



A Global View on Demographic Pressure and Labour Market Participation

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“Prediction is difficult - especially of the future”, ascribed to Mark Twain.

1. Introduction

Population ageing in developed countries, due to a declining fertility rate and a steadily increase in life expectancy, poses a challenge to the fiscal sustainability of conventional welfare programs such as public pay-as-you-go (PAYG) pension systems, comprehensive and universal health care coverage, child benefits and gratis education. In general, ageing increases the financial burden imposed on the active working age population and threatens the intergenerational contract, which Bovenberg (2008:601) describes as one where ... *each generation invests in the human capital of the next and is taken care of at the end of its life by the generations in which it has invested. Hence, each generation cares twice (once for the previous and once for the next generation) and is taken care of twice (as a child and in old age).* This statement duly illustrates that the active working age population has to bear the burden, mainly by paying for the education of the younger generation and providing health care and pensions to the elderly. We will show that the situation in the developed economies in the decades to come is not only characterised by a steadily growing inactive share composed of young and old people, and thus a declining share of the working age population, but also by a rising population share of the old aged and a falling share of the young. As the former is more costly in

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terms of public pensions and health care, while the latter is the future labour potential, it implies a gradually upward pressure on per capita fiscal costs imposed on those of working age. Countries where demographic changes worsen the fiscal position have a set of optional measures to cope with the challenges. For instance, countries can raise the official retirement age, abolish early retirement schemes, index retirement pensions at inflation instead of at wage growth, allow more immigration. The demographic dynamics in developing countries delivers less gloomy picture. For gradually reforming the PAYG system into a capital funded pension system or increase the public debt when ageing hits.

Decades to come, the share of the working age population will be high and increasing. Moreover, whereas in most OECD countries health care and public pension provisions are both comprehensive and universal, only a small minority of the old aged in developing countries are entitled to social security and coverage against health care costs (see Bloom and McKinnon 2010: 15). *Ceteris paribus* both factors imply a lower fiscal burden for the future, which might offer a potentially high “growth dividend” for these nations.

The problem of ageing in the developed countries is commonly expressed in terms of that the old age dependency ratio (OADR) will rise, which expresses that in the future there will be more pensioners for every person of working age. In principle, the same reasoning can be applied to the young, where rising young age dependency ratios (YADR) in developing countries by definition implies more youngsters for every person of working age. However, this is not the full story. The same economies that will experience steeply rising dependency ratios in the future are characterised by high inactive shares of the working age population, mainly because many of working age population (e.g. housewives, unemployed) do not perform paid work or only part-time because of the existence of easy accessible and generous welfare benefits, such as early retirement and disability schemes. In principle at least, reducing the inactivity among those of working age can relieve part of the fiscal pressure of ageing. So what is usually left out is that countries may differ not only in the development of the OADR or YADR, but also in the share of the working age population that is actually involved in paid work. In this paper, we focus on what we call the labour market space as a potential source to cushion the effects of demography. We define *labour market space* as that part of the working age population that is not doing (full-time) paid work. The labour force participation rate measured in full-time equivalents and henceforth its complement – labour market space – is a country-specific system variable in our analyses. A vast number of factors determine whether a country has a high or labour market space. Among them, there is the generosity and accessibility of the social benefits, labour market rigidities (trade unions, minimum wages, employment protection), habits and norms with respect to female labour participation, active labour market policies, (absence of) early retirement schemes, working hours and holidays legislation and tax-induced financial incentives to paid work. In most Anglo-Saxon countries, with a mean and lean welfare state, flexible labour markets and a strong financial incentive to do paid work, the labour

force participation rate is high and thus labour market space is low. Low labour force participation rates and thus a high labour market space characterises other countries, mainly in continental Europe.

The idea behind our analyses is that using the labour market space can at least partly accommodate the (fiscal) pressure from changing demographic structures. For instance, raising the statutory retirement age, cutting early retirement benefits or introducing more active labour market policies may raise the labour force participation rate and thus lower the ratio of inactive and active persons among the working age.

We analyse 50 economies across the globe, 21 developing and 29 developed, that cover 75% of the global population in 2050. Using data from various official sources (OECD, UN, World Bank) we show demographic changes for a large heterogeneous set of both developed and developing countries from 1950 to 2050, pitched against the labour market space. In doing so, we make two heuristic assumptions. First, for each country we fix the ratio of public old age expenditures per old person and GDP per capita to its 2008 level. Therefore, if in some country the public expenditures on pensions and health care per old aged are a certain fraction of GDP per capita in the base year 2008, we maintain this fraction in the projections up to 2050 due to the lack of better information. The same goes for public expenditures on the young, consisting mainly of family support (child benefits) and costs of education. This implies that we freeze the publicly organized generosity of countries with respect to the dependent young and old aged. In this way, we can exclude from the analysis the future growth in (labour) productivity, since GDP per capita is the numeraire for all monetary variables that we use. Second, since labour market space and the participation rate are system variables that will only change substantially by major changes in the system we take the labour market space as a country characteristic over time. In section 4.2 we will provide empirical support for this assumption for the period 1970-2010. Our historical track data show that the variation between countries is the lion share of the total variation in labour market space across countries and over time, while the variation within countries over time is low.

Although we assume space fixed relative to the working age population in the course of future decades, as a fraction of total population it may change due to changes in the population age structure. Ageing countries most likely will respond by taking policy measures to cope with the fiscal challenge of ageing. As demographic pressure is pitched against labour market space in our analyses, we are able to show to what extent countries are facing demographic pressures (measured by the projected old age and young age dependency ratios and the associated fiscal burdens), and the room to cope with these pressures (measured by the projected labour market space). For example, a country with a high labour market space but a high and increasing demographic pressure can easily accommodate, at least in principle, the additional fiscal spending by taking policy measures that raise labour market participation. In sharp contrast, a country with a similar demographic pressure but a low labour market space is in a dire state, because there is

little room to increase labour market participation even further. Of course, a host of other factors determines whether a country is able to cope with its demographic dynamics. Here we concentrate on demographics and macro labour market characteristics and postpone for further research the role of finance and migration.

The outline of this paper is as follows. Section 2 provides our motivation for studying the demographic pressures in relation to the labour market space and discusses the conceptual issues. Section 3 defines labour market space and demographic pressure and introduces the *pressure-to-space indicator* that we use later on to rank countries. Section 4 shows for a limited set of salient countries the development of fiscal pressure and space, as well a global overview of pressure-to-space. In section 5 we present sensitivity analyses for the developing economies, as statistical information for this group is lacking or unreliable. Section 6 presents the major policy trade-off that emerge from the analysis. Section 7 summarizes and concludes.

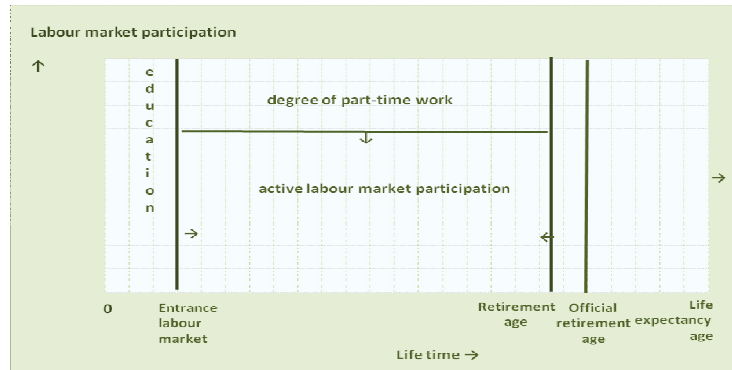
2. Motivation And Conceptual Issues

Before the G20-meeting in 2006 (see G20, 2006), there was not much attention for the global picture of projected demographic changes from an international policy point of view. Although there is ample research on the (fiscal) problem of ageing in developed economies, there is only scant attention to the position of developing economies (see Mason *et al.* 2006 and Lee *et al.* 2006 for ageing in Asia). One reason for disregarding developing countries is that they still have high fertility rates, a relatively short longevity and that public support for the old and young is still modest. Another reason might be more practical, being the lack of reliable data on the composition of public expenditures. The lack of attention for the international (comparative) perspective may be due to the belief that policy measures to cope with demographic challenges are taken to be at the national discretion, with little or no room for international coordination. Increasingly, however, economists point at the potential spillovers of demographic changes. More migration may occur, as immigration in tight domestic labour markets alleviates the pressure in filling job vacancies. For some countries, international financial flows could dry up in case national governments will not be able to maintain fiscal sustainability. In some developed economies, shrinking populations and henceforth-shrinking labour market forces will negatively influence domestic economic growth and global growth, which might affect global growth too. Although there are many perspectives to study demography and ageing, e.g. Brooks (2000) focuses on the impact of demographic developments on financial markets, e.g. Bloom *et al.* (2004) on public finances and Horioka (2010) on savings, this paper links demographic dynamics, public finance and labour market characteristics. The value added of this paper is further that we do not only include developed economies, as most studies do.

As a starting point for the conceptual analysis of demographic pressure and labour market space, consider the schematic overview of a representative person of the population over the life cycle in Figure 1, categorized into education, (part-time) working

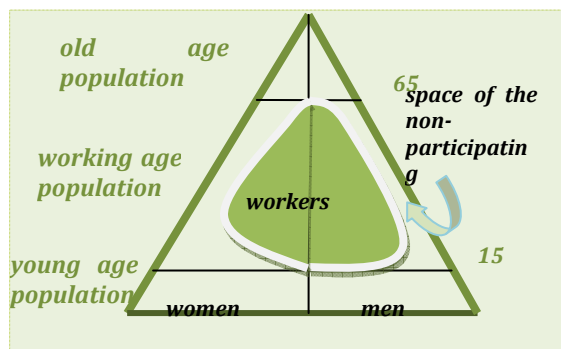
and (early) retirement, with age on the horizontal axis. The arrow left shows the tendency that rising education levels increases the age that people enter the labour market. The arrow above indicates the combined effect of a reduction of the working week, the utilization of (maternity, parental) leaves, part-time work and others factors that contribute to non-participation at the labour market. The arrow at the right pointing to the left illustrates the tendency to retire early. Finally, the arrow at the far right points at the rising average longevity.

Figure 1 Labour market participation over a person's life cycle



Source: Authors, see also Andersen (2006)

Figure 2 Categorised population pyramid



Source: Authors.

Note: Population is divided into young age (*yap*), old age (*oap*) and working age population (*wap*), where the latter is divided into paid workers and the non-participating part of *wap* (denoted by *s*). See the Appendix for the mathematical expressions.

The combined effect of the tendencies to start working later, to work fewer hours and to retire earlier while longevity is on the rise implies that in a smaller part of total lifetime

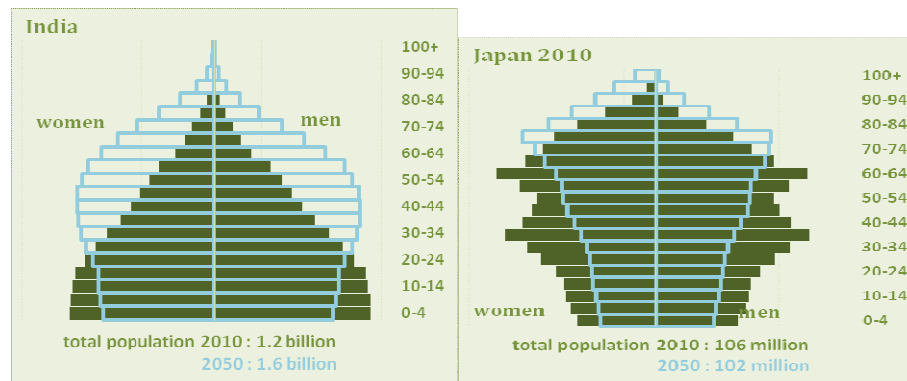
– the square in the middle representing the active part of the working age population – all expenditures of the population have to be earned. This pressure can be counteracted by a variety of policy measures aimed to push up the active to inactive ratio, such as raising the retirement age and the official number of hours of the full-time workweek or stimulating part-time workers to work more hours. Due to the absence of the relative population shares of the different age categories, Figure 1 does not reveal to what extent the demographic structure really burdens the active part of the working age population. We therefore present Figure 2 that provides schematically a population pyramid with roughly the same categories as in Figure 1.

In Figure 2, age is measured on the vertical axis and the population size on the horizontal axes, split into women (left) and men (right). The filled area inside the curved lines for both women and men stand for the labour force participation rate measured in full-time equivalents (fte) at different ages. Usually, labour market participation is higher for men than for women. We assume that all children at least up to the age of 15 are still attending school. Due to early retirement schemes, the curved lines bend inwards for the cohorts just below 65 year, which we take as the official retirement age.

Our main interest in this study is the area of non-workers or labour market space (denoted by s), being the part of the working age population (wap) that is not participating at the labour market. Examples are students above the age of 15, retirees below the age of 65, the disabled, sick and unemployed on welfare and other jobless people (e.g. housewives). As noted previously, we assume that the area of s , and thus employment measured in fte as the complement of s , remains constant relative to wap whatever population growth or changes in population structure. In effect, we fixed the composition of the working age population into working and non-working (s), both measured in fte. To get a clue how this works out, compare the actual and projected population of India and Japan in 2010 and 2050 per cohort of 5-years in Figure 3. For the sake of the argument, let us suppose that in 2010 the active working age population (in fte) is half the total working age population in both countries. As shown, there is only a small increase in the share of India's old age population and a much larger decrease in the share of the young, implying a rising population share of the working age population. Due to the fixed ratio of non-working and working people in the working age population, the ratio of inactive to active for the whole population will fall. In other words, even if we assume the same participation rate among the work force in 2050 as it is now, the population dynamics in India do not pose a rising demographic problem, as there will be sufficient labour supply. As will be clear from the right hand panel in Figure 3, Japan is a different story because of its kite-shaped population structure in 2010. Since there will be a huge increase in the share of the old-aged, only partially compensated by a modest decline in the share of the young, the share of the working age population will decline. Therefore, the inactive-active ratio will rise sharply, unless Japan is able to raise labour force participation.

In the next section, we will introduce an index measuring *pressure-to-space*, to identify which countries are most likely to face an increased burden on the working age population because of demographic dynamics in the next four decades. As noted before, this analysis is partial in the sense that countries may have other instruments at their disposal to deal with demographic challenges, among which increasing the government debt or stimulating a migration inflow. One can interpret our results therefore also as a first indication which countries are more likely to resort to these strategies in the more distant future.

Figure 3 Cohort population pyramid and kite in India and Japan 2010-2050
in number of persons



Source: Based on the projections median variant United Nations Population Information Network.

3. Defining Demographic Pressure And Labour Market Space

This section defines the various measures of demographic pressure, the labour market space, the inactive-active ratio and the indicator *pressure-to-space*. As illustrated in Figure 2, we split the populations of nations into three categories: *young* people as those that are below 15 years, *old* people as those above the age of 65, and the *working age* population as those between 15 and 65 years with the latter split into working and non-working measured in full-time equivalents.

As is customary in demographic studies, we express the pressure of the old aged as the old age dependency ratio, defined as the number of persons 65 or older relative to the working age population. As argued in the previous section, this dependency ratio gives a very incomplete picture of the actual pressure per (full-time) worker as soon as one takes into account that in some countries a significant part of the working age population is not doing paid work at all, or only part-time, summarized as the labour market space. The

burden per worker of providing public pensions and health care in an economy with an increasing old age dependency ratio is much lower if a large share of the working age are actually (full-time) working compared to when only a small share is working. To stress our point once more, we take this labour market space as a country-specific system variable that can change, but probably only in a significant way if authorities take policy measures that change the underlying system, such as flexibilisation of the labour market or abolishing early retirement schemes.

We stick to the convention by labelling old age and young age dependency ratios as *oadr* and *yadr* respectively (see also the Appendix), and express old age, young age and the non-participating part of the working age population relative to total population as *oap*, *yap* and *s* respectively, where the suffix *p* stands for the share of the total population. The ratio of the inactive and active persons (denoted *ia*) in a country *i* in year *t* and its change from year *t* to *T* (holding space fixed) can be expressed as a simple formula with only two factors, the population share of the working age population (*wap*) and the labour market space (*s*), as derived in the Appendix:

$$ia_{i,t} = \frac{1}{wap_{i,t}(1-s_{i,t})} - 1 \quad \text{and} \quad \Delta ia_{i,t} = \frac{-\Delta wap_t}{wap_{i,t} * wap_{i,T}(1-s_{i,t})} \quad (1)$$

Ceteris paribus, the lower the population share of the working age population *wap* or the higher the share of the potential workforce not inserted into paid work *s*, the higher is the *ia*-ratio. The lower bound for the *ia*-ratio is zero, which applies if and only if everyone is of working age and working full-time. As an upper bound, the *ia*-ratio goes to infinity in case the space *s* approaches one, having the logic interpretation that almost everybody in the economy is inactive as nobody is working. The *ia*-ratio can easily attain values higher than two (this is the case for the Netherlands, Italy, Denmark, Belgium, Bulgaria, South Africa and Turkey for 1995-2005), which means that against one person working full-time there are more than two persons not working at all. The *ia*-ratio is already two if half of the population is of working age and among them two thirds work full-time ($1 / ((1/2 * (1 - 1/3)) - 1) = 2$). In macro-economic terms, every full-time worker then cares for herself and two inactive persons. Obviously, in times of demographic change increasing the shares of young and old, which can be taken as exogenous, the variable space is what policy-makers may wish to reduce by means of their labour market policies. We come back to these policy issues in section 6.

Figure 4 shows the development of the population share of the working aged and the *ia*-ratio over the time span 1950-2050. Since we assumed labour market space to be fixed for the period 2010-2050, the change in the *ia*-ratio after 2010 is entirely driven by the change in the population share of the working age in each country (see Equation (1)). As the upper panel of the figure shows, there is considerable change in the share of the workforce over time, e.g. for South Korea it falls from 0.72 in 2020 to 0.54 in 2050,

which will *ceteris paribus* lead to an increase in the *ia*-ratio. Except for India and Egypt, all countries show an increasing *ia*-ratio for the next four decades.

Figure 4a. Development of the population share of the working age population

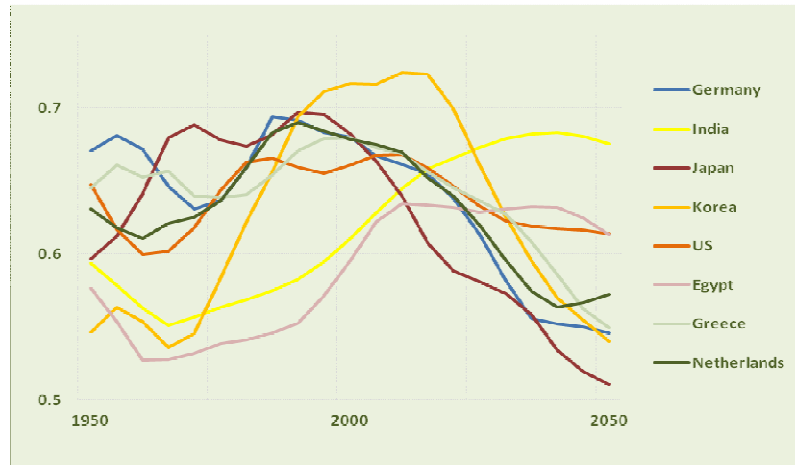
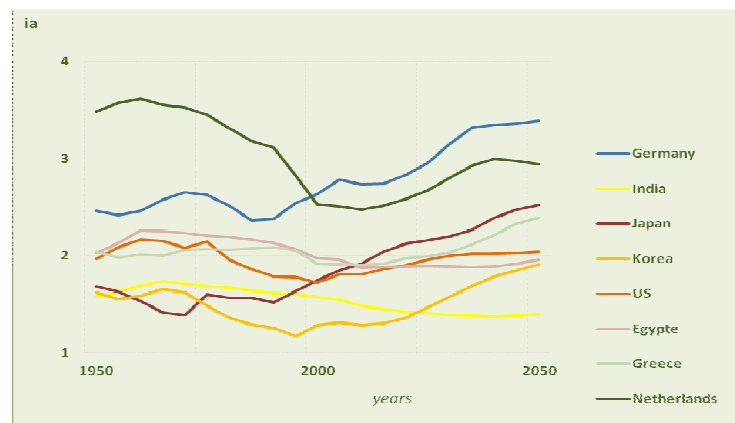


Figure 4b. Development of the *ia*-ratios



Source: Authors - based on projections by the United Nations Population Information Network, 2011.

Note: We keep the labour market space constant for each country during the whole period 2010-2050.

3.1 Demographic pressure

So far, we have only paid attention to the number of persons in different categories. However, the real fiscal pressure coming from the young and old is not only determined

by the number of young or old, relative to (the working part of) the workforce, but also by the average cost per person that the government is making relative to GDP per capita. Denoting these costs as YG and OG , it then follows that the fiscal pressure of the young and old relative to GDP are

$$ypres_{i,t} := \frac{YAP_{i,t} * YG_{i,t}}{GDP_{i,t}} \quad (2a)$$

and

$$opres_{i,t} := \frac{OAP_{i,t} * OG_{i,t}}{GDP_{i,t}} \quad (2b)$$

where YAP represents the young age population and OAP the old age population and GDP is the nominal gross domestic product.

In view of the significant changes in demographic structures, our interest is also in the change in pressure ($\Delta pres$) in year T in comparison with year t , that is

$$\Delta pres_{i,T-t} := pres_{i,T} - pres_{i,t} \quad (3)$$

As we wish to analyse future developments of the pressure while we lack reliable information on the costs per old or young person in the future, we assume that φ_i as the cost of a young and θ_i of an old person relative to GDP per capita are constant over time,¹ but country specific, so

$$ypres_{i,t} = yap_{i,t} * \varphi_i \quad opres_{i,t} = oap_{i,t} * \theta_i \quad (4)$$

with yap the young and oap old age, both as a ratio of the total population. In this way, the pressure variables reflect the fiscal burdens of (changes in) the age structure of the population. How much pressure results is thus both depending on the shares of young and old and on the parameters φ and θ which reflects how well the depended are taken care of by public services relative to GDP per capita. In case of a rejuvenating nation, that is a country with a pyramid age structure with a broad base such as India in 2010 (see the left hand panel of Figure 3), the relatively high fraction yap contributes to the pressure of the young. Analogously, in case of an ageing society, being a country with a kite age structure such as Japan in 2050 (the right hand panel of Figure 3), the pressure-of-the-old increases due to the increasing share of the old aged in the population.

¹ See also Volker and Werding (2010) that adopt the assumptions for the group of OECD countries. Note that in so far health care is a luxury good, the assumption of a constant ratio will lead to an underestimation of the real old age pressure.

3.2 Labour market space

To calculate the labour market space, we have to know the number of people of working age at work, and the number of hours they work. The employment rate (er) is defined as total employment (E) as a percentage of the working age population (WAP), that is

$$er = \frac{E}{WAP} \dots\dots\dots (6)$$

where for convenience we have left out the country and time subscripts. We assume that each person between the age of 15 and the official retirement age is part of the working age population (potential labour force). Note that the employment rate incorporates the effect of early retirement, since ceteris paribus the closer the effective retirement age (AGE_{ret}) is to the official retirement age ($AGE_{ret,of}$), the higher is the number of employed in the nominator of equation (6).

Under PAYG-systems, it matters to what extent those employed work part- or full-time. Therefore, in the definition of labour market space, we weigh the employment rate by the average number of working hours of the employed relative to full-time maximum working hours

$$s = 1 - er \frac{H}{H_{max}} \dots\dots\dots (7)$$

Accordingly, the labour market space is lower, the higher the employment rate and the more close the actual average number of hours worked per year among the employed (H) to the full-time maximum number of hours worked per year (H_{max}). We do not count the officially unemployed as employed. Consequently, the unemployed persons are part of the labour market space.

Some remarks are in order. A first point is that the group of people between the age of 15-65 that is not able to work due to a physical or psychological handicap is part of the labour market space according to our definition. The lack of harmonization in classification of disabled people across countries makes it difficult for us to exclude this group from the space definition. A second point is that the definition of the working age population as people between 15 and 65 may be too narrow for some countries. In developed and developing economies people above 65 are occasionally still working and in developing economies children of 15 or below are often working. At the macro level, this is however negligible for most countries.

3.3 Demographic pressure versus labour market space

Figure 4 pitches labour market space on the y-axis against demographic pressure on the x-axis, with four quadrants, each with either a low (high) demographic pressure

combined with a low (high) degree of labour market space. First, we take a static view and start with quadrant IV (southeast). This is the case of a high dependency rate in combination with a low degree of labour market space. This is good in so far as the burden of the demographically depended groups, given the size of the working age population, is spread over many workers, most of them working close to full-time. It is worrisome to the extent that not much space is left to relieve the burden, the more so if demographic pressure will rise further in the future. In quadrant I (north-west), the demographic pressure is low and there is ample room to raise participation and hence potential production. Quadrants II and III are intermediate cases, comparatively better than IV either because pressure is lower (III) or potentially the burden of the pressure can be relieved by reducing space (II), but worse than I because pressure is higher (II) or space to relieve the burden is limited (III). The situation of a country in quadrant II can be as inconvenient as the situation of a country in quadrant III. In fact, the ample labour market space available in quadrant II can be used to alleviate the burden of high demographic pressure. The absence of much pressure from the dependent population is a fortunate circumstance in quadrant III, but the already tight labour market leaves little room for cushioning an increasing demographic pressure.

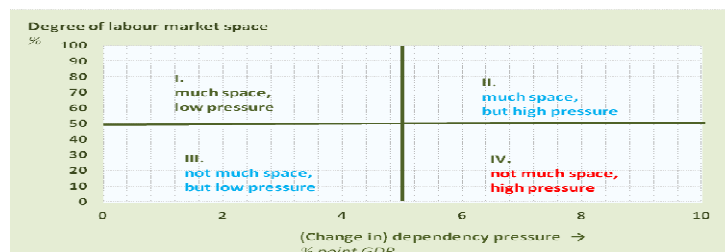
This brings us to the dynamic view. Obviously, countries may move from one quadrant to the other over time and one of the purposes of this paper is to present those movements. Since we assume a fixed, although country-specific, labour market space over time, this implies that countries can only move horizontally, so we either have movements from I to II or the other way around and likewise for III and IV. The purport of the empirical analyses, following in the next section, is to see where countries were located in this diagram in the past (1950/1970-2010) and where they will move to in the future (2010-2050). For the past, we expect that labour market space is both country-specific and roughly constant over time. If so, it vindicates our assumption to keep labour market space fixed as well in the future.

3.4 The indicator *pressure-to-space*

In our endeavour to compare the pressure of the dependent population in relation to the available labour market space across countries, we define the indicator *pressure-to-space* as:

$$PtS_{i,t} := \frac{ypres_{i,t} + opres_{i,t}}{S_{i,t}} \dots\dots\dots(8)$$

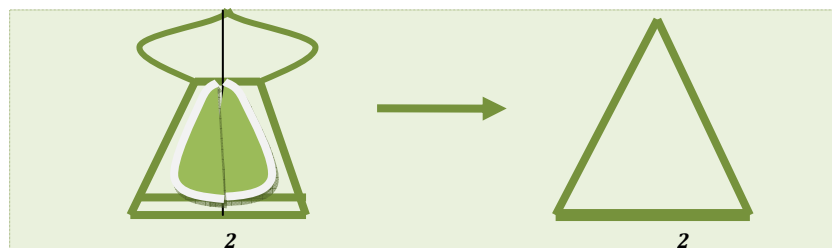
Figure 5 Demographic pressure and labour market space



Note: The scaling on the x-axis is indicative.

Consider the hypothetical chess pawn shaped population pyramid in Figure 6, which we introduce to illustrate both the static and the dynamical view on *pressure-to-space*. The pressure is high and labour market space is low, resulting in a high value for the indicator *pressure-to-space* in 2010, but for sure the exceptional bulge of old aged in 2010 will gradually disappear and the indicator will gradually decline. It illustrates that the dynamics of the demographic structure are important, as a high value for the indicator is less troublesome if one expects it to come down. The case is after all not so hypothetical as the demographic structures of Germany and Japan, for instance, are expected to show such a chess pawn form, albeit in 2050. In a similar vein, for the opposite case, a low indicator value is not a reason to simply sit and wait if one expects it to increase sharply in the future.

Figure 6 Transition of categorised population pyramid



Source: Authors.

Reforming the labour market is characterised by piecemeal social engineering and will take considerable implementation time. Even after the implementation of reforms, it will take time before the general equilibrium effects have become fully effective. Thus, in case of expected increasing pressure in the future and ample space at the labour market today, a wise thing to do is to take measures today. Therefore, the pressure variables at some future year T will be compared with the space variable today in our empirical analyses, where $T-t$ equals one, two, three or four decades.

As the hypothetical example above suggests, in addition to the actual level of *pressure-to-space*, also the change in *pressure-to-space* is relevant. Some countries face an already high *pressure-to-space* and seem to cope with it. However, countries that will face a major change in pressure for the years to come may consider increasing the labour market participation to cover the additional fiscal costs resulting from the demographic change. We therefore also measure the change in the *pressure-to-space* indicator, as:

$$\Delta PtS_t := \frac{\Delta ypres_t + \Delta opres_t}{space_t} \dots\dots\dots (9)$$

where Δ refers to the difference from time t to T . As derived in the Appendix, it holds that

$$PtS_t = \frac{(1 - wap_t)\varphi_t}{s_t} \Rightarrow \Delta PtS_t = -\Delta wap_t \frac{\varphi_t}{s_t} \dots\dots\dots (10)$$

Consequently, as we assumed that φ and s are country-specific but fixed over the future period, the *pressure-to-space* indicator mainly depends on (the change in) wap . Accordingly, a rise in the old or young age dependency ratios – which is per definition a decline in the population share of the work force - leads to an upward push of the indicator *pressure-to-space*. However, this upward pressure will be higher the more generously the dependent population is treated (φ is high) and the lower is the labour market space. We come back to this feature in our policy reflections in section 6.

4. A Global Comparison Of The Pressure-To-Space

This section presents the empirical measures for the key variables of the conceptual analysis and the derived indicators. The key variables are the dependency ratios for the young and old, relevant for the measurement of demographic pressure, and the population share of the workforce in combination with the effective retirement age and average working hours to calculate our measure of the labour market space. For a broad range of countries worldwide, we calculate the inactive-active ratio and the *pressure-to-space* indicator for the time span 2010-2050 according to the formulas presented in the previous section.

4.1 Demographic pressure across the globe

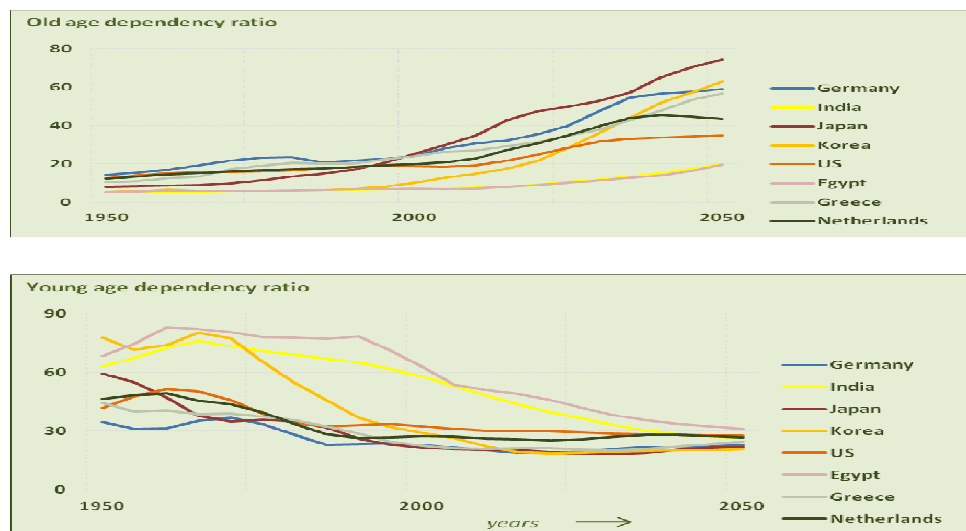
The dependency ratios in Germany, India, Japan, Korea, the US, Egypt, Greece and the Netherlands are illustrated in Figure 7 for the century 1950 - 2050. As the upper panel shows, the old age dependency ratios increase across the board and diverge after 2010, ranging from 20% for India to 90% for Japan in 2050. This means that in 2050 for each person in India of working age there will just be 0.2 person aged 65 or more, against 0.9 person in Japan. The opposite pattern applies for the young age dependency ratios, gradually declining and converging to around 30% in 2050. Egypt, a developing economy with a very young population, stands out: in 1960, there were almost as many Egyptian

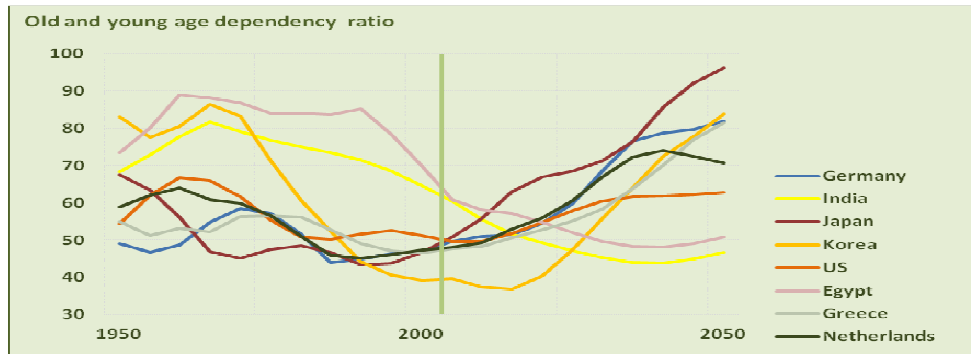
children below the age of 15 as there were people of working age and at the turn of the century against every two persons in working age there was still one child (on Egypt's demographics and labour supply problems, see also Peeters (2011)). In contrast, Japan's youth dependency ratio has dropped from 60% in 1950 to 20% in 2010 and is expected to stay at this level up to 2050, implying that for each five grown up persons of working age there is only one youngster below the age of 15.

An interesting feature emerging from the lower panel combining both dependency ratios is that almost all our countries, except Egypt and India, reach the lowest point in the period around 2010 (see the vertical line that marks the year 2010). Moreover, as the upper panel shows, in between 1950-2010 all countries are ageing, although developing nations Egypt and India only slightly due to the fall of the young age dependency ratios outweighing the increase of the old age dependency ratio. For 2010-2050, it is the other way around: the gradual decline in the youth dependency rates is outweighed by the increasing old age dependency ratios, leading to rising combined dependency ratios, again except for Egypt and India. If, from the fiscal point of view, young and old are equally costly, so public pensions and health care per old aged are roughly equal to educational expenditures and child benefits per young, then the lower panel of Figure 7 suggests that the fiscal challenge for the future is not that different from that in the past. For example, South Korea will face a steadily rising dependency ratio up to 2050, but it is roughly similar, albeit in reverse order, to the dependency ratio in the past five decades.

Figure 7 Development of dependency ratios

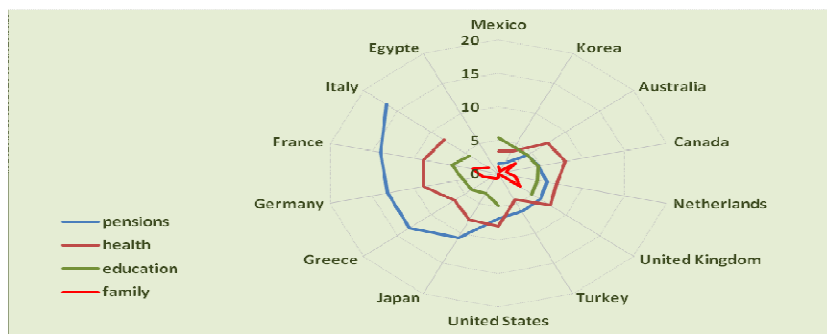
% of number of people between 15 and 65 years





Source: Own calculations based on the United Nations population information network med variant 2008.

Figure 8 Government spending on young and old in 2005
% GDP



Source: OECD Society at a glance 2005.

Note: Pensions include old age and survivors' pensions.

The burden on the working population does not only depend on the relative shares of the young and old aged as pictured in Figure 7, but also on the fiscal costs of family support and educational expenditures for the young and public health care and public pension outlays for the old. Figure 8 illustrates these for a number of countries in 2005, where the ranking of countries is according to the size of the pension outlays (as a percentage of GDP). As with dependency ratios, there is also considerable heterogeneity in spending relative to GDP. Italy, France and Germany rank highest with in between 12-15% of GDP spent on pensions, while South Korea, Australia and Canada pay the least in terms of public pensions, in between 1 to 5% of GDP. Overall, public health care is the second highest spending category, followed by educational spending, which is close to 5% of GDP for most countries. Family support, although minor compared to the other categories, shows the highest variation across countries. Some caveats are in order to

interpret Figure 8. Health care does not concern only the old people, although probably the lion share of these costs are made on behalf of the old as most health care is provided in the last part of people's life. Since we do not have information on the distribution of public health care costs by age categories, we will leave this item out of the analysis and only include them in the sensitivity analysis in section 5. To some extent, government expenditures on family support and education also need not be confined to the young only, but generally it mainly is. Therefore, in our subsequent analysis family support and education costs are attributed to the young.¹ The expenditure shares in Figure 8 are of course affected by the age composition of the populations, e.g. the high GDP share of pensions for Italy is not only due to the relative generosity of public pensions, but also to the current high old age dependency ratio and the high labour market space. Ideally, one would like to have statistics across countries for pensions, health care, education and family support expenditures per old and young aged relative to GDP per capita, but these are generally not available.

4.2 Labour market space across the globe

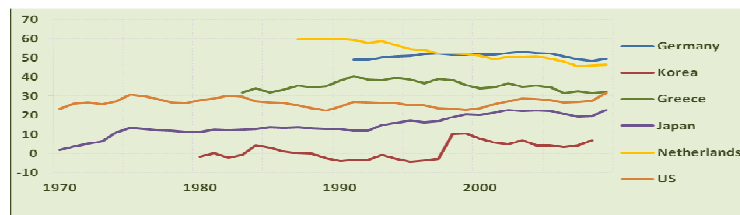
Since World War II, the emergence of part-time work and temporary leaves (maternity, parental), longer educational careers, the introduction of early retirement schemes and other welfare programs for those of working age have contributed to the phenomenon that a considerable part of the workforce is not doing paid work, or only part time, which we summarize in the statistic labour market space. Opposite these labour market loosening tendencies several countries have recently taken measures to increase labour market participation, either with a view to their demographic developments or because of favourable economic conditions.

Long term series of the labour market space show that there are some economies with a gradually increasing or gradually decreasing trend (see Figure 9). The labour market space in Japan, for instance, has a gradual increasing trend during the period 1970-2009. It had very little space in 1970 and moved up to 20% in 2007. Also South Korea shows an upward trend. On the other hand, the Netherlands shows a decreasing trend. Most countries, among them the US, Germany and Greece included in Figure 8, show a rather stable path over this long period. Even more interesting than the development of the labour market space over time is its average level by country. The labour market space is consistently very high in Germany and very low in South Korea, where the upward jump at the end of the 1990s can be attributed to the Asian crisis, which caused unemployment to increase dramatically by more than one million people. We split the total variation in labour market space across countries and over time into between country variation on the one hand and within country variation over time on the other and found that the former is

¹ Ideally, we would need public expenditures on education split per age group to distinguish the expenditures on the young and the working aged, but we lack this statistical information across countries.

four times as large as the latter. This provides empirical support for our assumption that labour market space is predominantly a country characteristic, rather constant over time.

Figure 9 Labour market space



Source: Own calculations on the basis of OECD databases, using equation (7).

Note: Calculations according to formula (7) with the maximum number of hours set at 1820 (52 weeks 35 hours per week) and the official retirement age at 65.

4.3 Demographic pressure versus labour market space across the globe

The pressure in relation to the space is illustrated in Figure 10, for the young (upper panel), for the old and for both combined (lower panel). Figure 11 illustrates the *change* in total pressure, again related to the labour market space. In these analyses we assume that the official retirement age is 65 and that the maximum number of working hours equals 2080, implying 52 weeks at 40 hours. As the base year we take 2008 because 2009 is the first recession year after the financial crisis which started in the autumn of 2008 (and 2010 is not yet available). Because of lack of information on fiscal spending for many of the developing economies, we imposed that fiscal spending to the young and old relative to GDP per capita are equal to the lowest level that we have among our set of countries, being Mexico. Since Mexico is member of the OECD, its fiscal statistics are harmonized with the other OECD countries. In the sensitivity analyses in the next section we come back to this assumption.

The results show that by and large the developing economies tend to cluster at the left while the developed economies cluster at the right, both for the young age pressure (top panel of Figure 10) and the old age pressure. Take the case of Egypt. Based on the high share of young people one would expect that the pressure of the young would be high, however, for the fiscal pressure it is not only the population share that counts, but also the amount of public support to the youth relative to GDP per capita. Since the latter is very low, Egypt, as well as many other developing countries with high population shares of young people, still end up with a low pressure. For the old age pressure, there is, with the exception of Ethiopia and Uganda, a narrow clustering of the developing countries around pressure levels below 4 percent, with widely diverging levels of labour market space. The developed countries are all over the place, with Iceland combining a very low old age pressure and little space at the labour market against France and Italy combining high pressure and much labour market space. Among the developed countries there seems to

be at face value a clustering of countries belonging to the same welfare regime type as identified by Esping-Andersen (1990). Countries belonging to the corporatist, continental, welfare regime, such as Italy, France, Austria, Germany and Belgium combine high old age pressure of more than 10 percent with considerable labour market space (50 percent or higher). Members of the social-democratic (the Scandinavian countries and the Netherlands) and of the liberal regime (the Anglo-Saxon countries USA, UK, Canada, Australia and Ireland) have on average both a lower old age pressure (less than 8 percent) and less labour market space.¹

As Figure 8 already illustrates, there is considerable variation among countries in their spending levels in pensions, health care, education and family support as a percentage of GDP. Iceland, for instance, has comparatively very high family costs, which explains why it is located at the right of the upper panel of Figure 10, while Italy, France and Greece rank highest on fiscal spending for the old, locating them at the right in the middle panel of Figure 10.

Figures 11a and 11b show the dynamic perspective of space versus pressure for the next decade (Figure 11a), but also for the period from 2010 to 2050 (Figure 11b). Figure 11a shows, interestingly, that some countries show a dauntingly high increase in pressure of 8%-points of GDP in between 2010 and 2020, while a limited but heterogeneous set of countries face a decrease in fiscal spending on the dependents during this period. However, most countries centre in the middle with modest increases in pressure combined with a high variation in space. Figure 11b illustrates the ranking of the countries according to the change in their pressure to space. As follows, Poland, Turkey and Greece rank highest for the period 2010 to 2050. Uganda, the Democratic Republic of Congo and Tanzania rank lowest. For econometric analyses on the pressure and space, see Peeters and Groot (2012).

Figure 10a Demographic pressure (young, old, young & old) & labour market space
labour market space in % and pressure in % of GDP

¹ See Van der Veen and Groot 2006 for a classification of OECD countries according to their degree of (post)productivism and see Goodin and Smitsman 2000 for a convincing case why the Netherlands scores social-democratic rather than corporatist.

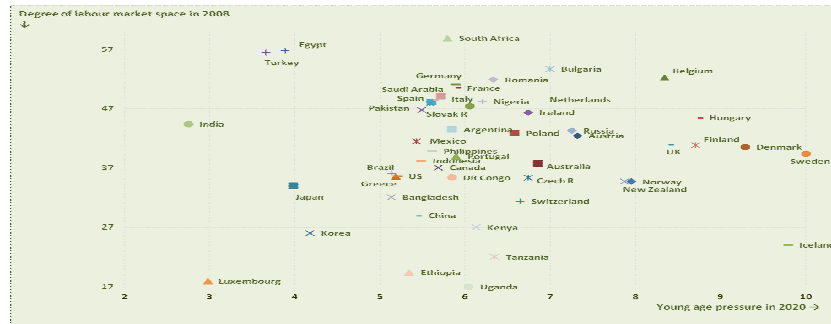


Figure 10b Demographic pressure of the old versus the labour market space
labour market space in % and pressure in % of GDP

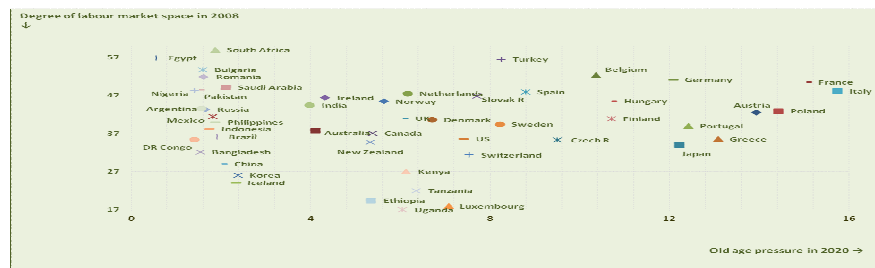


Figure 10c Demographic pressure of the young & the old versus the labour market space
labour market space in % and pressure in % of GDP



Source: Own calculations.

Note: The demographic pressure for the old is calculated according to equation (2b), for the young according to (2a). Health care costs are not included because the break-down of health costs per age category and thus elderly only are not available. The labour market space is according to (7).

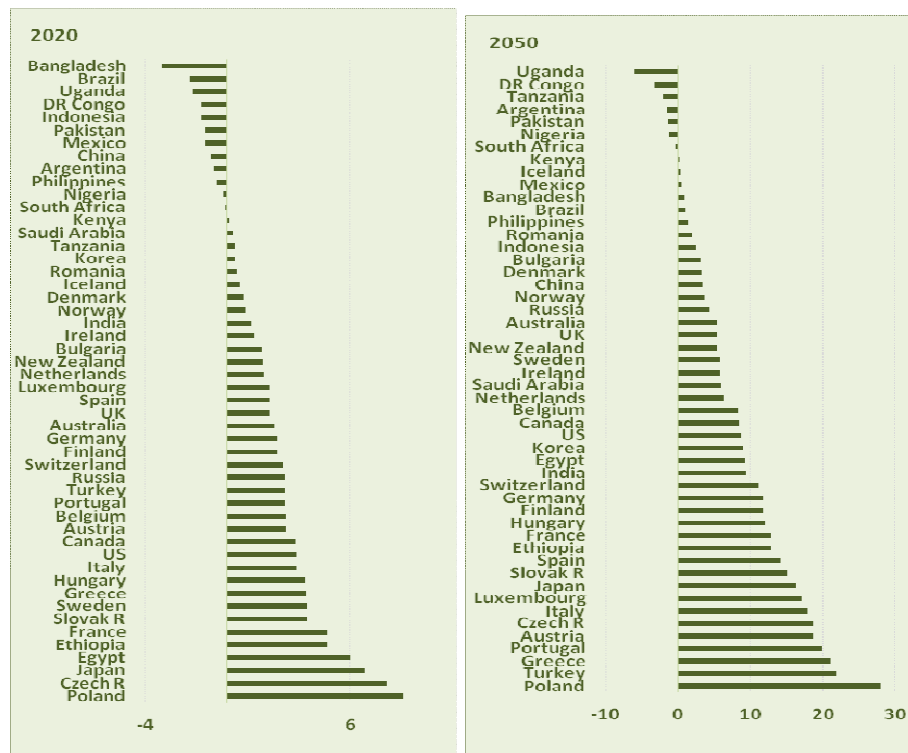
Figure 11a Change demographic pressure (young & old) & labour market space



Source: Own calculations.

Note: The change in demographic pressure includes the costs of the young and the old.

Figure 11b Change in pressure-to-space indicator for 2020 and 2050



Source: Own calculations.

Note: See also Figure 11a. The left figure gives the change in pressure from 2010 to 2020 in %-points of GDP divided by the space in 2008 as % of the working age population (see equation (9)). Similar for the right figure, but with the pressure measured from 2010 to 2050.

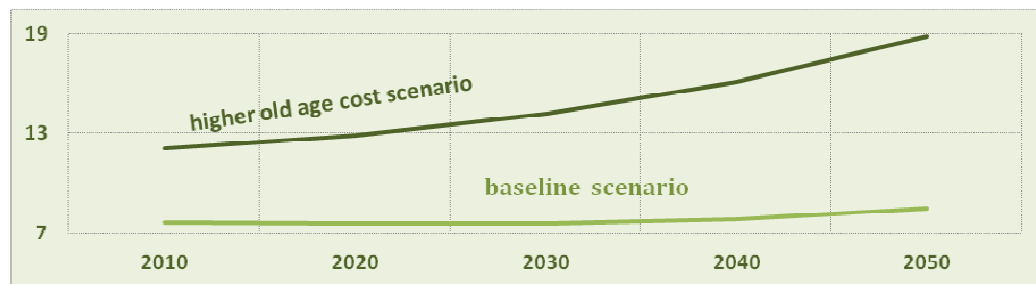
5. Sensitivity Analyses

In addition to the analyses in the previous sections, we now perform some simulations that show the sensitivity of the outcomes to changes in some of the parameters. It is meant to address the gist in the quote “Prediction is difficult - especially of the future” ascribed to Mark Twain.

5.1 Increasing the fiscal costs of ageing in the developing economies

Lack of reliable information on fiscal spending on the retired people in the developing economies forced us to make the rather strong assumption to equate the costs for each of these economies to the costs that Mexico reports to the OECD, being 1.4% of GDP. Some of the countries that we classified as “developing” will face much lower public costs than 1.4% of GDP as the old aged, in the absence of public pensions, are taken care of privately in the setting of so-called extended families. Other countries may incur higher costs, especially if future economic growth is used to provide income protection for the old aged. One alternative would be to stick to the level of public costs of the old aged as in Mexico, but to assume increasing costs over time to reflect improving protection for the old aged. In line with the assumption that the cost per old aged relative to GDP per capita is kept constant for the countries for which the data are available, we have chosen to set the public pension cost equal to that of Turkey, that spent 6.1% of GDP in 2008, and assume that all developing economies face similar fiscal costs per capita also in the course of time. This amounts to a costs increase of about 400% per capita compared to the Mexico-scenario.

Figure 12 Simulating higher old age pressure in the developing economies
in % of GDP



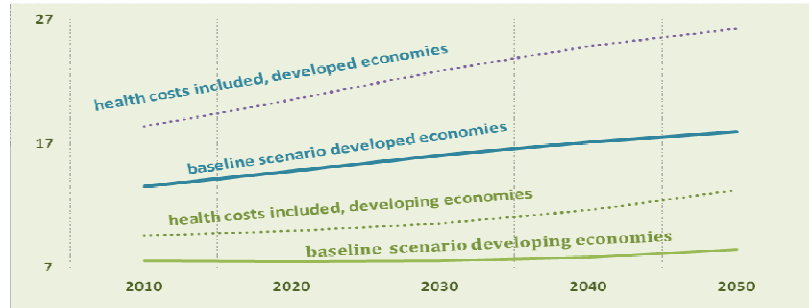
Source: Authors' calculations.

Figure 12 shows the average old age pressure of the 21 developing countries in our sample called the baseline scenario, along with the simulated higher old age costs scenario. It follows that the higher costs per capita would lead to an increase of the pressure of almost 4%-points from 2010 onwards, rising to 12%-points of GDP in 2050, which amounts to a fiscal pressure of 19% of GDP in 2050. While in the baseline scenario the ageing costs were compensated in many countries by the savings in expenditures on the young due to the gradual decrease in the population share of the young people, the rise in the costs to provide income support for the old aged dominate in the simulated scenario. This shows that also the developing countries may face higher costs due to their ageing populations, while their tax and administration systems may not always be advanced enough to raise the required tax revenues.

5.2 Including the costs of health care

In the next scenario we take into account the highly sensitive issue of health care costs. This makes the outcomes more realistic as most of the consumption of health care is taken in the last phase of a person's life. In developed economies on average 80% of all health care costs that is spent over a life time incurs above the age of 65. For this reason, let us indeed assume that a share of 0.8 of the health care costs as reported by the OECD for the developed economies is included in our measure of the pressure of the old (see equation 2b). For the developing economies we maintain the assumption that their health care costs are similar to the costs as reported by Mexico to the OECD, being 2.6% of GDP, where also here we take 80% of these costs.

Figure 13 Simulating higher health costs in developing and developed economies
in % of GDP



Source: Authors' calculations.

Note: The lines are simple averages of the developing and developed countries.

Figure 13 shows the results. The pressure in the developing economies increases by roughly 3 to 4% points across the board, in comparison with the baseline scenario. In the

developed economies, the pressure is already much higher, due to the higher outlays on pensions, family costs and education. When we include health care costs for people above the age 65, it follows that the pressure rises significantly. In the year 2050, it would lead to an additional 10%-points of GDP (from 17% to 27%).

6. Policy Reflections

The key drivers of the analysis are the labour market space (s), the degree of generosity towards the dependent (φ) and the population share of those of working age (wap). As Bloom *et al.* (2010: 10) notes, projecting demographic change, although still an inexact science, is easier than to predict social-economic variables as productivity growth, because the former is determined by only a few key parameters (fertility, life expectancy and migration). Therefore, we take the development of wap (and its complements yap and oap , see the Appendix) as uncontroversial and exogenous to the policy-maker.¹ So far we assumed a constant labour market space and fixed the ratio of government expenditures per young and old aged relative to GDP per capita in order to identify which countries, mainly due to ageing, will become most pressurized to change labour market policies or to adjust their social security systems. We will now drop these assumptions in order to focus on the main policy choices triggered by the changes in the demographic composition of the population. Basically the policy choice involves a trade-off between maintaining social protection and free or heavily subsidized public services for the young and old on the one hand and maintaining labour market space for the working age population on the other hand. In concrete terms, generous public provisions for the old in the form of adequate pensions and free health care and for the young in the form of child benefits and free education can only be sustained by inserting a high enough fraction of the workforce into paid work who pay the taxes required to finance the public expenditures. Analogous, there is more room for relaxed labour market arrangements – ranging from paid leaves, early retirement schemes, generous and easily accessible unemployment, sickness and disability benefits, waiving the duty to apply for jobs for single parent families with young children to all kinds of arrangements facilitating or stimulating working times below the default of a full-time work week – the lower the fiscal pressure of the young and old aged.

To illustrate the trade-off between generosity to the young and old and maintaining labour market space, the so-called magic quadrant in Figure 14 integrates the three key variables labour market space, the level of generosity and the population share of the working age, based on a balanced budget equation, equalizing tax revenues from income taxes on the employed to the public expenditures on dependents. For the sake of argument, we assume that public expenditures per old and young person are equal to a

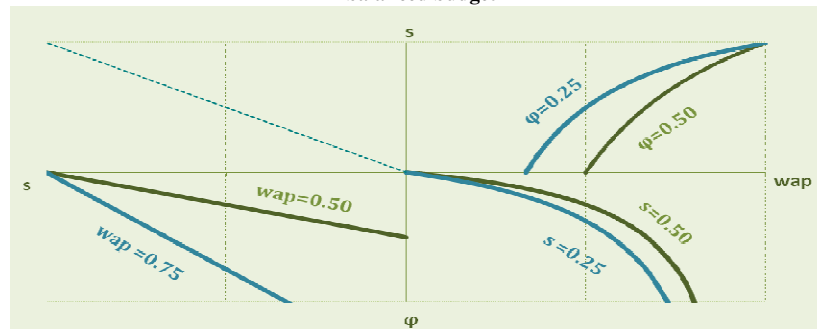
¹ We thus abstract from net migration flows and its impact on the population share of the working aged.

fraction φ of GDP per capita, so that the balancing budget tax rate is proportional to this generosity parameter φ (see the Appendix):

$$\tau * wap_{i,t} * (1 - s_{i,t}) = (yap_{i,t} + nap_{i,t})\varphi_{i,t} \Leftrightarrow \varphi_{i,t} = \tau * \frac{wap_{i,t}(1 - s_{i,t})}{(1 - wap_{i,t})} \dots\dots(11)$$

The curves in Figure 14 are the product of Excel simulations, where the tax rate is set for convenience at 0.5. In quadrant I (north-east), labour market space (vertical) is pitched against the working age population (horizontal) and the lines represent iso-generosity curves. Suppose the initial case is where half the population is of working age, half of them are at work (in fte) and that the public support for the young and old aged is 25 percent of GDP per capita, so $wap = 0.5$, $s = 0.5$ and $\varphi = 0.25$. If because of ageing, the population share of the working age goes down, then the generosity towards those of non-working age can only be sustained by moving along the iso-generosity line to the left, so reducing labour market space. In quadrant II (south-east), with wap on the horizontal and φ on the vertical axis, the curves depict all combinations of φ and wap compatible with the same level of space. Drawing a horizontal line at some arbitrary generosity level φ shows that more labour market space is only possible at higher shares of the working age population, e.g. to keep φ at 25% allows only a space of 0.25 if wap is 0.4, but it can be increased to 0.5 if wap is 0.5. Moving along the curves in quadrant II shows that at constant levels of space, generosity must fall if the share of the workforce declines. Finally, quadrant III (southwest) shows all possible combinations of space and generosity levels compatible with the same workforce. In general, given the share of the workforce, a higher level of generosity requires a reduction in space. The two iso- wap curves nicely illustrate that for the same level of generosity, say $\varphi = 0.25$, there is more room for relaxed labour market arrangements, the higher the population share of the workforce.

Figure 14 Magic quadrants – the trade off between space, the working age population and fiscal costs under a balanced budget



Source: Authors.

7. Summary, Conclusions And Future Research

Due to population dynamics, the population shares of young and old are continuously changing, which gives rise to changes in the population share of the working aged. This paper seeks to provide operational measures for comparing countries in terms of demographic pressure and labour market space. Normally the challenge of ageing is expressed in terms of a rising old age dependency ratio, or a combination of the old and young age dependency ratios, but this delivers an incomplete picture of the challenge. We argued that the share of the working age that actually performs paid work, measured in full-time equivalents, can be considered as a country-specific system variable, determined by a complex set of factors such as flexibility of labour markets, cultural norms with respect to female labour participation, working hours legislation, etc. Inclusion of this country-specific labour market space allowed us to calculate the inactive-active ratio and a *pressure-to-space* indicator for 50 countries, among which 21 developing countries, over the period 1950-2050. We included all G20-countries, all other OECD countries, and all countries belonging to the top-10 in world population in 2050, being Bangladesh, Democratic Republic of Congo, Nigeria, Pakistan and the Philippines, together covering about three quarters of the world population. The inactive-active ratios show the development of the number of inactive persons (all younger than 15 or older than 65 plus all those of working age not doing paid work) relative to the actives (measured in full-time equivalents). For the decades to come, this ratio will increase for all developed economies. The *pressure-to-space* indicator also includes information about the public expenditures on education and family support per young and public pensions per old relative to GDP per capita. Doing so identifies which countries will feel the pressure most, where pressure is higher, the higher the government outlays for education, family support and pensions relative to GDP per capita and the lower the labour market space.

We draw three main conclusions from our empirical analyses.

First, according to the indicator *pressure-to-space* Greece and Poland are most under pressure. In case they keep their current fiscal expenditure rates on the young and old constant, their fiscal spending as a percentage of GDP will be 8%-points higher in 2020 than in 2010. The situation is especially precarious for Greece, in view of its public debt position. In between 2010 and 2050, the population share of the working aged will fall from 0.67 to 0.55, while the currently available labour market space is comparatively rather low (0.36 in 2008), mainly due to the high average number of hours worked per worker, according to the OECD statistics. Based on this analysis, one may doubt whether Greece will be able to sustain its public expenditures to the young and old in the future relative to GDP per capita, unless it is able to raise the labour force participation rate.

Second, not only developed economies face a demographic challenge. Despite their higher population growth, also some developing economies may run into the situation of excessive fiscal spending. A clear example is Turkey that ranks second in the increases in fiscal spending in 2050, between Poland and Greece. Its additional fiscal spending will be 8%-points in 2030, 14% in 2040 and 21% in 2050 in comparison with 2010.

Third, across countries, the relation between fiscal pressure exerted by the dependent population and the labour market space is positive. This implies that countries with high fiscal pressure have more labour market space. There is thus room for working more hours, or increasing the retirement age, in order to alleviate the fiscal pressure.

A host of other factors not taken into account in this study are relevant to assess whether a country is able to accommodate its demographic pressure. Avenues for further research are to investigate the fiscal sustainability of countries, by taking into account financial variables such as the public debt stocks, the accumulated capital account balance and the share of capital funding in pensions benefits. Likewise, net migration flows matter and the indicators developed in this paper might be used to predict future migration flows from countries with low GDP per capita, high young age dependency ratios and high labour market space towards countries with high GDP per capita, low high young age dependency ratios and low labour market space.

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Appendix The *ia*-ratio and *pressure-to-space* indicator

As follows from Figure 2, the total population of country *i* at time *t* equals the young, the working age and the old-age population,

$$YAP_{i,t} + WAP_{i,t} + OAP_{i,t} = POP_{i,t} \quad (A1)$$

Dividing both sides by the total population gives

$$yap_{i,t} + wap_{i,t} + oap_{i,t} = 1 \quad (A2)$$

which gives us, for a random country, the distribution of the young, old and working age normalized at one. We therefore normalize the area of the pyramid in Figure 2 to unity, which is convenient for the comparison of the population structures of countries irrespective of their population size.

We defined the fraction of the working age population not engaged into paid work measured in full-time equivalents (fte) as the labour market space *s*. The population share of the *active* working age in fte can then be expressed as

$$wap_{i,t}(1 - s_{i,t})$$

and therefore the fraction of the *total* population that is inactive as

$$1 - wap_{i,t}(1 - s_{i,t})$$

for which reason the ratio of inactive to active (*ia*) ratio is equal to

$$ia_{i,t} = \frac{1}{wap_{i,t}(1-s_{i,t})} - 1 \quad (1)$$

The indicator *pressure-to-space* was defined as

$$Pts_{i,t} := \frac{ypres_{i,t} + opres_{i,t}}{s_{i,t}}$$

which, using (5), can be expressed as

$$Pts_{i,t} = \frac{yap_{i,t} * \varphi_{i,t} + oap_{i,t} * \theta_{i,t}}{s_{i,t}}$$

Space is country-specific at kept constant in the future. Moreover, we also fixed the country-specific per capita public expenditures relative to GDP per capita over time, so the equation above can be expressed as

$$Pts_{i,t} = (1 - wap_{i,t}) * \frac{\bar{\varphi}_i}{s_i} \quad (10)$$

by using (A2) and assuming an equal per capita cost for young and old relative to GDP per capita (φ). Besides pressure exerted by the young and old age, one might also be interested in the total pressure exerted by all the inactive persons, so also including the non-working part of the working aged. Total pressure by the inactive person per full-time active person can be expressed as:

$$[iapres]_i(i,t) = ([yap]_i(i,t) * \varphi_{i,t}) + ([oap]_i(i,t) * \theta_{i,t} + s_i(i,t) * wap_{i,t} * \gamma_i(i,t)) / ((1-s_i(i,t)) * [wap]_i(i,t)) = ([1 - [wap]_i(i,t)]$$

This indicator gives the fiscal pressure of all the inactive persons (in the numerator) relative to all active persons (denominator) and turns out to be proportional to the *ia*-ratio provided the generosity to the inactive can be summarized into a country-specific weighted variable ($\bar{\varphi}_i$).

In section 6, it was implicitly assumed that the non-working share of the workforce are not entitled to social benefits, since in the balance budget equation the tax revenues are used to finance public support to only the young and old:

$$t * wap_{i,t} * (1 - s_{i,t}) - (yap_{i,t} + oap_{i,t})\varphi_{i,t} = \varphi_{i,t} - t * \frac{wap_{i,t}(1-s_{i,t})}{(1-wap_{i,t})} - \frac{t}{ia_{i,t}} \quad (11)$$

This equation is the basis for the policy trade-off analysed in section 6 and illustrated in Figure 15. This confirms that given the optimal tax rate (or the politically feasible tax rate), the generosity that can be maintained to the young and old is inversely proportional to the *ia*-ratio.

However, assuming that all persons belonging to the labour market space are entitled to public support does not fundamentally change the analysis. The balanced budget equation changes into

$$t * wap_{i,t} * (1 - s_{i,t}) = (vap_{i,t} + oap_{i,t} + wap_{i,t} * s_{i,t}) \varphi_{i,t} \Leftrightarrow \varphi_{i,t} = t * \frac{wap_{i,t} (1 - s_{i,t})}{1 - wap_{i,t} (1 - s_{i,t})} \quad (11')$$

which gives slightly different curvatures of the lines in Figure 15, but does not change the trade-off between maintaining public support to the non-working and maintaining labour market space.