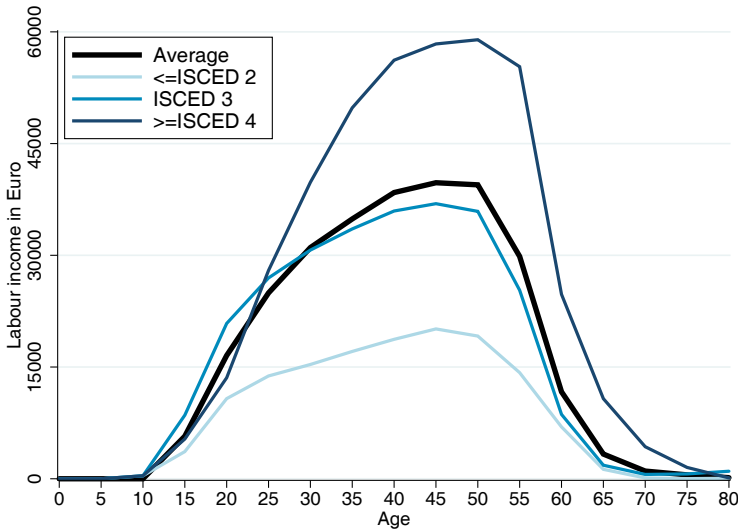
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4   Employment is measured in full-time equivalents; i.e., the total number of weekly hours worked divided by 40.

Figure 2:
Employment rate by age and education in full-time equivalents, Austria 2010
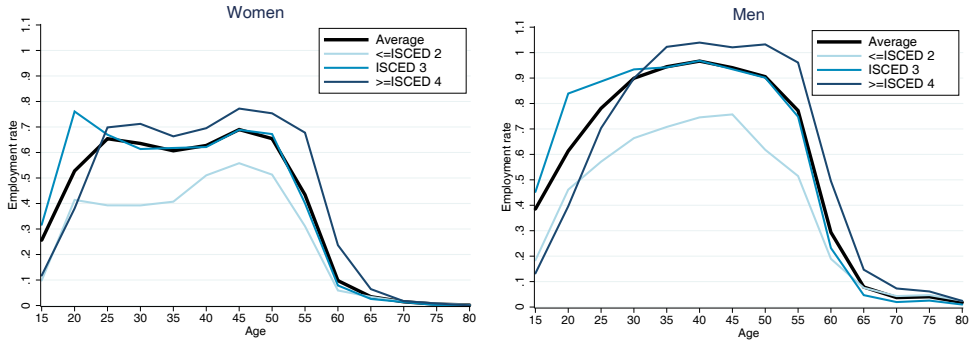
Source: European Labour Force Survey; own calculations.

Figure 3:
Labour income by age and education, Austria 2010
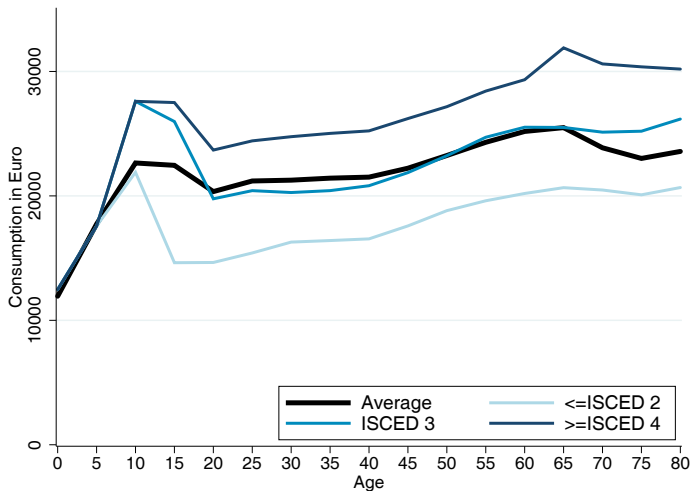

Source: EU-SILC; own calculations.

The difference in employment rates by education together with the difference in wages translate into the difference in labour income by education (Figure 3).[5]

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[5] Note that for income and consumption levels we are not differentiating by gender. These profiles are based on survey data, a distinction by age, education, and gender is not feasible due to small sample size.

Figure 4:
Consumption by education, 5-year age groups, Austria 2010
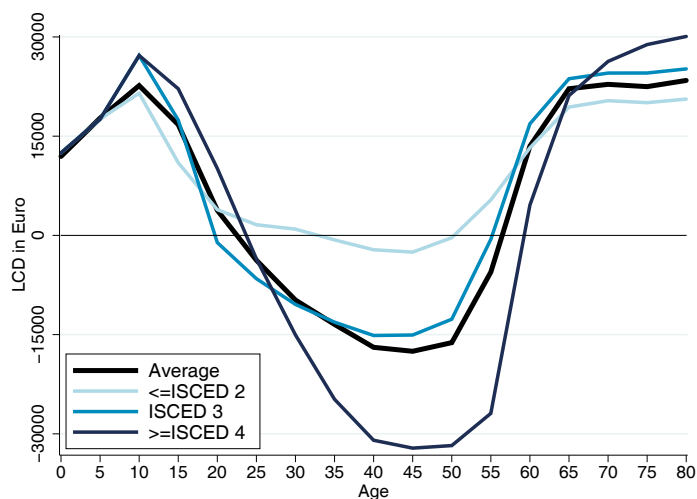

Source: Authors' own calculations based on various sources.

Total private consumption by education (including education, health, and other consumption) is plotted in Figure 4. The lower labour income of people with only basic education translates into lower consumption by this group than by higher educated people. The differences in consumption profiles by education are smaller than the differences in income profiles by education. This pattern can be explained by transfers across educational groups and differences in saving rates.[6]

A comparison of consumption (including private and public consumption) and labour income levels clearly reveals differences in the life-cycle deficit and surplus by education (Figure 5). The life-cycle deficit stays positive until people reach their early twenties, except among the group with upper secondary education, who enter the labour market between age 15 and age 19. Interestingly, the age at which the average age-specific labour income exceeds consumption is postponed to the mid-thirties for the lowest educational group (equal to or less than ISCED 2). The length of the period in which this lowest educational group has a life-cycle surplus (where labour income exceeds consumption) is therefore short, since their consumption again exceeds their labour income starting as early as age 50. The group of individuals with the lowest educational level have considerably lower employment rates and income levels than their better educated counterparts. The length of

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6   Note that consumption includes private and public consumption. We differentiate private and public educational consumption by education, but keep the other forms of public consumption independent of education.

Figure 5:
Life-cycle deficit and surplus by education

the life-cycle surplus is almost the same for individuals with upper secondary, post-secondary, and tertiary education. However, the size of the surplus is much greater for tertiary educated people. The higher labour force participation rates observed for people with upper secondary and post-secondary education implies that they become economically dependent (when consumption again exceeds labour income) at older ages than people with basic education (less than ISCED 2) only. While higher educated people generate a larger economic surplus once they are active in the labour market, Figure 5 indicates that their life-cycle deficit is more pronounced at younger and older ages. This trade-off, together with the composition of the population by age and education, will ultimately determine the economic dependency ratio that we introduce in the next section.

5 Simulating economic dependency ratios – does education matter?

Children and retirees are economically dependent in the sense that they rely on transfers from the employed population. Given the relationship between age and economic activity, the ageing of the population raises concerns that public transfers to the elderly are not sustainable in the future, and require adjustments. Dependency ratios are used to evaluate the pressure on the transfer systems. Based on the education-specific employment rates and the education-specific income and

consumption profiles, we define two alternative economic dependency rates and project them into the future, up to 2050.

The first ratio is based only on employment rates as presented in Figure 2. It takes the age- (a), gender- (g), and education-specific (e) employment rates in full-time equivalents of 2010 $lfpr_{a,g,e}$ and combines them with age-, gender-, and education-specific population numbers $N_{a,g,e}$ provided by the human capital database (WIC 2015):

$$EMPDR_{edu} = \frac{\sum_{a,g,e}(1 - lfpr_{a,g,e})N_{a,g,e}}{\sum_{a,g,e} lfpr_{a,g,e}N_{a,g,e}}. \tag{4}$$

Note that for our simulations we keep the employment rates fixed as observed in 2010, and only vary the population numbers. Summing over all ages, both genders, and all three educational groups gives the number of workers for each year in the denominator. We define the dependent population as the non-employed population. The term non-employed covers all individuals who do not work. Furthermore, individuals who work part-time are also counted as non-employed depending on the degree of their employment. Assuming that a person who works 40 hours a week is considered full-time employed, a person who, for example, works 20 hours a week is counted as 0.5 non-employed and 0.5 employed. Relating the non-employed (numerator) to the employed population (denominator) results in the employment-based dependency ratio ($EMPDR_{edu}$), as given in equation 4 and summarised in Table 2. As a comparison, we build up the same ratio without differentiating by education, and accounting for age and gender only. That is, we take the age- and gender-specific employment rates as observed in 2010 and multiply them with age- and gender-specific population numbers given in the WIC projections to obtain the number of employed people for each year. We then relate the non-employed population to the employed population ($EMPDR_{tot}$), as presented in equation (5):

$$EMPDR_{tot} = \frac{\sum_{a,g}(1 - lfpr_{a,g})N_{a,g}}{\sum_{a,g} lfpr_{a,g}N_{a,g}}. \tag{5}$$

As a comparison, we also present the demographic dependency rate ($POPDR$), for which all individuals under age 15 or above age 64 are counted as dependent, and all individuals between ages 15 and 64 are counted as non-dependent (compare equation 1 in Section 2). Relating the former group to the latter group results in the demographic dependency ratio.

We apply three different population projection scenarios by education that refer to three different Shared Socioeconomic Pathways (SSPs). SSPs have been developed as input for integrated scenarios of climate model projections that combine environmental, socio-economic, and climate policy scenarios (O'Neil et al. 2014). SSPs are set up to reflect plausible socio-economic developments over the time horizon of a century. All the elements of SSPs are given in Table 1 in O'Neil et al. 2014, p. 396. They include, for example, demographic characteristics like population growth, economic characteristics like GDP, urbanisation, and international trade. These SSPs are then combined with climate models to study

possible adaptation and mitigation strategies related to these societal trends. Recently, SSPs have been extended by also incorporating educational scenarios (WIC 2015; KC and Lutz 2017). In the following, we briefly describe the main assumptions of the three SSPs we apply.

Population Component of Rapid Development (SSP1): In this scenario, it is assumed that educational and health investments accelerate the demographic transition, leading to a relatively low world population. Consistent with this storyline are assumptions that mortality remains low and levels of education remain high. The fertility assumptions differ across countries. For rich OECD countries, the emphasis on quality of life is assumed to make it easier for women to combine work and family. Thus, further fertility declines are unlikely in this scenario. For this reason, the medium fertility assumption was chosen for this group of countries. Low fertility assumptions were chosen for all other countries, based on the expectation that the demographic transition will continue at a rapid pace. Migration levels were assumed to be medium for all countries under this SSP.

Population Component of Medium Development (SSP2): This scenario can also be seen as the most likely path for each country. It combines for all countries medium fertility with medium mortality, medium migration, and the Global Education Trend (GET) education scenario.

Population Component of Stalled Development (SSP3): In this scenario, a stalled demographic transition is assumed. Fertility is assumed to be low in the rich OECD countries and high in the other country groups. Hence, population growth is assumed to be high in developing countries and low in industrialised countries. Furthermore, high levels of mortality and low levels of education are assumed for all country groupings. Due to the emphasis on security and barriers to international exchange, migration is assumed to be low for all countries.

In Table 2, we summarise how the different SSP scenarios translate into differences in the shares of the working-age population by education for Austria. In the SSP1 scenario, the share of the working-age population with only basic education is assumed to decrease from 25% in 2010 to 9% in 2050. A similar decline in the working-age population with the lowest educational level is assumed in the SSP2 scenario, while a much smaller decline is assumed in the SSP 3 scenario (from 25% to 18%). The share of the working-age population in the highest educational group will more than double in the SSP1 scenario (from 25% in 2010 to 56% in 2050), while it will increase the least in the SSP3 scenario (from 25% in 2010 to 33% in 2050). In the SSP2 scenario, the shares of the working-age population in 2050 in the medium and the highest educational groups are quite close, at 42% and 48%; while in the SSP1 (high education) and SSP3 (low education) scenarios, these differences are much larger.

Table 3 summarises the projections of demographic and employment-based dependency ratios for the three different SSP scenarios. The values of the demographic dependency ratios are below those of the employment-based

Table 2:
Share of the working-age population (aged 15 to 64) by SSP scenario in 2010 and 2050 (in %)

	SSP1			SSP2			SSP3		
Year	ISCED 2 or less	ISCED 3	ISCED 4 and higher	ISCED 2 or less	ISCED 3	ISCED 4 and higher	ISCED 2 or less	ISCED 3	ISCED 4 and higher
2010	25	50	25	25	50	25	25	50	*25*
2050	9	35	56	10	42	48	18	49	*33*

Source: WIC (2015).

Table 3:
Demographic- and employment-based dependency ratios, projections for Austria

	SSP1			SSP2			SSP3		
					Type of dependency				
Year	POP	EMP_{edu}	EMP_{tot}	POP	EMP_{edu}	EMP_{tot}	POP	EMP_{edu}	EMP_{tot}
2010	0.48	1.23	1.23	0.48	1.23	1.23	0.48	1.23	1.23
2015	0.49	1.23	1.25	0.49	1.23	1.25	0.49	1.22	1.24
2020	0.52	1.28	1.32	0.51	1.27	1.31	0.50	1.26	1.29
2025	0.57	1.37	1.43	0.56	1.36	1.42	0.54	1.34	1.38
2030	0.65	1.47	1.55	0.64	1.45	1.53	0.60	1.42	1.48
2035	0.73	1.53	1.64	0.71	1.50	1.60	0.67	1.47	1.54
2040	0.78	1.57	1.71	0.75	1.54	1.65	0.71	1.51	1.59
2045	0.82	1.62	1.79	0.77	1.58	1.71	0.74	1.57	1.66
2050	0.87	1.68	1.88	0.81	1.63	1.78	0.78	1.64	1.73

Source: Authors' own calculations based on EU-LFS and WIC (2015).

dependency ratios in all three SSP scenarios. For the demographic dependency ratios, all individuals between ages 15 and 64 are treated as not economically dependent. However, many people in this age group are not active in the labour market, or they are not in full-time employment (i.e., they work less than 40 hours a week). On the other hand, there are a few individuals above age 64 who are still in the labour force. These individuals are treated as dependent in the common demographic dependency ratio, even though a small share of them are still working.

For the year 2010, the employment-based dependency ratios that do and do not differentiate by education are equal, since these numbers are based on observed data. However, for all other years, the projections that account for the educational change differ from the projections that ignore education-specific compositional change. From Table 3, we can see that in the SSPI scenario, the employment-based

Figure 6:
Changes of the demographic and the employment-based dependency ratio 2010-2050, SSP1 scenario
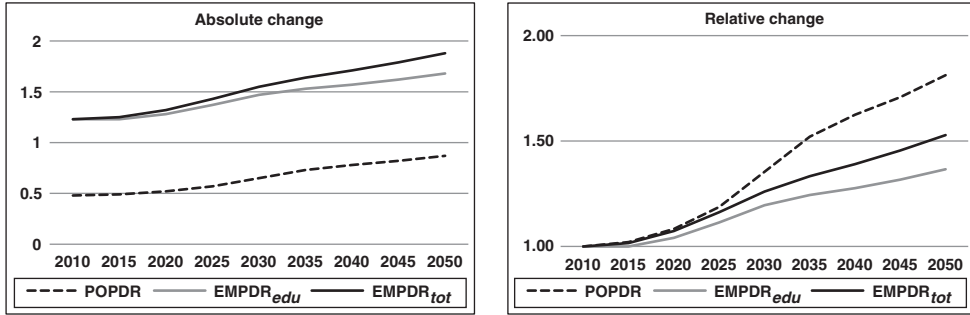
dependency ratio increases from around 1.23 in 2010 to 1.88 in 2050, provided we ignore the change in the educational composition as projected in the human capital database. Alternatively, if we take these changes in the educational composition into account, this ratio increases to just 1.68 in 2050. In the future, increasing levels of education (as projected in the WIC database) will lead to higher numbers of employed people, and to a lower economic dependency ratio. The demographic and the employment-based dependency ratios are lower in the SSP2 and SSP3 scenarios than in the SSP1 scenario. The differences between these scenarios are explained by the higher mortality level in conjunction with the lower educational attainment of the working-age population in 2050 (see Table 2) assumed in the SSP2 and SSP3 scenarios. Obviously, the higher mortality and, hence, the smaller number of dependent individuals outweighs the impact of lower levels of educational expansion and, hence, lower rates of labour force participation. Consequently, the employment-based dependency ratio is lower in the SSP2 and SSP3 scenarios than in the SSP1 scenario. The differences between the education-specific and the non-education-specific projections of the employment-based dependency ratio are smaller for the alternative shared socio-economic pathways of the SSP2 and SSP3 scenarios (since they assume a medium or a low education expansion) than of the SSP1 scenario (see Table 2).

In Figure 6 we plot the changes in all three dependency ratios over time in the SSP1 scenario. The left panel shows the absolute change, while the right panel shows the relative changes. Although the absolute level of the employment-based dependency ratio exceeds that of the demographic dependency ratio, the relative changes in these indicators are in the opposite direction. While the demographic dependency ratio almost doubles from 2010 to 2050, the relative increase in the employment-based dependency ratio is only 50% if we ignore educational heterogeneity ($EMPDR_{tot}$), and is less than 40% if we take educational heterogeneity ($EMPDR_{edu}$) into account.

Figure 7:
Changes of the demographic dependency and NTA-based dependency ratios
2010–2050, SSP1 scenario
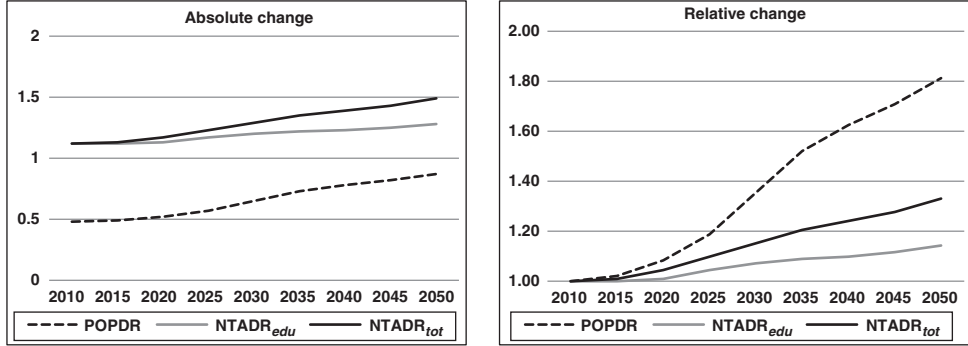
Another variant of an economic dependency ratio is based on the NTA age profiles, and relates the total consumption observed in a specific year to the total income generated in the same year.

We fix the age profiles of consumption and income in 2010, and again distinguish between two variants for the projections. First, we take the age- and education-specific consumption $C_{a,e}$ and labour income profiles $Y_{a,e}$ as of 2010 and multiply them by the age- and education-specific population numbers $N_{a,e}$ in each year of our simulations. Summing over all ages and all three educational groups gives the total amount of consumption and income in each year (Equation 6):

$$NTADR_{edu} = \frac{\sum_{a,e} C_{a,e} N_{a,e}}{\sum_{a,e} Y_{a,e} N_{a,e}}.$$ (6)

Alternatively, we build up the same ratio, but only account for age, ignoring the differences by education (Equation 7):

$$NTADR_{tot} = \frac{\sum_a C_a N_a}{\sum_a Y_a N_a}.$$ (7)

Looking at Table 4, we can see that in the SSP1 scenario, the NTA-based dependency ratio increases from about 1.1 in 2010 to 1.5 in 2050, if we ignore the changes in the educational composition over time. If we take the changes in the educational composition into account, the ratio increases to just 1.3 in 2050. Moreover, as in Table 3, these differences are smaller for the SSP2 and SSP3 projection scenarios. In all three scenarios, the increase in income that is associated with higher educational levels in the future outpaces the possible increase in consumption.

Table 4:

NTA-based dependency ratio based on education-specific data ($NTADR_{edu}$) and independent of education ($NTADR_{tot}$), Austria

	SSP1		SSP2		SSP3	
Year	$NTADR_{edu}$	$NTADR_{tot}$	$NTADR_{edu}$	$NTADR_{tot}$	$NTADR_{edu}$	$NTADR_{tot}$
2010	**1.12**	**1.12**	**1.12**	**1.12**	**1.12**	**1.12**
2015	1.12	1.13	1.12	1.13	1.12	1.13
2020	1.13	1.17	1.13	1.17	1.13	1.16
2025	1.17	1.23	1.17	1.22	1.17	1.21
2030	1.20	1.29	1.21	1.28	1.21	1.26
2035	1.22	1.35	1.23	1.32	1.24	1.30
2040	1.23	1.39	1.24	1.36	1.27	1.32
2045	1.25	1.43	1.26	1.39	1.30	1.36
2050	1.28	1.49	1.28	1.43	1.34	1.40

Source: Authors' own calculations based on NTA data for Austria.

Like the employment-based dependency ratio, the NTA-based dependency ratio exceeds the demographic dependency ratio in terms of absolute values (Figure 7, left panel). Note that in the NTA-based dependency ratio, a person may simultaneously contribute to the numerator (through his or her consumption level) and the denominator (through his or her labour force participation). When we look at the relative changes (Figure 7, right panel), we can see that the NTA-based dependency ratio increases by only around 30% if we ignore the educational composition, and by less than 20% if we take the educational composition into account. These relative changes are smaller than those plotted in Figure 6 for the employment-based dependency ratio. Note, however, that a direct comparison of the two dependency ratios is difficult because they measure different concepts of dependency.

While the employment-based economic dependency ratio measures dependency only in terms of numbers of people, the economic dependency ratio based on the NTA quantifies the degree of dependency. It has already been shown in Loichinger et al. (2017) that the NTA-based dependency ratio is lower than the employment-based scenario. The correlation between the two indicators is not unique across countries, as it will depend on the relationship between the level of consumption and labour income.

Differences in labour force participation, income, and consumption patterns by education are important, and therefore need to be considered when evaluating the degree of economic dependency. Accounting for increasing educational attainment leads to a reduction in the employment-based ratio and in the consumption- and income-based economic dependency ratio.

Our results are contrary to those of Philipov et al. (2014), who showed for Italy that increasing human capital may aggravate the consequences of population ageing if the possibility that public pension benefits will increase with higher levels of

human capital is taken into account. Philipov et al. (2014) defined a human capital-specific old-age dependency ratio that applies weights to each person according to his or her education-specific income for those aged 20 to 64, and according to his or her education-specific gross public pension benefits for those aged 65 and above. Relating the latter group to the former group results in the human capital-specific old-age dependency ratio for this population. The human capital-specific old-age dependency ratio is lower than the conventional old-age dependency ratio. However, the pace at which the indicator changes in the future is faster for the former than for the latter ratio. These results can be explained by the way dependency is defined. A direct comparison of the human capital-specific old-age dependency ratio and our employment- and NTA-based dependency ratio is therefore difficult. Moreover, the focus in our study is to gain insight into whether economic dependency ratios are sensitive to the projected changes in the educational composition, and not into whether education-specific economic dependency ratios differ from demographic dependency ratios, as in Philipov et al. (2014).

6 Discussion

Population ageing will lead to an increase in the retired elderly population relative to the working-age population, and thus to an increase in the demographic dependency ratio. However, the demographic dependency ratio tells us little about economic dependency. Using data on age- and gender-specific working hours, we have introduced the employment-based dependency ratio, which relates the number of employed individuals to the number of non-employed individuals, with employment measured in full-time equivalents. If we assume that current labour force participation rates remain the same, population ageing will lead to an increase in the inactive and economically dependent population relative to the employed population. The employment-based dependency ratio is informative, and represents a considerable improvement over the demographic dependency ratio. However, the level of economic dependency depends not only on the share of dependent individuals, but also on the degree of dependency and the ability of the non-dependent population to provide support. An alternative dependency measure that takes the degree of dependency into account is the NTA-based dependency ratio. This measure is based on consumption demand in relation to income. Using data from the NTA project, we measured economic dependency by relating the total consumption to the total income generated in an economy, while taking into account the age- and gender-specific values of consumption and income.

When projecting economic dependency ratios, a common practice is to multiply age- and gender-specific economic characteristics observed in a given year by age- and gender-specific population projections. Such a shift-share analysis takes changes in the population structure into account, but ignores behavioural changes by keeping age- and gender-specific economic quantities constant. In this paper, we used a shift-share analysis that accounted for changes in the population structure, but

also for changes in the educational composition. Many economic characteristics – like labour force participation, consumption, and labour income levels – vary across educational groups. By combining age-, gender-, and education-specific economic characteristics with education-specific population projections, we have illustrated the importance of taking education into account when estimating future dependency ratios. Indeed, this approach allowed us to relax the static assumption of fixed age- and gender-specific economic characteristics using a rather simple method. As the educational composition changes, the pattern of age- and gender-specific economic activities also changes. Nevertheless, our approach is still static, as we kept the age-, gender-, and education-specific characteristics constant over the projection period. As Loichinger and Prskawetz (2017) have observed, labour force participation rates within educational groups may change as well. We did not account for such behavioural changes in the labour force participation rates or in the consumption patterns. There are, however, plausible scenarios that would project the age-, gender-, and education-specific trends of economic characteristics from the past into the future; or, alternatively, would assume target values in 2050 towards which these age-, gender-, and education-specific patterns may converge. Methodologies that are more sophisticated would be based on computable general equilibrium models that allow for endogenous evolutions of household characteristics when macro-level conditions, like the age structure, change. Whether the inclusion of such behavioural changes in education-specific economic characteristics would further alleviate the projected challenges associated with population ageing remains an open question, as it would depend on how we define economic dependency, and on the extent to which such behavioural changes reduce the dependent population relative to the active population.

While the focus of our previous research (Loichinger et al. 2017) was the comparison of economic dependency ratios with the standard demographic dependency ratios, in this paper we extended our analysis to include two selected economic dependency ratios in order to account for educational heterogeneity. Our underlying hypothesis was that education is positively correlated with labour force participation rates and income, and that an educational expansion might therefore reduce the decline in the labour force due to population ageing. Thus, our aim was to investigate whether the projected changes in economic dependency due to changes in the age composition might be counteracted by taking increasing educational attainment into account.

Our results indicate that when we account for future changes in the educational structure, employment-based as well as consumption- and income-based dependency ratios are lower than in the projections that ignore the trend towards higher educational attainment in the years ahead.

We can conclude that educational expansion is related to changes in behaviour, such as increasing labour force participation and higher productivity. Thus, promoting higher levels of educational attainment could make it easier for countries to address the challenges associated with population ageing. Nevertheless, we also need to be aware that education is not a "free lunch"; and that continued

investment in educational institutions is required. Future research needs to extend our analysis by also studying the trade-off between short-run educational costs and the long-run gains of higher levels of educational attainment. Our analysis is only a first stylised step towards making the argument that educational expansion may be an effective policy approach to reducing economic dependency. Moreover, we have assumed fixed age-, gender-, and education-specific characteristics of labour force participation, and fixed education-specific consumption and income levels. Obviously, such assumptions are quite restrictive, and further work is needed to explain how the behaviour of individuals is likely to change in response to economic and demographic changes.

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