Long-term Model

Methodology Report

Irish Fiscal Advisory Council

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Contents

1 Introduction 5

2 Demographic outlook 6

2.1 The cohort component model 6

2.2 Life expectancy and mortality rates 8

2.3 Fertility rates 10

2.4 Migration flows 17

2.5 Labour Force Participation 21

3 Macroeconomic modelling 27

3.1 Growth and productivity 27

3.2 Prices and wages 32

4 Expenditure modelling 33

4.1 From general government to Exchequer spending 34

4.2 Pensions 38

4.3 Health 41

4.4 Education 45

4.5 Social Protection 47

4.6 Interest and Government Debt 48

4.7 Capital expenditure 51

4.8 Decomposition of pressures 52

5 Revenue modelling 55

Bibliography 60

Foreword

The Irish Fiscal Advisory Council was established as part of a wider agenda of reform of Ireland's budgetary architecture. The Council was initially set up on an administrative basis in July 2011 and was formally established as a statutory body in December 2012 under the *Fiscal Responsibility Act*. The Council is a public body funded from the Central Fund. The terms of its funding are set out in the *Fiscal Responsibility Act*.

The mandate of the Irish Fiscal Advisory Council is to:

- endorse, as it considers appropriate, the macroeconomic forecasts prepared by the Department of Finance on which the Budget and Stability Programme Update are based;
- assess the official forecasts produced by the Department of Finance;
- assess government compliance with the Budgetary Rule;
- assess whether the fiscal stance of the Government in each Budget and Stability Programme Update (SPU) is conducive to prudent economic and budgetary management, including with reference to the provisions of the Stability and Growth Pact.

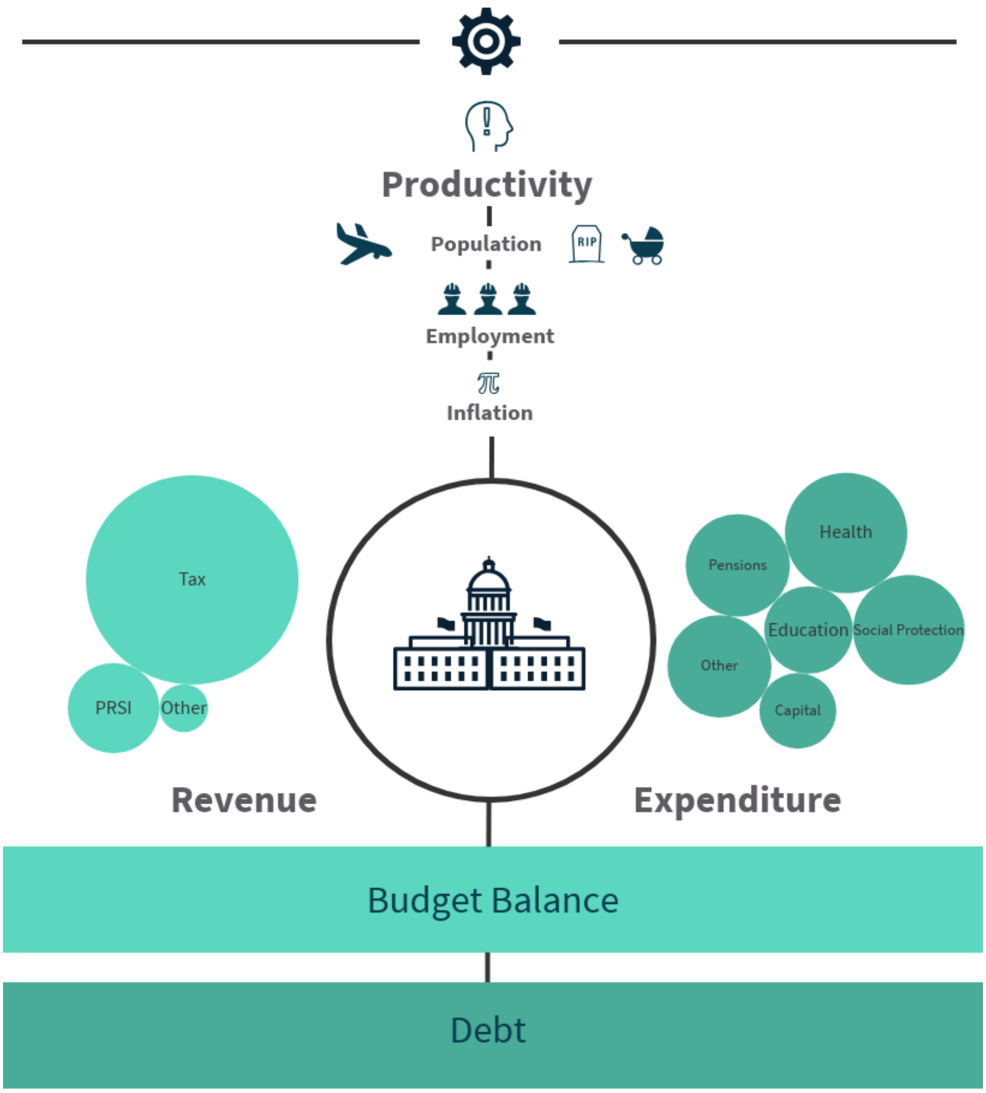
The Council's Chairperson is Mr Sebastian Barnes (Organisation for Economic Co-operation and Development). Other Council members are Dr Martina Lawless (Economic and Social Research Institute), Prof. Michael McMahon (Professor of Macroeconomics at the University of Oxford and Tutorial Fellow of St Hugh's College), and Ms Dawn Holland (Visiting Fellow, National Institute of Economic and Social Research). The Council's Secretariat consists of Dr Eddie Casey, Mr Niall Conroy, Mr Kevin Timoney, Mr Killian Carroll, Ms Karen Bonner, and Dr Elliott Jordan-Doak. The Council would also like to acknowledge the invaluable input from Ms Friederike Vogler, Ms Ainhoa Osés Arranz and Ms Kate Ivory, Economists formerly in the Council's Secretariat, and the input from Summer Interns at the Council: Eannán Monaghan, Orlagh Lavelle, and Jigisha Verma. The Council also wishes to acknowledge kind help from staff at the CSO, ESRI, NTMA, the Departments of Finance and Public Expenditure and Reform, the Health Service Executive and the Healthcare Pricing Office.

More information on the Irish Fiscal Advisory Council can be found at www.FiscalCouncil.ie

1 Introduction

This “Methodology Report” is a companion publication to the Council’s first Long-term Sustainability Report (LTSR), which looks at Ireland’s public finances over the period 2025 to 2050 as the population ages and the economy continues to grow. The Methodology Report is intended to document how the Long-Term Model (LTM)—used to develop demographic and macroeconomic projections—was developed.

The report starts with a look at how the demographic outlook is formed in the LTM in Section 2. Section 3 next explores how the macroeconomic projections are formed consistent with the demographic projections. The approach to developing government spending and revenue projections that are consistent with the demographic and macroeconomic projections is then covered in Sections 4 and 5.



2 Demographic outlook

The forecast horizon relating to the demographic projections is divided into three periods until 2050 where official forecasts are available. For the short run, Department of Finance forecasts are used for net migration and participation. These are then converged to the LTM's long-run demographic assumptions over a five-year period. For other inputs, such as fertility, there is no such convergence between different forecast horizons.

2.1 The cohort component model

The population dynamics used in the LTM are modelled using a so-called cohort-component model. This approach projects population by gender and age as a function of developments on fertility rates, survival probabilities and migration flows based on single-year age cohorts of the latest official population estimates (CSO, 2019). This methodology is widely used by national statistics offices and forecasting bodies at an international level.

The key question is how each of the three demographic inputs are modelled and included in the cohort-component model. Sections 2.2–2.4 set out the assumptions used in the cohort-component model and describes how the population projections for Ireland used in the LTM are produced.

The contribution of this exercise to previous research in Ireland is to provide a set of population projections based on new fertility and migration models. The analysis relies on demographic modelling techniques recently developed by the Council, and long data series are utilised in fitting the historical information. Despite this, results should be interpreted with caution, especially given the uncertainties involved over long forecast horizons.

The cohort-component model provides a comprehensive framework to project population levels with an age and sex breakdown. This is done by following the evolution of each of the cohorts (by sex) over time and adding the births (by sex) and net migration (by cohort and sex). Equation (1) shows the functioning of the cohort-component model as applied in this report, which is represented in matrix form through a time-dependent first-order Markov chain (Luenberger, 1979; Girosi & King, 2008). As a first step, the portion of the population that survived from period *t-1* to period *t* is calculated, and the projected net migration flows for the period are added. This part of the process excludes the new-borns of the period, which are calculated in a second step by applying the age-specific fertility rates to the surviving women (see Section 2.3, Equation 2), and adjusting for the probability of the new-born's gender.

The vectors contain as many rows as age groups (in the range of 1 to *X*) per gender, the first half corresponding to men *G=1*, and the second half to women *G=2*.

Equation (1) Cohort-component model for population projections

$$\begin{bmatrix} N_{1,1,t} \\ \vdots \\ \vdots \\ N_{X,1,t} \\ N_{1,2,t} \\ \vdots \\ \vdots \\ N_{X,2,t} \end{bmatrix} = \begin{bmatrix} 0 & \cdots & \cdots & 0 & F_{1,2,t-1} & \cdots & \cdots & F_{X,2,t-1} \\ S_{2,1,t-1} & & & \vdots & 0 & 0 & & 0 \\ \vdots & \ddots & & \vdots & \vdots & & \ddots & \vdots \\ 0 & \cdots & S_{X,1,t-1} & 0 & 0 & 0 & \cdots & 0 \\ 0 & \cdots & \cdots & 0 & F_{1,2,t-1} & \cdots & \cdots & F_{X,2,t-1} \\ \vdots & & & \vdots & S_{2,2,t-1} & 0 & 0 & \vdots \\ \vdots & & & \vdots & \vdots & \ddots & 0 & \vdots \\ 0 & \cdots & \cdots & 0 & 0 & \cdots & S_{X,2,t-1} & 0 \end{bmatrix} \times \begin{bmatrix} N_{1,1,t-1} \\ \vdots \\ \vdots \\ N_{X,1,t-1} \\ N_{1,2,t-1} \\ \vdots \\ \vdots \\ N_{X,2,t-1} \end{bmatrix} + \begin{bmatrix} M_{1,1,t} \\ \vdots \\ \vdots \\ M_{X,1,t} \\ M_{1,2,t} \\ \vdots \\ \vdots \\ M_{X,2,t} \end{bmatrix} - \begin{bmatrix} E_{1,1,t} \\ \vdots \\ \vdots \\ E_{X,1,t} \\ E_{1,2,t} \\ \vdots \\ \vdots \\ E_{X,2,t} \end{bmatrix}$$

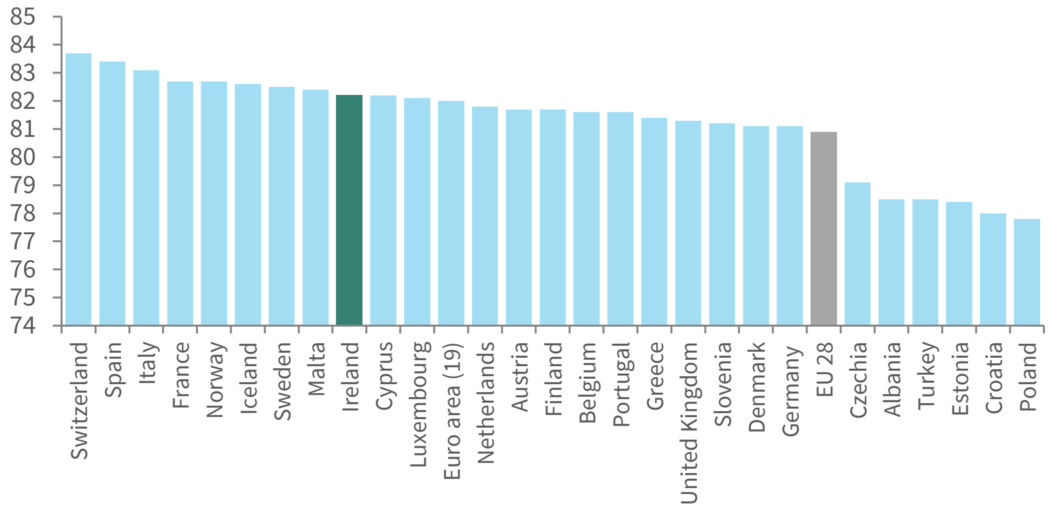
Source: Osés-Arranz and Quilis (2018).
Note: N refers to the population; S, to the survival probabilities; F, to the fertility rates; M, not the immigration flows; and E, to the emigration flows. The first sub-index denotes the age group of the cohort, where age = [1, X] and X = 100 in this exercise. Fertility rates are non-zero only for the fertile age of the mothers, assumed to be between 15 and 49 in this exercise. The second sub-index refers to the gender, where gender = [1, 2] refers to male and female, respectively. The last sub-index refers to the current period t, and to the previous period t-1.

2.2 Life expectancy and mortality rates

Mortality rates are a key contributor to the population dynamics. Over the last few decades, life expectancy at birth has experienced substantial overall improvements, positively contributing to population growth. Focusing on Ireland, reductions in mortality rates have been especially significant for the population aged below one (i.e., new-borns), as well as the cohorts aged over 65. Within the EU, Ireland's life expectancy at birth is higher than the EU 28 average (82.2 versus 80.9, as shown in Figure 2.1), largely driven by long-living prospects for women.[1]

Figure 2.1: Life expectancy at birth in Europe (2017)

Age in years



Source: Eurostat.

Based on recent improvements in mortality rates and the expectation that these will continue in the future, the CSO provides the following assumptions, which we adopt as our baseline projections of mortality rates. Over the short term, mortality rates are assumed to improve by 2.5 per cent per annum for males, and 2.0 per cent per annum for females.[2] Over the long run, the rate of improvement is assumed to decline to 1.5 per cent per annum for both sexes (CSO, 2018).

The methodology underpinning these assumptions is based on the estimation of the average rate of improvement of mortality rates over the period 2011–2015. While this is a relatively short time period to take into consideration, mortality rates

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[1] Female life expectancy in 2017 was 84.0, while for males this was 80.4 years. Over the last 30 years, Ireland has experienced sharp improvements in life expectancy: from 73.5 in 1986 to 82.2 in 2017.

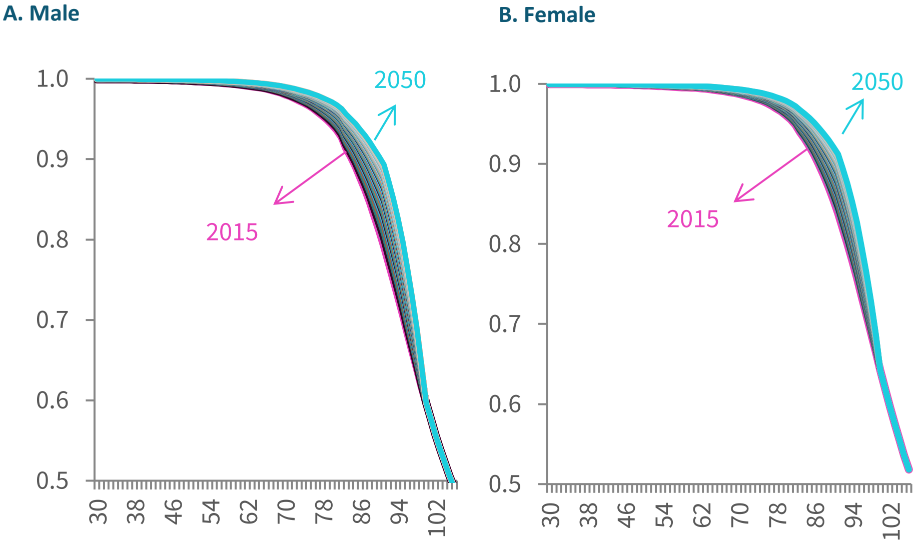
[2] The short-term rate declines linearly over 25 years before reaching the long-term rate.

projections are not typically the most substantial drivers of total population projections. This, together with the fact that mortality changes tend to be slow, alleviates the concerns from a methodological point of view.

The CSO's analysis shows that, while improvements in mortality rates were evident over this period, the pace of improvement has slowed somewhat for both sexes over the past few years. It also points out that male mortality rates were declining at a faster pace than female rates, hence the above-mentioned short-run divergence in assumed mortality rate improvements by sex.

In terms of the mortality rates that the CSO applies to individual age cohorts, the assumed mortality reductions are linearly interpolated across each cohort. For the cohorts aged 100 years or over, no improvements were assumed. For ages 90–100, the assumed rates were interpolated between the assumed rate at age 90 and zero per cent improvement at age 100. From 2041 onwards, an annual decline of 1.5 per cent was assumed for ages up to 90.[3] Figure 2.2 details the underlying survival probabilities projections, which are calculated as one minus the mortality rate projected for each age cohort. Relatedly, Figure 2.3 shows the implied life expectancy increases assumed by the CSO up to 2051.

Figure 2.2: Survival probabilities projections (CSO)

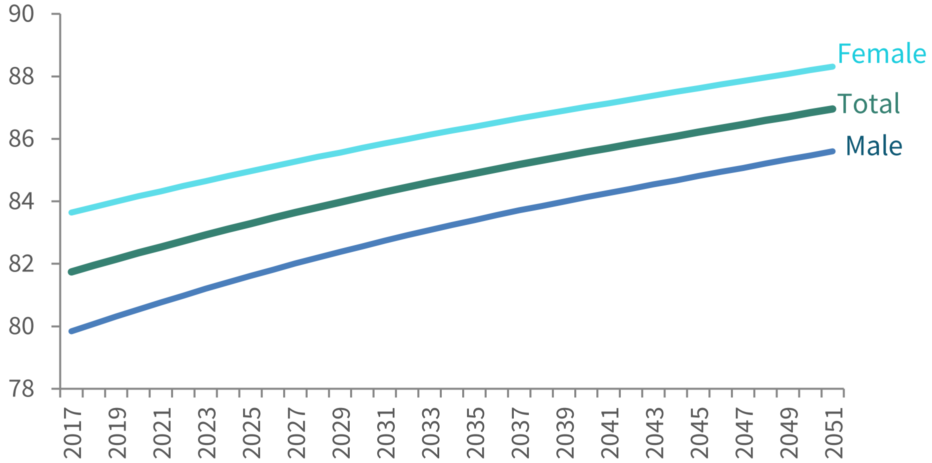


Sources: CSO; and Fiscal Council calculations.
Note: Improvements are mainly observed in older cohorts, thus ages 0–30 are omitted above.

[3] For ages 91–99, the rate followed a linear interpolation between the assumed rate for the age of 90 and a 0 per cent improvement at age 100. For ages over 100, no further mortality improvements were assumed.

Figure 2.3: Life expectancy at birth projections for Ireland

Age in years



Sources: CSO; and Fiscal Council calculations.
Note: The CSO's projections do not provide data for total life expectancy, but for gender-specific life expectancy. However, given that the gender split is close enough to 50/50, the total shown in the graph is simply the average life expectancy of both sexes.

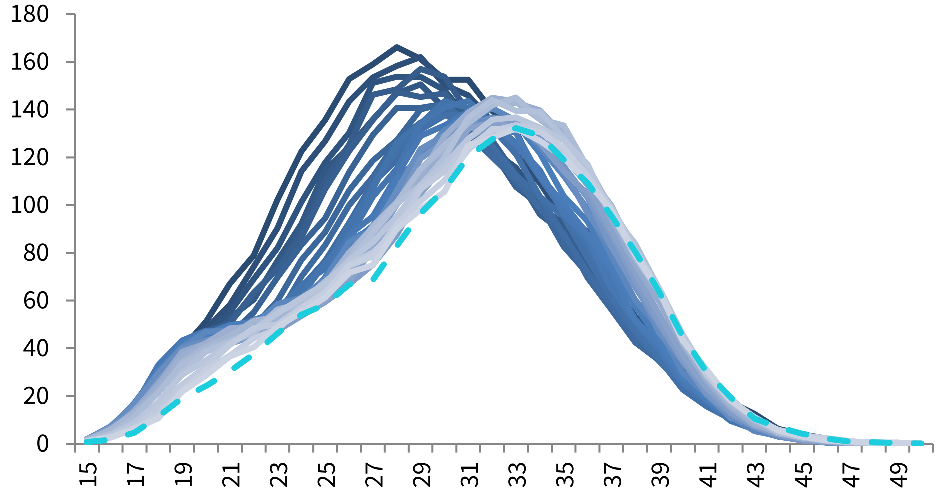
2.3 Fertility rates

Fertility rates are a key determinant of the population structure, especially in terms of the speed of population ageing (Alkema *et al.*, 2011). Most advanced economies are experiencing declining fertility rates, contributing to the challenge of demographic ageing.

An informative way to look at how fertility has changed historically is through age-specific fertility rates. These offer a detailed picture of the fertility rate per cohort. In particular, age-specific fertility rates show the average number of children per 1,000 women of a given cohort. The addition of each age-specific fertility rate yields the average number of children per woman in fertile age in a given country, also known as total fertility rates (see Equation 3).

In the Irish context, fertility curves have experienced substantial changes in the last few decades: They have seen a general shift towards lower fertility, as well as a delay in the typical age for having children (Figure 2.4). This reflects the fall in total fertility rates over time. In terms of the modal (most likely) maternal age, this increased from 28 in 1986 to 33 in 2016. While the total fertility rate in 1960 was 3.8, this declined to 2.4 in 1986, before reaching a rate of 1.8 in 2016.

Figure 2.4: Age-specific fertility rates in Ireland, 1986–2016

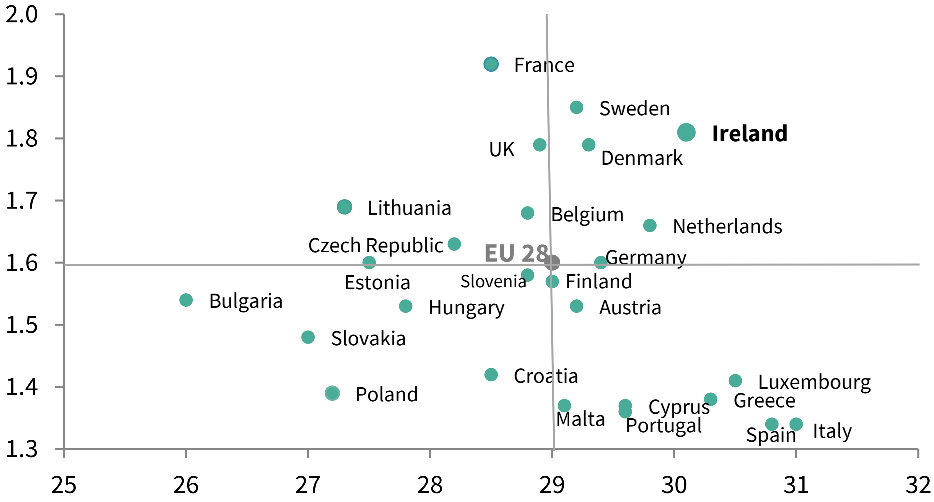


Source: Eurostat
Note: Darker lines indicate older vintages; lighter lines indicate more recent ones. The dashed line corresponds to 2016.

Yet, Ireland has high fertility rates relative to the EU average. Data for 2016 (Eurostat, 2018) shows Ireland has the third highest rate of average live births per woman in the EU (1.81), only surpassed by France (1.92) and Sweden (1.85) (Figure 2.5).

Figure 2.5: Fertility in 2016

Total fertility rate (vertical axis); mean age of mother at birth of first child (horizontal)



Sources: Eurostat (2018).
Note: Data for France, UK, Germany, and Italy are either provisional or estimated by Eurostat.

Projections of future fertility

The CSO's methodology for long-run projections is based on expert judgement. It can be augmented in a number of ways, which we explore here. The Council's methodology contributes to previous literature for Ireland in two main ways:

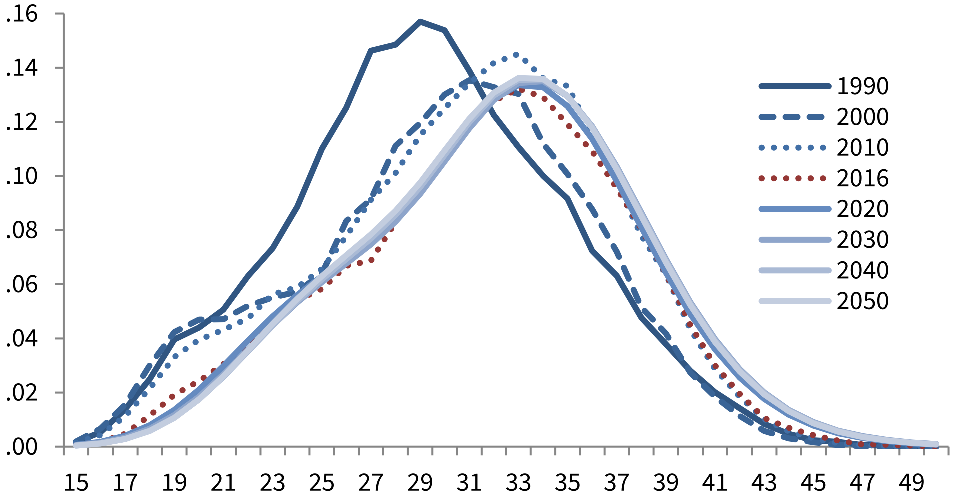
1) projections are model-based, rather than purely judgement-based; and

2) the basis of the projections follows a bottom-up approach based on a model of age-specific fertility rates (rather than assigning a value to the total fertility rates first and then distributing them according to the age of the mother).[4] In broader terms, projections of age-specific fertility rates provide richer information from a policymaking perspective (e.g., in a context of implementation of birth-incentivising programmes).

The Council's fertility projections are shown in Figure 2.6. These suggest that (1) the downward trend of fertility rates observed over recent years will generally continue at a similar pace over the projection horizon, and (2) the curves are expected to trend slightly rightwards, meaning an overall postponement of the modal fertility age of the mothers.

Figure 2.6: Irish fertility curves, historical and projected

Average number of children per woman in fertile age (vertical axis); age (horizontal axis)

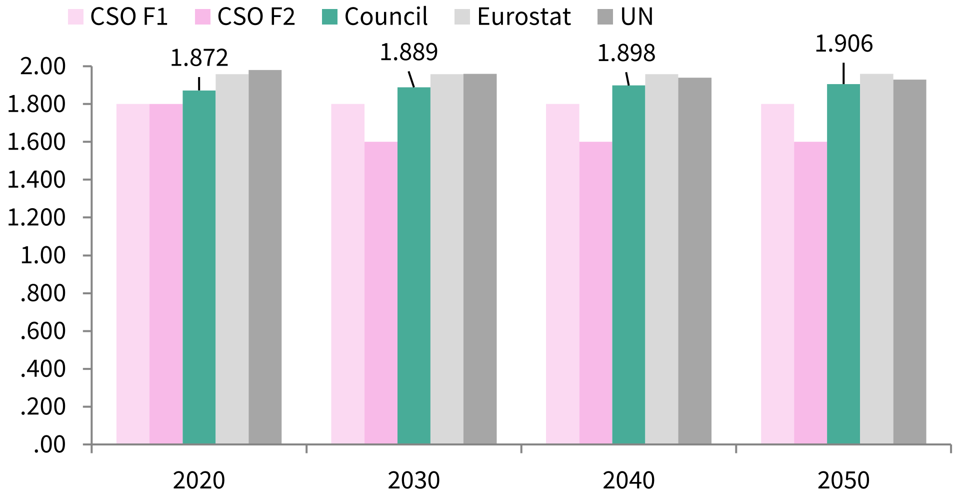


Sources: Eurostat (historical data 1990-2010); and Fiscal Council forecasts for 2020-2050.

[4] If one were to follow a top-down approach, this would mean that the behaviour of cohort-specific fertility rates would be disregarded, hence not making full use of all available information.

Compared to other institutions, the long-term total fertility rates produced here do not differ significantly in overall terms. However, there might be substantial differences in the age-composition of the rates that still give rise to the same total fertility rates.[5] For example, suppose that there are just two fertile-age groups in the population: 30 and 31. If the fertility rate of the age-30 group is 0.9 and that of the age-31 group is 0.6, the average number of children per woman will be 1.5.[6] However, the actual total number of children born in the population will depend on the number of women of fertile age at that point in time. Given this, it is important to account for age-specific fertility rates by cohort.

Figure 2.7: Total fertility rate projections by different institutions



Source: CSO; Eurostat; United Nations; and Fiscal Council workings.
Note: CSO F1 and F2 refer to the CSO's high and low fertility scenarios, respectively.

Focusing on the CSO, our projections are permanently slightly higher than the two CSO (2018) scenarios, and these differences increase over time. Conversely, the total fertility rates under this projection are permanently lower than those produced by the UN and Eurostat, although the differences in this aggregate indicator are not very substantial, and these projections get closer over the projection horizon. In particular, the 2050 Council projections suggest total fertility rates of 1.91, just slightly below the UN's projection of 1.93 and Eurostat's rate of 1.96. Figure 2.7 shows these vintages in more detail.

[5] The Council's fertility projections reflect that, while the total fertility rate is projected to remain broadly stable over the projection horizon (Figure 2.6), the age-specific fertility rates will vary for certain cohorts (Figure 2.5).

[6] As shown in Equation 3, total average fertility rate is the weighted sum over all age-specific fertility rates.

Fertility projection methodology

In the literature, a wide range of non-linear equations have been proposed to fit fertility curves. These include probability density functions like the Hadwiger function (inverse Gaussian) (Hadwiger, 1940; Gilje, 1972), the Gamma and Beta functions (Hoem *et al.*, 1981), the Coale-Trussel (Coale *et al.*, 1974), the Brass procedures (Brass, 1974; 1978) and the Gompertz curves (Wunsch, 1966; Murphy and Nagnur, 1972; Farid, 1973), among others.

Although some of these functions fit reasonably well in a wide range of countries' fertility curves (Peristera and Kostaki, 2007), they might be limiting as assumptions for countries characterised by more heterogeneous patterns. In particular, countries like the US, the UK and Ireland have shown marked humps in the young ages (Peristera and Kostaki, 2007). In the Irish case, this appears evident in a number of periods, as displayed in Figures 2.4 and 2.6.[7] This diverging behaviour limits the applicability of the traditionally proposed curves for fertility-fitting.

In order to address the inability of conventional models to describe these trends, Chandola *et al*. (1999; 2002) proposed a mixture of the Hadwiger function as a way to capture this new form in the fertility pattern. When fitting the Irish historical fertility curves, this double-peak Hadwiger was in fact the model that showed the best fit, while the conventional curves performed poorly in the adjustment. This non-linear Hadwiger mixture equation requires the estimation of six parameters and is of the following form:

Equation (2) Hadwiger mixture equation

$$f(x) = am\left(\frac{b_1}{v_1}\right)\left(\frac{v_1}{x}\right)^{\frac{3}{2}} exp\left[-b_1^2\left(\frac{v_1}{x}+\frac{x}{v_1}-2\right)\right] + (1-m)\left(\frac{b_2}{v_2}\right)\left(\frac{v_2}{x}\right)^{\frac{3}{2}} exp\left[-b_2^2\left(\frac{v_2}{x}+\frac{x}{v_2}-2\right)\right]$$

Note: *x* refers to the age of the mother at birth of the child (assumed to range between 15 and 50); *m* is a mixture parameter that determines the relative sizes of the two component distributions; and a, b_1, b_2, v_1 and v_2 are related to total fertility and the level and trend of the average ages of fertility in the two component distributions (Greater London Authority, 2017).

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[7] While the intensity of the hump appears to have diminished to an extent as a feature of the Irish fertility curve in recent years, alternative fits to traditional ones are found to still be more applicable in the Irish case.

Equation (3) Calculation of total fertility rates (TFR)

$$TFR_t = \frac{b_{x,t}}{w_{x,t}} * 1000 + \frac{b_{x+1,t}}{w_{x+1,t}} * 1000 + \cdots + \frac{b_{x+k,t}}{w_{x+k,t}} * 1000 = \sum_{x}^{x+k} ASFR_{x,t}$$

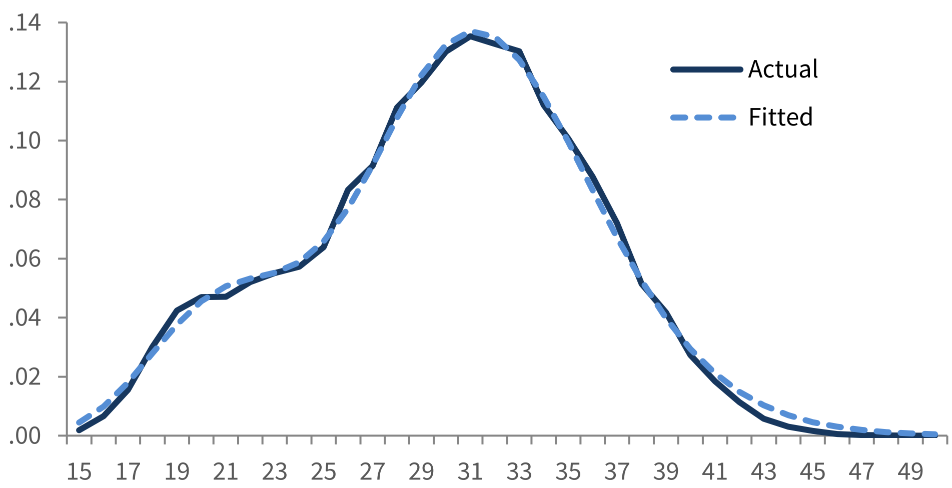
Note: b refers to the number of live births for the number of women w aged between *x* and *x+k* at a given period of time *t*. *ASFR* stands for age-specific fertility rate. The assumed fertility age in this case lies between 15 and 50.

The estimation of the set of curves is based on a Levenberg-Marquardt nonlinear least-squares algorithm. In total, 31 estimations are obtained for each of the six parameters (giving rise to 186 estimations in total). Given that these parameters form a multiple time-series, a VAR model is used to project their evolution. The selected VAR model is of order 1, i.e., each variable is a linear function of the lag 1 values for all variables in the set. The yearly projections of the coefficients are then plugged into Equation (2) yielding age-specific fertility rates for the projection horizon.

The non-linear least squares estimation of the double-peaked Hadwiger mixture equation provides a set of estimated curves that adjust relatively well to the actual data. Figure 2.8 shows the actual and fitted curves for Ireland for the year 2000, whose form—which follows a hump in the first half and is smoothed for older ages—evidences the good fit of the Hadwiger mixture equation.

Figure 2.8: Fertility curve fit for Ireland in 2000

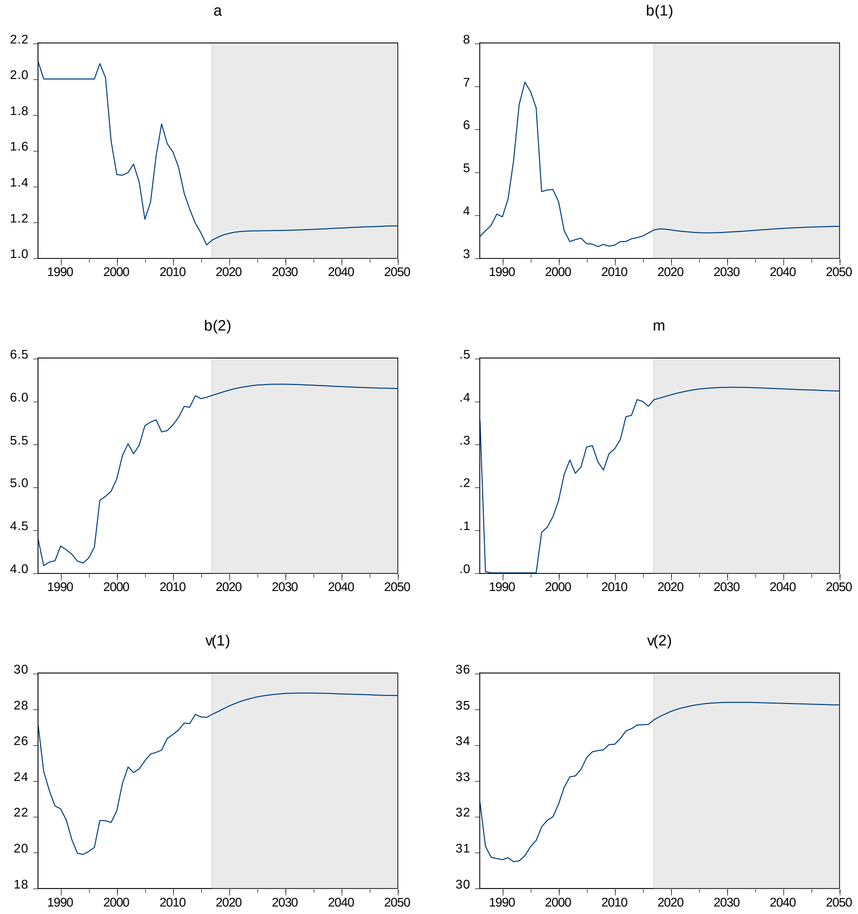
Average number of children per woman in fertile age (vertical axis); age (horizontal axis)



Sources: Eurostat; and internal Fiscal Council workings.

The estimated coefficients and their forward projection through an order-1 VAR model are displayed in Figure 2.9. This gives rise to the projected fertility curves up to 2050.

Figure 2.9: Fertility rates, projected evolution of the Hadwiger Parameters



Source: Fiscal Council projections.

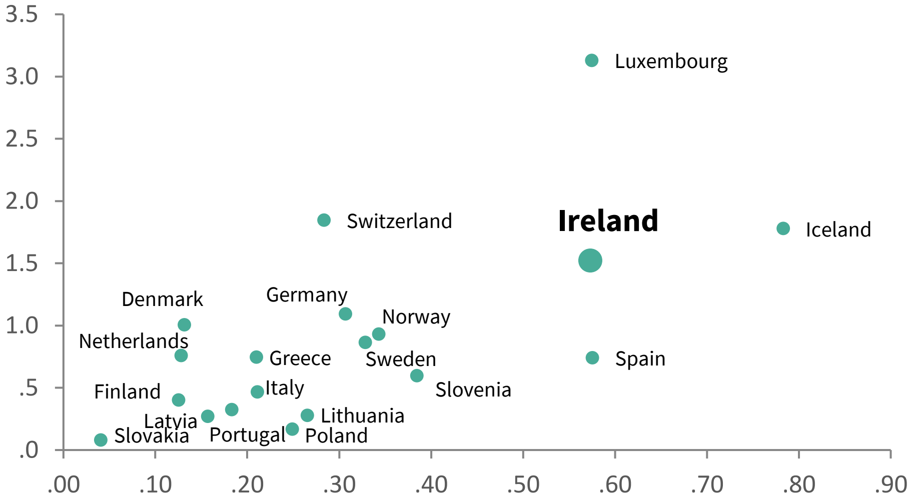
2.4 Migration flows

Migration is typically the most challenging demographic component to forecast and the main source of error in population projections. This is especially the case in Ireland, a small open economy where migration flows are particularly volatile. Migration can have important effects on the overall size of the population, and potentially on ageing if migrants—who typically move at relatively young ages—stay in the country over long horizons.

Figure 2.10 shows that (1) the volatility of immigration as a share of total population in Ireland is one of the highest in Europe, and (2) immigration as a share of total population in Ireland is one of the highest in Europe. The fact that Irish migration is so volatile implies that the overall Irish population structure is also subject to significant uncertainty in the event of future shocks.

Figure 2.10: Scale and volatility of immigration in Europe

Horizontal axis= Volatility, vertical axis= immigration share of total population (%)



Sources: Eurostat; and Fiscal Council workings.

Note: Volatility is measured as the standard deviation of the mean share of immigration over total population for the period 1990–2016.

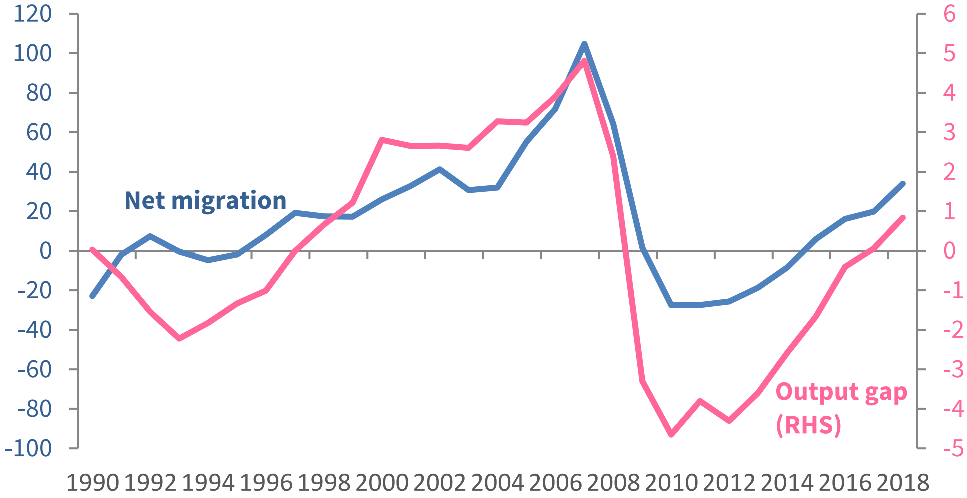
Figure 2.11 shows the close correlation between net migration flows and the Irish economic cycle.[8] Migration has been closely associated to the health of the Irish economy in the past, and the future population is likely to depend on how well

[8] The Irish economic cycle is reflected here through the "output gap", a measure that aims to reflect the cyclical position of the economy. This is calculated as the difference between the actual output and the estimated potential output at a particular point in time. Potential output is the maximum level of economic output that is sustainable in the medium to long run, where "sustainable" implies that output, when at its potential, is not unduly influenced in any particular direction by imbalances in the economy, be they external, internal or financial. The output gap estimates shown in this paper are based on Casey (2019).

Ireland's productivity fares. This is also important to bear in mind when starting off a set of migration projections, as initial migration flows might be projected forward from a temporarily high or low base depending on the cyclical position. Another relevant aspect to bear in mind relates to the elasticity of migration to potential output. In undertaking long-term projections, the assumed economic growth over those long horizons is typically gauged by the assumed potential output growth (rather than the output gap itself).

Figure 2.11: Net Migration and the Cyclical Position in Ireland

Migration in thousands (LHS); Output gap, % of potential output (RHS)



Sources: CSO; and Osés-Arranz (2019).

Note: Output gap estimates are based on Casey (2019).

With this in mind, well-founded migration projections are paramount. Drawing on international data on global bilateral migration and strong developments in migration estimation techniques, Osés-Arranz (2019) develops a gravity model of migration, with a special focus on Ireland. The model projects world migration in a bilateral fashion by relating country-pair migration flows with fundamentals like economic growth, demographics, and other relevant variables.

The equation underpinning the migration projections is shown in Equation (4) and further details of how the model is specified are provided in Osés-Arranz (2019). It relates the probability of migrating from the country of origin *o* to the country of destination *d* to (1) the network effects, that is the stock of co-nationals already living in country of destination, (2) population structures at origin and destination (*Pop*), broken down by broad age cohorts *i*, (3) economic growth (GDP per capita *GDPc*), and (4) Multilateral Resistance to Migration *(MRM)*.

Equation (4)

$$odds_{o,d,t} = exp\left(\delta_0 * lnM_{o,d,t-1} + \sum_i \delta_{1,i} * lnPop_{i,o,t-1} + \sum_i \delta_{2,i} * lnPop_{i,d,t-1} + \delta_3 * lnGDPc_{o,t-1} + \delta_4 * lnGDPc_{d,t-1} + \delta_{5,o,d} * MRM_{o,d,t}\right) + \alpha_{o,d,t}$$

$$\forall o \neq d, \text{where } o = 1, \dots, 232; d = 1, \dots, 232; t = 1970, \dots, 2020; i = [15^-, 15-64, 64^+]$$

Source: Osés-Arranz (2019).

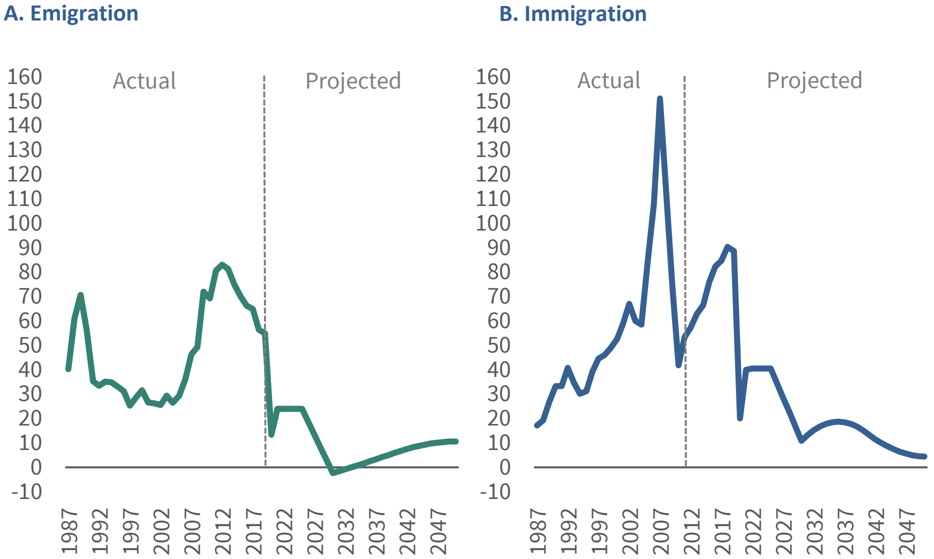
The projections shown in Osés-Arranz (2019) are updated in the LTSR to take account of the Council's baseline scenario of economic growth. The results suggest that net flows would amount to around 14,000 by 2031, and then trend down slightly to 9,400 by 2040, before turning into negative flows in the period 2044–2050. These positive flows are the result of (1) foreign migration flows to Ireland projected to be consistently positive over nearly the whole projection horizon, broadly in line with their long-term average (Figure 2.12A); and (2) Irish emigration being comparatively lower nearly over the whole projection horizon (Figure 2.12B), largely reflecting relatively favourable productivity growth in Ireland.

For the last decade of the projection horizon, the overall population of sending countries is expected to grow at a slower pace than the odds of migrating. This implies that migration stocks will grow but not as strongly as in the previous decade, triggering a slight slowdown in the migration flows. The opposite applies to Irish emigration; a growing Irish population in combination with a slowdown in economic growth are linked to emigration increasing steadily after a low in 2030.

Figure 2.13 compares the baseline projections with those undertaken by other institutions. The LTSR baseline projections are, on average, close to the CSO's lower migration scenario (M3) of average net migration flows of 10,000 over the entire projection horizon. For the 2030s, projections coincide with those of the CSO's second scenario, as well as with Eurostat's baseline estimates. For the last decade, the LTRS baseline is lower than estimated by all other institutions shown in Figure 2.12. In particular, the LTSR projections are significantly lower than those of the United Nations, which point at strong net migration flows of 50,000 over the whole projection horizon.

Figure 2.12: Projected migration flows for Ireland

Thousands

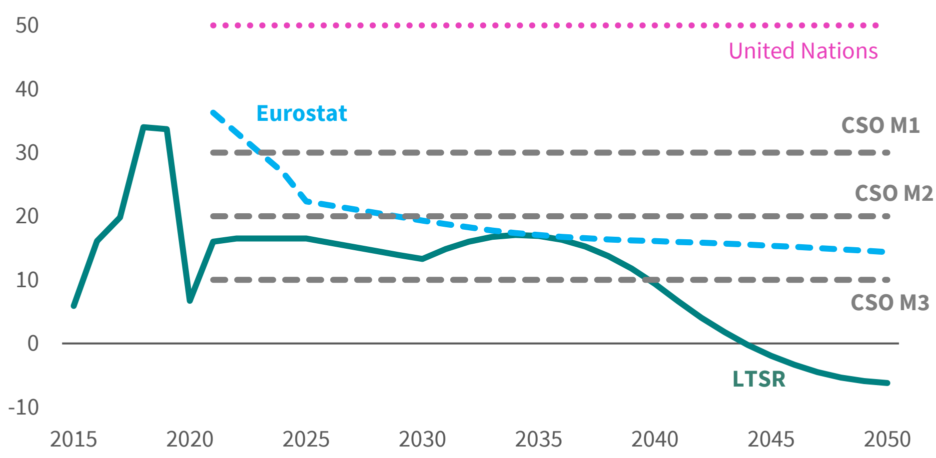


Sources: CSO; and Osés-Arranz (2019).

Note: CSO data on emigration and immigration is not available prior to 1987. The projections are based on Osés-Arranz (2019), but they are updated to take account of the baseline economic growth assumed for Ireland in the LTSR.

Figure 2.13: Migration flows projections, comparison with other institutions

Thousands (annualised projections for baseline)



Sources: CSO; Eurostat; United Nations; Department of Finance and Osés-Arranz (2019) for the "LTSR" scenario.

Note: Data shown in terms of net migration flows. The "LTSR" figures are based on Osés-Arranz (2019), but it is updated to take account of the baseline economic growth assumed for Ireland in the LTSR. Eurostat figures are from the baseline scenario.

CSO, UN and Eurostat projections were undertaken before the emergence of Covid-19, while the LTSR figures for 2020–2025 are consistent with the Department of Finance's *Stability Programme Update 2020*.

2.5 Labour Force Participation

Rising female participation rates and steady increases in participation rates among older cohorts are notable in recent years. This section considers recent trends and shows how the projections are informed by these developments.

Recent trends in participation rates

Figure 2.14 shows the distinctive participation rate developments by age and gender since 1995. Men of prime working age (broad age groups 25–49 and 50–59) exhibit the most stable participation rates. Female participation in those age groups has seen substantial increases, but levels still remain somewhat below respective male rates. Participation of the young (15–24) peaked during the boom years of 2007–2008, while participation of older workers has seen more steady increases.

After decreases in the crisis years, male rates for all age groups have picked up again. From a historic perspective, however, male participation rates are structurally lower than in 1971 (see data provided in Walsh, 1993). This is not just an Irish phenomenon: global total participation rates showed a negative trend prior to the crisis, but have stabilised since 2013 (ILO World Employment and Social Outlook 2015).

Out of the middle-aged working groups, the 25-29 year olds were affected most by the crisis, with unemployment peaking at 20.3 per cent in 2011.[9] This affected women of that age group, whose activity rates decreased slightly after 2008, unlike older female age groups. Cohort effects offer a likely explanation for the considerable rise of other middle-aged and older female age groups, meaning that women who are now, for example, in their 50s and 60s have structurally different participation rates than women who were the same age 20 years ago. However, as highlighted by Byrne and O'Brien (2016), it is unlikely for this growth pattern to continue as strong as in the past, at least under current structural settings. Similarly, the CSO labour force projections expect only marginal improvements to female participation rates. For euro area countries, this phenomenon is analysed in Balleer *et al.* (2009), finding that particularly, women born in the 1960s -1970s have contributed to the upward shift in female participation rates. As these women enter

[9] Source: Eurostat, accessed 21/08/2019

the 55-69 age bracket, more gains for older female participation rates also seem plausible. Another point why (older) female participation rates are likely to continue to rise, albeit at a slower pace, is survey evidence for educational attainment making participation more likely, especially for women (Mosca & Barrett, 2011). On a global level, gender participation gaps have narrowed over 1995-2015 for all regions of the world except South Asia (ILO, 2016).

Turning to younger workers' participation over the past 20 years, it should be noted that Irish education participation rates for 15-19 year-olds lie above the EU average.[10] Labour market participation of this age group has fallen by more than 15 percentage points for both boys and girls since its latest peak before the crisis. Likewise, the participation rates of 20-24 year olds decreased markedly over the past decade, suggesting that people tend to stay in education for longer.

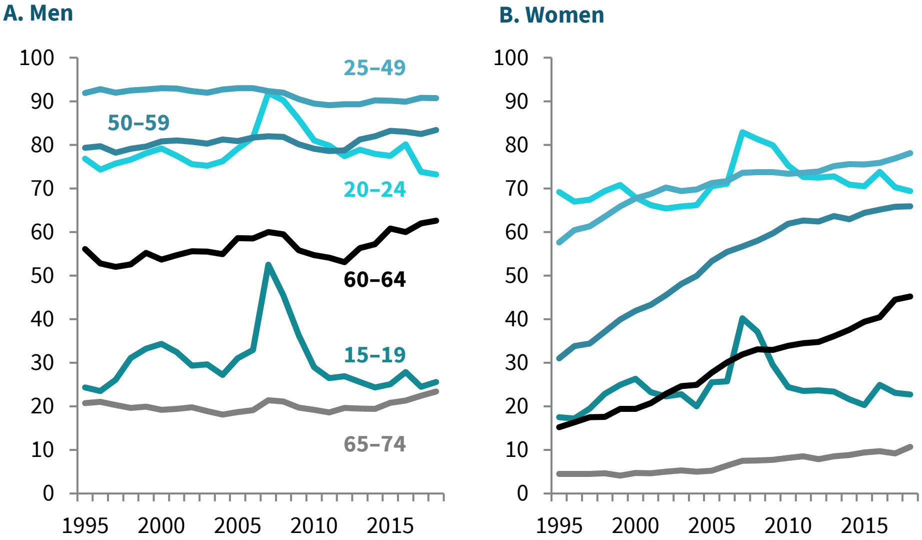
Conversely, 65-74 year olds have seen a small increase in participation since 2014, which could be due to both standardising the State Pension age to 66 as well as a general picking up of the labour market. It is noteworthy, however, that the pensionable age was 70 until 1972 and was gradually decreased thereafter to 65/66 by the late 1970s.[11] Correspondingly and despite rising life expectancy, the effective retirement age decreased for both genders since 1960 (O'Donoghue, 2004) and for men also, labour force participation rate for ages 65+ declined compared to 1971 (Walsh, 1993).

[10] Source: OECD Education at a Glance database, accessed 12/03/2019

[11] With a transitory pension payable from 65 and a state pension from 66 years of age, see http://www.welfare.ie/en/Pages/State-Pension-Transition.aspx, accessed 01/03/2019

Figure 2.14: Past participation trends by gender and broad age group

% of total cohort



Source: Eurostat

Note: There was a break in time series in 1998, 2005, 2007 and 2017.

Projections of participation rates

The Council's projections of future participation rates are determined exogenously and draw on evidence from recent trends. The assumptions made are specific to age group and gender and are summarised in Table 2.1. The approach is broadly similar to that used for the CSO's 2017-2031 labour force projections (CSO, 2018).

Broadly speaking, the projections assume that men's prime working age participation rates continue to return to their pre- financial crisis rates, while women's rates continue to make gains, getting closer to those of male counterparts.

A key aspect of participation rates is the pension age. Currently, there are two legislated changes to the state pension age, raising it to 67 in 2021 and to 68 in 2028. The latest such institutional change was in 2014, when the pension age was increased from 65 to 66 and the State Pension Transition payment was abolished. Compared to most other European OECD countries, Ireland's effective average retirement age is relatively high (66 for men, 64.2 for women) and there is only a small gap to the official state pension age of 66.[12] The normal state pension age lies above the OECD average of 64.3 for men and 63.4 for women.

To account for future state pension age changes, it is assumed that participation of the age group of 65–69-year-olds increases around the times of reform. At the same time, assuming that older workers stay in their jobs for one year longer, younger workers may find it harder to enter the labour market. For projecting participation changes in 2021 and 2028, it is assumed that rates of 65–69 as well as 15–24 year olds differ from preceding years similar to how 2014 differed from 2012–2013. Note that Redmond *et al.* (2017) did not find a clear effect of the 2014 increase in the pension age on actual retirement or employment. However, their data availability is described as limited. Given that in 2014 actual participation of 65–69 year olds was slightly higher than its moving average, the Council's projections do assume a positive effect of the pension age changes on participation.

For the rest of the projection period, young age groups' participation is assumed to stay constant, while further gains are expected for more senior workers. This reflects increases in observed data for 55–69 year olds, providing optimism for a rising share of working senior citizens. On a European as well as global level, the International Labour Organization (ILO) asserts a growing share of persons aged 55+ both in the population and in the labour force, a trend which is projected to continue (ILO, 2018). Another consideration is the rising employment rates of 55–64 year olds, with increases since 2000 exceeding reductions in the active share of the 25–54 age group in almost all observed countries, including Ireland (OECD, 2017).

Contrary to this, Belan *et al.* (2010) argue that strong female participation could lead to lower participation rates for older cohorts if they increasingly decide to care for their grandchildren while their own children are at work. However, this channel is only developed in the theoretical setting of an overlapping generations model.

Figure 2.15 shows the resulting projected participation rates by broad age group. While rates of age groups of 25–49 and 50–59 are expected to grow moderately, both men and women aged 60–74 are projected to make the relatively highest gains.

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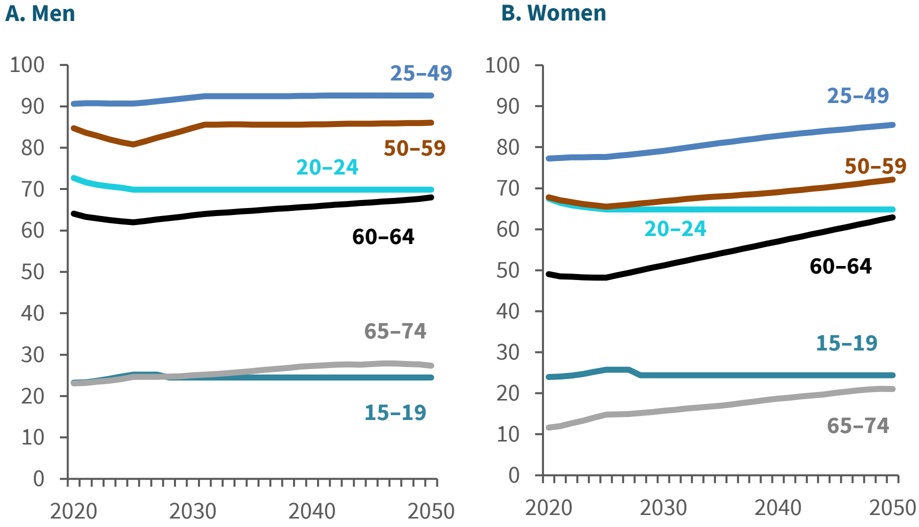
[12] 2017 data, see OECD Ageing and Employment Policies - Statistics on average effective age of retirement, see http://www.oecd.org/els/emp/average-effective-age-of-retirement.htm, accessed 12/03/2019

Participation of younger cohorts is assumed to fall slightly around 2021 and 2028—when the pension age changes—and to stay relatively constant thereafter. Figure 2.16 shows the resulting total participation rate. For ages 15–65, the rate is rising slightly, due to relatively optimistic assumptions by age group. However, when expressed differently in terms of the participation rate of the total population aged 15+, the rates decrease. This is due to a higher share of older people with structurally low participation rates.

Figure 2.15: Participation projections by gender and age

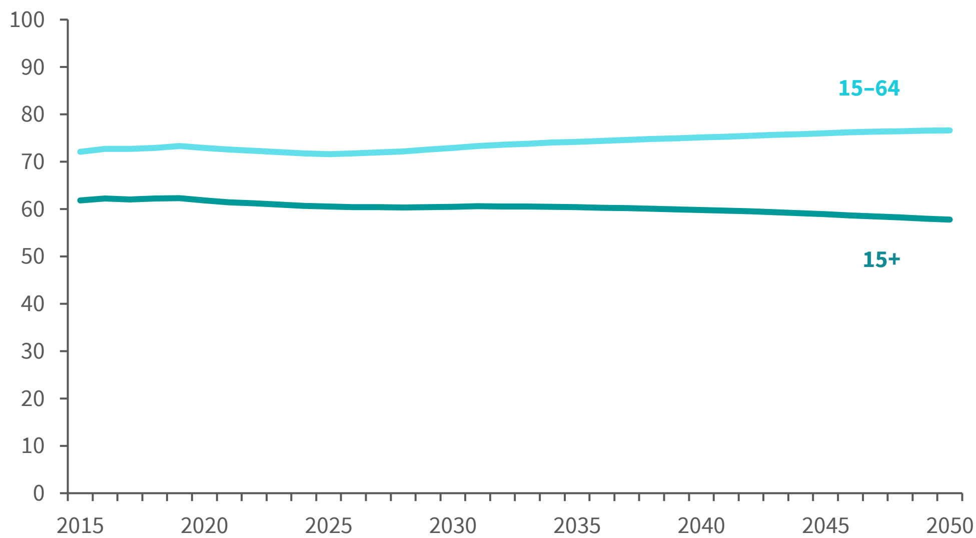
% of age group



Source: Eurostat and Fiscal Council projections.

Figure 2.16: Average participation rates by broad age

% of age group



Sources: Eurostat; Department of Finance; and Fiscal Council projections.

Note: Data for 2015–2019 is observed, data for 2020–2050 is projected. Participation is projected by 5-year age cohort, then summarised by broader age groups for illustrative reasons.

Table 2.1: Council participation rates projection assumptions

Age	Assumption	
15-24	In 2021 and 2028 (years of state pension age increases): decreases like in 2014–2015 (last year of state pension age change); constant thereafter (implying constant education participation assumption)	
25–54	**Men**: Gradual improvement to 2006 rate as unemployment assumed to stay low (like CSO)	**Women**: More gains than male participation rates, gap to male rate narrows
55-59	Continued growth until 2050, gap to 50–54 cohort decreases	
60-64	Continued growth until 2050, gap to 55–59 cohort decreases	
65-69	In 2021 and 2028 (years of state pension age increases): increases like in 2014–2015 (last year of state pension age change); expected gains continue thereafter until 2050, trending towards participation of 60–64 olds.	
70+	Only marginal improvements, outside of state pension age changes (like CSO)	

Note: “like CSO” refers to Labour Force Projections 2017-2031, see CSO (2018).

3 Macroeconomic modelling

This section outlines how the macroeconomic projections are developed for the purposes of the LTSR.

3.1 Growth and productivity

A Solow growth model framework is used for projecting economic activity.[13] As shown in Equation (5), real GNI* growth (ΔY_t) is the sum of the growth rate of total factor productivity (TFP) (ΔA_t), and the weighted growth rates of the net capital stock (ΔK_t) and labour inputs (ΔL_t). We assume standard elasticities of output with respect to capital (α=0.33) and labour (1−α=0.67).

Equation (5): Real GNI* growth

$$\Delta Y_t = \Delta A_t + \alpha \Delta K_t + (1-\alpha)\Delta L_t$$

Labour: Labour inputs are given by our assumptions on demographics, participation rates, average hours worked and the steady state unemployment rate. When combined, these series give an estimate of the total hours worked in the economy in a given year (L_t), which serves as our labour input to growth as in Equation (6).

Equation (6): Labour inputs (total hours worked)

$$L_t = Avghrs_t * (1 - une_t) * (pop_t * PR_t)$$

We use observed CSO data on average hours worked per week, which is then annualised to give $Avghrs_t$. We also have total numbers employed, given by the product of the employment rate $(1 - une_t)$ and the labour force $(pop_t * PR_t)$, where une_t is the unemployment rate, pop_t is the population aged 15 and over and PR_t is the participation rate for the same cohort.

The path for average weekly hours worked per person is assumed exogenous in the LTM. There has been an absence of a clear trend in either direction in recent years. Hours fell steadily from 1998 to 2011 but rose consistently from 2012 to 2019. Absent

[13] It is assumed that GNI*, GNP and GDP all grow at the same rate in the medium and long run.

any clear trend, for the July 2020 LTSR, it was assumed that average hours worked per person would stay constant at observed 2019 levels.

The unemployment rate is assumed to revert to a "natural rate" of 5.5 per cent by 2031 and to remain at this level thereafter. This rate is based on the Department of Finance's frequently used convergence assumption over the medium term (Fiscal Council, 2018).[14]

The population aged 15 and over and the participation rates are as given by the Council's demographics model (see Section 2.5 for participation rates and the rest of Section 2 for population).

Capital: The net capital stock (K) is defined as the previous period's stock minus depreciation and plus investment (I) as in Equation (7). An adjusted net capital stock based on the concept of Domestic GVA and obtained from the CSO is used. This strips out distortions associated with foreign-owned multinational enterprises. For the projection period, it is assumed that the depreciation rate (δ) stays constant at its last available outturn.

Equation (7): Capital inputs (the net capital stock)

$$K_t = (1 - \delta)K_{t-1} + I_{t-1}$$

The investment share of GNI* is exogenous. It is split into public and private investment. The LTM assumes that (voted) public investment is as set out in the National Development Plan (Department of Public Expenditure and Reform, 2018). By 2027, the public investment share according to official plans is stable around 4 per cent of GNI*. For the long run, it is therefore assumed to stay at that rate. The private investment share is assumed to revert to levels consistent with long-run historical norms. Private investment is calculated as the residual between underlying investment in the economy (gross fixed capital formation excluding intangibles) less the amount of investment that is attributed to general government.

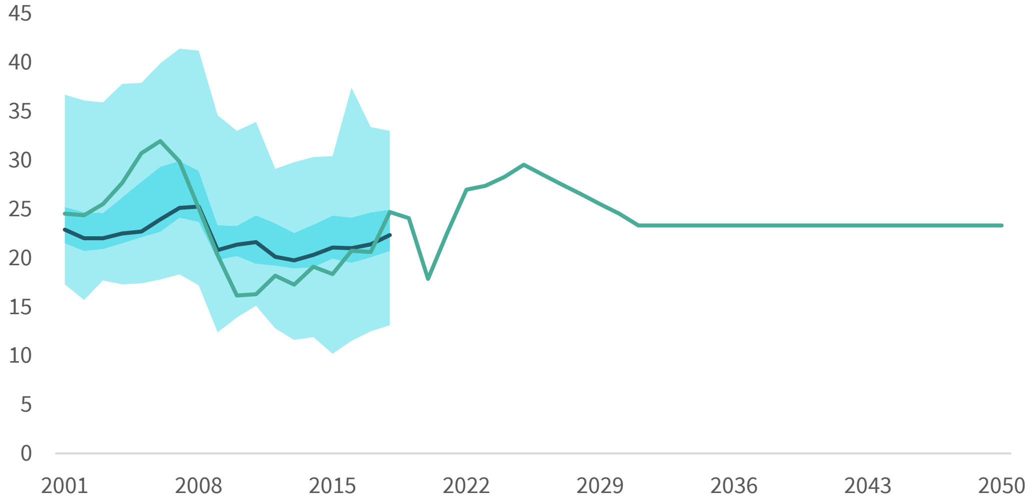
[14] This is broadly consistent with the unemployment rate below which real wage growth has tended to accelerate in a non-linear fashion (Linehan et al., 2017). Age-specific unemployment rates are derived from the total rate and the latest available distribution of unemployment. As shown in Figure 2.8C, employment growth slows after 2028, despite a stable unemployment rate. Again, this can be attributed to population ageing.

For the July 2020 LTSR, it was assumed that private investment converges to 19 per cent of GNI* (its 2000–2018 average).

The projected long-run investment-to-output ratio is given by the sum of the private and public shares. It converges to 23.3 per cent, which is around the Irish average over 1995–2018.[15] The long-run assumed share of 23 per cent also lies around the 60th to 70th percentile of observed EU shares over the period 2000–2018.

Figure 3.1: Investment shares in the EU and Ireland

% GDP (% GNI* for Ireland)



Sources: CSO; Eurostat; Department of Finance; and internal Fiscal Council calculations.
Note: Median (blue line), middle 50% (darker blue), and bottom/top 25% (lighter blue) range shown for former EU-28 excluding Ireland over 1995–2018. Irish investment shows gross fixed capital formation excluding intangibles.

TFP: As in other long-term forecasts, the LTM treats productivity growth as exogenous. This broadly follows the approaches adopted in, for example, McQuinn and Whelan (2015); the EU Ageing Reports; the UK's Office for Budget Responsibility's (OBR) Fiscal Sustainability Reports; and the OECD's long-run projections among others.[16]

As highlighted by Crafts (2019), there are a wide range of forecasts that could be assumed. This reflects diverging views on how technology advances will affect TFP in the future. On the one hand, recent productivity trends are low. This is despite the

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[15] Note that to avoid potential distortions, Irish investment is defined as Gross Fixed Capital Formation excluding intangibles.

[16] The *EU Ageing Report* (European Commission, 2018) assumes that annual TFP growth converges to 1 per cent by 2070 in all Member States. The OBR (2020) in its *July 2020 Fiscal Sustainability Report* assumes overall labour productivity growth of 1.5 per cent annually.

introduction of new technology as noted by Gordon (2016). However, this "econometric pessimism" may also be overly affected by the financial crisis. Others, such as Crafts and Mills (2017) argue that empirical trends are poor predictors of TFP, with observed productivity being highly volatile. As highlighted by Crafts (2019), much will depend on the future technology absorption capacity outside of multinational-dominated sectors in Ireland as well as the successful redeployment of workers.

The Council's assessments of how TFP will evolve are partly informed by: (1) historical evidence for Ireland's domestic economy; (2) a related analysis of labour productivity (output per worker), given regional performances in OECD countries; and (3) a comparative assessment of growth rates in other advanced economies. Boxes A and B of the July 2020 LTSR give an indication of assumptions used in the Council's projections and in other long-run projections.

Convergence to Long-Run assumptions

The macroeconomic forecasts underpinning the LTM consider three broad projection periods:

1) **Short run:** The first five years of the projection horizon are referred to as the short run. For this, the macroeconomic projections typically used would be those produced by the Department of Finance. However, for the purposes of the July 2020 LTSR, forecasts for the years 2020–2021 were only available from the Department of Finance's *Stability Programme Update 2020* (*SPU 2020*). Therefore, for the years 2022-2025, the Council relied on its own extension of the Department's central *SPU 2020* projections (*Fiscal Assessment Report, May 2020*).

2) **Medium run:** The next five years of the projection horizon are referred to as the medium run. The July 2020 LTSR references the years 2026-2030 as the medium run. This is a period of convergence from short run estimates to the more stable long-run inputs. Generally, it is assumed that the forecasts linearly converge on the long-run steady state assumptions (e.g., for unemployment rates, investment rates, TFP growth, etc.).

3) **Long run:** The subsequent two decades are referred to as the long run. For the July 2020 LTSR, this refers to the period of 2031–2050. In those years, most of the macroeconomic inputs have converged on the Council's steady-state assumptions.

3.2 Prices and wages

As wage and price pressures are also important for how the public finances will evolve, the LTM also models associated variables. In particular, the model focuses on the Harmonised Index of Consumer Prices (HICP) inflation, the GNP/GNI* deflator and wage growth.

HICP Inflation and the GNP/GNI* deflators: Ireland's inflation rates are assumed to converge on the ECB's price stability objective for the Euro Area of below, but close to, 2 per cent over the long run. This applies to the GNP deflator also, which imposes that the two indicators are broadly similar over the coming decades. While in recent years the HICP has been below this target and the GNP deflator has varied relatively widely with GNP, both are modelled to stabilise over the medium run.

Wage growth: wages are assumed to rise in line with labour productivity, so that real wage growth matches labour productivity gains in the long run. This is in line with economic theory (Blanchard and Katz, 1999).

4 Expenditure modelling

The LTM forecasts public expenditure based on demographic factors and price pressures. The projections are broadly based on a continuation of existing levels of public services and supports and factor in only those policy changes already legislated for (such as pension-age changes). This approach is similar to the Council's medium-term Stand-Still Scenario (Fiscal Council, 2019).

The core interest is in expenditure related to ageing and demographic change in general. The main areas identified as "age-related" in the LTM are health, pensions, social protection, and education. Growth rates in relevant age cohorts are used to forecast expenditure paths for these areas, assuming that while services provided "stand-still", demand follows changes in the population structure.

Price pressures can be thought of in terms of two key channels: wages and general prices of goods and services. Public sector pay is assumed to evolve in line with private sector wages, such that, implicitly, the model assumes that for the retention of staff, wages need to follow private sector pay developments. Social payment rates are also assumed to grow in line with wages. Price pressures for the non-pay aspects of government spending are assumed to be driven by economy-wide price pressures (typically represented by the GNP deflator).

The horizon for the fiscal forecasts in the LTM starts from the latest period of officially legislated plans. This meant that, for the July 2020 LTSR, most of the fiscal projections started after 2020 as *Budget 2020* plans had already been implemented with changes to planned expenditure and taxation for 2020 taking effect at the time of modelling. An exception was capital spending, which was assumed to match the capital plan to 2027, remaining constant in its share of GNI* thereafter.

4.1 From general government to Exchequer spending

The LTM generally looks at expenditure on a general government (GG) basis. This is based on the definitions of the CSO and Eurostat.[17] Data is in accordance with the *European System of Accounts* (ESA2010) accounting rules and includes all levels of government and transfers between them. For Ireland, the relevant government levels included in general government are central and local government.

While GG data is the most comprehensive way to look at total public expenditure, it is available by relatively broad categories, such as intermediate consumption, subsidies and gross fixed capital formation. At the time of writing the LTSR 2020, the latest available data was 2019. While the Budget includes estimates of GG expenditure, it does not break it down in a detailed enough way to model ageing pressures. The Eurostat database on GG expenditure by function (COFOG) provides more granular data, including by health and old age, as well as in terms of pay and non-pay expenditure. However, this is available at a lag and does not include current-year Budget estimates.

Consequently, the LTM employs detailed spending by heading from the Budget and Revised Estimates.[18] This includes spending on pay, non-pay, capital and public sector pensions and is used to project most of the LTM's ageing-related expenditure.

As shown schematically in Figure 4.1, Exchequer expenditure constitutes a large share of central government expenditure. However, it does not include certain central government bodies nor local authorities. In addition, it is not based on equivalent definitions and some (small) parts of the Exchequer are not counted in the GG total.

In general, central government public sector bodies are defined as (1) being established through political processes and (2) for whose activities a responsible person (usually a Minister of the State) is accountable to the Oireachtas. This responsibility extends to the presentation of audited annual records to the

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[17] For background information see: CSO: https://www.cso.ie/en/methods/surveybackgroundnotes/governmentfinancestatisticsannual/ and Eurostat: https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:General_government_sector

[18] Available on the Department of Public Expenditure and Reform's Databank

Oireachtas (CSO, 2020). That applies to so-called extra-budgetary funds, which have their own accounts and are administered by Departments as well as other bodies which source their main funding from the Exchequer and are subject to controls. Examples of such bodies in the 2019 GG data are the Environment Fund, the Ireland Strategic Investment Fund or Iarnród Éireann (CSO, 2020).[19]

While central government bodies are counted towards central and general government, some are not in the realm of the Exchequer or receive some but not all their funding from the Exchequer. Figure 4.1 and Table 4.1 show how the different levels of government are related and how their size of expenditure compared in 2019. Similar illustrations may be found in Fiscal Council (2016, Appendix E) and PBO (2019).

Figure 4.1: Levels of Government

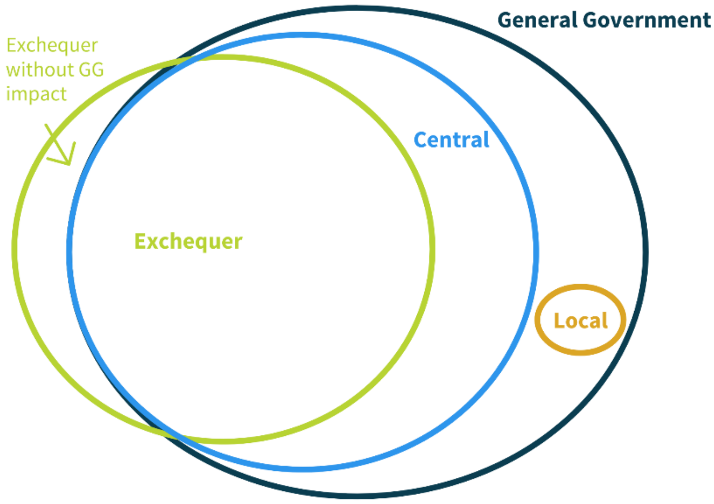


Table 4.1: Expenditure by level of Government, 2019

€ Million

Exchequer	Central Government	Local Government	General Government
64,964 *Of which non-GG impacting: 1,709*	81,323	8,386	86,114

Sources: CSO and Fiscal Monitor December 2019.

[19] Note that the so-called "commercial" public sector (S.11, S. 12) is not included in general government. This refers to Government-controlled units which charge market prices, such as AIB or ESB (CSO, 2020).

To model total expenditure, the LTM looks at the difference between Exchequer and general government expenditure by area, based on the most recent available data for both. This residual is then generally assumed to stay constant as a share of GNI*. Where the difference can be attributed to clearly ageing-related expenditure, it is also linked to demographic drivers.

For interest costs, it is the Exchequer balance rather than the GG balance that directly influences funding requirements, which comprise maturing debt less the cash budget balance (i.e. an Exchequer deficit adds to required new debt issuance). As debt matures it is redeemed with cash from the Exchequer account, typically with the proceeds of pre-funded debt issuance, although accumulated cash budget surpluses can also be used.

The difference between the Exchequer and GG balances includes within-government transfers that affect the Exchequer but not the GG balance. For example, a payment from the Exchequer to the Rainy Day Fund would reduce the Exchequer balance but would have no immediate impact on the GG balance; only when the Rainy Day Fund money is subsequently used for expenditure would the GG balance be affected.[20]

The Exchequer and GG balances can also differ due to surpluses or deficits that do not directly affect the Exchequer balance. For example, an annual surplus for the Social Insurance Fund (SIF) accrues to the SIF reserve rather than to the Exchequer account (the same mechanism applies to the National Training Fund). SIF expenditure is typically paid out of a separate account managed by the Department of Employment Affairs and Social Protection. Receipts of the SIF (PRSI receipts) are also paid into this account. When the SIF is in surplus, the excess of receipts over expenditure in a given year is transferred into an investment account (managed by the Minister for Finance). When the SIF is in deficit, the SIF deficit is funded by drawing down funds from the investment account. This happens until the funds from the investment account is exhausted. When the fund is exhausted, the deficit of the SIF is then funded by a transfer ("subvention") from the exchequer, in which case the amount of the SIF deficit is already incorporated in the Exchequer balance.

[20] The LTSR assumes €500 million of annual Rainy Day Fund payments take place from 2022–2026, based on legislation covering 2019–2023 and the 2019–2021 payments having been deferred.

As in, the GG and Exchequer balances will then reflect the same SIF transactions. In the LTSR baseline scenario, the SIF reserve accumulates until 2035 before annual deficits driven by ageing costs exhaust the funds entirely by 2045.

4.2 Pensions

Government pension spending in Ireland is based on two main pillars: the state pension and the public service pension. In this report, we provide long-term projections of total pension spending up to 2050. State pension expenditure is projected through an aggregate-accounting method that captures the pension dynamics as a function of demographic, macroeconomic, labour-market and institutional factors. This methodology is used by the European Commission in the *Ageing Report* in order to validate the country-specific projections which are provided at a national level.[21] For public service pensions, the LTSR uses official Departmental forecasts that are consistent with those used in the *Ageing Report 2018* (European Commission, 2018). The reason these official forecasts are used rather than estimates being constructed by the Council separately—as would be preferable—is that there is a notable lack of detailed data available in this area. This lack of data limits the scope for a thorough projection exercise.[22]

For projections of state pension spending, the aggregate-accounting method used in this report can be decomposed as follows:[23]

Equation (8)

$$\frac{Pension\ Expenditure}{GNI*} = \frac{Pop\ 65+}{Pop\ 20-64} * \frac{No.\ Pensioners}{Pop\ 65+} * \frac{Avg\ Pension\ Income}{\frac{GNI*}{Empl\ 20-74}} * \frac{Pop\ 20-74}{Empl\ 20-74}$$

$$= \text{(Dependency Ratio)*(Coverage Ratio)*(Benefit Ratio)*(Labour Market Effect)}$$

Where:

[21] The projection models used in the Ageing Report are country-specific, as “pension systems and arrangements are very diverse in the EU Member States, making it extremely difficult to reliably project pension expenditure on the basis of one common model, to be used for all the 28 EU Member States” (European Commission, 2018). This method is used by the European Commission as a cross check with the data supplied and the results tabulated by individual member states.

[22] For more detail on public service pension projections refer to Pender and Chambers (2018a, 2018b).

[23] This identity is slightly different from that used in the *Ageing Report*, as described in European Commission (2017). Firstly, our approach uses Irish GNI* rather than GDP, as the GDP figure heavily distorts the underlying domestic economy. In addition to this, we use projected data for the number of employees aged 20–74 instead of using ‘Total Hours Worked by employees aged 20–74’ used by the European Commission as the earlier appears as a more comprehensive and intuitive specification. However, it should be noted that this will not ultimately affect the pension expenditure ratio given the cancelling out effect of these components of the identity.

- The **Dependency Ratio** measures the number of individuals aged 65 and over compared with the total "active" population aged 20 to 64. This indicator gives insight into the ageing of population, which contributes to increasing pension expenditure over GNI*, all else constant. This figure is calculated using the Council's demographic projections in Section 2.

- The **Coverage Ratio** is a measure of the total number of pensioners divided by the total number of people aged 65 years and over. This ratio is heavily reliant on institutional factors, such as retirement age reforms, which can affect the pensionable age and, hence, the number of pensioners. In this report, this ratio takes into account past trends, as well as the previous legislative reform to pensions in 2014 when projecting its evolution. The demographic component is taken from the Council's demographic model, and the number of pensioners is implied from these two inputs.

- The **Benefit Ratio** is a reflection of the generosity of the pension system. It is a useful mechanism of calculating pension expenditure (per cent of GNI*), as it indicates how the average pensionable income develops relative to the average per capita income of the economy (European Commission, 2017). The benefit ratio is calculated by observing the trend in this ratio following the most recent pension reforms in 2014, and projecting future trends based on the average growth rate of the benefit ratio during this period. As well as this, the macroeconomic figures used are taken from the Council's macroeconomic projections, as are the labour market projections for employment.

- The **Labour Market Effect** quantifies the impact of labour market behaviour on pension expenditure. It can capture the effect of career prolongation and increased pensionable qualification ages on pension expenditure (European Commission, 2017). In this report, the labour market effect is based on the Council's employment projections, as well as the underlying demographic projections made by the Council.

As shown in Table 4.2, our approach contrasts to those of other independent fiscal councils in the UK (OBR), US (CBO) and Spain (AIReF). In general, because of the limited availability of data in the Irish context, this aggregate approach offers a sensible and comprehensive way of projecting future trends in pension expenditure in the Irish economy.

Table 4.2: Approaches of Other Institutions to Modelling Pension Expenditure

Ageing Report (European Commission)	
Method:	Aggregate-accounting approach
Description:	Pension spending (% GDP) expressed as a product of the dependency ratio, benefit ratio, coverage ratio and labour market effect.
Office for Budget Responsibility (OBR)	
Method:	Bottom-up approach
Description:	Basic state pension and new single-tier pension assumed to be revalued using the triple lock throughout the projection period. This states that the state pension will rise by the highest of earnings growth, CPI inflation, or 2.5 per cent.
OECD	
Method:	Aggregate-accounting approach (in the Ageing Report); other national estimates are made available through multilateral research projects
Description:	Projections and methodology taken from the Ageing Report for EU member states plus Norway, and from Standard & Poor's Global Ageing report.
Congressional Budget Office (CBO)	
Method:	Micro-simulation approach
Description:	Social Security spending on pensions progresses as scheduled under current law to 2029; thereafter, projected spending depends on the estimated number of beneficiaries and cost per beneficiary (for which excess cost growth is projected to move smoothly to a rate of 1.0 between 2030 and 2049).
Autoridad Independiente de Responsabilidad Fiscal (AIReF)	
Method:	Micro-simulation approach
Description:	Pension spending (% GDP) projected as an integrated framework of the demographic, macroeconomic and institutional components. Retirement rates projections based on a large panel of individual data (known as the Continuous Professional Life Sample).

Sources: European Commission; OBR; OECD; CBO; and AIReF.

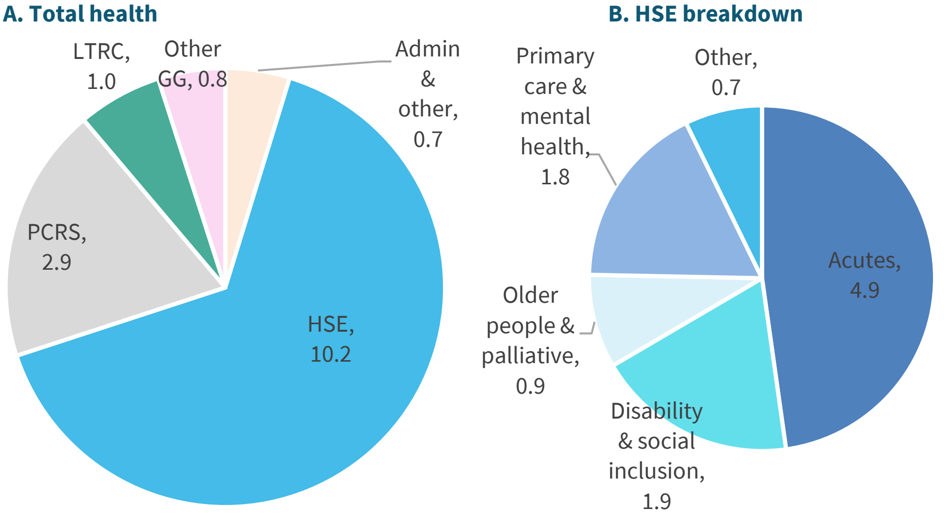
4.3 Health

As older generations use health services more, ageing is likely going to lead to an increase in health spending, absent policy changes. Health accounts for about a quarter of gross voted expenditure, making it a key area of interest for public finances forecasts.[24] Within health spending, there are four broad areas: the Health Service Executive (HSE), the Primary Care Reimbursement Service (PCRS), long-term residential care (LTRC) and administration and other expenditure.

As shown in Figure 4.2A, close to a fifth of health spending in the 2018 budget is on the PCRS, and around 6 per cent on long-term care. More than two thirds of total health spending can be allotted to the HSE, of which almost half falls upon acute hospitals (panel B). Other HSE spending is on various community services, including disability, mental health, primary care as well as services for older people and palliative care.

Figure 4.2: Decomposition of health expenditure (2018)

Expenditure in € billion



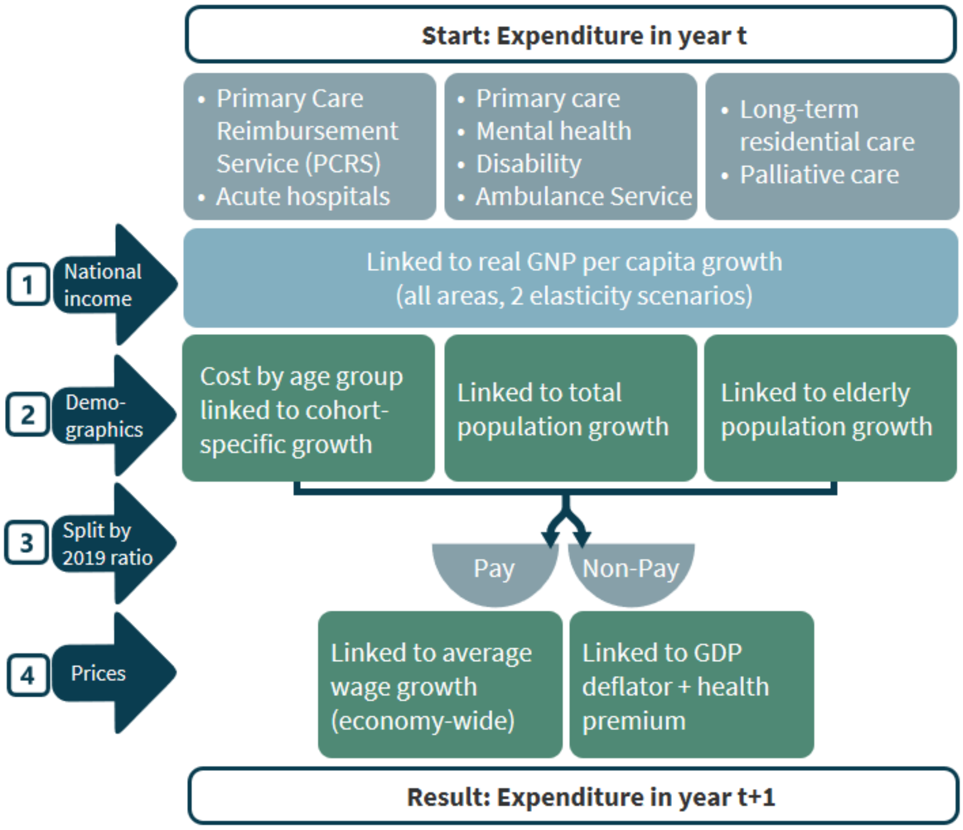
Sources: Eurostat, Department of Expenditure and Reform databank and Revised Estimates 2019.
Notes: Total GG health expenditure was €15.6 billion in 2018 (COFOG data, excluding GFCF). Admin & other denotes other Exchequer expenditure outlined in the Revised Estimates, while Other GG is the difference between the COFOG total and current Exchequer expenditure. HSE Acute Services include the National Ambulance Service and Cancer Control Programme.

In the LTM, demographic pressures are modelled for the HSE, PCRS and LTRC. Administration and other expenditure (including grants, WHO contributions etc.) are not assumed to be directly affected by ageing. For the projections, administration expenses are kept constant as a share of total expenditure and other general

[24] Based on Budget 2019.

government health expenditure are held constant in per cent of GNI*. Health capital expenditure is not modelled explicitly but is projected as part of total capital spending.

Figure 4.3: Illustration of health expenditure modelling approach



Step 1: National income demand pressures

To account for increased demand as living standards rise, expenditure is increased by real GNP per capita growth. This reflects the observed positive relationship of countries' national income and their spending on health, as described in OECD publications by Guillemette & Turner (2019) and Lorenzoni *et. al.* (2019). As summarised in Wren *et al.* (2017), there is an ongoing discussion regarding the extent of this relationship. To account for the idea that health may be viewed as a normal good, it is assumed that health expenditure grows in line with GDP per capita at an elasticity of one in the baseline scenario. This mirrors the approach of other institutions including the OBR, the CBO and the Commission (see Licchetta & Stelmach, 2016, CBO, 2009, and EC, 2018). As an alternative scenario in the *July 2020 LTSR*, health spending increases with national income at an elasticity of 0.7, the magnitude found across OECD countries over 1994–2015 and used in recent OECD projections (Lorenzoni *et. al.*, 2019).

Step 2: Demographic pressures

An age-group specific cost breakdown is available for expenditure on PCRS and acute hospital discharges.[25] Demographic pressures in these two spending areas are calculated from age-group specific growth. There is no demographic breakdown for other areas. Depending on the nature of the service, spending is assumed to increase by either total population growth or growth of cohorts 65+. For projecting the cost of LTRC, the number of residents in the Nursing Home Support Scheme (NHSS) is projected based on the current age profile of NHSS applicants and average length of stay. Implicitly, it is assumed that these resident characteristics inputs do not change over the projection period.

Step 3 and Step 4: Price pressures by pay and non-pay spending

The final projection step accounts for inflationary pressures. Almost half of total current expenditure on health is pay expenditure.[26] It is not straightforward to estimate productivity growth in the health sector, and gains tend to be smaller than in other economic sectors (see Charlesworth and Johnson, 2018, for the UK). Nonetheless, in order to keep services constant, it is assumed that wages will keep up with other less labour-intense industries — a phenomenon known as the Baumol cost disease (Wren *et al.,* 2017).

Price pressure on non-pay current expenditure is linked to general price growth through the GNP deflator. To account for rises in technological costs, a health price premium of 1 percentage point is added to non-pay price pressures. Again, this is similar to the OBR and CBO convergence assumptions on excess cost growth, see OBR (2018) and CBO (2019).

Note that non-pay expenditure includes spending on drugs. It is difficult to determine how price inflation of medication will develop over the coming years. While the use of generics may help to balance the bill, research by Castanheira *et al.* (2019) suggests that this remedy is limited since prescriptions for certain substances

[25] From the Healthcare Pricing Office (HPO) and the HSE, upon request.

[26] For 2019 Budget, see DPER Databank (accessed 05/09/2019). For the entire projection horizon, it is assumed that the ratio between pay and non-pay spending does not change.

declines as patents run out, probably driven by promotion of pharmaceutical companies. For projections in this report, medication is treated like other non-pay spending.

4.4 Education

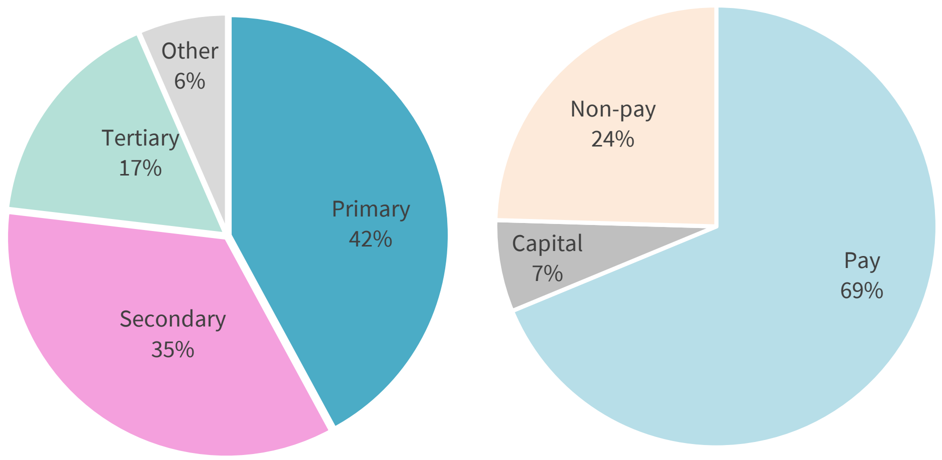
Education expenditure is projected by level of education to account for demographic growth by different school-age groups. As shown in Figure 4.4A, around 42 per cent of education spending falls on primary and early years, and 35 per cent on secondary schools (2018 data, Eurostat). Accounting for price pressures, expenditure is then further divided into pay and non-pay, which are linked to average wage growth and the GNP deflator respectively. Wage growth is the key driver for education, as pay-related expenditure constitutes almost 70 per cent of the total (Figure 4.4B).

The modelling approach also includes spending of the National Training Fund (NTF), which is assumed to stay constant as a share of GNI*.

Figure 4.4: Breakdown of education expenditure (2018)

Per cent of total

A. By level **B. By driver**



Source: Eurostat.
Note: Total general government spending on education was 10.35 billion in 2018. Tertiary education (Panel A) includes post-secondary non-tertiary education. Capital spending (Panel B) is gross fixed capital formation.

Table 4.3 Education projection drivers in LTM

	Demographic cohort	Pay	Non-pay
Primary/pre-primary	4–12	All levels: Wage growth (non-agricultural)	GNP deflator
Secondary	13–18		GNP deflator
Higher education	19–24		GNP deflator
Skills development	25–64		GNP deflator
Other	none		GNI*

Note: Skills development is disclosed in DPER's databank (Exchequer); it is not one of the categories in Eurostat's COFOG data and thus not shown in Fig. 4.d. The NTF is included in Other.

4.5 Social Protection

Like other areas in the LTM, social protection spending is attributed to different demographic groups. The largest components are unemployment benefits and activation supports, which are linked to the LTM projections of unemployment. Other supports with a clear demographic link include child allowance, for example, and welfare payments, which are linked to the pension age. Note that pension payments are treated separately for presentational reasons, although they are administered by the same government department.

Social welfare payments are linked to wage growth, implying that spending by recipient stays constant in distributional terms. An alternative would be to link welfare to price inflation. That would mean that payments stand still in real terms, but the gap between welfare recipients and the working population rises (Callan *et al.*, 2019). Note that social protection pay expenditure, which relates mainly to administration, is low compared to other areas such as health.

Table 4.4 Social protection projection drivers in LTM

	Demographic cohort	**Pay**	**Non-pay**
Unemployment	Labour force × unemployment rate	n.a.	Wage growth
Other working-age supports	18–66/67	n.a.	Wage growth
Children	0–17	n.a.	Wage growth
Old age	67+/68+	n.a.	Wage growth
Rent supplement	Total population	n.a.	Wage growth
Other	None	Wage growth	GNI*
Admin	None	Wage growth	Constant share of total social protection expenditure

Note: Spending on Illness, disability and carers is included in pension expenditure (Section 4.2). Vote 37 agencies are included in Other. Household benefit package (counted as old-age support) uses demographic cohort 70+ as only select claimants of younger ages are eligible, see https://www.citizensinformation.ie/en/social_welfare/social_welfare_payments/extra_social_welfare_benefits/household_benefits_package.html.

4.6 Interest and Government Debt

Interest

Interest costs in the LTM are modelled based on borrowing costs for currently held debt and an endogenous projected cost of servicing future gross general government debt. This means the projected cost of future borrowings may increase over time in response to rising government debt, depending on interactions with other factors.

Equation (9) calculates the marginal 10-year yield, which is the key determinant of interest costs, whose coefficients have been estimated by Casey and Purdue (forthcoming):

Equation (9): Marginal 10-year sovereign bond yield in %

$$10yr\ yield_t = 0.99 * 10yr\ yield_{t-1} + \Delta ECB\ Policy\ Rate_t + 0.03 * \Delta \frac{GGDebt_t}{GNI^*_t} * \left(\frac{\frac{GGDebt_t}{GNI^*_t}}{60\%}\right)$$

The first and second terms combine a lagged dependent variable with the change in the ECB policy rate (the assumed overnight interest rate on bank deposits). The third term is based on the change in the debt-to-GNI* ratio, with the impact changing non-linearly with the gap of the ratio to 60 per cent. For *LTSR 2020*, the ECB policy rate is assumed to evolve in line with the six-month Euribor's forward curve plus a margin of 120 basis points after 2025. The margin assumption brings the 10-year yield close to 1 per cent in 2025 (as assumed in Fiscal Council, 2020a).

Government debt

Government debt is projected with the identity in equation (10), while net debt is approximated with equation (11).[27, 28] Debt-related assets are residually determined using the estimate of net debt, as shown in equation (12).

[27] GGDebt is gross general government debt, GGBalance is the general government balance, GGNetDebt is net general government debt, GGAssets is general government debt-related assets, and SFA is the stock-flow adjustment.

[28] Debt increases either as a result of a budget deficit or a higher stock-flow adjustment, for example due to a higher exchequer cash balance. The stock-flow adjustment is explicitly modelled as the change in exchequer cash balance (which evolves depending on an assumed pre-funding strategy), the surplus/deficit of the social insurance and national training funds (provided the deficit is not funded by an Exchequer subvention), equity and loan transactions, and a miscellaneous category. The latter categories are assumed to be zero for 2025–2050.

Equation (10): General government debt

$$GGDebt_t \equiv GGDebt_{t-1} - GGBalance_t + SFA_t$$

Equation (11): General government net debt

$$GGNetDebt_t = GGNetDebt_{t-1} - GGBalance_t$$

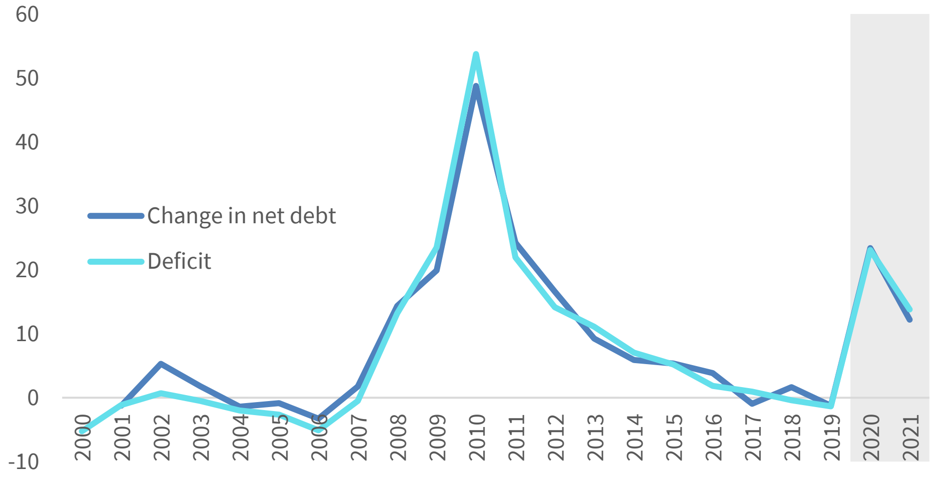
Equation (12): General government debt-related assets

$$GGAssets_t \equiv GGDebt_t - GGNetDebt_t$$

The approximation in Equation (11) excludes the impact of debt-adjustment effects and statistical discrepancies (see Eurostat, 2019), which are assumed to be zero for the projection horizon. These account for much of the historical differences between the general government balance and the change in general government net debt, as shown in Figure 4.5:

Figure 4.5: Approximating the change in net debt with the budget deficit

€ billion



Sources: CSO; Department of Finance; and Fiscal Council calculations.

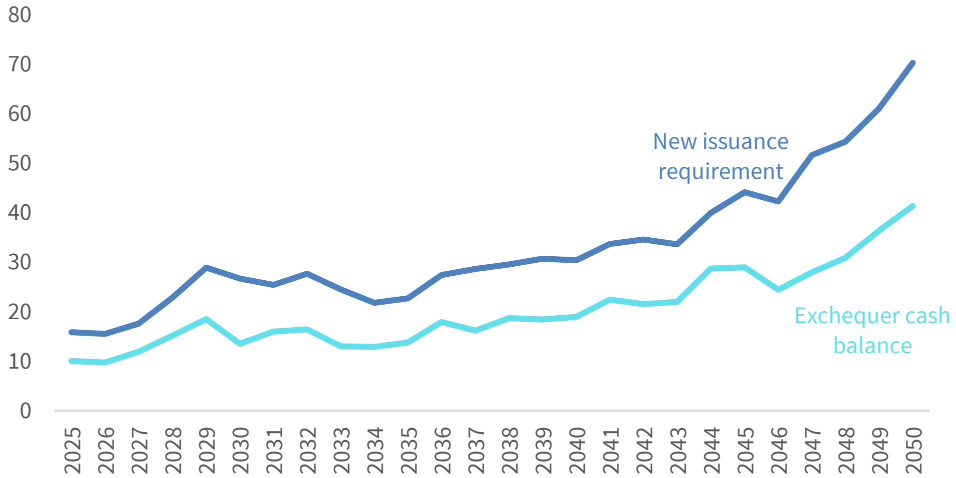
The quantity of new cash borrowing each year is determined by the projected exchequer borrowing requirement, the projected change in cash balance, and maturing debt. The change in cash balance is modelled such that the end-year Exchequer cash balance is pre-funded in advance by an assumed seven months.[29]

[29] For example, assume new debt issuance is €10 billion in year *t+1*, and the end-year cash balance is €5 billion in year *t–1*. In this case, the change in cash balance should be close to +€1 billion in year *t* to ensure that an amount of pre-funding equivalent to nearly 60 per cent (seven out of 12 months) is available in the Exchequer account at the end of year *t*. Compared to a scenario with no modelled pre-funding, this implies a required increase in gross debt of close to €1 billion in year *t*.

Figure 4.6 presents the baseline projected requirement for new debt issuance and the Exchequer cash balance in the Council's *Long-term Sustainability Report* (Fiscal Council, 2020b).

Figure 4.6: *LTSR 2020* new debt issuance and the end-year cash balance

€ billion



Sources: CSO; and Fiscal Council calculations.

Besides the Exchequer cash account, other balances included in the general government assets are reserves for the social insurance fund and the national training fund. These reserves evolve according to the expenditure modelling described earlier in this chapter, i.e. when there is an annual surplus in the social insurance or national training fund, this accumulates to a higher reserve. (See Section 4.1 for further details.) Overall general government assets are equal to the difference between general government debt and general government net debt.

New debt is assumed to be raised in the following proportions: 12.5 per cent in 5-year bonds, 25 per cent in 7-year bonds, 50 per cent in 10-year bonds, and 12.5 per cent in 30-year bonds.[30] For *LTSR 2020*, this assumption results in a long-run weighted average maturity of marketable and official debt of 8.4 years, which is in line with Ireland's current weighted average maturity excluding floating rate notes (NTMA, 2020).

[30] If debt can be issued with a longer weighted average maturity than assumed, this would imply lower re-financing needs, but results in little change for gross debt by 2050.

4.7 Capital expenditure

The assumptions for government capital spending in the long-term model over the projection period derive from the latest available official capital plan.

For the purposes of the July 2020 Long-term Sustainability Report, the capital plans build on the National Development Plan 2018–2027 (Department of Public Expenditure and Reform, 2018). This official plan sets out increases that were estimated to take annual Exchequer capital spending from 2.9 per cent of GNI* in 2018 to a projected 4.1 per cent by 2027. For years beyond 2027, the *July 2020 LTSR* assumes that future governments would continue to stick to these broad targets, with public investment rates equivalent to 4 per cent of GNI* projected for subsequent years.

For General Government capital spending, the LTM considers gross fixed capital formation (GFCF). In terms of GNI*, this was some 0.3 percentage points higher than Exchequer capital expenditure in 2019. For the projection period, the gap between the two measures is assumed constant at this level.

Note that the public capital expenditure assumptions feed into Ireland's capital stock growth and the production function, as described in Section 3.1.

4.8 Decomposition of pressures

Over the long run, the costs associated with providing the same level of services and benefits rises in line with wage growth and price inflation. As both inflation and demographics factors drive the projections that ultimately result, it can be difficult to disentangle the appropriate proportion of the increase in spending that can be attributed to either demographics or inflationary pressures over the long run.[31]

To isolate the nominal costs associated with demographic changes, the following equation is used to decompose the increases in spending into demographic costs and other pressures (including pay and non-pay inflationary pressures):

Equation (13): Demographic cohort costs

$$Demographic\ cohort\ costs_t^i = Price_{t-1}^i \times \Delta Demographics_t^i$$

Demographic contributions are based on the year-on-year changes in relevant demographic cohorts in the current year (t), $\Delta Demographics_t^i$, and the cohort costs in the previous year (t-1), $Price_{t-1}^i$. All relevant cohorts are then aggregated together in order to arrive at a decomposition of the changes in total spending for all age-related spending:

Equation (14): Total change in spending

$$Change\ in\ total\ spending_t = \sum Demographic\ cohort\ costs_t^i + Other\ pay\ and\ non\ pay_t$$

Health

As outlined in Section 4.3, three broad areas of health spending are related to demographic pressures, spending by the HSE, long-term residential care (LTRC) and primary care reimbursement service (PRCS).

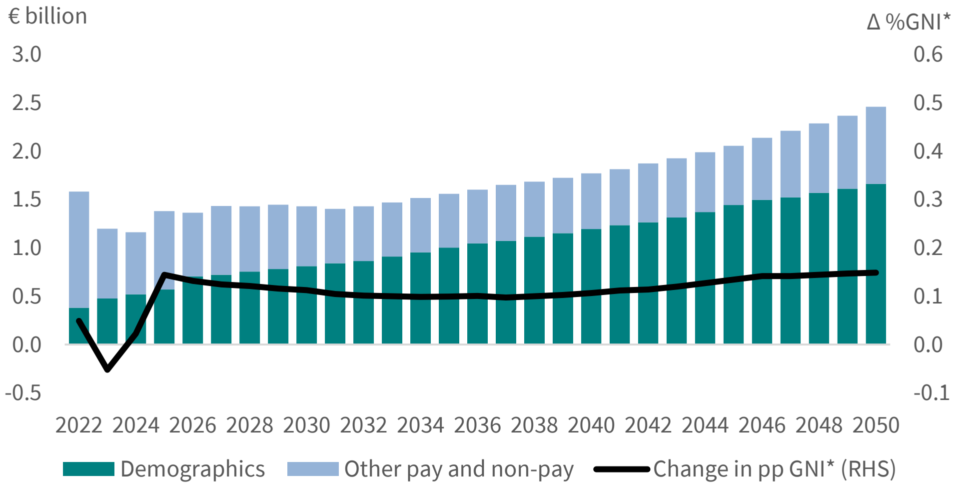
[31] In the Council's standstill model for the short run, a slightly different approach is taken to decompose the various pressures. In the standstill model latest available historical factor cost is used, and is held constant over the projection horizon (i.e. the cost does not rise with inflation). This method will marginally underestimate the costs associated with demographic changes in the short run. However, it is a reasonable approximation over the short run as the inflationary pressures will be relatively small over this period. However, over the long run, not allowing the factor cost to rise in line with inflationary pressures will significantly underestimate the cost attributed to rising demographics.

To derive the cohort specific cost, the latest available figure for that cost is used as the starting point. This cost is then split into a proportion that is related to non-pay factors, and a proportion related to pay based on the available breakdown of pay and non-pay in the relevant categories, e.g. for Acute services, which is part of HSE spending, the cost per weighted unit for inpatients is split into pay and non-pay based on the proportion of pay and non-pay for the HSE category (see Section 4.3). The pay component is then grown in line with wage growth, while the non-pay element is grown in line with the GNP deflator, with an additional 1 percentage point health premium (see steps 3 and 4 of Section 4.3 for details). The two components are then combined to get the cohort specific cost for each year.

Shown in Figure 4.7 is the decomposition of healthcare spending using Equations (13) and (14). From 2027 onwards, the change in demographics contributes more to the overall increase in health spending than other pay and non-pay factors.

Figure 4.7: Healthcare spending pressures

Annual changes in € billion and in p.p. GNI*



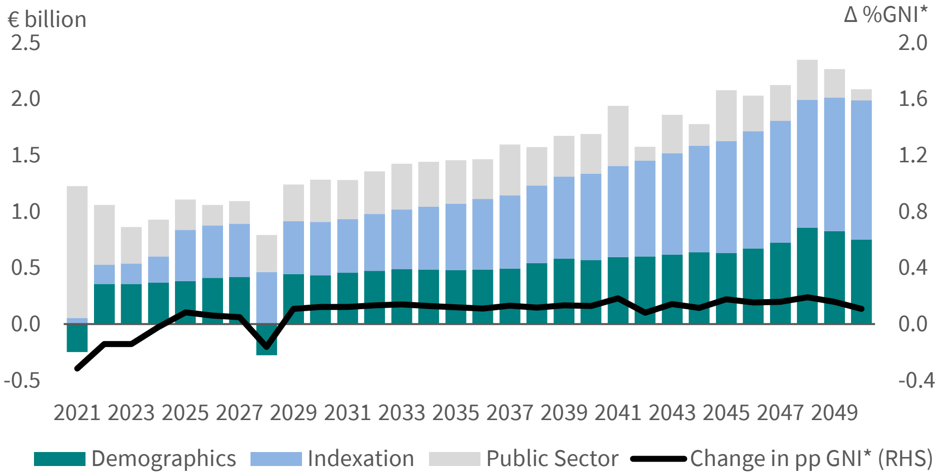
Sources: Department of Public Expenditure and Reform; and Fiscal Council workings.
Note: Healthcare spending includes spending on long-term care. Changes in spending as a share of GNI* depend on the relative pace of growth in spending and GNI*. Demographic contributions are based on the year-on-year changes in relevant cohorts in the current year (t) and the cohort costs in the previous year (t-1).

Pensions

For state pensions, the average pension income per person is grown in line with wage growth. Using Equations (13) and (14) the same decomposition is carried out for pensions. Note, not enough detail is available for public service pensions to be able to decompose this component in to changes in demographics and other factors. The results of this decomposition are shown in Figure 4.8. What is notable from the figures is that in the two years of the legislated changes in pension age, demographics contribute negatively to the year-on-year increase in spending.

Figure 4.8: Pension expenditure increases by driver

Annual changes in € billion and in p.p. GNI*



Sources: Department of Public Expenditure and Reform; and Fiscal Council projections.
Note: Changes in spending as a share of GNI* depend on the relative pace of growth in spending and GNI*. Demographic contributions are based on the year-on-year changes in claimants in the current year (t) and the average pension payments in the previous year (t-1). Public sector pension estimates from 2021-2050 are official estimates consistent with the *Ageing Report 2018* (European Commission, 2018). The 2021 increase is a break in time series, since 2020 public sector pensions are taken from the Revised Estimates, 2020.

5 Revenue modelling

At present, the LTM broadly assumes that government revenues will grow as projected for the short run (using official forecasts) and then, over the long run, in line with wider economic activity. This means that government revenues maintain a stable share of GNI* over the long run. Of course, there are some exceptions to this, notably for corporation tax and for transfers where other assumptions are made. The modelling of revenue is an area that offers lots of scope for future development, with several specific avenues considered in this section.

General government revenue

The projections for general government revenue start by splitting total revenues up into four main categories:

(1) taxes and social contributions,

(2) revenue from sales of public goods and services,

(3) investment income, and

(4) transfers (both current and capital).

For the projections, the first three categories are grown in line with nominal GNI* where official projections are not available (Table 5.1). An exception for the *July 2020 LTSR* is corporation taxes. These form part of direct taxes within general government taxes. For the *July 2020 LTSR*, corporation tax revenues are gradually adjusted down by €2 billion relative to a baseline where they would grow in line with nominal GNI* to reflect the expected impact of the OECD's BEPS initiatives. This is in line with the Department of Finance's (2020b) estimates of the potential impact of the OECD's BEPS initiatives on the level of corporation tax receipts (€0.5 billion in 2022, rising by a further €0.5 billion each year up to a cumulative €2 billion in 2025).

The fourth category of general government revenue is transfers. These include transfers between government subsectors, from international institutions and capital transfers owing to asset disposals. As these show no clear link to wider economic activity over time, it is assumed that they remain broadly constant.

Table 5.1: Summary of long-run revenue projections

€ billions unless stated

	ESA Code	2019 € billion	Projection approach
General Government			
Total GG Revenue	TR	87.5	D2+D5+D91+D61+P10+D4+D7+D9N
Taxes and social contributions	D2+D5+D91+D61	78.9	D2+D5+D91+D61
Taxes	D2+D5+D91	64.4	D2+D5+D91
Indirect taxes	D2	27.2	Nominal GNI* growth rate
Direct taxes	D5	36.6	Growth rate of income tax + corporation tax + capital gains tax
Capital taxes	D91	0.5	Nominal GNI* growth rate
Social contributions	D61	14.5	Nominal GNI* growth rate
Sales of goods and services	P10	6.0	Nominal GNI* growth rate
Investment income	D4	1.6	Nominal GNI* growth rate
Current transfers (excl. taxes)	D7	0.5	Constant in € levels
Capital transfers (excl. taxes)	D9N	0.5	Constant in € levels
Exchequer + PRSI + NTF + A-in-As			
Gross Exchequer Revenue		77.0	Exchequer Tax + Exchequer non-tax + capital resources + A-in-As
Exchequer Tax		59.3	
Income tax		22.9	Nominal GNI* growth rate
Corporation tax		10.9	Nominal GNI* growth rate (adjusted for OECD BEPS losses)
Capital gains tax		1.1	Nominal GNI* growth rate
VAT		15.1	Nominal GNI* growth rate
Excise		5.9	Nominal GNI* growth rate
Customs		0.3	Nominal GNI* growth rate
Stamps		1.5	Nominal GNI* growth rate
Motor tax		1.0	Nominal GNI* growth rate
Capital acquisitions tax		0.5	Nominal GNI* growth rate
Exchequer Non-Tax		2.6	
Central bank surplus income		1.7	Nominal GNI* growth rate
Other non-tax		1.0	Nominal GNI* growth rate
Capital Resources		1.8	
EU receipts (with GG impact)		0.0	Nominal GNI* growth rate
FEOGA intervention loans		0.7	1% growth (in line with recent trends)
Other capital resources		1.0	Constant
A-in-As		13.3	
Non-Exchequer PRSI + NTF		1.7	Excess SIF and NTF income
Exchequer PRSI + NTF + Other A-in-As		11.5	Nominal GNI* growth rate

Sources: CSO; Department of Finance; and Fiscal Council workings.

Table 5.2: Relationship between total revenues and nominal GNI*

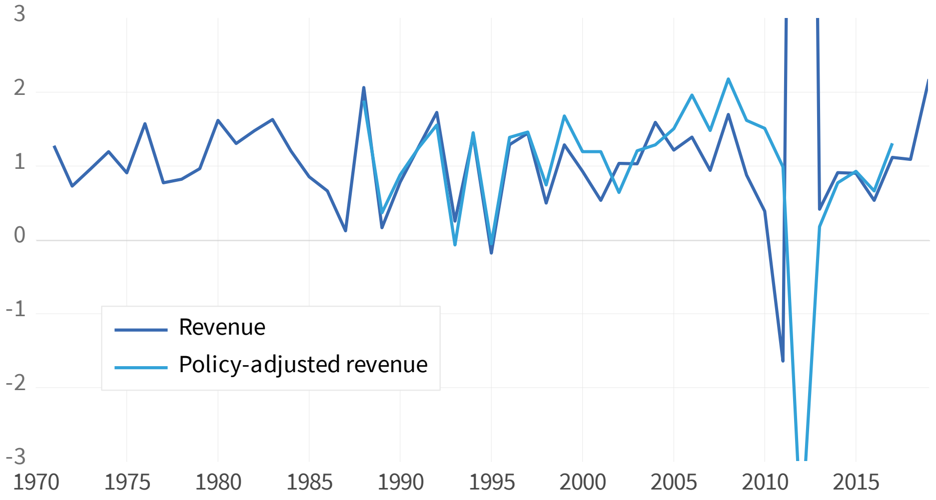
	Revenue	Policy-adjusted revenue
Nominal GNI*	0.956	1.291
Constant	0.007	-0.023
Adjusted R-Squared	0.69	0.75
Durbin-Watson stat	2.19	2.37
Sample	1971–2019	1988–2017
Observations	49	30

Sources: CSO; Department of Finance; and Fiscal Council workings.
Note: Revenues are on a general government basis and exclude transfers and property income. The policy-adjusted revenue series is constructed using the sum total of adjustments outlined in the "Tax Policy Changes Dataset" from Conroy (2020), which covers income tax, VAT, PRSI, corporation tax, capital taxes, stamp duties, and excise duties.

The assumption that government revenues will grow broadly in line with nominal GNI* is justified by historical evidence. As Table 5.2 shows, general government revenue tends to grow in line with nominal GNI* on a one-to-one basis. That is, a one per cent increase in nominal GNI* tends to lead to a one per cent increase in general government revenue (when transfers and property income are excluded). If we also adjust for known policy changes, as in Conroy (2020), this suggests that the underlying relationship with economic growth is slightly stronger than suggested by the unadjusted measure, with an elasticity of 1.3. However, the sample period is substantially smaller, policy adjustments are only partially accounted for, and, as Figure 5.1 shows, the broad one-to-one assumption seems robust over time.

Figure 5.1: Annual revenue elasticities with nominal GNI*

Percentage changes in revenue as a ratio of percentage changes in nominal GNI*



Sources: CSO; and Fiscal Council workings.
Note: Revenues are on a general government basis and exclude transfers and property income. The policy-adjusted revenue series is constructed using the sum total of adjustments outlined in the "Tax Policy Changes Dataset" from Conroy (2020), which covers income tax, VAT, PRSI, corporation tax, capital taxes, stamp duties, and excise duties. The vertical axis is tapered to omit an outlier for 2012, which arises due to both growth rates being relatively small (close to zero).

Exchequer revenue

While the Council is mainly focused on general government revenue, it is also necessary to model Exchequer revenue. This allows us to estimate the annual Exchequer borrowing requirement, which allows us to get an accurate sense of how net government debt will evolve over time.

As Table 5.1 shows, the long-run projections for Exchequer revenues also broadly assume that revenues grow in line with nominal GNI*. Corporation tax receipts are assumed to grow in line with nominal GNI*. However, from 2022 to 2025, negative judgement is applied to incorporate the anticipated effect of the OECDs BEPS project. This is in line with the Department of Finance's (2020) estimates of the potential impact of the OECD's BEPS initiatives on the level of corporation tax receipts (€0.5 billion in 2022, rising by a further €0.5 billion each year up to a cumulative €2 billion in 2025).

Income tax is assumed to be higher than would result from simply growing in line with GNI*. This is because it is assumed that revenue raising measures are introduced in 2024 and 2025 to bring about a balanced budget. These revenue raising measures amount to €2 billion in 2024 and 2025. These policy changes are assumed to be permanent, hence they increase the base for the later years of the projections. Other smaller components of capital resources are assumed to follow recent trends or to remain constant.

Future development of revenue projections

The Council has developed a number of models for forecasting tax receipts based on their relationship with the tax base (see, for example, Conroy, 2019). While these are useful for understanding short-run expectations, there are potential long-run factors that may be important for how tax revenues evolve. One reason why revenue growth might deviate from nominal GNI* growth would be if the composition of the economy might change in important ways in the future such that revenues fall relative to overall incomes. Total wages paid in the economy have tended to grow in line with nominal GNI*, though this pattern might not hold. Demographic changes could potentially have implications for transactional taxes, with older individuals potentially trading less frequently, hence reducing stamp duty receipts.

While not the focus of this report, modelling the path for the public finances in Ireland over the long term could benefit from further development of revenue projections. This is something that future Long-Term Sustainability Reports should seek to address.

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