Quantifying Economic Dependency

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Abstract

In this paper we compare several types of economic dependency ratios for a selection of European countries. These dependency ratios take not only into account the demographic structure of the population, but also the differences in age-specific economic behaviour such as labour market activity, income and consumption. In simulations where we combine patterns of age-specific economic behaviour with population projections, we show that in all countries population ageing would lead to a pronounced increase in dependency ratios if present age-specific patterns were not to change. Our analysis of cross-country differences in economic dependency demonstrates that these differences are driven by both differences in age-specific economic behaviour and in the age composition of the populations. The choice which dependency ratio to use in a specific policy context is determined by the nature of the question to be answered. The comparison of our various dependency ratios across countries gives insights into which strategies might be effective in mitigating the expected increase in economic dependency due to demographic change.

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1 Introduction

One of the most challenging developments in European societies is the rapidly changing demographic structure of the population. The age composition of the population is in many European countries shaped by declining sizes of birth cohorts in the last 30 to 50 years. In the European Union about 70 million persons will reach age 60 between 2020 and 2029, while only about 55 million will turn 20, about the average age at which young people enter the labour force (EUROPOP2013, main scenario). Without changes in economic activity this anticipated change in the demographic composition will result in a pronounced reduction of workers compared to elderly persons. This will in particular affect public sector funding: in most European countries the needs of inactive elderly persons are mainly provided and financed by the workers through public transfers, for example pensions, health care and long-term-care. The situation is different in countries like the USA and Mexico where asset income is the most important source of elderly income (Mason, 2013). The expected changes in the age-structure of the population require therefore accompanying adjustments in the economic behaviour of individuals and the design of the transfer system. Understanding the economic consequences of population ageing is not only of importance for policy makers, but also for the society as a whole in order to understand the challenges posed by population ageing for the welfare state. Only with a realistic assessment how demographic change affects the economy and the transfer systems policy makers as well as individuals will be able to make appropriate economic decisions, in particular regarding retirement provision.

A large part of any population is usually economically dependent in the sense that a part of its consumption is financed through transfers from other persons. The dependent population consists most notably of children and retired elderly persons. The needs of children are mainly covered through transfers from the parents, the needs of elderly persons mainly through public transfers from the population which is active in the labour market. The relative size of these groups as well as the degree of the dependency determines the burden for the active population. An increase in economic dependency will lead to a reduction of per capita production and will require a more pronounced reallocation from workers to the dependent population if they are not counterbalanced by a change in economic behaviour.

A group of indicators which provide aggregate information on the degree of economic dependency in a given society are economic dependency ratios. We will introduce and present results for two types of economic dependency ratios: the first type is based on a person's economic activity status and relates the number of dependent persons to the number of workers; the second type relates the consumption of children and the elderly population which is not financed by their own income to income of the working population which exceeds their own consumption. The level of economic dependency depends on both, individuals' economic characteristics and the age-structure of the population, in particular on the share of children

and elderly persons in the total population. We will illustrate in this paper that the level of economic dependency is strongly determined by the design of the economic life course, thus the age-specific type and intensity of economic activities. The economic dependency ratios which we analyse give information about the different mechanism through which economic dependency ratios can be influenced. It includes an increase in economic activity - in particular of women and among older age groups - and changes in income and consumption patterns. The chosen cross country comparisons with different types of dependency ratios should help to identify the most successful strategies for dampening the projected increase in economic dependency and the burden on the active population.

We limit our analysis to the 10 EU countries for which data from National Transfer Accounts (NTA) are available. These data consist of age-specific information on economic activities, in particular the generation of income, consumption and the value of transfers which are paid/received. In the following section we compare three dependency measures starting with standard demographic dependency ratios for 2011 and 2050. These dependency ratios are based on the population structure alone, ignoring any other characteristics of a population, like e.g. individual variation in economic behavior. In order to incorporate this heterogeneity, we introduce a measure of economic dependency which explicitly considers differences by age and between men and women when it comes to economic activity. The most common economic dependency ratio relates the share of those that are not working to those that are working. We calculate such dependency ratios in Section 2.2, also decomposing them into several types of dependency according to the type of economic inactivity. Since this measure does not reflect the intensity of work, we also calculate an adjusted ratio which accounts for the number of hours worked. The two economic dependency ratios calculated in Section 2.3 go one step further and additionally take different age-specific economic needs into account: the NTA based dependency ratio relates the surplus of consumption over labour income of the dependent age-groups to the surplus of labour income over consumption of the working population. Alternatively, we also present a general NTA dependency ratio in which we include asset based reallocations (ABR) in addition to labour income. ABR represent the difference between asset income and savings. These cross-country analyses provide detailed insight into which strategies are most promising in mitigating the expected increase of economic dependency. We compare the effect of selected strategies by creating scenarios and simulating economic dependency until 2050 in Section 3, comparing them also to the traditional projections of demographic dependency. Section 4 consists of a summary and lists policy-relevant conclusions we draw from our analysis.

2 Dependency Measures

2.1 The Demographic Dependency Ratio

The most commonly used dependency ratios are the demographic young age and elderly dependency ratio. The young age dependency ratio relates the number of persons below the age of 20 to the number of persons aged 20-64, the old age dependency ratio the number of persons aged 65+ to those aged 20-64. Adding up both ratios results in the total dependency ratio. The demographic young age, old age and total dependency ratios are compact measures for the age structure of a population. They get an economic interpretation by assuming that children and the elderly are dependent and persons between 20 and 64 are economically active. These measures have the serious drawback as they do not contain any information about actual economic behaviour of individuals, in particular the age of labour force entry and exit. Instead, they assume fixed age limits (age 20 and 65) and do not allow for variation across countries and within countries over time.

Table 1: Demographic dependency ratios, 2011 and 2050

Country	2011 Young	2011 Old	2011 Total	2050 Young	2050 Old	2050 Total	Increase in Total
AT (Austria)	0.33	0.28	**0.61**	0.35	0.51	**0.86**	41 %
DE (Germany)	0.31	0.34	**0.65**	0.34	0.62	**0.96**	48 %
ES (Spain)	0.31	0.27	**0.58**	0.36	0.68	**1.04**	79 %
FI (Finland)	0.38	0.29	**0.67**	0.41	0.46	**0.87**	30 %
FR (France)	0.42	0.29	**0.71**	0.45	0.49	**0.94**	32 %
HU (Hungary)	0.33	0.27	**0.60**	0.36	0.52	**0.88**	47 %
IT (Italy)	0.31	0.34	**0.65**	0.35	0.58	**0.93**	43 %
SE (Sweden)	0.40	0.32	**0.72**	0.43	0.41	**0.84**	17 %
SI (Slovenia)	0.30	0.26	**0.56**	0.39	0.59	**0.97**	73 %
UK (United Kingdom)	0.40	0.28	**0.68**	0.43	0.50	**0.92**	35 %
Average	**0.35**	**0.29**	**0.64**	**0.39**	**0.54**	**0.92**	**43** %

Source: Eurostat, population on January 1st (2011); Eurostat, EUROPOP2013 (2050), main scenario

Table 1 shows the demographic dependency ratio in the European NTA countries. The age structure of the population in these countries is quite different: Finland, France, Sweden and the UK are countries with a comparable large share of young people and a consequently high young age dependency ratio between 0.38 and 0.42. The share of persons below the age of 20 is rather low in Germany, Italy, Spain and Slovenia with a young age dependency ratio of 0.30 and 0.31. Germany and Italy are not only the countries with the lowest share of young persons, but also the countries with the highest old age dependency ratios of 0.34.

The demographic dependency ratios in 2050 are calculated using the EUROPOP2013 population projections (for more details, see section 3.1). The young age dependency ratio in 2050 is projected to be slightly higher than in 2011 in all 10 countries, but it is in particular the old age dependency ratios that are expected to increase notably. The increase of the old age

dependency ratio is projected to be most pronounced in Spain with an increase from 0.27 in 2011 to 0.68 in 2050. The increase is also expected to be high in Slovenia with an increase from 0.26 to 0.59. The projected increase in the old age dependency ratio is moderate in Sweden because of a balanced population structure and a relatively high fertility rate. It is also moderate in Finland, France and the UK due to the current and projected high fertility rates in these countries.

This type of dependency ratio shows nicely the aggregate effects of changes in the age-structure of the population. However, what it eventually comes down to is how to financially sustain an ageing population. Demographic dependency ratios are only of limited use to address this question. Age-specific economic behaviour, e.g. length of schooling, retirement age, employment and unemployment rates, share of persons focusing on household tasks, etc. varies greatly between countries. In contrast to demographic dependency ratios, economic dependency ratios take these cross-country differences in age-specific economic behaviour into account.

2.2 An Economic Dependency Measure Based on Employment

There are several ways to design measures of economic dependency, depending on the purpose for which they are built up. What they all have in common is that they aim at defining peoples dependency in a way that goes beyond the allocation of persons to the dependent group based on strict cut-off ages, as demographic dependency ratios do. Instead, economic dependency is derived by making use of the fact that the type and intensity of economic activity of individuals varies strongly by age. Just as not everyone of working-age is actually working, there are persons beyond the age of 65 that are still employed. Examples of economic dependency measures that incorporate these differences in economic activity are used in Zamaro et al. (2008) and in the EU Publications *The 2012 Ageing Report* (European Communities, 2011) and *Demography, active ageing and pensions* (European Communities, 2012).[1]

Our first measure of current economic dependency is based on age-specific estimates using data from EU-SILC for 2011. To identify working and non-working persons we use peoples self-defined economic activity status. The working, i.e. supporting, population is defined as those who report their economic status as working full-time or part-time, including those who carry out compulsory military or civil service. The non-working, i.e. dependent, population consists of inactive elderly persons, children, the unemployed, persons focusing on household

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[1]The concept of the economic dependency ratio is closely related to the concept of the economic support ratio where the effective number of workers are set in relation to the effective number of consumers (e.g. Cutler et al. (1990); Lee and Mason (2011); Prskawetz and Sambt (2014)). The conceptual difference between dependency and support ratios is the treatment of those that are supporting: in the calculations of dependency, those supporting (in the denominator) do not appear in the numerator as dependents, whereas in the case of support ratios, those supporting (in the numerator) appear as consumers in the denominator as well. We deliberately chose the economic dependency ratio, as compared to a support ration, since our aim is to study whether a more detailed measures of dependency can give a more refined picture than the widely-used demographic dependency ratio.

tasks and other inactive persons. Persons below 16 are treated as students because there is no personal information for the population younger than 16 in the survey. We decompose the total dependency ratio into 5 sub-ratios dependent on the type of (in-)activity: a child-dependency ratio, an unemployment dependency ratio, a domestic worker dependency ratio, a retirement dependency ratio as well as a ratio which includes other types of inactivity. By splitting up the data in this way we gain insight why the dependency ratios vary across countries. This employment-based economic dependency ratio $EbDR$ is calculated as follows:

$$EbDR = \frac{\text{Children} + \text{Unemployed} + \text{Housewives/-men} + \text{Retirees} + \text{Other inactive}}{\text{Workers}} \quad (1)$$

The dependency ratio is high in Spain, Hungary, Italy and Slovenia. In these four countries the unemployment dependency ratio is rather high compared to the other countries in our comparison (Table 2). Italy, Hungary and Slovenia are also the countries with the highest retired dependency ratio. Spain does not have a particular high retired dependency ratio but a high share of unemployed persons in the population, which is not surprising, given that Spain was affected most by the financial crisis of all countries of our analysis. In Italy and Spain, a large share of persons state domestic work as their main activity. Looking at the distribution of economic dependency by age for Spain reveals that the share of housewives is increasing with age, which suggests that there is a strong cohort effect, given that the share of housewives is rather low among persons between ages 30 and 40. Sweden and the UK in return are the countries with the lowest dependency ratio since there is a low number of retirees compared to workers, a rather low share of unemployed persons, and only very few persons who indicate that their main economic activities are domestic tasks. The child dependency ratio is also low in the UK as the education system is compact and young persons enter the labour market at a comparably young age.

Table 2: Employment based dependency ratios by economic status, 2011

Country	Total	In Education	Unemployed	Retired	Domestic Work	Other	Total (FT-Equivalents)	Total (Stand. Pop.)
AT	1.26	0.48	0.09	0.58	0.10	0.01	1.27	1.32
DE	1.18	0.45	0.09	0.56	0.07	0.02	1.24	1.24
ES	1.62	0.58	0.27	0.60	0.14	0.03	1.63	1.79
FI	1.39	0.61	0.11	0.60	0.06	0.01	1.41	1.32
FR	1.42	0.63	0.11	0.61	0.04	0.03	1.47	1.33
HU	1.60	0.60	0.18	0.71	0.07	0.05	1.59	1.64
IT	1.66	0.56	0.15	0.73	0.20	0.03	1.70	1.68
SE	1.10	0.53	0.06	0.46	0.02	0.03	1.30	1.18
SI	1.50	0.59	0.18	0.69	0.02	0.01	1.46	1.61
UK	1.11	0.50	0.06	0.46	0.08	0.01	1.19	1.14

Source: EU-SILC 2011 (Activity); Eurostat, population on January 1st (2011)

Interestingly, with the UK and Sweden being the countries who have the lowest economic dependency ratios, they are - besides Finland and France - the countries that can expect the

lowest relative increase in total demographic dependency between 2011 and 2050 (cf. column 8 in Table 1). Spain in turn is among the countries with the highest economic dependency ratio and is also the country where population ageing is most pronounced, reflected in the strong expected relative increase in the demographic dependency ratio. Figure 1 compares the ten EU countries that are part of this analysis directly in terms of their present levels of demographic and economic dependency. Countries that register relatively similar levels of demographic dependency, like Germany and Italy, can differ significantly when it comes to economic dependency. At the same time, there is a negative correlation between demographic and employment based economic dependency. This is probably the result of some countries already implementing some balancing mechanisms: in countries that have moved or are moving towards a population structure that entails high demographic dependency, measures to react to this development are more likely to already have been undertaken. If these measures are conducive to e.g. higher female employment and later retirement, this is directly picked up by our employment based economic dependency measure $EbDR$.
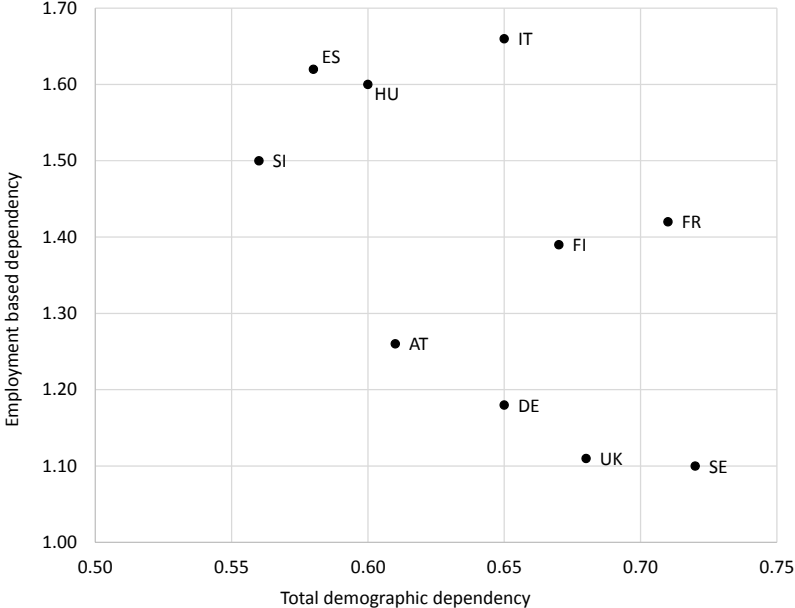

Figure 1: Employment based and demographic dependency ratios, 2011

What this measure and other economic dependency measures based on participation do not consider is the number of hours which are usually worked. Differences across countries in the share of persons who work part-time are thus not picked up. We try to take this into account by calculating the dependency ratios in full-time equivalents (column 8 in Table 2). As full-time equivalent we assume a weekly working time of 40 hours. The information on working time is based on the reported number of hours which are usually worked per week. For most of the countries it makes not much of a difference in the total dependency ratio as the average weekly working time is around 40 hours, the exceptions being Sweden and the

UK. The dependency ratios for these two countries increase considerably, albeit from a very low level, since the usual weekly working time is reported to be much less than 40 hours.

The economic dependency ratios presented so far are a combination of both, age-specific distributions of activity and non-activity, and the respective population structure in each country. To control for demographic differences between countries, one approach is to apply the same population to all countries. This so-called standard population is calculated as the average population structure of the 10 countries, ignoring differences in total population sizes but instead giving each country the same weight. Column 9 in Table 2 shows the total dependency ratio using this standard population. As total economic dependency based on the national population showed, Slovenia, Spain and Hungary are among the countries with the highest economic dependency ratio, and are at the same time countries with an economically favourable demographic structure as a large part of their population is of working age. As the standard population contains relatively more older persons and children, total economic dependency for these countries is therefore even higher when the standard population is applied. The opposite is observed in the two countries with already the lowest economic dependency ratio, UK and Sweden: with the use of the standard population their economic dependency ratios decrease. Still, even given these effects, the influence of the population structure on the country differences in economic dependency is rather low, which supports our earlier statement that older countries are more likely to have already implemented policies to react to their ageing populations.

2.3 Economic Dependency from a Life Cycle Perspective: The NTA Dependency Ratio

The employment based dependency ratio just presented above only takes the production side into account. It ignores different degrees of dependency within the dependent population, as well as the different economic abilities of those who are employed to support others. National Transfer Accounts dependency ratios that we introduce in this section use the difference between average consumption and average production at each age as a measure of dependency and thereby take the age-specific differences in needs and productivity into account. This means that while the employment based dependency ratio is calculated using age-specific activity status, the NTA based dependency ratio rests on age-specific averages of consumption and income.

NTA are a system of satellite accounts which break down the System of National Accounts (SNA) quantities by age, and thereby introduce information on the relation between the age of individuals and their economic activities into the System of National Accounts framework. NTA measure how much income each age group generates through labour and through the ownership of capital, how income is redistributed across age groups through public and private

transfers and how each age group uses its disposable resources for consumption. The dataset consists of an extensive number of age profiles containing the age-specific averages of labour income, consumption, public transers, private transfers, asset income and saving. A detailed introduction to the methodology is given in UN (2013) and in Lee and Mason (2011). NTA data is available for the following European countries: Austria, Finland, France, Germany, Hungary, Italy, Slovenia, Spain, Sweden and the UK.[2]

The age-specific averages of labour income in our application have been estimated from EU-SILC 2011, referring to the year 2010 for all countries. The information on consumption is not available for the same year. We use the relative age profile of consumption from the NTA, referring to various years[3], adjusted to match the values from the SNA 2010.

NTA are based on an accounting identity which states that for each individual, and for each age group, the resources used for consumption (C) and saving (S) equal the disposable income composed of labour income (YL), asset income (YA) and net transfer inflows (τ)[4]:

$$C + S = \underbrace{YL + YA + \tau}_{\text{disposable income}} \qquad (2)$$

A measure for average economic dependency at each age can be derived as the difference between consumption and production. The most common way is to use the difference between consumption and labour income. This measure has been analyzed by gender for several European countries in Hammer et al. (2014). Based on this age-specific dependency measure the economic life course can be divided into three stages: childhood, working age and old age. Children and elderly persons are economically dependent as total labour income falls short of consumption. Working age is defined as those age-groups for which average labour income exceeds average consumption. This qualitative pattern of the economic life cycle is similar in all countries (see also Lee and Mason, 2011).

When age-specific consumption is larger than labour income, consumption can be financed through transfers - private as well as public - and asset based reallocations (ABR) which are defined as asset income minus savings. People can save and produce, buy or inherit assets and use asset income and and the resources from selling assets to finance their consump-

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[2]For detailed description of the NTA results for Finland, Germany, Hungary, Slovenia, Spain and Sweden see Lee and Mason (2011). For the Italian data see Zannella (2013) and for Austria see Hammer (2014).

[3]The base year for the consumption profiles are as follows: Austria 2010, Finland 2004, France 2001, Germany 2003, Hungary 2005, Italy 2008, Slovenia 2004, Spain 2000, Sweden 2003, UK 2007. The use of consumption age profiles from different years should not affect our results much. The historical NTA data show that the shape of the age profiles changes only slowly with time (see e.g. Hammer, 2014, for Austria from 1995 to 2010). Furthermore, consumption of adults is rather constant over the whole adult age range.

[4]Transfer inflows and outflows are recorded from the individuals point of view: inflows constitute the benefits, outflows the contributions to the transfer systems. Public transfer inflows consist for example of benefits such as pensions, health services or child benefits while the public transfer outflows consist mainly of taxes and social contributions.

tion. The exact combination of these components differs across countries. In Europe, the economic needs of children are mainly financed through a combination of public and private transfers, the consumption of elderly persons mainly through public transfers. Taking asset based reallocations into account in addition to labour income introduces a further interesting and important aspect to our dependency measure: the cross country differences in age-specific asset accumulation result in a different degree of economic dependency and differences in the vulnerability of the welfare system regarding demographic change.

We have the data on asset based reallocations available in the NTA results by country - referring to different years in the past. Just like for the consumption age profile we adjust relative age profiles of asset based reallocations to match the aggregate controls in 2010. [5]

Figure 2 shows the age-specific estimates for labour income, consumption and ABR based on NTA results for 2010.[6] To facilitate comparison across countries we depict labour income, consumption and ABR age-profiles relative to average labour income in the age group 30-49 for each country. Compared to the employment rates presented in the Appendix (5.1), average labour income includes not only information on employment but also how the level of wages and labour income from self-employment varies across age.[7] Nevertheless, as with $EbDR$ the cross-country comparison again shows early entering into the labour market in Austria, working till high ages in Sweden and a 'narrow' labour income age profile for Slovenia.

The pattern of consumption is similar across countries. The consumption of young children is lower than of adults because of the equivalence scale used for distributing most of the private consumption expenditures to household members: 0.4 for those age 4 and younger, 1.0 for adults age 20 and older, and a linear increase between age 4 and 20. Nevertheless, in most countries the consumption increases to the level of adults, or even higher, already during school ages because of the high (public) education expenditures. This is especially emphasized in Italy, Slovenia and France. The consumption of adults is rather stable across ages except in Germany and Hungary, where consumption increases to a higher level during their 50s. In Sweden there is a strong increase of consumption above age 70 due to the comprehensive but expensive system of long-term care (see Bengtsson, 2010). For all countries we observe a phase of dependency in young and old age (i.e. labour consumption exceeds income) and a period of surplus (labour income exceeds consumption) during the working ages. However, the shape of the specific age profiles of consumption, labour income and asset based reallocations are different across countries reflecting country specific institutional settings.

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[5] A more detailed description of the data used in the construction of the NTA age-profiles is given in the attachment to the manuscript

[6] The age profiles of ABR have not been actually calculated for 2010. We use the available age profiles of ABR that refer to more distant years (different across countries) and we calibrate them to match their actual aggregate values in 2010.

[7] Labour income from self-employment comprises part of mixed income (income of non-incorporated firms). In NTA 2/3 of mixed income is allocated to labour and 1/3 to capital income.

The ABR is defined as the difference between asset income and savings, therefore it is positive at ages where asset income is greater than savings and negative where savings are greater than asset income. The ABR is usually positive as asset income is usually higher than savings and part of the asset income is used for financing consumption. Individuals use intentionally accumulated assets for financing their consumption after they retire, especially in (partially) funded pension systems. Furthermore, according to economic literature there are various motives for holding wealth at higher ages, including inter-vivo transfers and bequest. At lower ages the level and sign of ABR is more ambiguous. Young people can save first to receive asset income later in life, which would make their ABR negative. Also interest payments for loans (negative asset income) can create negative ABR. But young persons also receive bequests from their ancestors, causing an inflow of asset income[8]. In Finland, for example, the elderly often transfer their wealth to children while they are still alive because intervivo transfers are taxed at lower rate than bequest. Also, the pension system is generous enough for the elderly therefore they can finance their consumption without relying on assets. In Hungary, elderly do not receive much asset income since they did not have much opportunities to accumulate them during the period of socialism. On the other hand, younger cohorts have been more successful in acquiring assets during the transition period. Slovenia is exceptional with a very low level of asset income and correspondingly a very low ABR age profile. For France and Italy the ABR age profiles are unfortunately missing.

To obtain a measure for the dependency across individual ages in childhood and old age, respectively, the average measure of economic dependency at each age is multiplied with the corresponding population size and added up over those age-groups where the difference between consumption and labour income is positive (also referred to as positive life cycle deficit) and over those age-groups where the difference between consumption and labour income is negative (negative life cycle deficit, also called life cycle surplus). Two dependency ratios, $NtaDR_{young}$ and $NtaDR_{old}$, can then be calculated by relating the dependency of children and the elderly to the surplus of the working age population, respectively.

$$NtaDR_{young} = \frac{\sum_{i=0}^{i=L}(C_i - YL_i)}{\sum_{i=L+1}^{i=O-1}(YL_i - C_i)}$$

$$NtaDR_{old} = \frac{\sum_{i=O}^{i=80+}(C_i - YL_i)}{\sum_{i=L+1}^{i=O-1}(YL_i - C_i)}$$

where the index L stands for the age where the life cycle deficit at young ages is still positive

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[8]NTA capture only current transfers. Capital transfers such as bequests are not directly captured, but through the the income which they generate for their owners
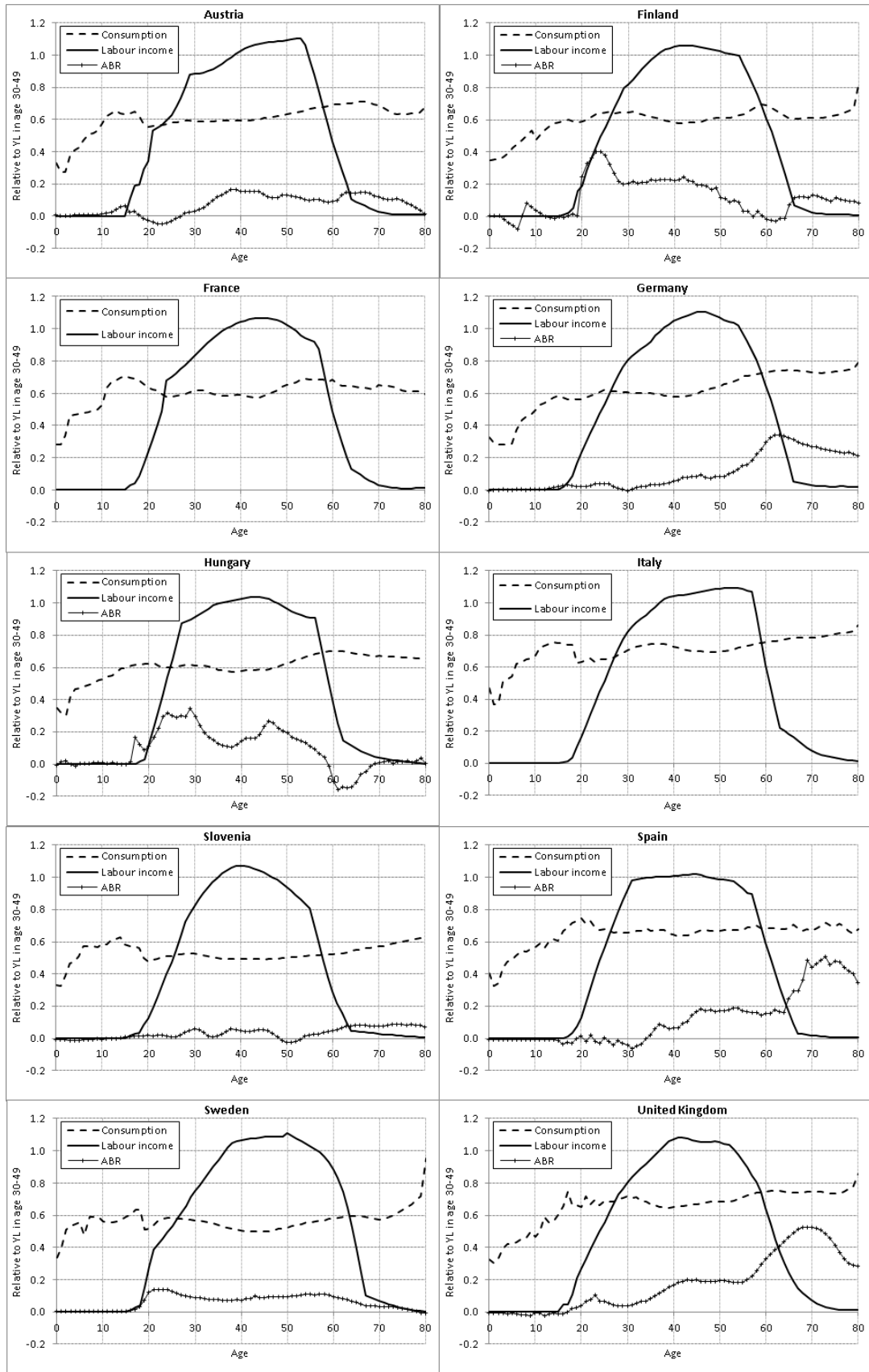
Figure 2: Per capita labour income, consumption and asset based reallocations by age, in relation to average labour income of ages 30-49, 2010

and similarly O stand for the lowest old age at which the life cycle turns positive again. These ages correspond to the ages where the lines for labour income and consumption cross in Figure 2. The other variables are aggregate age specific consumption C_i and labour income YL_i. The two measures relate consumption of children and the elderly that cannot be financed out of their own income to total surplus and reflects both, the population structure as well as the design of the economic life course, i.e. the involvement in production and consumption activities.

Adding up $NtaDR_{young}$ and $NtaDR_{old}$ results in our measure of NTA based total dependency, $NtaDR$:

$$NtaDR = NtaDR_{young} + NtaDR_{old} = \frac{\text{total life cycle deficit}}{\text{total life cycle surplus}} \tag{3}$$

Finally, if we take into account ABR we obtain the general dependency ratio $NtaDR_{ABR}$, which again is the sum of its two components $NtaDR_{ABR,young}$ and $NtaDR_{ABR,old}$:

$$NtaDR_{ABR,young} = \frac{\sum_{i=0}^{i=L}(C_i - YL_i - (YA_i - S_i))}{\sum_{i=L+1}^{i=O-1}(YL_i + (YA_i - S_i) - C_i)}$$

$$NtaDR_{ABR,old} = \frac{\sum_{i=O}^{i=80+}(C_i - YL_i - (YA_i - S_i))}{\sum_{i=L+1}^{i=O-1}(YL_i + (YA_i - S_i) - C_i)}$$

The results for the NTA dependency ratios are shown in Table 3. Italy is the country with the highest dependency in old age as it is the country with a rather high level of consumption relative to total labour income; it also is the country with the highest demographic dependency ratio. The old age NTA dependency ratio is also quite high in the UK; however, once asset based reallocations are considered, dependency is reduced significantly, as the general dependency ratio shows. In theory, the total general dependency ratio would sum up to 1, but the existence of transfers with the rest of the world leads to some deviation. High levels of consumption and low shares of asset income affect also the dependency of children: it is highest in Italy and the UK. In all of the analyzed countries the elderly receive some income out of asset based reallocations, the old age general dependency ratio is therefore lower as compared to the NTA dependency ratio considering only labour income. However, the difference between consumption and income remains large in all of these countries.

To illustrate how the age-profiles of the per capita life cycle deficit (LCD) differ between our

Table 3: NTA dependency ratio $NtaDR$ and general NTA dependency ratio $NtaDR_{ABR}$, for young age, old age and total population, 2010. Age-borders until and from which life cycle deficit is positive

	NTA Dependency Ratio			Age-Borders	
Country	Young Age	Old Age	Total	Positive until	Positive from
AT	0.60	0.79	1.39	23	58
DE	0.60	0.98	1.58	26	60
ES	0.89	0.85	1.74	26	60
FI	0.88	0.87	1.75	26	59
FR	0.94	0.78	1.73	23	59
HU	0.78	0.86	1.64	24	58
IT	1.05	1.36	2.41	27	60
SE	0.67	0.58	1.25	26	64
SI	0.59	0.59	1.18	25	58
UK	1.13	1.08	2.21	27	60
	General NTA Dependency Ratio			Age-Borders	
Country	Young Age	Old Age	Total	Positive until	Positive from
AT	0.46	0.51	0.97	24	59
DE	0.46	0.47	0.93	25	63
ES	0.70	0.27	0.97	26	61
FI	0.48	0.48	0.96	20	59
HU	0.43	0.58	1.01	22	58
SE	0.50	0.45	0.95	22	64
SI	0.54	0.47	1.01	25	58
UK	0.68	0.25	0.94	26	64

two measures of NTA based dependency, we plot them for the five countries for which we have data for all three indicators (Figure 3). The LCD profiles based only on labour income and consumption show the highest positive LCD and lowest negative LCD, whereas the inclusion of ABR shifts the whole profile down significantly, i.e. positive LCD decreases and negative LCD increases. This downward shift is accompanied by a change in the ages when the LCD turns negative and positive. With the exception of Finland, where the incorporation of ABR lowers the age until which the LCD stays positive considerably, the addition of ABR mostly entails an upwards shift in the age where LCD turns positive again. Slovenia is different from the other four countries in that the definition of income affects the age borders where the LCD turns negative and positive only marginally. However, keeping in mind the rather low level of asset income and the consequently minor importance of ABR in Slovenia (cf. Figure 2), this result comes as no surprise.

In Figure 4 we compare the two NTA based dependency ratios directly with the employment based dependency ratio $EbDR$. The fact that there is no clear correlation but that countries with very similar levels of $NtaDRs$ can have quite different levels of $EbDRs$ - e.g. Italy and the United Kingdom - and vice versa - e.g. Sweden and the United Kingdom - warrant the use of more than one measure for assessing economic dependency. The inclusion of asset based
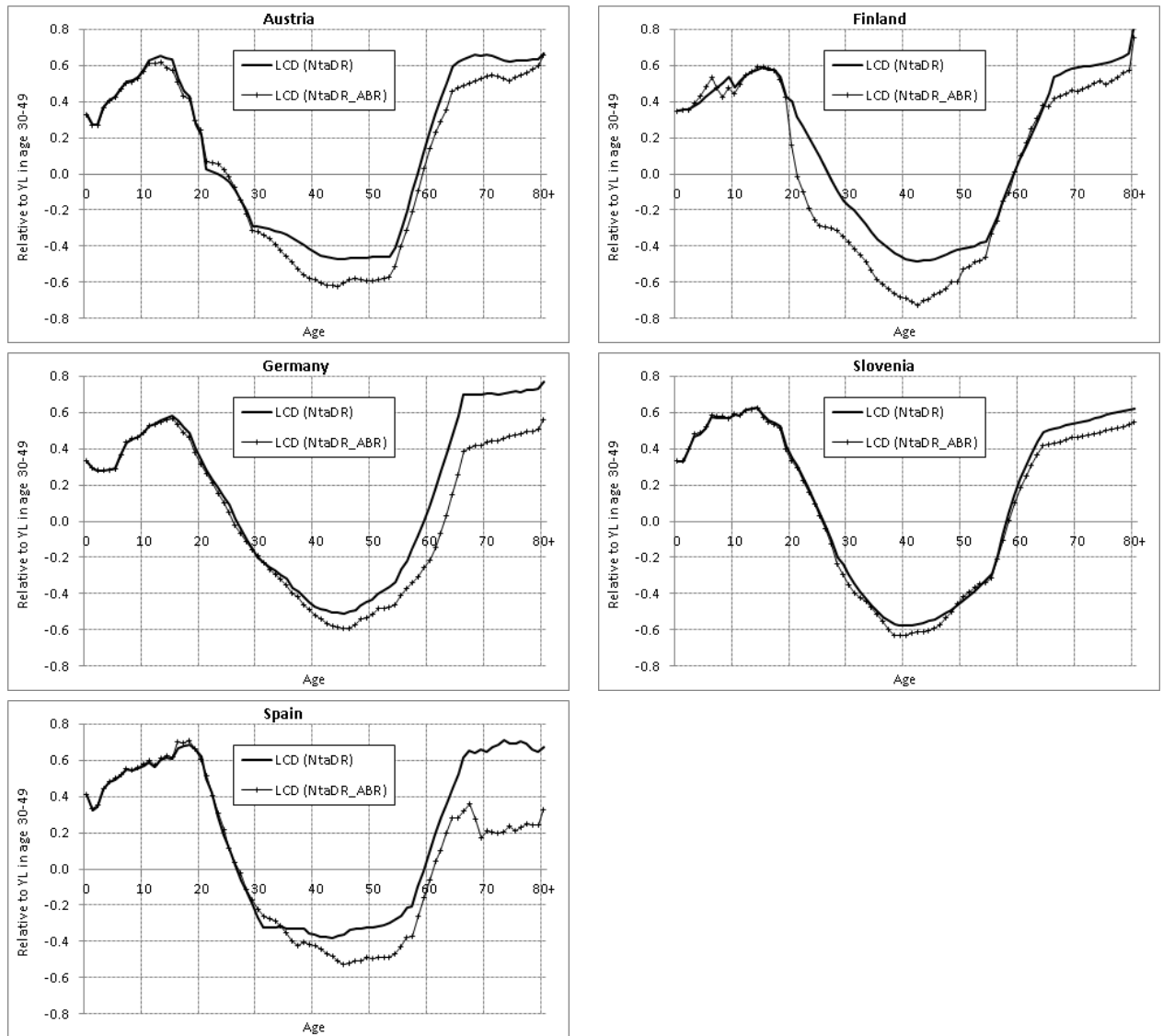
Figure 3: Per capita life cycle deficits for the two NTA based dependency ratios, 2010, by country

Source: EU-SILC 2011 (Labour income); www.ntaccounts.org (Consumption and ABR)

reallocations in the case of the $NtaDR_{ABR}$ make the level of NTA based dependency "drop" significantly and the differences between countries become much smaller. Then again, this assimilation is not surprising: since in a closed economy the transfers received have to equal all transfers paid, the ratio of net transfer inflows to net transfer outflows is close to one. Hence, the $NtaDR_{ABR}$ is 1 by definition. Small departures from 1 are due to the interaction with the rest of the world. For example, public deficit can be partially financed by borrowing abroad.
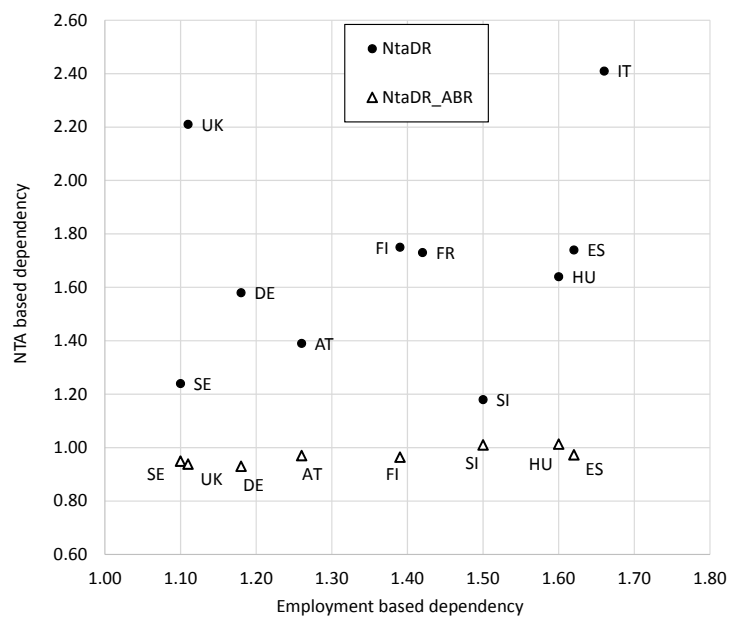
Figure 4: Employment based ($EbDRs$) and NTA based ($NtaDR$, $NtaDR_{ABR}$) dependency ratios, 2010/2011

Source: EU-SILC 2011 (Employment and labour income); www.ntaccounts.org (Consumption and ABR)

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3 Projections of Dependency Ratios

So far, we only compared the four measures of dependency - demographic dependency, economic dependency, and the two dependency measures based on NTA data - for the present. In a next step, we are interested in simulating how these four measures develop during the next 40 years, based on Eurostat population projections and alternative scenarios for the development of age-specific economic activity. In case of the $EbDR$, we present results for three employment scenarios: in the first one, employment rates are kept constant at the present level. Under the assumptions of the second one, female employment increases significantly until 2050. In the third one, we gradually impose the age- and sex-specific employment pattern of Swedes on the population in all countries. The two scenarios for the $NtaDR$ are closely related to the assumptions for the $EbDR$ simulations: in the first one, the currently observed age-profiles of labour income and consumption are kept constant, whereas the second one is based on the assumption of convergence to the age-profiles of Sweden. Finally, we present projections for $NtaDR_{ABR}$ where we hold age-profiles of labour income, consumption and asset based reallocations constant.

3.1 Population Projections

Eurostat provides projections for all EU-28 member states, Iceland, Norway and Switzerland. The most recent projections, EUROPOP2013, cover the period 2013-2080. Of the five scenarios that are prepared (main scenario, no migration variant, reduced migration variant, higher life-expectancy variant, lower fertility variant) we make use of the main scenario. In this scenario, also refered to as convergence scenario, total fertility (TFR) is assumed to converge to a value of 1.93 in all countries by 2150. Similarly, life expectancy at birth is assumed to universally converge to 92.9 years for males and 96.3 years for females by 2150 (Statistik Austria, 2014). In the year 2050, the projection limit for this paper, convergence in assumptions will not be reached yet. In 2050, the assumptions for the TFR range from 1.51 in Spain and 1.58 in Italy to 1.92 in Sweden and 1.93 in the UK. Male life-expectancy is assumed to be lowest in Hungary (80.1) and highest in Sweden (84.5). The respective values for women are 85.5 years in Hungary, and 89.1 years, in France and Spain.

In Table 4 we show the development of each country's population between 2013 and 2050 by three broad age-groups. The share of the population aged 20 to 64 is projected to decline in every country, however, in those countries with lower fertility, this decrease is more pronounced. In 2013, Germany and Italy were the only countries where the share of the population above age 65 was already above 20%. By 2050, this share is anticipated to increase to more than 30% in Germany and Spain, and up to 30% in Italy and Slovenia. In Finland, Sweden and the UK, the share of elderly is expected to be less than 25%.

Table 4: Population distribution (in %) 10 European countries and for the standard population, by broad age-groups, 2013 and 2050

	ages 0-19		ages 20-64		ages 65+	
Country	2013	2050	2013	2050	2013	2050
AT	20.1	18.7	61.8	53.9	18.1	27.4
DE	18.1	17.1	61.2	51.0	20.7	31.8
ES	19.8	17.5	62.5	49.1	17.7	33.4
FI	22.3	21.9	58.9	53.4	18.8	24.7
FR	24.6	23.3	57.8	51.6	17.6	25.1
HU	20.2	19.2	62.7	53.2	17.2	27.5
IT	18.7	18.4	60.1	51.8	21.2	29.9
SE	22.8	23.2	58.1	54.3	19.1	22.5
SI	19.3	19.5	63.6	50.6	17.1	29.8
UK	23.7	22.9	59.1	53.2	17.2	23.9
Standard	21.2	20.4	60.6	52.3	18.2	27.4

Source: Eurostat, EUROPOP2013, main scenario

3.2 Projections of Employment-Based Dependency

In order to project economic dependency based on employment, we need the future number of workers and non-workers in each country, since these two groups enter our formula for the employment-based dependency ratio *EbDR* (cf. Section 2.2).

The simulations to obtain the number of workers is a two-stage process. First, we define and implement three scenarios of future employment, which means we create sets of age- and sex-specific employment rates for 2015 to 2050, in 5-year intervals. Employment rates for the starting year 2011 are calculated by dividing the number of people who are working by the total population, separately for men and women and for each 5-year age-group. Everyone who reports their main activity status as working full- or part-time (including conscripts) is counted as being employed (cf. Section 2.2). Since EU-SILC starts collecting employment information for the population aged 16+, the youngest age-group comprises persons aged 16-19. The last age-group covers ages 70-74. The assumptions for the three employment scenarios are described in detail below. In a second step, these employment rates are multiplied with the respective population numbers from the EUROPOP2013 population projections (cf. Section 3.1). Summing up everyone who is employed results in the total number of workers, who enter the denominator of the *EbDR* formula.

It is not feasible to simulate the different categories of non-workers that are explicitly mentioned in the numerator in Equation 1. Rather, the numerator subsumes everybody who is not working and is the residual when we substract the total number of workers from the total population. Once we do this for every country, scenario and year from 2015 to 2050, in 5-year intervals, we can calculate the respective economic dependency ratios.

In the first employment scenario, we keep age- and sex-specific employment rates constant at the level observed in 2011. Keeping employment levels unchanged means that any future

change in economic dependency is solely driven by changes in the population structure. Since, as demonstrated above, the age-composition in every country is shifting towards older ages, assuming no changes in economic activity leads inevitably to an increase in economic dependency. However, the level of the projected increase in this scenario varies significantly between countries (cf. column 4 in Table 5 and Figure 5), given that countries show varying degrees of population ageing and different levels of employment, particularly of women and persons above the age of 50 (see Figure 9 and Figure 10 for country-specific employment profiles). The lowest increase is projected for Sweden and the United Kingdom, where high employment rates meet with a relatively favorable population structure. On the other hand, there are countries like Slovenia and Spain, where on average lower employment is combined with an above-average increase in the older population.

Having said that, the constant scenario does not portray any likely development. It serves rather the purpose of a reference scenario that shows the unmitigated effect of anticipated changes in the population structure. In order to estimate what an increase in employment would mean for economic dependency, we calculate another scenario, called equalization scenario. In every country, labour market activity of women is lower than that of men, and activating women is an often cited source of labour potential. At the same time, female employment has been on the rise in all 10 countries. The question is what level it will eventually attain. One conceivable development is that it will converge to the same or close to the same level as that of males. We demonstrate the effect of this assumption by allowing age-specific female employment rates in each country in 2050 to reach the respective employment levels of men that are observed in 2011. For the years in between, we interpolate linearly. In a way, this is a very strong assumption, since men and women do not have completely equal age-specific employment rates anywhere in Europe. At the same time, it is a conservative assumption in terms of overall employment, since it does not assume any changes in male employment at higher ages at all and also older females will in this scenario not increase their employment in any way that goes beyond what is observed for men today. Assuming this described increase in employment of women, economic dependency would increase to a significantly lower extend than under the constant scenario (cf. column 6 in Table 5 and Figure 5). The largest relative impact is seen for Italy, where economic dependency would not increase between now and 2050 if Italian women were participating in the labour market as much as Italian men.

Given that not only female employment has been on the rise in all countries but that also an increase in economic activity of the population above age 50 can be expected due to past and ongoing changes in pension systems and labour laws, we create a third scenario where we change the employment rates of the whole population: In order to estimate what an increase in employment to overall higher levels - yet not beyond levels empirically presently observed - would mean for economic dependency, we calculated a further scenario, called benchmark scenario, where we take a benchmark approach: of all the 10 countries we analyze, Sweden

Table 5: Economic dependency ratio, 2011, 2030 and 2050, by employment scenario

Country	2011	Constant Scenario		Equalization Scenario		Benchmark Scenario		Standard Population	
		2030	2050	2030	2050	2030	2050	2030	2050
AT	1.26	1.55	1.69	1.40	1.40	1.32	1.27	1.60	1.75
DE	1.18	1.49	1.66	1.39	1.46	1.35	1.40	1.42	1.58
ES	1.62	2.03	2.43	1.83	2.05	1.49	1.45	2.09	2.28
FI	1.39	1.64	1.65	1.58	1.54	1.45	1.28	1.55	1.72
FR	1.42	1.68	1.72	1.60	1.58	1.47	1.37	1.57	1.72
HU	1.60	1.78	2.12	1.67	1.88	1.37	1.29	1.98	2.15
IT	1.66	1.95	2.15	1.68	1.64	1.49	1.35	1.97	2.14
SE	1.10	1.24	1.26	1.20	1.18	1.24	1.26	1.19	1.33
SI	1.50	2.01	2.25	1.91	2.04	1.53	1.40	2.00	2.16
UK	1.11	1.31	1.38	1.22	1.21	1.27	1.30	1.28	1.42

Source: EU SILC, 2011, own employment projections; Eurostat, EUROPOP2013 (2050), main scenario

shows the highest levels of employment for men as well as women for the majority of age-groups (cf. Appendix 5.1). What would achieving these same levels mean for economic dependency for the other 9 countries? In order to estimate this effect, we assume that current Swedish employment levels are obtained in every country in 2050 and project age- and sex-specific employment rates by linear interpolation for the years in between. The effect is overwhelming: economic dependency would actually decrease during the next four decades in six of the ten countries, namely Spain, Finland, France, Hungary, Italy and Slovenia (cf. column 8 in Table 5 and Figure 5). In the four remaining countries (Austria, Germany, Sweden and the United Kingdom) dependency in 2050 would still stay below dependency levels observed in any of the ten countries today.

Just as we calculated economic dependency using a standard population in Section 2.2, it is possible to project dependency applying the same future population structure to all countries. This allows us to see in how far the results in each country are driven by differences in the age-composition of the national populations. As before, in order to obtain a standardized population, we calculated the unweighted average of the projected populations for the 10 countries. We then combined this population with the employment rates from the constant scenario. Depending on whether a country's population structure is older - as in Germany, Slovenia and Spain - or younger - as in Austria, the UK, Finland, and Sweden - than the average population, economic dependency using the standard population is lower or higher in 2050 than in the constant scenario where we use actual national population projections (cf. columns 4 (constant scenario) and 10 (standard population) in Table 5).

3.3   Projections of NTA Dependency

In the section where we introduced NTA dependency ratios (Section 2.3) we presented two alternative definitions of dependency: one taking into account only labour income ($NtaDR$), and a second one where we take into account asset based reallocations ($NtaDR_{ABR}$). Using the age profile of ABR from NTA results enables us to consistently project the general NTA
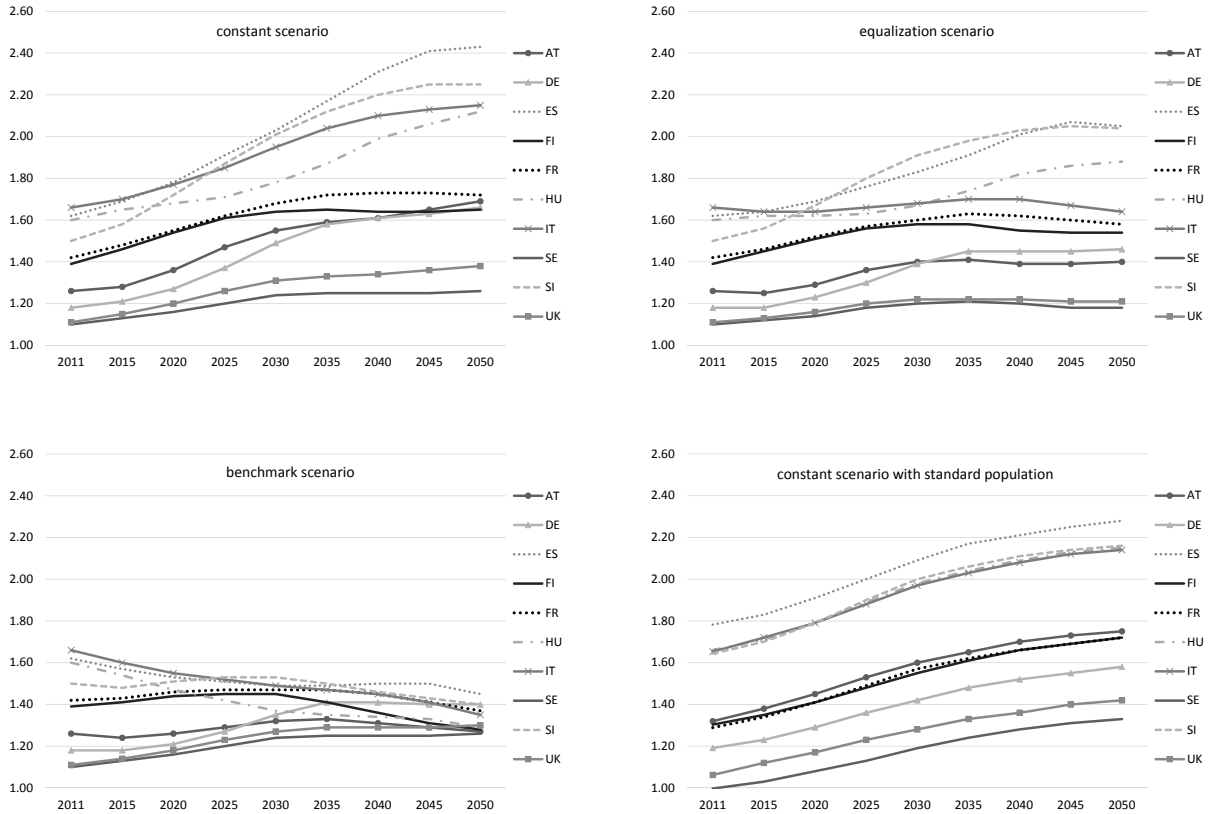
Figure 5: Economic dependency ratios, 2011-2050, by country and scenario

dependency ratio $NtaDR_{ABR}$ into the future, taking into account both inflows from asset income but also outflows in form of savings. To correctly project future dependency we have to include information on savings, because without savings the continuous flow of asset income at the current level will not be sustainable in the long run. There is a caveat using this measure though. In projections we keep age profiles of asset based reallocations constant through the projection period. However, there is no insurance that savings from the base year are at the right level for sustaining asset income, observed in the base year, also in the long run.

We create two scenarios to demonstrate possible future developments of $NtaDR$, using two different assumptions how the age profiles of C and YL (and consequently life cycle deficit and surplus) will develop in the future:

1) In the first scenario we assume fixed consumption and labour income age profiles, as depicted in Figure 2. The results for each country are therefore driven by the changing demographic age structure.

2) As the results of scenario 1 are indicating, Sweden is the country that shows the most favourable development until 2050 in terms of the absolute level of the NtaDR. Therefore,

in the second scenario, we assume linear transition from the actual age profiles of C and YL in individual countries to the respective age profiles of Sweden during the transition period 2010-2050. The C and YL age profiles are normalized relative to average YL in age 30-49.

In both presented scenarios we apply the EUROPOP2013 population projections. The constant scenario of Figure 6 presents the ratio of the life cycle deficit to the life cycle surplus for every country between 2010 and 2050. In all countries the ratio stays above 1 during the whole projection period indicating that the life cycle deficit of young and old individuals is greater than the life cycle surplus of prime age individuals. The missing part has to be financed from other sources either from asset income exceeding savings, through borrowing or transfers.
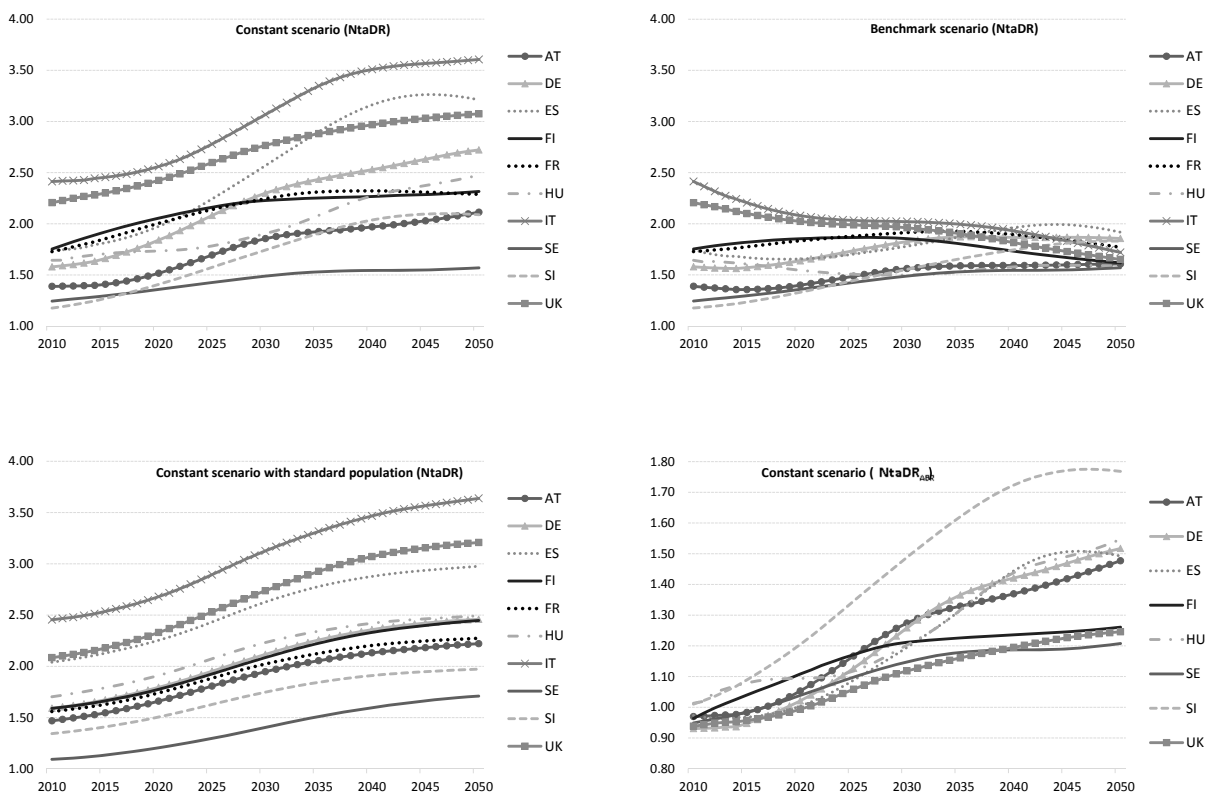

Figure 6: NTA dependency ratios, 2010-2050, by country and scenario

Source: EU SILC, 2011; www.ntaccounts.org, own NTA projections; Eurostat, EUROPOP2013 (2050), main scenario

There are big differences among countries already in 2010 and they become even larger during the projection period up to 2050 (cf. Table 6). Italy had the highest $NtaDR$ in 2010 and it is projected to still be in the lead in 2050. Between 2010 and 2030 the UK has a similar $NtaDR$ trajectory as Italy, but thereafter the demographic pressure is expected to become less than in Italy. On the other hand, under the current patterns of consumption and labour income Spain would face strong demographic pressure on dependency in the future - from about an average value of $NtaDR$ of 1.74 in 2012 to 3.21 in 2050, which is the second highest among all ten

analyzed countries. The countries with projected high increases in $NtaDR$ are also Germany, Austria, Slovenia and Hungary. Relative changes of the NtaDR during the projection period are more relevant than the absolute level of $NtaDR$. For example, Slovenia's low level of $NtaDR$ in 2010 is mainly due to the high labour income relative to consumption, since there is not much asset income available for covering consumption. Thus, lower level of $NtaDR$ does not necessarily mean better outlook for a country, it can be a consequence of low reliance on assets.

The benchmark scenario (second panel in in Figure 6) shows that gradual convergence from current C and YL age profiles of individual countries to C and YL age profiles of Sweden would largely neutralize future demographic pressure on economic dependency in most countries. In Italy, Finland, Hungary and the UK, dependency would even decrease. In Slovenia the increase in dependency is still large.

The third panel in Figure 6 shows the results when using a standard population, again calculated as the unweighted average of projected populations for all 10 countries. In this scenario the differences among countries are driven only by their respective age profiles of labour income and consumption but not by different populations. When using the standard population, Spain and Slovenia would face substantially lower increases in the NTA dependency ratio compared to the constant scenario. This means that in the constant scenario for those two countries it is population ageing that causes such high increase of NtaDR during the projection period.

Finally, the fourth panel in Figure 6 presents projections of the general dependency ratio, $NtaDR_{ABR}$. In 2010 the general dependency ratio is close to 1 in all countries, according to the construction of NTA accounts (cf. Equation 2), i.e. the ratio of the overall life cycle deficit for young and elderly to the life cycle surplus of adults is in this case equal to the ratio of net transfers of the dependent population to the net transfers from the working age population (Mason, 2013). Assuming constant age profiles of labour income, consumption and ABR and applying population projections $NtaDR_{ABR}$ will increase in all countries in the future .

The largest increase in $NtaDR_{ABR}$ is projected for Slovenia (cf. Table 7). This is a result of strong population ageing and heavy reliance on labour income relative to asset based reallocations. A declining share of working-age population will reduce labour income whereas increasing share of elderly will only increase consumption, without much positive effect through assets income of elderly. Also in Hungary the situation worsens considerably in this scenario. Although ABR is relatively high in Hungary, is it allocated to individuals in working-age (see Figure 2), whose share will decline, but not to the elderly, whose share will increase. For other countries the results depend on the degree of population ageing, the share of asset based reallocations in financing consumption needs and the age distribution of asset based reallocations. As already presented in Section 2, in cross-sectional perspective including asset based reallocations in the analysis reduces age spans of dependency and the level of dependency

compared to *NtaDR*. In this section we have learned that including ABR in the projections also mitigates future increase in dependency. In most countries elderly support an important share of their consumption by themselves through ABR. Therefore population ageing will increase dependency in the future less than shown by the results that ignore ABR.

Table 6: NTA dependency ratio, 2010, 2030 and 2050, by NTA scenario

Country	2010	Constant Scenario		Benchmark Scenario		Standard Population	
		2030	2050	2030	2050	2030	2050
AT	1.39	1.85	2.11	1.56	1.61	1.95	2.22
DE	1.58	2.30	2.72	1.83	1.86	2.12	2.46
ES	1.74	2.57	3.21	1.78	1.92	2.63	2.98
FI	1.75	2.23	2.32	1.85	1.62	2.08	2.45
FR	1.73	2.24	2.29	1.91	1.77	2.02	2.27
HU	1.64	1.90	2.47	1.50	1.59	2.23	2.49
IT	2.41	3.07	3.61	2.02	1.72	3.13	3.64
SE	1.24	1.49	1.57	1.49	1.57	1.40	1.71
SI	1.18	1.74	2.09	1.55	1.83	1.75	1.97
UK	2.21	2.77	3.07	1.96	1.65	2.74	3.21

Source: EU SILC, 2011; www.ntaccounts.org; Eurostat, EUROPOP2013 (2050), main scenario

Table 7: NTA general dependency ratio, 2010, 2030 and 2050

Country	2010	Constant Scenario	
		2030	2050
AT	0.97	1.27	1.48
DE	0.93	1.26	1.52
ES	0.97	1.19	1.49
FI	0.96	1.21	1.26
HU	1.01	1.20	1.55
SE	0.95	1.15	1.21
SI	1.01	1.49	1.77
UK	0.94	1.12	1.25

Source: see source table 6

4 Discussion

Dependency ratios are commonly used as indicators of the sustainability of the public transfer system as the share of elderly increases. The rules for funding and access of public transfers is embodied in laws and structured rigidly around fixed age-borders which makes this system vulnerable to demographic change. In this paper we show that the way in which dependency is defined will impact on the final dependency ratio in a society and also determine the lower and upper age limits in the life cycle where people switch from being dependent to independent and then again from independent to dependent.

We compared three measures of dependency for a selection of 10 European countries, one of the measures being purely demographic, and the other two including information on economic characteristics. We demonstrated that the level of dependency varies significantly between the three indicators. We also showed through simple simulations how changes in economic behavior - changing economic activity or labour income and consumption patterns - affects projected levels of economic dependency. These simulations were based on a strict shift-share approach in which we focused on changes in the population structure and age-specific profiles of economic activities. The goal was not to accurately forecast future employment, consumption or income patterns, but to illustrate the effect of demographic changes as well as constant and changing age-profiles of economic activity and to demonstrate that the definition of economic dependency matters in this context.
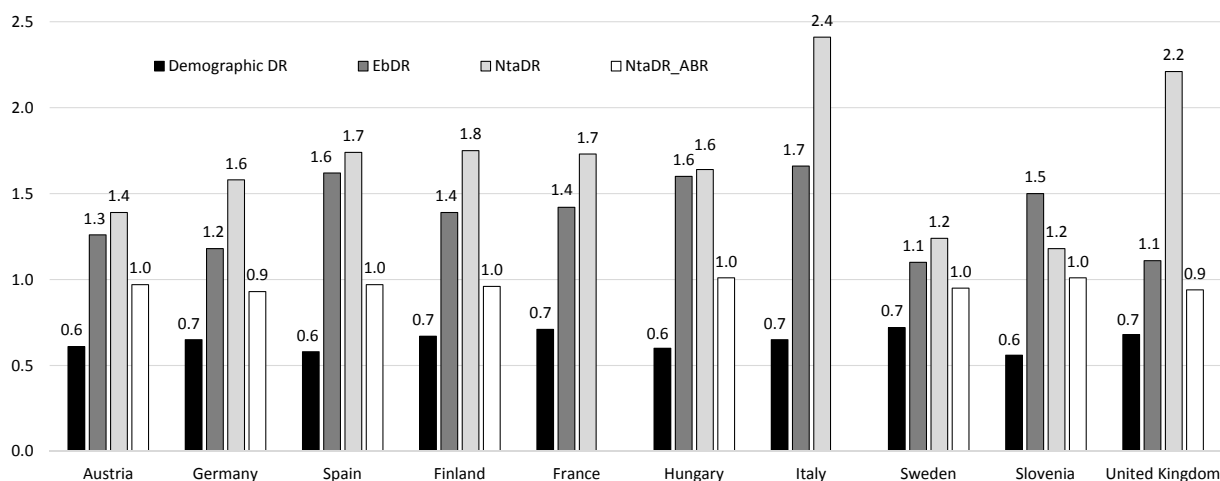

Figure 7: Demographic, employment based, and NTA based dependency ratios, 2010/2011

Source: EUROSTAT (population data); EU-SILC 2011 (EbDR); EU-SILC 2011, www.ntaccounts.org (NtaDR, NtaDR$_{ABR}$)

The absolute values of dependency compiled in Figure 7 for the year 2011 have related yet different interpretations. In the case of demographic dependency, a ratio larger than one

means that more than one young (less than 20 years) or older (65 years or older) person faces one person of working-age. In no country has demographic dependency reached this level yet. When it comes to economic dependency, on the other hand, two of our indicators - $EbDR$ and $NtaDR$ - show consistently values larger than one in all 10 countries. Looking at the employment based dependency ratio, a ratio larger than one implies that there are more not employed than employed persons in a given society, whereas a $NtaDR$ larger than one signifies a situation where a population's life cycle deficit is larger than its life cycle surplus. By definition, the $NtaDR_{ABR}$ is 1 or close to 1 in any observed year, due to the construction of NTA accounts (cf. Equation 2). It is hard if not impossible to say what level of dependency, for any of our presented indicators, becomes unsustainable in the long run. What can be said though is that increasing levels of economic dependency go along with higher stress on the economy, and that the speed of the increase in dependency matters. Furthermore, in the case of $NtaDR$, the difference between consumption and labour income in the future could be financed through public and private transfers and asset income exceeding savings, as it is already being done today. The existence and availability of ABR relieves some pressure from transfer systems.

Indeed, as outlined in Mason (2013) we can directly relate our general NTA based dependency ratio $NtaDR_{ABR}$ to intergenerational transfers. Rearranging equation (2) in Section 2.3 it follows that the life cycle deficit/surplus equals the net transfers:

$$C - YL - (YA - S) = C - YL - ABR = T \tag{4}$$

As discussed in Mason (2013) net transfers are initially zero in a closed economy. However when we project the difference between consumption minus labor income and asset based reallocation forward in time, keeping their age profiles constant and only applying age specific demographic projections, the balancing Equation (4) will no longer hold. Similar to Mason (2013) we can however ask how the net transfers have to change to keep the balancing equation valid also in the future under such a scenario where we keep age profiles of consumption, labour income and ABR constant. To obtain an analytical expression for the necessary change in net transfers we can rely on (4).

Let us denote the left hand side in Equation (4) as X and decompose it into the life cycle deficit for young and old:

$$X_{young} = \sum_{i=0}^{i=L}(C_i - YL_i - (YA_i - S_i))$$

$$X_{old} = \sum_{i=O}^{i=80+}(C_i - YL_i - (YA_i - S_i))$$

and the life cycle surplus for adults:

$$X_{adult} = \sum_{i=L+1}^{i=O-1}(YL_i + (YA_i - S_i) - C_i)$$

where we applied the same notation as in section 2.3.

We can now write Equation (4) as the sum of the life cycle surplus/deficit:

$$C - YL - ABR = X = X_{young} - X_{adult} + X_{old} = T$$

and rearrange the terms as follows:

$$\frac{T}{X_{adult}} = \frac{X_{young} + X_{old}}{X_{adult}} - 1 = NtaDR_{ABR} - 1$$

From the last expression it follows that for any forecast of $NtaDR_{ABR}$ as shown in Table 7 we can now derive the necessary change in net transfers expressed as a fraction of the life cycle surplus. Table 8 includes a column with the respective values for changes between 2010 and 2050. The smallest changes would be required in Sweden, Finland and the UK, with 27%, 31% and 33%, respectively. The by far largest changes based on constant age profiles of consumption, labour income and ABR can be expected in Germany (63%) and Slovenia (75%).

Figure 8 combines the projection results of all three dependency measures and shows the relative changes in dependency ratios between 2011 and 2050. What has to be kept in mind when interpreting the height of the bars in Figure 8 is that they show country-specific relative changes, which means nothing can be deducted about the absolute levels of dependency.

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Table 8: $NtaDR_{ABR}$, 2010 and 2050, and change between 2010 and 2050 in %

country	2010	constant scenario 2050	change 2010-2050 in %
AT	0.97	1.48	53
DE	0.93	1.52	63
ES	0.97	1.48	53
FI	0.96	1.26	31
HU	1.01	1.55	53
SE	0.95	1.21	27
SI	1.01	1.77	75
UK	0.94	1.25	33

Source: see source table 6

Hence, the fact that Spain and Slovenia show by far the largest increase in demographic dependency is partly due to them being the two countries with the lowest dependency in 2011 (Figure 7). Similarly, the result that Germany, Sweden and the UK do not experience a decrease below 2011 levels by 2050 in any of the scenarios of the $EbDR$ is to a large extend due to them being the countries with the lowest levels of economic dependency to begin with in 2011. This is to be partly explained by their employment levels of women and/or among persons 50+ which are already today higher than in the other seven countries, meaning that the latter have more leverage when it comes to increasing employment in the future. The extent to which it is possible to further increase female labour force participation without negatively affecting fertility depends strongly on the design of the transfers to children, in particular the education system and the distribution of childcare tasks between the state, the core family and the extended family. As (Hammer et al., 2014) indicate, the high female participation rates in Sweden and Slovenia might be only possible through the high provision and use of public child care institutions, and in the case of Slovenia, through a high involvement of the extended family (grandparents). Hence, a pronounced increase of female participation rates would in most countries only be possible if it was accompanied by a reconstruction of the child care and education system.

The profound differences in current and projected levels of the three dependency ratios raise the question which one of them should be considered in which specific policy context and to address what kind of issue. The $NtaDR$ will be chosen if one wants a comprehensive picture about the supporting capabilities but also consumption needs within a society, both varying across age. Compared to the $EbDR$, not only employment rates are taken into account on the production side in case of the $NtaDR$ but also the level of wages, social contributions, lower wages due to part-time work and potentially other factors that impact labour income.

The bottom line is that it is not enough to look at traditional demographic dependency measures alone, as it is often done, when the economic consequences of population ageing are to be assessed. One needs to consider activities of people - their employment activities (employment based dependency ratio) but also more general their extend of consumption
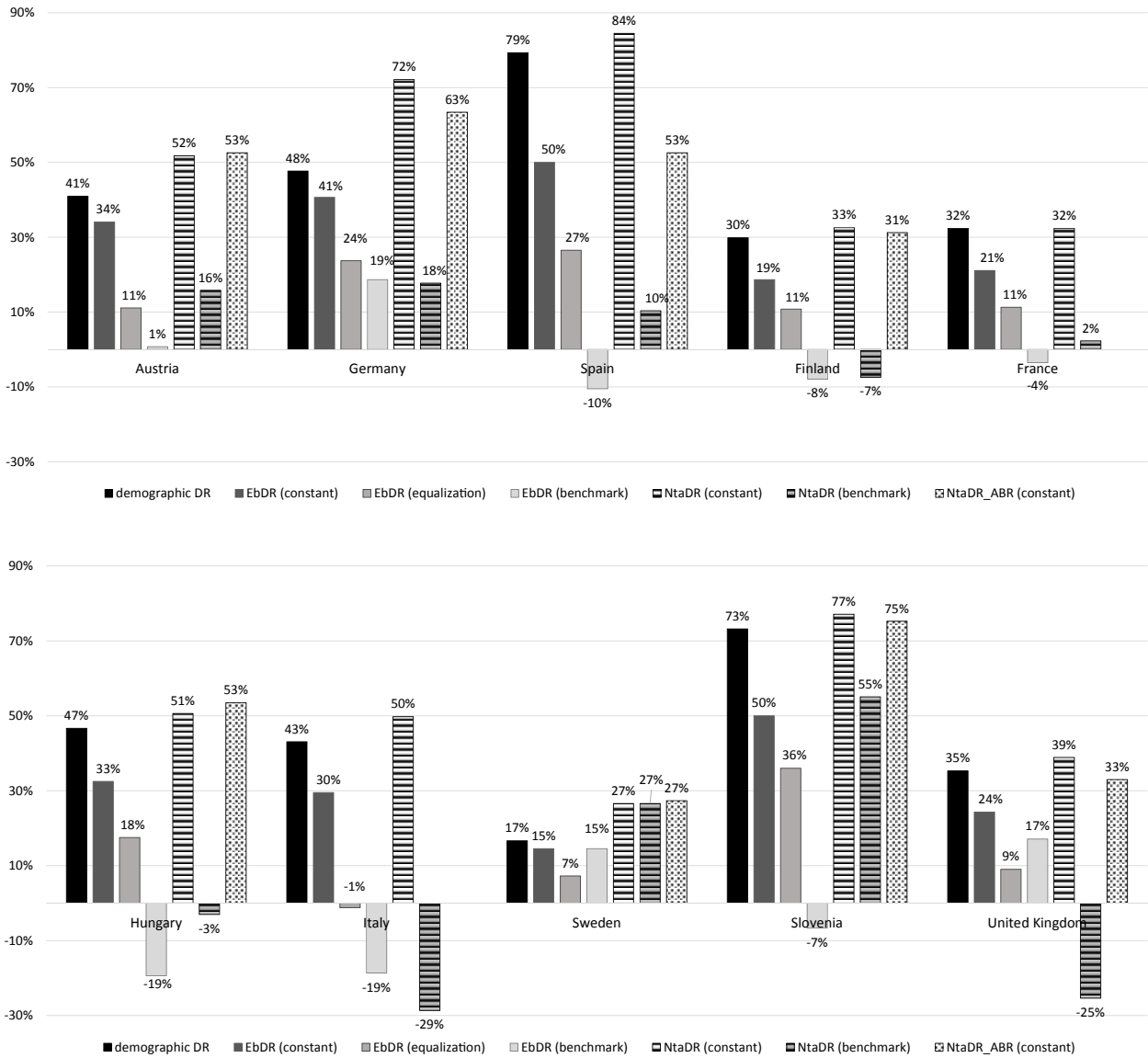
Figure 8: Relative change in demographic and economic dependency ratios between 2010/2011 and 2050, by scenario

Source: EUROSTAT (population data); EU-SILC 2011 (EbDR); EU-SILC 2011, www.ntaccounts.org (NtaDR, NtaDR$_{ABR}$)

and production at each Age (NTA based dependency ratios) - as well, since there is a lot of variation between people of different ages when it comes to labour market activity and consumption and production.

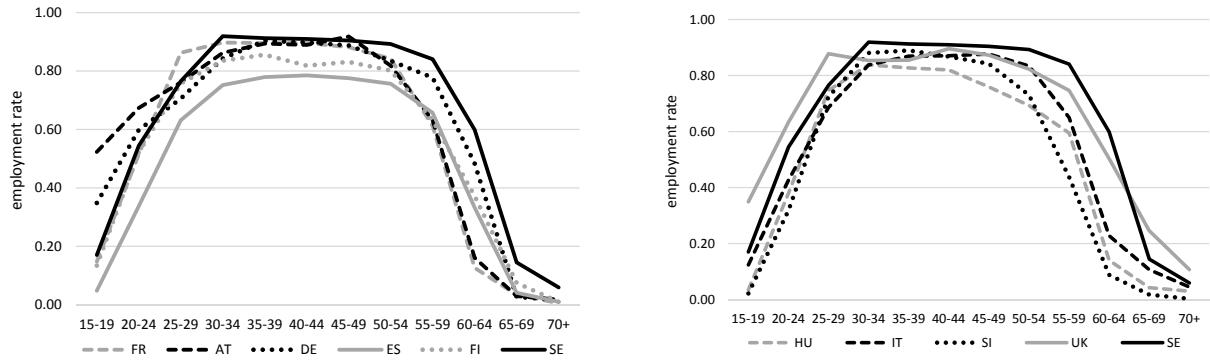# 5 Appendix

5.1 Employment patterns by age and sex

Figure 9: Age-specific employment rates, men, 2011

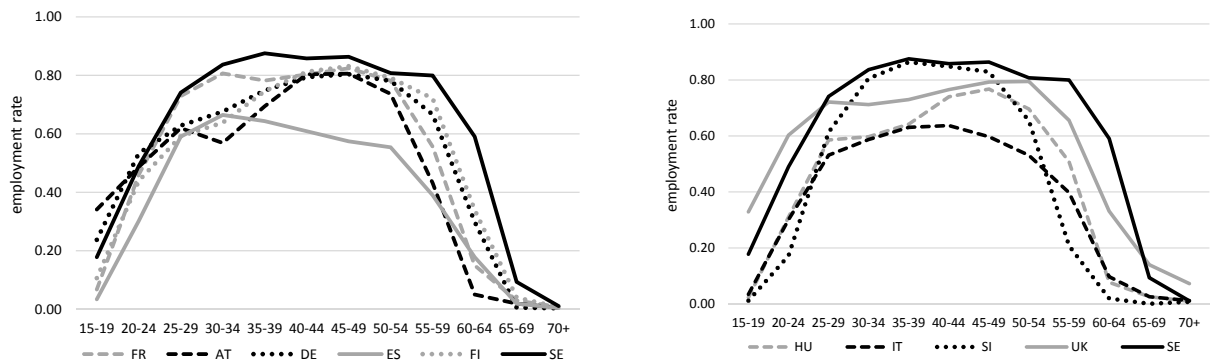*Source:* EU-SIlC 2011 (based on self-defined activity status)

Figure 10: Age-specific employment rates, women, 2011

Source: EU-SIlC 2011 (based on self-defined activity status)

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