Chapter 2. Ageing and productivity growth in OECD regions: Combatting the economic impact of ageing through productivity growth?

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OECD countries and their regions are ageing fast. In principle, the negative impact of ageing on the growth of per capita gross domestic product (GDP) could be offset by increases in productivity. However, for many regions, the actual growth rates recorded have been lower than productivity growth required to maintain per capita GDP levels in recent years. One reason for this is that ageing also has a direct negative impact on productivity growth, with the effect being concentrated in urban areas. Part of the explanation is that cities specialise in sectors such as tradable services, where the content of tasks makes it difficult to automate the production process, and where business dynamism – negatively affected by demographic change – is a key driver of productivity growth. Finally, ageing seems to be associated with a redistribution of revenues away from workers, towards capital and firm owners.

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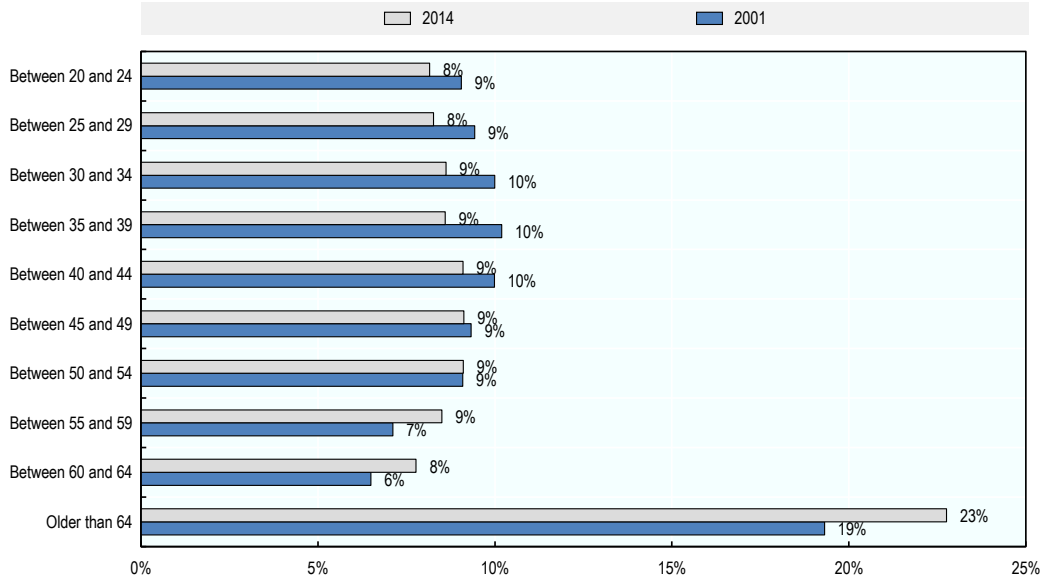
Introduction

Most OECD countries are facing a continuous increase in the share of older cohorts in the population, in other words, they are "ageing". The share of individuals aged 65 or older increased from 19% in 2001 to 23% in 2014, an increase of 21%, within only 14 years across 1 669 OECD Territorial Level Three (TL3) regions (Figure 2.1).[1] Ageing can have adverse economic consequences. For example, gains in life expectancy could be expected to be matched by an increase in the savings rate and a decline in the natural rate of interest, therefore making it harder for monetary policy to stabilise the economy (Bernanke, 2005[1]). The picture on the fiscal side is equally challenging. An increasing share of retirees means that a growing share of public spending needs to be diverted towards health and pension expenditure and away from investment.[2]

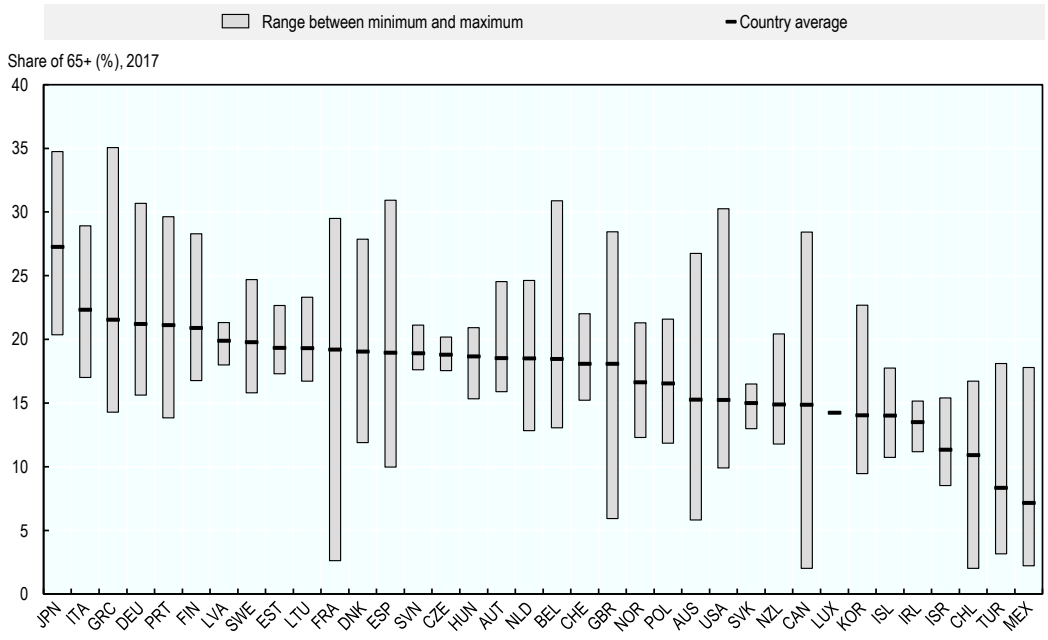
Figure 2.1. The share of individuals aged 65 or older increased between 2001 and 2014



Notes: Countries included are: AUS, AUT, CAN, CZE, DEU, DNK, ESP, FIN, FRA, GBR, HUN, IRE, ITA, JPN, KOR, NOR, NZL, POL, PRT, SVK, SVN, SWE, USA.
Source: OECD (2019[2]), *OECD Regional Statistics* (database), http://dx.doi.org/10.1787/region-data-en.

While most of the public discussion focuses on the national level, addressing ageing is even more pressing at the regional level given that ageing is progressing much more rapidly in some regions than in others (Figure 2.2). In the United Kingdom, for example, 18% of residents are 65 years or older, but the share is as low as 6% and as high as 28% across the country's small (TL3) regions. Moreover, at a regional level, the outflow of working-age residents towards places with more economic opportunities either within their own countries or abroad exacerbates the impact of low fertility rates and increased longevity on the average age.

Figure 2.2. Average ageing masks the severe pressures some regions are facing



Notes: Data for TL3 regions in 2017, except for AUS, JPN, NZL, USA (2016); CAN (2012).
Source: OECD (2019[2]), *OECD Regional* Statistics (database), http://dx.doi.org/10.1787/region-data-en.

This chapter provides a quantitative analysis of the potential for productivity growth to counter the expected negative impact of ageing on per capita gross domestic product (GDP). Older workers have lower labour force participation and employment rates. Ageing will, therefore, reduce the active workforce unless employment rates adjust. In principle, policies succeeding at boosting labour productivity growth could effectively contain the negative impact of ageing on per capita GDP growth (IMF, 2016[3]). However, the potential for productivity growth to compensate for ageing might be impaired by a direct negative impact of ageing on productivity growth itself, as several cross-country studies find. Complementing existing research, this chapter explores the link between ageing and productivity growth from a regional perspective.

The rate of productivity growth required to prevent per capita GDP from falling given the current trend of population ageing in OECD regions is, however, high. Cumulative per capita GDP growth would have been 1.5 percentage points higher in the absence of ageing on average across OECD regions between 2006 and 2014, while the actual average rate of productivity growth was 2.3% over the same period. However, zooming in on individual regions, productivity growth fell short of compensating for the negative impact of ageing on per capita GDP growth in almost half (49%) of OECD regions, with the resulting implication that per capita GDP would have contracted in these regions unless compensated by other factors, such as an increase in the participation rate.

The pressure from ageing and therefore, the need for productivity growth, varies widely across regions. For example, in the absence of ageing, cumulative per capita GDP growth would have been 5.7 percentage points higher for the average Japanese region, while this number is as low as 1.9 percentage points for the average Western European region. However, while in Japan productivity growth was on average 6.4%, it was negative for the average Western European region. Productivity growth, therefore, failed to even partially compensate for the negative impact of ageing on per capita GDP growth in Western European regions.

The second contribution of this study is to ask why productivity growth failed to attenuate the impact of ageing on per capita GDP growth in many regions. It does so by considering the link between ageing, measured as the increase in the ratio of those 50 years or older in the region to those 20-49 years old, with productivity growth in itself. This link turns out to be negative and statistically significant: the results indicate that a region where ageing exceeds the country average by 10 percentage points was expected to grow cumulatively 1.5 percentage points less than the country average in terms of labour productivity between 2001 and 2014. Taking a concrete example, the productivity growth of Madrid, the capital city of Spain, was 6.5%, about 3.6 percentage points lower than for the country as a whole. At the same time, the ratio of older residents to younger ones rose 10.4 percentage points more in Madrid than in Spain as a whole. The most conservative estimates suggest that about 50% of the growth gap is associated with the ageing population in the capital city. Similarly, ageing in Kyoto was 7 percentage points lower than the country average, while at the same time labour productivity growth exceeded the country average by 2.6 percentage points, implying that about 45% of higher growth experienced by Kyoto is due to more favourable demographic trends.

A breakdown by regional typology shows that the impact of ageing on productivity growth is primarily driven by urban regions. Predominantly urban TL3 regions where the growth rate of the old-to-young ratio was 10 percentage points higher than the country average had, on average, 1.9 percentage points slower productivity growth than the country average. For intermediate regions, the effect is 1.4 percentage points lower than for urban regions, whereas the estimate for predominantly rural regions is statistically insignificant. Differences in sectoral composition offer a potential explanation for the differential impact of ageing across region types. Productivity growth in the manufacturing sector is not found to differ systematically between regions ageing faster and those ageing more slowly. In contrast, the negative association between ageing and productivity growth is strongest in knowledge-intensive, tradable services (information and communication technologies, finance and insurance), which are predominantly located in cities.

A variety of channels can lead to the differential impact across sectors. Tradable services are characterised by a prevalence of non-routine and interactive tasks, which, in the past, have been harder to substitute for, while the standardised nature of processes in manufacturing has made it easier to automate production or outsource the most labour-intensive elements.

Another channel is that the process of "creative destruction" – the notion that less profitable (or productive) business ventures are abandoned in favour of more profitable (or productive) ones – is likely to matter more in sectors where technological progress is rapid. Dynamism, measured by the "churn" of businesses, i.e. the ratio of the total newly created and closed down business to total businesses in the region, is indeed lower in regions with an older workforce. This negative relationship is more pronounced in urban regions, in line with the argument that the sectors located in cities are more dependent on "creative destruction".

Related academic literature

Several studies have analysed the consequences of ageing on productivity growth (Feyrer, 2007[4]; Aiyar, Ebeke and Shao, 2016[5]; Liu and Westelius, 2016[6]; Maestas, Mullen and Powell, 2016[7]). In line with the findings in this chapter, most of these studies find a negative association between the age structure of the population and aggregate productivity. An exception is Acemoglu and Restrepo (2018[8]), who find a positive link. Their results indicate that countries, where ageing has been faster, are also characterised by a higher rate of technology adoption, which can, therefore, be considered the market response to increasing labour shortages and upward pressure on wages.

Ageing can have an impact on productivity growth for multiple reasons. One explanation has to do with the changing composition of the workforce and the way in which individual productivity evolves during the life cycle of the worker. A few studies show that productivity tends to increase up to a certain age and levels out thereafter (Aubert and Crépon, 2007[9]), (van Ours and Stoeldraijer, 2011[10]). Skirkbekk (2004[11]) further shows that whether productivity starts declining after a certain age heavily depends on the type of tasks carried out by workers.

A second explanation stresses that an ageing population can have detrimental effects on productivity growth of all workers. Maestas, Mullen and Powell (2016[7]) show in particular how ageing has a negative impact on productivity growth of workers belonging to different age groups. In a similar vein, the relationship between the productivity and the age of workers is not identical to the one between the productivity of firms and the age structure of their employees (Grundke et al., 2017[12]).

One reason why the relationship between age and productivity at the aggregate level is not just a rescaled version of the one observed at the individual level is that there exist complementarities and spillovers across different elements of an integrated economic system, such as a firm or a region. The productivity of individual workers hinges, in fact, on the practices adopted by their managers (Bloom and Van Reenen, 2007[13]), and on the teams to which they belong (Garicano, 2000[14]). The negative consequences for firms of being located in an ageing labour market are amplified by the existence of productivity spillovers at the local level (Ahrend, Lembcke and Schumann, 2017[15]).

Alternatively, the relationship between age and productivity at the aggregate level differs from the one observed at the individual level by the way in which ageing affects the interaction and competition among individual firms. A few studies have dealt with the relationship between demographic shifts and firm dynamics and found a close link between population decline – which is closely connected with ageing – and the decline in the start-up rate, the rise in product market concentration and the decline in the labour share (Karabarbounis and Neiman, 2014[16]; Hopenhayn, Neira and Singhania, 2018[17]).

Finally, differences in productivity growth between faster and slower ageing countries might be explained by differences in the rate of capital accumulation, as opposed to differences in the growth rate of average worker productivity (Oliveira Martins et al., 2005[18]; Börsch-Supan, Ludwig and Winter, 2006[19]; Geppert, Abiry and Abiry, 2016[20]; Bárány, Coeurdacier and Guibaud, 2019[21]).

Overall, if the evidence on the nexus between the age structure of the population and labour productivity across countries appears to be scant, it is even scarcer at the regional level. An exception is a study by Zaninotto et al. (2018[22]) who consider the relationship between productivity and the share of workers affected by the postponement of the effective

retirement age imposed by the "Fornero reform" (2011) across Italian provinces. They also find a negative link between productivity and the share of older workers.

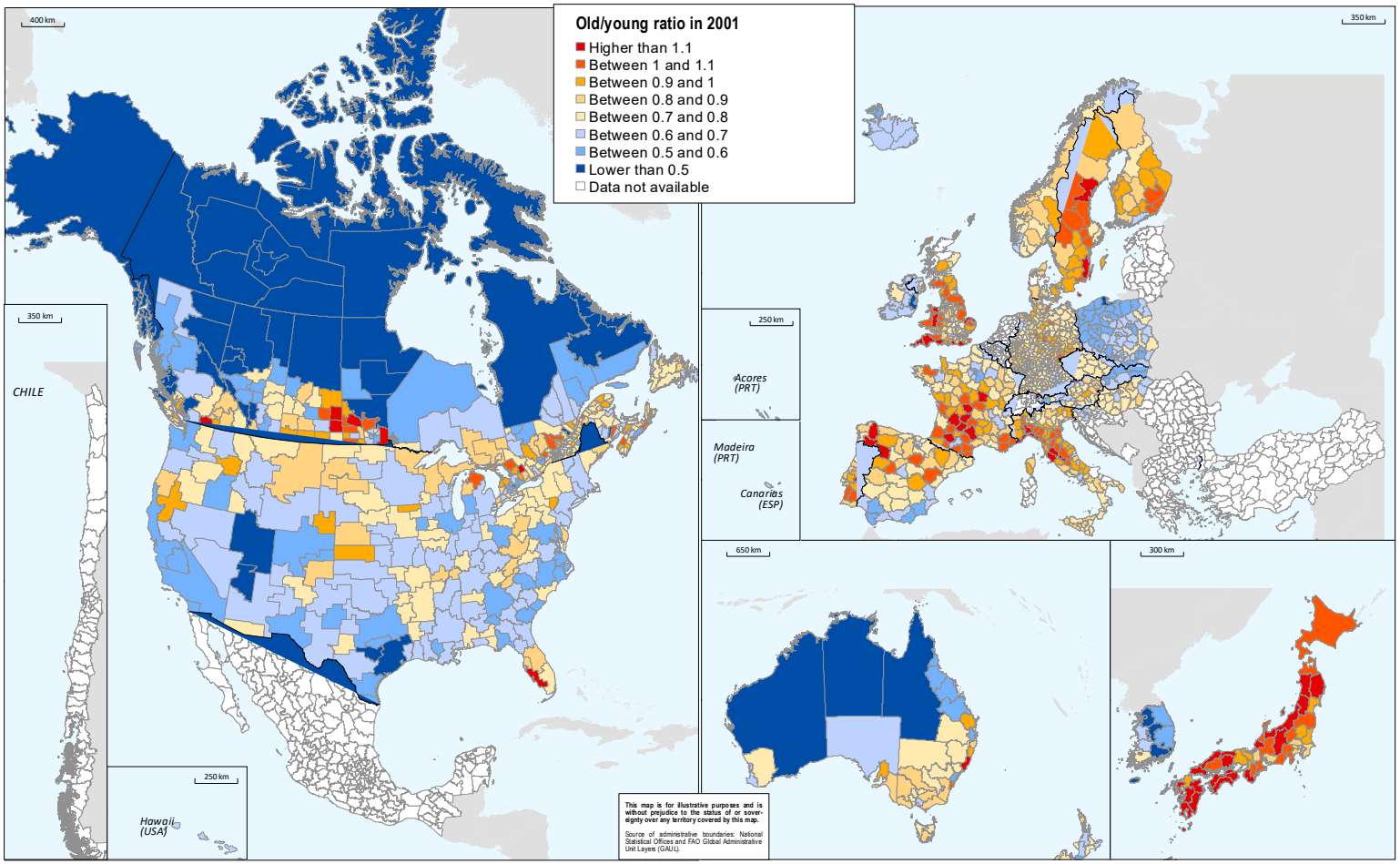
There are several reasons to depart from a national perspective and opt for a regional analysis. The main one is that ageing could reinforce existing productivity gaps (McCann, 2016[23]; OECD, 2018[24]). For instance, it could be that productivity growth is negatively affected by ageing only in the more productive regions so that ageing would act as a force towards convergence. Alternatively, a negative link might only exist for less productive regions. Within countries, public transfers might help overcome the economic decline that individual regions face. Some of these transfers are natural as retirees start drawing on their (public) pensions. As output gaps continue to increase with ageing, the need for (additional) transfers will also continue to increase. Sorting of young people into more productive (and higher cost) places and the elderly into less expensive areas reinforces these divides. This risks an increasing dependence of some regions on transfers, risking a region's capacity to leverage its growth potential and develop new economic opportunities.[3]

Demographic change across regions today and tomorrow

Ageing is progressing rapidly in OECD regions. Some regions already had a high share of elderly residents in 2001; others are rapidly catching up (Figure 2.3 and Figure 2.4). These two figures show the level and the change in the "old-to-young ratio", namely the ratio between the number of people aged 50 or more and the number of people aged between 20 and 49. In some regions, both of these factors coincide: for example, Spanish regions already had very high old-to-young ratios in 2001 and they increased during 2001-14. Other regions were "young" in 2001, but they experienced rapid ageing during 2001-14, such as in Korean regions.

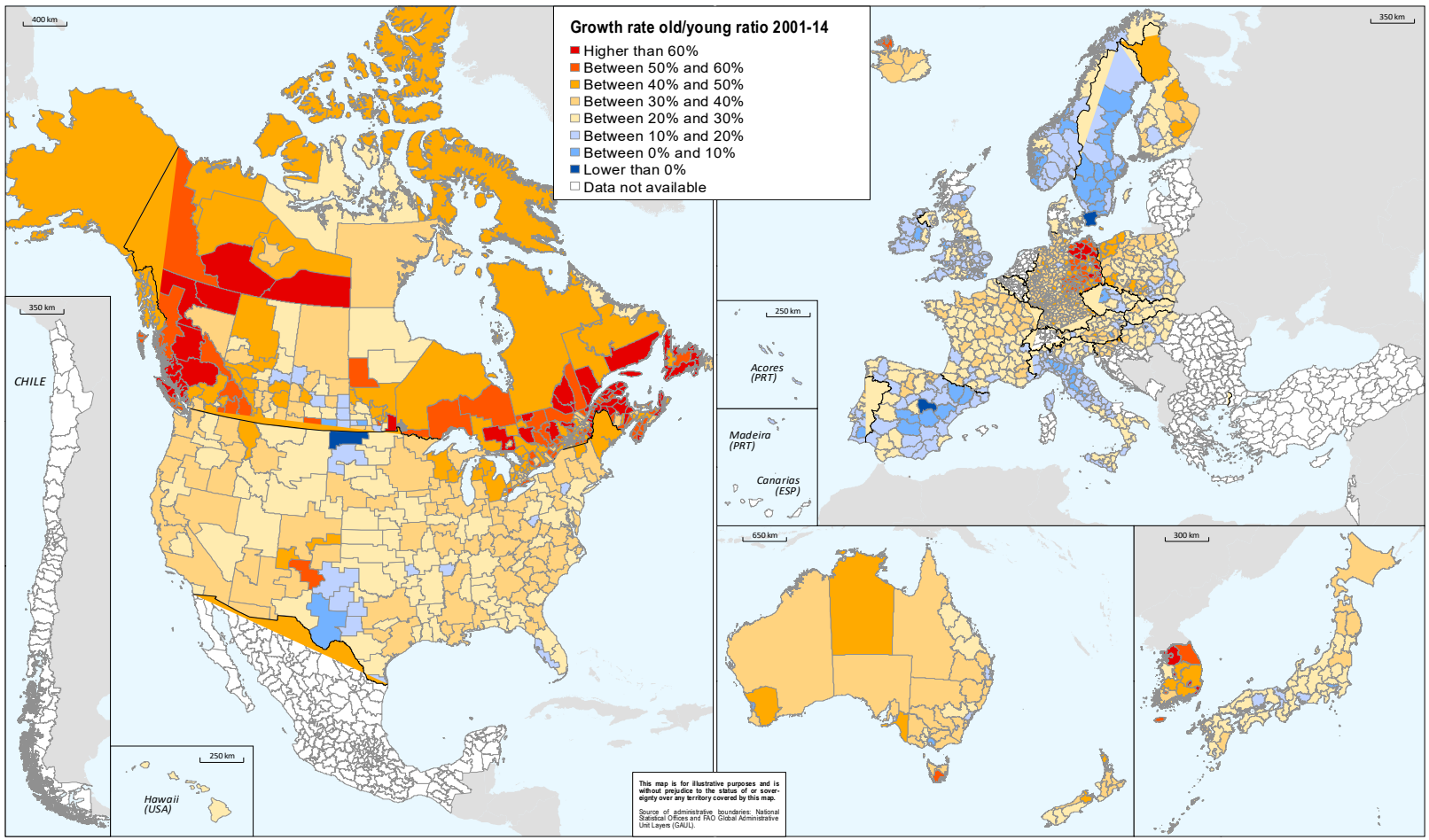
Working with the European Commission's Joint Research Centre (JRC), the OECD has adapted one of the few subnational population projections that exist, the main scenario of Eurostat's "Europop2013" model (Eurostat, 2015[25]).[4] The projections highlight a convergence in the age profiles of rural and intermediate regions, and a divergence of rural and intermediate regions with respect to urban ones (Figure 2.5). Urban regions are expected to age slower than rural and intermediate regions. Diverging trends in birth rates certainly play a role, but the economic migration of young workers is likely to be also crucial in countries where the productivity gap between slow and fast-ageing regions is increasing.

Figure 2.3. The ratio of old (50+ years) to young (20-49 years) people in 2001 across OECD TL3 regions



Source: OECD (2019[2]), *OECD Regional Statistics* (database), http://dx.doi.org/10.1787/region-data-en (accessed on 5 February 2019).

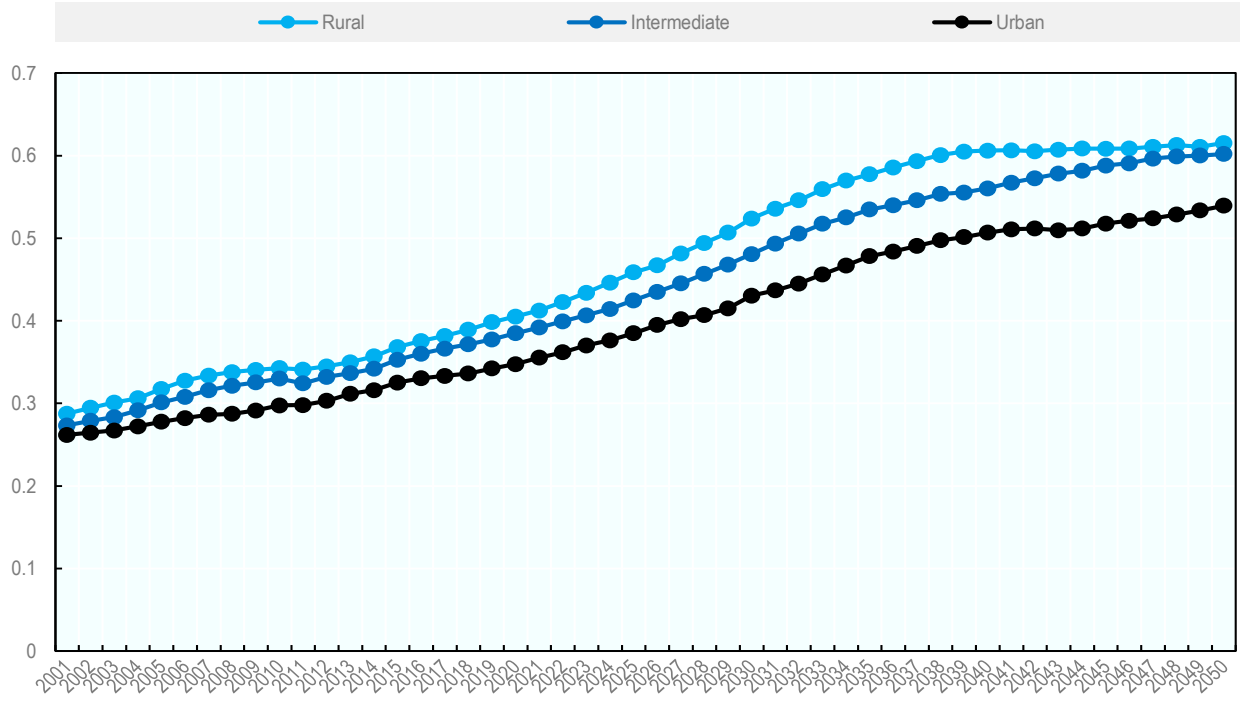
Figure 2.4. The growth rate in the ratio of old (50+ years) to young (20-49 years) people during 2001-14 across OECD TL3 regions



Source: OECD (2019[2]), *OECD Regional Statistics* (database), http://dx.doi.org/10.1787/region-data-en (accessed on 5 February 2019).

Figure 2.5. The rural-urban divide in terms of demographic profiles will grow

Dependency ratio by TL3 region type: Actual values and projections



Notes: Population projections based on the Eurostat's "Europop 2013 scenario". Countries included are: AUT, CZE, DEU, DNK, ESP, FIN, FRA, GBR, HUN, IRE, ITA, NOR, POL, PRT, SWE, SVK, SVN. First year of projections: 2018.
Source: OECD (2019[2]), *OECD Regional Statistics* (database), http://dx.doi.org/10.1787/region-data-en (accessed on 5 February 2019); Eurostat statistics on regional population projections in Eurostat (2015[25]), *People in the EU: Who are we and how do we live? 2015 Edition*, Eurostat Statistical Books.

The need for productivity growth

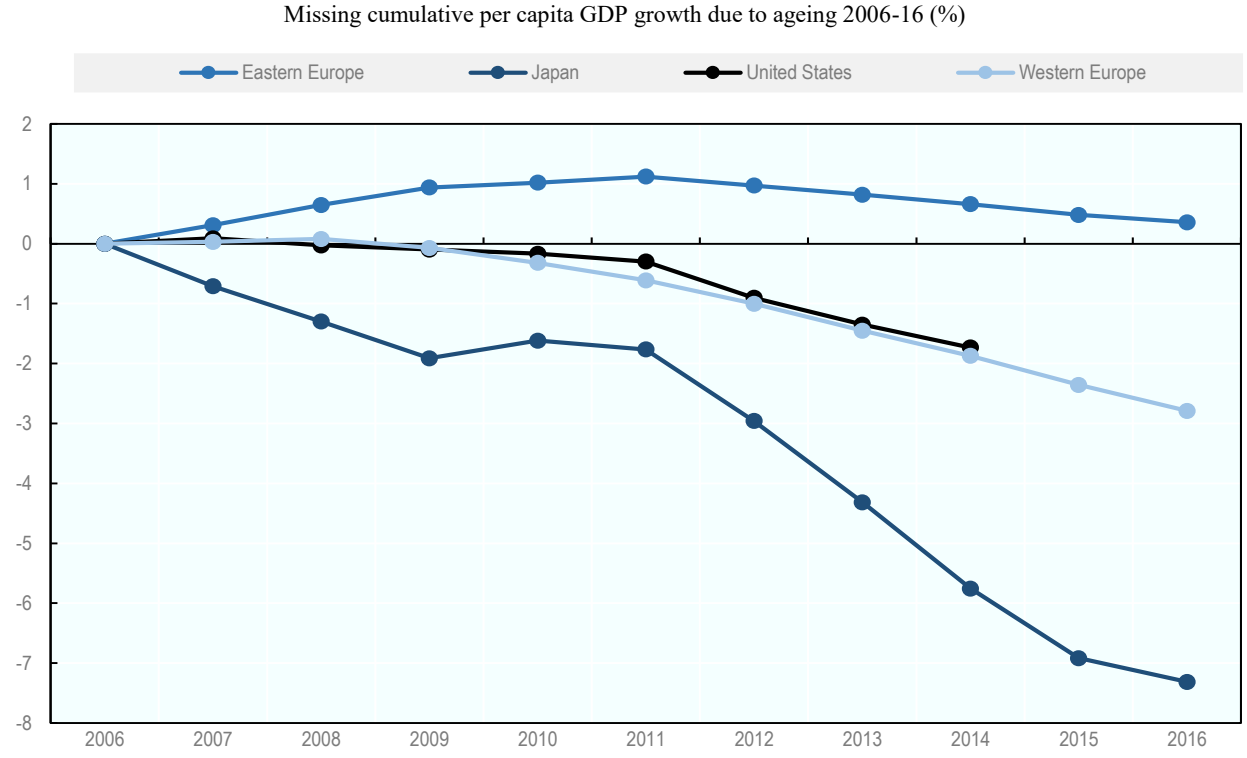
Ageing affects per capita income in regions through different channels. The most direct channel is a decline in the labour force as labour force participation eventually declines with age and people reach retirement age. Due to the declining share of individuals of working age in the population, per capita GDP growth is expected to slow or even decline in regions ageing faster unless, of course, employment rates rise for older workers or the retirement age is postponed.

The extent to which ageing has negatively affected per capita GDP growth in regions over the period analysed also depends on whether productivity growth was sufficient to keep per capita GDP from declining due to ageing (assuming that employment rates remain constant at their 2006 value).[5] For example, if ageing in a given region has caused per capita GDP growth to be 1 percentage point lower than it would have been without a change in the population distribution, then a 1 percentage point increase in labour productivity growth could have kept per capita GDP from decreasing.

Cumulative productivity growth between 2006 and 2014 that was required to offset the negative contribution of ageing on per capita GDP growth was about 1.5 percentage points for the average Territorial Level Two (TL2) region. In some rapidly ageing regions, the value was even higher, up to 5.7 percentage points for the average Japanese region

(Figure 2.6). This need is sizeable when benchmarked against actual productivity, which was 6.4% for the average Japanese region. The impact of ageing was compensated and per capita GDP prevented from falling. About half (51%) of OECD regions raised productivity sufficiently to offset the negative impact of ageing on per capita GDP growth during the 2006-14 period (Figure 2.7). In 85% of the 49% of remaining regions, the result was a decline in per capita GDP.

Figure 2.6. Ageing reduced per capita GDP growth by 1.5 percentage points during 2006-14



Notes: Countries included are: AUT, BEL, BGR, CZE, DEN, GRE, ESP, FIN, FRA, HUN, IRE, ITA, JPN, NLD, NOR, POL, PRT, SWE, SVK, USA. Eastern Europe countries are: BGR, CZE, HUN, POL and SVK.
Source: OECD (2019[2]), *OECD Regional Statistics* (database), http://dx.doi.org/10.1787/region-data-en (accessed on 5 February 2019); Eurostat (2019[26]), *General and Regional Statistics* (database), https://ec.europa.eu/eurostat/data/database (accessed on 5 February 2019); Statistics Japan (2019[27]), *Labour Force Survey*, https://www.stat.go.jp/english/data/roudou/index.html; US Census Bureau (2020[28]) *American Community Survey (database)*, Explore Census data (accessed 20 May 2019).

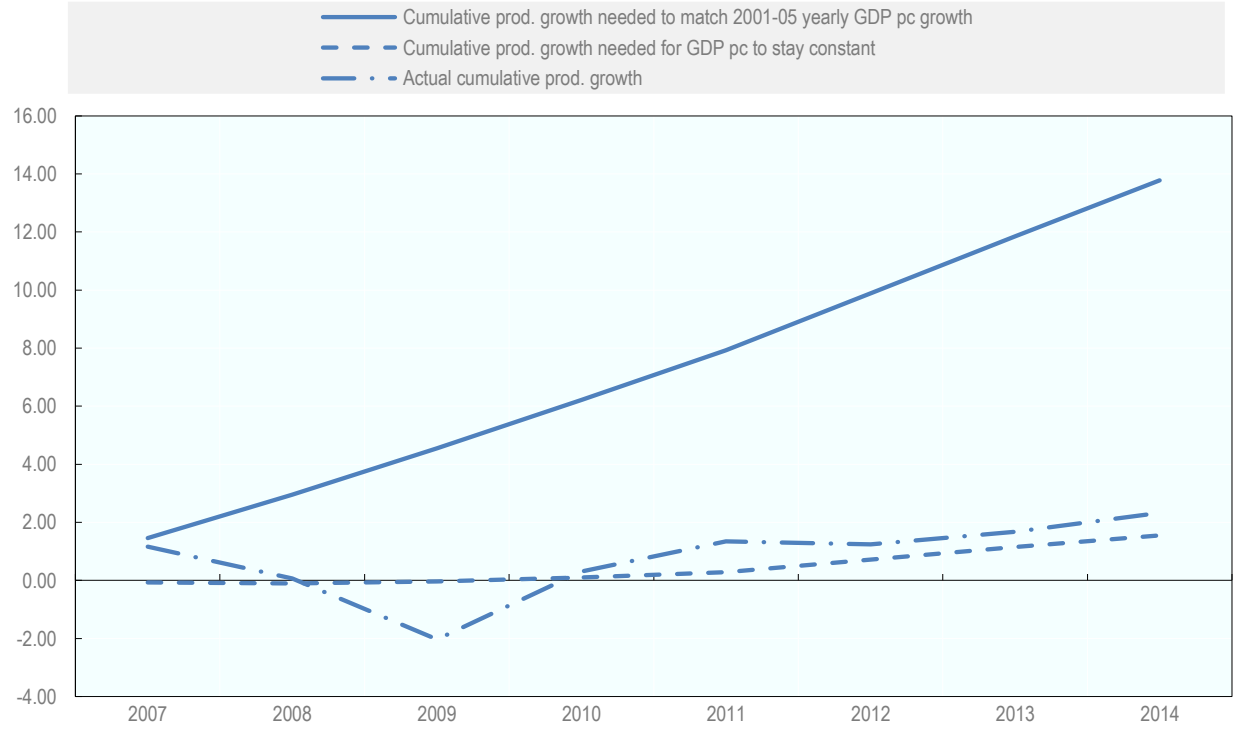
Differences in the severity with which the Great Recession hit Japanese and Western European regions can explain the different degree of compensation provided by productivity growth in the two sets of regions. In Japan, more than 50% of the regions featured enough productivity growth to offset the negative impact of ageing. Per capita GDP declined in just 50% of the remaining regions, i.e. fewer than one in four regions experienced a decline in income levels. In contrast, in Western Europe, productivity growth in less than 50% of regions was high enough to compensate for ageing, and per capita GDP declined in more than 80% of the remaining ones.

An alternative benchmark is the pre-crisis growth in the different regions. The required productivity growth to retain pre-crisis per capita GDP growth levels during the 2006-14 period is significantly higher than the growth required to simply maintain income levels (Figure 2.7). Nearly 88% of TL2 regions were not able to reach the more ambitious

productivity growth target and recorded strictly less productivity growth than the level required to maintain the same per capita GDP growth the region posted during the 2001-06 period.

Figure 2.7. In half of regions, productivity growth fell short of compensating for ageing

Actual labour productivity growth vs. needed productivity growth in TL2 regions (%)



Source: OECD (2019[2]), *OECD Regional Statistics* (database), http://dx.doi.org/10.1787/region-data-en (accessed on 5 February 2019); Eurostat (2019[26]), *General and Regional Statistics* (database), https://ec.europa.eu/eurostat/data/database (accessed on 5 February 2019); Statistics Japan (2019[27]), *Labour Force Survey*, https://www.stat.go.jp/english/data/roudou/index.html.

Ageing and labour productivity growth from a regional perspective

The geographical units employed for this analysis are TL3 "small" regions. There are a total of 1 802 small regions in OECD countries. Each TL3 region is contained in a TL2 region. In most cases, TL3 regions correspond to administrative regions. This classification is largely consistent with the Eurostat "NUTS 3" classification.

As mentioned above, ageing is measured as the growth rate in the ratio of old (aged 50 or more) to young workers (aged between 20 and 49). The old-to-young ratio increased for the median region by 25% between 2001 and 2014 (Table 2.1). Behind this aggregate statistic, there is, however, a high degree of heterogeneity. The difference between median ageing in rural and urban regions is 6 percentage points and is expected to widen according to projections (Figure 2.4).

Table 2.1. Old-to-young ratio growth rates by regional typology (TL3), 2001-14

Group	5th percentiles	Median	95th percentile	Number of regions
Predominantly rural	3.30	27.37	57.92	369
Intermediate	4.53	26.00	41.08	375
Predominantly urban	-0.76	21.41	39.69	382
All regions	1.95	25.16	49.54	1 126

Notes: TL3 regions are grouped into rural/intermediate/urban typology based on the OECD classification.
Source: OECD (2019[2]), *OECD Regional Statistics* (database), http://dx.doi.org/10.1787/region-data-en (accessed on 5 February 2019).

To identify the causal impact of ageing on productivity growth, the share of 0-4 year-olds in 1981 and 1991 is used as an instrument for ageing in a region.[6] The validity of this instrument is justified based on the assumption that fertility decisions taken in 1981 and 1991 do not affect productivity growth between 2001 and 2014 except through their impact on population ageing. Given data limitations, only a subset of regions can be included in the analysis. The relevant OLS (ordinary least squares) estimate is reported alongside the instrumental variable (two-stage least squares) results.

The two-stage least squares (2SLS) results indicate that 10 percentage point faster ageing causes a 1.5 percentage point decline in productivity growth within countries. Hence, for instance, productivity growth was 1.5 percentage points lower than the country average in a Korean region where ageing exceeded the country average by 10 percentage points, which corresponds to the extent of ageing for the average region in the sample between 2001 and 2007. The impact is marginally lower compared to the OLS estimates (second column of Table 2.2), and the direction of the change suggests a downward bias, which is in line with what the majority of omitted variable examples would suggest.[7]

Table 2.2. Ageing and labour productivity growth

Variables	Labour productivity growth, 2001-14	
	OLS	2SLS
Growth old/young	-0.16***	-0.15*
	(0.04)	(0.08)
Initial labour productivity	-0.03	-0.03
	(0.02)	(0.03)
Observations	461	461
R-squared	0.54	0.54
Country FE	Yes	Yes
F-test		62.81

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Countries included: ESP, FIN, FRA, GBR (only England and Wales), IRE, ITA, JPN, SWE. The set of instruments comprises the share of 0-4 year-olds in 1981 and 1991.

Source: Labour productivity and population data: OECD (2019[2]), *OECD Regional Statistics* (database), http://dx.doi.org/10.1787/region-data-en (accessed on 5 February 2019).

Historical population: Statistics **Finland** (2019[29]), *Statistics Finland - Statistics by topic - Population structure* (database) https://www.stat.fi/til/vaerak/tau_en.html; for **France**: INSEE (2019[30]), "Estimation de la population au 1er janvier 2019 | Insee", https://www.insee.fr/fr/statistiques/1893198; for **Ireland**: Central Statistics Office (2019[31]), "Historical Reports - CSO - Central Statistics Office", https://www.cso.ie/en/census/censusvolumes1926to1991/historicalreports/; for **Italy**: ISTAT (1982[32]), "12. Censimento generale della popolazione: 25 ottobre 1981", https://ebiblio.istat.it/SebinaOpac/resource/12-censimento-generale-della-popolazione-25-ottobre-1981/IST0069127 and ISTAT (2019[33]), "Popolazione residente ricostruita - Anni 1991-2001", http://dati.istat.it/Index.aspx; Statistics **Japan**, (2019[34]), "Population estimates 1920-2000 for Japan", https://www.e-stat.go.jp/en/; for **Spain**: INE (2019[35]), "Población (1981) por provincias, edad y sexo", http://www.ine.es/jaxi/Tabla.htm?path=/t20/e245/p06/l0/&file=1981.px&L=0 and INE (2019[36]), "Censos de Población y Viviendas 1991", http://www.ine.es/censo91/es/seleccion_ambito.jsp; Statistics **Sweden** (2019[37]), *Statistical database*, http://www.statistikdatabasen.scb.se/; and for the **United Kingdom** and **Wales**: Casweb (2019[38]), "Casweb - Census Area Statistics on the Web", http://casweb.ukdataservice.ac.uk/step0.cfm.

Ageing is strongly negatively associated with productivity growth in predominantly urban and intermediate regions, once corrected for bias (second column of Table 2.3).[8] In predominantly urban TL3 regions, 10 percentage point faster ageing is associated with a 1.9 percentage point decline in productivity growth relative to other regions within the country. The concentration of the impact of ageing in cities matters for at least two reasons. The first is that the affected population is larger as more people live in cities, thus aggravating the aggregate repercussions of ageing. The second is that ageing is expected to progress more slowly in urban areas compared to rural areas (Table 2.1). The heterogeneous speed of ageing across regions, therefore, provides an hidden benefit. The adverse impact on productivity growth due to the increase in the old-to-young ratio is milder in places where this ratio will increase the most. There is a notable difference between the estimates that account for potential bias (2SLS) and those that do not (OLS), a difference that was not evident when the spatial heterogeneity was ignored. As the omitted variable is of course unobserved it is impossible to identify the channel with certainty. The most likely explanation is that the IV strategy (historic births in the region) adopted in this chapter accounts for bias created by migration flows. An inflow of migrants from other parts of the country or abroad reduces the old/young ration, i.e. it is negatively correlated with its growth. An inflow of new residents is also expected to be negatively associated with average productivity in the region (slack in the labour market lowers wages and makes less productive activities possible, the average skill and experience of migrants is below the regional average, etc.), which in combination results in an upward bias in the OLS estimates.

Table 2.3. Ageing and labour productivity growth: Breakdown by regional typology

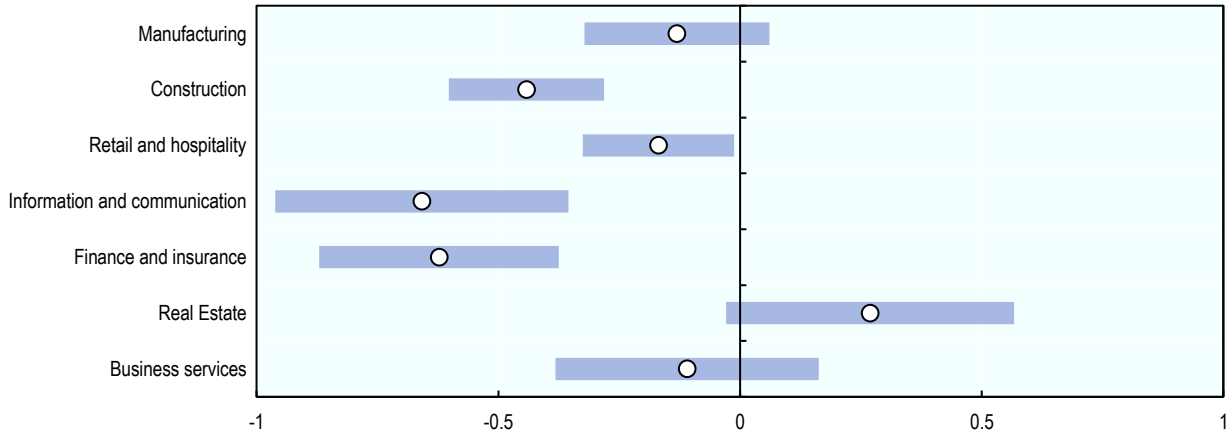
Variables	Labour productivity growth, 2001-14	
	OLS	2SLS
Growth old/young (Rural)	0.18***	0.05
	(0.07)	(0.06)
Growth old/young (Intermediate)	0.06	-0.14**
	(0.07)	(0.06)
Growth old/young (Urban)	0.05	-0.19***
	(0.05)	(0.04)
Observations	697	697
R-squared	0.58	0.77
Country FE	No	Yes

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Observations are TL3 regions in the following countries: AUT, CZE, DNK, ESP, FIN, FRA, GBR, HUN, IRE, ITA, JPN, KOR, NOR, POL, PRT, SWE, SVN, SVK. The distinction between rural/intermediate/urban is based on the OECD classification. The coefficients on initial labour productivity for each group of regions are omitted from the displayed results.
Source: OECD (2019[2]), *OECD Regional Statistics* (database), http://dx.doi.org/10.1787/region-data-en (accessed on 5 February 2019).

Differences in sectoral composition between rural and urban regions offer a potential explanation behind the disproportionate negative impact of ageing on productivity growth in cities. As mentioned above, the sectors in which ageing has the most negative impact on productivity growth are in knowledge-intensive, tradable services, such as information and communication, finance and insurance (Figure 2.8), which tend to be disproportionately located in cities.

One potential channel behind the heterogeneous impact of ageing on productivity growth across sectors is the existence of compensating mechanisms – in particular, capital investment – supporting productivity growth more easily in some sectors than in others. For instance, the adoption of robots in the wake of mounting labour shortages can be an effective tool for compensating for the negative consequences of ageing on productivity growth in the manufacturing sector. Existing research provides empirical evidence in support of the effectiveness of this compensating mechanism for the United States (Acemoglu and Restrepo, 2018[8]). Unlike the study for the United States that focuses on per capita GDP and finds that automation can even overcompensate the impact of ageing and create a positive stimulus for per capita GDP growth, the results for regional labour productivity suggest that the impact of ageing is, at best, absorbed through compensation mechanisms (Figure 2.8). Productivity in manufacturing or hospitality and retail is less or not at all affected by ageing, in line with tasks performed by workers in these sectors being at among the highest risk of being replaceable by automation (OECD, 2018[39]).

Figure 2.8. Ageing and labour productivity growth by sector, 2001-14

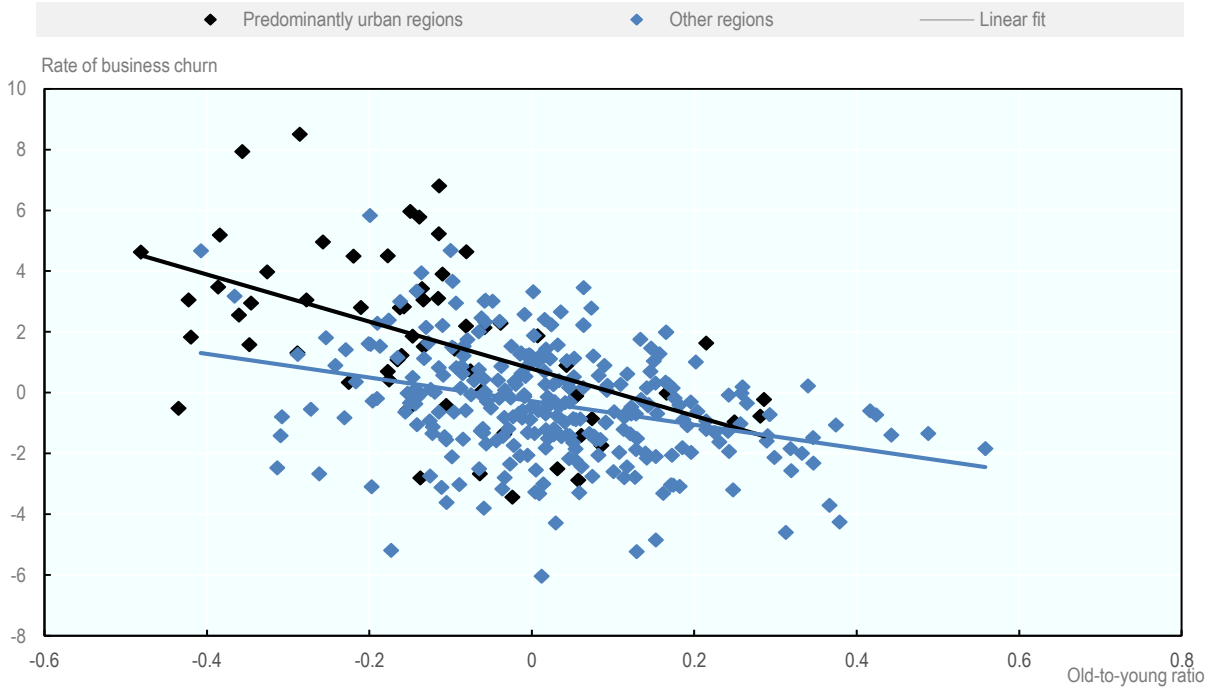


Notes: Each dot corresponds to the OLS coefficient on the growth rate of the old-to-young ratio in a regression of the growth rate of labour productivity in a specific sector with country-fixed effects and controlling for the speed of convergence. The line for each dot spans the 90% confidence interval of the corresponding coefficient. Observations are TL3 regions in the following countries: CZE, DNK, FIN, FRA, GBR, HUN, IRE, ITA, PRT, SWE, SVN, SVK, 462 regions in total. For the breakdown into tradable vs. non-tradable, see (OECD, 2018[24]).
Source: OECD (2019[2]), *OECD Regional Statistics* (database), http://dx.doi.org/10.1787/region-data-en (accessed on 5 February 2019).

Another potential channel behind the heterogeneous impact of ageing on productivity growth across sectors is that knowledge-intensive sectors tend to rely more on business dynamism than other ones. Business dynamism is measured by the sum of firm births and deaths over the total number of firms in a given period, and it underlies the process of "creative destruction" through which new ideas are created that replace the old ones, thus pushing the innovation frontier further. Business dynamism is lower in older regions, and the negative association between business dynamism and ageing is stronger in urban regions (Figure 2.9). The concentration of knowledge-intensive sectors in urban regions might explain the stronger impact. Another reason might be that the decline in dynamism is mainly driven by a lack of start-ups. Ageing is associated with population decline and population decline, in turn, has a negative contemporaneous impact on the start-up rate (Hopenhayn, Neira and Singhania, 2018[17]). Other explanations are of course, possible. The ambition of entrepreneurs might change with age. Evidence from the United States finds, on the one hand, that successful firms (in terms of growth) are, on average, founded by entrepreneurs in their mid-forties (Azoulay et al., 2018[40]). On the other hand, the ambition of expanding a firm tends to decline with age and only a small fraction of early-stage entrepreneurs is driven by the desire to bring a new idea to market (Hurst and Pugsley, 2011[41]).

Figure 2.9. Business dynamism is lower in "older" regions

Rate of business churn and ageing inTL3 regions, 2014



Notes: Both the rate of churn and the old-to-young ratio are demeaned within countries, such that a value of 5 for business churn indicates the region has a churn rate that is 5 percentage points higher than the (unweighted) country average across TL3 regions.
Source: Calculations based on OECD (2019[2]), *OECD Regional Statistics* (database), http://dx.doi.org/10.1787/region-data-en (accessed on 5 February 2019).

Conclusion

Ageing is gaining pace across the majority of OECD regions. The elderly dependency rate is expected to double, on average, across a large set of European regions by 2050, and other OECD countries are likely to follow suit. Ageing is likely to exacerbate existing divides further. Large metropolitan areas are expected to age more slowly than smaller cities and rural areas. More broadly, the economically stronger regions are ageing more slowly. Within Europe, the gap in the elderly share between (today's) richest 25% of TL3 regions and the poorest 25% is projected to be about 4 percentage points (OECD, 2019[42]). This means ageing is not just a challenge in selected rural regions but is more pervasive. Many urban regions are ageing as fast as rural regions, and the findings in this chapter show that the consequences in terms of productivity growth will be mostly felt in small and medium-sized cities. It is therefore important to take concrete steps to address the negative consequences of ageing in terms of economic growth.

Fiscal transfers that support local economic and public sector activity are often the first proposed option. Ageing implies a decline in the local tax base, thus forcing regions to rely more on transfers to finance the provision of public services, although it may also imply less demand for public services and therefore allow downsizing of public employment in the face of shifting demographics (Pilichowski, Arnould and Turkisch, 2008[43]). In many instances, transfers are indispensable to maintain living standards, but a compensatory approach risks displacing other economic activity or the incentive to develop

them (OECD, 2016[44]), and persistent cross-regional subsidies can lead to a perceived regional stigma and loss of pride and cultural identity (OECD, 2019[42]). Instead, the policies should leverage the local economic potential that remains, by increasing employment and productivity.

Drawing on the analysis in this study, an important set of policies that has, so far, not been associated with strategies to address the impact of ageing are those targeting productivity growth. At the individual level, initiatives promoting lifelong learning through the concerted efforts of both employers and employees can successfully reduce the risks associated with skill obsolescence during older ages, and raise productivity in general. The result that particularly knowledge-intensive occupations are most adversely affected by ageing reinforces this point. Developing skills and human capital via a place-based approach offers high potential returns, as training can be targeted to local needs, engage with existing employers and avoid (costly) migration to other places. Such a place-based approach requires that regional economic development strategies be connected with education and labour policies for local skills development (OECD, 2016[45]; OECD, 2018[24]).

Many fast-ageing countries are already adapting their economic structure through increasing labour force participation among older cohorts (Banks, Emmerson and Tetlow, 2018[46]; OECD, 2017[47]).[9] This includes measures such as indexing the retirement age to life expectancy (OECD, 2017[47]). Beyond extending the working life, the inactive working-age population can be a source of additional inflow into the labour force (Barr, Magrini and Meghnagi, 2019[48]). The challenge in both cases is that the skills of the workforce and labour market needs are not necessarily well matched. There are no quick fixes to this challenge, but interventions need to start early and ensure that the supply of skills can map into local demand. Providing measures to mid-career workers that help them adapt their skillsets to changes in the labour market and their personal capabilities is therefore as important as providing training to workers in later career stages. This might require changing the way firms produce as older workers' physical capabilities change and often decline. High productivity might, therefore, require investment into new tools and machines, but also changes in production processes that ensure that firms can get the most out of their experienced workforce (OECD, 2018[49]).

Promoting entrepreneurship among older age segments also helps prolong the working lives of older people. Nearly one-third of new senior entrepreneurs in EU and OECD countries indicated that they offered new goods and services over the 2012-16 period – the same proportion as in the adult population (OECD/European Union, 2017[50]). In particular, high-skilled workers can leverage their experience and use entrepreneurship as a tool to transition into retirement. But ageing among entrepreneurs creates additional challenges. The transfer of successful businesses is often challenging and can deter investment. As owners near the retirement age, they are less likely to take risks and forego opportunities for longer-term investments. In Japan, for instance, more than 300 000 small and medium-sized enterprises are run by owners who are at least 65 years old. Among these, about one in five micro-firms believe that discontinuing the business when the owner retires is unavoidable. In Italy, about 9% of entrepreneurs are over 70. In Canada, approximately 50-60% of current business owners will retire by 2027 (OECD, 2018[51]). The challenge is exacerbated in rural areas, as urbanisation trends make it more difficult for business owners to find eligible successors.

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Notes

1. Regions (TL2 and TL3) are classified by the OECD into two territorial levels that reflect the administrative organisation of countries.

2. See the handbook article in Lee and Mason (2017[53]) for a more detailed discussion of the macroeconomic effects of ageing.

3. See OECD (2014[52]) for a discussion of the need to move beyond transfers in regional policy and rather focus on investments that unlock growth potential.

4. Europop2013 includes a component that projects demographic change at the regional level until 2050.

5. See the full version of the working paper for details on how to compute the impact of ageing on per capita GDP growth through the reduction in the ratio of working age to total population (Daniele, Honiden and Lembcke, 2019[54]).

6. Out-migration of young workers from less productive regions towards more productive regions in the same country is one reason why regions whose productivity is growing less are also ageing faster. The instrumental variable approach is proposed precisely to eschew these concerns.

7. A downward bias as in this case occurs when the omitted variable is positively (negatively) associated with ageing and negatively (positively) associated with productivity growth. Quality of institutions, presence of good universities or of an entrepreneurship-friendly policy environment are all examples.

8. TL3 regions have been classified as predominantly urban, intermediate and predominantly rural based on the percentage of regional population living above certain thresholds of population densities, i.e. upon the share of urban dwellers.

9. One finding of the present study is that differences in the growth rate of the employment rate across countries can account, for the most part, for the positive and statistically significant relationship between ageing and per capita GDP growth found by existing research.