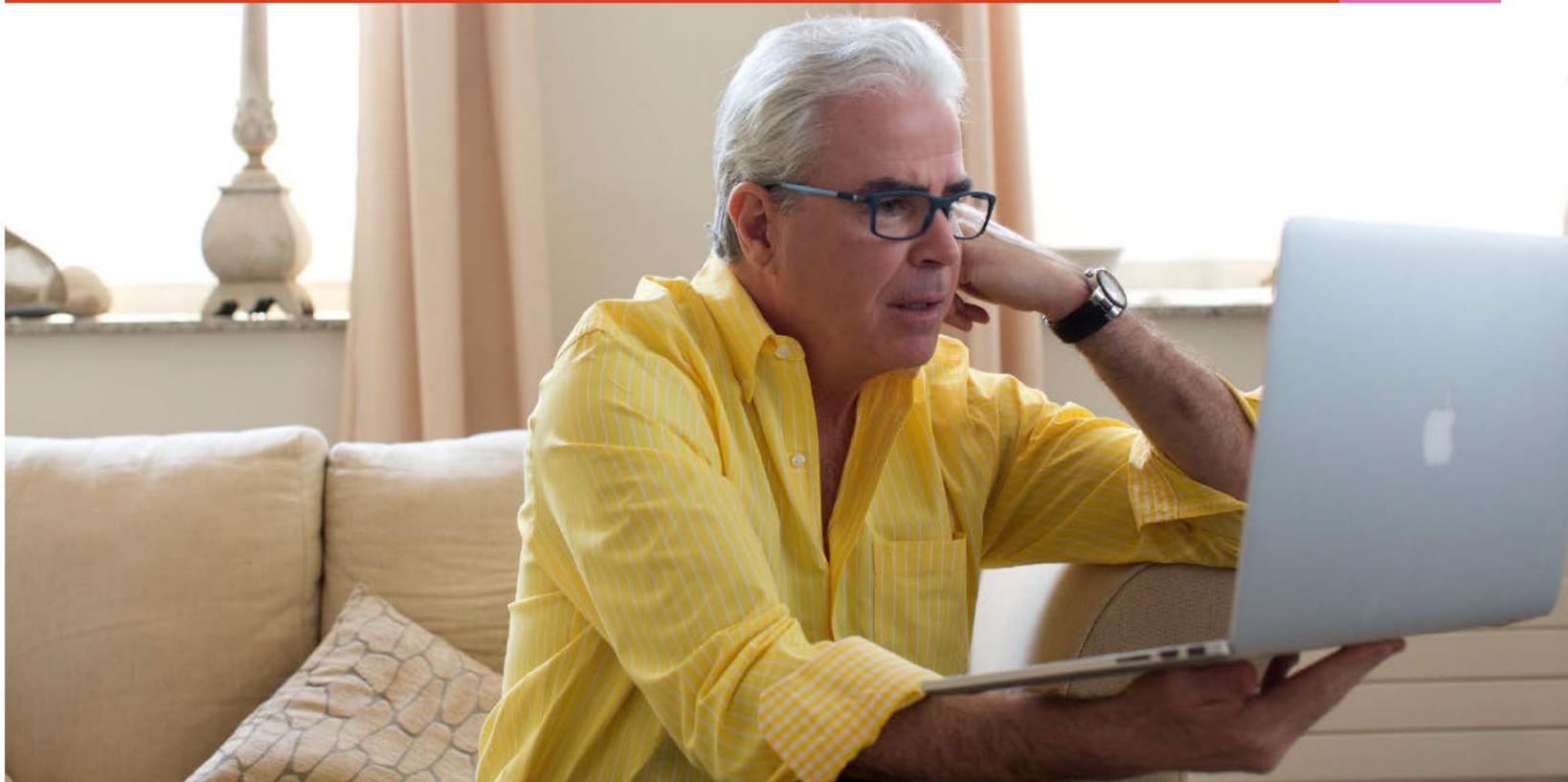


# *PwC Golden Age index*

## Unlocking a potential \$3.5 trillion prize from longer working lives

June 2018



# Contents

*Executive summary*

Page 4

*Key results from the Golden Age Index*

Page 9

*Potential boost to GDP from longer working lives*

Page 16

*Drivers of the employment for older workers*

Page 21

*Focus on: Automation and older workers*

Page 26

*Focus on: The United Kingdom*

Page 33

*Comparison of key labour market indicators across the OECD*

Page 41

*Appendices*

Appendix 1: Methodology Page 50

Appendix 2: Bibliography Page 56

Appendix 3: Contacts Page 58

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# *The potential \$3.5 trillion prize from longer working lives*

**Between 2015 and 2050, the number of people aged 55 and above in OECD countries will grow by almost 50% to around 538 million.** It is good news that we are living longer, but an ageing population is already putting significant financial pressure on health, social care and pension systems, and this will only increase over time.

To offset these higher costs, we think **older workers should be encouraged and supported to remain in the workforce for longer.** This would increase GDP, consumer spending power and tax revenues. It could also help to improve the health and wellbeing of older people by keeping them mentally and physically active.

**We have developed our Golden Age index to quantify how far different economies are harnessing the power of their older workers.**

The index captures a broad range of indicators relating to the participation of older people in employment and training. We find that Iceland, New Zealand, Israel, Estonia and Sweden lead the OECD on this index, with large potential economic gains if employment rates for those over 55s could be raised to those of the top performers. Note that this year the Golden Age index includes an extra country - Latvia, which joined the OECD in 2016.

**Specifically, across the OECD as a whole, we estimate that the potential long-term GDP gain from raising employment rates for those aged 55 and over to New Zealand levels could be around \$3.5 trillion.** Potential gains could be as high as 23% of GDP for Greece and 20% for Belgium.

We also consider trends in the UK in more detail in this year's report. While progress has been made over time in boosting working lives, we estimate there could be a **potential 9% (c.£180bn) boost to UK GDP in the long run if it could match New Zealand's performance.**

For governments across the OECD, the priorities include reforming pension systems and providing other financial incentives to encourage later retirement. **This year, we take a closer look at the drivers of employment rates for older workers.** We find that financial incentives can explain people's decision to stay employed, for example pension policy and family benefits, and that longer life expectancy is associated with longer working lives.

**Automation poses both potential opportunities and challenges for older workers.** AI technology can boost economic growth, generate more labour demand and support longer working lives (e.g. through use of digital platforms that allow older workers to market their skills more widely). However, our estimates suggest that older workers do face a higher risk of job automation compared to other age groups. Female older workers face a higher risk than male older workers over the next decade mainly because of their higher employment in clerical jobs. Measures to support lifetime learning and retraining for older workers will be critical to maximising the gains from these technologies.

**For employers, flexible working and partial retirement options** can pay dividends, as can redesign of factories, offices and roles to meet the changing needs and preferences of older workers.

I hope you find our analysis useful as a contribution to this important area of debate. Please do come back to us if you would like a more in-depth discussion of how we can help you to harness the power of older workers in your own organisation.



**John Hawksworth**  
Chief Economist, PwC UK

# *Executive summary*



# Increasing the employment rates of older workers in the OECD to New Zealand levels could boost GDP by around \$3.5 trillion in the long term

A geographically diverse group of relatively small economies occupy the top 3 places in our index



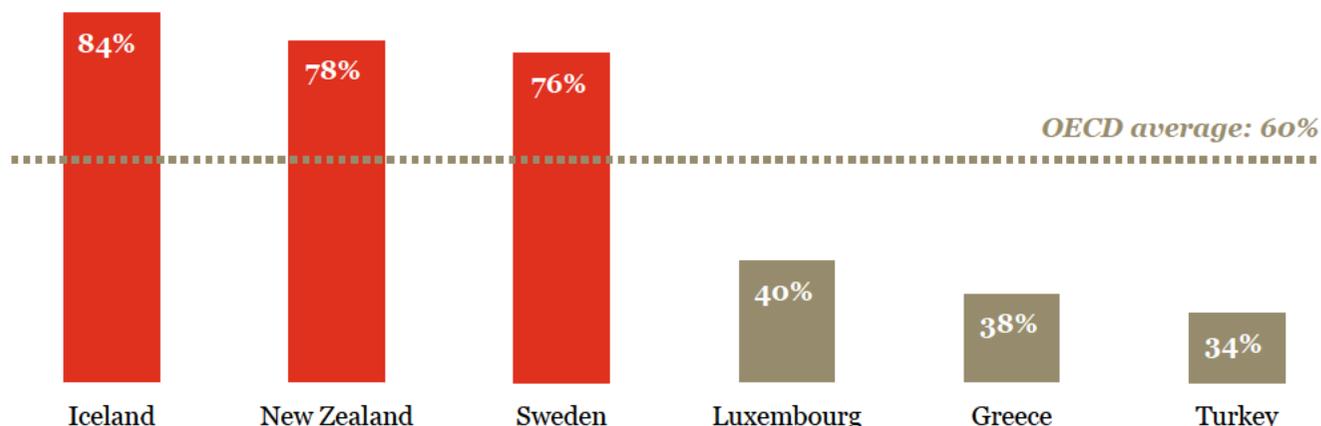
## \$3.5 trillion

Our analysis suggests the OECD could experience a potential long-run increase in GDP of c.\$3.5 trillion by increasing older worker employment rates to New Zealand<sup>1</sup> levels.

<sup>1</sup> We have moved away from using Sweden as a benchmark as it has fallen to fifth place in our index whilst New Zealand is in second place after Iceland, where employment rates are extremely high and may be difficult to replicate for other OECD countries.

Countries with the highest older worker employment rates (55-64 year olds)...

...and the lowest rates



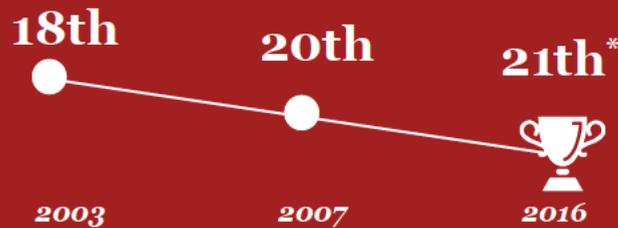
If OECD countries raised their older worker employment rates to New Zealand's levels, they could experience a long-run boost to GDP of...



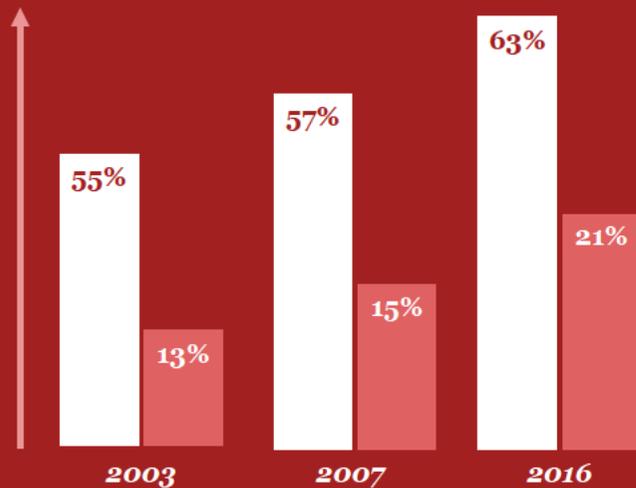
Sources: PwC analysis, OECD

**The UK has made gradual progress in increasing older worker employment but further improvements to New Zealand levels could boost GDP by around 9% in the long run, equivalent to around £180 billion at today's values.**

UK performance on the Golden Age Index has worsened as other OECD countries outpace improvements in older work employment rates



Employment rate of 55-64 year olds and 65-69 year olds



The UK lags behind high performers such as New Zealand in terms of employment of 55-64 year olds (2017)



**£182 billion**

Boost to long-run UK GDP, which is equivalent to around

**£16,300** per 55-69 year old from boosting FTE employment rates to New Zealand levels

There is a large variation in the employment rates of 50-64 year olds regionally in the UK



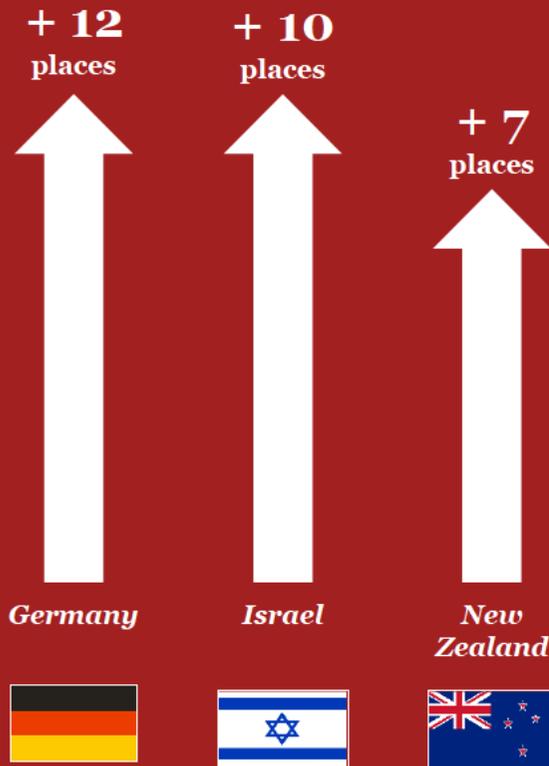
Low employment rate High employment rate

Sources: PwC analysis, OECD

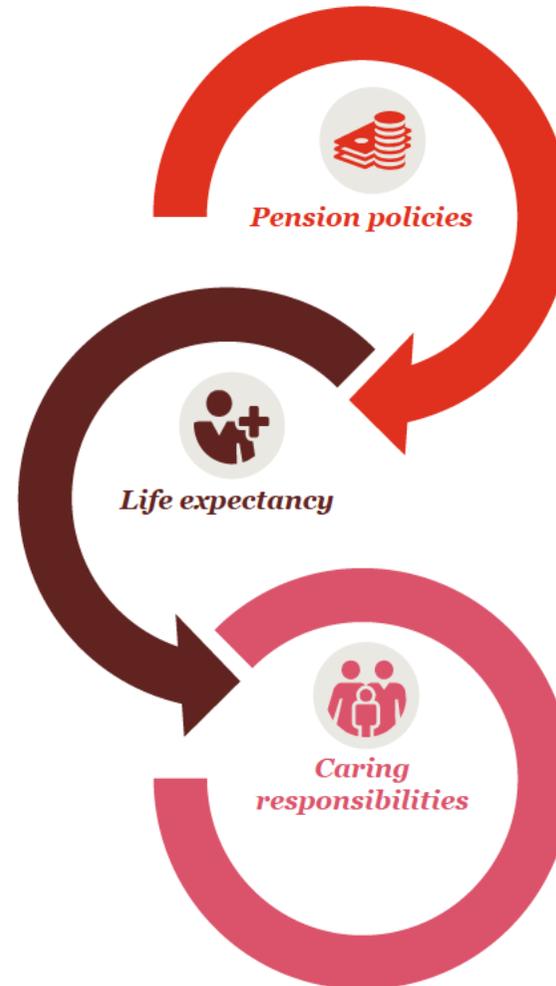
\*Note – out of 35 OECD countries

# A flexible labour market that encourages and supports older workers is a key feature of top performers on our Golden Age Index

Some of the biggest risers on the index since 2003 have implemented strong labour market reforms targeted at older workers such as redesigning jobs to meet physical needs:



Key drivers of the employment of older workers include:



Successful policy measures of the top performers include:

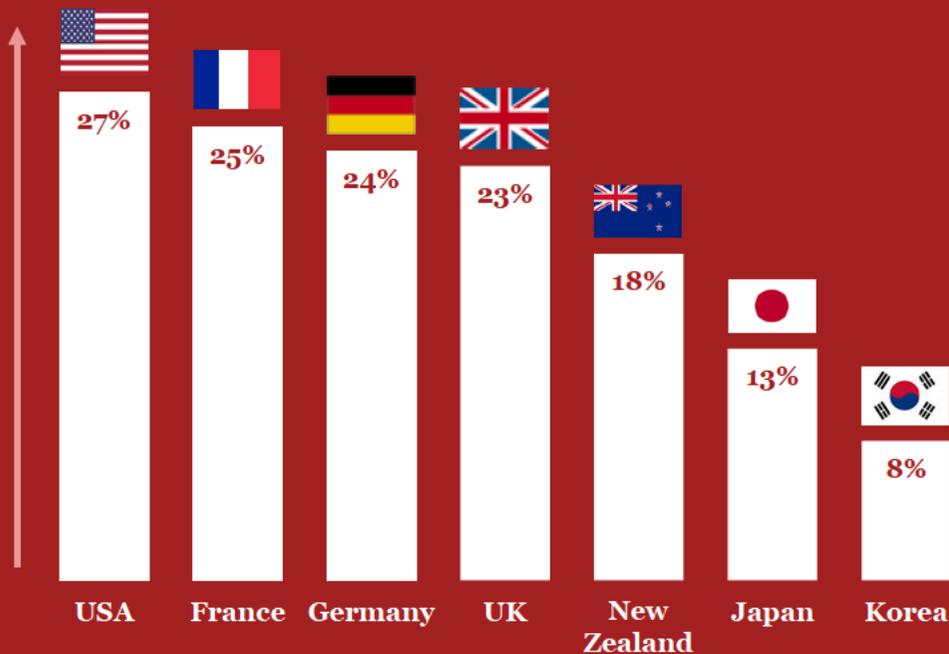
-  Increasing the retirement age
-  Supporting flexible working
-  Improving the flexibility of pensions
-  Further training and support for older workers to become 'digital adopters'

Sources: PwC analysis, OECD

# Public policy-makers and employers need to promote lifelong learning and retraining to help older workers adapt to the challenges of automation

The percentage of jobs at risk of automation for older workers within the next ten years for some of the largest economies ranges from around 5% up to 30%, with an average of around 20%.

Percentage of jobs at potential risk of automation for 55+ years old over the next ten years



Up to **19%** of jobs could be at risk of automation over the next decade for **male older workers**...



...compared with **26%** of jobs for **female older workers**.



However, automation technologies can create **new job opportunities** for older workers in **new industries and new business models**; and through **boosting economic growth**.

## Policy measures to lower the risk of job automation for older workers:



Invest in **technology training** for older workers



Engage policy makers and employers to **retrain** older workers to be more suited for jobs at lower risk of automation



Encourage **lifelong learning** and career development

Sources: PwC analysis, OECD



*Key results from the  
Golden Age index*

## ***Our Golden Age Index takes a holistic view of the labour market for older workers across the OECD, combining indicators into one comparable metric***

### **Labour market indicators**

The PwC Golden Age Index combines a broad range of labour market indicators as listed below with relative weights shown in brackets. Employment rates have the highest weights but other variables are included to present a more holistic picture:

- Employment rate 55–64 (40%)
- Employment rate 65–69 (20%)
- Gender gap in employment, 55–64: ratio women/men (10%)
- Incidence of part-time work 55–64 (10%)
- Full time earnings 55–64 relative to 25–54 (10%)
- Average effective exit age from the labour force (5%)
- Participation in training: ratio 55–64 to 25–54 (5%)

### **Process**

These indicators are normalised, weighted and aggregated to generate index scores for each country.

The index scores are on a scale from 0 to 100, with the average OECD value in the base year of 2003 set to 50. However, the average index values for 2007, 2015 and 2016 can be higher or lower than this 2003 baseline.

We can therefore compare how each country's performance has evolved over time in absolute terms, as well as the relative performance of countries in a particular year.

**See Appendix 1 for more details of the methodology.**

### **Labour market indicators**

All data are taken from the OECD.

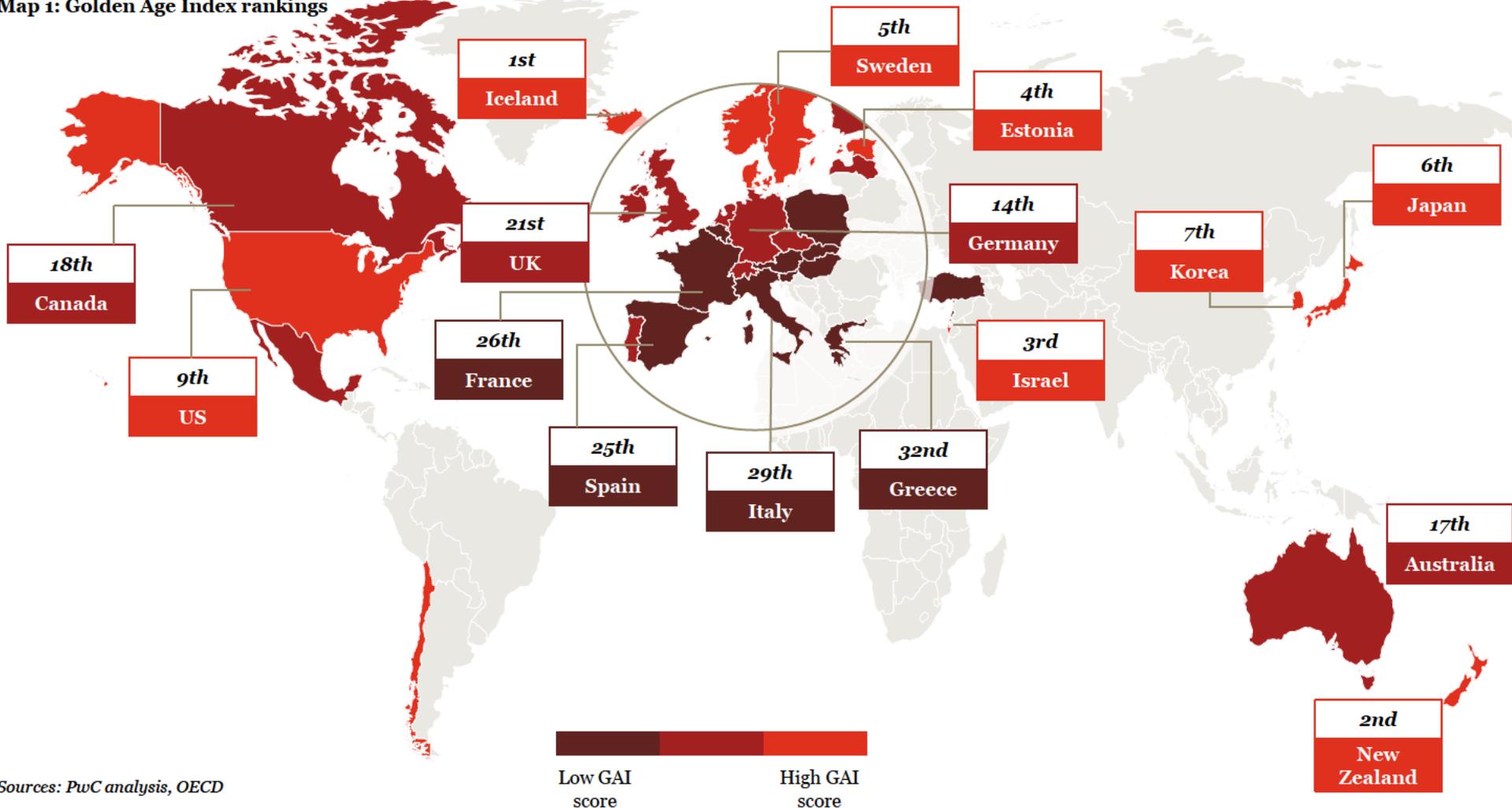
We focus mostly on the 55–64 age group for data reasons. We do, however, include total employment rates for 65–69 year olds in the index and look at all workers over 55 in calculating potential boosts to GDP from higher employment rates for older workers.

The latest data available across the broad range of countries covered are for 2016, so this is the final year covered by the index.

# Our Golden Age Index explores the economic prospects of older workers across 35 OECD countries over time

Iceland and New Zealand continue to occupy the top two places, with Israel and Estonia outperforming Sweden this year. The Southern European countries including Turkey, Greece and Italy perform less strongly on the index.

Map 1: Golden Age Index rankings



Sources: PwC analysis, OECD

# PwC Golden Age Index: Key results

## Iceland, New Zealand, Israel, Estonia and Sweden take the top five places

Ranking				Country	Raw Index Score			
2003	2007	2015	2016		2003	2007	2015	2016
1	1	1	1	Iceland	93.1	93.7	99.5	98.7
9	3	2	2	New Zealand	61.1	71.8	84.7	85.3
13	11	3	3	Israel	58.3	66.0	80.6	82.3
8	2	5	4	Estonia	63.7	73.9	78.8	81.8
3	4	4	5	Sweden	68.4	71.5	80.1	81.2
5	7	8	6	Japan	67.1	70.6	76.2	78.6
7	6	7	7	Korea	64.3	71.0	77.3	77.7
4	8	6	8	Norway	67.6	70.0	77.9	77.3
2	5	9	9	United States	69.0	71.0	75.0	75.9
14	12	10	10	Chile	57.4	66.0	72.1	74.5
11	15	13	11	Denmark	59.8	59.6	68.0	70.5
17	9	12	12	Latvia	48.6	67.7	68.5	70.4
10	14	11	13	Switzerland	60.9	63.0	71.2	70.4
26	21	15	14	Germany	36.9	47.6	66.2	68.0
16	16	14	15	Finland	51.2	58.5	66.4	66.8
12	10	18	16	Portugal	59.4	66.9	62.7	66.4
21	18	17	17	Australia	45.7	55.0	64.7	66.3
15	17	16	18	Canada	53.6	58.2	65.6	66.1
6	13	19	19	Mexico	64.7	65.7	62.5	63.2
22	23	22	20	Czech Republic	43.5	45.8	59.3	62.5
18	20	20	21	United Kingdom	47.8	51.1	61.4	62.1
19	19	21	22	Ireland	47.3	54.7	60.3	61.1
28	27	23	23	Netherlands	34.6	42.5	56.4	58.3
31	26	24	24	Austria	32.3	43.3	55.0	56.3
25	22	26	25	Spain	42.5	46.5	52.5	54.3
24	25	25	26	France	42.7	44.9	53.3	53.9
30	31	27	27	Hungary	32.3	36.1	51.1	53.4
33	33	29	28	Slovak Republic	29.7	35.4	48.6	51.9
29	29	28	29	Italy	32.9	36.6	49.5	51.5
27	35	30	30	Poland	35.5	32.2	48.0	50.1
35	30	31	31	Belgium	28.8	36.5	47.7	49.6
20	24	32	32	Greece	46.2	45.1	46.4	48.9
34	28	33	33	Slovenia	29.4	37.2	44.5	48.2
32	32	34	34	Luxembourg	30.0	35.4	41.1	38.8
23	34	35	35	Turkey	43.4	34.0	36.5	38.4
<b>OECD Average</b>					<b>50.0</b>	<b>55.6</b>	<b>63.9</b>	<b>65.4</b>

Estonia continues to rise up the rankings, having gained 4 places since 2003.

Sweden has slipped to 5<sup>th</sup> position in the index this year, despite an absolute increase in performance.

The United States is now only the second highest G7 country in the list as Japan has seen a relatively strong increase in its score since 2015.

Latvia has newly been added to the index and is in 12<sup>th</sup> position on the index.

The UK's relative ranking has fallen from 18<sup>th</sup> place to 21<sup>st</sup> since 2003, despite a gradual improvement in its absolute index score over time.

The Nordic countries continue to do very well as Iceland, Sweden and Norway all occupy a place in the top 10.

The East Asian countries in our index perform strongly, with both Korea and Japan making strong improvements in their absolute index scores and improving on their rankings since last year.

Canada has fallen in the rankings from its 2015 position, while Portugal has risen by two places this year from 2015.

Italy is the lowest ranking G7 country and has slipped by one position to 29<sup>th</sup> place this year.

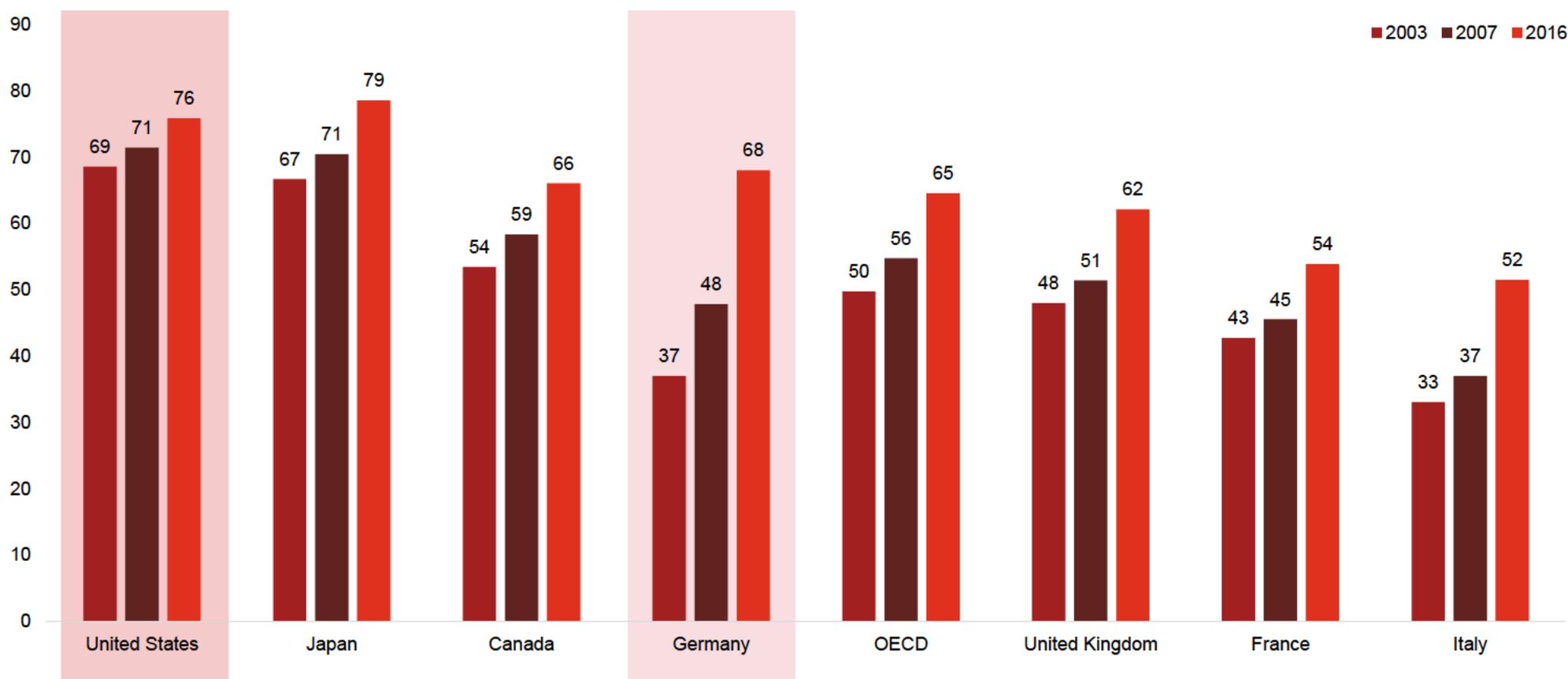
Sources: PwC analysis, OECD

<sup>1</sup> The PwC Golden Age Index 2018 edition uses 2016 data as the latest available data.

## All G7 countries have seen a gradual rise in absolute index scores since 2003, with Germany increasing the most in the G7

Germany has seen the largest improvement in their absolute index score since 2003 within the G7. This is due to an increase in employment rates for those aged 55-64 as a result of labour market and pension reforms which have improved the flexibility of the labour market. In contrast, the United States has experienced slower growth in their index score given the relatively higher performance on the index in 2003.

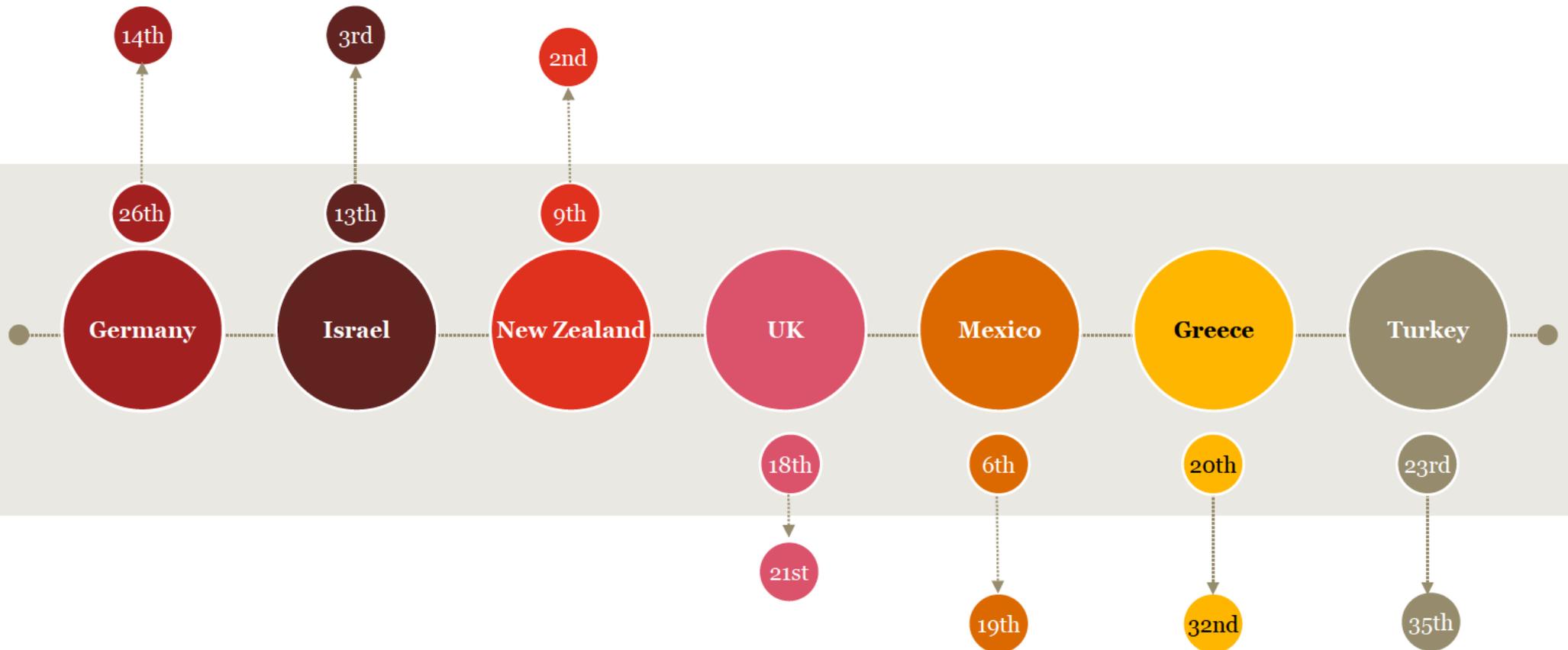
Figure 1: G7 Index scores over time\*



Sources: PwC analysis, OECD

\* Rounded to nearest whole number

***Germany, Israel and New Zealand have seen the biggest rise in the rankings between 2003 and 2016, while Mexico, Turkey and Greece have each fallen by over 10 places. Overall, the UK has seen a slight fall in its ranking.***



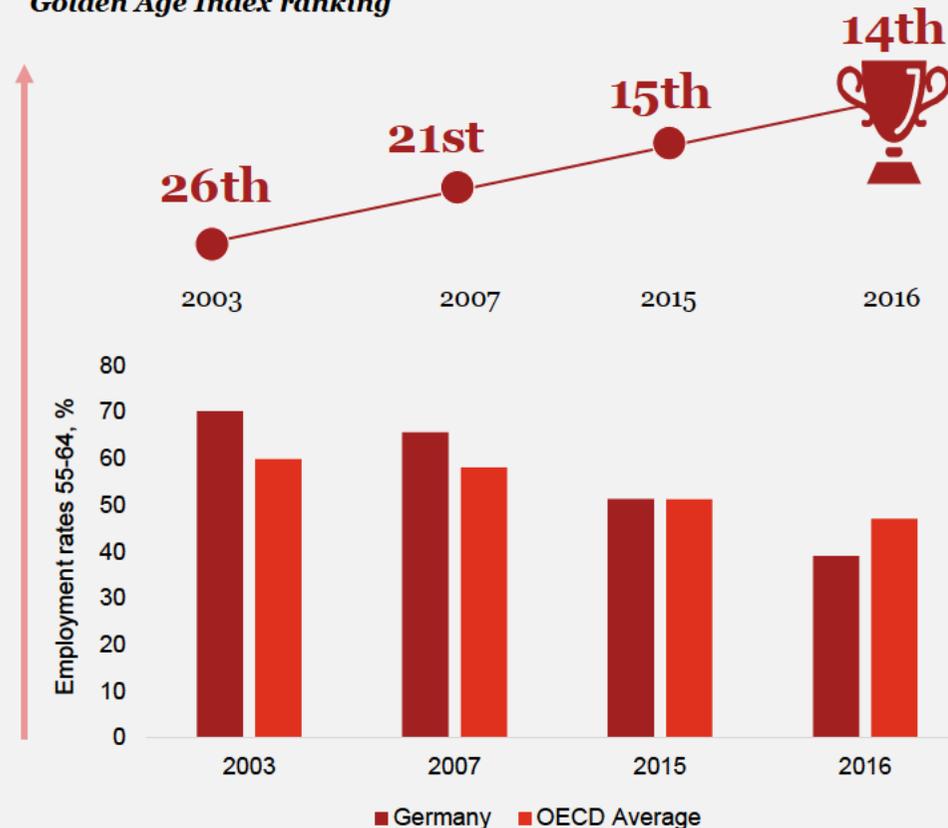
Sources: PwC analysis, OECD

## Enhancing incentives to remain in work longer and raising retirement ages have been key drivers for the rise of Germany in our index

Germany  
Index rank: 14



### Golden Age Index ranking



The German labour force has been experiencing structural changes over the last decade. Workers in Germany benefit from a generous pay-as-you-go public pension scheme, with relatively low retirement ages when compared to other OECD countries. However, recent labour market and pension reforms have improved work incentives for older workers. These changes, coupled with increased reduced gender disparity in participation rates (Dietz and Walwei 2011), have resulted in greater participation of older German workers (Dlugosz et al 2013).

In particular, several policies have driven the increase in older workers:

- The 'Hartz reforms' (2003–2006) aimed to **increase work incentives** for people with low earnings potential. Maximum entitlement periods for unemployment benefit were substantially reduced, especially for the older unemployed from a maximum of 32 months to 18 months.
- **Regional employment pacts** have been launched to ensure better employment for older workers. These have used a wide range of different policies and activities including profiling, assessments, special training measures, internships in companies, placement activities and publicity campaigns to raise **awareness of the benefits of working later in life**.
- The **age of retirement has been increased** and will reach 67 by 2029, increasing the overall time that workers remain in employment and participation. For instance, early retirement options were mostly used by low skilled and industrial older workers (OECD 2006), increased employment rate of these workers due to reduced opportunities to retire following pension reforms may also contribute to the positive trend seen in the labour force participation of workers aged 55 and above over the last decade.

Sources: PwC analysis, OECD

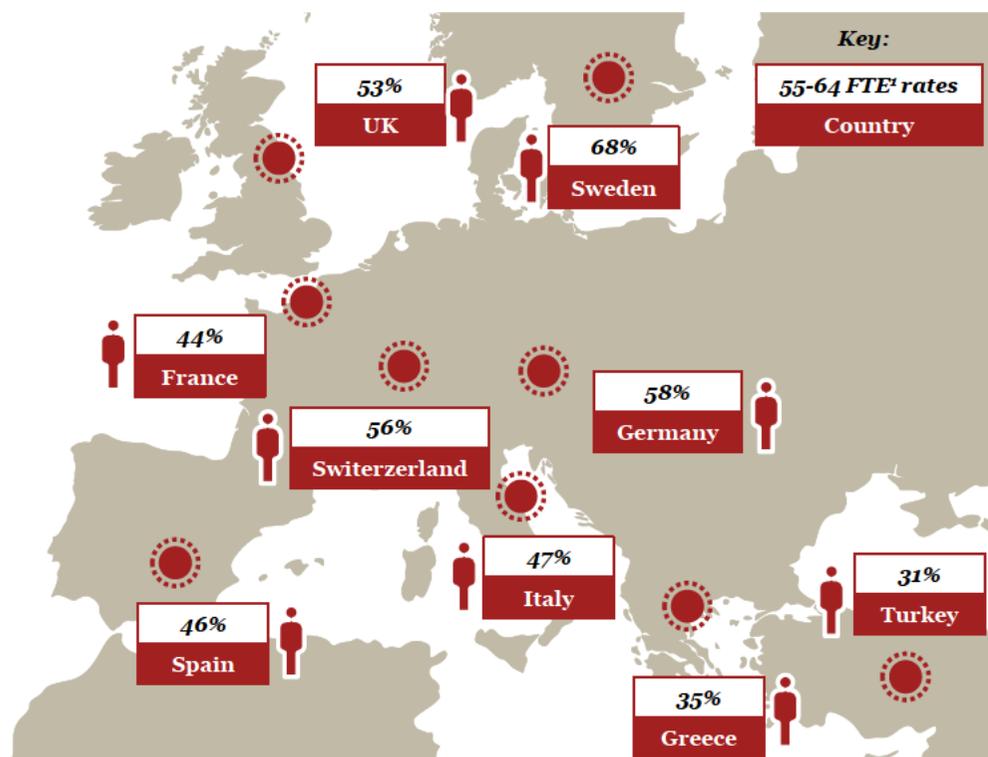


*Potential long-run  
boost to GDP from  
longer working lives*

# We estimate how much countries could gain from boosting the employment rates of older workers to levels in New Zealand, one of the top performers

There is a large variation in the employment rates of older workers (Full Time Equivalent rates) across the OECD countries, ranging from around 30–40% in many of the Southern European countries, to over 60% in many of the Nordic countries. Therefore, there is scope for many OECD countries to improve the economic prospects of their older workers.

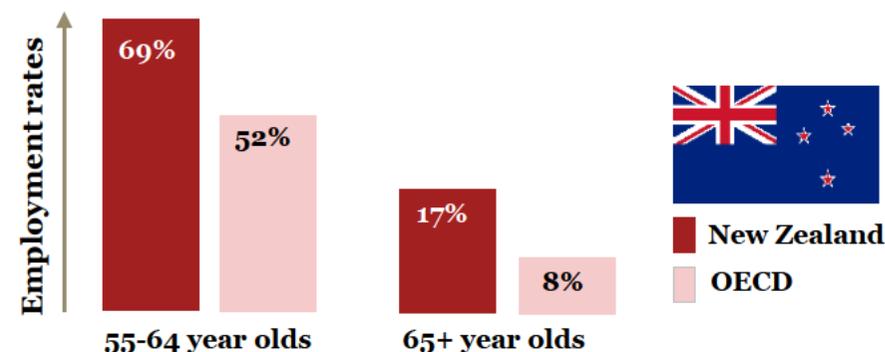
We have moved away from using Sweden as our benchmark as it has fallen to fifth place this year in the rankings as other countries such as Estonia outpace Sweden's improvements. We have chosen to use New Zealand as a benchmark as it is the second highest performer, after Iceland which is deemed a special case given very high employment rates that are not feasible for many OECD countries to match.



Source: OECD

<sup>1</sup> We use the latest annual available data for full-time equivalent employment rates for 55–64 year olds across the OECD.

## New Zealand's Full Time Equivalent employment rates, 2017



### Why does New Zealand score so highly?



**Public services**

**New Zealand's Superannuation (NZS)** public policy of benefits for the elderly which simultaneously discourage early withdrawal and rewards those who continue to work beyond the age at which workers are eligible for pensions has improved incentives to work for the elderly.



**Culture**

**Low prevalence of age discrimination** driven by a 'culture of inclusion' supported by HR practices of organisations that boost the employability of older workers, encouraging working later in life.



**Flexible working**

**Flexible working patterns** are commonplace within New Zealand. A factor that has driven an increase in participation for older workers is the increasing availability of part-time work, a structural shift that is valued by many older workers.

# Increasing employment rates of those aged over 55 to match New Zealand levels could boost total OECD GDP by around \$3.5 trillion in the long run

The OECD could add around \$3.5 trillion to total GDP if countries with lower employment rates<sup>1</sup> among those aged over 55 increased their rates to New Zealand levels

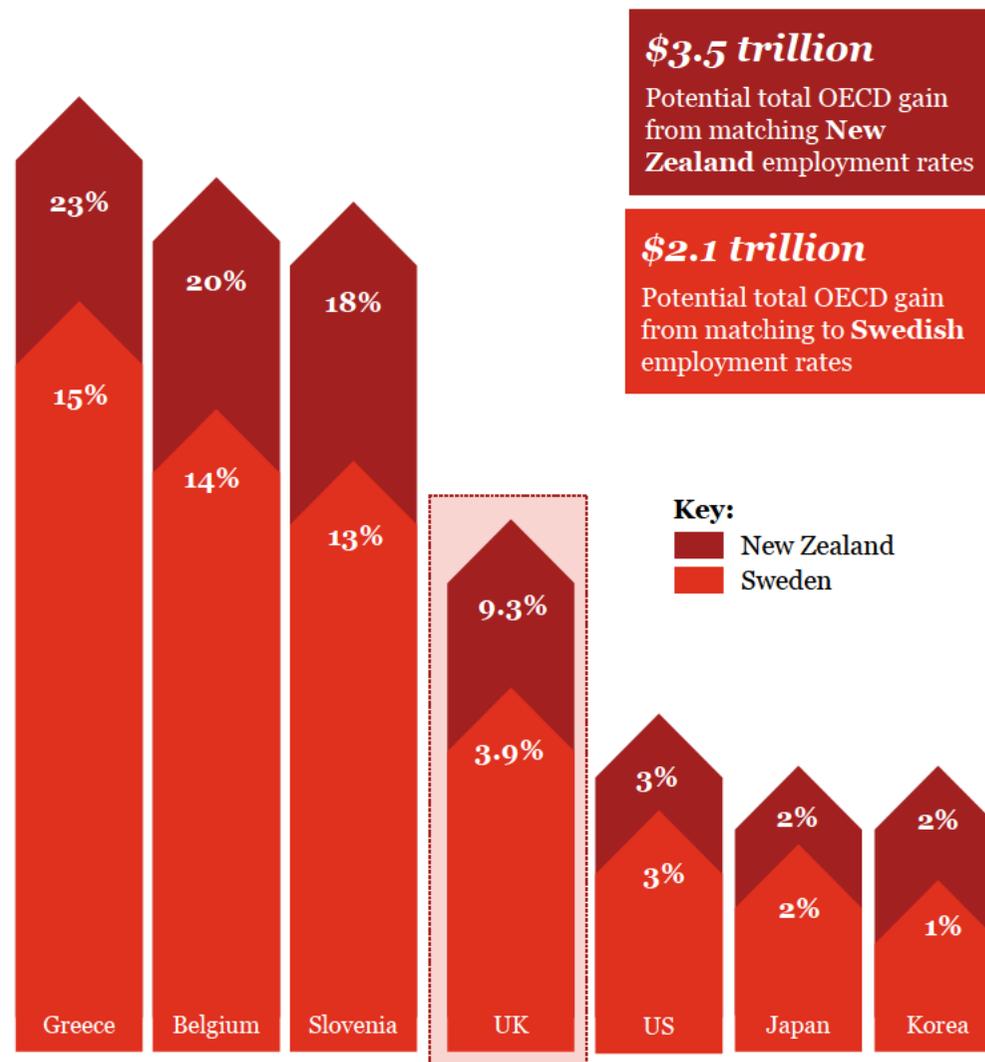
- Our analysis provides an estimate of the broad order of magnitude of **potential gains from raising older worker employment rates** to match those of New Zealand and Sweden – our previous benchmark country.
- The potential GDP boost from increasing the employment rates to match those of New Zealand for 55–64 year olds and people aged 65+ varies significantly across countries, from around 2% in Korea to around 23% in Greece.
- **Within the G7, the overall gain could be c.\$2.4 trillion**, with Italy and France having the potential for long-run increases in GDP of c.17% from moving towards New Zealand’s employment rates.

Countries that scored lower on the Golden Age Index have the most to gain in the long-run from increasing their employment rates to match those of New Zealand

- **Greece** could experience the **largest increase in GDP** of around 23%.
- For top scorers the gains are lower as their employment rates are likely to be quite close to New Zealand levels already.

Moving towards New Zealand levels, the UK could achieve an increase in GDP of around 9.3%

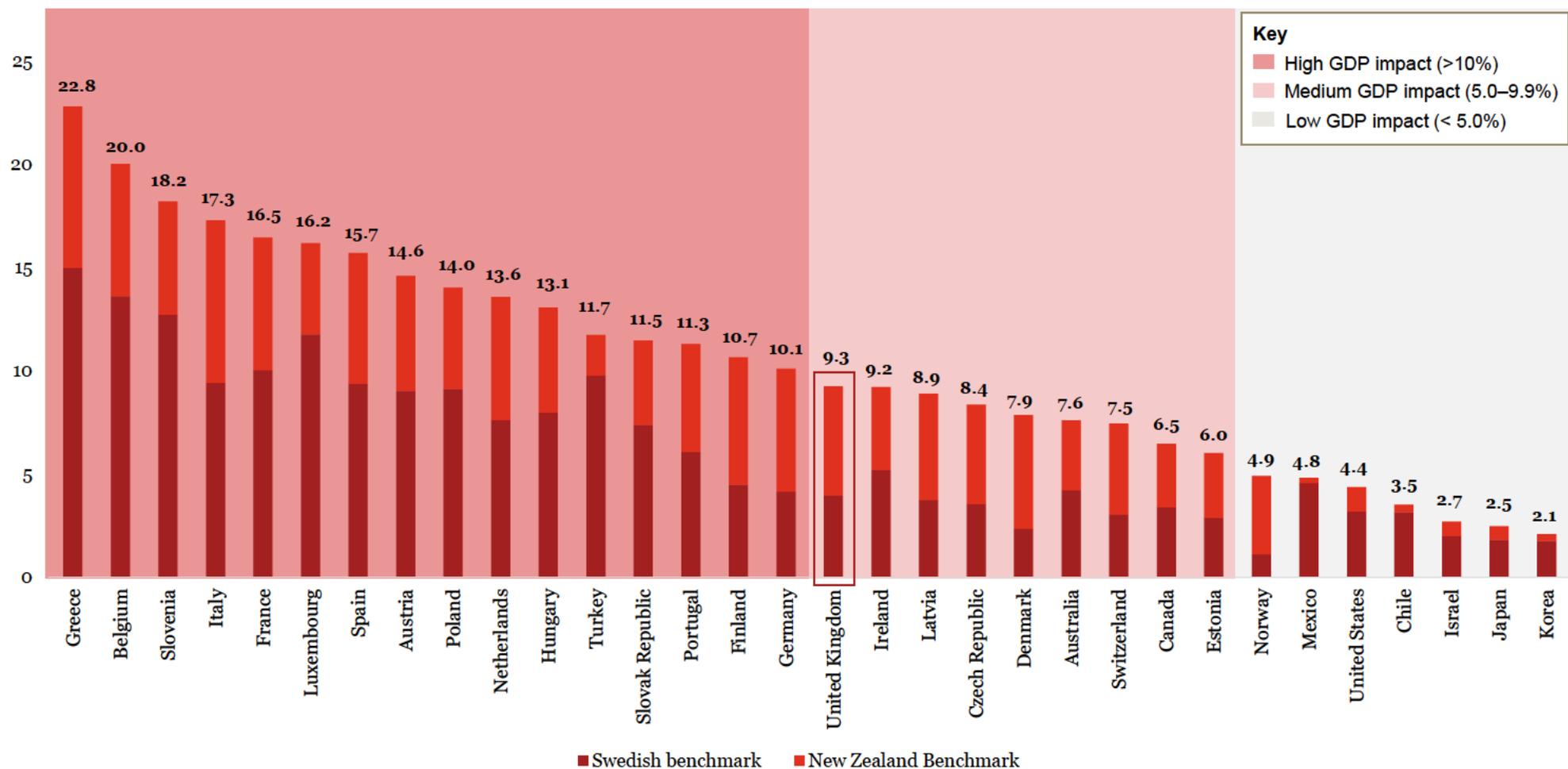
- The UK has increased its employment rate among 55–64 year olds broadly in line with New Zealand since 2003, but the gap between the two economies remains similar. For people aged 65+, the gap between employment rates is particularly sizeable, with substantial room for improvement.
- By increasing its 55+ employment rates to New Zealand levels, the UK could increase its **GDP by around £182 billion or 9.3% of GDP** (at 2017 values).



<sup>1</sup> We focus on employment rates as they are the most important indicators in our index (70% weight including part-time/full-time split) and the ones most readily related to GDP.

# Countries scoring lower on our Golden Age Index have the most to gain from boosting employment rates for those aged over 55 to New Zealand and Swedish levels

Figure 2: Potential long-run GDP boost, %



Sources: PwC analysis, OECD

Note: Iceland is excluded from the analysis as it has a higher employment rate of 55+ year olds than both New Zealand and Sweden.

## *The United States could increase its GDP by over \$800bn by increasing the employment rate of its older workers to match New Zealand levels*

Country Name	Change in GDP (billions, 2016 prices) using New Zealand levels	Change in GDP (billions, 2016 prices) using Swedish levels	Country Name	Change in GDP (billions, 2016 prices) using New Zealand levels	Change in GDP (billions, 2016 prices) using Swedish levels
United States	815	591	Greece	44	29
France	406	247	Korea	30	25
Germany	351	144	Ireland	28	16
Italy	322	175	Finland	25	11
<b>United Kingdom</b>	<b>245</b>	<b>105</b>	Denmark	24	7
Spain	194	116	Portugal	23	12
Japan	123	90	Norway	18	4
Netherlands	106	59	Hungary	16	10
Turkey	101	84	Czech Republic	16	7
Canada	99	52	Slovak Republic	10	7
Australia	99	55	Luxembourg	9	7
Belgium	94	64	Chile	9	8
Poland	66	43	Israel	9	6
Austria	57	35	Slovenia	8	6
Mexico	52	49	Latvia	2	1
Switzerland	50	20	Estonia	1	1

Sources: PwC analysis, OECD

Note: Iceland is excluded from the analysis as it has higher employment rate of 55+ year olds than New Zealand and Sweden.

A woman with curly hair, wearing glasses and a colorful patterned scarf, is sitting at a desk in an office. She is looking towards the camera with a slight smile. In front of her is a laptop, and to her left is a large computer monitor. The background shows a bright office space with large windows and other desks.

*Drivers of  
employment rate  
for older workers*

# *We use an econometric approach to analyse drivers of the employment rate of older workers across the OECD*

Understanding the policies and incentives for continuing to work for longer are becoming increasingly important as we face ageing populations and increasing pressures on health and social care requirements. Our analysis explores the key drivers of labour participation amongst older workers, including structural factors such as life expectancy, financial incentives, as well as personal traits such as marital status. Note that there could be other factors that influence employment rate of older workers which have not been included in the econometric analysis due to limitations in the data available.

## **Our approach**

- We use a dynamic panel model to estimate the key drivers of the employment rate of older workers, using employment rate for the 55 to 64 age group as our dependent variable. Our dataset covers all 35 OECD countries over 17 years (2000-2016).
- Our approach exploits cross-country differences in the labour market for older workers across the OECD. Our approach is robust, as it accounts for a) potential reverse causalities where the employment rate for older workers influences one or more of the explanatory variables and b) endogeneity concerns (e.g. unobserved factors that are potentially correlated with labour market and policy variables).
- We model the drivers of employment as the function of a number of explanatory variables, as outlined on the right. The model accounts for country-specific characteristics (or ‘fixed effects’) that explain the employment rate for older workers and are constant over time.
- The dynamic panel model also tests whether the employment rate of older workers is persistent over time. Persistency (i.e. when the current employment rate is influenced by past employment rates) could be caused by policy and structural factors which take time to have an effect such as health policies which influence life expectancy, or pension policies which do not vary significantly unless there is major structural reform.
- Appendix 1 contains more details of our econometric specification, modelling approach and results.

## **Variables used in the econometric model**

### **Dependent variable**

**Employment rate,  
55-64 (% of age group)**

### **Independent variables**

**Life expectancy**

**Public pension  
expenditure**

**Annual average  
wage growth**

**Public expenditure on  
family benefits as a  
share of GDP**

**Marital status**

**Employment protection  
for temporary contracts**

**Gender  
participation gap**

*Other variables (e.g. training participation rate, share of public sector employment, gender pay gap) were also considered for the econometric model which were not statistically significant (please see appendix 1 for the long list)*

# ***The existing evidence suggests that both structural and policy factors can help explain the employment rate amongst older workers***

## ***Life expectancy***

Life expectancy is likely to have a positive impact on employment because the longer that people are expected to live, the more likely they are to spend more of their life working. Life expectancy also captures other factors which may influence the employment rate for older workers such as level of health which could be impacted by health care policies, medical advances and technological developments. Disney et al. (2006) suggests that health can influence the age at which a worker retires. Cai (2010) also finds a positive relationship between health and labour force participation.

## ***Public pension expenditure as a share of GDP***

Greater expenditure on pensions is expected to reduce the incentive for older workers to participate in work. Hurd, Michaud and Rohwedder (2012) find that increasing state pension wealth is associated with a lower retirement age. Gruber and Wise (2001; 2004) and Sousa-Poza (2009) also suggest pension generosity, which includes policies around state pension age, have substantial impacts on employment.

## ***Annual average wage growth***

The impact of wages on employment is ambiguous. On the one hand, economic theory suggests that higher wages should encourage greater levels of workforce participation. However, higher wages could also be associated with higher unemployment for older workers. This is because it is often easier for older workers to find alternative income to that from paid employment, such as pension or disability benefits. Halberg (2011) also finds that where employers' payroll taxes are progressive with regards to age and wage, this means older workers are more costly so there is a greater incentive for employers to offer early retirement packages.

## ***Marital status***

Marriage may have a knock on impact on employment in older age if the spouse is assumed to have greater responsibility to take care of their partner or other relatives, decreasing availability for full-time employment (Hoskins, 1996). Hesselius (2009) analyses Swedish data to find that spouses' retirement increases average sickness absence among women. Combined income from a family unit can be greater than an individual which could decrease the financial incentive to work for longer.

## ***Public expenditure on family benefits as a share of GDP***

Public expenditure on family benefits, including direct cash benefits and benefits in kind for childcare, may help explain a person's choice to participate in the workforce for longer. Greater financial benefits for families can lower the financial burden for the parents and grandparents. Research on the impact of various other financial incentives show that they are a strong determinant of people's retirement choices (IEA, 2014).

## ***Gender participation gap***

Lowering the barriers that prevent women from participating in the labour force is likely to improve the overall employment rate. The gender participation gap is an indicator of both the structural and policy factors which have impacted women's decision to work. The continued support for women, for example during earlier years when they start a family, is likely to increase the amount of time they spend in the labour force after parental leave.

## ***Employment protection for temporary contracts***

Studies on effect of general employment protection laws and age discrimination laws have been mixed. Some studies argue that these laws negatively affect employment among older workers, as employers see older workers as a greater burden if they have greater protection, even though the intended effect is to help improve employment prospects for older workers (Heywood and Siebert, 2009). However, employment protection for part-time work has not been widely studied previously and may help older workers who decide part-time work is more suitable or are involuntary part-time workers.

# Higher levels of public expenditure are associated with lower employment rates, while longer life expectancy is associated with higher employment amongst older workers

## Reduces older worker employment rate



### Average annual wage growth

Countries with higher average wage growth tend to have lower employment rates for older workers. A 1pp increase in average wage growth rate is associated with a 5.09pp decrease in the employment rate for 55-64 workers.



### Public expenditure on family benefits as a share of GDP

Countries with higher levels of public expenditure on family benefits are associated with lower employment rate in the 55 to 64 age category. A 1pp increase in public expenditure on family benefits as a % of GDP is associated with a 0.95pp decline in the employment rate for older workers.



### Public pension expenditure as a share of GDP

Countries with higher levels of public pension expenditure are associated with lower employment rate in the 55 to 64 age category. A 1pp increase in public pension expenditure as a % of GDP is associated with a 0.95pp decline in the employment rate for older workers.



### Marital status

There is a negative relationship between the percentage of people in the 55-64 age group being currently married and employment rate within this age category. A 1pp increase in the proportion of married people in the 55-64 age group is associated with a 0.29pp decrease in the employment rate for older workers.



### Employment protection of temporary contract

Higher levels of employment protection for temporary contracts has a negative relationship with the employment rate for older workers. A 1 unit increase of the index used to measure strictness of employment protection of temporary contracts is associated with a 0.79pp decrease in the employment rate for older workers. This may reflect the fact that employment protection is not tailored to help older workers enough.

## Increases older worker employment rate



### Life expectancy

Countries with higher average life expectancy is associated with higher employment rate for older workers. A one year increase in life expectancy is associated with a 0.013pp increase in employment rate for 55-64 workers.

## Limited effect



### Gender participation gap

A lower gender participation gap does have an association with higher employment rate for 55-64 workers but is not statistically significant. This may be because the structural and policy factors which have helped close the gender participation gap has had limited impact for some of the older female workers who did not benefit from more recent policies compared to younger female workers.

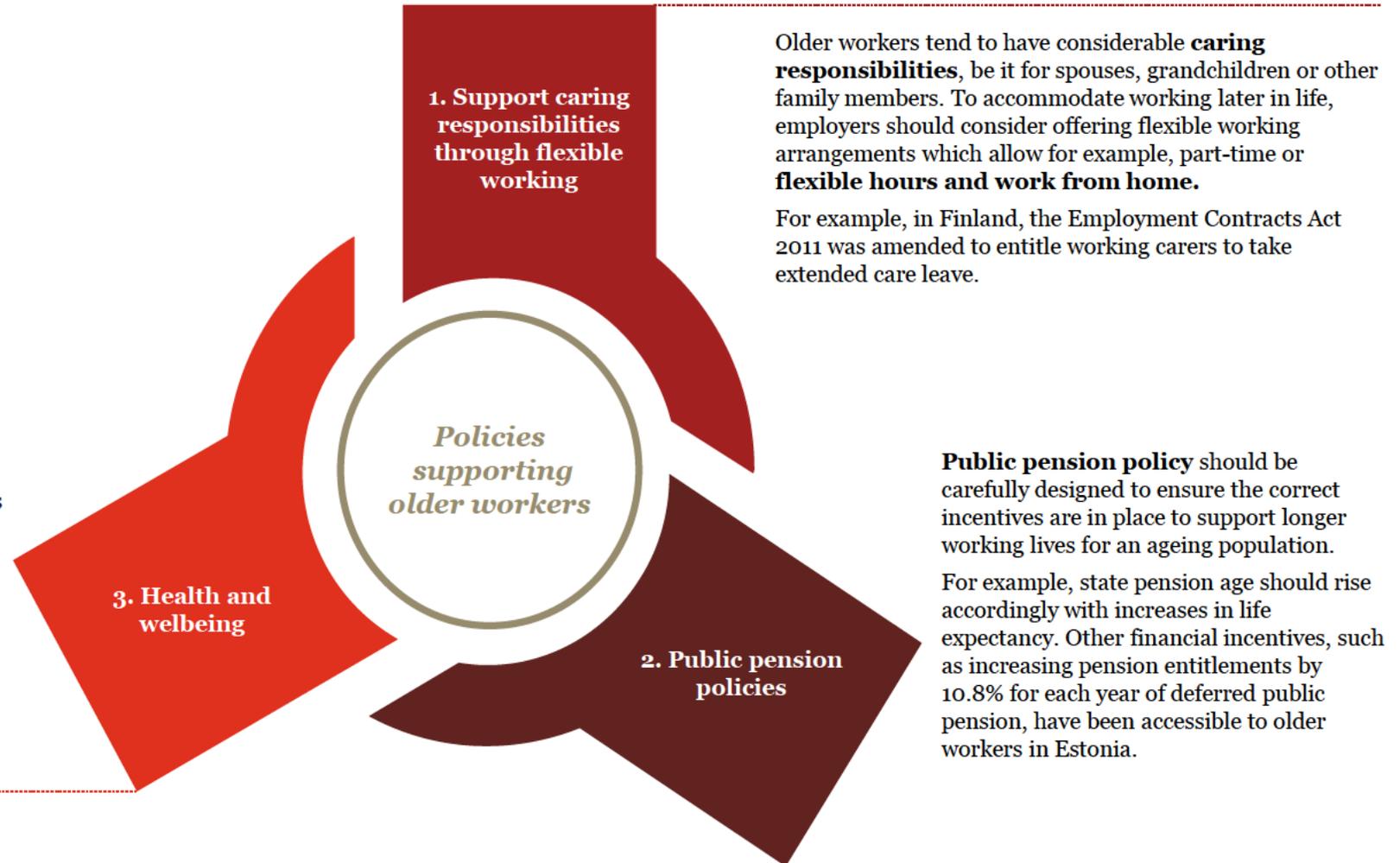
Refer to the Appendix for results on statistical significance of variables

# ***Financial incentives and caring responsibilities are key drivers in the decision for older workers to continue participation in the workforce and this finding should be factored into decisions by both policy makers and employers***

**Our econometric analysis suggests that direct financial drivers such as pension expenditure are important in determining the employment rate amongst older workers. Support for caring responsibilities, including both cash benefits and benefits-in-kind, are also influential.**

**Greater support for health and wellbeing** of employees at work could contribute to a healthier workforce so that workers can be more productive and contribute to society for longer.

For example, in Denmark, the government has supported a variety of funds to help better working lives, including the 'Senior Starter Kit' initiative. This starter kit has helped firms diagnose the health and safety situation at work for this particular age group to promote dialogue about skills of older workers and working arrangements.



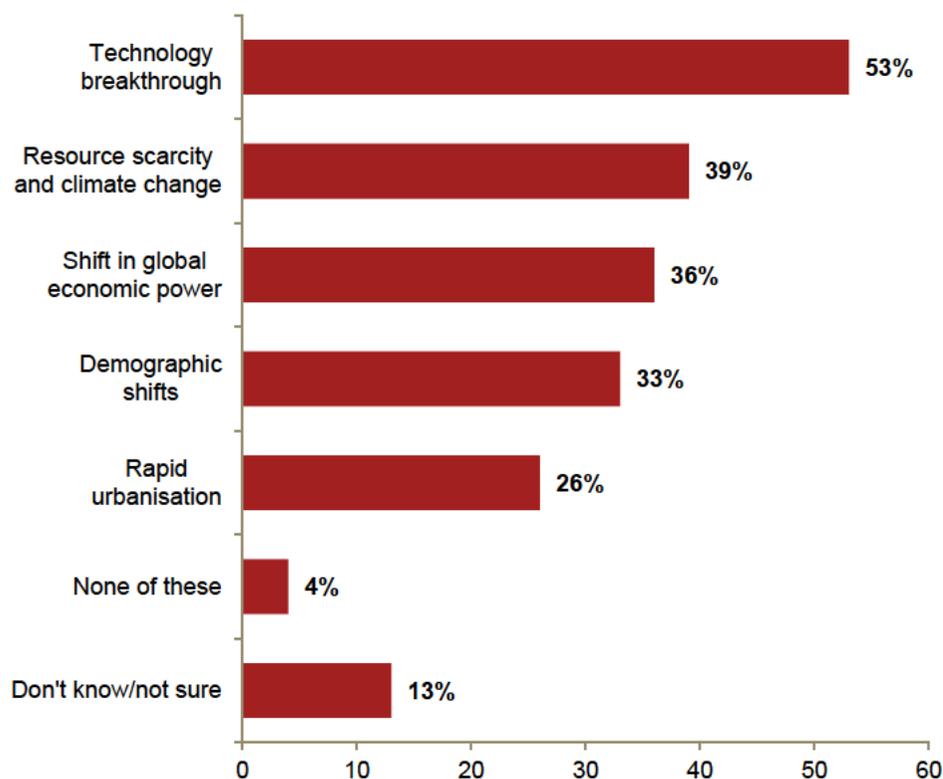


*Focus on:  
Automation and  
older workers*

# Technological advances, such as automation, are fundamentally changing the way we work – putting some jobs at risk whilst also creating many new opportunities and business models

Recent analysis by PwC suggests that the biggest perceived driver of change to the world of work is **technological innovation**.

**Figure 2: What will transform the way people work over the next 10-15 years?**

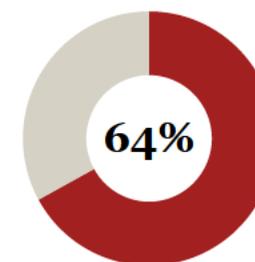


Sources: PwC (2017).

<sup>1</sup> These results are from a PwC survey of 10,000 members of the general population based in China, Germany, India, the UK and the US.

As workforces become more diverse and people work for longer; traditional jobs and career models may soon become outdated. Many of the roles and job titles of the future may be ones we haven't even thought of yet.

**64%** of people around the world believe that their job prospects will improve from the overall economic boost technology can provide.



**2 out of 5 people** around the world believe that traditional employment won't be around in the future. Instead, people will have their own 'brands' and sell their skills to those who need them.

**44% of people** around the world said that the most important thing in a job for them is job security.

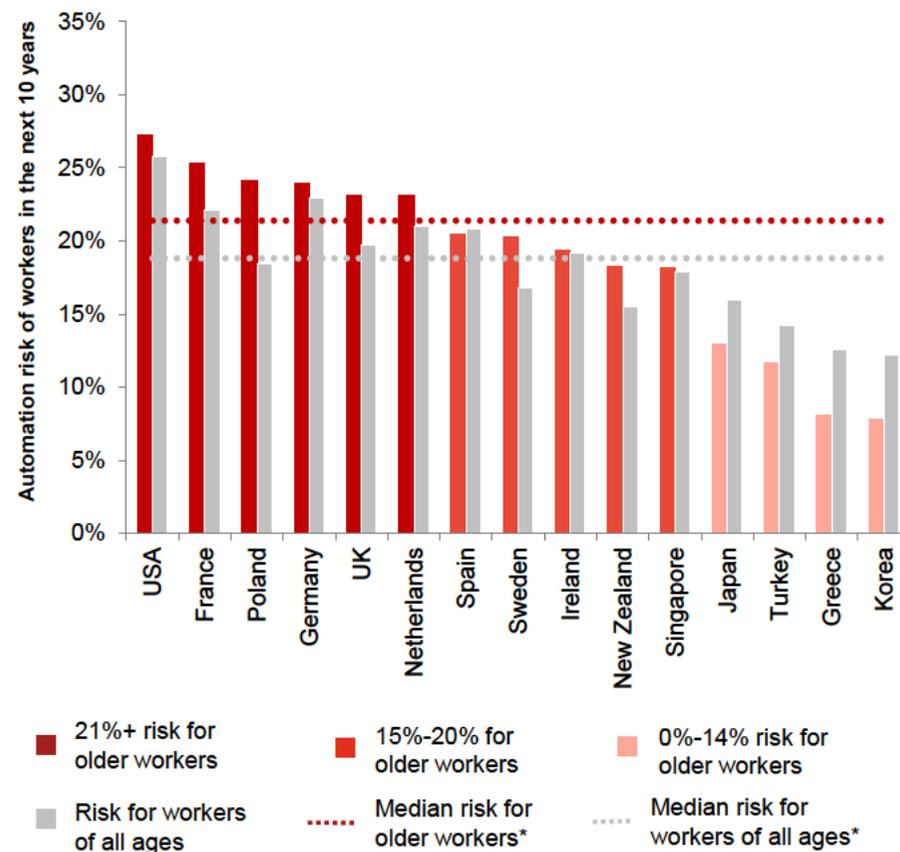


# Automation could impact up to 20% of jobs on average for older workers over the next decade

Artificial intelligence is set to be a key source of transformation, disruption and competitive advantages in today's fast changing economy. Over the past few years, fears of technology-driven job losses have intensified with advances in robotics, artificial intelligence and other digital technologies producing innovations which have the potential to replace the need for humans in many industries – driverless cars and trucks, intelligent virtual assistants and healthcare robots. So what are the implications for today's older workers?

By the late 2020s, our analysis suggests that around 20% of jobs for older workers could be at risk of automation in many developed and developing countries<sup>1</sup>

- Recent [PwC analysis](#) has found that the potential jobs at high risk of automation within the next ten years could range from around 5-30% across many developed and developing countries.
- These estimates are based on an algorithm which links automatability to the characteristics of the tasks involved in different jobs and the characteristics of the workers doing them.
- The graph to the right illustrates the potential risk of automation to jobs within the next ten years currently held by older workers across various countries. The average risk across all countries and sectors is around 20% by the late 2020s. This is higher than the average risk (19%) across all age groups.
- In the UK, for example, up to 23% of jobs currently held by older workers could be displaced by automation technology, in particular for its use in clerical support and simple decision making within the next decade. This potential risk is greater than the average for workers of all ages in the UK (20%).
- Looking even further into the future, expectations for technological advancements in physical labour and problem solving of dynamic real-world issues will further increase the risk associated with job automation to an average of 32% for older workers by the mid-2030s.



<sup>1</sup> Average across Austria, Belgium, Chile, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Israel, Italy, Japan, Korea, Poland, Netherlands, Norway, Russia, Singapore, Slovenia, Slovakia, Spain, Sweden, Turkey, United States and United Kingdom.

# The financial services and insurance sector has the highest potential risk of automation over the next decade, particularly for clerical roles

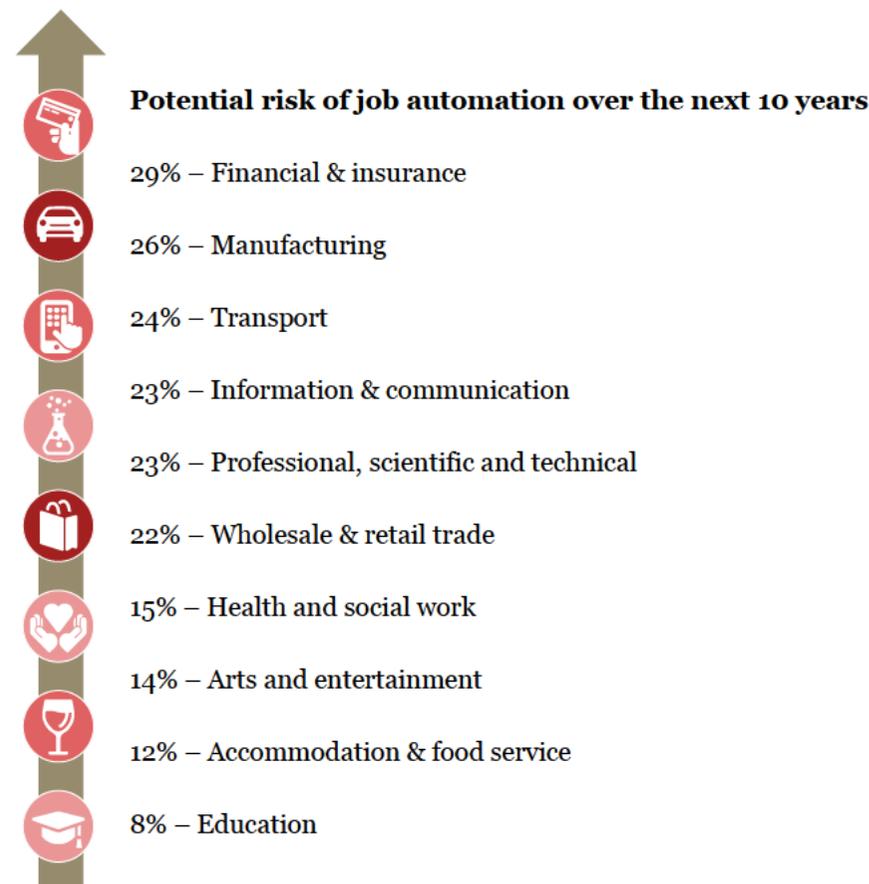
*Older workers tend to be employed in clerical support roles, which involve routine tasks, that are more easily automated. These types of roles make up a high proportion of jobs in the financial services and insurance sector, as well as the manufacturing and transport sectors. Therefore, public policy needs to be focussed at supporting and training older workers for digital jobs that require more social skills and literacy skills.*

## Which industries are most at risk of job automation?

- The risk of automation varies considerably across industries, as shown in the list to the right.
- The potential risk of automation varies quite considerably by sector, with financial services and insurance, manufacturing and transport facing some of the largest risks.
- This is partly explained by the composition of tasks involved in these sectors – the sectors most at risk often involve manual or routine tasks, for example filling forms or solving simple problems. In contrast, sectors at low risk such as education and health care place a much greater focus on social and literacy skills which are relatively less automatable.

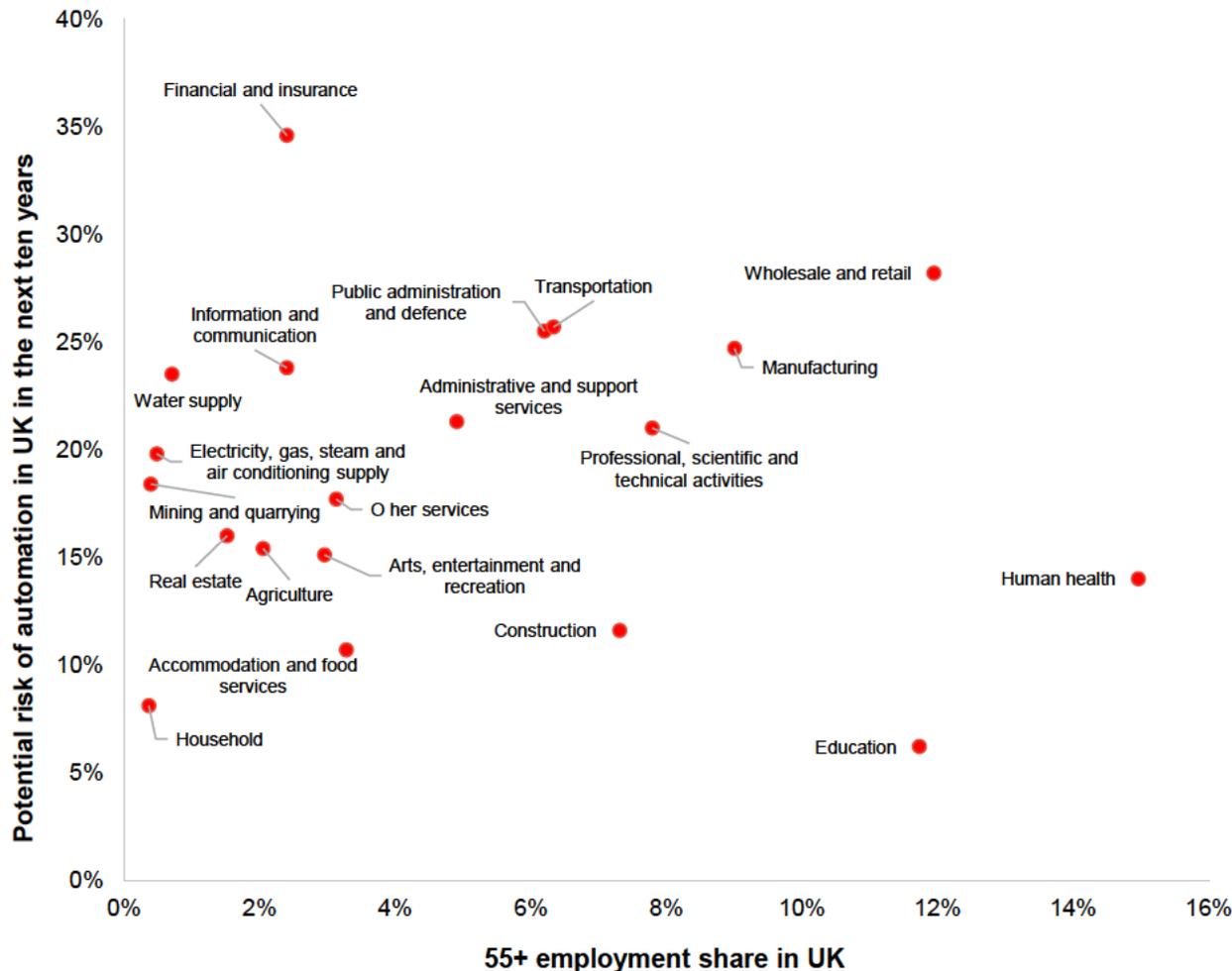
## What are the implications for older workers?

- Based on these estimated sector impacts, we can draw out the implications for older workers. Across most OECD countries, older workers tend to be employed in clerical roles which constitute a high proportion of jobs in the financial services sector. Other sectors such as manufacturing and transport also consist of a high proportion of clerical support roles.
- It is estimated that 50% of clerical jobs are at risk of automation within the next ten years. This is in contrast to managers and professionals roles, that are likely to involve more complex computational tasks, social skills and literacy skills, which are only at 9% risk of automation over the next ten years.
- Workers taking on clerical roles also tend to be relatively less skilled, with lower educational attainment and qualifications, potentially limiting their ability to flexibly move between industries and into new jobs in response to automation.



Source: PwC (2017).

## ***In the UK, our analysis suggests that up to 20% of jobs held by current older workers could be at risk of automation by the late 2020s***



### **Older people and automation in the UK**

- In the UK, the story is very similar to that of the average across OECD and non-OECD countries, with around 20% of older workers at risk of automation within the next ten years.
- Manufacturing and transport, which are at high risk of automation, employ 9% and 6% of older workers respectively. On the other hand, the sector with the highest global average risk of automation only employs 2% of older workers in the UK.
- In contrast, there is a high proportion of workers in the health and education sectors (15% and 12%, respectively) which are at relatively low risk of automation. However, the roles of older workers in these sectors may consist of more clerical tasks.

### **Implications for public policy**

- Within the UK, around 28% of older workers are low education employees with below upper secondary education.
- This suggests policies should be oriented to help low skilled workers to access more learning opportunities to broaden their skill set and move into other industries that are at lower risk of automation which require learning new skills and training.
- Jobs that are less likely to be automated may require greater experience with technology, which arguably younger workers find quicker to adopt. Hence skills training (both formal and informal) in technology for older workers is important to ensure that they remain productive and employable.

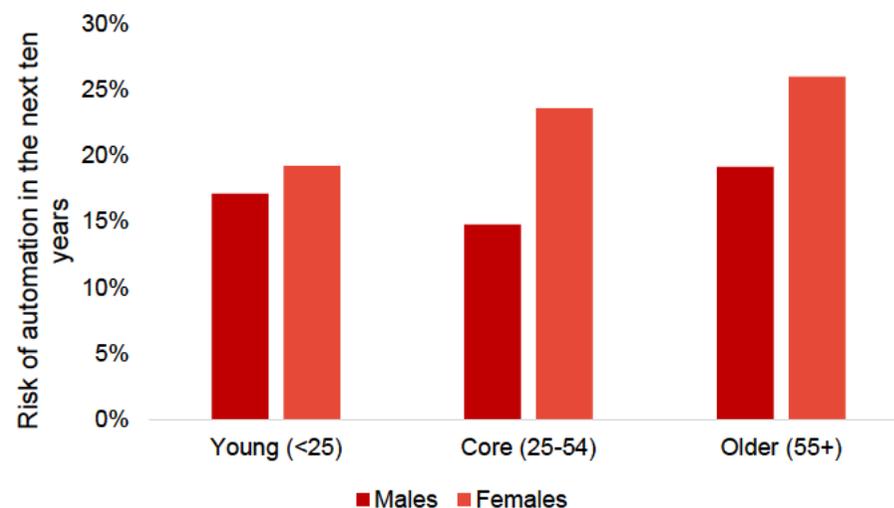
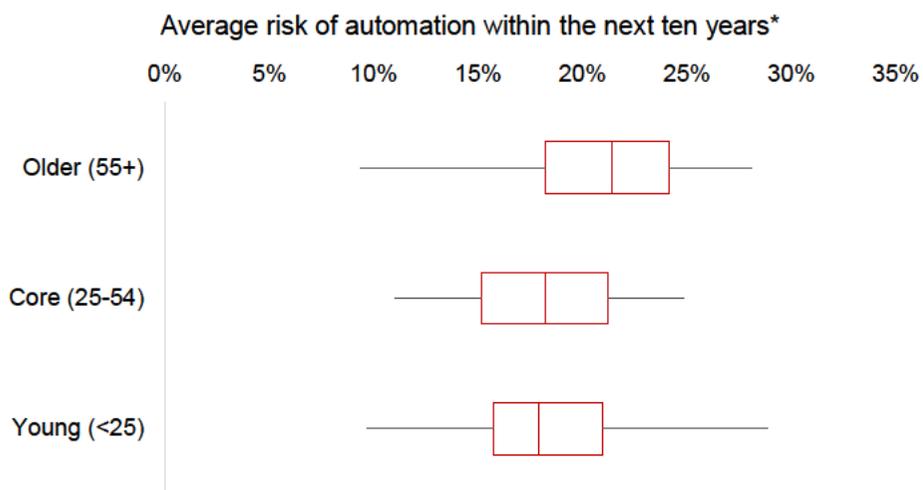
# Older workers could be at greater risk of job automation compared to young workers, and older female workers could be at a greater risk compared to male counterparts over the next decade

## Automation is likely to impact older workers more than younger workers within the next ten years

- The average risk of automation for older workers is higher (21%) compared to young workers (18%) and core age group workers (18%).
- This could be explained by the differences in skills and educational attainment as the older workforce consist of a higher proportion of low education workers. Workers with lower levels of education are at higher risk of job automation as the roles that they are employed in are more easily automated (e.g. craft and trade work, services and sales work).
- Public policy should therefore focus on education and training of older workers to help them adapt to technological changes that they will experience.

## Older female workers face a higher risk of job automation compared to their male counterparts within the next ten years

- Female workers have a higher risk of job automation compared to males for each age group. The risk for older female workers is 7pp higher than for older male workers.
- This can be explained by the higher proportion of older female workers in clerical roles compared to older male workers (13% compared to 4%), which could be associated with factors such as educational attainment or career breaks that may have impacted a female worker's career opportunities in the past.
- Therefore, a focus on supporting older female workers transition from clerical roles to jobs in an automated workplace is essential for improving employment rates of older workers.



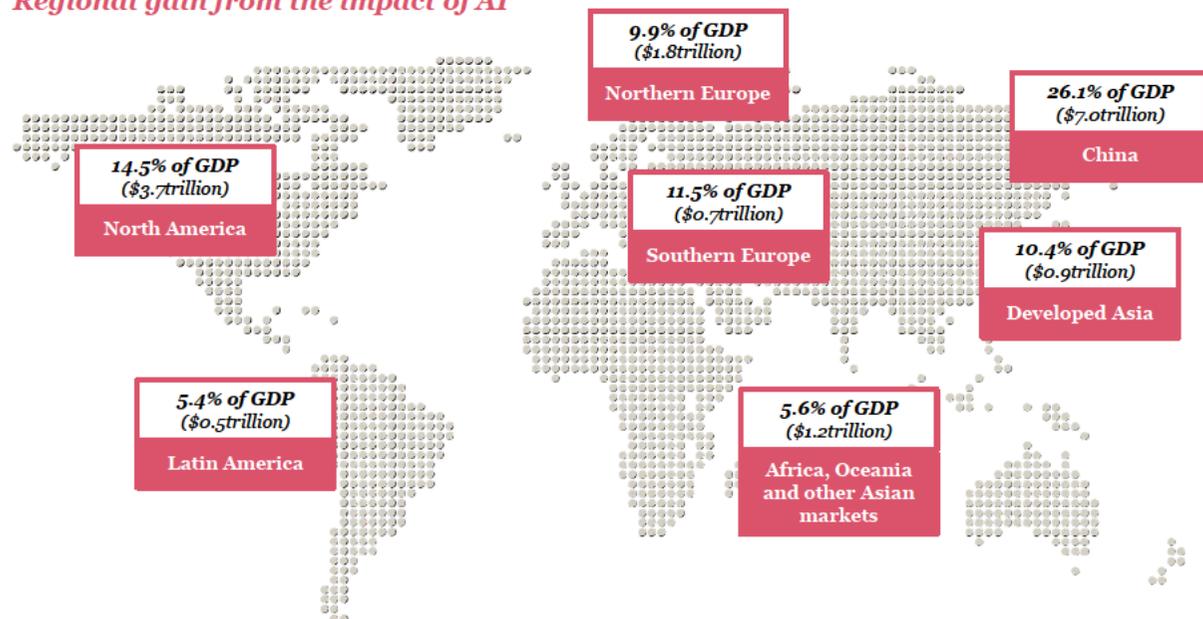
\*Average across Austria, Belgium, Chile, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Israel, Italy, Japan, Korea, Poland, Netherlands, Norway, Russia, Singapore, Slovenia, Slovakia, Spain, Sweden, Turkey, United States and United Kingdom.

# Automation has the potential to boost economic growth from increased productivity and consumer demand, creating new jobs for older workers

## Economic growth from automation technology

- PwC analysis suggests that global GDP will be up to 14% higher in 2030 as a result of the accelerating development and take-up of AI. This is the equivalent of an additional \$15.7 trillion.
- Economic growth will primarily be driven by:
  1. Productivity gains from businesses automating processes (e.g. robots and autonomous vehicles)
  2. Productivity gains from businesses augmenting their existing labour force with AI technology (i.e. assisted and augmented intelligence)
  3. Increased consumer demand from the availability of personalised and/or higher-quality AI-enhanced products and services.
  4. Spill-over effects of increased product demand on industries that are not directly affected by technological progress.

## Regional gain from the impact of AI



## Potential opportunities for older workers

- Older workers have the opportunity to take advantage of the benefits that AI can bring. For example, process automation will mean that workers can focus on more productive tasks at work and also spend more time for skills training and learning about new technologies.
- AI is also likely to create new markets in personalised products, which can create new job opportunities in the design and production of these goods and services. Older workers can benefit from the increased labour demand in these new sectors.
- Advances in AI have, and will, also lead to supporting healthier and longer lives. For example, AI has potential in supporting faster and more accurate diagnoses and more personalised treatment which can save time and reduce the risk of illness and hospitalisation. This can improve health and well-being and save lives, meaning older workers are more likely to participate in the work force for longer.

# *Focus on: The United Kingdom*



## Overall, despite steady improvements in absolute terms, the UK's relative performance on the Golden Age Index remains slightly below the OECD average

Similar to other OECD countries, the UK has made improvements over time but there is scope for further improvement in this area in the future (which also apply to most other OECD countries).

1

We have chosen to focus on the UK as it has been a **median performer** on the Golden Age Index – with employment rates, average effective labour force exit age and participation in training relative to younger workers close to the OECD average

2

The UK, like most other OECD countries, has seen **relative improvements in its absolute index score** since 2003 – driven by financial incentives for older workers to remain in employment for longer, the reduction of early retirement schemes and the ratification of age discrimination laws

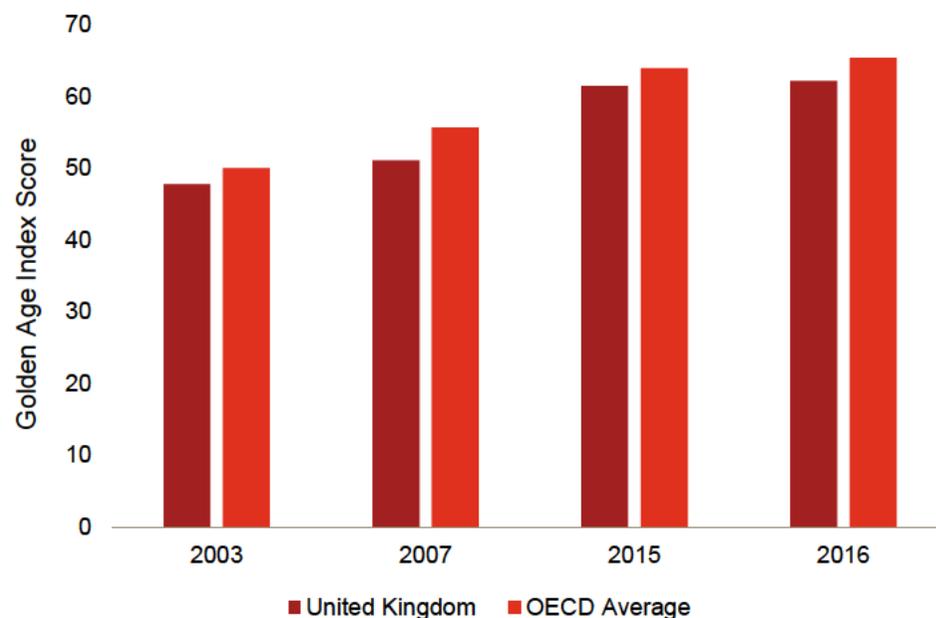
3

Similar to other OECD countries, there are **key policy issues that face the UK**, which both businesses and governments should work together in resolving to increase participation rates for older workers

### How has the UK performed?

- The UK has scored slightly below the OECD average on the Golden Age Index between 2003 and 2016.
- But the UK's **absolute performance on the index has improved over time**. This largely reflects a **significant improvement in the employment rate** of 55-64 and 65-69 year olds, which have both seen a respective increase of 8 and 9 percentage points respectively. But in both age groups there are still many OECD countries that still outperform the UK and have improved at a faster rate, indicating many challenges still remain.

Figure 3: UK and average OECD index score over time



Sources: PwC analysis, OECD

## Regional variations in employment of older workers across the UK are related to variations in average educational attainment and gender disparities

In the UK, there are **considerable disparities in the employment** rates of older workers across the country, ranging from 75.3% in the South East, to 63.2% in Northern Ireland.

Our analysis suggests that there are three key reasons for these disparities. We discuss the latter two in more detail in the following slides.

1

**Economic performance:** regions with lower older worker employment rates tend to be the lower performing regions in terms of GVA per head and have lower overall employment rates too.

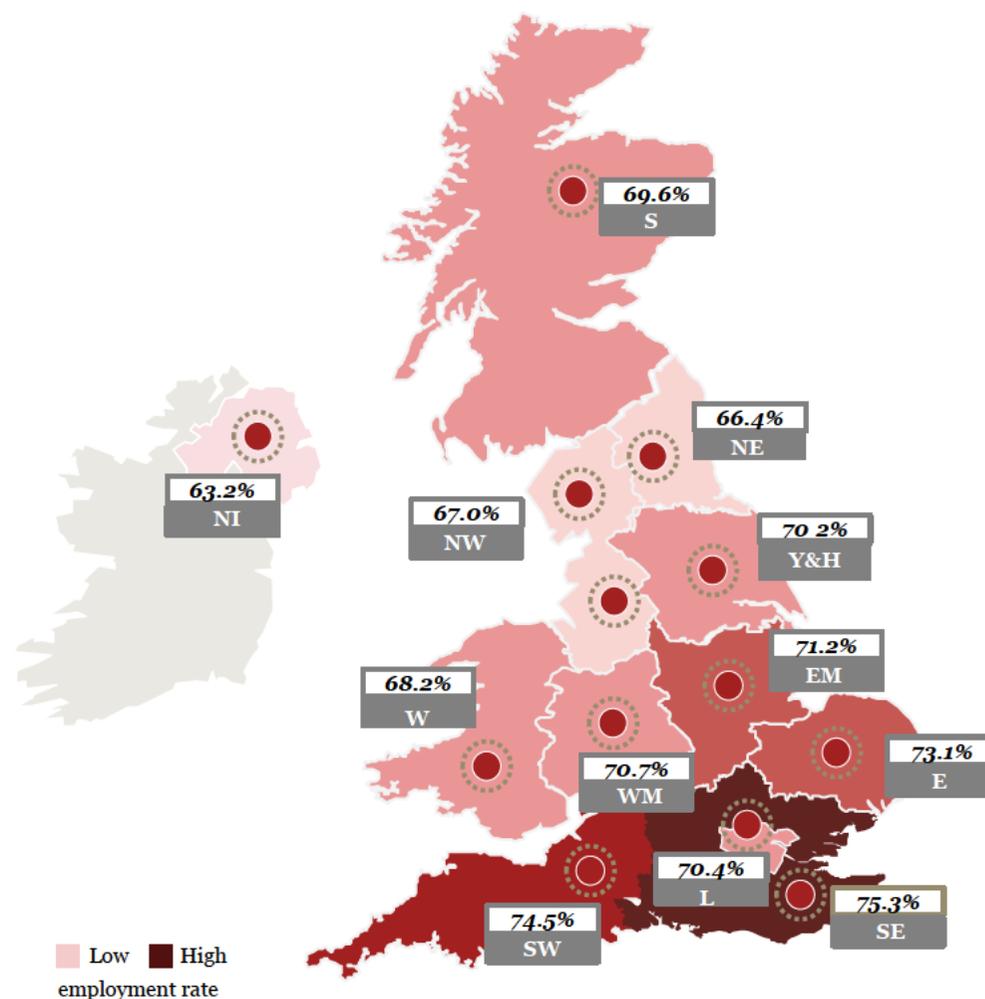
2

**Educational attainment:** regions with a greater proportion of older workers with degrees and qualifications tend to have higher employment rates.

3

**Gender disparities:** lower older worker employment rates are often driven by lower female employment rates, with these low-performing regions tending to have a greater disparity between male and female older worker employment rates. For example, in Northern Ireland, the difference between female and male employment for over 50s is over 12.1 percentage points.

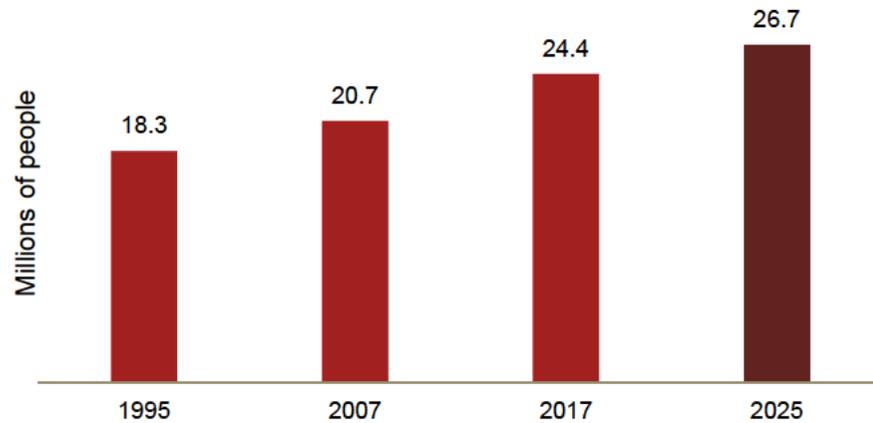
Map 2: Employment rate of 50–64 year olds



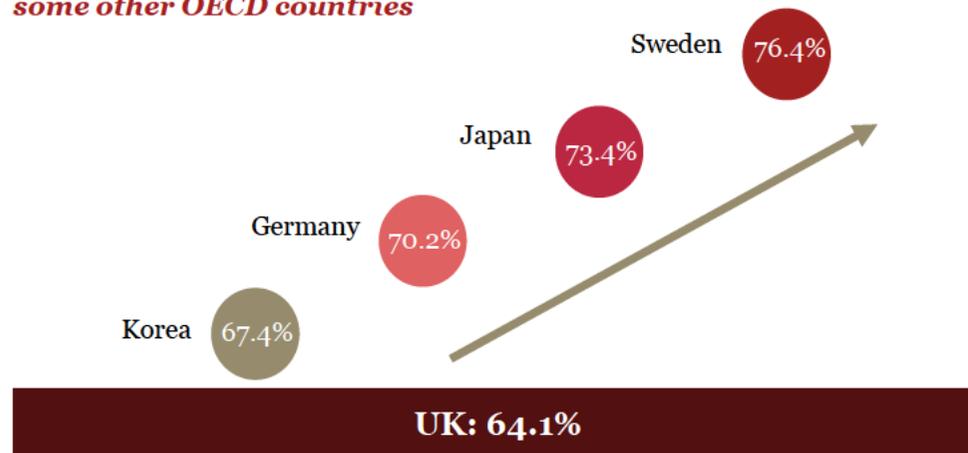
Sources: PwC analysis, APS (2017)

# Employment of older workers in the UK has increased over time, but there is further room for improvement

The number of people aged over 50 is growing steadily in the UK



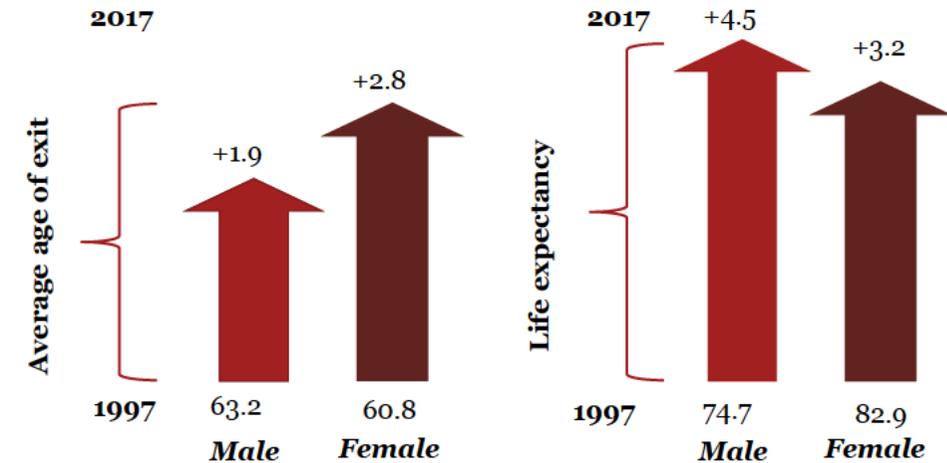
The UK has a lower employment rate of 55-64 year olds than some other OECD countries



Sources: United Nations (2016), ONS (2016), DWP (2018)

PwC Golden Age Index

In the past two decades, more people are working later in life, but improvements have not kept pace with life expectancy



There is scope for further increases in employment rates of older workers as the UK increases the state pension age over the next few years



“From 2019, the State Pension age will increase for both men and women to reach **66 by October 2020.**”

“The Government is planning further increases, which will raise the State Pension age from **66 to 67 between 2026 and 2028.**”

# Work-life patterns and occupational segregation are two of the key drivers of disparities in older worker employment rates between men and women

- In the UK, **female older workers have a lower employment rate than their male counterparts** at 66.5% for 50-64 year olds, compared to 76.0% for males. The gender pay gap also tends to increase with age. Since last year, the gap in employment rate has narrowed slightly from 10.5 percentage points to 9.5 percentage points.
- The data suggests that the labour market experience of older women is often characterised by **lower pay, more part-time work and higher barriers to entry than males of the same age**. These working characteristics are driven by two key factors: work-life patterns and occupational segregation.

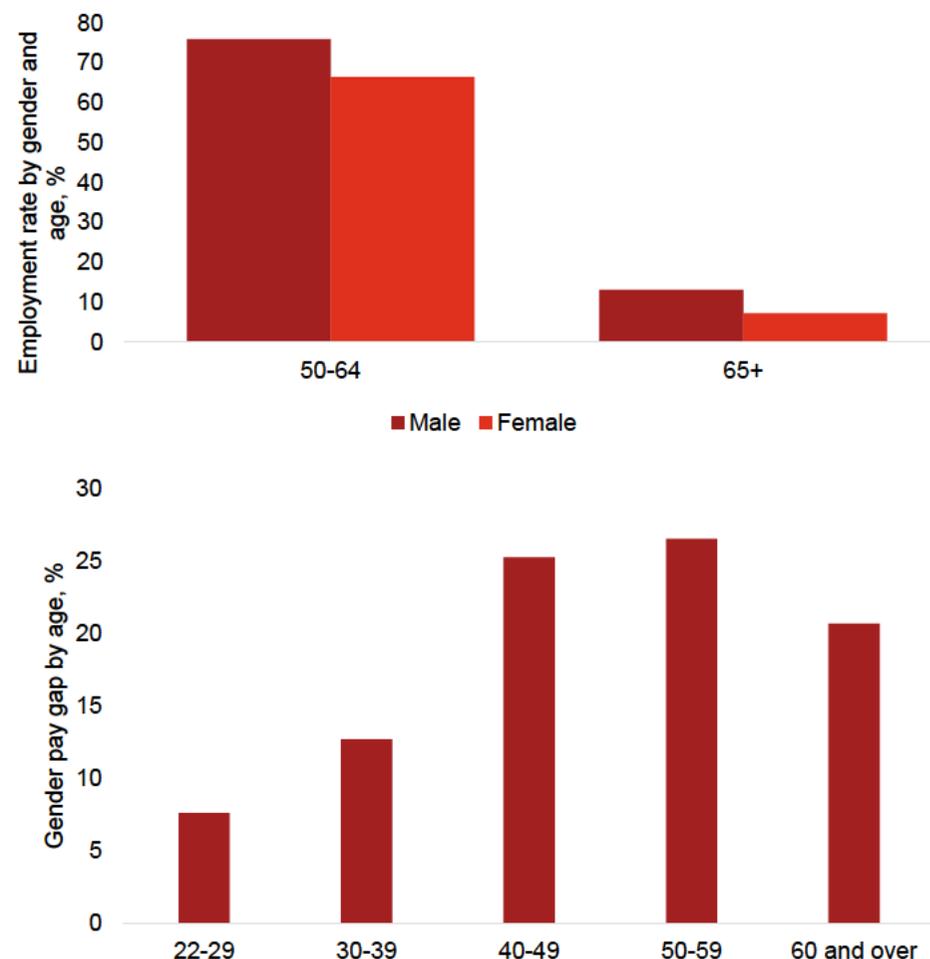
## 1. Differences in work-life patterns

- Many women tend to spend more time out of the workforce than men to take care of families, meaning that they find it harder to return to work after having a child.
- The Resolution Foundation noted those with caring responsibilities are significantly less likely to be in employment over 50. Similar studies have also found that the fifties represent a pivot age where women divide their time between care and work roles.

## 2. Occupational segregation

- Women are more likely to work in sectors and occupations that offer greater flexibility, for example administrative and secretarial roles. These tend on average to be lower paid occupations. The overrepresentation in lower-paid jobs reinforces gender wage inequalities and reduce the incentive for women to work.
- Many women tend to be 'sandwich careers' providing care for ageing parents as well as younger generations. The peak age for caring duties is 50-64 and affects one quarter of older women.

Figures 4 and 5: UK employment rate and gender pay gaps by age

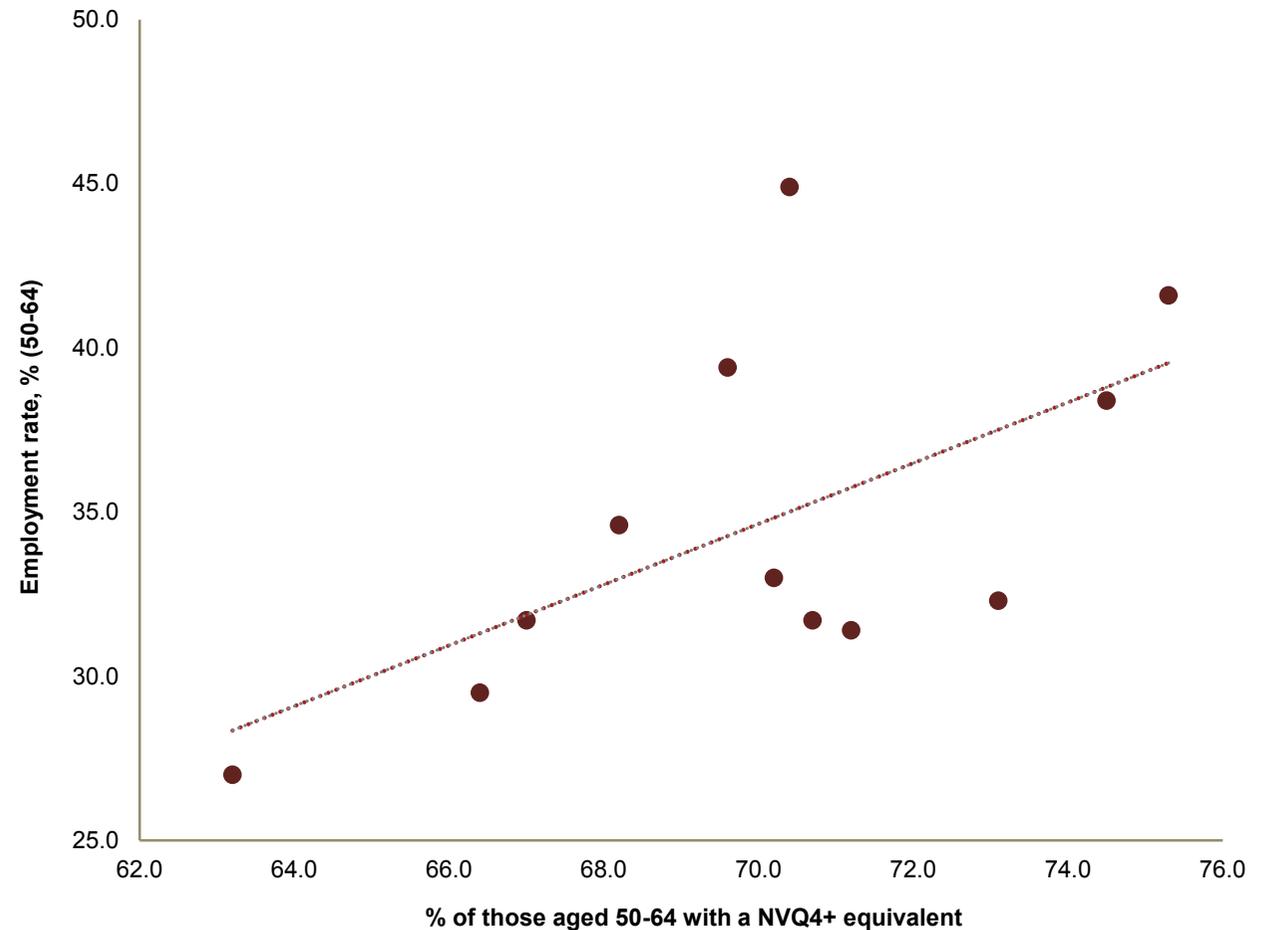


Sources: ASHE (2017), APS (2017), Resolution Foundation (2012)

## Regions with a more qualified workforce tend to have higher employment rates for older workers

- Our analysis shows that **workers with a more qualified background is associated with working later into old age.**
- This could be because more qualified older workers are better able to compete against younger educated workers, or that the industries in which more qualified workers are employed are better suited to working later in life (e.g. self-employed professionals such as accountants, lawyers, business consultants and surveyors)
- There is a considerable difference in the qualifications of older workers across the UK: 27.0% of people aged between 50-64 have a level 4 NVQ (certificate of higher education/bachelor's degree), whilst in the South East this is 41.6%, which is strongly attributed with the regional variation in the employment rates for older works.
- The situation in London is relatively less clear. It has the largest proportion of workers that are qualified (as per NVQ4+) across all regions but falls in the middle of the pack for employment rates. This is likely due to the disparity of male and female employment in London, caused by **higher barriers to mothers with young children returning to work due in particular to relatively high childcare and travel-to-work costs in the capital** (as compared to other UK regions).

Figure 6: Correlation between qualifications of older workers and the employment rate

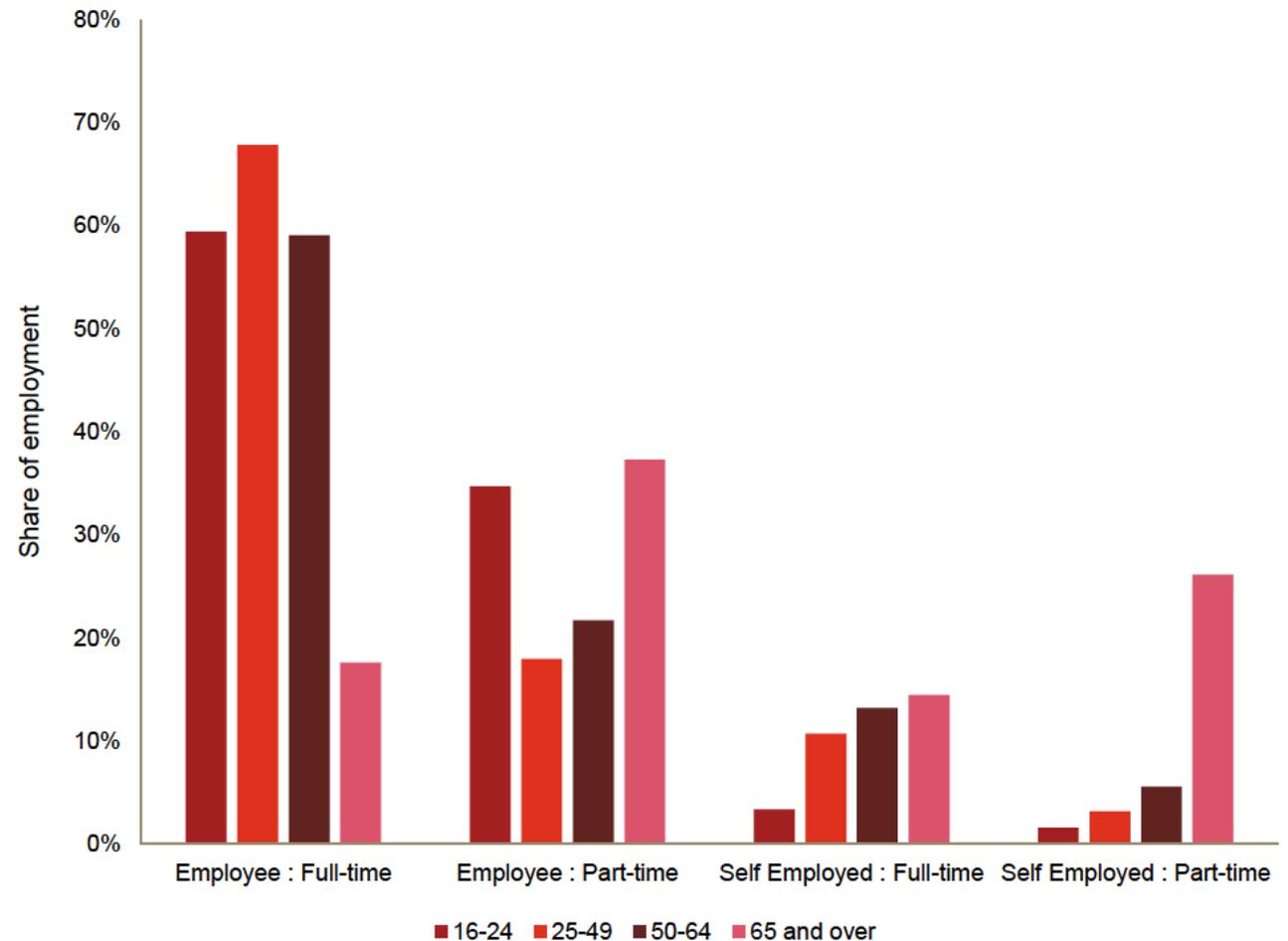


Sources: PwC Analysis, APS (2017)

## Across the UK, older workers engage in jobs which offer greater levels of flexibility

- Using flexible working arrangements such as part-time employments can help retain older workers and increase overall employment rates for older workers.
- Findings from Rix (2004) and Haider & Loughran (2001) suggest that flexible work arrangements and other non-monetary characteristics of work may be more important than wages to many older workers.
- As figure 7 demonstrates, the proportion of workers that work full time decreases with age, while the proportion of workers that work part time rises. Whilst at the same time, the share of employment that is self-employment, across both full and part time, is higher for older workers.
- Increasing flexible working opportunities for older workers can increase the attractiveness of work, enabling older workers to re-design their jobs and tailor their working arrangements to meet their needs, improving overall incentives to work.

Figure 7: Share of employment by employment type, by age



Sources: APS(2017), Rix (2004) and Haider & Loughran (2001)

# Despite improvements in removing obstacles to employment for older workers in the UK, challenges around training and recruitment remain

The UK has made progress in improving the labour market prospects of older workers through legislation and the correct incentives

## Removing barriers to entry



Legislation such as The Equality Act (2010) has made it illegal to discriminate against employees by age. Removing the mandatory retirement age (2011) has also allowed employees to continue working past 65. Coupled with increasing the state pension age, these policies have increased the retention of older workers.

## Incentivising people to work longer



The new 'Fuller Working Lives' strategy is aimed at highlighting the need to 'retain, retrain and recruit' older workers by working with job centres and businesses. Support is provided for older workers through guidance on returning to work and through upskilling training provided by Jobcentre Plus.

## Highlighting the economic benefits of older employees



The UK government has appointed the 'Business in the Community Age at Work leadership' as Business Champion for older workers to promote the benefits of older workers to employers. By using existing evidence, community engagement and campaigns to highlight the benefits, policymakers are attempting to increase awareness to businesses.

But the UK still performs slightly below the OECD average on our index and needs to focus its attention on three key areas

## Greater focus on education and training



Analysis of the UK Labour Force Survey suggests that older workers are less likely to receive training than younger employees, with only 45% of those aged 65 and over having received one day of training in the past 12 months. With rapid progress and adoption of AI technology, substantial retraining to adjust to technological change will be critical, particularly for older workers.

## Incentivise the recruitment of older workers



Employers often have negative perceptions of the productivity of older workers. Financial incentives to employers who hire and retain mature age employees may increase employment for older workers. For example, Australia's Restart Campaign which was launched in 2017, gives \$10,000 to employers to hire over 50s.

## Increasing labour force participation of older women



Women still face significant barriers to entry after childcare (and elder care); both government and employers need to promote more flexible working policies to accommodate this. In addition, policy needs to be aimed at retaining elder female workers who are at risk of exiting the workforce due to caring responsibilities for their spouse or grandchildren.

Source: DWP (2017)



*Comparison of key  
labour market  
indicators across the  
OECD*

## *Our Golden Age Index is constructed using 7 key labour market measures*

**1** *Employment of 55-64 year olds*

**2** *Employment of 65-69 year olds*

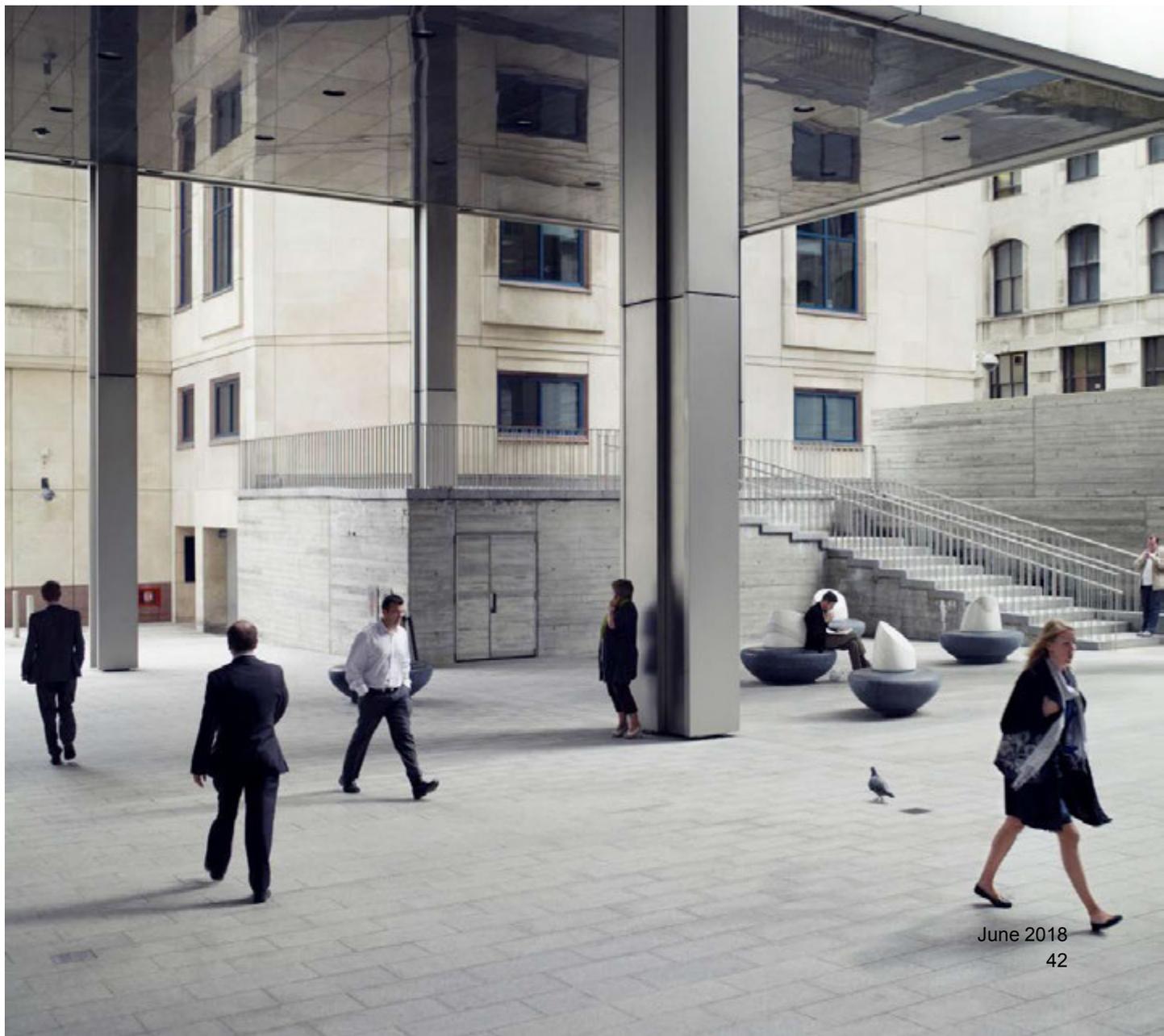
**3** *Gender gap in employment*

**4** *Incidence of part-time work*

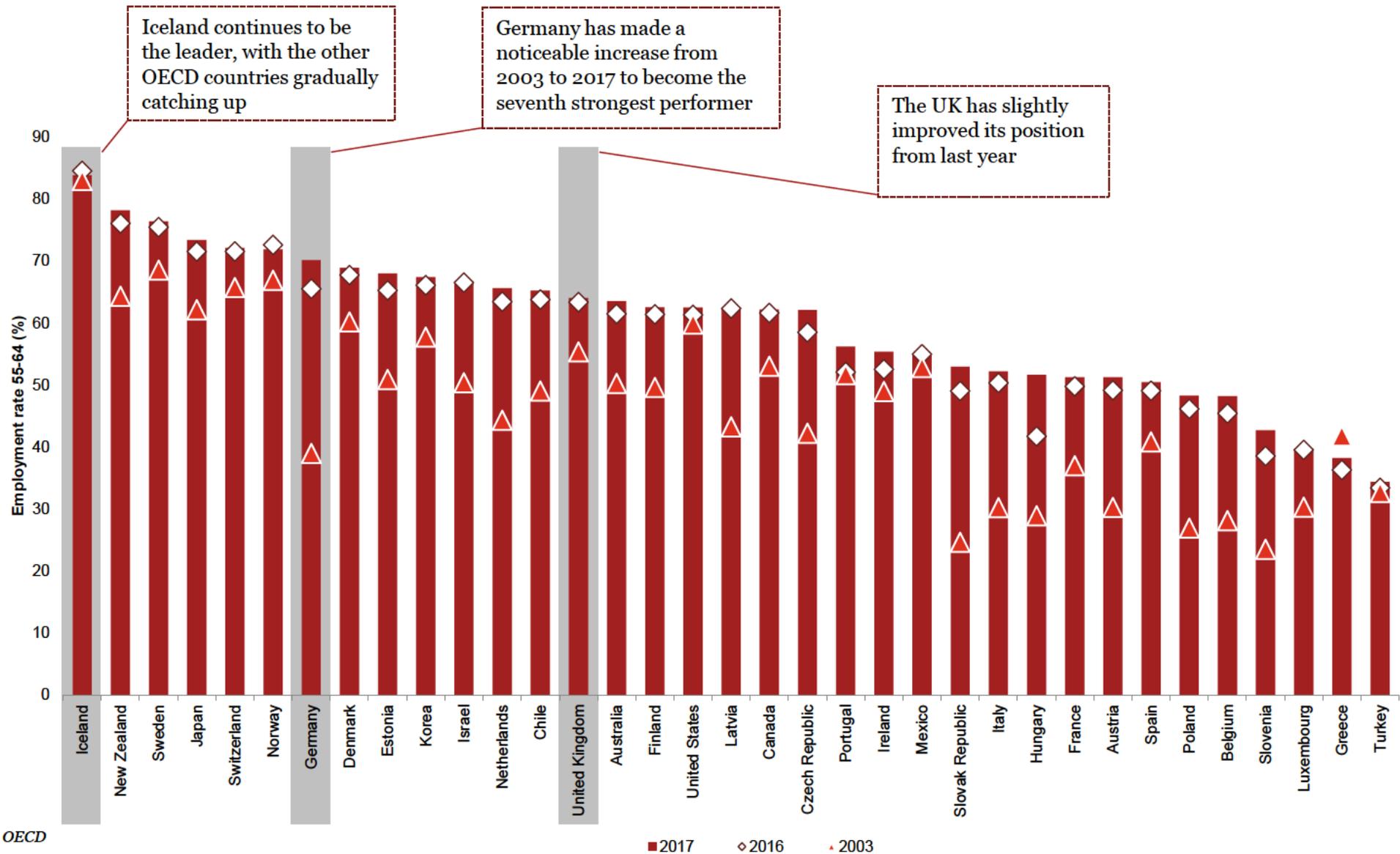
**5** *Full-time earnings*

**6** *Effective labour force exit rate*

**7** *Participation in training*

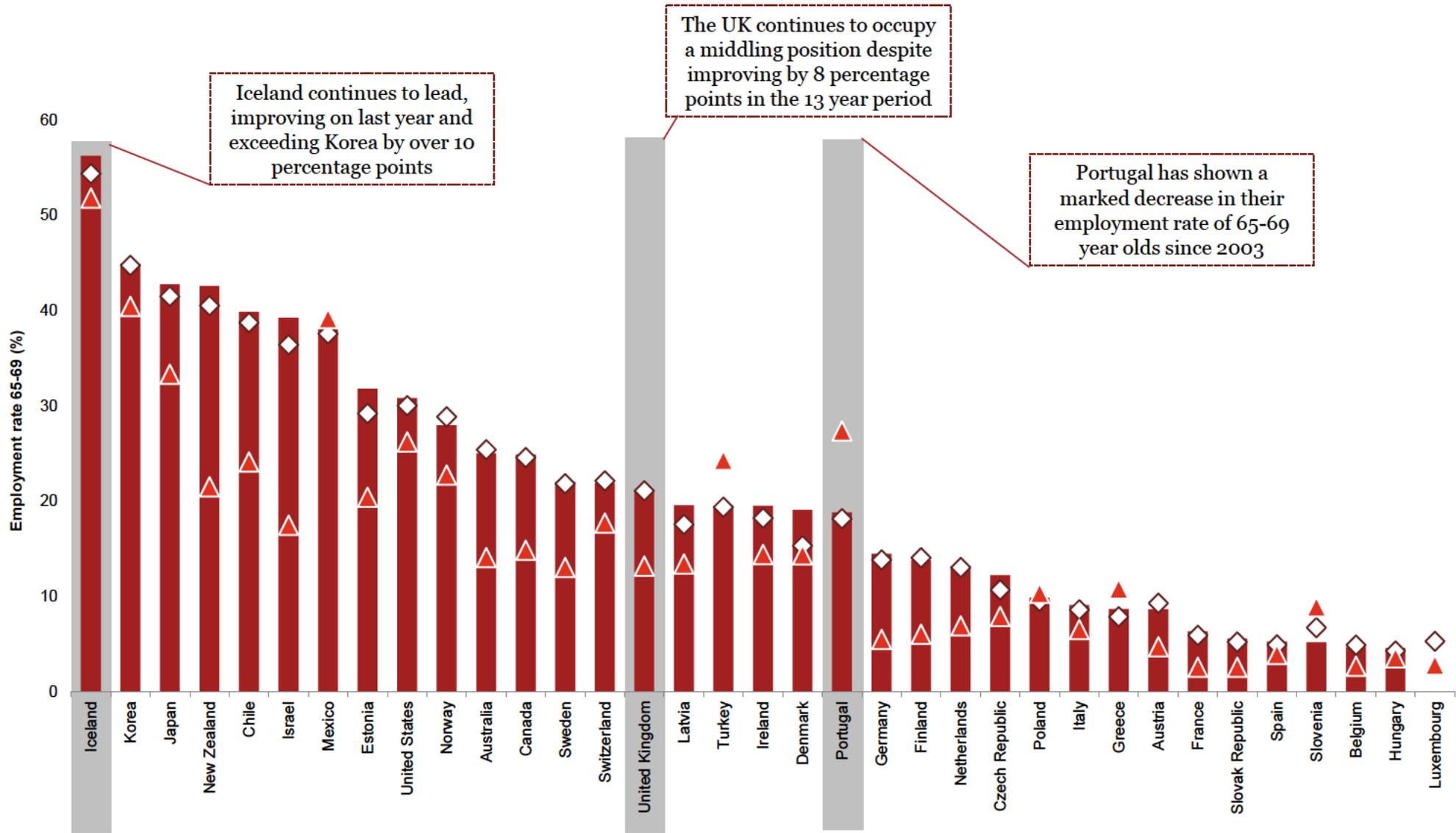


# Employment rates of 55-64 year olds



Source: OECD

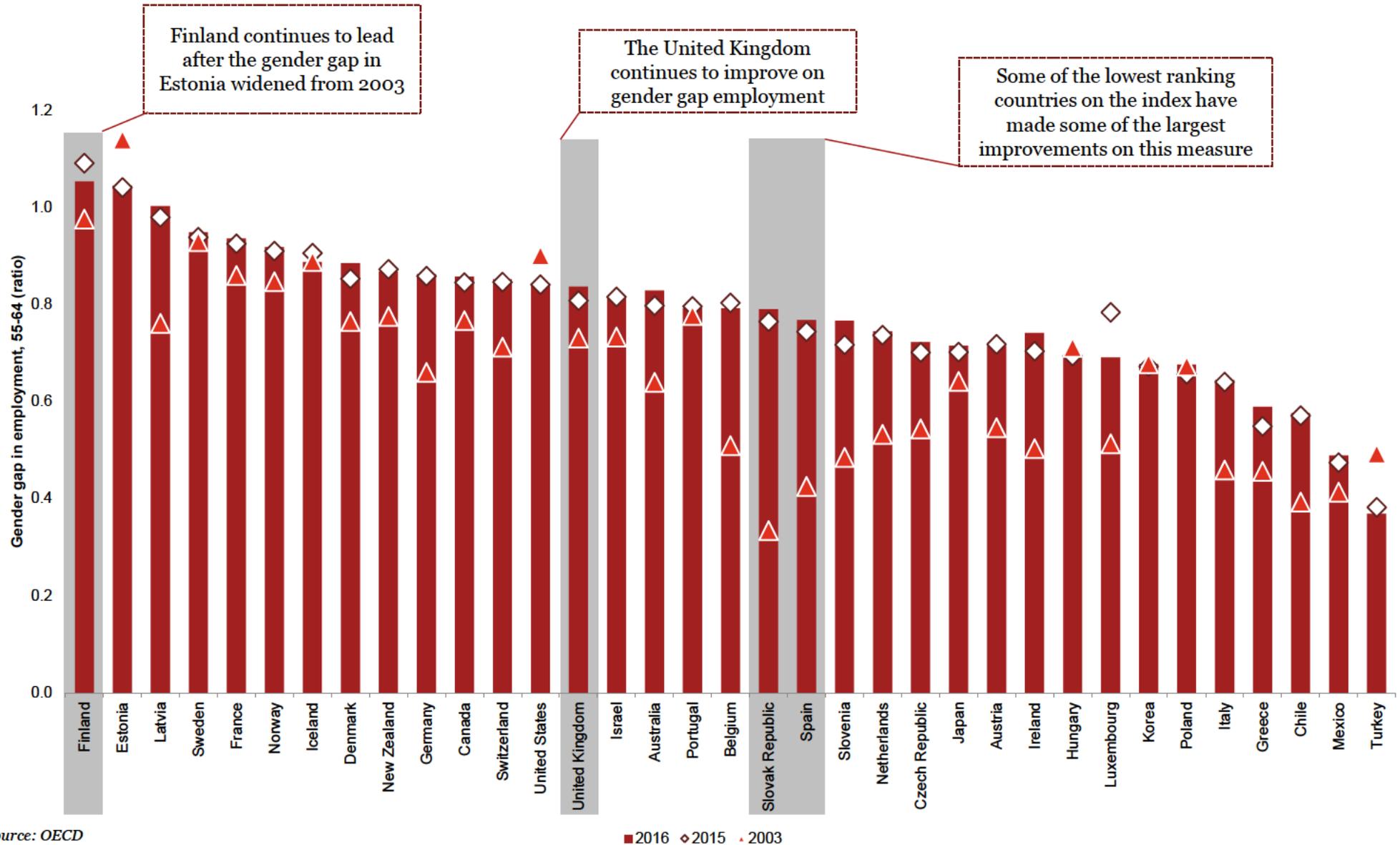
# Employment rates of 65-69 year olds



Source: OECD

■ 2016   ♦ 2015   ▲ 2003

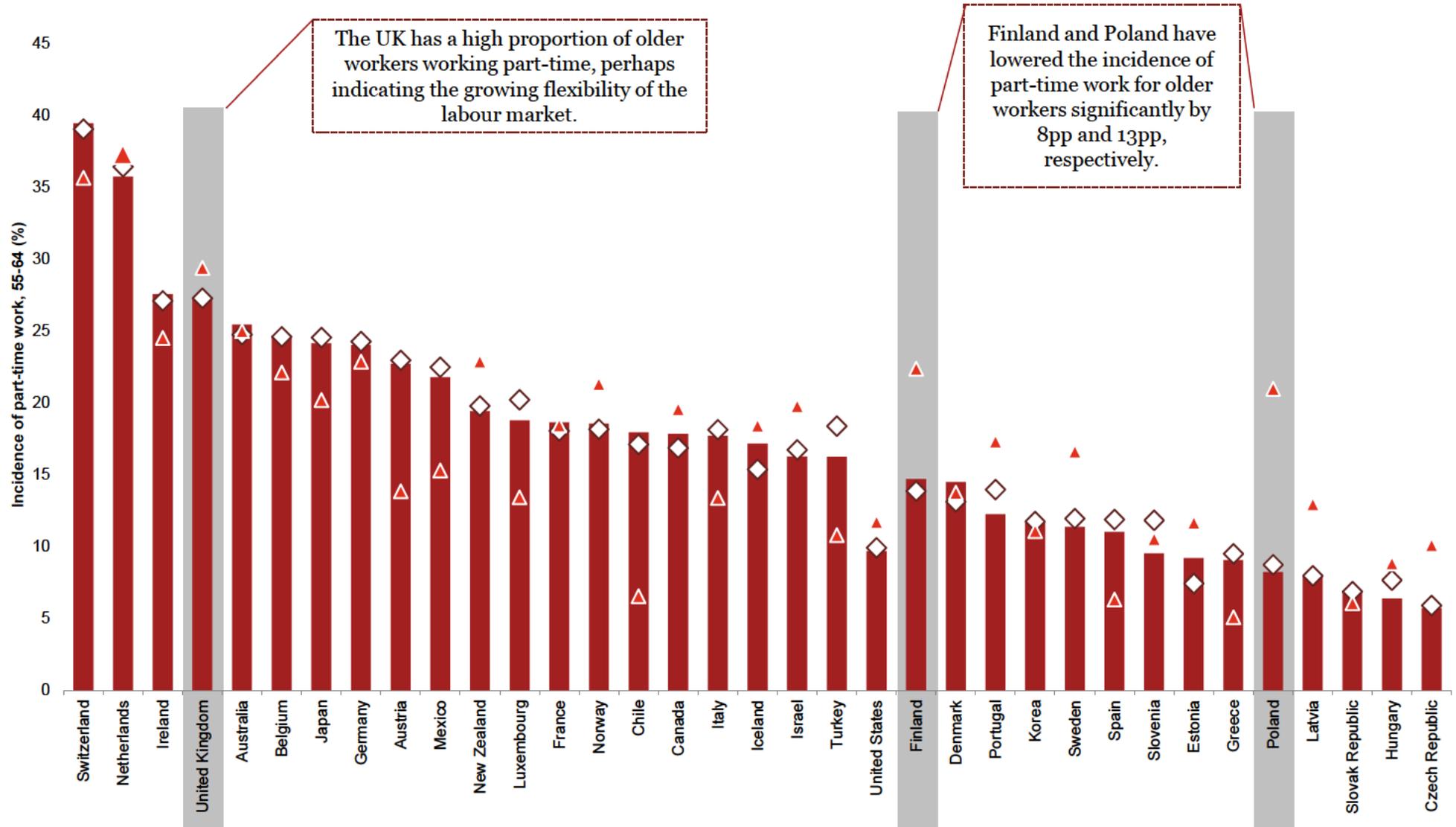
# Gender gap in employment for 55-64 year olds



Source: OECD

PwC Golden Age Index

# Incidence of part-time work for 55-64 year olds



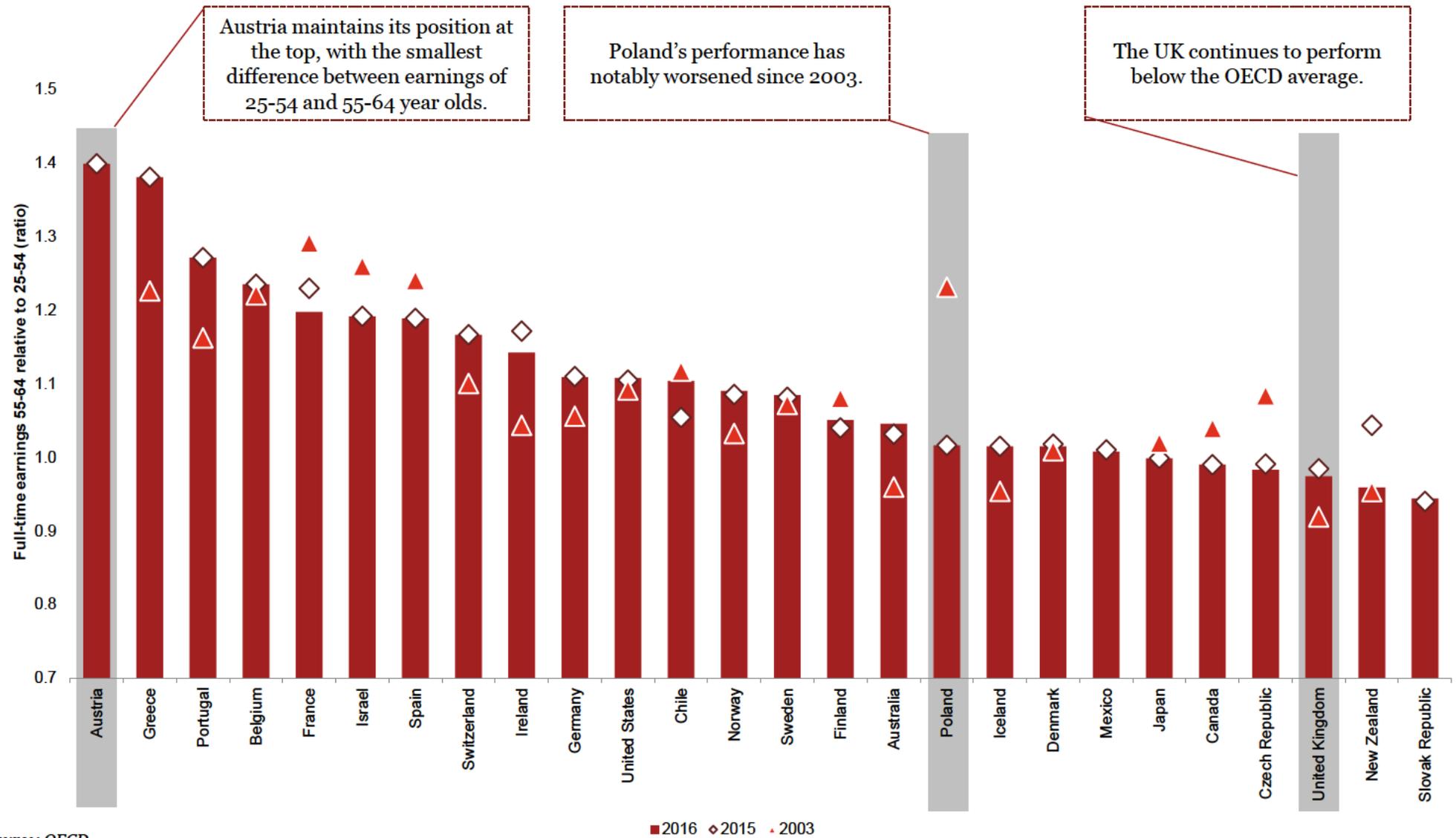
The UK has a high proportion of older workers working part-time, perhaps indicating the growing flexibility of the labour market.

Finland and Poland have lowered the incidence of part-time work for older workers significantly by 8pp and 13pp, respectively.

Source: OECD

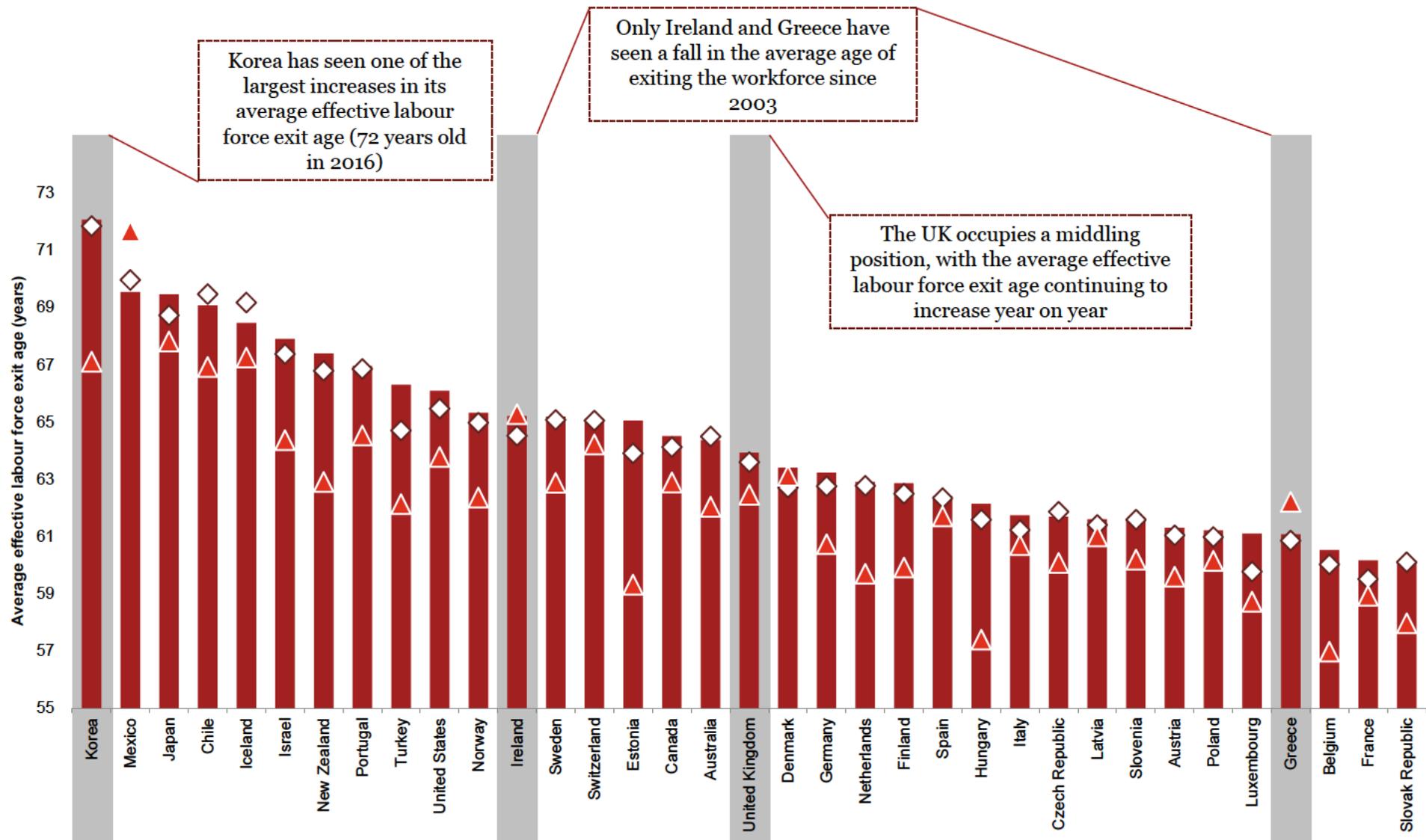
■ 2016   ♦ 2015   ▲ 2003

# Full-time earnings: ratio of 55-64 year olds relative to 25-54 year olds



Source: OECD

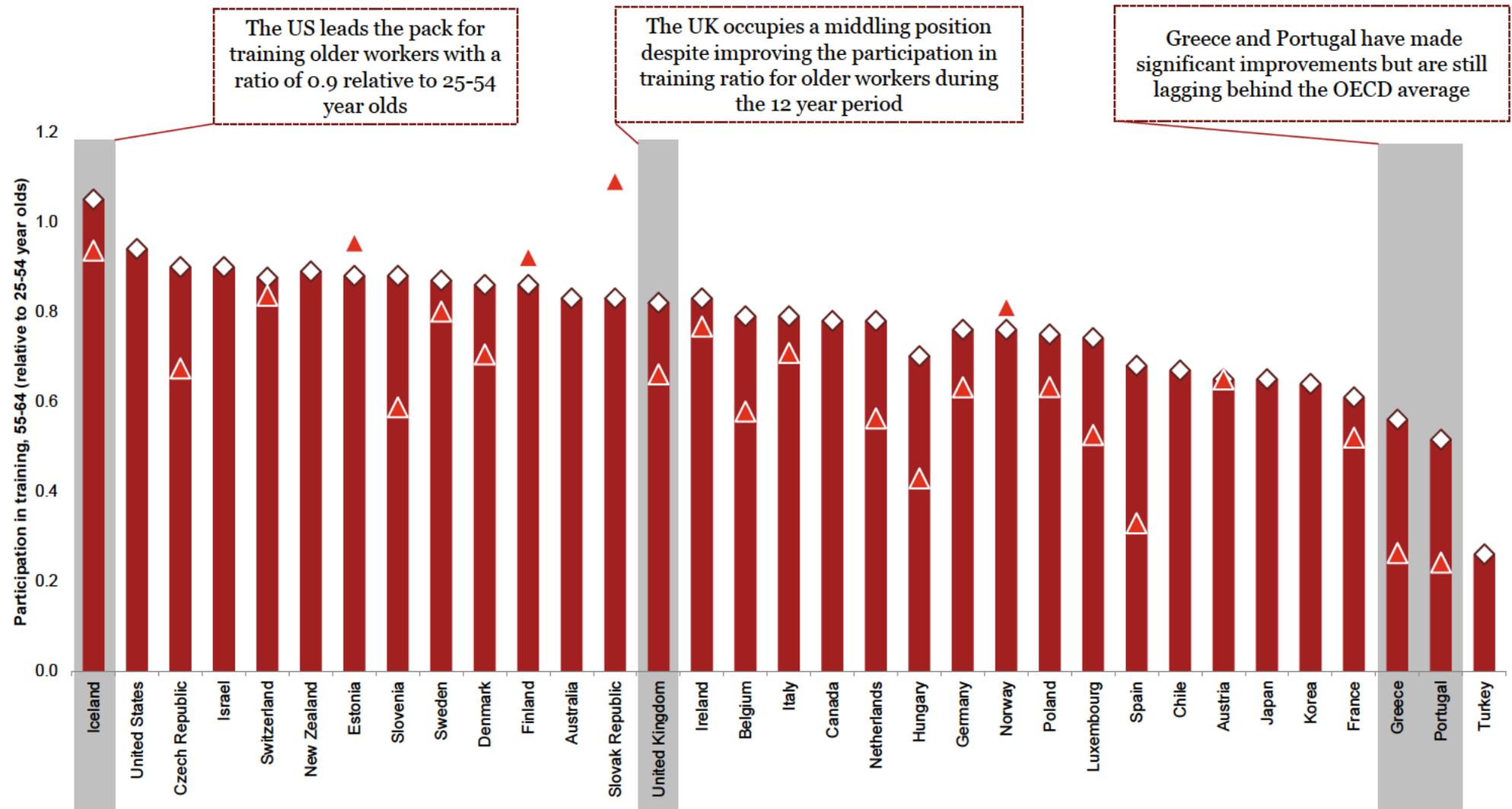
# Average effective labour force exit age (years)



Source: OECD. Note that data is not available for all OECD countries.

■ 2016 ◆ 2015 ▲ 2003

# Participation in training for 55-64 year olds relative to 25-54 year olds

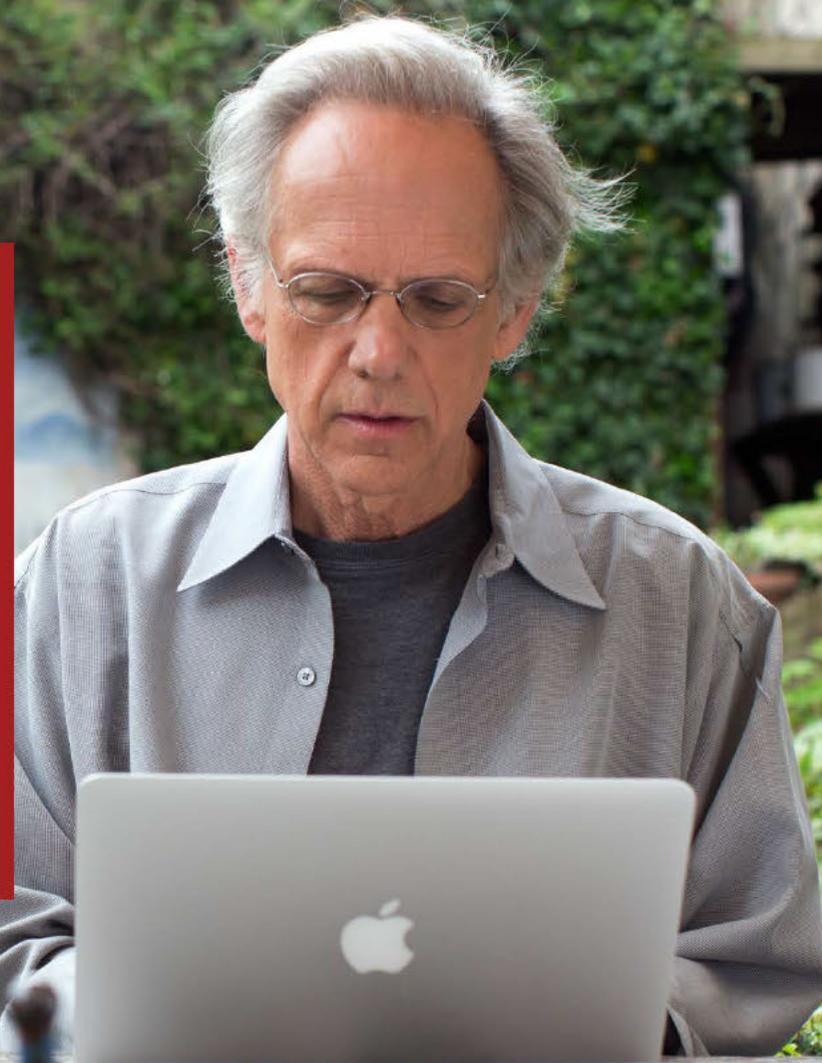


Source: OECD

■ 2016 ◆ 2015 ▲ 2003

<sup>1</sup> Note: The data from Iceland, Switzerland and Hungary is taken from 2014 as this was the latest data available.

# *Appendix 1: Methodology*



## ***PwC Golden age index methodology***

### Variables included in the index

<b>Indicator</b>	<b>Weight</b>	<b>Factor</b>	<b>Rationale</b>
<b>Employment rate, 55-64 (% of the age group)</b>	40%	1	The proportion of 55-64 year old workers in employment is the most important measure in our index and so has the highest weight of 40%.
<b>Employment rate, 65-69 (% of the age group)</b>	20%	1	The proportion of 65-69 year old workers has half the weighting of that of 55-64 year old workers assuming the 65-69 age group is roughly half as large in terms of population.
<b>Gender gap in employment, 55-64 (ratio women/men)</b>	10%	1	Gender equality in employment is included here as lower employment rates among older women tend to be a particular feature of many OECD countries.
<b>Incidence of part-time work, 55-64 (% of total employment)</b>	10%	- 1	Part-time employment may adversely affect earnings, pensions and job security, but this is given a lower weight in the index since some older workers may prefer part-time work.
<b>Full-time earnings, 55-64 relative to 25-54 (ratio)</b>	10%	1	Earnings equality would represent equal pay across age groups and could also be an indicator of the relative labour productivity of older workers. But it has a lower weight in the index as higher relative earnings could also price some older workers out of jobs in certain cases.
<b>Average effective labour force exit age (years)</b>	5%	1	This measures the length of time a worker stays in the labour force before they become economically inactive. However, there is some overlap with other variables such as employment rates so we do not give it too high a weight in the index.
<b>Participation in training of 55-64 age group (ratio, relative to employed persons aged 25-54)<sup>1</sup></b>	5%	1	This is an indication of how far older workers keep learning beyond age 55, which will be important in keeping them employable and renewing their skills. But data are lacking for several countries, so we do not give this too high a weight in the index.

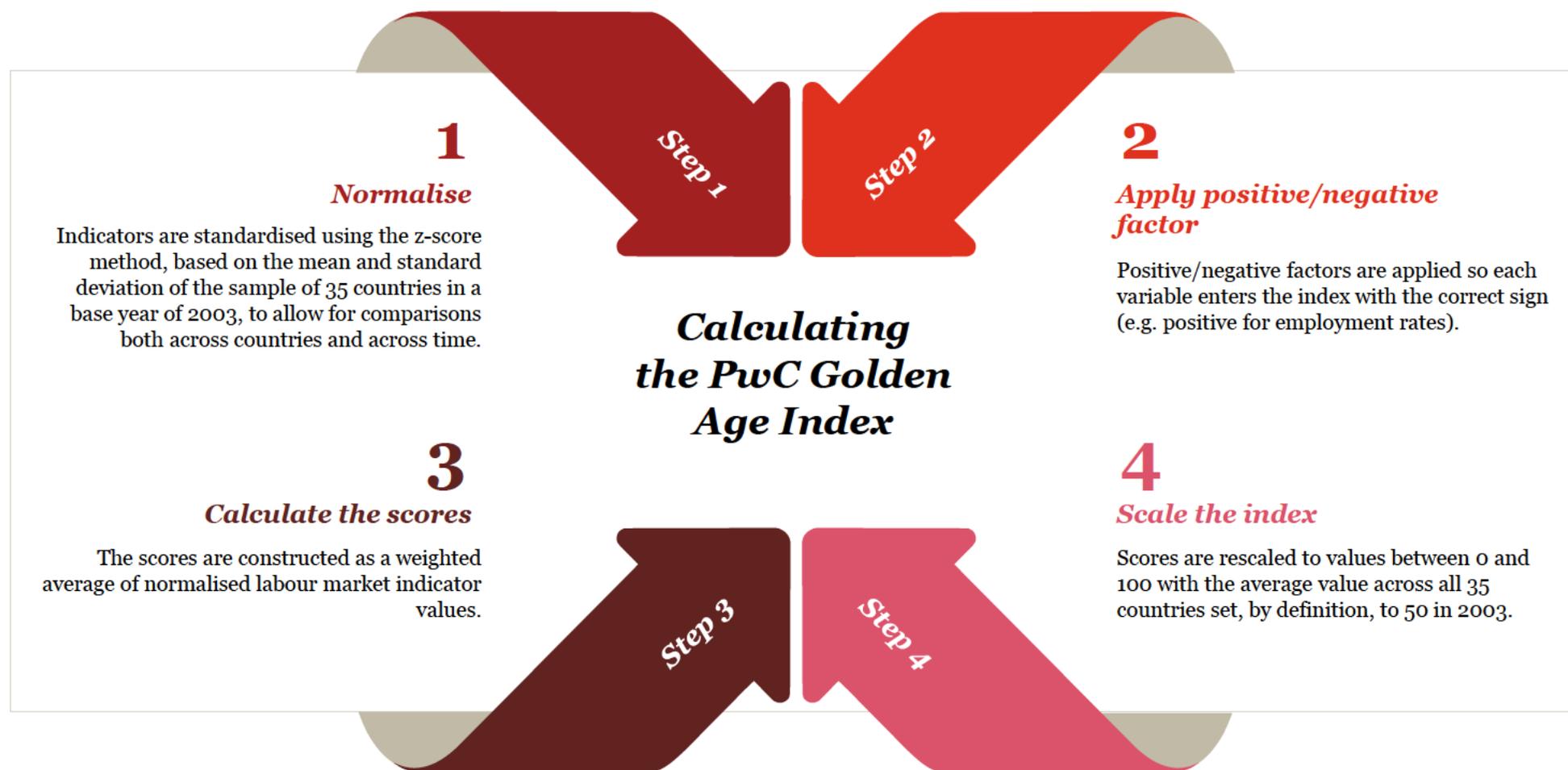
*Note: The index scores reported in this 2018 release reflect the latest OECD data. Index scores for 2003, 2007, 2014 and 2015 may have changed relative to the results in our release last year (June 2017).*

<sup>1</sup> *This indicator was defined as the absolute number of 55-64 year olds in training in our previous June 2015 release, but we have had to change to this for data availability reasons. However, this does not have a major impact on the overall rankings relative to two years ago.*

# ***PwC Golden age index methodology***

## How does it work?

*We used a standard method to construct this index, similar to the one used in the PwC Women in Work, Young Workers and ESCAPE indices, and by many other researchers constructing such indices.*



## ***PwC Golden Age index methodology***

### How did we calculate the potential long-term GDP increase?

We break down GDP in the following way:

$$GDP = \frac{15-54 FT * GDP}{per FT worker} + \frac{15-54 PT * GDP}{per PT worker} + \frac{55-64 FT * GDP}{per FT worker} + \frac{55-64 PT * GDP}{per PT worker} + \frac{65+ FT * GDP}{per FT worker} + \frac{65+ PT * GDP}{per PT worker}$$

#### **Key assumptions**

- Total employment in the economy is equal to the employment of 15 year olds and above.
- A full-time (FT) worker is twice as productive on average as a part-time (PT) worker, due to working twice as many hours on average.

We took New Zealand as a benchmark country as it is one of the best performing countries in the OECD and calculated the impact on GDP if countries raised their 55-64 and 65+ employment rates to New Zealand levels. New Zealand is a high performer in the 55-64 year old employment rates category and also performs relatively well in the 65+ employment category. However, if a country has a higher full-time equivalent employment rate than New Zealand in either age category, as is the case, for example, in the US and Norway for the 65+ category, we did not assume any change to the employment rate currently experienced in that country.

#### **Data**

- Employment data by age and FT/PT split is sourced from the OECD.
- Due to data constraints for some countries with the employment data based on a common definition, we used FT/PT data employment based on national definitions.
- FT/PT employment data based on a national definition is only available for the 65+ age range, as opposed to 65-69 which is used within our index.
- For Korea, the OECD did not provide data based on a national definition, so we used the employment data based on an OECD common definition instead (which was an option in the case of Korea). There was also no data on the FT/PT breakdown of the 65+ age group so we estimated this by applying the average change in the distribution of FT/PT workers across the OECD economies as you move from the 55-64 age group to the 65+ age group to the overall employment estimate for 65+ years olds in Korea.

# Drivers of the employment rate of older workers in the OECD

## Econometric methodology

- We used a dynamic panel approach in our analysis of employment of older workers, exploiting cross-country differences in employment rate for the 55-64 age group across the OECD.
- We used the existing academic literature on employment of older workers to inform our specification of drivers that explain the variables that could explain the employment rate. We narrowed our selection using the step-wise model selection technique in order to avoid the problems associated with multicollinearity, such as variables being individually insignificant and at times with unreliable coefficient signs.
- Our specification also contains fixed effects for each country to account for country-specific characteristics that explain the employment rate of older workers. The employment rate is also likely to be driven by structural factors – to account for this we included a lagged term for the employment rate in our overall specification to account for the persistence in the employment rate over time.
- To ensure robustness under a serially correlated dependent variable (in this case the employment rate of older workers), we used a system generalised method of moments (GMM) estimator (Blundell and Bond, 2000). The GMM approach involves using an instrumental variable-based approach where higher lag values of the lagged dependent variable are used as instruments. This approach also serves to eliminate any potential omitted variable bias and unobserved heterogeneity, which means country fixed effects are accounted for.
- The results from our analysis are shown in the table to the right.
- We find that our preferred specification pass all the robustness tests – (i) Robust Hansen test for validity of instruments (p-value = 0.234) (ii) Hausman test for the relevance of fixed effects (p-value = 0.01) and (iii) Arellano-Bond autocorrelation test for one (p-value = 0.072) and two lags (p-value = 0.272). We also checked normality of the model with quantile plots.

### Table of coefficients

Dependent variable: Employment rate, 55-64 year old	Coefficient (standard error)
Lagged employment rate, 55-64 age group	0.62 (0.12)***
Life expectancy	1.55 (0.50)***
Logarithm of average annual wage	-5.09 (2.08)***
Marital status	-0.29 (0.11)**
Expenditure on family benefits as a share of GDP	-0.95 (0.43)**
Public pension expenditure as a share of GDP	-0.95 (0.45)**
Strictness of employment protection for temporary contracts	-0.79 (0.35)**
Gender participation gap	-0.08 (0.07)

Source: PwC analysis.

\*significant at 10% level \*\*significant at 5% level \*\*\*significant at 1% level.

# ***Drivers of the employment rate of older workers in the OECD***

List of model variables used and other variables considered but not statistically significant

<b>Variables used in the econometric model</b>	<b>Definition</b>	<b>Source</b>
<b>Life expectancy</b>	Life expectancy at birth in years	OECD
<b>Logarithm of average annual wage</b>	Natural logarithm of average annual wage, measured in USD, at constant prices and 2010 PPP terms	OECD
<b>Marital status</b>	Share of the 55-64 population who are currently married	UN Population Division
<b>Expenditure on family benefits</b>	Government expenditure on family benefits as a percentage of GDP	OECD
<b>Public pension expenditure</b>	Government expenditure on public pensions as a percentage of GDP	OECD
<b>Gender participation gap</b>	Male labour force participation rate minus female labour force participation rate for the 55-64 age category	OECD
<b>Strictness of employment protection for temporary contracts</b>	OECD constructed index to measure the strictness of regulation on dismissals and the use of temporary contracts	OECD
<b>Other variables considered but not statistically significant</b>	<b>Definition</b>	<b>Source</b>
<b>GDP per capita</b>	GDP per capita, measured in USD, at constant prices and 2010 PPP terms	OECD
<b>Share of public sector employment</b>	Employment of public sector as a percentage of public and private employment	ILO
<b>Gender pay gap</b>	The difference between median wages for male and female	OECD
<b>Dementia deaths per 100,000</b>	Deaths per 100,000 population (standardised rates)	OECD
<b>Old age benefits</b>	Old age and survivors benefits as a % of GDP	OECD
<b>Disability benefits</b>	Incapacity related benefits as a % of GDP	OECD
<b>Share of 55-64 age group with tertiary education</b>	Share of population with tertiary educational attainment in the 55-64 age category	OECD
<b>Training and education participation rate for adults</b>	Participation in education and training by adults as a % of total adults above 18 years old	OECD, LFS, National Centre for Education Statistics
<b>Household wealth</b>	Household wealth per capita as a percentage of GDP per capita	OECD

## *Appendix 2: Bibliography*



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# *Appendix 3: Contacts*

## ***For more information about this report, please contact***



***John Hawksworth***  
Chief Economist, PwC UK  
E: john.c.hawksworth@pwc.com



***Carol Stubbings***  
Global Leader for People and Organisation, PwC UK  
E: carol.a.stubbings@pwc.com



***Carmen Cheung***  
Economist  
E: carmen.cheung@pwc.com



***Swati Utkarshini***  
Economist



***Saloni Goel***  
Economist  
E: saloni.x.goel@pwc.com

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