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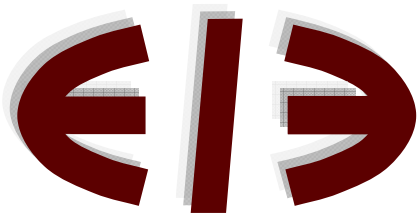

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Demographic Pressure in the European Union

Increasing Labour Market Participation, Migration or Old Age Participation to Maintain Fiscal Sustainability

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Abstract

On top of the sovereign debt crisis in the European Union, demographic change is exerting enormous pressure on public finances. We analyse four policy options: lowering pension benefits, increasing labour market participation of the native population, immigration and participation of older people. Our results show that the most publically indebted EU economies face the highest increases in public spending on the retiring baby boom generations over the coming decades. Fortunately for these economies, it turns out that adjusting their labour market participation is easier than for their neighbouring economies within the EU. Increasing labour market participation to 60% keeps several countries largely out of the woods.

Keywords: Demography, fiscal policy, labour, ageing, European Union.

JEL-Codes: C01, D6, E24, E62, F22, H53, H55, J11, J18, J21, J48, O57.

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Table of contents

1. Demographic pressure, equal profiting and equal pressure, and policy 3
2. Demographic projections and fiscal facts 7
3. An explosion of public debt in case of no policy change? 10
4. Policy options 14

Scenario 1: Cutting pensions 14

Scenario 2: Exploiting the native working age population 17

Scenario 3: Adjusting the labour force by allowing for more migration 22

Scenario 4: Adjusting the labour force by employing older people 25

Overall results of the scenarios 30

5. Summary and policy conclusions 33

References 36

Table of figures

Figure 1 Older people to full time workers in the period 2010 and 2050 8

Figure 2 The evolution of EU public debt in case of no policy change 11

Figure 3 Current debt and expected fiscal spending in 2025 12

Figure 4 Required cut in pensions to maintain fiscal pressure at the level of 2010 17

Figure 5 Required labour participation to maintain fiscal pressure at the level of '10 19

Figure 6 Public debt, benefit cuts and adjustments in participation rates 20

Figure 7 Required immigrants to maintain fiscal pressure at the level of 2010 24

Figure 8 Required older workers to maintain fiscal pressure at the level of 2010 28

Figure 9 Required migrants and old age workers in relation to public debt 29

Figure 10 Adjusting the participation of the native population to 60% 32

Table of tables

Table 1 The status quo in 2010

Table 2 Panel regressions for 2010-2050

Table 3 A summary of the policy options' outcomes from 2010 to 2025

1. Demographic pressure, equal profiting and equal pressure, and policy

Demographic change exerts pressure on public finances and labour markets. In this study, our *objective* is to analyse the demographic dynamics in the European Union (EU) from 1950 to 2100 and present labour market strategies. We identify several ways to cope with the challenge of ageing.

The aim of this study is to investigate whether the EU economies that are currently under fiscal distress due to the sovereign debt crisis, that is in particular the South of the EU, will be able to cope with the impact of the retiring baby boom generations in the decades to come. This impact does not only involve the public budget for the society as a whole, but also the burden for the actual workers who, in the EU social security systems, mainly pay for the old age financing of the current old age generations. In our analyses of the policy options, we explicitly take account of these workers by imposing a no-change in fiscal pressure for these native workers[2] from 2010 onwards.

Moreover, considering public pensions as being part of an implicit contract between generations, we impose the fairness criterion, obtained from generational accounting (see for a comparison e.g. Auerbach *et al.* 1999, Kotlikoff 2002, Horst *et al.* 2010, Meijdam and Verbon, 1997, Siebert, 2002, Sinn, 2005), that the net profit from public spending has to be equal across persons (see also Teulings and De Vries (2006)). This is what we call *equal profiting*. Independent of the number of persons in a generation, each person should be entitled to the same public benefits. The main rationale for imposing

[2] In this study we use the word "native worker" for people who work in the country in which they were born. Alternatively, we could speak of "autochthonous" (as the British seem to do).

this fairness criterion is that the best chance to maintain the implicit contract between generations is when the terms of the contract are fair. Another criterion that we maintain in most of our analyses is that the fiscal pressure per worker should not augment. This is another criterion of fairness, referred to as *equal pressure*. The reason for taking this criterion is that the burden can easily be imposed on workers while this group in the society is needed most, from an economic and financial point of view. An ageing population means that there are relatively less workers and this shrinking group has to pay more in order to maintain the social security system at current (high) levels. As a benchmark, we take this situation of no change in fiscal pressure per worker.

This brings us to four policy options, decreasing the old age benefits to accommodate the fiscal pressure from changing demographics, stimulating labour force participation of the native working age population, increasing migration or putting older people back to work.

With respect to the strategy of raising labour force participation, Peeters and Groot (2012b) showed that there is a negative correlation between the projected change in demographic-induced fiscal pressure over future decades on the one hand and the present labour market participation rate (measured in full-time equivalents) of the working age population on the other hand. This is good news because it suggests that countries facing higher and/or increasing fiscal pressure have more room to raise their labour force participation rate. This negative correlation can be interpreted as a legacy of the baby boom generation born after WW-II. The reasoning here is that when the baby boom generation was of working age, it was relatively cheap to have generous public pensions, generous public health care, generous family allowances and gratis

education because the total fiscal cost of all these programs could be shared among a relatively high number of workers (that is, the population share of those of working age was high relative to the population shares of the young and old aged). Interpreted in terms of generational accounting, this amounts to an *inter*generational transfer: benefits bestowed to the young and old aged financed by those who at that time belonged to the baby boom generation. However, the baby boom generation also had the opportunity to bestow benefits on their own cohort, mainly by introducing relatively generous and easy accessible social assistance, unemployment benefits, disability benefits, sickness benefits and paid parental leave schemes. One may expect that the more extensive this set of welfare state arrangements is, the lower the labour force participation rate will be. In terms of generational accounting, this amounts to an *intra*generational transfer: benefits to the non-working part of the working age population financed by the working part of the working age population. Both effects together might explain the present state of affairs as a legacy of the period in which the baby boom generation was of working age, coinciding with the period of the vast expansion of the welfare state in developed economies.

Alongside raising labour force participation (e.g. by raising the official retirement age), immigration of young people alleviates fiscal pressure. Migration flows will most likely be from countries with low GDP per capita, high young age dependency ratios and low labour market participation rates towards countries with high GDP per capita, high old age dependency ratios and high labour force participation rates among those of a working age.

A higher (lower) life expectancy, also determined by the age-specific death rates in the longevity tables, implies a structural higher (lower) fiscal burden of ageing. Because it is structural, net migration will not be of much help, unless the flow of migration is itself steady and structural. In a country in which the shape of the pyramid is at odds with its stable counterpart, net migration might be an option. For instance, suppose there is a bulge in the pyramid for the old aged. The comparison with the stable pyramid shows to what extent the bulge is just a temporary phenomenon (e.g. due to the retirement of the baby boom generation). A temporary flow of net immigration of young people might then help to cushion the fiscal pressure of the temporary bulge of old aged. As Clemens (2011) has shown, there is potentially a large welfare gain of migration flows from low-wage to high-wage countries. One may expect larger temporary shortages of labour and hence higher wages in ageing economies and hence more immigration, the more the projected population share of the old-aged is above its stable population share. Obviously, countries that have accumulated a large government surplus and/or a strong net international investment position will have a lower incentive to rely on immigration to alleviate the fiscal pressure of ageing.

The outline of the rest of this paper is as follows. Section 2 presents the old age dependency ratios for the period 2010 and 2050 and the facts on public debt and their financing for each of 21 EU economies. Section 3 then illustrates the explosion of public debt for many of these economies, only accounting for the additional fiscal spending ensuing from the ageing populations. In response to this, section 4 presents four policy options to anticipate the debt explosions. Section 5 wraps up the main results and concludes.

2. Demographic projections and fiscal facts

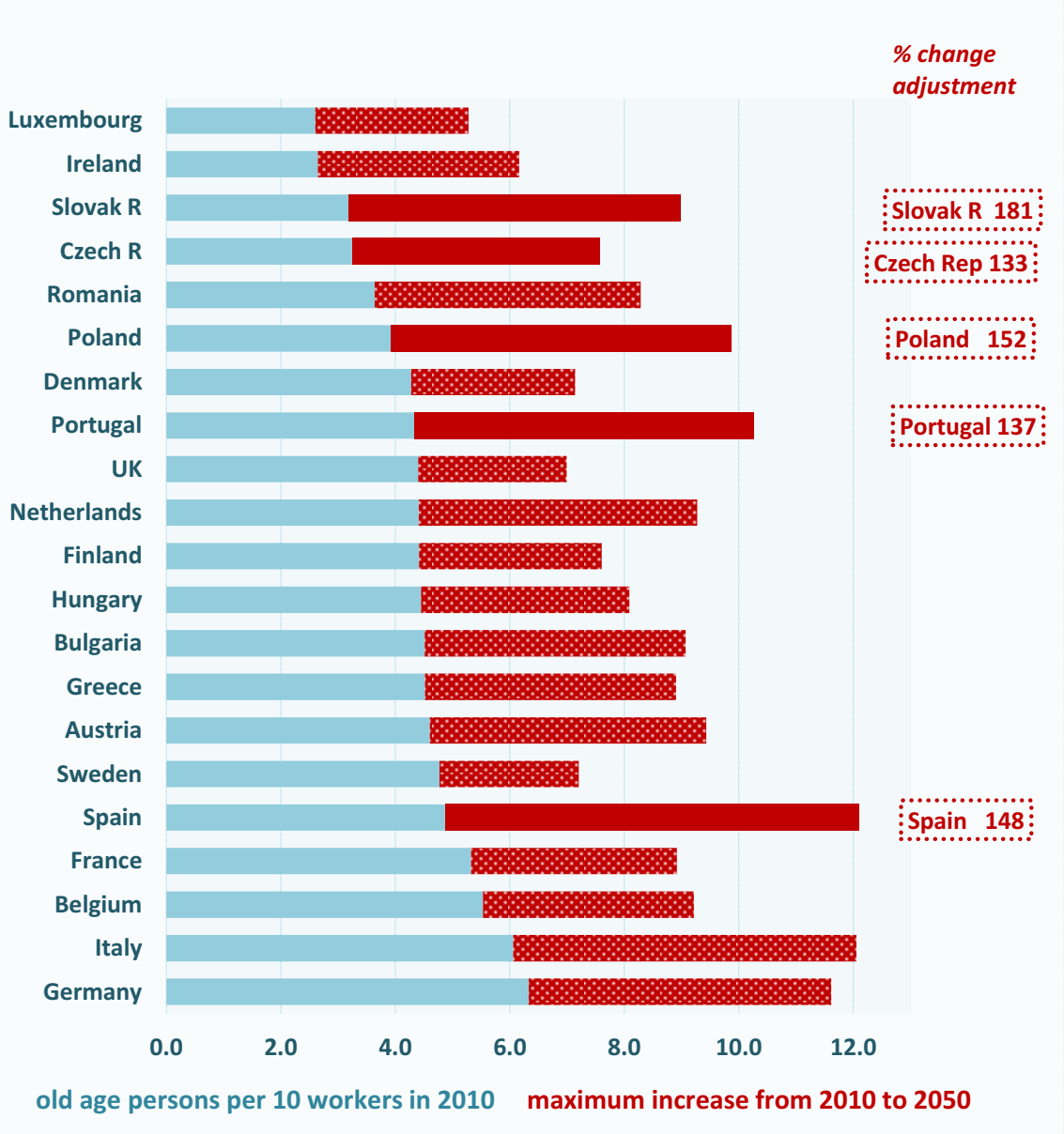
The demographic changes that EU countries are facing is shown in Figure 1. It presents old age dependency rates for 21 EU countries for the years 2010 and 2050. We calculate these rates, however, in a specific way. The number of older people in a country is not related to the number of persons that are of working age, but the number of persons that are actually working. Throughout our analyses in this study we will do this, in view of the fact that the workers carry the burden in Western social security systems, concerning the additional spending due to the ageing population. While the population of older people increases, the population of working age people shrinks. The share of people that are actually working is determined by the labour participation rate, that we use here in full-time work equivalents (similar to the analyses in Peeters and Groot (2012b)).

As Figure 1 illustrates, there is quite some variety in the older people to active workers ratio. Luxembourg, on the one extreme, has little more than 2 older people per 10 active full time workers in 2010 while Germany, on the other extreme, has more than 6. For the year 2050, these ratios more or less double, implying that Luxembourg goes from 2 to 4 and Germany from 6 to (almost) 12. The countries in which these old-age dependency rates are increasing most from 2010 to 2050 are the Slovak Republic (181%), Poland (152%), Spain (148%), Portugal (137%) and the Czech Republic (133%). These changes will require additional public spending (on pensions, health care), even if the spending per person is kept at the level of 2010.

The five countries that top the list in terms of demographic change do not top the list of public debt in 2010 as Table 1 shows. Portugal, however, has a rather high public

Figure 1 Older people to full time workers in the period 2010 and 2050

in persons, per 10 full time workers



Source: Authors' calculations based on demographic statistics of the United Nations (UN) and labour participation statistics of the Organisation for Economic Cooperation and Development (OECD).

Note: The participation rate of 2008 is assumed to remain constant during the subsequent years. The maximum increase in the ratio of older people to workers per country is taken over the years 2015, 2020, 2025 until 2050.

Table 1 The status quo in 2010

Country	Public debt	Labour participation
	% GDP	*% working age population*
Greece	142	61
Italy	119	51
Belgium	97	48
Ireland	96	66
France	84	49
Portugal	83	62
Hungary	80	54
Germany	80	49
United Kingdom	77	57
Austria	70	56
Netherlands	64	52
Spain	60	51
Poland	56	49
Finland	48	59
Denmark	44	59
Slovak Republic	42	52
Sweden	40	59
Czech Republic	40	64
Romania	35	59
Bulgaria	18	56
Luxembourg	17	75

Source: Authors' calculations based on International Monetary Fund (IMF) World Economic Outlook (WEO) of Autumn 2011 and OECD databases.

Note: Data for Cyprus, Estonia, Latvia, Lithuania, Malta and Slovenia are lacking in the OECD database, for which reason we have 21 instead of 27 countries.

debt to GDP ratio of 83 in 2010. The Slovak Republic, Poland, Spain and the Czech Republic list far lower. This is fortunate, though the nominal impact of demographic change on public finances matters more. This is worked out in the next section.

3. An explosion of public debt in case of no policy change?

Let us assume here that older people consume a public pension (and no public health care) and that this remains at the level of 2010. Fiscal spending on older people is determined in 2010, denoted here by φ_{2010}, multiplied by the additional number of older people at time t (OAP_t) in deviation from 2010 as

$$G_t^{age} = -\varphi_{2010} * (OAP_t - OAP_{2010})$$

equation (1)

The public debt at time t accumulates this spending on older people and equals the debt in the previous period plus this additional spending, denoted as

$$D_t = D_{t-1} - G_t^{age}$$

equation (2)

The debt grows faster in case government spending on older people is higher and it grows slower otherwise. We are then interested in the debt-to-GDP ratio[3], that is

$$public\ debt\ pressure_t := \frac{D_t}{GDP_t}$$

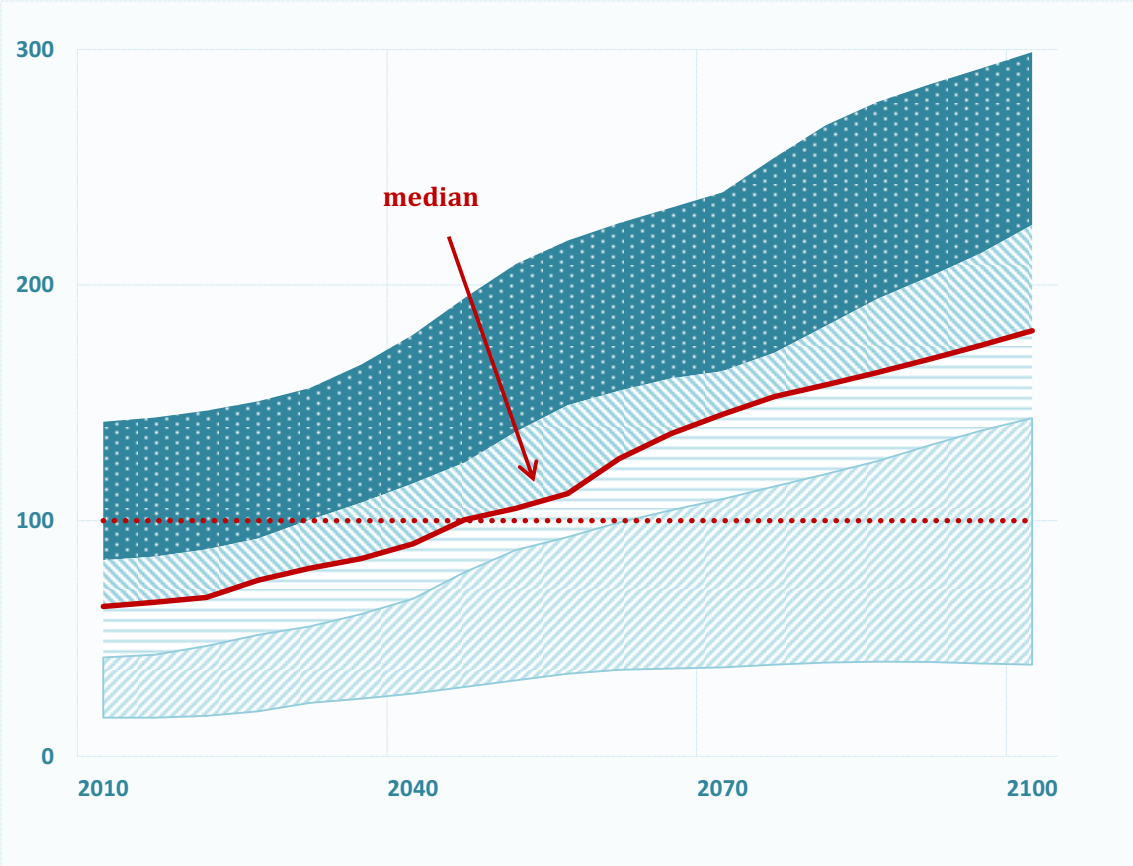
equation (3)

Figure 2 shows the result. Until 2010, there are actual values. From 2010 onwards, the debt-to-GDP ratio is simulated using **equation (3)**. The figure illustrates the median of the debt-to-GDP ratio across the 21 EU countries (red line), along with a band indicating the width of the minimum and maximum, for each five years in the period 2010 until 2100. This band falls in four parts, each for 25% of the countries. For a description of the data, see Groot and Peeters (2011), or Peeters and Groot (2012a).

[3] We calculate future nominal *GDP* by $GDP_t = \gamma * part_t * WAP_t$ where γ is the productivity, *part* the participation rate and *WAP* the working age population, defined as persons between 15 and 65. The productivity and participation rate are kept constant from 2008 and 2010 onwards.

Figure 2 The evolution of EU public debt in case of no policy change

% of nominal GDP

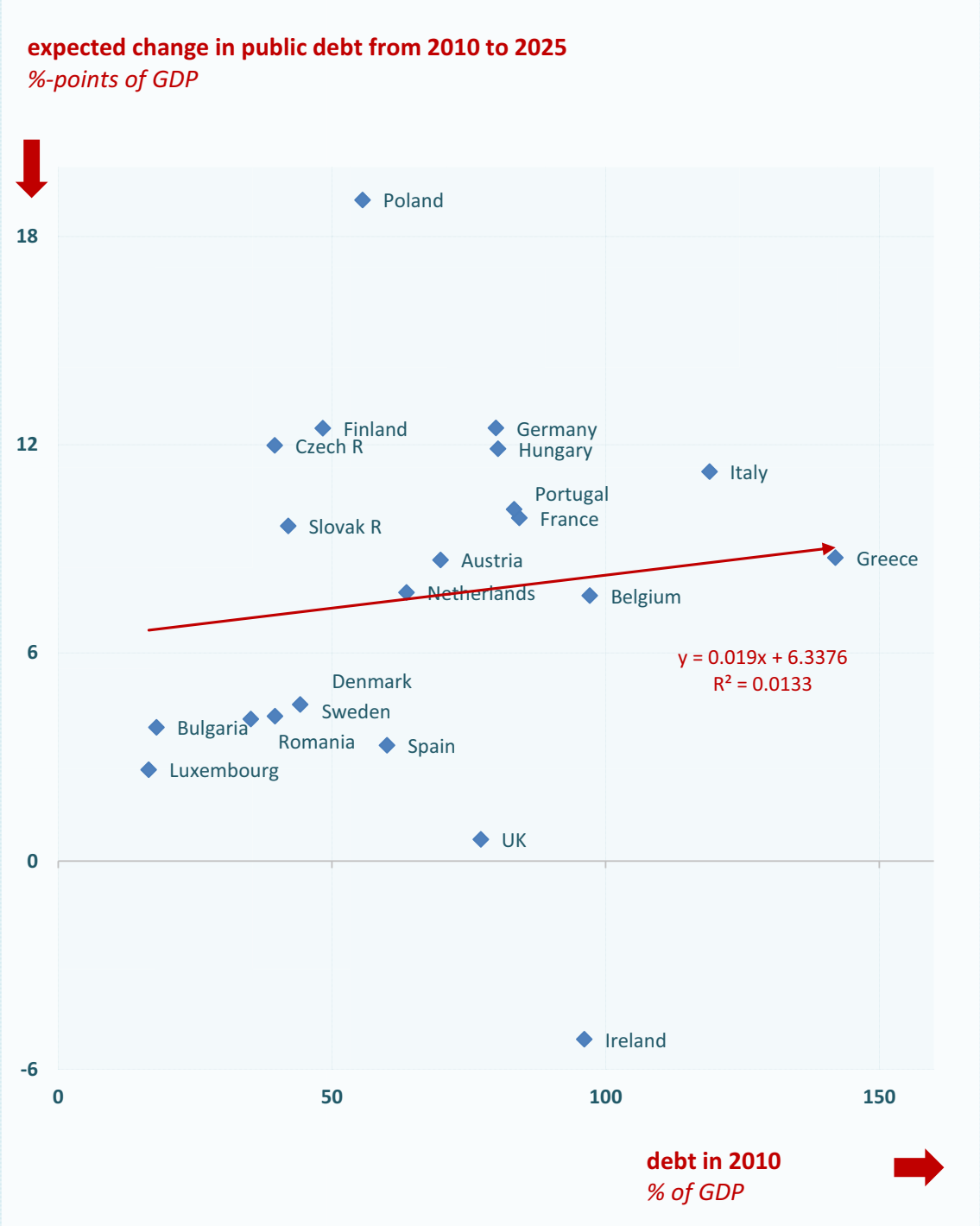


Source: Authors based on UN and OECD and UN

Note: Until 2010 actual values, from 2010 onwards simulated according to equation (3). The red line is the median across the 21 countries. Each of the four colour areas represents 25% of the economies, respectively.

As follows, there is a strong increase in the median and it crosses the 100% in 2045, starting from 60% in 2010. The three upper bands show a strong upward increase afterwards. The threat of fiscal unsustainability thus looms for the majority of EU countries, in case no anticipating policies are pursued, even in this scenario where only the pension costs are taken into account.

Figure 3 Current debt and expected fiscal spending in 2025



Source: Authors' calculations

While the speed in debt increase is already fast in the first decades 2010-2030, we wish to analyse here how this works out for the individual countries. In order to do so, we take a cross-sample of **Figure 2**, in this case the year 2025 (halfway 2010 and 2050 and nearby the current year) and relate them to the debt-to-GDP ratios of 2010 as presented in **Table 1**. **Figure 3** illustrates the scatterplot.

As follows, the countries that were identified in Figure 1 as most ageing in the period in 2050 in comparison with 2010, are not all found in the highest regions as it comes to the expected change in public debt. The Czech Republic, Portugal, the Slovak Republic and Spain will face an increase of 6 to 12% of debt-to-GDP in the period from 2010 to 2025, less than or equal to many other EU countries. However, Poland faces high additional fiscal expenditures of more than 18%-points. Nonetheless, Poland started from a rather low debt-to-GDP ratio. Countries such as Greece, Italy, Belgium and France were already at higher debt levels in 2010 than the Polish debt including this expected increase.

Remarkable is the fact that the relationship between the current debt level (of 2010) and the expected public debt increases is positive, as **Figure 1** clearly shows. The adjusted R^2 of the trend line is rather low, due to outliers Poland and Ireland. Ireland has a rather young population in comparison with the other economies. Apart from Poland and Ireland, the positive relationship is highly significant. This implies that the expectations are that EU economies with a high debt in 2010 face more fiscal pressure in the coming decades due to ageing, than the economies that had lower debt levels in 2010.

4. Policy options

Due to the increase of demographic pressure in economies that are ageing, policy makers need to take measures to maintain the equal profiting principle. In order to keep their social security for younger generations (pensions, health care) at similar levels as for the older generations, policy makers may pursue several policy options of which we investigate the following four main ones.

Scenario 1: Cutting pensions

According to our own definition, *demographic pressure* is the pressure coming from the incremental fiscal spending due to demographic change, such as family costs or state pensions or health care costs, per working person in a certain country. In an economy that is in transition towards a society with relatively more elderly people as a share of the total population, this pressure increases for three main reasons. First, more state pensions are going to be paid as the volume of retirees augments. Second, public health costs increase, as elderly people need in general more health care than young people. Third, the higher share of elderly in the societies entails a lower number of people working. The fiscal pressure contains thus a nominator (pension and health care costs) and a denominator (workers) effect.

Social security systems, as they exist in most developed economies worldwide, are pay-as-you-go (*PAYG*) systems. This implies that workers pay the needed social security premiums to cover the costs of public pensions, public health care costs and also

unemployment and other social security benefits. Limiting us to the costs of the ageing population only, the demographic pressure put on the workers at time *t* equals

$$pressure\ per\ worker_t := \frac{\varphi_t * OAP_t}{part_t * WAP_t}$$

equation (4)

where the nominator gives the total old age government expenditures as the expenses of ageing per old age person (φ), let us say again the "pension", times the number of people that is old age (OAP). The denominator gives the labour participation rate ($part$) times the number of people that is working age (WAP).[4] Subscript *t* indicates the year in which we measure the variables.

An ageing society by definition implies that the share of the old in comparison to the working age population increases. The change in pressure from the current state, let us say time t_0 to time *T (T>*t_0*)*, is given by

$$\Delta_{T-t_0} pressure\ per\ worker = \Delta_{T-t_0} \frac{\varphi * OAP}{part * WAP}$$

equation (5)

with $\Delta_{T-t_0} x := x_T - x_{t_0}$. A mounting pressure thus comes from the old age dependency ratio, but may also come from the expenses per ageing person. In case a country has generous public pensions or sophisticated and therefore costly health care services, the pressure mounts. Moreover, the higher the initial labour market participation rate is,

[4] The total population (*POP*) is split in young (*YAP*), working age (*WAP*) and old people (*OAP*), that is *POP=YAP+WAP+OAP* where the young are below 15 and the old above 65 years (see Peeters and Groot, 2012b).

the higher the burden of these additional costs for the working population will be.[5] This follows also from **Figure 6**.

Sticking to the fairness rule that the pressure per worker should not change, a scenario of cutting pensions implies that optimal old age fiscal costs ($\tilde{\varphi}$) should be such that the change in pressure in **equation (5)** remains constant. It then follows that

$$\tilde{\varphi}_t = \tilde{\varphi}_{t-1} * \frac{WAP_t}{WAP_{t-1}} \frac{OAP_{t-1}}{OAP_t}$$

equation (6)

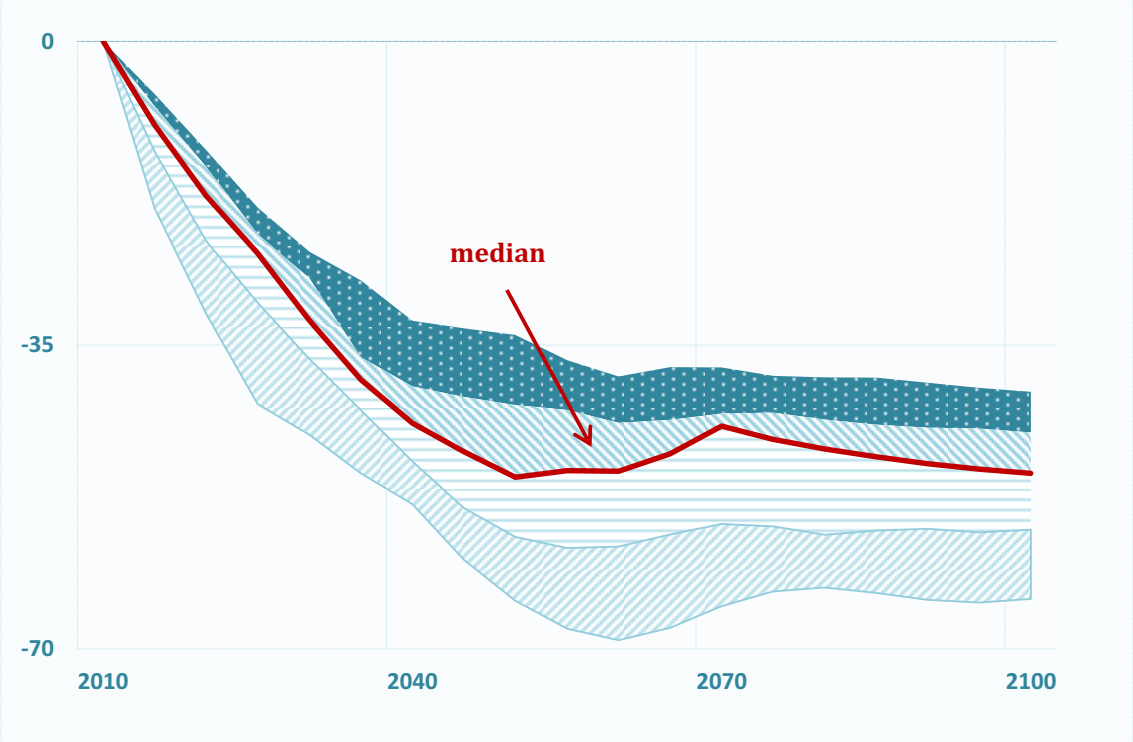
Figure 4 shows the results. It follows that all countries need significant cuts, even up to 35% in 2040 in comparison with the benefits in 2010. This follows from the fact that the working age population is shrinking, for which reason the second term in **equation (6)** is decreasing, and that the old age population is growing, for which the last term in **equation (6)** is shrinking over time. Moreover, in these analyses we only consider the nominal pension benefits. In case price indexation were to take place, for instance at 2% each year, the decreases in real terms are even higher than shown here.

From a social point of view this policy option is hard to sell to the public. The welfare states that have been built during the last decades, thanks to the baby boom generations that allowed for many hands to fulfil the work and much choice, gave rights to the employees' and the (future) pensioners. In most countries, it turns out to be hard to reverse these rights.

[5] This may sound counterintuitive, but a country has to adjust more when it carries its public old age costs with many working people as the social security premium payment per person is low.

Figure 4 Required cut in pensions to maintain fiscal pressure at the level of 2010

% change in comparison with 2010



Source: Authors based on UN and OECD data

Scenario 2: Exploiting the native working age population

Instead of paying pensioners less, adjustments can be made so that the working age population of persons between the age of 15 and 65 will work more (implying shorter education for students, working more hours, less early retirements, employing housewives).

Given the demographic changes as reflected in the old-age-dependency ratio, we then have to calculate again the future path for the participation rate in such a way that the pressure remains constant. It follows that, for the optimal participation rate at period t in order not to increase the pressure per worker, it should hold that

$$\overline{part}_t = \overline{part}_{t-1} * \frac{WAP_{t-1}}{WAP_t} \frac{OAP_t}{OAP_{t-1}}$$

equation (7)

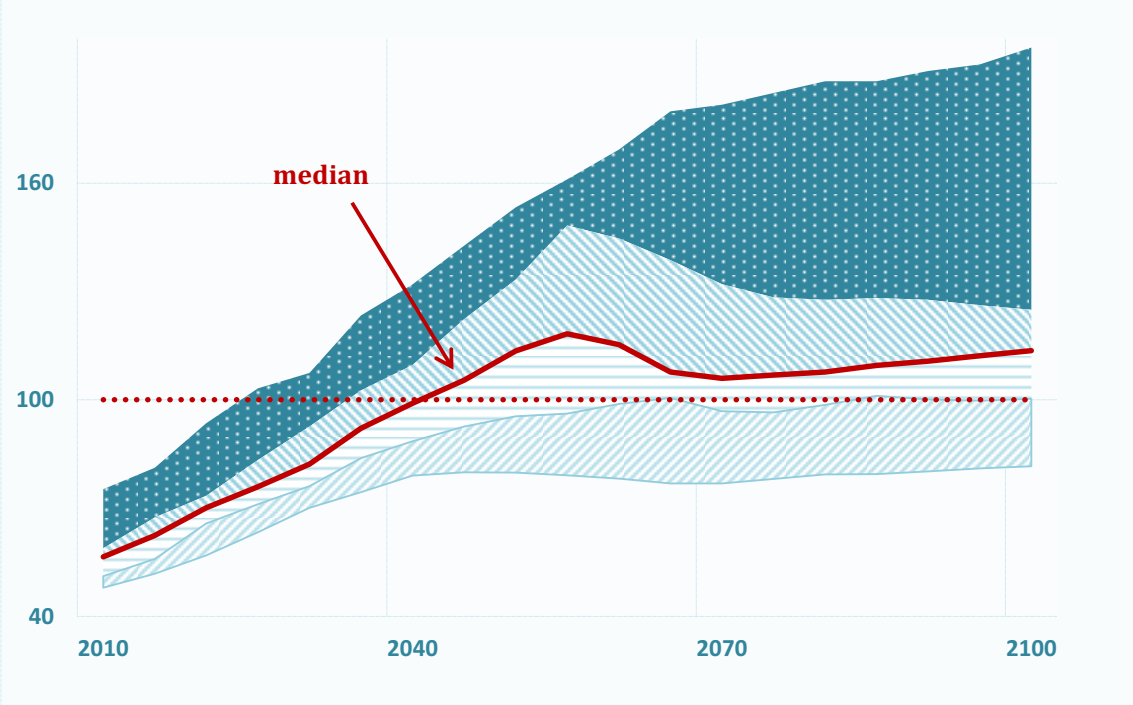
where we assume that the old age fiscal costs per worker (φ) remain constant. The last terms here are the inverse of the terms in **equation (6)**. In a similar vein therefore, as the economies are ageing, this cost-neutralising participation rate at time t is larger than the participation rate at time $t-1$, pushed up by the decrease in the working age population and the increase in the older population.

Figure 5 illustrates the outcomes for the 21 EU countries. In 2010 the median participation rate among the developing economies is almost 56% of the working age population while, in order not to increase the public costs of ageing, the participation rate should rise to 76% in 2025. **Figure 5** shows that for 75% of the countries it is feasible to increase their participation rate for the next decades to come, as the fiscally neutral participation rate remains well below 100%. For the other 25% other solutions need to be found, that we will try to find in the next sections.

Although this graph is almost the mirror image of Figure 4, the starting points matter. After all, it is the size of the adjustment or the percentage change that matter in pursuing these policy options. This implies that the country in which the old-age fiscal costs have to be cut most in %-points in comparison with 2010 does not need to be the country that should be adjusting its participation rate most upwardly.

Figure 5 Required labour participation to maintain fiscal pressure at the level of 2010

% of the working age population



Source: Authors based on UN and OECD data

This follows from **Figure 6**. Take for instance Greece and Italy. Greece has to adjust its labour participation rate more than Italy, in order to maintain the fiscal pressure constant. However, in the scenario of the benefit cuts, Greece has to cut less than Italy. This follows from the facts that Greece has a higher labour participation rate than Italy in 2010 (64% in comparison with 54%), but paid far lower benefits in that year than Italy did.

Highly relevant is the finding that the more heavily indebted economies require less change in labour market participation and smaller cuts in fiscal spending on the old, in comparison with the less indebted economies. This follows from the regression slopes.

Figure 6 Public debt, benefit cuts and adjustments in participation rates

Source: Authors' calculations

Although **Figure 6** only presents the results for the year 2025, a similar relationship is found for all the intermediate years between 2010 and 2050. This follows from the regressions as presented in **Table 2**. The left part of this table shows the results of the required changes in participations as the endogenous variable, regressed on the public debt ratio in the year 2010 and year dummy's. The estimated reaction coefficient of the debt ratio is -0.07 and significant, as the *t*-statistic is -2.5. This proves that highly indebted economies have to adjust their participation rate less than less indebted economies.

The right panel shows the panel regression results where the endogenous variable is the expected change in debt, as shown in **Figure 3**. As follows, the estimated reaction coefficient of the debt ratio is 0.12 and is thus positive and significant with a *t*-value of 3.95. This proves that high indebted economies are expected to have a larger increase in their debt levels than the less indebted economies, due to ageing.

Table 2 Panel regressions for 2010-2050

Endogenous variable is the required change in labour participation rate of the native population	*Endogenous variable is the expected change in debt*
Coefficient *(t-statistic)*	Coefficient *(t-statistic)*
constant	37.8 *(18.0)*	10.8 *(4.8)*
debt ratio 2010	-0.07 *(-2.5)*	0.12 *(3.95)*
fixed effects	significant	Significant
number of obs.	168	168
$Adj - R^2$	0.69	0.59

Source: Authors' calculations

Note: Numbers in brackets are *t*-values. The left panel regressions corresponds with the line in the upper part of **Figure 6** and the right with the line as shown in **Figure 3**, though for the years 2015-2050 (instead of 2025 only). Only each fifth year is included due to the availability of UN data population statistics. The number of observations is thus 21 (countries) times 8 (2015, 2020, 2025, 2030, 2035, 2040, 2045, 2050) years, equalling 168.

Scenario 3: Adjusting the labour force by allowing for more migration

In the ageing economies, policy makers may also choose to enlarge the working age population instead of requiring the existing working age population to work (more). This can be done by allowing for more immigrants.[6]

We stick to the principle of fiscal equality and the fairness rule that the pressure *per native working person* in terms of social security costs should not change. We can now do the maths to work out the number of migrants needed to remain at the level of 2010.

The **equation (8)** here below provides us with the information that the working age population of 15 to 65 years (WAP_t) at period t are equal to the working age population in the previous period (WAP_{t-1}) in addition to the generation of 15-19 year old persons that join the working age population in period t ($WAP15\_19_t$) but without the generation that retires ($WAP60\_64_{t-1}$). In addition, on the one hand, all immigrants minus the emigrants should be added ($NMIG_t$), while the working age population diminishes on the other hand because of the number of people that passes away (DTH_t).

$$WAP_t = WAP15\_19_t + WAP_{t-1} - WAP60\_64_{t-1} + \widehat{NMIG}_t - DTH_t$$

equation (8)

As net migration is our instrumental variable in this scenario, that means the variable that is to be adjusted to meet the objectives, we denote it with a hat on top of *NMIG*.

[6] The UN statistics that we use assume that the migration stabilises or fades out over the projection period. Therefore, our migration scenario represents *additional* migration, on top of this trend.

The fiscal equality principle makes that the social benefits per old age person remains the same ($\varphi_t = \varphi_{2010}$, t>2010). We further assume that the participation also remains the same, that is ($part_t = part_{2010}$, t>2010). Keeping the fiscal pressure per worker constant at the pressure in 2010 is then specified according to equation (5), as

$$\frac{\varphi_t * OAP_t}{part_t * \widehat{WAP_t}} = \frac{\varphi_{2010} * OAP_{2010}}{part_{2010} * WAP_{2010}}$$

equation (9)

for t>2010. From this follows that

$$\widehat{WAP_t} = WAP_{2010}\ \frac{OAP_t}{OAP_{2010}}$$

equation (10)

for t>2010. Substitution of **equation (8)** into **equation (10)** and collecting terms then gives us that

$$\widehat{NMIG_t} = \widehat{WAP_{t-1}} * (\frac{OAP_t}{OAP_{2010}} - 1) + WAP60\_64_{t-1} - WAP15\_19_t + DTH_t$$

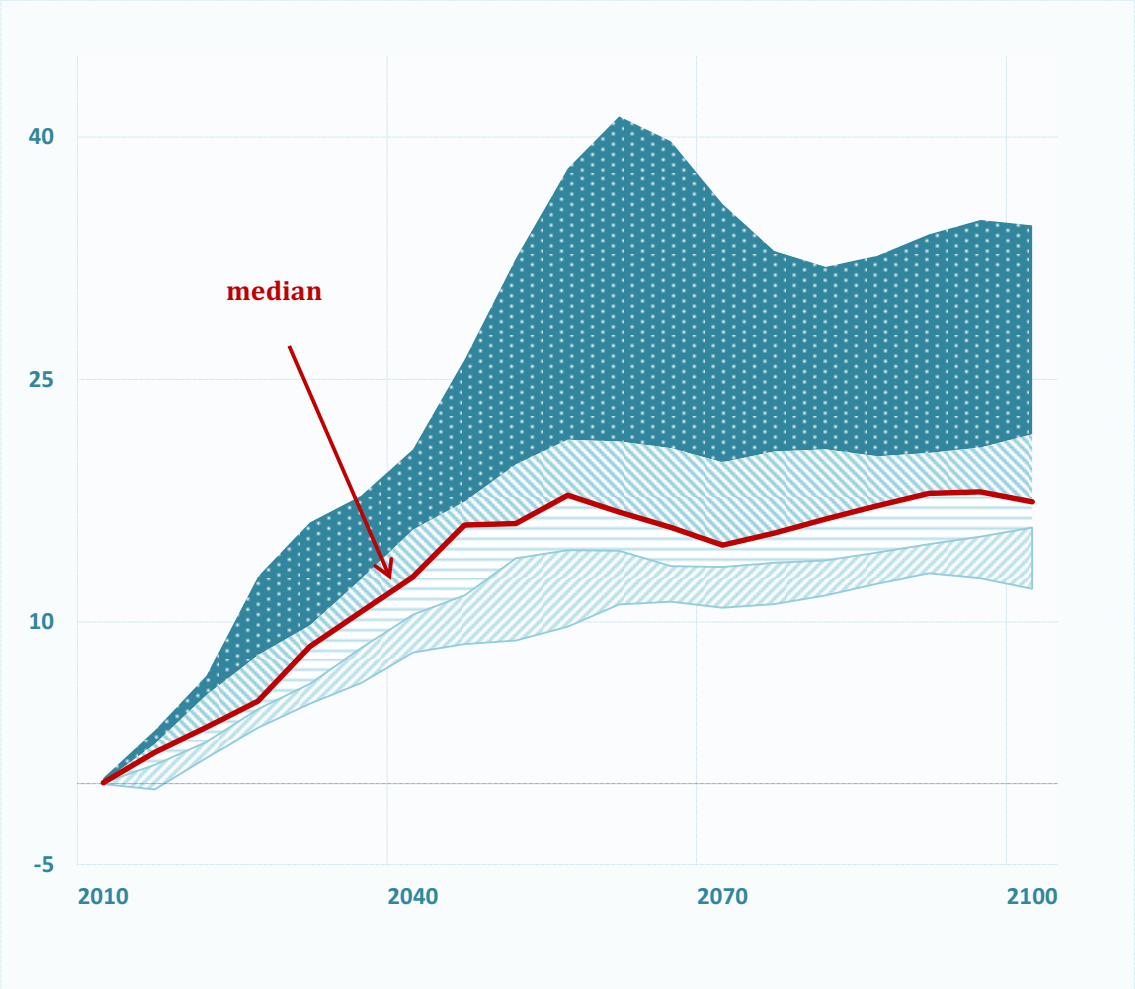
equation (11)

for t>2010.

The working age population thus follows the working age population in 2010 corrected by the ratio of old age populations in period t and period 2010 (**equation (11)**). Net migrants are only needed to the extent of the gap between the retired generation and the young generation joining the working age population, including the coverage of the number of people deceased, and the working age population in the previous period to the extent it was and already adjusted in the previous period.

Figure 7 Required immigrants to maintain fiscal pressure at the level of 2010

per 10 native workers



Source: Authors based on UN and OECD data

As **Figure 7** shows, the outcomes are large in size. The median country needs for each 10 native workers 10 migrants in 2040. Moreover, the band is rather small during this horizon. So even the country less in need of migrants needs relatively high immigration levels. Some economies need even up to 40 migrants, around 2060.

Scenario 4: Adjusting the labour force by employing older people

Instead of changing the migration policy, policy makers may also choose to enlarge the working age population by stimulating older people to remain in the labour force or to join it again. In the way that we presumed in the migrant scenario (see scenario 3) that migrants are not entitled to old age benefits, we assume here that older people that are inserted in the labour force renounce their old age benefits during the time that they are working. An older person thus either participates in the labour market and earns his or her own living or enjoys a public pension benefit, but not both. We can then calculate how many older workers are needed to sustain the pressure *per working person* in terms of social security costs 2010.

The **equation (8)** provides us again with the determination of the working age population of 15 to -65 years (WAP_t) at period *t,* but now we add the share of older people that offer their labour, defined as α, with $0 \leq \alpha \leq 1$, multiplied by the older people.

$$\overline{\overline{WAP_t}} = WAP15\_19_t + \overline{\overline{WAP}}_{t-1} - WAP60\_64_{t-1} + NMIG_t - DTH_t + \bar{\bar{\alpha}} * OAP_t$$

equation (12)

The parameter α is the instrumental variable here. In case it is close to zero, no older people are offering their labour, while α close to 1 means that most of the older people still work or try to find work. Until and including the year 2010 persons above 65 retired, so $\alpha = 0$ for $t \leq 2010$.

In keeping the fiscal pressure per worker constant at the pressure in 2010 there is a remaining share of older people $(1-\bar{\bar{\alpha}})$, after 2010 requiring pension benefits. The adjusted **equation (5)** thus reads as

$$\frac{\varphi_t * (1-\bar{\bar{\alpha}}) * OAP_t}{part_t * \overline{\overline{WAP}}_t} = \frac{\varphi_{2010} * OAP_{2010}}{part_{2010} * WAP_{2010}}$$

equation (13)

for t>2010. The fiscal equality principle and the participation rate remain again the same ($\varphi_t = \varphi_{2010}$, t>2010 and $part_t = part_{2010}$, t>2010). From this follows that

$$\overline{\overline{WAP}}_t = (1-\bar{\bar{\alpha}}) * WAP_{2010} * \frac{OAP_t}{OAP_{2010}}$$

equation (14)

for *t>2010.* Substitution of **equation (12)** into **equation (14)** and collecting terms then gives us that

$$\left\{WAP15-19_t + \overline{\overline{WAP}}_{t-1} - WAP60-64_t + NMIG_t - DTH_t + \bar{\bar{\alpha}} * OAP_t\right\} * \frac{OAP_{2010}}{WAP_{2010}}$$

$$= (1-\bar{\bar{\alpha}}) * OAP_t$$

$$\Leftrightarrow$$

$$\bar{\bar{\alpha}} * OAP_t * \left(1 + \frac{OAP_{2010}}{WAP_{2010}}\right) = OAP_t -$$

$$\left(WAP15\_19_t + \overline{\overline{WAP}}_{t-1} - WAP60\_64_{t-1} + NMIG_t - DTH_t\right) * \frac{OAP_{2010}}{WAP_{2010}}$$

$$\Leftrightarrow$$

$$\bar{\bar{\alpha}} = \left\{WAP_{2010} - \left(WAP15\_19_t + \overline{\overline{WAP}}_{t-1} - WAP60\_64_{t-1} + NMIG_t - DTH_t\right)\frac{OAP_{2010}}{OAP_t}\right\} * \frac{1}{WAP_{2010} + OAP_{2010}}$$

equation (15)

for *t>2010.*

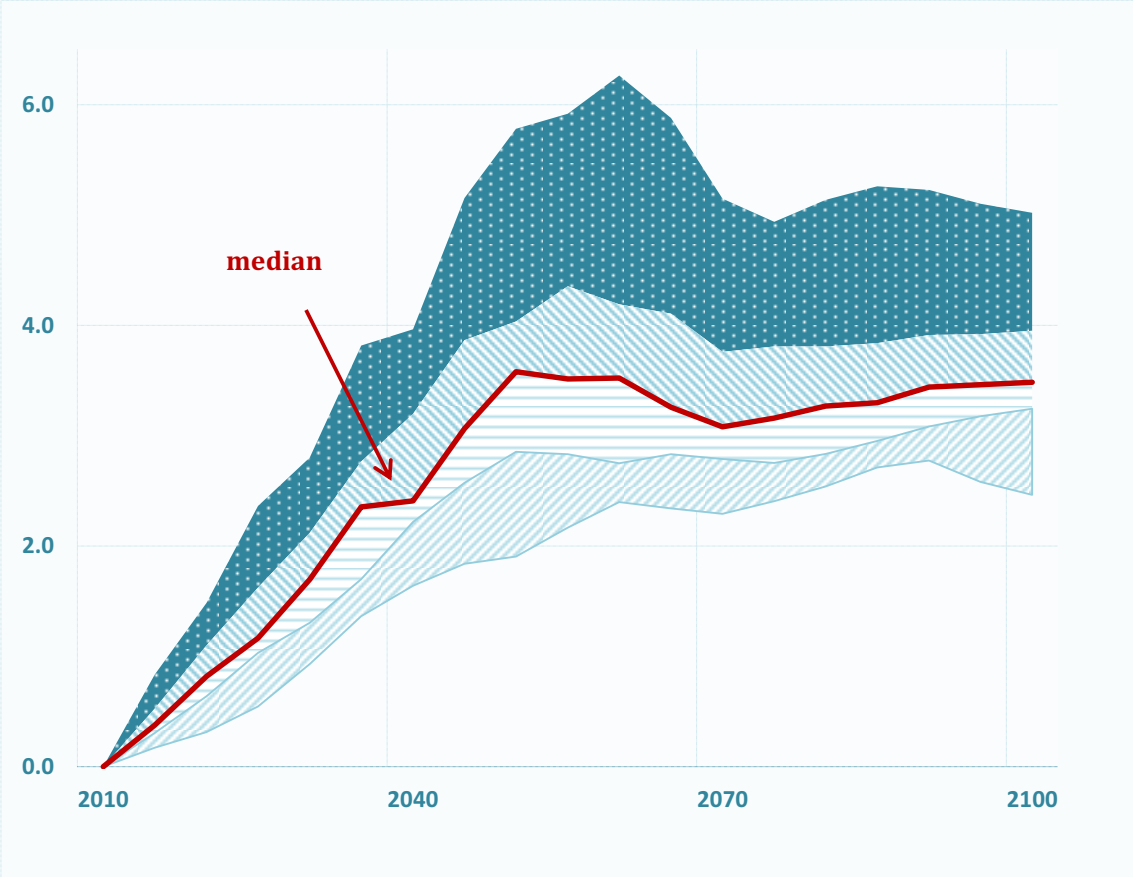
The share of older people needed to fulfil our objective is now expressed in terms that are either exogenous in our model (the generation of young workers $WAP15\_19_t$, the old age dependency rate in 2010) or predetermined (number of older people OAP_t, net migrants $NMIG_t$ and the number of deaths DTH_t). Having α determined by **equation (15)**, we can easily calculate the number of older people that is needed to offer their labour by $\alpha * OAP_t$ and the working age population WAP_t by means of **equation (14)** for t>2010.[7]

Figure 8 shows the outcomes. While the shape of this graph, pointing at the rather small band up to 2040 and the broad band around 2060, is quite similar to the one in **Figure 7**, its size is far smaller. Up until 2040 only 2 older people are required to work for each 10 native workers. By consequence, this is a factor of five times smaller than in the migrants' scenario.

[7] Here it is also interesting that the number of migrants needed (scenario 3) or the number of older people (scenario 4) is independent of the costs of the public pensions (φ), as follows from **equation (10)-equation (11)** and **equation (13)-equation (15)**. So whether or not the costs per older person concerns pension, or health care costs, in nominal or real terms, the needed immigrants or older people to participate in the labour force remains the same. This makes the outcomes universal.

Figure 8 Required older workers to maintain fiscal pressure at the level of 2010

per 10 native workers



Source: Authors based on UN and OECD

Figure 9 pitches the public debt ratio in relation to the required number of migrants and the required number of old age workers in the year 2025. As follows, the countries with a higher debt ratio have to adjust less than the countries with a lower debt ratio. This is in line with the results for the adjustment of the labour participation of the working age population, as illustrated in **Figure 5.**

Figure 9 Required migrants and old age workers in relation to public debt

Source: Authors' calculations

Overall results of the scenarios

Table 3 summarises the main results emerging from the scenario analyses. Policy makers can chose between the three options of (1) augmenting the labour market participation of the working age population (2) adjusting migration or (3) stimulating older native persons to participate in the labour force. Policy mixes of the interior solutions are also possible. This implies for Portugal, for instance, that it either increases its labour force by 20% from 2010 to 2025 or that it allows for 4 more immigrants per native worker or that it stimulates 1 native older person to work per native worker. Alternatively, it can take a mix of these options, being an interior point of these three extremes.

Alternatively, we analyse to which extent certain countries can keep their fiscal pressure per employee in 2025 at the level of 2010 by adjusting their participation of their native labour force to 60%. The result is given in **Figure 10**, which ranks the countries from the highest to the lowest in terms of this adjustment. The length of the bars indicates the total adjustment to make to keep the pressure per employee constant. As follows, Germany ranks highest, followed by Belgium and France (see also **Table 1** for the rates in 2010). These countries hardly have to make other adjustments in case they would succeed in stimulating their native non- or part-time working age populations to work (more). The graph further shows the achieved adjustment in case, in addition to this adjustment, 1 immigrant per 10 native workers were to join their labour force and, in addition to this, the remaining needed adjustment by inserting older people. The latter concerns at most 1 older person per 10 native workers. As follows, in this case no other adjustments are needed for any of the countries.

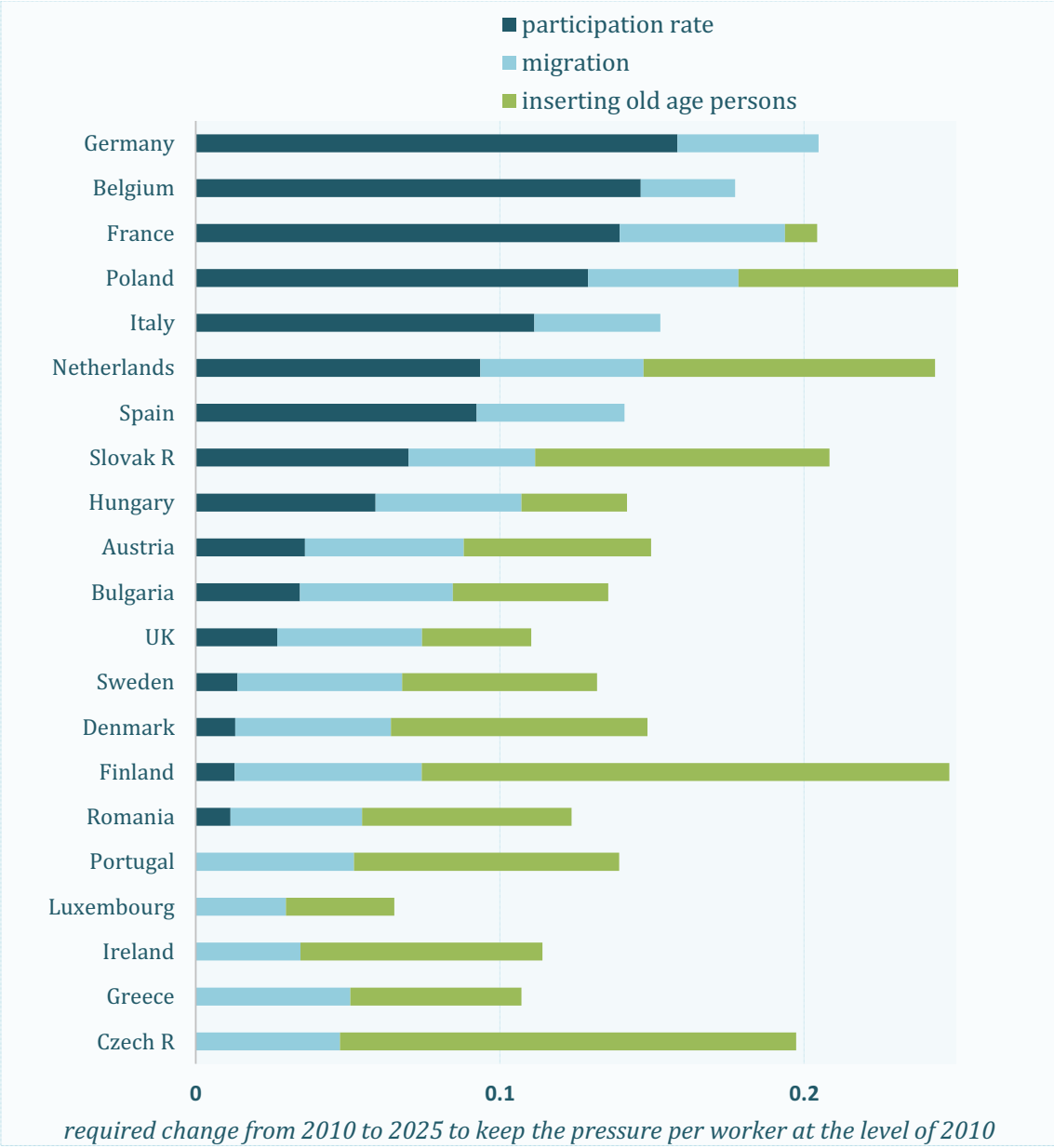
Table 3 A summary of the policy options' outcomes from 2010 to 2025

Country	Public debt in 2010 *% GDP*	Adjustment labour market participation *% -points working age population*	Adjustment in migration *migrants per 10 native workers*	Participation of old age workers *old age workers per 10 native workers*
Greece	142	15	3	1
Italy	119	13	4	1
Belgium	97	15	6	1
Ireland	96	28	8	1
France	84	19	8	2
Portugal	83	20	4	1
Hungary	80	17	5	1
Germany	80	16	5	2
United Kingdom	77	14	5	1
Austria	70	18	5	1
Netherlands	64	29	10	2
Spain	60	15	5	1
Poland	56	35	13	2
Finland	48	33	9	2
Denmark	44	20	6	1
Slovak Republic	42	34	11	2
Sweden	40	16	5	1
Czech Republic	40	39	9	2
Romania	35	20	5	1
Bulgaria	18	17	4	1
Luxembourg	17	19	4	1

Source: Authors' calculations

Note: Policy workers can chose between the three options of (1) augmenting the labour market participation of the working age population (2) adjusting migration or (3) stimulating older native persons to participate in the labour force. Policy mixes of the interior solutions are also possible.

Figure 10 Adjusting the participation of the native population to 60%



Source: Authors' calculations. Available upon request

Note: The length of the bars represents the total required adjustment while the share obtainable by increasing the labour market participation to 60% of full time work equivalents is indicated by the dark coloured bars. Countries are ranked according to the highest adjustment in labour market participation to make, from the highest (Germany) to the lowest (Romania). Portugal, Luxembourg, Ireland, Greece and the Czech Republic already have rates above 60%.

5. Summary and policy conclusions

This paper sticks to two fairness principles, called *equal profiting and equal pressure per worker*. The first implies that a person is entitled to the same public benefits in real terms as any other person in the society, irrespective of the birth year or any other discriminatory factor. It entails that each person has the right to the same pension and health care provisions as its' compatriot older people, whether or not s/he is part of a generation that is numerous such as the baby boom generation or a generation that is small in size such as the post- baby boom generation. We impose further the second principle, of equal pressure per worker. This implies that a worker financially supports an equal amount in the pay-as-you-go systems, in which the working population supports the retired generations. Independent of how strong the pressure is, pointing at the heavy load of the older generation in ageing societies, the workers should not suffer as they are crucial for the maintenance of the social security system from an economic and financial point of view.

Greece, Italy, Belgium, Ireland and France have the highest public debt-to-GDP ratio among the EU-countries. Using United Nations projections on demographic developments, our calculations on future public pensions show that the relationship between these expenditures and the debt-to-GDP is positive. Highly indebted EU-countries thus face relatively high increases in public expenditures, a result that is more due to the relatively high pension per old age person than to the higher number of old age people. However, our analyses also point out that the highly-indebted EU economies have to adjust their labour markets far less than the less-indebted economies to

maintain the fairness principles of *equal profiting* and *equal pressure*. This follows from our scenario analyses in which we investigate three labour market options: (1) utilising the native work potential of the working age population more optimally (2) increasing immigration or (3) employing native persons above the age that was the retirement age in former years. Comparing Greece, Italy, Belgium, Ireland and France to Poland, which is a strongly ageing economy with a far lower public debt, these highly indebted countries have to increase the labour participation rate of their labour force far less. We also test econometrically the significance of the positive relationship between the debt ratio and the expected increase in old age spending and the negative relationship between the debt ratio and the required labour market adjustment. The relationships are not rejected at the 5%-level and robust over the period 2010 to 2050.

On the one hand, this is good news as the EU economies that are in the most dire public finance situation have relatively less labour market reforms to make in their anticipation of the on-going ageing of their population that is putting additional pressure on their welfare states. On the other hand, however, the adjustments to make are enormous.

This follows from the outcomes of the aforementioned scenario analyses. They point out that maintaining the current level of the countries' welfare state implies that each of the EU countries has to raise the participation of their native working age population by at least 13%, or to allow for at least 3 immigrants or at least 1 old person per 10 native workers. Alternatively, each country can opt for a combination of these three policy options in which case it can take less to adjust per option. Notably, these seemingly

large outcomes of the labour market policy options are even lower bounds as they do not include (additional) pension provisions for immigrants or for older workers.

Although our analyses are in nominal and not in real terms, part of these is universal in that they both hold in nominal and real terms.

Interestingly, many of the EU countries would be largely out of the woods if they were to increase their labour market participation of the native working age population to 60% full-time working equivalents (see **Figure 10**). This holds in particular for Germany, Belgium, France but also for Poland. Apart from some exceptions, such as Luxembourg, current participation rates are rather low.

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