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Research Article

Quantifying policy trade-offs to support aging populations

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Research Article

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Abstract

BACKGROUND

Coping with aging populations is a challenge for most developed countries. Supporting non-working adults can create an unsustainable burden on those working. One way of dealing with this is to raise the normal pension age, but this has proven unpopular. A complementary approach is to raise the average labor force participation rate. These policies are generally more politically palatable because they often remove barriers, allowing people who would like to work to do so.

OBJECTIVE

To conceptualize and estimate the trade-off between pension age and labor force participation rate policies.

METHOD

We project the populations of European countries and apply different levels of labor force participation rates to the projected populations. We introduce the notion of a relative burden, which is the ratio of the fraction of the income of people in the labor market in 2050 that they transfer to adults out of the labor market to the same fraction in 2009. We use this indicator to investigate the trade-offs between changes in normal pension ages and the general level of labor force participation rates.

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RESULTS
We show that, in most European countries, a difference in policies that results in an increase in average labor force participation rates by an additional one to two percentage points by 2050 can substitute for a one-year increase in the normal pension age. This is important because, in many European countries, without additional increases in labor force participation rates, normal pension ages would have to be raised well above 68 by 2050 to keep the burden on those working manageable.

CONCLUSION
Because of anticipated increases in life expectancy and health at older ages as well as because of financial necessity, some mix of increases in pension ages and in labor force participation rates will be needed. Pension age changes by themselves will not be sufficient.

1. Introduction

Most developed countries face a demographic challenge – population aging will reduce the portion of the adult population who participate in the labor force, given current age-specific participation rates (Lutz, Sanderson, and Scherbov 2008; United Nations 2010).

Nonworking adults will have their consumption financed significantly by those who are working and the burden of these transfers can become unsustainable (European Commission 2010; Kotlikof and Burns 2004). This paper is part of a dialog on how best to conceptualize and respond to this challenge.

One way of dealing with this is to think about population aging simply as a public pension problem. An obvious solution, then, would be to decrease pension costs, often by increasing normal pension ages (OECD 2011). Governments can always save money by increasing normal pension ages. But if budgetary considerations are the sole rationale for raising the pension age it is unclear why alternative expenditure reductions or revenue increases are not equally satisfactory. After all, if education costs rise we do not automatically argue that, for the sake of government budgets, the age at which students begin primary education should be increased. Thinking about aging solely in terms of raising money for public pensions defines the challenge too narrowly.

Another rationale for raising pension ages is that pensioners are living longer. According to this argument, it is unfair for younger generations to have to pay for the older generations' longevity gains, and older generations enjoying those gains should help pay for them by retiring later. But retiring later is not the only way for generations enjoying longevity gains to help finance their retirement years. Higher labor force participation rates during their working ages would also contribute.

In this article we argue that addressing the effects of aging is best done in a framework that takes both pension age and labor force participation rate policies into account. We do this by quantifying the trade-offs between pension ages and labor force participation rates in affecting the burden on younger generations of supporting nonworking adults as life expectancies increase and populations grow older. The political dialogue, however, has not generally recognized that there exists a potential trade-off between normal pension ages and labor force participation rates that can be translated into policy with good effect.

We have conceptualized and estimated these trade-offs for the first time for all EU countries. We show the mix of pension age policies and labor force participation rate policies that would keep the burden on workers of supporting nonworking adults at selected levels relative to 2009. As part of this analysis we demonstrate that, in most European countries, an increase in normal pension ages to 68 by 2050 would not be enough to keep the burden on the working population from ballooning. Policies that rely entirely on changes in normal pension ages may require normal pension ages of 70 or more by 2050 in order to do this. In a world in which normal pension ages could get quite high it is especially important to note that policies that increase labor force participation rates by an additional one to two percentage points by 2050 can substitute for a one year increase in the normal pension age.

2. Methodology

The quantity that underlies our analysis is the average proportion of the income of people in the labor force transferred to adults out of the labor force. In year *t* this can be written:

$$TR_t = \frac{\tau_t \sum_{j=1}^{2} \sum_{i=20}^{\omega} P_{i,j,t} \left(1 - lfpr_{i,j,t}\right)}{\varphi_t \sum_{j=1}^{2} \sum_{i=20}^{\omega} P_{i,j,t}\, lfpr_{i,j,t}}, \quad (1)$$

where TR_t is the average proportion of the income of people in the labor force transferred to adults out of the labor force in year *t* (relative transfer), τ_t is the average amount received by people out of the labor force in period t from those who are in the labor force, ω is the highest age at which these amounts are received (100 in our computation), $P_{i,j,t}$ is the population of people at age *i* and gender *j* in year *t*, $lfpr_{i,j,t}$ is the labor force participation rate at age i for people of gender j in year t, and φ_t is the average income of people in the labor market in year t.

There are three important features of this formulation which deserve note here. First, the income transferred to those out of the labor market can come from both

private and public sources. This concept of the transfer is broader than the fraction of labor income taxed to pay for a Pay-As-You-Go pension system, because it includes all money transfers to people out of the labor market. Second, the normal pension age does not appear explicitly in the equation for the average transfer. It does, however, appear implicitly. Countries have different patterns of age- and gender-specific labor force participation rates and we allow changes in normal pension ages to have an effect on the labor force participation rates of older workers. Third, we do not assume that labor force participation rates become zero after the normal pension age, although they are typically quite small. We do assume that labor force participation at age 75 and beyond is small enough to ignore.

The average transfer is related to another well-known quantity, the economic dependency ratio. There are a number of minor variations in how this ratio is defined, but the version most closely related to the average transfer is

$$\mathrm{EDR_t} = \frac{\sum_{j=1}^{2}\sum_{i=20}^{\omega} P_{i,j,t}\left(1-lfpr_{i,j,t}\right)}{\sum_{j=1}^{2}\sum_{i=20}^{\omega} P_{i,j,t}\, lfpr_{i,j,t}},$$

where $\mathrm{EDR_t}$ is the economic dependency ratio at time *t*.

In our computations we hold $\frac{\tau_t}{\varphi_t}$ constant. Therefore,

$$RB_{2050} = \frac{TR_{2050}}{TR_{2009}} = \frac{EDR_{2050}}{EDR_{2009}}, \tag{2}$$

where RB_{2050} is the relative burden in 2050. It is the ratio of the fraction of the income of people in the labor market that they transfer to those out of the labor market in 2050 to the same fraction in 2009. If the fraction of income transferred to those out of the labor market were the same in the two years, the relative burden would be 1.0.

The population age structures in 2009 are known (Vienna Institute of Demography 2010), as are the labor force participation rates in that year (Table A1 and its source). The age structures of populations in 2050 are derived from the population projections of the Vienna Institute of Demography (2010). Therefore, everything in the relative burden in equation (2) is known except for the labor force participation rates and the normal pension age in 2050.

In order to investigate the trade-offs between changes in normal pension ages and the general level of labor force participation rates, we parameterize hypothetical future patterns of labor force participation rates. We determine these possible future patterns of labor force participation rates by age and sex in a two-step procedure based on rates observed in 2009. In the first step we compute what we call 'baseline labor force participation rates'. Below age 55 the baseline labor force participation rates are those

observed in 2009. For age 55 and above the baseline rates are adjusted for possible changes in normal retirement ages. Essentially, the procedure is just an age rescaling of the participation rates. For example, if the normal pension age were to rise by one year, from 65 to 66, then the baseline labor force participation rate of 58 year olds would be assigned a value equal to the one observed in 2009 at age 57, one year of age earlier. In the second step we take the baseline labor force participation rates (2009 rates adjusted for normal pension age changes) and parameterize them as follows:

$$lfpr_{i,j,t}\{\lambda\} = \lambda \max\left(lfpr_{i,j,2009}\right) + (1-\lambda) lfpr_{i,j,b}\ , \tag{3}$$

where *i* is an index for age, *j* refers to gender and *t* to the year, $lfpr_{i,j,b}$ are the baseline labor force participation rates, and the maximum in equation (3) for each gender separately is taken over all EU countries in 2009, supplemented by Iceland, Norway, and Switzerland. These maximum labor force participation rates are shown in Appendix Table A1. After these two steps are completed the entire schedule of labor force participation rates by age and sex can be specified using only two parameters, the normal retirement age and λ.

Figure 1 shows age- and sex-specific labor force participation rates for Germany, Italy, and Spain respectively for three values of λ, 0.0, 0.5, and 1.0, assuming a normal pension age of 65. When λ is 0.0 the labor force participation rates are those observed in 2009. When λ is 1.0 the labor force participation rates are the maxima observed in 2009, and when it is 0.5 it is halfway between the 2009 values and the maxima.

Figure 1: Hypothetical age- and sex-specific labor force participation rates for Germany, Italy, and Spain for three levels of λ, assuming a normal pension age of 65 (based on equation (3) above)

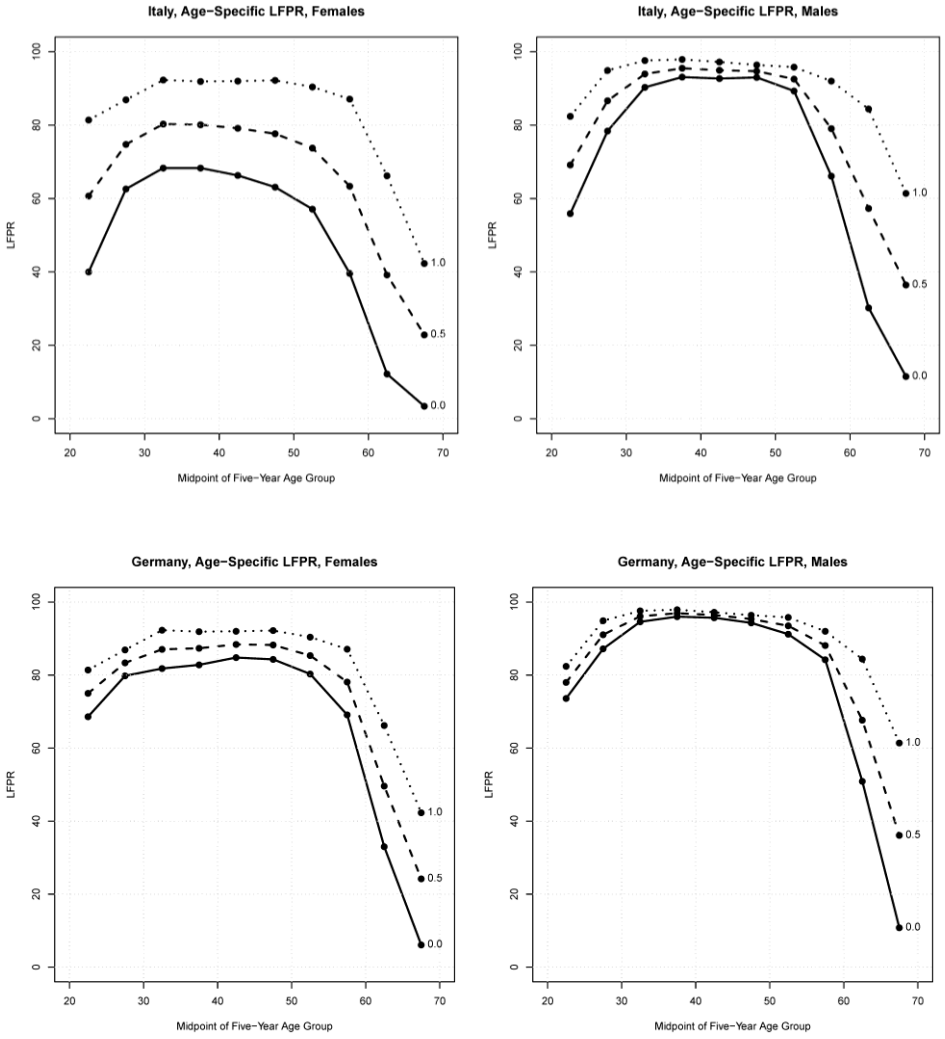
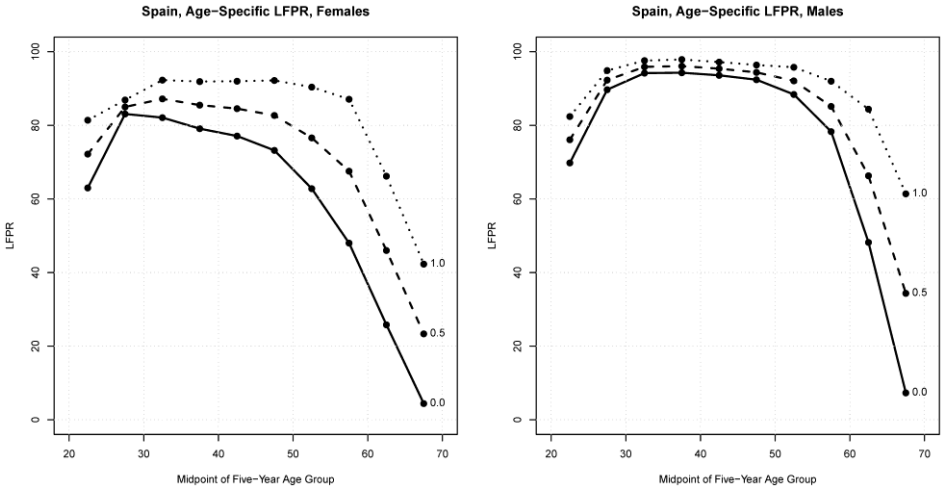


Figure 1: (Continued)



For men and women in Germany there are only minor differences between the baseline age-specific labor force participation rates and the European maxima through age 55–59. Much larger differences occur at ages 60+. For Spain the pattern of male labor force participation rates is similar to that of Germany, but the participation rates for women, particularly older women, are much lower. In Italy men tend to have high labor force participation rates, but starting at age 50–54 they are considerably lower than for Spain or Germany. Italy stands out as having relatively low rates of participation for women at all ages and particularly at older ones. In general, the groups where labor force participation rates can increase significantly are men and women above the age of 50. In some countries, such as Italy, there is substantial scope for increases in the labor force participation rates of women at all ages. In others, such as Germany, there is little scope for increasing labor force participation for either sex, except above age 50.

Figure 2: Baseline age- and sex-specific labor force participation rates for Germany, Italy, and Spain for three normal pension ages, assuming λ=0.5

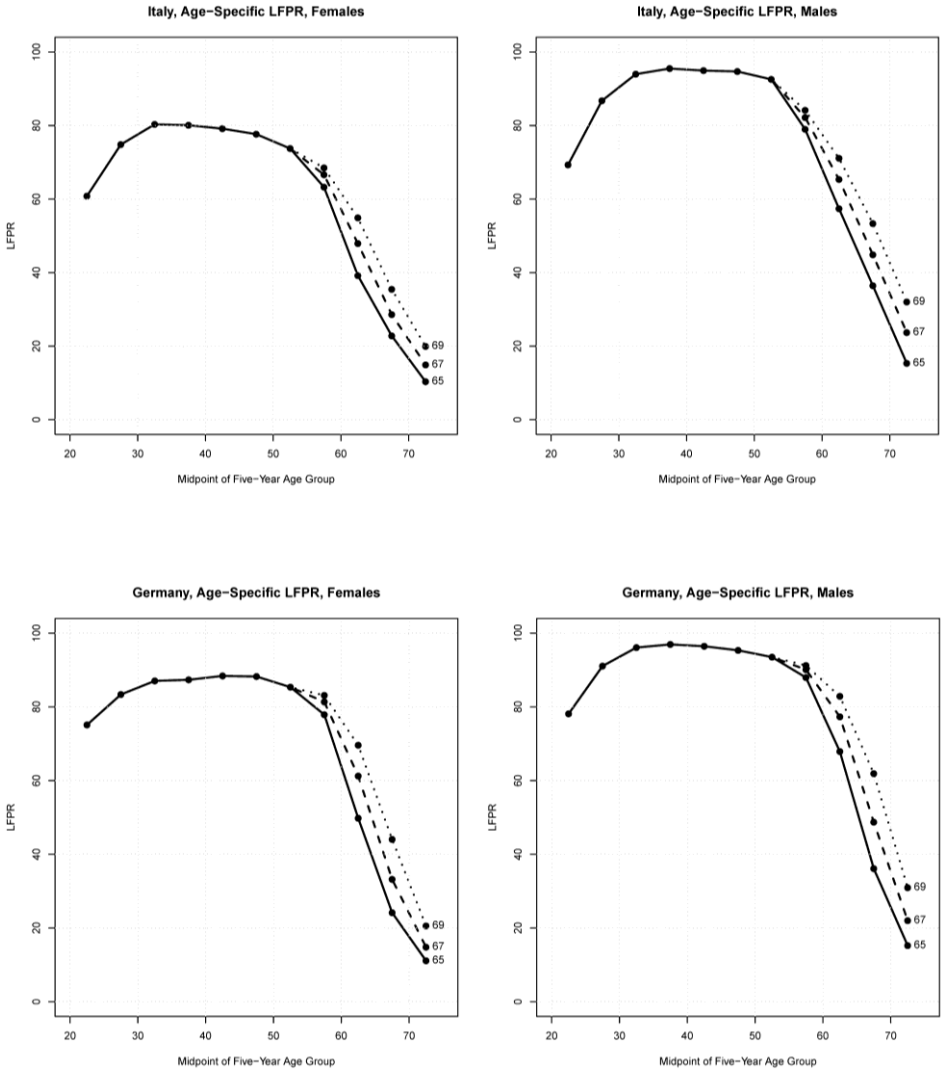


Figure 2: (Continued)

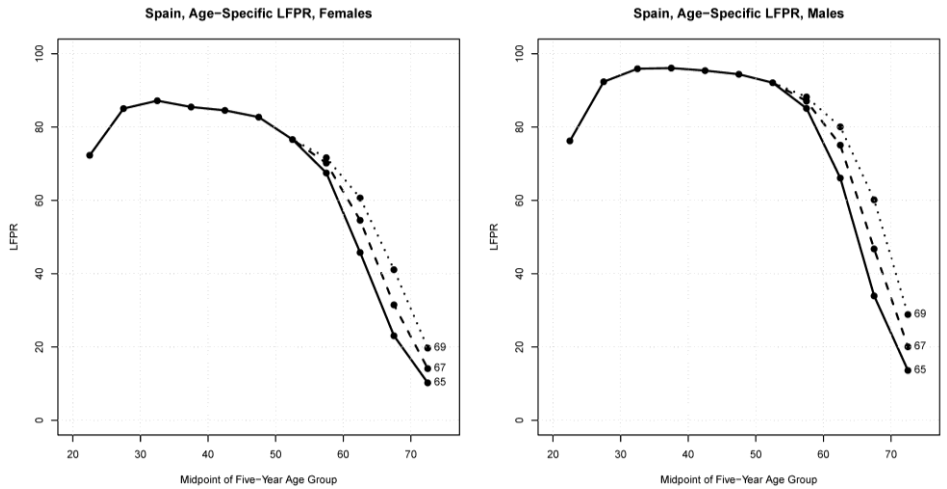


Figure 2 shows how we model the effects of changing normal pension ages on labor force participation rates in the same three countries, when λ is set equal to 0.5. Labor force participation rates below age 55 are unaffected. The largest changes in rates due to an increase in the normal pension age from 65 to 69 are for men in the age group 65–69. Women also have substantial increases in the participation rates at 60–64. For both sexes there is some increase in the labor force participation rates of 70–74 year-olds.

For our current purposes the parameterization of labor force participation rates by normal pension age and λ has a disadvantage. The same level of λ in different countries could be associated with different labor force participation rates because of differences in the 2009 rates. To provide a measure that is comparable across countries we compute truncated average labor force participation rates by taking the unweighted average of the age-specific labor force participation rates through age 64:

$$ALFPR_t\{\lambda\} = \frac{1}{90}\sum_{j=1}^{2}\sum_{i=20}^{64} lfpr_{ij,t}\{\lambda\}\,. \qquad (4)$$

The results would be only slightly different if we had used a standard age structure to compute the $ALFPR_t\{\lambda\}$. We take the average only up to age group 64 so as to keep the averages consistent as normal pension ages (all age 65 or over in our examples) are changed.

3. Results

In Figure 3 we investigate the trade-off between normal pension age and average labor force participation in the United Kingdom. According to current legislation the normal pension age in the UK will increase to 68 by 2046, although planned five-year reviews of the normal pension age could change this (BBC News 2013; UK Department of Work and Pensions 2006). To show the trade-off we specify three different values of the relative burden on the left-hand side of equation (2), the same as in 2009 (1.0), a 10% higher relative burden than in 2009 (1.1), and a 28% higher burden (1.28). A 28% increase in the burden is what we forecast would occur in 2050 if the pension age was 68 and the average labor force participation rate remained at its 2009 level. A 28% increase in that burden would certainly be substantial. We plot iso-burden lines at each of these three levels of the relative burden to indicate the trade-off between higher labor force participation rates and a higher normal pension age.

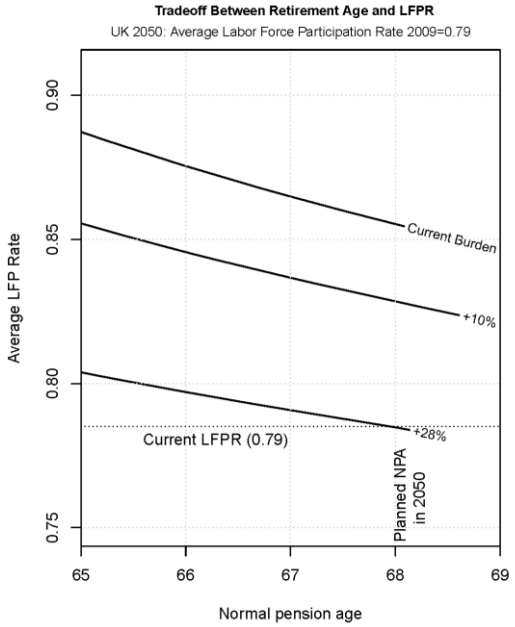
Figure 3 shows an array of policy options available to UK policymakers. One option is to set the retirement age at 68 and raise the average labor force participation rate from its 2009 level of 0.79 to 0.86. This mix would keep the relative burden at its 2009 level. An alternative policy with the retirement age at 68 would be to increase the average labor force participation rate to 0.83 instead of 0.86. In this case the relative burden would be 10% higher in 2050 than in 2009. If the UK wanted to keep the relative burden at its 2009 level it could increase the normal pension age to 69 and increase the average labor force participation rate to 0.84, or keep the normal pension age at 65 and raise the average labor force participation rate to 0.88.

In Appendix Section 2 we present similar trade-off plots for all EU-27 countries, showing three iso-burden levels, 1.0, 1.1, and 1.2. In most EU countries, keeping the relative burden at its 2009 level in 2050 with a pension age of 68 would require increases in the average labor force participation rates. In some countries there are no feasible average labor force participation rates which would allow the average burden to remain at its 2009 level, even with a normal pension age of 68.

Spain has recently enacted a pension reform to increase the normal pension age from 65 to 67 by 2027. We can see from the Figure for Spain in Appendix Section 2 that if the relative burden in 2050 is to be less than 20% higher than its 2009 level, an even greater increase in the pension age would be necessary. The 20% higher figure could be attained with a normal pension age of 69 and an average labor force participation rate of 0.88, up from 0.75 in 2009. The difference between the relatively accommodating situation of the UK and more difficult situation of Spain is due to their different recent demographic histories. Spain had a rapid fertility decline in the 1980s to a level considerably below that of the UK. The speed and extent of the Spanish fertility

decline relative to that in the UK makes aging there more rapid and causes the support of nonworking adults to be much more challenging.

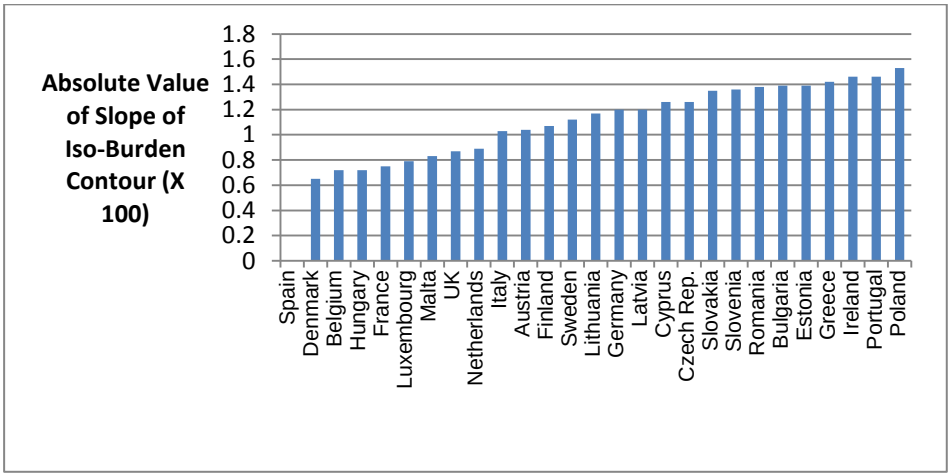
Figure 3: Trade-off between pension age and labor force participation in the UK in 2050. The 2009 average labor force participation rate of 0.79 is indicated on the graph. Current plans in the UK are for the normal pension age (NPA) to be 68 in 2050. At the 2009 average labor participation rate of 0.79 and a normal pension age of 68, the relative burden would be 28% higher than it was in 2009



Italy had a recent demographic history similar to that of Spain but in 2009 had one of the lowest average labor force participation rates in the EU, which means that each working adult had to support more nonworking adults. A recent pension reform in Italy raises the normal pension age to 68 years and 4 months by 2050. In the Figure for Italy in the Appendix, Section 2, we can see that with that pension age and an increase in the average labor force participation rate from 0.65 in 2009 to 0.74 in 2050, the relative burden would increase by 20%. In order for the relative burden in 2050 to remain at its 2009 level the average labor force participation rate would have to increase to 0.80.

We can see from Figure 3 and the figures in Section 2 of the Appendix that the iso-burden lines are relatively linear. This makes it feasible to make good approximations of their slopes. In Figure 4 we show the slopes of the iso-burden lines for the EU countries, measured at the level of the relative burden of 1.1. The slope of the iso-burden contour could not be computed for Spain because that computation would have required a normal pension age higher than 69, which is the highest that we used in our computations.

Figure 4: Absolute value of the slope of the iso-burden contour lines (multiplied by 100) for EU countries when the relative burden is 10% higher in 2050 than in 2009



The absolute value of the slope is the percentage point increase in the average labor force participation rate that keeps the relative burden constant when the normal pension age is reduced by one year. The median value of the absolute values shown in Figure 4 is 1.2. This indicates that, in general, it would take around a 1.2 percentage point increase in the average labor force participation rate to keep the relative burden constant when the normal pension age is reduced by one year.

Another way to interpret Figure 4 is to see that the inverse of the absolute value of the slope is the number of years that the normal pension age could be reduced when the average labor force participation rate is increased by one percentage point, so as to keep the relative burden constant. The median value of those inverses is 0.84, indicating that, keeping the relative burden constant, a one percentage point increase in the average

labor force participation rate can compensate for around a 0.84 year decrease in the normal pension age. In the Appendix, Section 4, we show that the slopes are rather insensitive to whether they are measured using labor force participation rates based on 2009 or on 2012.

Average labor force participation rates in the EU in 2009 varied from a low of 0.63 in Malta to a high of 0.84 in Sweden. In France the average was 0.75 and in the UK it was 0.79 or four percentage points higher than in France. An additional increase in the French average labor force participation rate of four percentage points by 2050 would almost completely substitute for a three-year increase in the normal pension age. Italy had a relatively low average labor force participation rate in 2009 of 0.65, ten percentage points lower than France. An additional five percentage point increase in the average labor force participation rate in Italy in 2050, half the difference to France's level in 2009, would substitute for a three-year increase in the normal pension age. In developed countries labor force participation rates in the ages prior to the normal pension age differ widely. For example, in 2009 the labor force participation rate among 55–59 year olds in Denmark was 83.2%, 62.5% in France, while in Malta it was 48.5% (see Appendix Section 1 for the labor force participation rates of all EU-27 countries). These differences in labor force participation rates are uncorrelated with rates of disability (Sanderson and Scherbov 2010) (see Appendix Section 3), and are likely to be influenced by policy differences (Burniaux, Duval, and Jaumotte 2004; European Commission 2010).

4. Discussion

Although economic dependency ratios can be found in Economic Policy Committee (2005), Toosi (2009), and Whiteford (2006), among others, this is the first detailed analysis of the trade-off between normal pension ages and average labor force participation rates.

Increasing the normal pension age is generally unpopular (BBC News 2010; Euronews 2010; Guardian 2011). In part this is because increases in the normal pension age are seen as a narrowly targeted tax increase. If there is a general problem in the country of the central government not having enough money, then it seems unjust that people nearing the normal pension age should differentially be asked to bear the burden of solving the problem. It seems more just to ask everyone including current pensioners to pitch in and share the load. If the current level of pensions is deemed to be too high by the central government, then it would also seem appropriate for all generations including current pensioners to pay something. It is not clear why someone, say, 65

years old should get a public pension in one year, and someone 65 years old but born one year later should not get it.

In some countries increasing the normal pension age also increases the uncertainty of income when people have adverse health shocks. Some people are concerned that they might not be healthy enough to continue working up to later pension ages.

Pension age increases also have a disadvantage from a macroeconomic perspective. Pension age increases raise the labor force participation rates of people close to the end of their working lives. These are ages at which productivity is generally declining (Gordo and Mertens 2010; Gordo and Skirbekk 2012; Koolhaas et al. 2012; Skirbekk 2004, 2008) and at which it can be difficult to find job openings.

Pension age increases take decades to implement, as the British example shows. Labor force participation policies typically can be implemented much more rapidly, in part because they are likely to be more popular and so can contribute to solving the fiscal problems associated with aging much sooner. Despite these drawbacks, some increases in normal pension age may be desirable. With increasing life expectancies, spreading working time more evenly over the lifecycle is becoming necessary and desirable (Vaupel and Kistowski 2008; Vaupel and Loichinger 2006). To do this and to reduce the burden on working adults of supporting those who are not working requires changes both in normal pension ages and in labor force participation rates.

Labor force participation rate policies can be divided into those that primarily affect the supply of labor and those that primarily affect the demand for labor. Two groups are most frequently targeted by these policies: women and older workers. For women, three supply-side policies are particularly relevant. They are more flexible working hours, support for families with young children, and equal tax treatment for married and single women. Empirical studies have shown that these policies can result in an increase in female labor force participation (Del Boca 2002; Euwals 2001; Jaumotte 2003; Kornstad and Thoresen 2006; Lefebvre, Merrigan, and Verstraete 2009; Smith et al. 2003). The demand-side policy of enforcing anti-sex discrimination laws could also help.

Flexibility in hours of work, working conditions, and wages can provide an environment in which older people can continue to work. When wages are rigidly tied to seniority, older workers could have their positions terminated when their productivity falls. A phased retirement approach could keep them working, perhaps with fewer hours and at a lower wage (Hutchens 2003). Education and training programs for older workers could also keep them interested in continuing to work and employers interested in continuing to hire them (Crépon, Ferracci, and Fougère 2007; Jones et al. 2009; Lechner, Miquel, and Wunsh 2008).

Tax and pension policies also affect the incentives for remaining in the labor force. In some countries these policies produce high implicit tax rates on continued work.

Evidence shows that removing financial incentives to retire prior to the normal pension age and making pension systems more actuarially fair would have a substantial effect on the labor force participation rates of older workers (Blöndal and Scarpetta 1999; Börsch-Supan 2000; Duval 2003; Gruber and Wise 1998, 1999, 2004).

Disability pensions are sometimes abused and become a vehicle to finance early retirement. (Euwals, van Vuuren, and Wolthoff 2010; Gruber 2000; Whiteford 2006). For the majority of the working population abuses of the disability system are often regarded as something negative. Reforming such systems is likely to be politically popular. A nuanced approach to disability where partially disabled people are encouraged to work up to their potential can also keep people in the labor force (Yin 2008). Anti-age discrimination policies can also be used.

While, in the medium-term, policies to increase labor force participation rates can reduce the pressure for increases in the pension age, there is a limit to the ability to increase labor force participation rates. Because of this, and anticipated increases in life expectancy and improvements in health, some increases in the normal pension age are appropriate in the long-run (Sanderson and Scherbov 2005, 2010), in order to keep intergenerational balance.

While the public widely perceives increases in the normal pension age as a negative thing, many labor force participation policies are viewed positively, because they eliminate distortions, provide people with more opportunities, and reduce the fraudulent use of disability pensions. Because of anticipated increases in life expectancy and health at older ages as well as because of financial necessity, some mix of increases in pension ages and in labor force participation rates will be needed. The best mix is more likely to be found where the trade-offs between the two are clearly articulated.

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Appendix Section 1: Participation rates in 2009, selected age groups, both sexes

Table A1: Labor force participation rates by selected age groups and country in 2009 (%) [lfsa_argan] (Last update: 28-07-2011)

	40–44	45–49	50–54	55–59	60–64
Austria	90.7	88.5	81.4	61.0	21.4
Belgium	87.2	84.6	76.7	53.2	19.6
Bulgaria	88.0	85.8	81.0	68.9	30.4
Cyprus	88.3	85.0	80.7	68.8	46.2
Czech Rep.	94.3	93.7	90.3	70.7	27.2
Denmark	91.5	89.7	88.3	83.2	37.5
Estonia	91.5	90.7	86.1	78.6	51.7
Finland	91.0	90.3	87.2	76.8	41.2
France	90.8	89.7	85.6	62.5	18.1
Germany	90.4	89.4	85.7	76.5	41.8
Greece	85.1	81.3	72.6	56.5	32.0
Hungary	85.2	81.8	75.3	52.1	13.6
Ireland	79.0	78.7	74.8	63.6	44.4
Italy	79.6	77.9	72.9	52.5	20.9
Latvia	90.9	90.2	85.7	79.0	40.0
Lithuania	88.5	88.0	82.7	72.0	39.8
Luxembourg	85.6	81.5	76.5	54.9	20.2
Malta	72.5	64.9	59.9	48.5	13.8
Netherlands	89.5	88.0	84.2	74.7	38.6
Poland	87.6	83.5	73.0	45.7	19.1
Portugal	88.8	87.0	80.2	64.3	42.1
Romania	83.0	79.4	69.8	53.1	31.6
Slovakia	92.1	91.1	85.1	61.4	17.3
Slovenia	91.8	91.4	80.9	49.6	18.8
Spain	85.5	82.8	75.5	62.8	36.6
Sweden	92.4	90.7	88.4	84.6	64.0
UK	86.3	86.4	83.0	74.2	46.8

Source: European Commission (2011). Eurostat [electronic resource]. European Union. http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database

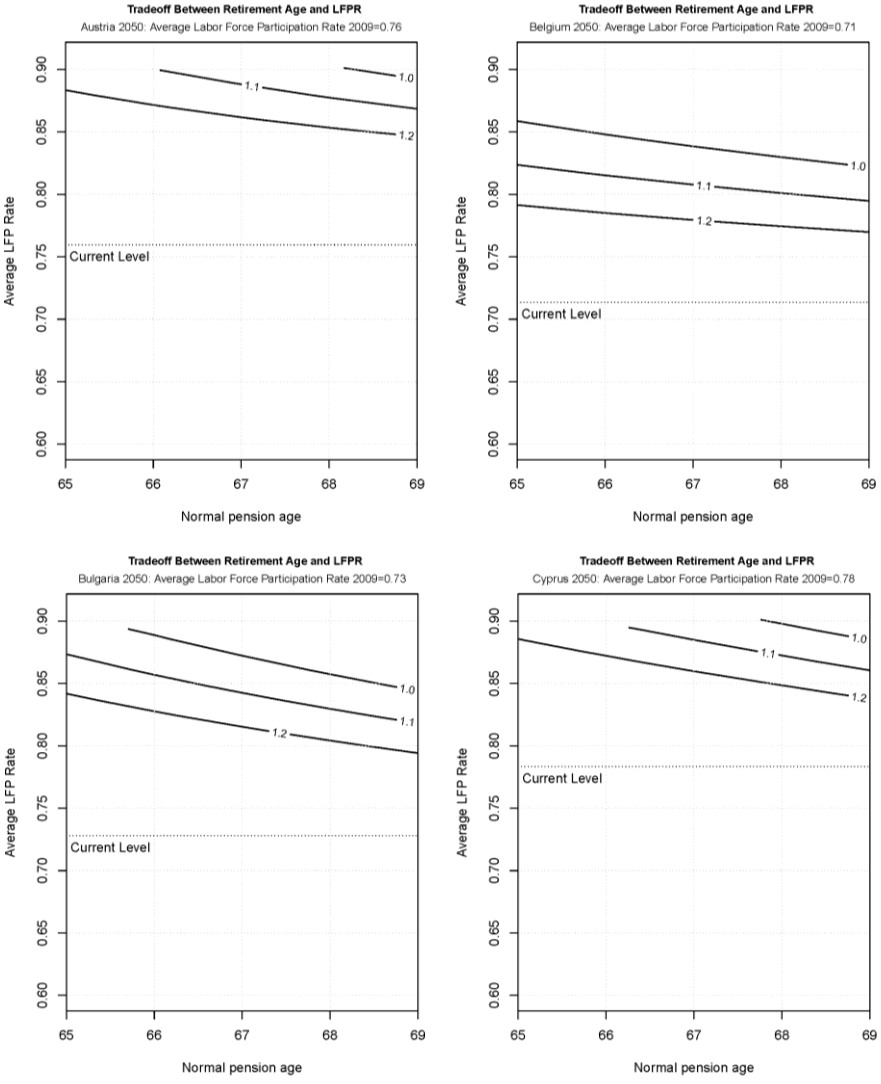
Maximum labor force participation rates

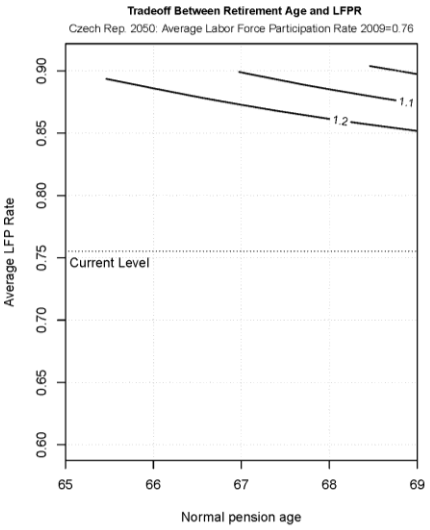
Table A2: Maximum age-specific labor force participation rates: EU-27 Countries plus Switzerland, Iceland, and Norway, in 2009

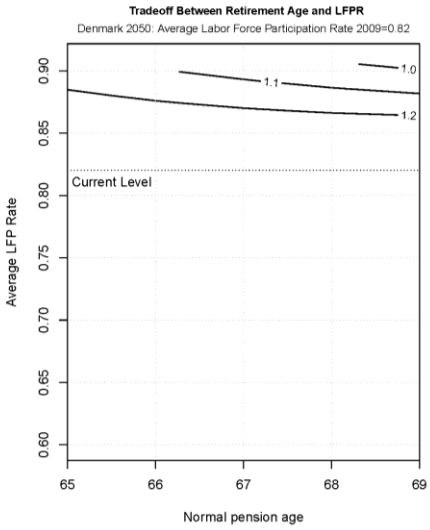
Age	LFPR
20-24	81.9
25-29	90.2
30-34	94.2
35-39	93.3
40-44	94.3
45-49	93.7
50-54	93.1
55-59	89.6
60-64	75.5
65-69	51.7
70-74	21.9

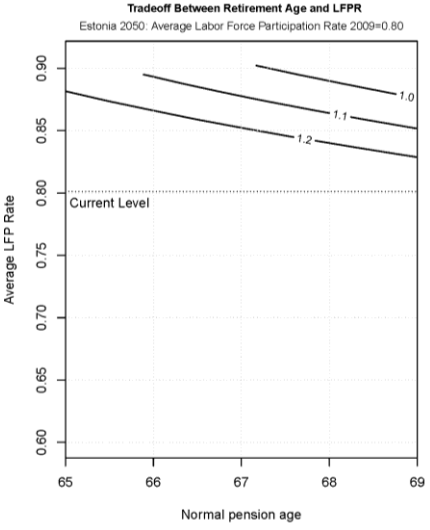
Source: European Commission (2011). Eurostat [electronic resource]. European Union. http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database

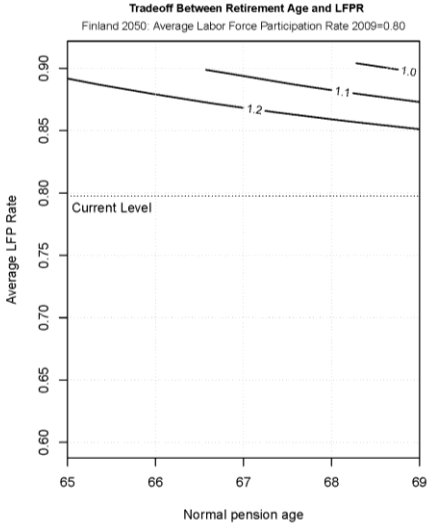
Appendix Section 2: Trade-off graphs for EU countries

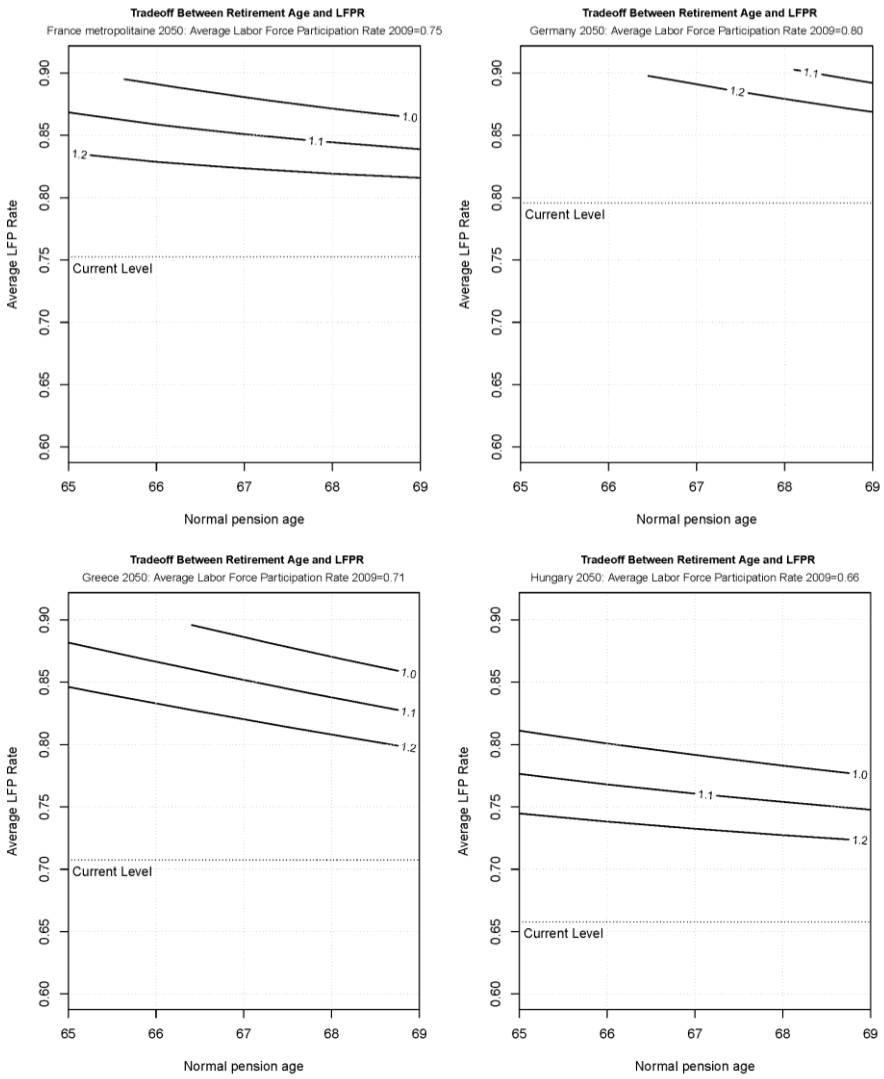


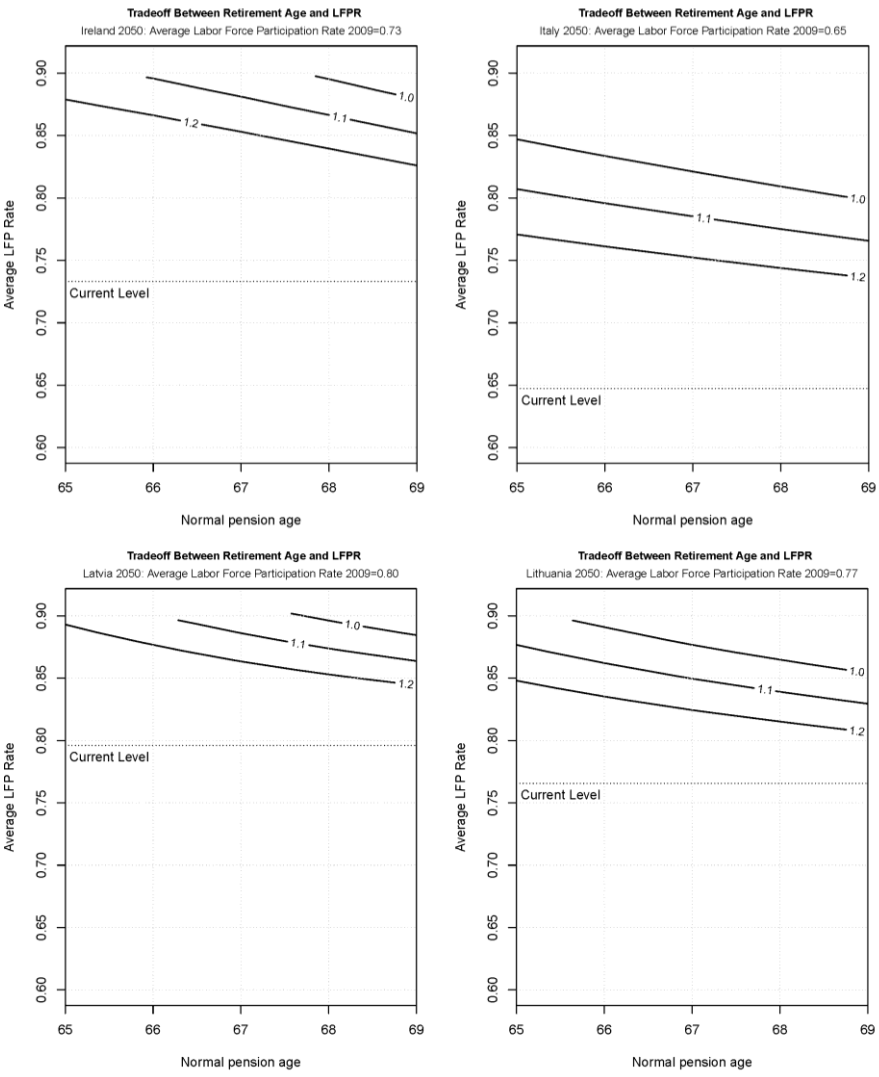

Tradeoff Between Retirement Age and LFPR
Czech Rep. 2050: Average Labor Force Participation Rate 2009=0.76
Average LFP Rate
0.60
0.65
0.70
0.75
0.80
0.85
0.90
1.1
1.2
Current Level
65
66
67
68
69
Normal pension age

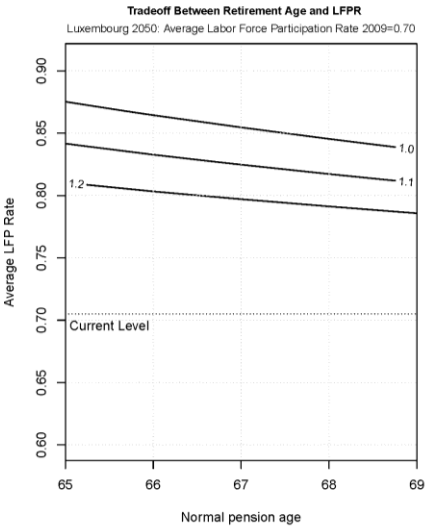

Tradeoff Between Retirement Age and LFPR
Denmark 2050: Average Labor Force Participation Rate 2009=0.82
Average LFP Rate
0.60
0.65
0.70
0.75
0.80
0.85
0.90
1.0
1.1
1.2
Current Level
65
66
67
68
69
Normal pension age

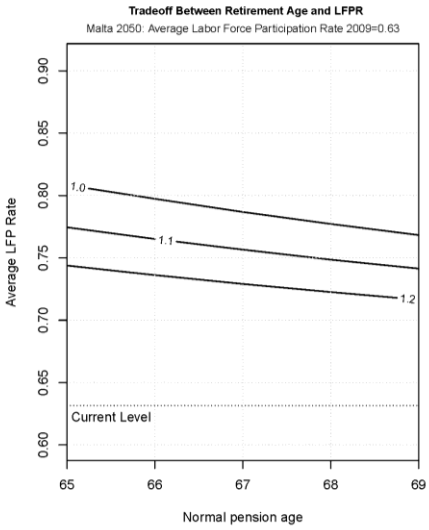

Tradeoff Between Retirement Age and LFPR
Estonia 2050: Average Labor Force Participation Rate 2009=0.80
Average LFP Rate
0.60
0.65
0.70
0.75
0.80
0.85
0.90
1.0
1.1
1.2
Current Level
65
66
67
68
69
Normal pension age

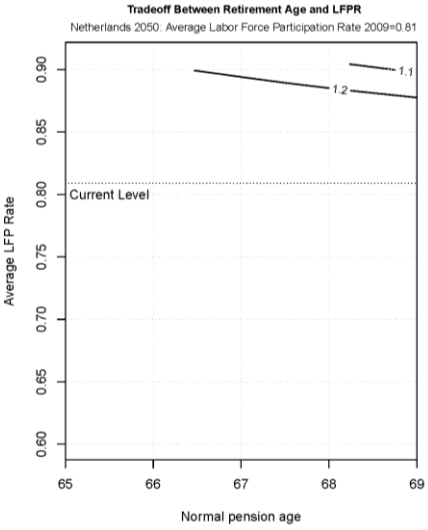

Tradeoff Between Retirement Age and LFPR
Finland 2050: Average Labor Force Participation Rate 2009=0.80
Average LFP Rate
0.60
0.65
0.70
0.75
0.80
0.85
0.90
1.0
1.1
1.2
Current Level
65
66
67
68
69
Normal pension age

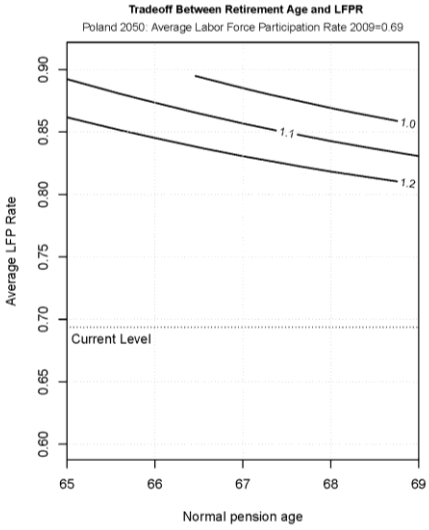

Tradeoff Between Retirement Age and LFPR
France metropolitaine 2050: Average Labor Force Participation Rate 2009=0.75
Average LFP Rate
Normal pension age
1.0
1.1
1.2
Current Level
Tradeoff Between Retirement Age and LFPR
Germany 2050: Average Labor Force Participation Rate 2009=0.80
Average LFP Rate
Normal pension age
1.1
1.2
Current Level
Tradeoff Between Retirement Age and LFPR
Greece 2050: Average Labor Force Participation Rate 2009=0.71
Average LFP Rate
Normal pension age
1.0
1.1
1.2
Current Level
Tradeoff Between Retirement Age and LFPR
Hungary 2050: Average Labor Force Participation Rate 2009=0.66
Average LFP Rate
Normal pension age
1.0
1.1
1.2
Current Level

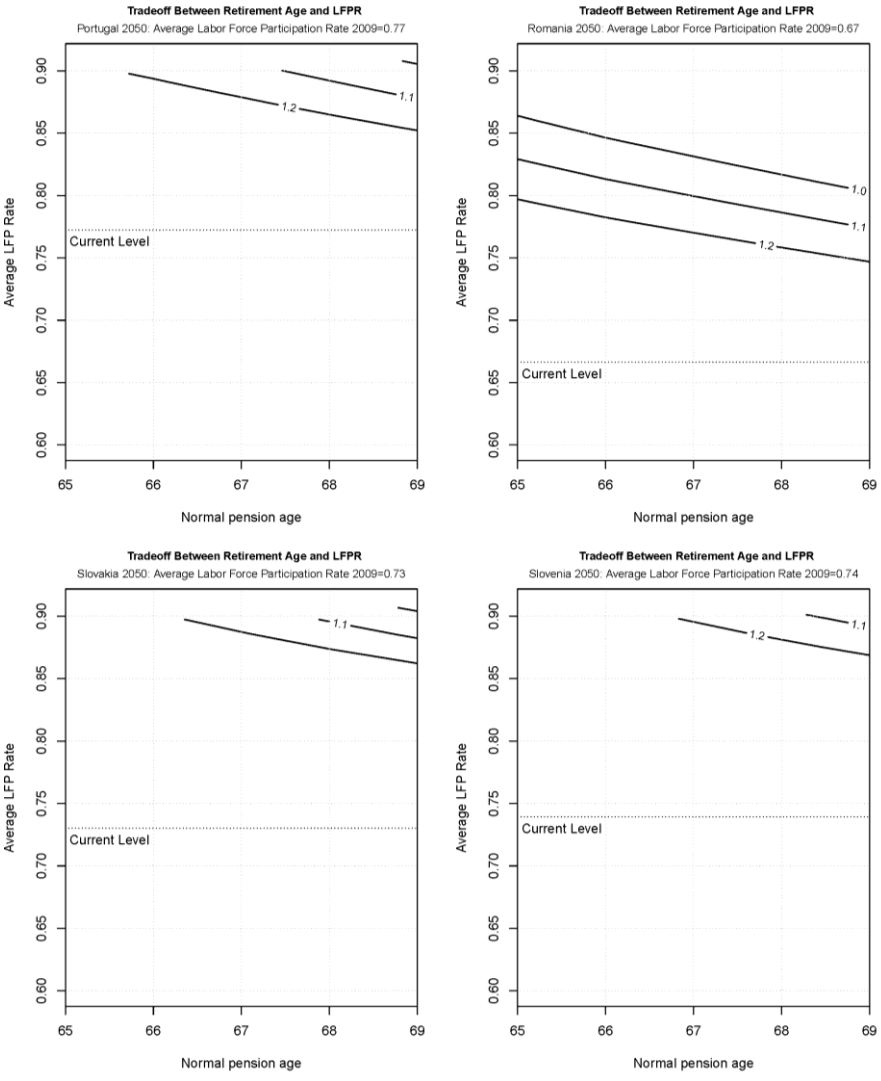

Tradeoff Between Retirement Age and LFPR
Ireland 2050: Average Labor Force Participation Rate 2009=0.73
Tradeoff Between Retirement Age and LFPR
Italy 2050: Average Labor Force Participation Rate 2009=0.65
Tradeoff Between Retirement Age and LFPR
Latvia 2050: Average Labor Force Participation Rate 2009=0.80
Tradeoff Between Retirement Age and LFPR
Lithuania 2050: Average Labor Force Participation Rate 2009=0.77
Average LFP Rate
Normal pension age
1.0
1.1
1.2
Current Level
0.60
0.65
0.70
0.75
0.80
0.85
0.90
65
66
67
68
69

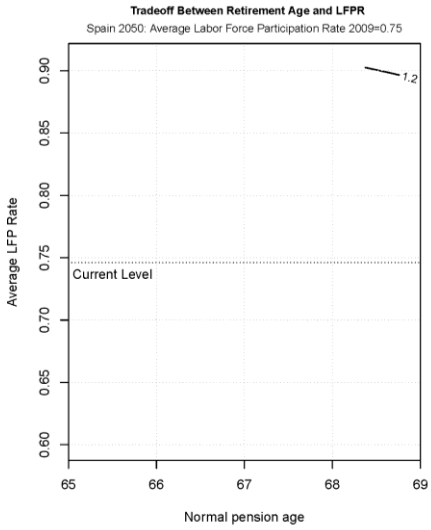

Tradeoff Between Retirement Age and LFPR
Luxembourg 2050: Average Labor Force Participation Rate 2009=0.70
Average LFP Rate
Normal pension age
1.0
1.1
1.2
Current Level

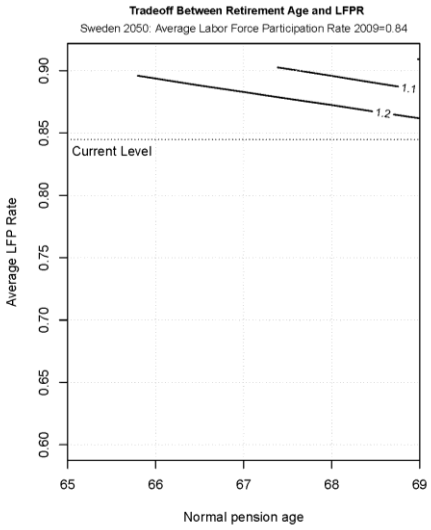

Tradeoff Between Retirement Age and LFPR
Malta 2050: Average Labor Force Participation Rate 2009=0.63
Average LFP Rate
Normal pension age
1.0
1.1
1.2
Current Level

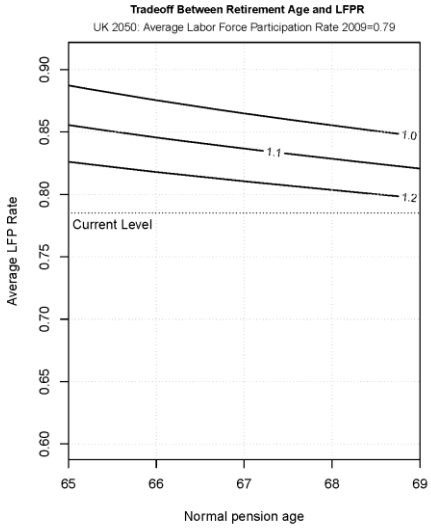

Tradeoff Between Retirement Age and LFPR
Netherlands 2050: Average Labor Force Participation Rate 2009=0.81
Average LFP Rate
Normal pension age
1.1
1.2
Current Level


Tradeoff Between Retirement Age and LFPR
Poland 2050: Average Labor Force Participation Rate 2009=0.69
Average LFP Rate
Normal pension age
1.0
1.1
1.2
Current Level


Tradeoff Between Retirement Age and LFPR
Portugal 2050: Average Labor Force Participation Rate 2009=0.77
Average LFP Rate
Normal pension age
Current Level
1.1
1.2
Tradeoff Between Retirement Age and LFPR
Romania 2050: Average Labor Force Participation Rate 2009=0.67
Average LFP Rate
Normal pension age
Current Level
1.0
1.1
1.2
Tradeoff Between Retirement Age and LFPR
Slovakia 2050: Average Labor Force Participation Rate 2009=0.73
Average LFP Rate
Normal pension age
Current Level
1.1
Tradeoff Between Retirement Age and LFPR
Slovenia 2050: Average Labor Force Participation Rate 2009=0.74
Average LFP Rate
Normal pension age
Current Level
1.1
1.2


Tradeoff Between Retirement Age and LFPR
Spain 2050: Average Labor Force Participation Rate 2009=0.75
Average LFP Rate
0.60
0.65
0.70
0.75
0.80
0.85
0.90
1.2
Current Level
65
66
67
68
69
Normal pension age


Tradeoff Between Retirement Age and LFPR
Sweden 2050: Average Labor Force Participation Rate 2009=0.84
Average LFP Rate
0.60
0.65
0.70
0.75
0.80
0.85
0.90
1.1
1.2
Current Level
65
66
67
68
69
Normal pension age


Tradeoff Between Retirement Age and LFPR
UK 2050: Average Labor Force Participation Rate 2009=0.79
Average LFP Rate
0.60
0.65
0.70
0.75
0.80
0.85
0.90
1.0
1.1
1.2
Current Level
65
66
67
68
69
Normal pension age

Appendix Section 3: The relationship between age-specific disability rates and labor force participation rates

Table A3: Relationship between the log of the prevalence of disability (limited and severe) and labor force participation rates for men 45 to 64 years old, EU-SILC countries, 2009

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	-2.10190	0.20535	-10.235	3.71e-14***
Prev. of Disability	-0.38890	0.72572	-0.536	0.59428
Age[50-54]	0.20741	0.07644	2.713	0.00896**
Age[55-59]	0.93922	0.11267	8.336	3.26e-11***
Age[60-64]	1.81400	0.12740	14.239	< 2e-16***
Belgium	0.09399	0.15673	0.600	0.55127
Czech Republic	-0.45157	0.15300	-2.952	0.00470**
Denmark	-0.46246	0.15154	-3.052	0.00355**
Estonia	-0.06411	0.14810	-0.433	0.66686
Finland	-0.04496	0.14775	-0.304	0.76207
France	-0.11399	0.15824	-0.720	0.47448
Germany	-0.38981	0.15340	-2.541	0.01401*
Greece	-0.22714	0.15397	-1.475	0.14607
Hungary	0.45598	0.15049	3.030	0.00378**
Ireland	-0.13354	0.15914	-0.839	0.40516
Italy	-0.07391	0.15960	-0.463	0.64519
Luxembourg	-0.08832	0.16285	-0.542	0.58986
Netherlands	-0.32485	0.15024	-2.162	0.03513*
Poland	0.34518	0.14884	2.319	0.02428*
Portugal	-0.20911	0.14785	-1.414	0.16312
Spain	-0.21094	0.15359	-1.373	0.17540
Sweden	-0.59779	0.19767	-3.024	0.00384**
United Kingdom	-0.28403	0.15959	-1.780	0.08085.

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 0.2088 on 53 degrees of freedom
Multiple R-squared: 0.9464, Adjusted R-squared: 0.9242
F-statistic: 42.55 on 22 and 53 DF, p-value: < 2.2e-16

Sources: Disability Rates: European Health Expectancy Monitoring Unit (EHEMU) (2009). Data on activity limitation from Statistics on Income and Living Conditions (SILC) Survey [electronic resource]. Montpellier: Centre de Recherche de Val d'Aurelle. www.ehemu.eu/. Labor Force Participation Rates: European Commission (2011). Eurostat: Activity rates by sex, age groups and nationality (%) [lfsa_argan] (Updated: 28-07-2011). European Union. http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database

Notes: Age groups and countries are dummy variables. The omitted age group is 45-49 years old. The omitted country is Austria. Dependent variable is the age-specific labor force participation rate. The results with respect to the statistical significance of the disability rate are the same when the dependent variable is the labor force participation rate instead of the log of the labor force participation rate and when we consider females instead of males.

Appendix Section 4: Sensitivity of the slopes to the use of 2009-based labor force participation rates

Table A4: Slopes of iso-burden contours for three levels of the relative burden, 2009 and 2012 labor force participation rates for Germany, Italy, and the UK

	Relative Burden =1.0	Relative Burden =1.1	Relative Burden =1.2
Germany			
2012 LFPR	NA	-1.23	-1.23
2009 LFPR	NA	-1.20	-1.14
Italy			
2012 LFPR	-1.30	-1.14	-0.94
2009 LFPR	-1.22	-1.03	-0.87
UK			
2012 LFPR	-1.00	-0.85	-0.68
2009 LFPR	-1.02	-0.87	-0.73