The impact of ageing on Spain's economic growth: a regional focus

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Eduard Llorens i Jimeno
Economist
ellorensi@caixabank.com

Josep Mestres Domènech
Economist
jmestres@caixabank.com

Abstract

- *This paper analyses the impact of Spain's ageing population on its economic growth.*
- *By combining regional economic and demographic data with an identification strategy based on predicted ageing as an instrumental variable, we find that ageing has had a significant negative impact on economic growth in the past few decades and will continue to do so in the coming decades. Both the size of the labour force and its productivity contribute equally to this negative impact.*
- *Simulations show that measures to help increase the labour force can mitigate ageing's negative impact although they are not enough to completely offset it and must therefore be accompanied by policies to promote growth in labour productivity.*

Keywords: demographics, ageing population, economic growth, labour productivity, instrumental variable.

JEL codes: J14, J24, J26, H55.

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1. Introduction

An ageing population is one of the key factors that, together with the technological revolution and climate change, will redefine our societies in the coming decades. In Spain, the population will age at a notable rate: whereas one in five Spaniards were 65 or older in 2019, the ratio is expected to be one in three by 2050; i.e. more than 17.5 million people (European Commission, 2018). This change will affect not only the configuration of our societies but also that of our economies, since an ageing population has a considerable effect on economic growth. International data for advanced economies indicate that, on average, the decline in the working-age population is expected to lower annual GDP growth, up to 2025, by 0.64 pp compared with the long-term historical trend (Aksoy *et al.*, 2019). Similarly, growth in GDP per capita in the OECD countries is estimated to fall by 0.25 pp annually in the 2030s (OECD, 2018).

Ageing reduces economic growth because it affects the size and productivity of the labour force. A smaller labour force is the first factor that directly impacts on an economy's level of production. When there are no significant changes in the employment rates of the older population, a decline in the working-age population will reduce an economy's aggregate labour force and therefore its total GDP. Likewise, if the proportion of the working-age population compared with the overall population decreases, GDP per capita will also fall.

However, ageing also affects an economy's aggregate productivity as each age group has different skills and abilities. Changes in the age composition of the population influence the aggregate composition of skills, resulting in changes in labour productivity. Anghel and Lacuesta (2020) show that older workers tend to have greater planning and interpretation skills while their physical ability, literacy and numeracy skills deteriorate. Also, Ozimek *et al.* (2018) show that companies with older workforces are more risk averse in making investment decisions and have less incentive to adopt technological changes, which may end up making them less productive.

Until now, a large number of studies linking ageing and economic growth have focused on the reduction in the labour supply but very few have analysed the impact on productivity.[1] An exception to this rule is Maestas *et al.* (2016), which breaks down economic growth into variations in the share of the working population (i.e. the number of workers per capita) and variations in labour productivity (GDP per worker). From this breakdown, they estimate the impact of ageing on each of these factors using data for the US.

In the case of Spain, few analyses have examined the impact of ageing on economic growth as most are comparative studies between countries (e.g. Aksoy *et al.*, 2019 and OECD, 2018). However, this paper analyses the impact of an ageing population on economic growth in the case of the Spanish economy following a similar methodology to that used by Maestas *et al.* (2016). The empirical strategy employed makes it possible to control for potential endogeneity

[1] See Bank of Spain (2019) for a summary of the different channels through which ageing affects the economy.

between ageing and economic growth by using an instrumental variable that predicts regional ageing. We also break down the impact of ageing on economic activity into changes in labour force size and productivity, using regional variability in each dimension. Finally, we break down labour productivity in order to differentiate between the impact on wages and on hours per worker.

The rest of the article is structured as follows. In Section 2 we analyse ageing in Spain from a regional perspective; in Section 3 we describe the data used and in Section 4 the empirical strategy. Next, in Section 5 we present the findings of how ageing affects Spain's economic growth, in Section 6 we discuss the policies which could be implemented to counteract the impact of ageing and, finally, Section 7 presents the conclusions.

2. Ageing in Spain: a regional focus

Spanish society is becoming increasingly grey-haired (those who still have hair!). The country's lower birth rate is the main factor for its ageing population, shrinking the base of the pyramid. Back in the early 1980s, Spain's fertility rate was already below its replacement rate (that rate which would ensure the total population remains constant without immigration, which is around 2.1 children per woman) and, since the 1990s it has been well below this figure, at approximately 1.3 children.[2] In addition to this low birth rate, life expectancy has increased, widening the top of the population pyramid as the elderly population has grown. Life expectancy has increased to 86 in Spain and is expected to be over 89 by 2050. Moreover, not only are the years of life increasing but we will also live these additional years in a better condition. According to the OECD (2015), half an average person's life expectancy from the age of 65 will be in good health.

As a result of these trends, the older population will continue to grow while the working-age population is likely to remain constant or even shrink. Consequently, the dependency ratio, which is the ratio of the population over 65 to the working-age population and which stood at 29.6% in Spain in 2018, will increase to 49.6% by 2040 (European Commission, 2018).

The ageing of the population has the greatest effect in the regions of so-called «empty Spain» («España vaciada»). The main reason is that, for several decades a significant proportion of the population, mostly of working age, has been migrating from areas in «empty Spain» towards the country's major towns and cities (located in coastal areas and Madrid), a key factor behind the demographic imbalance between regions. Nevertheless, since the year 2000 foreign immigration has offset part of this imbalance and, at present, almost all autonomous regions are net recipients of immigrants to a greater or lesser extent.[3] However, this immigration has not completely compensated for the loss of population which the regions of «empty Spain» continue to suffer. One inevitable consequence is that population growth is now only positive in four autonomous regions (Madrid, Murcia, the Balearic Islands and Ceuta & Melilla) and in some

[2] These data are based on basic demographic indicators by the Spanish Statistics Institute.
[3] With the exception of Extremadura and Ceuta & Melilla.

it is considerably negative, such as Galicia and Castile & Leon. By contrast, in the early 1980s more people were born than died in all the autonomous regions.

Moreover, within the same region, depopulation particularly affects rural areas and a large proportion of these are concentrated precisely in «empty Spain». Consequently, ageing in the rural areas of these regions is even higher than in their urban areas, presenting a huge demographic challenge.[4]

These regional differences in population ageing can be seen most clearly if we look at the ratio of the population aged 60 and over to the adult population in general (aged 20 and over), the key variable with which we analyse the impact of ageing on economic activity in this paper. In Spain, this ratio increased from 23.6% in 1981 to 30.9% in 2017, a change that was particularly pronounced in the regions of «empty Spain». So, while autonomous regions such as the Basque Country, Asturias, Galicia and Castile & Leon posted ratios higher than 35% in 2017, in the Canary and Balearic Islands and Murcia this figure was around 26% (for more details see Chart 1 and the complete results in Table 1).

Regional differences are even more marked in economic terms than demographic. The well-being of all Spain's regions has increased substantially over the past 40 years. A Spaniard's GDP per capita in real terms was around 30,000 euros in 2017 when it had been below 20,000 euros in 1981. However, although we now enjoy higher levels of GDP per capita, the relative differences between regions have not diminished. At the top, in 2017 Madrid's GDP per capita was still 37% higher than the Spanish average (the same percentage as in 1981); the Basque Country, 30% higher (+19% in 1981) and Catalonia, 20% higher (+17% in 1981). At the bottom, the GDP per capita in Andalusia was 24% lower than the average in 2017 (-20% in 1981) while that of Castile-La Mancha was 20% lower (-24% in 1981). On the other hand, regions such as Aragon now have a higher than average GDP per capita, while Asturias or Cantabria have a lower one when, in 1981, the well-being of these three regions was close to the national average.[5]

3. Data

To carry out our study, we use long series of aggregate economic and demographic data at the level of the autonomous region with annual frequency, covering the period 1981-2018 (De la Fuente, 2019).

Table 2 provides descriptive statistics for the variables used throughout our analysis. In all these we find significant variation over time and between autonomous regions.

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[4] For more details, Delgado and Martínez (2017) describe the demographic challenges within the eight autonomous regions in the FREDD (Forum of Spanish Regions with Demographic Challenges): Aragon, Asturias, Cantabria, Castile & Leon, Castile-La Mancha, Extremadura, Galicia and La Rioja.

[5] For more information on the factors behind the economic diversity between Spanish regions, see De la Fuente (2019).

The share of the population aged 60 and over varies from a minimum of 19.66% to a maximum of 38.71%, with an average of 28.28% and standard deviation of 4.06%. The ten-year growth of this variable[6] has also varied significantly, from a minimum of -12.55% to a maximum of 24.04%, with an average of 5.64% and standard deviation of 7.77%.

With regard to the economic variables of interest, the ten-year growth in GDP per capita varies from a minimum of -16.27% to a maximum of 48.40%, with an average of 12.77% and standard deviation of 12.10%. The ten-year growth in labour productivity (GDP per worker) ranges from a minimum of -17.66% to a maximum of 46.45%, with an average of 10.89% and standard deviation of 9.90%. Finally, the ten-year growth in the extensive margin of labour supply (the number of workers per capita) has a minimum of -20.82% and a maximum of 31.27%, with an average of 2.20% and standard deviation of 12.20%.

4. Empirical strategy

To quantify the impact of an ageing population on the economic variable in question, we estimate an equation very similar to that of Maestas *et al.* (2016):

$$\ln Y_{c,t} - \ln Y_{c,t-10} = \delta_t + \beta\left[\ln\left(\frac{A_{c,t}}{N_{c,t}}\right) - \ln\left(\frac{A_{c,t-10}}{N_{c,t-10}}\right)\right] + X'_{c,t-10}\gamma + \left(\varepsilon_{c,t} - \varepsilon_{c,t-10}\right)$$

where $Y_{c,t}$ is our economic variable of interest: GDP per capita in autonomous region c for period t. A is the number of people aged 60 and over, N is the number of people aged 20 and over, X is a vector of control variables that includes the share of workers in each economic sector (agriculture, industry, construction and services) and the migratory balance in period $t-10$, and δ_t are year fixed effects.

Although our main variable of interest is GDP per capita, in order to identify the mechanisms through which ageing affects economic growth, we can first carry out the following breakdown and estimate the above equation separately:

$$\frac{GDP}{N} = \frac{L}{N} \times \frac{GDP}{L}$$

where $\frac{L}{N}$ is the number of workers per capita (extensive margin of labour supply) and $\frac{GDP}{L}$ is the GDP per worker (labour productivity).

Moreover, we can go a step further and break down labour productivity as follows:

$$\frac{GDP}{L} = \frac{GDP}{Earnings} \times \frac{Earnings}{H} \times \frac{H}{L}$$

where $\frac{GDP}{Earnings}$ is the GDP per euro paid to workers, $\frac{Earnings}{H}$ is the hourly wage of workers and $\frac{H}{L}$ is the number of hours worked per worker (intensive margin of labour supply).

[6] Mathematically, by ten-year growth of a variable we mean $(X_t - X_{t-10})/X_{t-10}$

What problems are involved in this estimate?

In identifying the impact of ageing on economic growth, there are two sources of bias that could call into question the reliability of the findings if we simply estimate the above equation via Ordinary Least Squares (OLS). On the one hand, there is the problem of simultaneity as there could be a causal relationship in the opposite direction to our object of study; i.e. not only does ageing have an impact on economic growth but economic growth also has an impact on population ageing. For instance, a region that grows more than the average may be less aged because it offers more job opportunities to young people. There is also the problem of omitted variables; i.e. there may be other factors we have not considered in our analysis but which contribute to economic growth and are also correlated with ageing. One example would be not taking into account the quality of public health services, which has a positive influence on economic growth (a healthier population is more productive) and at the same time correlates positively with ageing (a healthier population lives longer).

To obtain more reliable estimates, what Maestas *et al.* (2016) propose and what we will replicate for the case of Spain is the use of an instrumental variable which is not affected by the aforementioned sources of bias. In this respect, we define our instrumental variable as predicted ageing, which is calculated as follows:

$$\ln\left(\frac{\hat{A}_{c,t}}{\widehat{N}_{c,t}}\right) - \ln\left(\frac{A_{c,t-10}}{N_{c,t-10}}\right)$$

where $\hat{A}_{c,t} = \sum_{j\geq 60} N_{j-10,c,t-10} \times \frac{N_{j,t}}{N_{j-10,t-10}}$ and $\widehat{N}_{c,t} = \sum_{j\geq 20} N_{j-10,c,t-10} \times \frac{N_{j,t}}{N_{j-10,t-10}}$, where c refers to each autonomous region, t to each year and j to each age group. For example, if we want to predict the number of people aged 60 living in Catalonia in 2010, we multiply the number of people aged 50 living in Catalonia in 2000 by the ratio between the number of people aged 60 living in Spain in 2010 and the number of people aged 50 living in Spain in 2000.

Regarding the relevance of the instrument, Chart 2 shows how the predicted variation in ageing predicts actual ageing very accurately. The correlation between both variables is 0.85, a figure very similar to that found by Maestas *et al.* (2016) (0.82).

Since the endogenous variable is perfectly identified (1 instrument), we cannot carry out a test to check the exogeneity of the predicted ageing. Nevertheless, this can justifiably be deemed exogenous for two reasons. Firstly, because there is no simultaneity since a region's economic growth in any given year could not determine its demographic variables from ten years earlier. Secondly, the correlation between variables with an impact on economic growth in any given year and the demographic variables from ten years earlier tends to be much lower compared to the correlation with the ageing variable in the same year.

5. Findings

The impact of ageing on economic growth

Using the methodology explained in the previous section, we estimate the impact of ageing on economic growth in Spain, which we then use to make projections for the past (1990-2019) and the future (2020-2049).

Column 1 of Table 3 shows the estimated impact of ageing on growth in GDP per capita using OLS as an identification strategy. The estimated coefficient is slightly positive but not significant.

However, as mentioned above, our estimated OLS coefficient could suffer from different biases due to several reasons. In this respect, in Column 1 of Table 4 we make use of the predicted ageing instrument and estimate the impact on growth in GDP per capita using the instrumental variable (IV) method. The result shows that, when ageing in an autonomous region increases by 1%, its economic growth falls by 0.39%. In other words, we find that the elasticity of economic growth with respect to ageing is -0.39. This elasticity is similar to that found by Maestas *et al.* (2016) for the US (-0.55) and indicates that ageing significantly hinders economic growth.

This result enables us to calculate the cost of ageing in Spain in the past. During the 1990s and 2000s, the population did not age significantly and its impact on economic growth was therefore limited. However, in the last decade (2010-2019) ageing increased by 4.7 pp, meaning that economic growth was 0.6 pp lower, in annualised terms, than the economic growth that could have occurred if ageing had remained constant during the decade or, in other words, equal to the ageing observed in the first year of the decade (counterfactual). This means that in 2019, for example, in the absence of increased ageing, annual growth in GDP per capita would have been 2.2% instead of the 1.6% observed. These findings are clearly described in Chart 3, where actual annual growth in GDP per capita and its non-ageing counterfactual figure almost overlap for the first two decades analysed but clearly separate from 2010 onwards.

Having analysed what has happened in the past three decades, we ask ourselves what might happen in the next three. Combining our estimates with the Spanish Statistics Institute's demographic projections by age group (which predict that Spanish society will continue to age), our calculations show that the detrimental effect of ageing on economic growth observed in the past decade will continue into the current decade and the next. In annualised terms, ageing will reduce economic growth by 0.7 pp in the current decade[7] and by 0.6 pp in the next. Looking ahead to the decade of 2040-2049, as the population will already be very old, the projection is that ageing will have a smaller impact on economic growth, as indicated by the last bar in Chart 4 being smaller than the two previous ones.

[7] This number is comparable to that found by Maestas *et al.* (2016), who estimate that, for the same decade and in annualised terms, ageing will reduce economic growth by 0.6 pp in the US.

Breakdown between the extensive margin and productivity of labour supply

As explained above, the next step is to identify the mechanisms through which ageing affects economic growth. Until now, a large number of studies on ageing and economic growth have focused on the declining labour force but very few have examined productivity. This was taken into account by Maestas *et al.* (2016), whose approach for the US we extrapolate for Spain, breaking down economic growth between variations in the share of the population that is working (i.e. the number of workers per capita or extensive margin of labour supply) and variations in labour productivity (GDP per worker). Based on this breakdown, we estimate the impact of ageing on each of these factors using the same identification strategy as for GDP per capita.

The first channel through which ageing impacts on the economy is by reducing the relative size of the labour force. As shown in Column 2 of Table 4, our estimates suggest that a 1% increase in the proportion of the population aged 60 and over reduces growth in the extensive margin by 0.21%. Nevertheless, the productivity channel is equally important, since a 1% increase in the share of the population aged 60 and over reduces labour productivity growth by 0.18% (Column 3 of Table 4). By construction, the aggregate impact of ageing on economic growth is the result of the sum of both impacts. In this respect, lower growth in the size and productivity of the labour force are equally responsible for the lower economic growth caused by ageing.

Breakdown of labour productivity

As we have just done with GDP per capita, we can also break down labour productivity into three factors: GDP per euro of earnings, wages (earnings per hour worked) and hours per worker (intensive margin of labour supply) and estimate the impact of ageing on each of these factors.

According to our calculations, two-thirds of the impact transmitted through the labour productivity channel occurs via wage adjustments (Column 5 of Table 4). This supports the hypothesis that the wage per hour worked of each worker is close to the increase in the company's production volume for each additional hour worked (known as the «marginal productivity of labour»), so that this wage should decrease when there is a decline in labour productivity. Similarly, Column 6 of Table 4 shows that the impact on the intensive margin is negative but not significant.

Sector-specific analysis

Ageing does not need to have a negative impact on labour productivity. This depends on the sectors that make up an economy, as well as the response of workers, companies and public administration to counteract such an effect. In fact, Acemoglu and Restrepo (2017) state that greater ageing is associated with higher productivity because, as a result of ageing, more has been invested in automating production processes. Along the same lines, Jimeno (2019) analyses how ageing might encourage the implementation of technological changes, although he also points out that such changes would be unlikely to completely offset the lower growth in GDP per capita.

As we have already mentioned, some of the discrepancies found in the literature on the impact of ageing on economic growth are due to the different sectors that make up each economy and the potential for automation within each sector. To explore this point, we divide the autonomous regions into three groups according to their most important economic sector (agriculture, industry or services) in terms of relative employment (compared to the rest of the autonomous regions),[8] to calculate the impact of ageing on each of these groups separately. The results in Table 6 show that, in regions where industry is more important, the impact of ageing on economic growth is positive thanks to increases in labour productivity that could readily be explained by the increased automation of industrial processes. In contrast, in regions where services are predominant (less automated given the very nature of the sector), ageing significantly reduces GDP per capita (Table 7). This reduction is due equally to a decline in the labour force and in labour productivity. In the case of agriculture, we only find significant results in the intensive margin (Table 5). These different findings depending on the predominant economic sector reflect the importance of taking the sectoral configuration of economies into account when gauging the impact of ageing on economic growth, and may help to explain why some studies have found a positive and others a negative impact.

6. Policies to offset the impact of ageing on economic growth

In the previous section we analysed how Spain's ageing population has had and will continue to have a negative impact on its economic growth. In this section we discuss some of the measures that could help to counteract this adverse effect, focusing on both the extensive margin and labour productivity.

Extensive margin

In order to promote growth in the extensive margin within a context of an ageing population, the main measures are to increase the birth rate, the length of time worked, immigration or participation of the population in the labour force. A higher birth rate increases the base of the labour force but it takes several decades to achieve an impact. We will therefore focus on the last three measures and analyse hypothetical scenarios to determine to what extent they could help to offset the negative impact of ageing in the coming decades.[9,10]

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[8] Grouping of autonomous regions by the most important sector (compared to the other autonomous regions) in employment terms: Agriculture (Andalusia, Extremadura and Murcia), Industry (Aragon, Catalonia, La Rioja, Navarre, Basque Country and Valencia) and Services (Balearic Islands, Canary Islands, Cantabria, Castile-La Mancha, Castile & Leon, Galicia and Madrid).

[9] It is important to note that, although they are useful for our analysis, caution must be applied with these simulations as they are based on assumptions that may not be fulfilled or implemented by public policymakers.

[10] To analyse these scenarios we use the forecasts of demographic and labour market variables by autonomous region and age group produced by the Spanish Statistics Institute.

Firstly, the increase in life expectancy we are currently enjoying is so considerable we can now devote a small part of our longer lifespan to working for longer, either by making retirement more flexible and combining retirement and work or by raising the retirement age.[11]

In this respect, we examine the potential increase in the number of workers per capita and, therefore, economic growth if, during the present decade (2020-2029), the next decade (2030-2039) and the one after (2040-2049), the effective retirement age were raised to 66, 67 and 68 years, respectively. In annualised terms, economic growth would be 0.19 pp, 0.27 pp and 0.18 pp higher for each of the respective decades compared to a scenario in which the effective retirement age remained at the current age of 65. Referring back to the figures for ageing's negative impact on economic growth, such figures suggest that this hypothetical scenario of an increase in the effective retirement age would offset 27% and 45% of the negative impact of ageing on economic growth in this decade and the next, respectively, and would compensate for it entirely in the last decade (since the impact of ageing would already be much less in the period 2040-2049).

Secondly, another factor analysed that would help to boost the labour supply is immigration. To provide a context for immigration to Spain, in 2017 the foreign immigrants who settled in Spain accounted for 0.7% of the total population. This figure is higher than countries such as Italy, Portugal and France, where the percentage was 0.4%, but lower than countries such as the Netherlands and Germany, with 0.8% and 1.1%, respectively. We will take the latter country as a benchmark when constructing a hypothetical scenario of migratory flows and examine how much economic growth would increase if the number of immigrants compared with the total population in Spain were to converge, by 2049, with those observed in Germany in 2017. Our findings show that, in annualised terms, economic growth would be 0.02 pp, 0.12 pp and 0.15 pp higher in the decades 2020-2029, 2030-2039 and 2040-2049, respectively, compared with the scenario of immigration flows predicted by the Spanish Statistics Institute.[12] This means that this hypothetical scenario of «German-style» immigration would offset the negative impact of ageing on economic growth by 3% and 20% in the present decade and the next, respectively, and would completely offset it in the last decade.

Thirdly, the extensive margin can be increased by reducing the unemployment rate, a particular problem faced by Spain considering that our unemployment rate (13.9%) is the second highest in the euro area, behind Greece. We will focus our attention on this point, quantifying how much an economic policy that, up until 2049, progressively halves the difference between Spanish unemployment and the euro area average (7.5%) would help economic growth. Such a reduction in unemployment would mean that, in annualised terms, economic growth would be 0.12 pp,

[11]Increasing the number of years worked also has a direct and significant impact on improving the sustainability of the public pension system (Funcas, 2019).

[12] The fact that, during the decade 2020-2029, economic growth increases by almost zero is due to the fact that the difference between our hypothetical scenario and the immigration forecasts of the Spanish Statistics Institute are very similar. By contrast, for the following two decades the difference between the two scenarios widens and, as a result, the impact on economic growth is greater.

0.13 pp and 0.13 pp higher in the decades 2020-2029, 2030-2039 and 2040-2049, respectively, compared with the scenario in which the unemployment rate remained at its current level. This would reduce the negative impact of ageing by 17%, 22% and 130% in the current decade and the following two decades, respectively.

All three measures analysed, with the aim of increasing the extensive margin of labour supply, help to reduce the impact of ageing. However, the results obtained indicate that their effect is only partial and varies greatly depending on the moment in question (Table 8). Consequently, focusing solely on economic policies that increase the number of workers per capita is not enough to offset the negative impact of ageing in the present decade and beyond. It is therefore also necessary to emphasise the other pillar that supports economic growth, namely labour productivity.

Labour productivity

Labour productivity is often neglected when talking about ageing but, as we have seen in the previous section, in Spain it is as important as the extensive margin. For this reason, measures to boost labour productivity in Spain should be considered in order to reverse the impact of ageing. The trend in labour productivity has been rather poor over the past two decades and a large number of reforms are required to improve it. Canals and Carreras (2020) extensively analyse the role played by new technologies in increasing productivity, especially as applications consolidate, new business models mature, worker training improves and production factors are reallocated.

Another important lever to boost productivity is education, both in formal and non-formal settings. The latter have a significant role to play in preventing workers' skills from deteriorating, including those of older workers, and also in improving how they adapt to the new tasks to be performed within their companies due, for example, to technological change.

If we look at the specific aspect of labour productivity among the older population, Anghel and Lacuesta (2020) show that workers' skills change as they get older. For this reason, tasks should be reallocated so that older workers can continue to be productive at work. One example would be to replace those tasks that require more physical effort (and are therefore less suitable for older workers) with new ones focusing on other types of skills, such as planning or interpreting. More generally, increasing and improving not only productivity but also employment opportunities for older workers is a major challenge for Spain as a society, and workers, companies and public administration must all face up to this challenge given that the labour force of the future will be older (OECD, 2019).

7. Conclusions

The ageing population represents a social and economic challenge for the coming years in Spain, especially in those regions of so-called «empty Spain». Using long series of aggregate economic and demographic data at the level of autonomous region, we estimate that, during the decade 2010-2019, ageing set back economic growth by 0.6 pp in annualised terms. This trend will

continue over the present and coming decades, in which we estimate that ageing will reduce economic growth by 0.7 pp and 0.6 pp in annualised terms, respectively.

In analysing the impact of ageing on economic growth, a large number of studies have focused on the extensive margin of the labour supply. However, our findings for Spain show that labour productivity is equally important when analysing the impact of ageing on economic activity. Moreover, two-thirds of the impact through labour productivity is produced by wage adjustments.

Sectoral configuration also plays an important role when analysing the relationship between ageing and economic growth. In this respect, our estimates show that, in those autonomous regions where services are relatively more important in employment terms than the rest of the autonomous regions, ageing has a negative impact on economic growth. Nevertheless, in regions where industry predominates, this impact is positive, due possibly to the increased automation of industrial processes.

With regard to measures that could mitigate the negative impact of ageing, longer working lives, increased net immigration flows and greater labour force participation seem to be the main candidates for consideration. However, while measures aimed at enlarging labour supply help to reduce the impact of ageing, these need to be accompanied by greater labour productivity if population ageing is not to significantly hamper Spain's economic growth in the years ahead.

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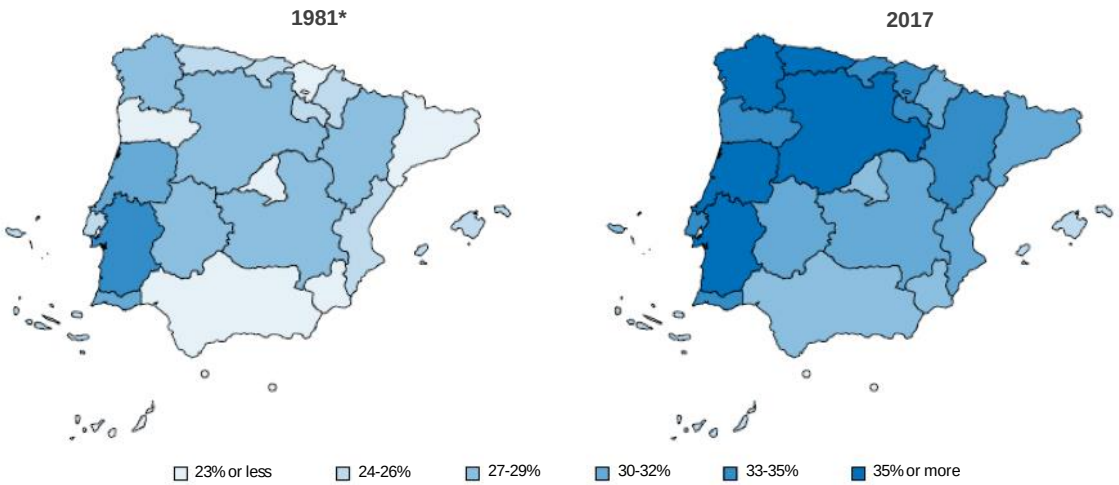
Charts and tables

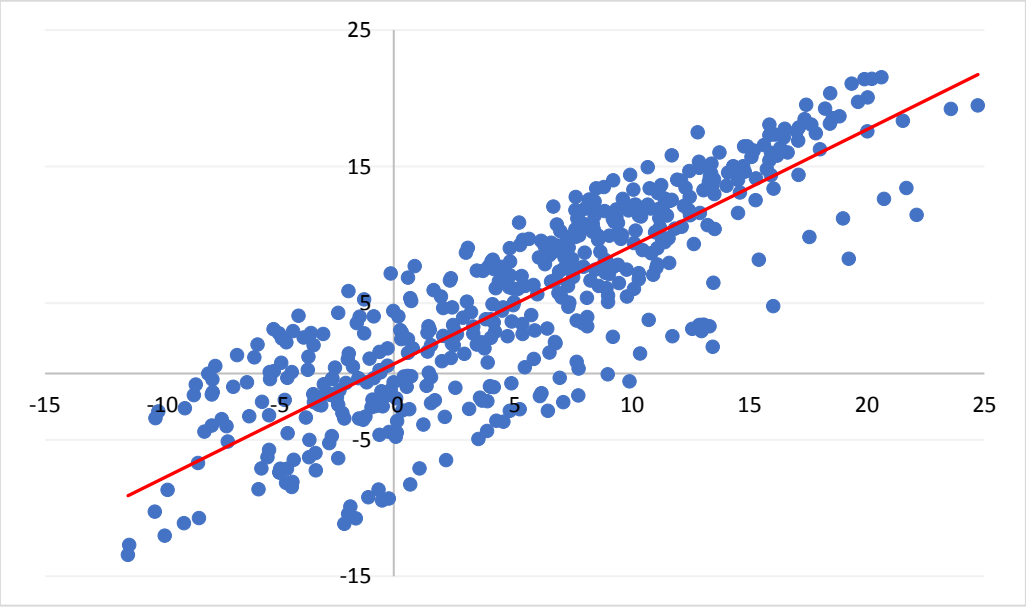
Chart 1: Regional ageing in Spain and Portugal



Note: *(*) 1991 for Portugal. The colour scale represents the ratio (%) between the population aged 60 and over and the adult population (20 years and over).*

Source*: CaixaBank Research, based on data from Reg Data Dem (Spain) and Eurostat (Portugal).*

Chart 2: Spain - Actual and predicted growth in ageing (%)

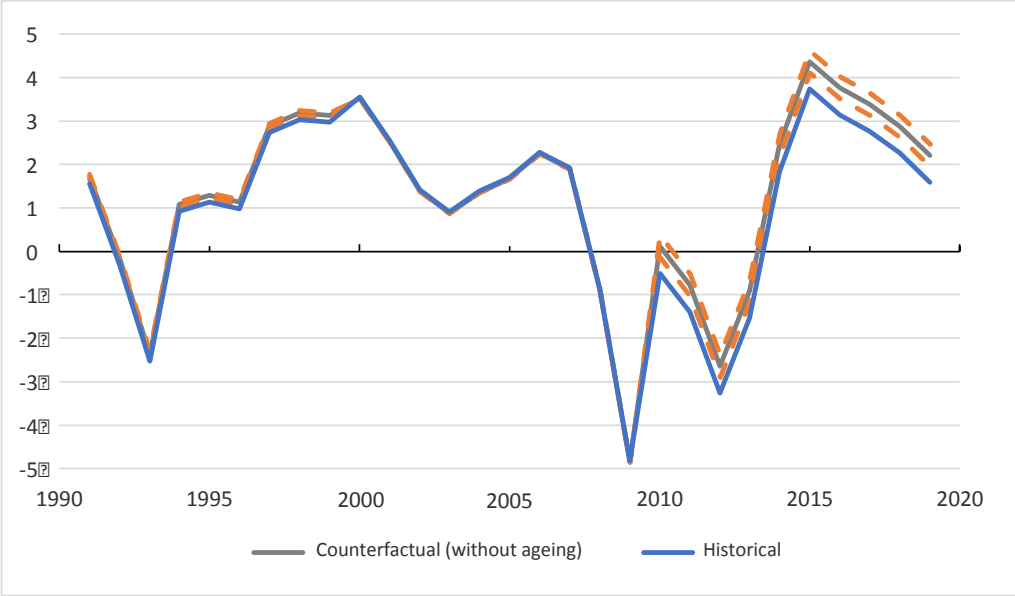


Note: *The vertical axis represents the actual growth in ageing over a ten-year period while the horizontal axis represents the growth predicted by the instrument.*

Source: *CaixaBank Research, based on data from FEDEA and CSIC.*

Chart 3: Spain - GDP per capita in different demographic scenarios

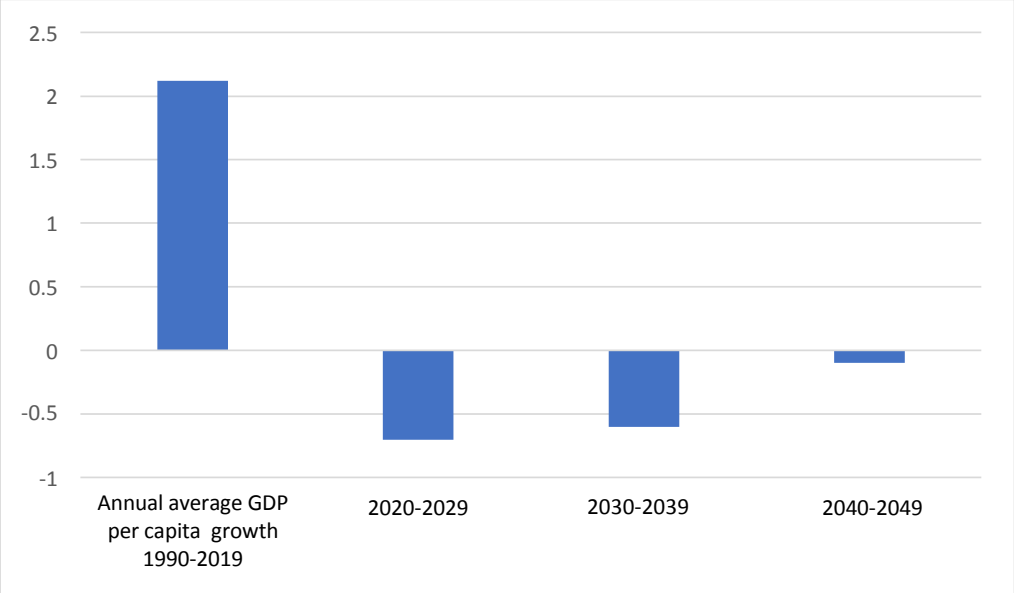
Annual growth (%)



Note: *In the absence of the growth observed in ageing during the decades 1990-1999, 2000-2009 and 2010-2019, annual GDP per capita growth would have been 0.2 pp higher, 0.03 pp lower and 0.6 pp higher than observed, respectively. The orange dotted lines represent the 95% confidence interval.*

Source: *CaixaBank Research, based on data from FEDEA and CSIC.*

Chart 4: Spain - Annual historical growth in GDP per capita (%) and forecast of ageing's impact by decade (pp)



Note*: During the decades 2020-2029, 2030-2039 and 2040-2049, ageing is expected to reduce annual GDP per capita growth by 0.7 pp, 0.6 pp and 0.1 pp, respectively.*

Source: *CaixaBank Research, based on data from FEDEA, CSIC and Spanish Statistics Institute.*

Table 1: Demographic and economic indicators by autonomous region

	Natural growth		Net immigration*		Population		Ratio 60+/20+		GDP per capita	
	Number of people						Percentage		Euros	
	1981	2017	1981	2017	1981	2017	1981	2017	1981	2017
Ceuta & Melilla	1,200	1,300	-700	-1,500	119,000	169,800	20.3%	22.2%	18,600	26,400
Canary Islands	15,000	-800	1,600	26,300	1,373,100	2,163,100	19.1%	26.3%	21,900	24,600
Balearic Islands	3,900	1,900	3,100	16,700	658,300	1,158,000	25.7%	26.2%	26,000	31,000
Murcia	9,500	3,200	2,400	2,200	959,400	1,473,600	22.4%	26.6%	18,200	27,200
Andalusia	62,000	-400	4,100	2,800	6,463,000	8,402,800	22.7%	28.3%	15,500	23,100
Madrid	37,400	11,600	2,400	71,300	4,702,600	6,504,800	20.3%	28.9%	26,600	41,900
Castile-La Mancha	8,800	-3,700	-4,300	1,400	1,650,600	2,033,100	28.1%	30.2%	14,800	24,500
Catalonia	28,700	-1,900	-4,600	68,100	5,964,900	7,450,400	23.0%	31.0%	22,700	36,500
Valencia	23,800	-6,700	7,600	25,200	3,658,300	4,929,900	23.6%	31.2%	18,700	27,000
Navarre	2,500	-200	-100	5,400	510,100	641,000	24.5%	32.0%	21,800	38,300
Extremadura	6,500	-3,500	-4,200	-2,400	1,065,600	1,073,100	27.2%	32.0%	11,100	20,800
La Rioja	1,000	-700	500	1,100	254,900	312,400	25.5%	33.2%	16,900	31,500
Cantabria	3,300	-2,200	200	2,200	514,400	580,900	24.7%	34.0%	20,400	27,000
Aragon	3,900	-3,700	-1,100	4,000	1,198,200	1,315,700	27.6%	33.7%	18,500	33,200
Basque Country	12,300	-5,300	-8,800	10,300	2,144,100	2,167,600	19.8%	35.2%	23,100	39,800
Asturias	3,200	-7,400	-3,000	1,900	1,130,100	1,030,000	25.4%	38.0%	19,000	25,600
Galicia	10,700	-14,800	-10,200	10,600	2,812,800	2,703,400	26.7%	37.1%	14,500	26,200
Castile & Leon	10,800	-13,400	-6,800	900	2,585,200	2,423,300	27.5%	37.4%	15,500	27,500
Spain	244,600	-46,400	-21,900	246,500	37,764,500	46,532,900	23.6%	30.9%	19,400	30,500

Note: *(*) Net immigration corresponds to immigration from other regions as well as other countries (for the autonomous regions) and to immigration from abroad (for Spain).*

Source: *CaixaBank Research, based on data from Reg Data Dem (Spain).*

Table 2: Descriptive statistics

Variable (N = 497)	Mean	Deviation	Min.	Max.
Level				
% Population 60+	28.28	4.06	19.66	38.71
% Agriculture	6.81	5.06	0	29.14
% Industry	17.59	7.46	1.88	35.32
% Construction	9.68	2.94	4.37	16.98
% Services	65.92	10.29	44.50	92.47
Migratory balance	13.33	27.40	-66.18	155
Growth				
% Population 60+	5.64	7.77	-12.55	24.04
% Predicted population 60+	5.73	8.07	-10.90	28.18
GDP per capita	12.77	12.10	-16.27	48.40
Extensive margin	2.20	12.20	-20.82	31.27
Labour productivity	10.89	9.90	-17.66	46.45
GDP per euro of earnings	4.42	5.98	-10.13	29.97
Hourly wage	10.04	13.23	-24.64	55.01
Intensive margin	-2.88	5.13	-27.57	7.64

Note: *The migratory balance is expressed in thousands of people. Growth in the variables refers to variations over a ten-year period (%).*

Table 3: Estimates by Ordinary Least Squares

	(1) $\frac{GDP}{N}$	(2) $\frac{L}{N}$	(3) $\frac{GDP}{L}$	(4) $\frac{GDP}{Earnings}$	(5) $\frac{Earnings}{H}$	(6) $\frac{H}{L}$
Ageing	0.0675	0.0493	0.0183	0.0170	0.0287	-0.0322
	(0.0621)	(0.0577)	(0.0609)	(0.0452)	(0.0749)	(0.0457)
Agriculture	0.257***	-0.400***	0.658***	0.124***	0.601***	-0.0648**
	(0.0412)	(0.0444)	(0.0420)	(0.0360)	(0.0466)	(0.0299)
Industry	0.190***	0.0847**	0.105**	-0.296***	0.349***	0.0501***
	(0.0355)	(0.0337)	(0.0442)	(0.0353)	(0.0342)	(0.0164)
Construction	-0.391**	-0.0301	-0.360**	-0.903***	0.721***	-0.194**
	(0.151)	(0.129)	(0.149)	(0.127)	(0.153)	(0.0965)
Migration	-0.321***	-0.411***	0.0907	0.0172	0.120	-0.0548*
	(0.107)	(0.0961)	(0.0644)	(0.0685)	(0.0822)	(0.0323)
Constant	0.139***	0.0774***	0.0616**	0.210***	-0.0378	-0.109***
	(0.0276)	(0.0214)	(0.0306)	(0.0229)	(0.0289)	(0.0199)
N	497	497	497	479	479	479
R^2 adjusted	0.706	0.813	0.576	0.332	0.783	0.585

Note: **10%, **5%, ***1%. Robust standard errors in parentheses. The benchmark category for the share of workers in each economic sector (expressed in relation to 1) is that of services. Time fixed effects omitted from the table.*

Table 4: Estimates by Instrumental Variable

	(1) $\frac{GDP}{N}$	(2) $\frac{L}{N}$	(3) $\frac{GDP}{L}$	(4) $\frac{GDP}{Earnings}$	(5) $\frac{Earnings}{H}$	(6) $\frac{H}{L}$
Ageing	-0.393***	-0.209***	-0.184***	-0.00327	-0.125*	-0.0676
	(0.0805)	(0.0749)	(0.0627)	(0.0519)	(0.0684)	(0.0466)
Agriculture	0.300***	-0.376***	0.676***	0.126***	0.616***	-0.0613**
	(0.0409)	(0.0427)	(0.0412)	(0.0338)	(0.0461)	(0.0293)
Industry	0.231***	0.108***	0.123***	-0.295***	0.363***	0.0533***
	(0.0366)	(0.0348)	(0.0419)	(0.0339)	(0.0329)	(0.0161)
Construction	-0.655***	-0.178	-0.477***	-0.915***	0.631***	-0.215**
	(0.161)	(0.135)	(0.151)	(0.123)	(0.153)	(0.0953)
Migration	-0.223*	-0.356***	0.134*	0.0215	0.152*	-0.0473
	(0.117)	(0.0963)	(0.0684)	(0.0666)	(0.0844)	(0.0310)
Constant	0.201***	0.112***	0.0888***	0.213***	-0.0170	-0.104***
	(0.0283)	(0.0234)	(0.0297)	(0.0227)	(0.0274)	(0.0188)
N	497	497	497	479	479	479
R^2 adjusted	0.670	0.803	0.565	0.332	0.779	0.584

Note: **10%, **5%, ***1%. Robust standard errors in parentheses. The benchmark category for the share of workers in each economic sector (expressed in relation to 1) is that of services. Time fixed effects omitted from the table.*

Table 5: Estimates by Instrumental Variable (agricultural regions)

	(1) $\frac{GDP}{N}$	(2) $\frac{L}{N}$	(3) $\frac{GDP}{L}$	(4) $\frac{GDP}{Earnings}$	(5) $\frac{Earnings}{H}$	(6) $\frac{H}{L}$
Ageing	-0.151	-0.114	-0.0363	0.442***	-0.277	-0.314***
	(0.138)	(0.115)	(0.151)	(0.0863)	(0.195)	(0.0738)
Agriculture	0.157	-0.369***	0.526***	0.493***	-0.0800	0.124
	(0.113)	(0.125)	(0.128)	(0.102)	(0.172)	(0.0819)
Industry	-0.488***	-0.122	-0.365***	-0.143*	-0.888***	0.643***
	(0.0871)	(0.0866)	(0.0988)	(0.0807)	(0.147)	(0.0653)
Construction	1.208***	-0.420	1.628***	0.0760	0.956**	0.605***
	(0.277)	(0.279)	(0.381)	(0.165)	(0.418)	(0.119)
Migration	-0.737***	-0.458***	-0.279**	0.131*	-0.758***	0.393***
	(0.114)	(0.116)	(0.121)	(0.0788)	(0.161)	(0.0770)
Constant	0.164***	0.168***	-0.00381	-0.0382	0.358***	-0.313***
	(0.0474)	(0.0559)	(0.0614)	(0.0417)	(0.0891)	(0.0331)
N	84	84	84	81	81	81
R^2 adjusted	0.947	0.947	0.870	0.763	0.884	0.881

Note: **10%, **5%, ***1%. Robust standard errors in parentheses. The benchmark category for the share of workers in each economic sector (expressed in relation to 1) is that of services. Time fixed effects omitted from the table. Autonomous regions included: Andalusia, Extremadura and Murcia.*

Table 6: Estimates by Instrumental Variable (industrial regions)

	(1) $\frac{GDP}{N}$	(2) $\frac{L}{N}$	(3) $\frac{GDP}{L}$	(4) $\frac{GDP}{Earnings}$	(5) $\frac{Earnings}{H}$	(6) $\frac{H}{L}$
Ageing	0.416***	-0.0516	0.467***	0.338***	0.124	0.000884
	(0.138)	(0.0842)	(0.138)	(0.115)	(0.0892)	(0.0566)
Agriculture	0.688***	-0.722***	1.409***	0.400**	0.806***	0.220**
	(0.204)	(0.101)	(0.224)	(0.189)	(0.146)	(0.0910)
Industry	-0.0140	-0.455***	0.441***	-0.286**	0.534***	0.230***
	(0.141)	(0.105)	(0.146)	(0.141)	(0.109)	(0.0732)
Construction	-1.598***	-1.413***	-0.185	-0.574*	0.815**	-0.325**
	(0.378)	(0.284)	(0.391)	(0.320)	(0.320)	(0.164)
Migration	-0.256*	-0.543***	0.287**	0.163	-0.0190	0.126**
	(0.137)	(0.129)	(0.140)	(0.111)	(0.0940)	(0.0640)
Constant	0.220***	0.453***	-0.233**	0.108	-0.206***	-0.158***
	(0.0848)	(0.0551)	(0.0969)	(0.0874)	(0.0707)	(0.0392)
N	168	168	168	162	162	162
R^2 adjusted	0.773	0.882	0.510	0.302	0.806	0.596

Note: **10%, **5%, ***1%. Robust standard errors in parentheses. The benchmark category for the share of workers in each economic sector (expressed in relation to 1) is that of services. Time fixed effects omitted from the table. Autonomous regions included: Aragon, Catalonia, La Rioja, Navarre, Basque Country and Valencia.*

Table 7: Estimates by Instrumental Variable (service regions)

	(1) $\frac{GDP}{N}$	(2) $\frac{L}{N}$	(3) $\frac{GDP}{L}$	(4) $\frac{GDP}{Earnings}$	(5) $\frac{Earnings}{H}$	(6) $\frac{H}{L}$
Ageing	-0.823***	-0.412***	-0.411***	-0.128	-0.164	-0.144**
	(0.147)	(0.124)	(0.111)	(0.0853)	(0.109)	(0.0703)
Agriculture	0.408***	-0.455***	0.862***	0.214***	0.682***	-0.0280
	(0.0557)	(0.0522)	(0.0476)	(0.0311)	(0.0525)	(0.0382)
Industry	0.255**	0.123	0.131*	-0.248***	0.519***	-0.142***
	(0.103)	(0.0951)	(0.0786)	(0.0704)	(0.0712)	(0.0479)
Construction	-1.924***	-1.420***	-0.504**	-0.692***	0.589**	-0.445**
	(0.322)	(0.293)	(0.244)	(0.234)	(0.250)	(0.196)
Migration	0.277	-0.593***	0.870***	-0.138	1.227***	-0.229**
	(0.236)	(0.211)	(0.165)	(0.116)	(0.202)	(0.0891)
Constant	0.307***	0.250***	0.0575	0.161***	-0.0176	-0.0799**
	(0.0644)	(0.0579)	(0.0468)	(0.0423)	(0.0474)	(0.0367)
N	224	224	224	216	216	216
R^2 adjusted	0.579	0.755	0.663	0.240	0.791	0.646

Note: **10%, **5%, ***1%. Robust standard errors in parentheses. The benchmark category for the share of workers in each economic sector (expressed in relation to 1) is that of services. Time fixed effects omitted from the table. Autonomous regions included: Balearic Islands, Canary Islands, Cantabria, Castile-La Mancha, Castile & Leon, Galicia and Madrid.*

Table 8: Measures to increase extensive margin growth

	Decade 2020-2029	Decade 2030-2039	Decade 2040-2049
Increase in retirement age	0.19 (27%)	0.27 (45%)	0.18 (180%)
Increase in immigration	0.02 (3%)	0.12 (20%)	0.15 (150%)
Reduction in unemployment	0.12 (17%)	0.13 (22%)	0.13 (130%)

Note: *The annualised impact on economic growth (pp) is shown for each of the three measures analysed, as well as the percentage of ageing's impact that would be offset by these measures.*

Source*: CaixaBank Research, based on data from the Spanish Statistics Institute.*