

**DEMOGRAPHICS, PRODUCTIVITY AND THE NATURAL INTEREST RATE**

Demographics takes pride of place in the debate on the structural transformations that will affect the economy in coming decades. In turn, productivity growth has been persistently low since the last downturn. This box uses an economic life cycle model<sup>1</sup> to illustrate the effects of both these factors on the natural rate of interest.

Since the start of the century, in most euro area countries there have been major changes in the share of population of the different age groups (see Chapter 4). According to Eurostat projections, these changes will continue in coming decades (see Chart 1). Thus, throughout this period, the proportion of young adults has decreased and is expected to continue to decrease, while the proportion of adults, which was stable in the first decade of the century, has fallen since 2010 and is expected to continue to fall in coming decades. Lastly, it is estimated that the proportion of over-65s will increase, from 22% in 2000 to 31% in 2030.

The model used combines a standard production framework and households across three stages of the life cycle: young adults (20-29 years), adults (30-65 years) and retirees (65+). The share of each age group in the population depends on fertility and mortality rates, which evolve to give the population structure depicted in Chart 1. In the model, labour income depends on age: young adults command lower wages than older ones, while the over-65s also receive labour income (although they work fewer hours than the other age groups), as well as public pensions.<sup>2</sup> Individuals can save either by accumulating productive capital or by buying (government or corporate) bonds.

The model is calibrated using data on wages and hours worked by age group taken from the European Household

Community Panel and the OECD. These data show that labour income peaks during the adult stage (30-65 years) of the life cycle. According to European Commission estimates (2018 Ageing Report), the benefit ratio (average pension to average wage) is expected to fall from 45% to 40% for the EU countries over the next two decades. Lastly, the annual average rate of growth of total factor productivity (TFP) was 0.9% in the euro area in its first decade of existence. Since the onset of the crisis it has declined considerably, to 0.3% in annual average terms. The following simulations assume, as a conservative estimate, that TFP growth will gradually decrease, from 0.9% in 2007 to 0.6% in 2040.<sup>3</sup>

Chart 2.2 depicts the natural rate of interest that would result, according to the model, from these demographic patterns and productivity growth, taking as the starting point the real interest rate observed in 2007 (2.1%).<sup>4</sup> Lower total factor productivity growth translates into a decline in the return on investment in productive capital, which implies a drop in the natural rate of interest. In turn, the effect of demographics on the labour supply and the supply of savings affects the natural rate of interest. On the one hand, a decline in the labour supply associated with a lower birth rate drives down the labour to capital ratio, further moderating the return on capital. On the other, the sustained increase in life expectancy prompts adults to save more for their retirement (which drives down the consumption to GDP ratio, as shown in Chart 2.1), generating a further fall in the natural rate of interest. Overall, according to these simulations, the natural rate of interest would fall by 3 pp - 4 pp between 2007 and 2030.<sup>5</sup>

1 H. S. Basso and O. Rachedi (2018), *The young, the old, and the government: demographics and fiscal multipliers*, Banco de España Working Paper 1837.

2 To incorporate wage differences by age into the model, it is assumed that adults are more productive than young adults and than the over-65s.

3 The figure of 0.6% is calculated as the midpoint between TFP growth observed in the last ten years and the rate of growth used in the European Commission's projections up to 2050, presented in European Commission (2018), *The 2018 Ageing Report: Economic and Budgetary Projections for the 28 EU Member States (2016-2070)*, Institutional Paper 079.

4 Under the simplifying assumption that the economy was stationary in 2007, the real interest rate ( $r$ ) in that year is equal to the natural interest rate ( $r^*$ ), such that  $r^* = r = 2.1\%$ . The real interest rate is calculated as the difference between the 3-month EURIBOR and core inflation (i.e. excluding energy prices) in the euro area. The paths of the real and natural interest rates in these simulations are very similar, and practically identical in the medium and long term, as the nominal rigidities that prevent the two interest rates from coinciding have only temporary effects.

5 G. Eggertsson, N. Mehrotra and J. Robbins (2019), in "A Model of Secular Stagnation: Theory and Quantitative Evaluation", *American Economic Journal: Macroeconomics*, 11(1), pp. 1-48, perform a similar exercise for the United States for the period 1970-2015, estimating a decline of more than 400 bp in the natural rate of interest. Y. Aksoy, H. S. Basso, R. Smith and T. Grasl (2019), in "Demographic Structure and Macroeconomic Trends", *American Economic Journal: Macroeconomics*, 11(1), pp. 193-222, using an estimated empirical model drawing on OECD country data, conclude that the natural rate of interest could fall by up to 400 bp in the United States between 2000 and 2030 owing to demographic change.

**DEMOGRAPHICS, PRODUCTIVITY AND THE NATURAL INTEREST RATE (cont'd)**

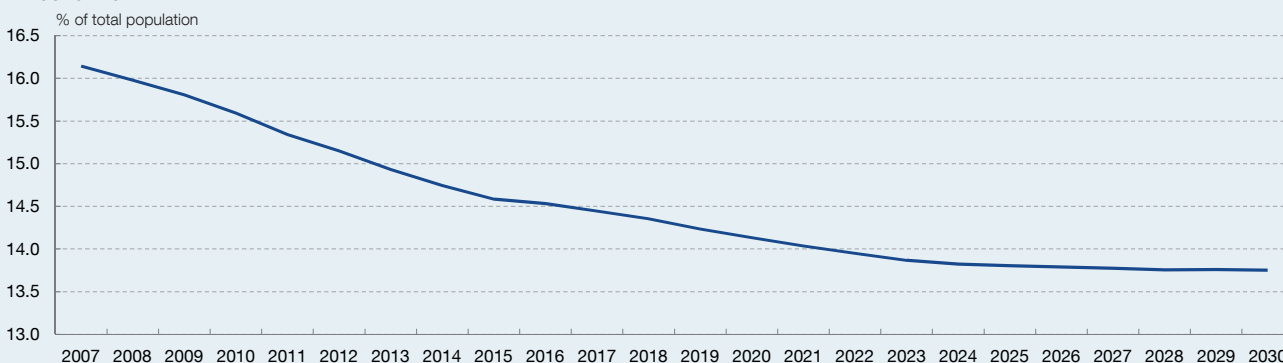
To measure the contribution of demographics and productivity to the projected fall in the natural rate of interest two further simulations are made: the first considers that only productivity growth changes, and the second includes only demographic changes. By comparing the two it may be concluded that

more than 65% of the fall in the natural rate of interest estimated in the previous exercise is due to demographic change, in keeping with the empirical findings presented in Box 3.1. The impact of demographic change is also analysed by comparing the baseline scenario with alternative scenarios

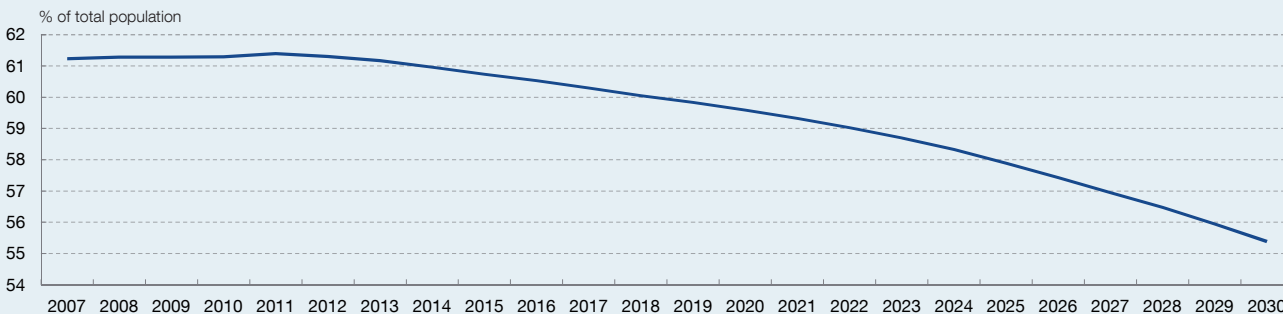
Chart 1  
OFFICIAL DEMOGRAPHIC PROJECTIONS SHOW PROGRESSIVE POPULATION AGEING

The chart depicts population changes in three age brackets: i) young people (under 20); ii) adults (20 to 65); and iii) old people (over 65).

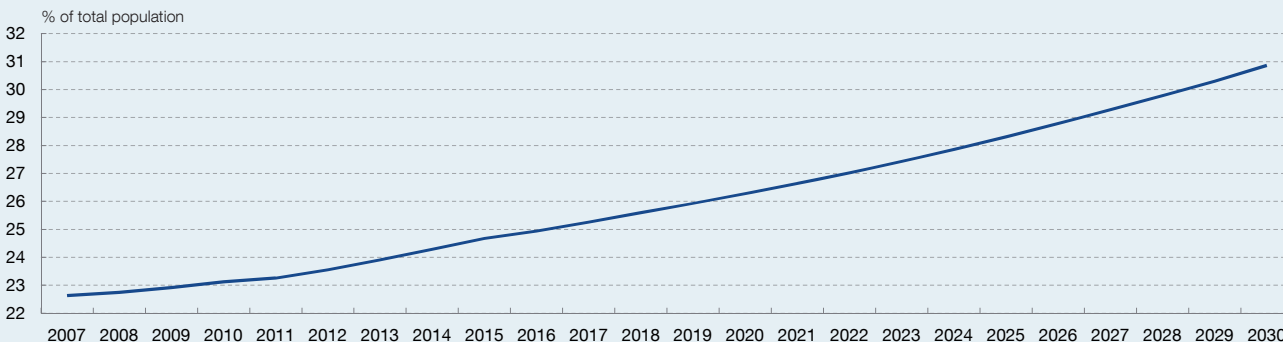
1 YOUNG PEOPLE



2 ADULTS



3 OVER-65s

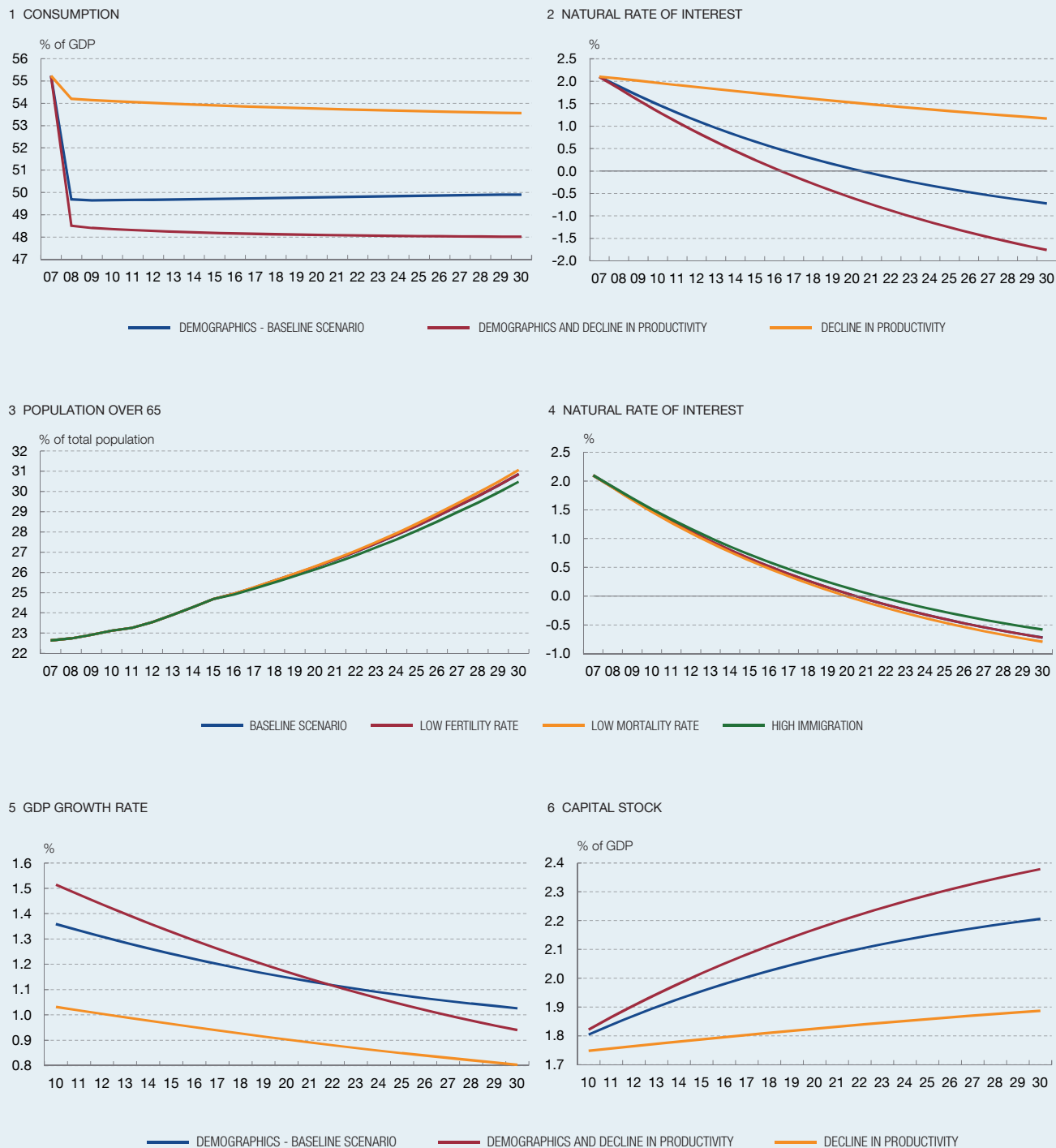


SOURCE: Eurostat.

**DEMOGRAPHICS, PRODUCTIVITY AND THE NATURAL INTEREST RATE (cont'd)**

Chart 2  
MACROECONOMIC IMPACT OF DEMOGRAPHIC CHANGE AND DECLINE IN PRODUCTIVITY

The chart depicts the simulation of the impact of demographic change in the euro area using the Basso and Rachedi model (2018).



SOURCE: Banco de España, drawing on the Basso and Rachedi model (2018).

**DEMOGRAPHICS, PRODUCTIVITY AND THE NATURAL INTEREST RATE** (cont'd)

that envisage lower fertility and mortality rates and higher immigration (see Charts 2.3 and 2.4).<sup>6</sup> These simulations show that, in general, the sensitivity of natural interest rates to the different demographic scenarios considered in 2030 is quite low (25 bp at most).

Lastly, aside of the impact on the natural rate of interest, it is important to examine the effects on GDP growth

and capital accumulation (see Charts 2.5 and 2.6). The lower natural rate of interest coincides with an increase in capital accumulation, on account of higher savings and lower labour supply. Yet despite the higher level of capital, GDP growth falls continuously over the entire simulation horizon, owing to the lower growth in TFP and the labour supply.

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6 Specifically, the assumptions used in each alternative scenario are as follows: 1) lower fertility: a 20% decline in fertility rates across all the projections; 2) lower mortality: a gradual decline in mortality rates by age and sex; and 3) higher migration: a 33% increase in net immigration throughout the projection period.