Identifying European countries that are most vulnerable to population ageing problems

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Summary

Old-age-dependency ratios are reaching record levels in European countries and are estimated to rise even further in the near future, which makes finding solutions increasingly important. One of these solutions might be to invest in human capital development. This thesis will discuss human capital variables in relation to population ageing and provide an empirical analysis of a theoretically informed classification system designed to reveal differences between the European countries in terms of how well they will be able to deal with population ageing problems. Results show that heterogeneity within the EU is pervasive with respect to what measures different member states will need to take in order to ensure future human capital development. However, it is clear that certain regional patterns emerge in the Baltic states, southern Europe and the Balkans. Based on the classification system, the EU would be well advised to actively invest in human capital development in these regions in order to avert future economic and service issues linked to population ageing.

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1. Introduction

Background

According to Richard Disney (1996) a person who has retired from the labour market is, from an economic point of view, a "burden" on society in the specific sense that his current consumption expenditure outweighs his current contribution to the total marketable output. Consequently, there is a social mechanism permitting the transfer of consumption availability—that is, a process by which some goods and services produced by the economically active young are reallocated to the old. This process can be termed an intergenerational resource distribution and it helps to sustain the elderly people. But with changes in population structure in European countries this is becoming more difficult. The old-age-dependency ratio is the ratio of the number of elderly people at an age when they are generally economically inactive (i.e. age 65 and over), compared to the number of people of working age (i.e. 15-64 years old). With this dependency ratio reaching record levels (Eurostat, 2017), finding solutions is becoming increasingly important. According to certain studies, one of these solutions might be to invest in human capital accumulation, which could stimulate economic growth and significantly reduce the potential negative impact of ageing (Goetz & Hu, 1996). Besides knowing reasons why to invest, it is also important to know where to invest. By combining dependency ratio measures with two macro measures of human capital (tertiary education rates and per-person labour productivity), this thesis creates a classification system designed to identify the European countries that are most vulnerable to population ageing problems. In doing so, it is able to identify which European countries/regions have the most pressing need for investment.

1.1. Research questions

Central Aim

The central aim of this thesis is "To integrate country-specific dependency ratios with two dimensions of human capital attainment and identify the European countries that are most vulnerable to the negative effects of population ageing". In order to address this overall aim, four secondary questions are defined as follows:

Secondary questions

1. In what ways can population ageing influence the macroeconomic conditions of a country?
2. How might human capital development alleviate the effects of population ageing?
3. How does population ageing vary across Europe?
4. Using a theoretically informed selection of variables to create four classifications, which European countries appear best or worst placed to deal with population ageing?

Structure of thesis

Given the nature of these questions, they are answered in different sections of the thesis. The first two secondary questions are answered through a critical review of the literature (section 2). Questions 3 and 4 are answered using secondary data and are therefore addressed in the Analysis section (section 4). Finally, drawing on the discussion and results of the four secondary questions, the central aim will be addressed in the concluding section (section 5), where policy recommendations

are also provided. To further clarify the structure of this thesis a conceptual model is made (see figure 1).

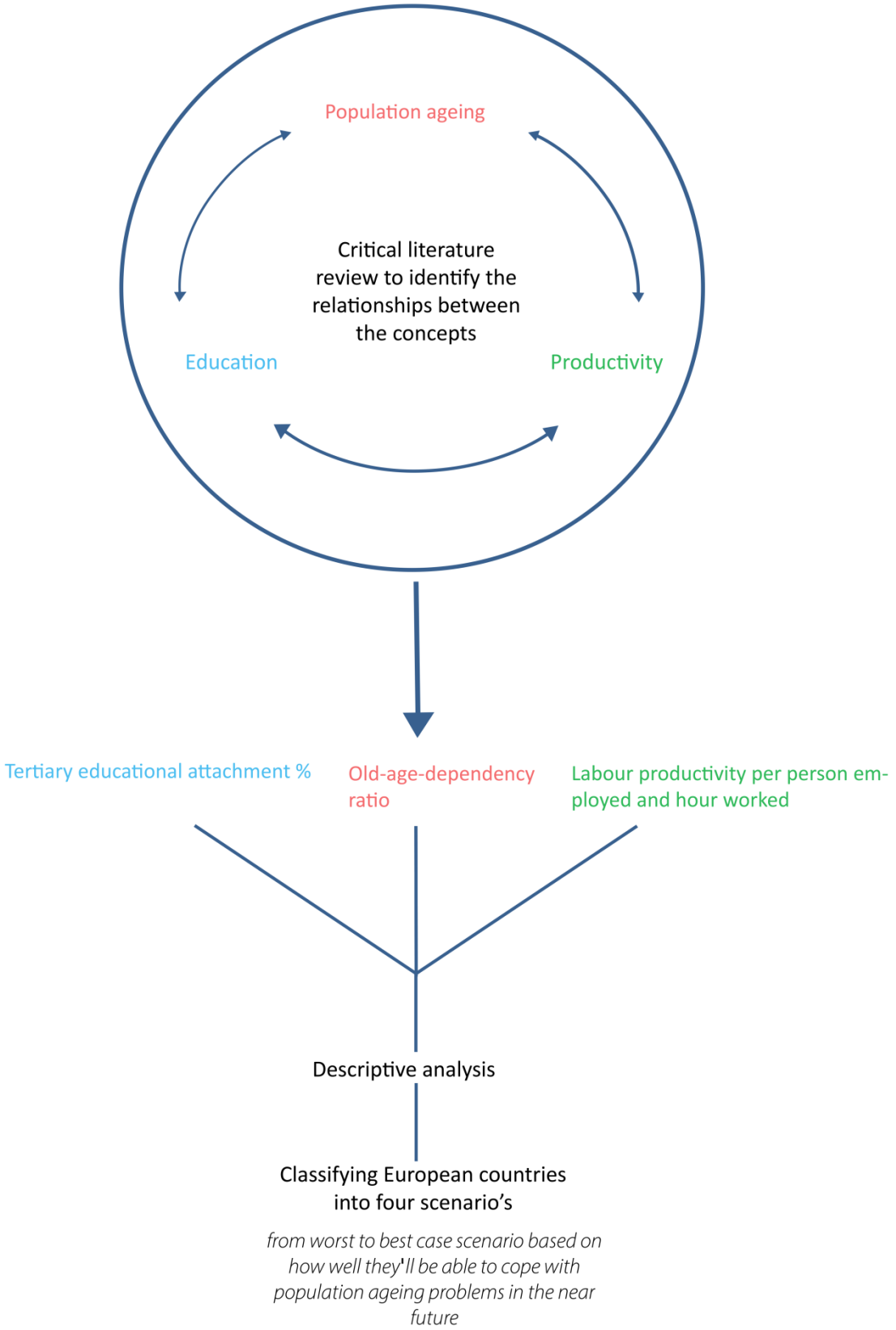


Figure 1

2. Theoretical framework

2.1. In what ways can population ageing influence the macroeconomic conditions of a country?

With increasing population ageing and higher dependency ratios the productivity of a country becomes more important. This makes the need to understand the driving forces behind productivity growth ever more critical. Human capital development, international knowledge spillovers, entrepreneurship, innovations, and the information technology constitute the major drivers of productivity growth in Europe (Skirbekk, et al., 2006). However, there is only limited knowledge about the relations between these factors and the age structure of the workforce.

Clearly educational attainment, health of the population, and tax policies are all drivers of productivity as well. An ageing population may constitute a major burden on these drivers since older people are less educated and less healthy (Skirbekk, et al., 2006). In this chapter a theoretical discussion will be made about the possible burdens of population ageing on macroeconomics of countries and the increasing pressures pension schemes.

Low fertility rates and higher longevity result in population ageing and have the potential to hinder many factors of potential growth. It can be expected to reduce the labour supply over time since older workers will tend to have lower participation rates and fewer young workers will be entering the labour force (Nerlich & Schroth, 2018). With a lower fertility rate, the size of the younger cohorts reduces, which can eventually be expected to reduce labour supply and the GDP per capita. According to Bloom & Williamson (1998) the opposite was shown in emerging Asia over the period 1960-1990 where the strength of young cohorts entering the labour market was one of the factors that created the rapid growth.

Having fewer dependent children will at first lead to an increase in the working-age population as a percentage of the total population. Though, when these cohorts reach working age, there will be an unfavorable impact on the working-age population, both in absolute terms and as a percentage of the total population. Combined with an increasing life expectancy, which results in a larger number of people reaching retirement age, this will increase the old-age dependency ratio.

Ageing may also negatively impact the aggregate total factor productivity, and subsequently the output per worker. One effect of ageing could develop through weaker growth in total factor productivity, which captures underlying productivity growth derived from more efficient production processes and technological progress (Nerlich & Schroth, 2018). According to Skirbekk, et al. (2006) this might be explained by the ubiquitous hump-shaped distribution pattern of average productivity across cohorts that has been found by numerous studies, which may be related to a slowdown in the adoption of the latest technology as age increases (with statistics showing, for example, a reduction in workers' participation in training with increasing age) or a deterioration in the health of some older workers (European Commission, 2014). The estimated drag on GDP growth varies across countries depending on the population structure. For example, it is large in Spain, where the number of prime-age workers, between the ages of 30 and 49 (Skirbekk, et al., 2006), is set to decline strongly over the next 20 years as a percentage of the total working-age population, and it is small in Germany, where a series of large cohorts are about to retire (European Commission, 2014).

2.1.1. Influence of health on productivity

An ageing working-population can have negative effects on the total productivity of a population. An important cause of age-related productivity declines is likely to be age-specific reductions in cognitive abilities. Certain abilities, like perceptual speed, show relatively large decrements already from a young age, while others, such as verbal abilities, show only small changes throughout the working life. Increasing experience does boost productivity up to a point beyond which, however, further tenure has little effect. Older individuals have reductions in their memory and reasoning abilities and learn at a slower pace. In particular, older workers are likely to have difficulties in adjusting to new ways of working (Waldman & Avolio, 1994).

Health effects of age represent an especially important issue if decreased health makes it difficult to work or if employment represents a health hazard for older individuals. With older age muscle strength and endurance will decrease, maximum oxygen uptake decreases, bone mass decreases (especially among women), blood circulation deteriorates, hearing and eyesight decline and the likelihood of becoming sick grows. Older individuals' work capacities are therefore usually lower in many occupations, although technical aids, adjusted working environments, and ergonomic equipment can improve the situations. Furthermore, physical exercise, less smoking and alcohol and a healthier lifestyle with better nutrition would improve the working capacity of older individuals, and presumably, this also holds true for younger individuals (Skirbekk, et al., 2006). When looking at the possible health effects on productivity, increasing the pension age might seem to not be an effective resolution. However, with the increasing longevity of people, possibly resulting in postponing many negative health effects on productivity to later stages in life, this might still prove an effective solution. According to Feinstein et al. (2006) increasing education and lifelong learning, which results in healthier lifestyles. This might also have a positive effect on postponing the negative effects of health on productivity.

2.1.2. Changing labour market demands

Autor et al. (2003) estimated productivity potential by weighing age-specific ability levels against the labour market demand for their abilities. Their study suggested that there is an increasing demand of the workers for using cognitive abilities over a long period of time. Analytic, numerical and interpersonal abilities are increasingly in demand, while physical strength and bodily co-ordination have lost much of their importance.

According to Autor et al. (2003), this means that experience is becoming even more important. And when the demand for experience increases, the age-productivity profile peak shifts towards older ages. Though, according to Skirbekk et al. (2006) estimations of the productivity profile reflects that job performance on average tends to decrease in the second half of the working life due to negative health effects on productivity, such as the decreasing cognitive abilities. And with the shift towards the increasing importance of cognitive abilities this makes older cohorts less productive.

These things again show the quite clearly substantial possible effect of education on productivity. Because better education results in younger cohorts having more experience and can result in healthier lifestyles to combat negative health effects on productivity (Feinstein, et al., 2006). Besides that, life-long learning might make it able for older cohorts in the working force to still stay productive with the increasing dependence on technical automatic and digital programs.

2.1.3. Increased pressure on public spending

Population ageing will place an increased pressure on the already high levels of age-related public spending. The European Commission's 2015 Ageing Report expects public spending on health care, long-term care, and pensions to rise from 21% of GDP in 2013 to 23% of GDP in 2060.

The spending on health care and long-term care as percentage of GDP are estimated to increase by an average of 0,7 and 1,3 percent respectively over the period 2013-2060 (European Commission, 2015). Naturally, older people are more likely to make use of healthcare services, which in Europe are primarily provided by the public sector. One thing that needs to be discussed, however, is that population ageing is only one factor driving healthcare costs and not necessarily the most important one. Healthcare costs are driven, among other things, by demand for higher-quality healthcare services, growth in GDP per capita and by technological progress (European Commission, 2015).

At the same time, spending on long-term care is also expected to rise; as such care is increasingly being provided by professional suppliers, rather than via intra-family support, partly as a result of increases in female labour market participation (Nerlich & Schroth, 2018). Finally, public spending on education can be expected to decline as the number of young people gradually decreases as a percentage of the total population, partially offsetting the rising expenditure discussed above. Although in the presence of a limited labour force governments could have the incentive to invest more in education and lifelong learning (Maddaloni, et al., 2006). In this case, spending on education might not decline and possibly increase spending on education.

2.1.4. Population ageing might force changes on pension schemes

Overall, population ageing is expected to place a burden on fiscal sustainability. Many countries carried out pension reforms following the sovereign debt crisis, although the pace of reform has slowed lately. Despite recent progress, there is a risk of complacency. Further reforms in this area would seem to be essential and should not be delayed (Nerlich & Schroth, 2018). While pension reforms could help contain the fiscal impact of population ageing, their exact macroeconomic implications may vary considerably depending on the specific nature of those reform measures.

Lifting the statutory and effective retirement ages, in line with increased longevity, is predicted to have a strong positive impact on the economic growth and the labour supply (Nerlich & Schroth, 2018). Lengthening people's working lives (for instance, by reducing early retirement or increasing the retirement age) efficiently increases the size of the active labour force relative to the number of elderly. Furthermore, if that increase in the retirement age is complemented by appropriate labour market measures, the added older workers will be unlikely to displace younger workers. The longer working lives can also motivate to increase incentives for lifelong learning and the accumulation of human capital, both of which are growth enhancing. Additionally, having longer working lives could be able to reduce the financing pressures on public pension systems by means of increases in pension contributions.

However, directly raising contribution rates on their own are expected to have less favourable economic implications. According to Nerlich & Schroth (2018), it could improve the financing of pay-as-you-go pension systems, but such measures actually have the potential to aggravate the macroeconomic effects of population ageing, rather than dampening them. Adding to that, the

distortionary effects of higher contribution rates on the labour supply and employment can result in weaker economic growth (Nerlich & Schroth, 2018).

Similarly, decreasing the benefit ratio is, also potentially less favourable than raising the retirement age. Decreasing pension entitlements can have adverse macroeconomic effects through reductions in domestic demand. Pensioners are likely to respond to reduced pension transfers by saving more and decreasing their consumption. Additionally, the working-age population may, in turn, increase precautionary savings in view of the reduction in future pension entitlements.

2.2. How might human capital development alleviate the effects of population ageing?

When there are more people retiring than entering the labour market the pool of working age people will diminish, and reduce the potential gross domestic product growth if leaving all other things equal. Higher productivity can help maintain the trend of GDP growth, and it can be enhanced through investing in human capital (Research Office, 2014). Human capital refers to the productive capacity of individuals, that is, the knowledge and abilities that allow them to receive a flow of income during their lifetimes. Human capital benefits are measured as the increase in the flow of income people will earn over their life cycle because of the productivity gain associated with more education (International Labour Office, 2013).

The relationship between education and productivity and economic growth has been the subject of analysis and research for a long time. Psacharopoulos and Woodhall (1985) mentioned that the concept that investment in human capital promotes economic growth actually dates back to the time of Adam Smith and the early classical economists, who emphasized the importance of investing in human skills. This importance still holds true today, when human capital can influence economic growth directly by increasing the rate of domestically produced technological innovations, and indirectly through speeding the adaptation of imported technology (Al-hajry, 2002). Since workers with a better educational background would be more complementary with new technologies.

2.2.1. Human capital and technology

Expansion of technical and scientific knowledge can raise the productivity of labour and other inputs in production. The systematic application of scientific knowledge to production of goods has greatly increased the value of education, technical schooling, and on-the-job training (Al-hajry, 2002). It is apparent that most countries, which have managed continual growth in income, have also had large increases in the education and training of their labour forces. A great example of the link between technology and human capital comes from agriculture. Education is of little use in traditional agriculture because farming methods and knowledge are then readily passed on from parent to children. Farmers in countries with traditional economies are among the least educated members of the labour force (Al-hajry, 2002). But on the other hand, modern farmers must deal with more complicated methods and equipment. Education here is of great value since it helps farmers adapt new hybrids and other new technologies more quickly. Education and training is also helpful to cope with increasing productivity and changing technologies in the service sectors. Various studies show that more rapidly progressing industries attract higher-educated workers and offer better training on the job (Al-hajry, 2002).

2.2.2. Human capital welfare enhancing

A lot of literature on human capital suggests that human capital is welfare enhancing and could alleviate negative effects of population ageing. According to Peng (2005), policy simulations show that accelerating human capital accumulation raises both total output and per capita real income dramatically. Public expenditure on increasing productivity and improving education is, therefore, welfare enhancing, mitigating the adverse effects of population ageing while laying the foundation for supporting rapidly increasing elderly populations. Another study showed that raising labour productivity can partly offset the impacts of an ageing population. A higher labour productivity would enhance income growth, helping to sustain economic growth and living standards, and increase the capacity to 'pay' for the costs of ageing, as well as through taxation (Productivity Commission, 2005).

With human capital seemingly an important factor in helping to mitigate population ageing problems, it is important to identify empirical measures of human capital.

Two commonly used empirical measures of human capital are educational attainment and labour productivity. Education has long been recognized as one of the key factors determining the success of individuals and of countries as a whole. In developed countries more educated individuals earn on average higher wages (International Labour Office, 2013). One of the main reasons that education increases future wages is that education increases individuals' productive capacity, that is, it increases their efficiency in the labour market, and therefore the productivity of their firms and of the country as a whole.

With that said, a positive relationship between education and wages does not necessarily mean that education increases productivity alone. Human capital can also be acquired on the job market, for instance through on-the-job training. This instruction is usually more specific than human capital acquired through education. And what also needs to be discussed is that productivity and population ageing variables are directly influencing each other. So does an increasing productivity help alleviate population ageing problems and so does population ageing decrease the productivity of a population (Alexia Prskawetz, 2006). Therefore it is for this research interesting to also include the productivity variable besides the education variable for human capital.

2.2.3. Human capital and income distribution

Education is often considered one of the most efficient mechanisms of achieving growth with social justice, because it increases growth and reduces inequality at the same time. In particular, since the children of the elite tend already to be well educated in most countries, educational expansion tends to affect primarily the children coming from poorer families. Also the fact that education expenditures are financed by income tax, which is mostly generated from individuals with higher incomes, while the current benefits accrue to all those who are enrolled. In other words, while all are sharing the benefits, it is primarily the wealthy individuals or tax payers who are bearing the cost. This is seen as a form of income distribution where part of rich individuals' incomes is redistributed to the poor through the provision of education services. When more of those children of poorer families reach the labour market and start earning higher wages, due to the improved education, inequality tends to decline (International Labour Office, 2013). Increasing earning potential and individual productivity should in turn increase working fiscal contributions and help counteract some of the burdens related to population ageing.

Although using a single and broad productivity variable might seem unjustifiable, various studies on age-productivity differentials show that productivity can be seen as a system attribute and cannot be understood in isolation of its social context (Skirbekk, et al., 2006). It is a system attribute because productivity of a country can be influenced by many factors, such as demographic factors, capital formation, external-foreign factors, and other technological developments. For example look at the technological advancements in terms of automation, which has been a major driver behind increased productivity (Muro & Andes, 2015).

While productivity is a system attribute of many factors, one pattern seems to be ubiquitous across studies on age effects on productivity, which is that the highest productivity is expected between the ages of 30 to 49 (Skirbekk, et al., 2006). So firms where the share of the middle age group is higher have a higher productivity compared to firms with a higher share of younger or older workers.

2.2.4. Human capital and health

As in a previous chapter is discussed, when people get older certain negative health effects can have large negative effects on the productivity of a workforce. Human capital development could be able to extenuate these negative health effects a bit. According to Feinstein et al. (2006) increasing education and lifelong learning can result in healthier lifestyles, which might have a positive effect on postponing the negative effects of health on productivity. In other words, an increase of productivity can happen when older cohorts experience less of the negative health effects on productivity.

2.2.5. Educational investments

According to Nerlich and Schroth (2018), one positive thing about low fertility rates, is that it may, for instance, allow for stronger investments in human capital per child. Additionally, the scarcity of labour could increase the return to investment in human capital and thus incentivize training in the course of a person's working life with lifelong learning, especially when accompanied by increases in the retirement age. Besides that, the benefits of accumulated human capital may continue to develop throughout a person's working life. Thus, structural shifts towards knowledge-based sectors, in which high productivity levels can be maintained throughout the working lives of people, could limit the downward impact that ageing has on future productivity.

So raising education levels are important to be able to maintain growth in ageing economies, however it is important to know that for reasonable levels of education to be attained the delay in productivity effects is quite substantial, as in most cases appreciable effects do not occur until twenty years after such efforts have been initiated (Nerlich & Schroth, 2018). Therefore, investing in human capital development as soon as possible is a wise thing to do.

What my research will add to the existing literature

The critical literature review on the human capital concepts and population ageing could provide a more clear understanding of their relationships and effects on one another. With these variables effecting one another, an endogeneity in their relationships exist and make modelling difficult. For this reason, an empirical analysis of a classification system is used instead of a model-based approach. With this classification European countries are identified that are best or worst placed to deal with population ageing. This can help policy makers at both the national and EU level to know where to implement policies and investments.

3. Methodology

While research questions 1 and 2 are answered with a critical review of the existing literature and question 3 is addressed using existing secondary data on old-age dependency ratios, secondary question 4 draws on three country-specific variables (discussed below) to classify European countries according to their ability to deal with population ageing. To classify the countries a three-dimensional graph is used (see figure 2). Based on the positions of the countries in the coordinate system, the countries will be mapped from worst to best using GIS. Figure 3 shows how the classifications in the coordinate system are defined.

It is now possible to detail how the three concepts of population ageing, education and productivity are measured in this thesis. Population ageing is measured via the old-age dependency ratio. Commonly used in empirical research on populating ageing, this indicator is the ratio between the number of persons aged 65 and over (age when they are generally economically inactive) and the number of persons aged between 15 and 64 (Eurostat 2018). Tertiary education is used as a measure of educational attainment. This commonly used indicator in empirical research is defined as the % of the population aged 25-64 who have successfully completed tertiary studies (e.g. university, higher technical institution, etc.) (Eurostat 2018). Furthermore, this variable correlates substantially with many other variables (Schneider, 2011). For a measure of productivity, the thesis employs labour productivity per person employed. GDP per person employed is intended to give an overall impression of the productivity of national economies expressed in relation to the European Union (EU28) average. The figures are expressed in PPS, i.e. a common currency that eliminates the differences in price levels between countries allowing meaningful volume comparisons of GDP between countries. Labour productivity per hour worked is calculated as real output per unit of labour input (measured by the total number of hours worked). Measuring labour productivity per hour worked provides a better picture of productivity developments in the economy than labour productivity per person employed, as it eliminates differences in the full time/part time composition of the workforce across countries and years (Eurostat 2018).

All the data are retrieved from Eurostat. To make the data for all three variables usable in the 3D coordinate system all three variables were compared with the respective EU average (based on the European countries that had available data). The length of the axes were adjusted so that the weight of the variables are represented accurately. For example, having the y-axis (population ageing) being 7,95 max and the z-axis (productivity) being max 71,85. Moreover, The length of the axes were set from the lowest to highest values. For example, with productivity, Macedonia has a score -58,6 lower than the EU average, while Ireland has a score 85,1 higher than the EU average. Together, the total length of the axis is 143,7, with 71,85 being maximum and -71,85 being minimum. This is done for every variable making the center (0, 0, 0) the median point for all the three dimensions.

For clarity, an illustration is now given. Using Bulgaria as an example country, Bulgaria has a score 6,73 lower than the average in education, 48,5 lower than the average in productivity and 4,07 higher than the average in the old-age dependency ratio than the EU average (**-6,73**, **4,07**, **-48,5**) (see appendix). As such, Bulgaria is placed in the worst-case scenario.

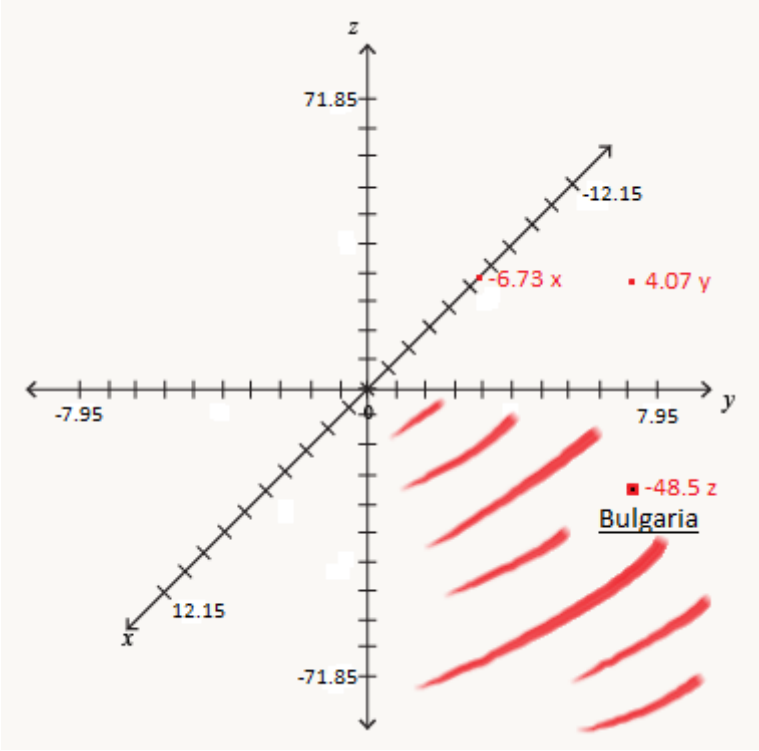


Figure 2

The four classifications

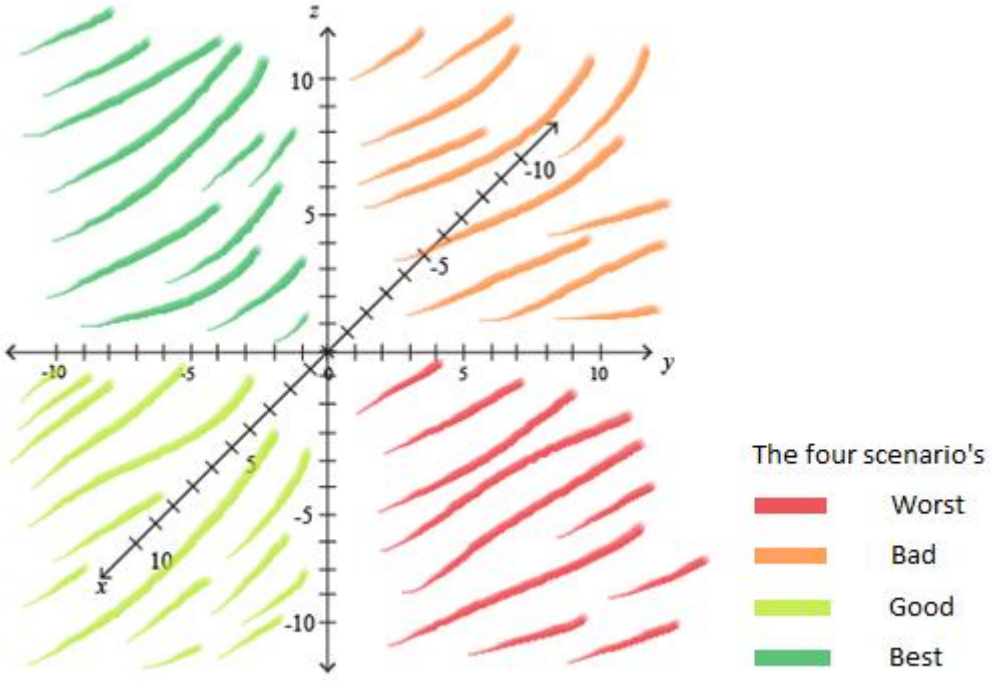


Figure 3

4. Results

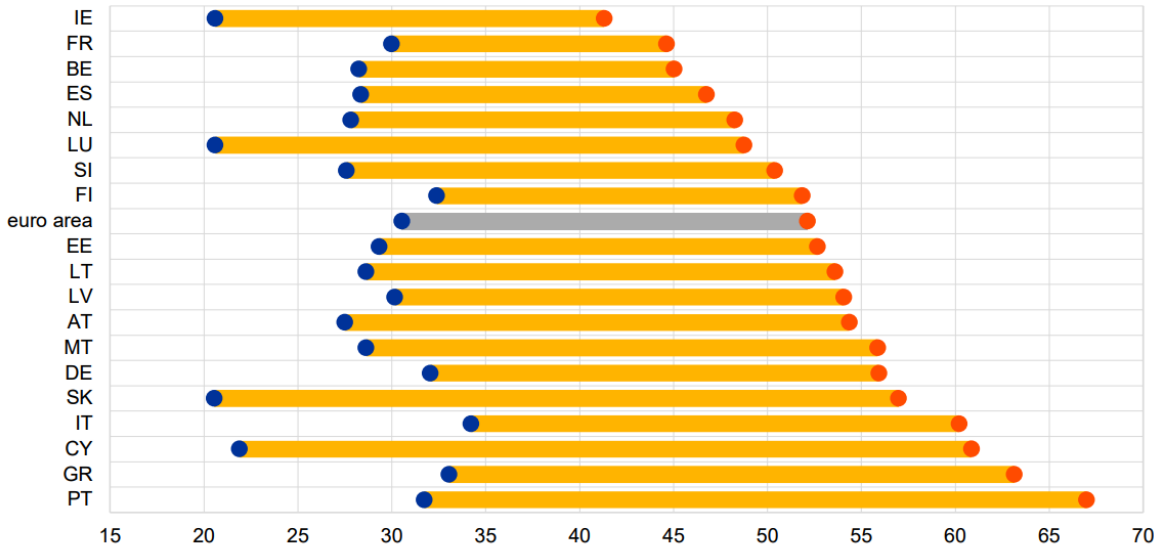
4.1. How does population ageing vary across Europe?

European countries are facing considerable demographic challenges, which are estimated to have major economic consequences. According to the Eurostat (2015) population projections the total population of the euro area is estimated to increase from 340 million in 2016 to around 352 million in 2040, before falling to 345 million in 2070. Moreover, the age structures of European countries are also set to change, with population ageing estimated to continue and increase further. Those developments will be driven mainly by further increases in life expectancy, as well as by low birth rates, while net migration flows will, on average, only somewhat mitigate the impact of population ageing. Major cohort effects are also expected, with the whole of the baby boomer generation (the large numbers of people who were born in the 1950s and 1960s) entering retirement over the next two decades.

While all European countries are having population ageing, the extent of that demographic challenge will vary significantly across countries. The countries with the highest old-age dependency ratios are currently Italy, Greece, Germany, Finland and Portugal (see Eurostat image below). According to ECB estimations of the old-age dependency ratios are estimated to increase by more than 35 percent by 2070 in Portugal, Slovakia and Cyprus, with Portugal ending up with a ratio of 67%, being the highest in Europe. Ratios of 60% or more are also projected for Greece, Italy and Cyprus. On the other hand, Ireland is estimated to have the lowest ratio in the euro area by 2070, while France, Spain and Belgium are estimated to have the smallest increases. Nevertheless, it is important to see that all dependency ratios are estimated to increase a substantial amount till 2070. This means that complacency now, even in the "best" countries, might result in many problems later.

Old-age dependency ratios in 2016 and 2070

(percentages)



Sources: Eurostat and ECB calculations.

Figure 4

In the 20th century it was Western and Northern Europe that had the oldest populations (Creighton, 2014), but by 2070 this will be almost reversed, with the oldest populations being in Eastern and Southern Europe. These patterns are now already showing, with certain Balkan countries like Greece and Bulgaria and with southern countries like Portugal, Spain and Italy (see appendix). The geographical pattern is also evident in the Baltic States, which all have high old-age dependency ratios. However, there are still Northern European countries with old populations, such as Germany and the Scandinavian countries (excluding Norway).

The estimated drivers of population ageing also vary across countries themselves. Whether ageing is driven by increases in life expectancy and/or low fertility rates has important ramifications for the dynamics of population ageing and its fiscal and economic implications.

Life expectancy is predicted to increase in all European countries (Eurostat, 2017). Though, the predicted increases tend to be larger in the countries where life expectancy are presently lower, with the biggest increases estimated in Slovakia and Latvia. Furthermore, according to Eurostat (2017), the low fertility rate is estimated to increase slightly in all countries except France, which will, still, continue to have the highest fertility rate in all of Europe. The Southern Europe and certain Balkan countries all show the lowest fertility rates (see appendix), which consequently resulted in their increased old-age dependency ratios. Estimations concerning net migration demonstrate a big amount of cross-country heterogeneity. For some countries, those projections even show net migration outflows, which could further amplify their ageing problems (Eurostat, 2017).

What needs to be stated though, is that carefulness is required when estimating long-term demographic trends. Population projections are highly dependent on the underlying expectations regarding life expectancy, fertility rates and migration flows. While all those components have a certain degree of unpredictability, the unpredictability relating to migration flows is by far the greatest. As a consequence, population estimations have historically been subject to forecasting errors and regular revisions.

4.2. Classifying European countries

This chapter shows the results after putting most European countries into the 3D coordinate system as discussed in the methodology. The classifications are shown in figure 5, it shows the differences in how well European countries will be able to deal with their population ageing problems.

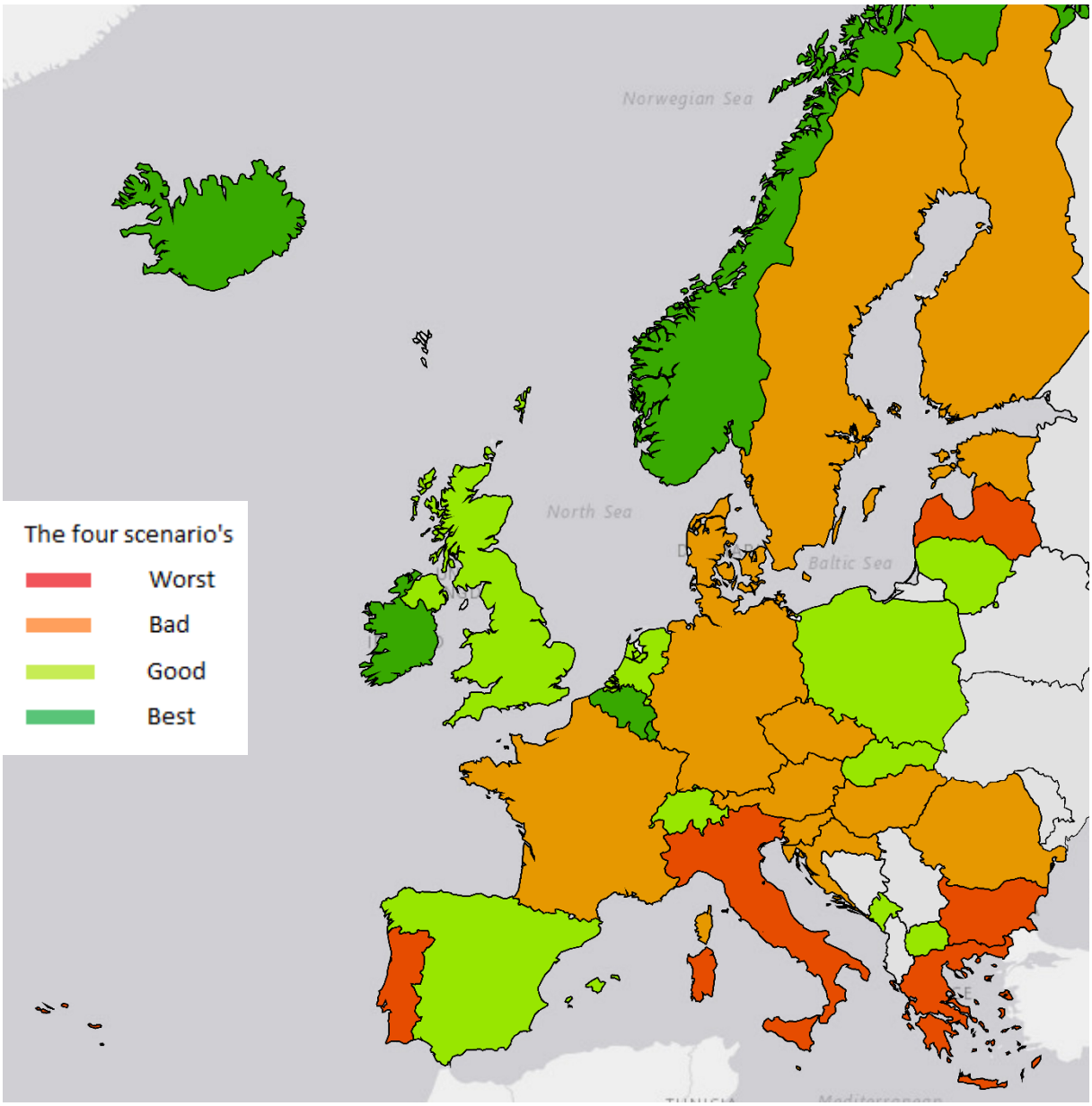


Figure 5

Certain striking outcomes are Ireland, Iceland, Belgium, Luxembourg and Norway, which are, relatively to other EU countries, in the best position to deal with their population ageing. They are in this position on account of their significantly lower old-age dependency ratios and their high education and productivity levels (see Appendix). On the other hand, there are countries placed in the worst position to deal with population ageing, such as Portugal, Italy, Greece, Bulgaria and Latvia. These countries experience substantially high old-age dependency ratios and low education and productivity levels, which are often far below the EU average. Consequently, these increasing old age cohorts will not be able to be compensated by a higher educated and productive workforce, and will subsequently have to deal with negative effects of population ageing. However, differences do exist

in their lack of education or productivity, such is the case with Italy and Latvia. Italy actually shows a higher productivity but is experiencing substantially lower education levels compared to the EU average. Latvia shows a little higher education but has a considerably lower productivity compared to the EU average (see Appendix). Which still hampers them incredibly in the ability to deal with their high old-age dependency ratio. Though, investments in these lacking regions might seem promising with their potentially high rates of return and its potential to alleviate negative population ageing effects.

Countries like Denmark, Sweden, Finland and Germany all have substantially high old-age-dependency ratios however, they are able to somewhat compensate it with high productivity and education levels. Although, in the case of Germany there is only compensation taking place with a high productivity level (see Appendix). As a result of their human capital development being relatively high, these countries emerged from the worst-case scenario into the bad case scenario. Furthermore, migration might also be a factor in compensating the relatively high old-age dependency ratio in these and other north-western European countries. Still, with these regions being in a bad position in dealing with population ageing further human capital development should be actively sought after.

Countries with relatively low old-age dependency ratios, such as the Netherlands, United Kingdom, Poland, Spain, Switzerland and Lithuania were able to compensate fairly well with high productivity and education levels. An exception is Poland that has low education and even lower productivity levels compared to the EU average. Interestingly Poland is still placed in a good-case scenario on account of their population ageing being considerably lower than most countries. On the other hand, you have Lithuania that has substantially higher productivity and education levels than the EU average which makes them fairly able to compensate their old-age dependency ratio. For this reason, Lithuania might be a model to copy for the other Baltic States. Yet, most of these countries still have room for improvements regarding human capital development, which would put them in a better position to deal with population ageing.

In addition to variations between countries, there are also variations between regions. Some heterogeneity exists in the North but for the most part they seem to be doing well. Mostly on account of their higher productivity and education levels. Though, migration might also be an influencing factor here since they are the destination countries. The regions that seem particularly vulnerable are the Balkans and Southern Europe. Most of these countries experience high old-age dependency ratios and substantially lower productivity and education levels compared to the rest of the EU. For that reason, the EU would do well to invest in human capital development in these regions.

5. Conclusions

Population ageing will have major macroeconomic and fiscal implications for European countries. In particular, ageing will lead to a decline in the labour supply and is likely to decrease productivity. There will also be increasing pressures on public spending on pensions, health care and long-term care. This will make it challenging for European countries to ensure fiscal sustainability in the long term and it will possibly make pension reforms imperative.

Human capital development could alleviate population ageing problems. Expansion of technical and scientific knowledge can raise the productivity of labour and other inputs in production. Besides that raising education is welfare enhancing, which can result in a higher GDP per capita which also makes it easier for countries to deal with population ageing problems. Furthermore, human capital development could be able to extenuate negative health effects. Raising education and lifelong learning can result in healthier lifestyles, which might have a positive effect on postponing the negative effects of health on productivity. Moreover, the benefits of accumulated human capital may continue to develop throughout a person's working life, which could limit the downward impact that ageing has on future productivity. Besides that, increasing education levels might not even need many extra investments. This as a result of the low fertility rates, which gradually decreases the number of younger people and allows for stronger investments in human capital per child. Furthermore, the scarcity of labour can also increase the return to investment in human capital and thus incentivize training in the course of a person's working life with lifelong learning. Structural shifts towards knowledge-based sectors, in which high productivity levels can be maintained throughout the working lives of people, could limit the negative impact that ageing has on future productivity.

There is a geographical pattern that is changing in Europe. The regions with the oldest populations are shifting towards Eastern and Southern Europe and will continue to do so till 2070. This pattern is already emerging in the Baltic States, southern Europe and in the Balkan region. As the results of the classification show, heterogeneity within the EU is pervasive with respect to what measures different member states will need to take in order to ensure future human capital development. The regions that seem particularly vulnerable in their ability to deal with future population ageing problems are the Balkans and Southern Europe. These regions experience high old-age dependency ratios and substantially lower productivity and education levels compared to the EU averages. Countries like Portugal, Italy, Greece, Bulgaria and Latvia demand the highest immediate attention to increase their productivity and education levels in order to help avert future economic and service issues linked to population ageing.

One could argue that the problem of an ageing workforce is not the biggest problem. Since it could be relatively easy to decrease these problems through raising educational levels and other human capital development. The fiscal problems associated with rising dependency burdens are likely to overshadow the problem of an ageing workforce. Thus the problem of how to organise increasing redistribution within an ageing population might seem more pressing than how to deal with an ageing workforce, even though success in the latter aspect will make the former problem easier to deal with. Another interesting thing for future research is the effect that migration might have in this context. Migration can be able to decrease old-age dependency ratios and might increase productivity levels and therefore potentially improve the capabilities of a country to deal with future population ageing problems.

This thesis discussed human capital variables in relation to population ageing and provided an empirical analysis of a theoretically informed classification system designed to reveal differences between the European countries in terms of how well they'll be able to deal with population ageing problems. A limitation to using a classification system in this context is that it has levels of uncertainty, by cause of population projections being highly dependent on underlying expectations regarding life expectancy, fertility rates and migration flows. Therefore when estimating long-term demographic trends carefulness and regular revisions are required.

Something else that should be reflected on, is that when in this classification model a country is placed in a good- or best-case scenario this doesn't imply that these countries will not have to deal with any future economic issues linked to population ageing. However, it is an indication that as things are looking now these countries are in a decent position and somewhat well equipped to deal with population ageing in the near future. But as showed in figure 4 the old-age dependency ratios are estimated to increase substantially in all EU countries till 2070, so if these countries would now get complacent with their human capital development these countries could still likely suffer many negative effects of population ageing. Therefore, human capital development should stay on the agenda of all European countries, but for some European countries, the pressing need for improvements is substantially higher…

6. References

Al-hajry, A. S., 2002. *Human capital theory and the financing of higher education in Oman,* Sheffield: Department of Economics, the University of Sheffield.

Alexia Prskawetz, B. M. V. S. I. F. a. M. W.-D., 2006. *The Impact of Population Ageing on,* Stockholm: Vienna Institute of Demography, Austrian Academy of Sciences .

Autor, D. H., Levy, F. & Murnane, R. J., 2003. The skill content of recent technological change. An empirical exploration. *Quarterly Journal of Economics,* 4(118), pp. 1279-1333.

Bloom, D. E. et al., 2015. Macroeconomic implications of population ageing and selected policy responses. *The Lancet,* 2015(9968), pp. 649-657.

Bloom, D. E. & Williamson, J. G., 1998. Demographic transitions and economic miracles in emerging Asia. *The World Bank Economic Review,* 1998(12), pp. 419-455.

Disney, R., 1996. *Can We Afford to Grow Older?: A Perspective on the Economics of Aging.* 1 ed. Massachusetts Institute of Technology: Palatino.

European Commission, 2014. *Population ageing in Europe: facts, implications and policies,* Luxembourg: European Commission.

European Commission, 2015. *The 2015 Ageing Report - Economic and budgetary projections for the 28 EU Member States (2013-2060),* Brussels: European Economy.

Eurostat, 2017. *Population structure and ageing.* [Online]
Available at: http://ec.europa.eu/eurostat/statistics-explained/index.php/Population_structure_and_ageing
[Accessed 15 3 2018].

Eurostat, 2017. *Population structure and ageing,* Brussels: Eurostat.

Feinstein, L. et al., 2006. *What are the effects of education on health?,* Copenhagen: OECD.

Hviding, K. & Mérette, M., 1998. *Macroeconomic effects of pension reforms in the context of ageing populations: overlapping generations model simulations for seven OECD countries,* Paris: OECD.

International Labour Office, 2013. *Perspectives on Labour Economics for Development.* Geneva: International Labour Office.

Maddaloni, A. et al., 2006. *Macroeconomic implications of demographic developments in the euro area,* Frankfurt: European Central Bank.

Muro, M. & Andes, S., 2015. Robots Seem to Be Improving Productivity, Not Costing Jobs. *Harvard Business Review*, 16 6.

Nerlich, C. & Schroth, J., 2018. *The economic impact of population ageing and pension reforms,* Frankfurt: ECB Economic Bulletin.

Peng, X., 2005. *"The Demographic Window", Human Capital Accumulation and,* The University of Adelaide: Australian Institute for Social Research.

Productivity Commission, 2005. *Economic Implications of an Ageing Australia,* Australia: IDEAS.

Psacharopoulos, G. & Woodhall, M., 1985. *Education for Development - An analysis of Investment Choices,* Oxford: Oxford University Press.

Research Office, 2014. *Preparing for population ageing,* Hongkong: Legislative Council Secretariat.

Skirbekk, V. et al., 2006. *The Impact of Population Ageing on Innovation and Productivity Growth in Europe,* Vienna: Vienna Institute of Demography, Austrian Academy of Sciences.

Waldman, D. & Avolio, B., 1994. Variations in cognitive, perceptual, and psychomotor abilities across the working life span: examining the effects of race, sex, experience, education, and occupational type. *Psychology and Aging,* 9(3), pp. 430-442.

7. Appendix

	Tertiary educational attainment	Old-age dependency Ratio	Labour productivity per person employed and hour worked
Belgium	40,13	28,6	136,7
Bulgaria	25,48	31,8	45,1
Czech Republic	23,6	28,6	73,6
Denmark	36,6	29,7	129,3
Germany	27,6	32,4	127,2
Estonia	39,7	30	63,2
Ireland	42,9	20,7	178,7
Greece	27,67	33,6	65,1
Spain	36,7	28,7	97,8
France	36,06	30,7	124,7
Croatia	23,65	29,8	63,1
Italy	18,6	34,8	101,7
Latvia	33,9	30,8	55,7
Lithuania	40,3	29,3	62,5
Luxembourg	39,9	20,5	175,4
Hungary	21,34	27,9	62,9
Malta	20,4	28,1	77,3
Netherlands	34,92	28,4	126
Austria	30,79	27,6	118,4
Poland	28,51	24,2	59,1
Portugal	21,87	32,5	68,3
Romania	17,64	26,7	56,1

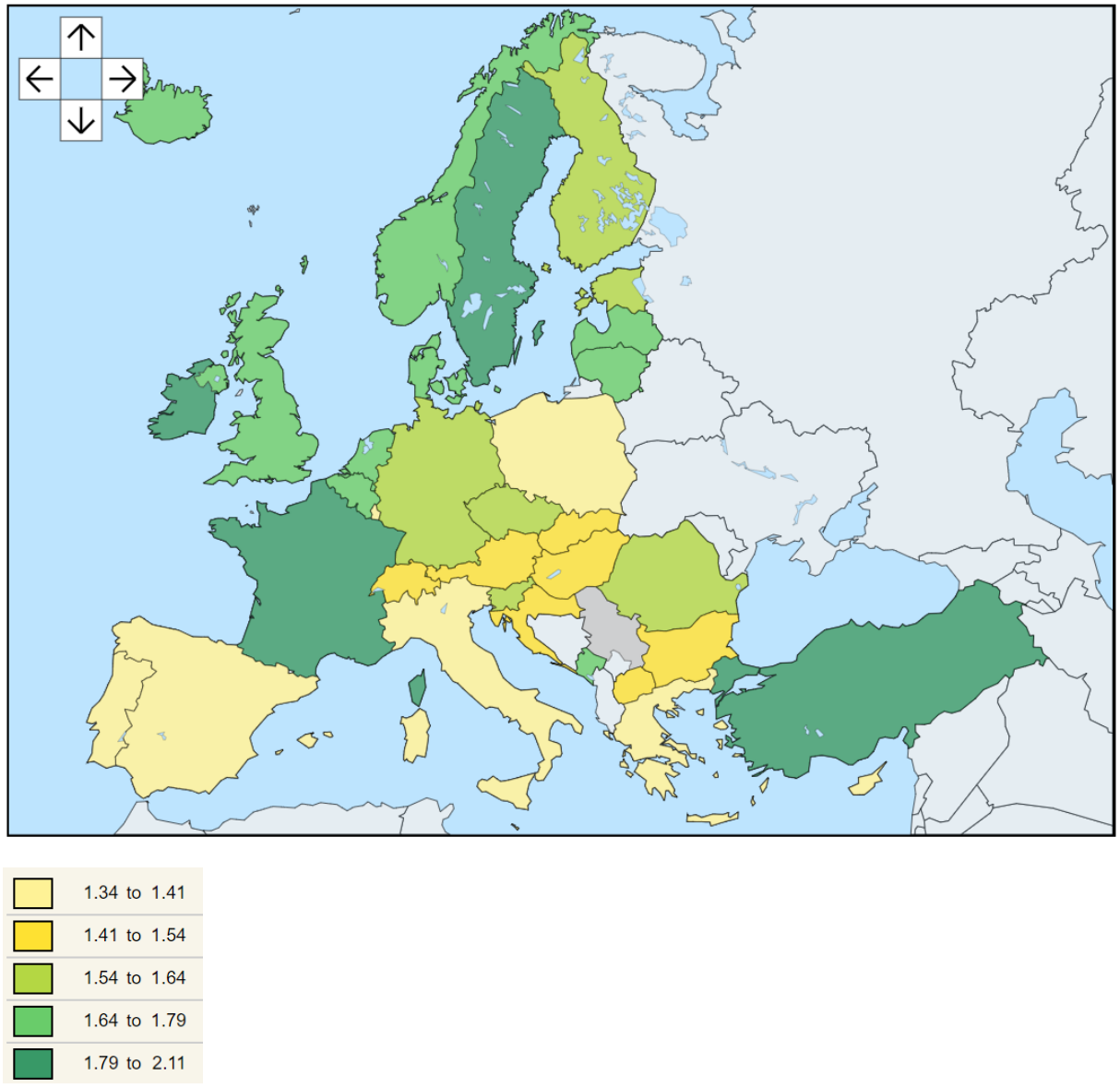
Slovenia	32,85	28,6	79,1
Slovakia	25,95	21,5	76,7
Finland	40,42	33,2	108,7
Sweden	39,28	31,6	114,2
UK	42,18	28,2	98,7
Iceland	42,5	21,2	120,1
Norway	41,57	25,4	145,9
Switzerland	42	27	126,9
Montenegro	24,8	21,4	39,9
Macedonia	20,7	18,9	35,2

Differences from the EU average

	Prod. variable	Education variable	Old-age dependency Ratio
Belgium	43,1	7,92	0,87
Bulgaria	-48,5	-6,73	4,07
Czech Republic	-20	-8,61	0,87
Denmark	35,7	4,39	1,97
Germany	33,6	-4,61	4,67
Estonia	-30	7,49	2,27
Ireland	85,1	10,69	-7,03
Greece	-28,5	-4,54	5,87
Spain	4,2	4,49	0,97
France	31,1	3,85	2,97
Croatia	-30,5	-8,56	2,07
Italy	8,1	-13,61	7,07
Cyprus	-16,5	10,19	-4,93
Latvia	-37,9	1,69	3,07
Lithuania	31,1	8,09	1,57
Luxembourg	81,8	7,69	-7,23
Hungary	-30,7	-10,87	0,17
Malta	-16,3	-11,81	0,37
Netherlands	32,4	2,71	0,67
Austria	24,8	-1,42	-0,13
Poland	-34,5	-3,7	-3,53
Portugal	-25,3	-10,34	4,77
Romania	-37,5	-14,57	-1,03
Slovenia	-14,5	0,61	0,87
Slovakia	-16,9	-6,26	-6,23
Finland	15,1	8,21	5,47
Sweden	20,6	7,07	3,87

UK	5,1	9,97	0,47
Iceland	26,4	10,29	-6,53
Norway	52,3	9,36	-2,33
Switzerland	33,3	9,79	-0,73
Montenegro	-53,6	-7,41	-6,33
Macedonia	-58,6	-11,51	-8,83

Total fertility rate - number of children per woman (Eurostat 2016)



Old-age-dependency ratio