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The Fiscal Implications of Demographic Change in the Health Sector

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THE FISCAL IMPLICATIONS OF DEMOGRAPHIC CHANGE IN THE HEALTH SECTOR

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ABSTRACT

The population profiles of most of the developed world are forecast to age rapidly in light of advancements in medical care and overall public health. In the Irish case, the shift in the age profile of the population is expected to be accompanied by expansions in the resident population. In light of these developments, the long term sustainability of effective public services is an important issue. This is of particular relevance to the health sector given its relative weight in the public service and its overall importance to society.

In this paper, a growth accounting model is developed and used to forecast real current public health expenditures to 2035 using publically available preliminary estimates of current health expenditures for 2013. Per capita health cost growth is estimated as a function of demographic, income and residual components.

Demographic cost pressures are forecast to amount to at least €100 million annually for all forecast years, approaching €200 million by 2021 under all demographic assumptions. Cumulative pressures should exceed €1 billion, in real terms, somewhere between 2019 and 2021. The evolution of demographic pressures from the 2020s onwards is dependent on assumptions of population growth and morbidity. Cumulative cost pressure ranges from €3.6 to €5.7 billion in 2035 if measured at 2013 prices. Expenditure as proportion of GDP is forecast to increase from approximately 7.3 per cent in 2013 to between 8.3 and 10.2 per cent of forecast GDP in 2035 under the central projection set, although this range expands under different assumptions regarding model parameters. Estimates at the upper end of that range appear more likely, and forecasts of approximately 10 per cent of GDP in 2035 seem reasonable. In all cases, the portion of health costs attributable to those over 65 increases from 30 per cent to approximately 40 per cent of current health expenditures.

The findings suggest that steps to curb residual cost growth are likely to produce the largest savings. However, savings associated with policies targeting the incidence of morbidity are more modest. Higher levels of investment will be required in the future to adapt the Irish health system to the needs of an expanding and ageing population and address issues arising from chronic under capacity.

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THE FISCAL IMPLICATIONS OF DEMOGRAPHIC CHANGE IN THE HEALTH SECTOR

Paul Goldrick-Kelly: Nevin Economic Research Institute Dublin

1. INTRODUCTION

The long term implications of an ageing population on fiscal policy are among the most challenging issues facing public policy across the developed world. Though forecasts of future spending pressures exerted by such changes are intrinsically uncertain and sensitive to underlying model assumptions, investigation is merited into the *likely range* of resources required to respond effectively to these shifts.

Among the most important areas of concern for society in light of these changes is the funding of health services. Gains in life expectancy and changes in the overall composition of populations are predicted to generate significant pressures on healthcare budgets (and overall government expenditures more broadly) and alter the composition of health spending (Gray 2005).

Irish health expenditures expanded rapidly in the two decades preceding Ireland's recent economic crash in 2008. As displayed in figure 1, real current public spending per capita nearly doubled between the year 2000 and its inflation adjusted peak in 2009, although these increases occurred from a low base relative to other EU nations (Wren 2004). Low levels of infrastructural investment arising from expenditure reductions enacted in the late 1980s are also believed to have reduced the efficacy of subsequent increases in current expenditure as the system faced capacity bottlenecks (Tussing and Wren 2006).The years 2009 to 2013, however saw substantial fiscal retrenchment and cuts in public spending on health.

Current Public Expenditure was 6 per cent less in real terms in 2013 than in 2009. These reductions included reductions in staffing levels, pay and cost shifting to increased out-of-pocket expenditures. These reductions occurred despite the countervailing cost tendency arising from increases in medical-card coverage as increasing portions of the population qualified on a low income basis (although medical card entitlements have subsequently been curtailed).While there may remain some scope for reductions in overall costs reflecting gains in system efficiency and productivity, it is unlikely that these measures can fully curtail costs in the longer term.

These reductions in expenditure have occurred as demographic pressures accumulate from an expanding and ageing population. While Ireland currently has one of the youngest populations in the EU, the population over the age of 65 is projected to nearly treble over the next three decades, from about 606,000 in 2015 to between 1.7 and 1.8 million individuals in 2046. This implies increased expenditures due to the higher costs associated with these cohorts as well as changes in the overall allocation of resources within the public system.

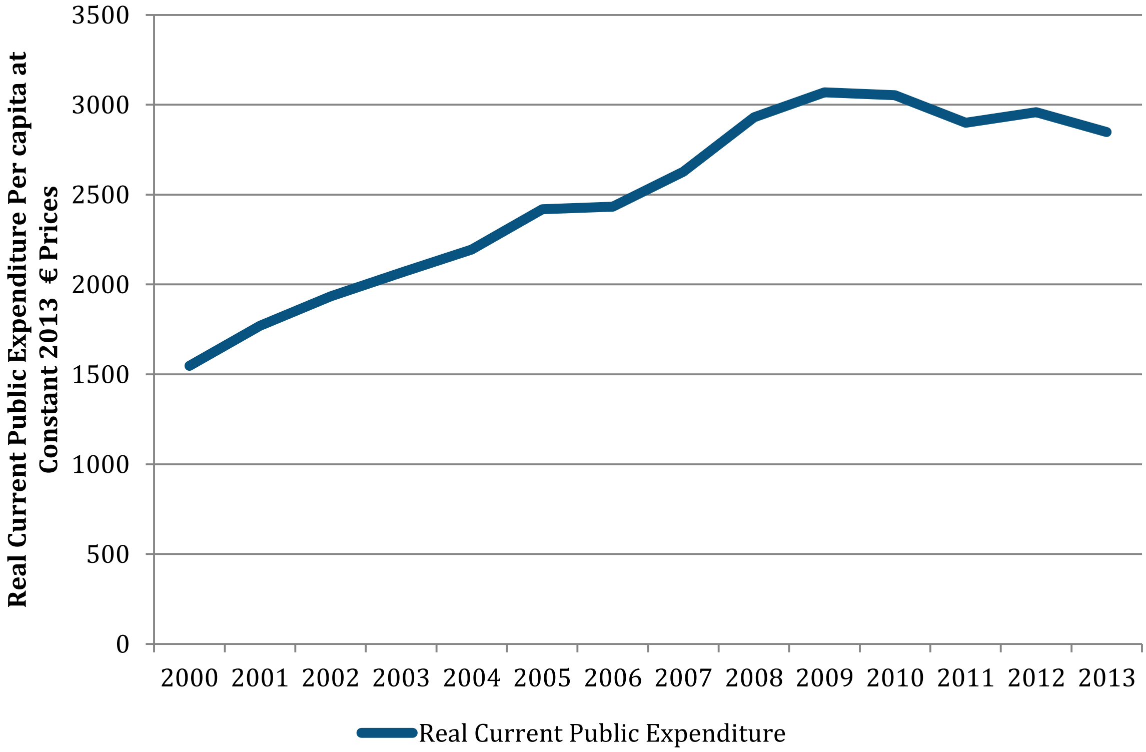
I use a growth accounting methodology employed by the Organisation for Economic Cooperation and Development (OECD) to project the evolution of current public healthcare expenditure. I use publically available data from the CSO of net current expenditures in Ireland according to the System of Health Accounts (2011) for the year 2013, to forecast health spending in 2035 as a function of demographic, income and residual cost components.

The following section offers an overview of the theoretical literature concerning the expenditure growth components used within this study. Section 3 presents the model used along with the assumptions underpinning the model projections.

Section 4 presents the forecast results under several headings. The first subsection outlines the specific costs pressures arising due to changes in demography. The central projection of the full model is then presented. The central model is then subjected to a range of sensitivity tests varying the responsiveness of health demand to changes in income and population projection. Section 4 concludes by briefly presenting the compositional changes in expenditure by broad age cohort for overall current public expenditures.

Section 5 concludes with a discussion of the results and touches upon policy issues arising from them, including compliance with fiscal rules and possible directions for future research in the projection of public health. Sensitivity analysis produces a range of estimates between 7.53 per cent and 11.55 per cent of GDP in 2035, while central estimates of expenditure produce a more narrow range from 8.3 per cent to 10.2 per cent of GDP. Estimates at the lower end of these ranges imply rather favourable values for underlying parameters and successful implementation of policies to address non demographic or income related cost growth. As such, estimates at the higher end of this range (circa 10 per cent of GDP in 2035) appear more likely. These forecasts also entail increases in the portion of health spending attributable to those aged 65 and over.

Figure 1: Real Current Public Health Expenditure Per Capita 2000-2013



Source: CSO (2015) Ireland's System of Health Accounts, Annual Results 2013 (Preliminary), World Bank GDP Deflator Estimates and author's calculations.

2. COMPONENTS OF PUBLIC HEALTH EXPENDITURE GROWTH

This section briefly outlines the theoretical basis for the expenditure growth factors used in this study. This section begins with a discussion of current research into the impact of demographic shifts on healthcare utilisation and costs. The following section discusses the non-demographic drivers of health cost growth reported in the literature: income growth and supply side factors.

2.1 *Demographic Change Component*

The demographic component of public health expenditure growth can be explained as occurring through three main pathways: age structure of population costs, death related costs and morbidity compression.

Changes in the age structure of the population are among the most intuitive and commonly mentioned drivers of health cost growth in public commentary. This stems from the observation that per capita healthcare costs are higher among certain cohorts. Average per capita costs are relatively high for groups such as infants and women of child bearing age. Particularly notable is the escalation of average spending among the elderly. Expenditure increases rapidly following middle age, reaching many multiples of younger costs. Figure 2 displays the adjusted cost profile used in the projections.

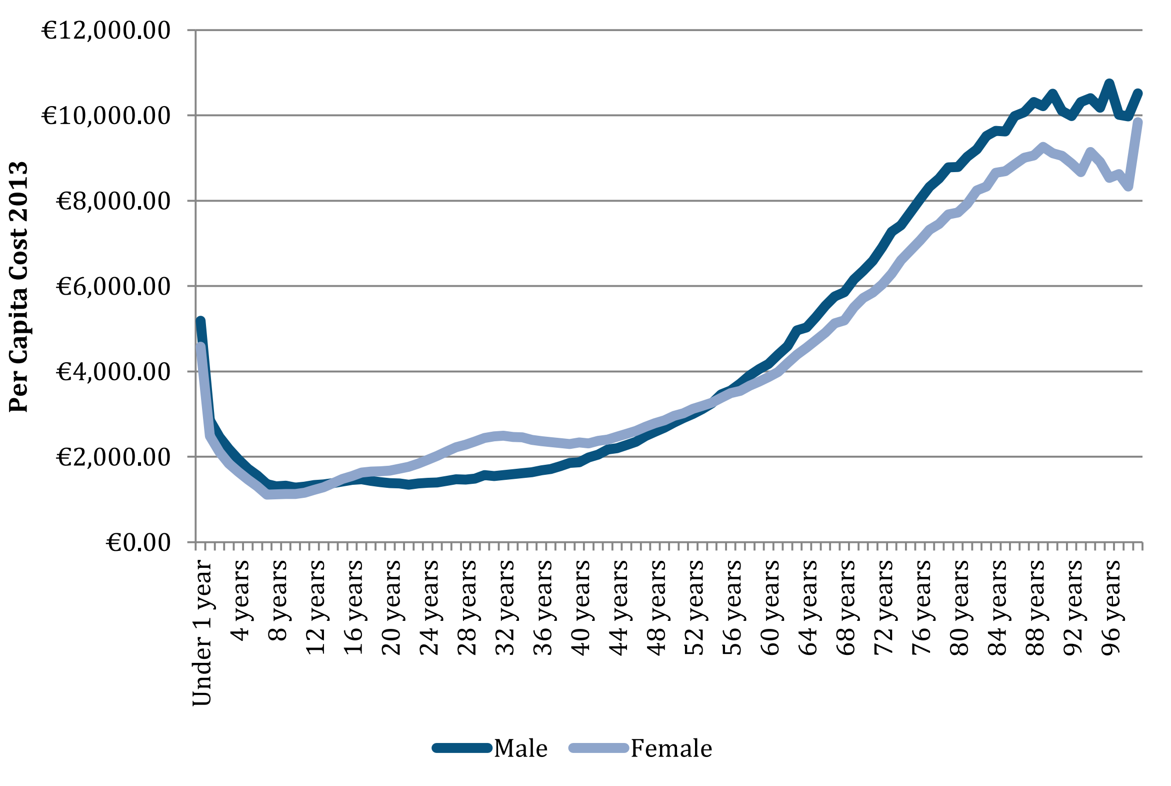
Given this observed tendency, increases in the population of costly cohorts, particularly the elderly due to increases in life expectancy, are often assumed to result in higher average expenditures.

There does not appear to be evidence, however, that this has constituted a major driver in the past. Seshamani and Gray (2002) attempted to use demographic composition to predict changes in per capita health expenditure within sample and found that the extent to which demography drove changes varied widely from about 2 per cent in England to some 56 per cent in Japan. Zweifel et al. (1999) go so far as to say that changes in the average age of a population constitute a “red herring” when attempting to explain increases in expenditure. Similarly, a number of other studies have found that the age composition of the population is not a statistically significant predictor of health expenditures (Anderson and Hussey (2002), Gerdtham et al. (1998) and O’Connell (1996)).

A much more significant relationship is believed to exist between health expenditure and “death related costs”. This theory asserts that increased costs are not associated with age per se; rather, proximity to death is a more reliable predictor of health costs. This theory has found support in research by Stooker et al. (2001) who, using data from the Netherlands, found that hospital costs in the last year of life were 170 per cent larger than the previous year. Similarly, McGrail et al. (2000) conclude that age is less significant that proximity to death as a health cost predictor. Hoover et al. (2002) concluded that health expenditure in the last year of life accounted for 22 per cent of all medical expenses in the United States between 1992 and 1996.

Morbidity compression or expansion refers to opposing views on possible changes in the incidence of ill health, particularly among older cohorts. Proponents of morbidity expansion argue that improvements in life expenditure are largely the result of improvements in the efficacy of life saving treatments among the chronically ill and frail. The incidence of debilitating disorders and age related illnesses, in this view, will remain largely resistant to advances in medical technology (Gruenberg 1977). Recent trends in costly chronic ailments related to increases in obesity, for example, will likely place upward pressure on healthcare utilisation and expenditures as populations age. This can occur if life expectancy outpaces gains in healthy life years or the number of healthy life years remains fixed.

Figure 2: Age and Gender Specific Average per Capita Current Public Expenditure EU-15 (2013 Adjusted)



Source: 2012 Ageing Report, European Commission EU-15 estimates, CSO Population and Labour Force Projections 2016-2046 (2013) and author's calculations

Note: Adjusted to coincide with 2013 SHA estimates of Current Public Expenditure.

Morbidity compression, on the other hand, asserts that increases in life expectancy will be associated with declines in average health costs among the elderly, as life gains are translated into an increased number of healthy life years and a relatively smaller portion of life is spent unwell. In its original formulation, it was suggested that the delayed onset of disability should result in morbidity compression provided that life expectancy gains slow as human beings reach the limits of possible longevity increases (Fries 1980). This interpretation is disputed as there does not appear to be generalised slowdown in life expectancy gains (Howse 2006). Alternatively, Fries (2003) postulates that the increased prevalence of healthy life styles and attendant social supports can delay the onset of age related pathologies sufficiently so as to compress morbidity.

It is unclear whether expansion or compression has been occurring to date and there appears to be a considerable degree of variation between countries. Robine et al. (1998), for example conclude that the European Union is experiencing a "pandemic phase" of disability. Mathers (1996) similarly finds an expansion of morbidity in Australian data. American data appears to show declines in age-specific rates of disability between the 1980s and 1990s (Manton et al. 2001). Cai and Lubitz (2007) found increases in active life years for individuals aged over 65 and increased rates of mortality associated with severe chronic ailments consistent with a mixture of morbidity compression and dynamic equilibrium effects, wherein one may see an increase in chronic illness incidence as populations age but see a reduction in the severity levels of these pathoses.

In the projections that follow, both scenarios are modelled by firstly fixing survivor and death costs at initial values so that gains in life expectancy are associated with increases in sick years (morbidity expansion) and by allowing costs to adjust with life expectancy gains (morbidity compression). Projection assumptions are outlined in more depth in the following section.

2.2 *Income and Residual Growth*

Increases in income (generally, growth in real GDP per capita is used as a proxy) are thought to influence the demand for health as a good. There is a considerable degree of disagreement as to the responsiveness of public health demand to changes in income. Some econometric estimates of income elasticity are greater than 1, and several estimates are less than or equal to unitary elasticity.[1] Musgrove et al. (2002) estimate an income elasticity of public health expenditure slightly greater than one. Baltagi and Moscone (2010) found a long run health expenditure elasticity of 0.87 for 20 OECD countries when stationarity in cointegration were accounted for between health expenditures and GDP and non-income determinant controls were used to isolate the effects of income. Acemoglu et al.'s (2009) central estimate for income elasticity is 0.72 while Kea et al. (2011) estimate an income elasticity of government expenditure in wealthy countries of 0.369. The baseline projections here use an income elasticity of 0.8 as that lies in the middle of the literature estimates. Sensitivity analysis is also undertaken at unit elasticity and an elasticity of 0.6.[2]

The residual component of health expenditure cost growth represents everything left unexplained in growth accounting exercises for health expenditure growth. It is thought to encompass several supply-side factors such as changes in medical technology, relative prices and the particular arrangements of a given health system (Kea et al., 2011). Newhouse (1992) found that the majority of health spending growth in advanced countries was the result of

[1] Income elasticity of health demand refers to the responsiveness if healthcare demand to changes in income. Health demand is thought to be relatively elastic, but debate exists as to whether changes in income induce proportional increases in health expenditures or otherwise. This is generally expressed in the literature as a disagreement as to whether health constitutes a "necessity" (expenditure response less than proportional to income changes) or "luxury" (expenditure response more than proportional to income changes). Unit elasticity implies changes in health demand are exactly proportional to income variations.

[2] It should be noted that income elasticity is likely non-linear, as health demand may become less responsive at the upper end of the income distribution.

technological advances a finding supported by Okunade and Murthy (2002). This may even be the case where technology reduces unit costs, as lowered costs may induce demand through substitution and income effects that offset efficiency gains in health expenditures (Dybczak and Przywara (2010)).

Relative prices largely reflect the so called Baumol "cost curse" wherein the relative price of sectors with low than average labour productivity growth rises faster than other sectors with higher growth. These sectors are generally more labour intensive (as labour is not readily substitutable by capital) but wages rise in line with the rest of the economy (Baumol 1967). This effect is exacerbated in sectors where demand is relatively inelastic as expenditure in that sector will progressively grow relative to total output (Hartwig 2006). Pomp and Vujic (2008) find the Baumol effect to be a significant predictor of health costs in the OECD.

3. PROJECTION MODEL AND DATA

This paper uses a classic linear growth accounting model to forecast current public health expenditure growth. Following OECD (2006, 2015), the projection model uses a growth equation to express real per capita current public expenditure growth as a function of demographic, income and unexplained residual components.

1. $\Delta\, ln\left(\frac{H}{N}\right)_t = \Delta\, ln\, D_t + \varepsilon\Delta\, ln\left(\frac{Y}{N}\right)_t + \Delta\, ln\, \gamma_t$

In the equation above, the percentage growth rate of real current public health spending per capita at time t is $\Delta\, ln\left(\frac{H}{N}\right)_t$, $\Delta\, ln\, D_t$ represents the portion of cost growth attributable to demography, ε refers to the income elasticity of demand, real growth in income per capita is $\Delta\, ln\left(\frac{Y}{N}\right)_t$ while $\Delta\, ln\, \gamma_t$ refers to the residual component of expenditure growth.

The demographic component is the result of interactions related to the age structure of the population, death related costs and morbidity compression. Real GDP per capita growth is used here to proxy general increases in income while income elasticity of demand reflects the responsiveness of healthcare demand to changes in income. The residual component simply refers to the portion of expenditure growth unexplained by the preceding factors which includes cost associated with technological advance, relative prices and institutional arrangements.

The demographic component of expenditure growth requires a separation of costs for survivors and decedents. Death costs are estimated by multiplying per capita costs of the oldest age group for which data was present (over 100 years) by four for all cohorts under 60, to reflect increased death costs at younger ages. This coefficient is allowed to decline linearly to unity for older cohorts (OECD, 2015).[3] This is consistent with empirical studies finding substantial declines in death costs after middle age (Aprile, 2008). Survivor costs are estimated by

[3] A discrepancy existed between the oldest cohort estimate available for CSO population estimates, 99+ years and the oldest per capita cost estimate from the *2012 Ageing Report* at 100+ years. 100+ years values were assigned to the 99+ years cohort. This is not thought to substantially impact forecast estimates.

subtracting death costs by cohort from the total health cost of that cohort using 2013 adjusted data and dividing these costs by the surviving population.

Morbidity expansion assumes that current age and gender specific health cost profiles remain constant over time. Total survivor costs (TSC) are the sum of the current survivor cost profiles for each cohort j ($C_{j,t}$) multiplied by the surviving population of that cohort at time $t+h$ ($N_{j,t+h}$).

2. $\text{TSC}_{t+h} = \sum_1^j C_{j,t} \cdot N_{j,t+h}$

3. $\text{TDC}_{t+h} = \sum_1^j D_{j,t} \cdot M_{j,t+h}$

Death costs for each cohort ($D_{j,t}$) remain constant over time and are multiplied by the yearly non-surviving population ($M_{j,t+h}$) to obtain the annualised Total death costs (TDC_{t+h}). Mortality rates used to calculate the decedent population are constant across all projections (CSO 2013). Total costs associated with demographic change are the sum of total survivor and total death costs.

The morbidity compression model proceeds in a similar manner, but adjusts the 2013 cost profile to reflect increases in healthy life years in line with life expectancy gains (morbidity compression) from 2014 onwards. Total survivor costs are equal to the sum of the individual products of life expectancy adjusted cohort costs ($C_{j-\Delta LE,t}$) and cohort population ($N_{j,t+h}$) at time *t+h.*

4. $\text{TSC}_{t+h} = \sum_1^j C_{j-\Delta LE,t} \cdot N_{j,t+h}$

Costs are adjusted for all cohorts over 44 years of age as it is assumed that younger cohort health is unaffected by life expectancy gains (Caley and Sidhu 2010). All cohorts over 65 are adjusted directly by life expectancy gains multiplied by a unit factor. This factor is allowed linearly taper to zero at 44 years. By this model, a 5 year gain between 2013 and 2023 in life expectancy for a 70 year old implies that a 70 year old in 2023, on average, incurs the costs of a 65 year old in 2013. Within year costs differences are assumed to be linear.

Baseline death costs are calculated as before, and a k-ratio calculated between each cohort's death costs and their survivor costs. This ratio is kept constant over the projection period and death costs are subsequently adjusted to reflect changes in survivor costs following the European Commission's methodology in *The 2015 Ageing Report* (2015).

The cost per capita is calculated by dividing total health spending in both morbidity cases by projected population. The annual rate of growth is then calculated between projected annual demographic costs abstracting from considerations of income or residual cost growth. This estimate forms the basis for the demographic component of per capita health expenditure growth.

The projections in this study utilise data from *The 2012 Ageing Report* (2012) produced by the European Commission concerning age and gender specific per capita public health expenditure. As Ireland did not provide data, EU-15 averages are used. This data is subsequently adjusted such that the total estimated costs (the sum total of health costs by cohort) were equal to the preliminary estimates of current public health expenditure from the Central Statistics Office (CSO) compiled in accordance with the System of Health Accounts methodology for 2013.

Current expenditure was chosen as capital expenditures tend to be comparatively volatile and do not necessarily reflect expansions in health service demand.

Population estimates are sourced from the CSO (2013) projections of population by yearly cohort. Two scenarios of population based on differences in estimated net migration and fertility are used here to assess the impact of these developments on model forecasts. M1F1 entails net inward migration of some 18,200 individuals per year between 2016 and 2021, with annual net migration rates of 30,000 thereafter. The Total Fertility Rate (TFR) is assumed to remain constant at 2.1 births. M2F2 entails slower population growth due to a decline in TFR to 1.8 in 2026 that remains constant over the rest of the projection period. Annual net migration is assumed to be 4,700 between 2016 and 2021 and 10,000 yearly to 2035.

Estimates of real GDP growth between 2013 and 2017 (inclusive) are from the NERI's Winter Quarterly Economic observer 2015. Real GDP growth thereafter is assumed to average a constant 3 per cent per year in line with OECD (2013) long run estimates for the M1F1 scenario. It is assumed for M2F2 estimates that long run growth is equivalent to the sum of employment and productivity growth. Employment growth is calculated from the CSO's estimates of cohort specific labour-force participation (2013) between 2016 and 2026. Labour Force participation is assumed to remain constant for all subsequent forecast years at 2026 rates. Employment rates are assumed constant from 2020. Productivity growth is assumed to average 1.5 per cent annually over the period.[4]

Income per capita (the relevant metric for this forecast model) are calculated by dividing estimated real GDP by population forecast. The annual rates of real per capita income growth are multiplied by a constant income elasticity ε. Income elasticity is assumed to remain constant at 0.8 for standard estimates. Tests of sensitivity occur at income elasticities of 0.6 and 1. These reflect recent values ascertained in the empirical literature (section 3.3).

Estimates of residual cost growth are inherently uncertain, due to the difficulty forecasting supply side drivers of cost growth such as technological advance. Maisonneuve and Martins (2015) use an OECD average estimate for all country projections of 1.7 per cent (for central estimates with an income elasticity of 0.8). This estimate arises from growth decomposition undertaken using data from 1995 to 2009. This data may, however reflect atypical expansions during a long period of sustained economic growth and expansions in health expenditures arising from systemic advancement from a relatively undeveloped state. Growth accounting for 13 Euro area nations, undertaken for the purposes of this present study, (Table 1 Appendix A) of similar wealth and development using current expenditure data from 2003 to 2012 produces a lower estimate of approximately 1.3 per cent (assuming an income elasticity of 0.8).This period may be similarly exceptional due to widespread reductions in public expenditures arising from the worldwide financial crisis and subsequent European debt crisis. An OECD (2006) accounting exercise produced a residual estimate of 1 per cent (assuming unitary

[4] It should be noted that these estimates of future productivity growth and real output growth are considered rather sanguine by some observers. An overview is provided by McDonnell (2015).

income elasticity) using data from OECD members between 1981 and 2002. Tables A2 and A3 present the results of the two OECD accounting exercises mentioned.[5]

The residual component used for the following projections will be 1.5 per cent, which is fairly consistent with the accounting outlined above. Irish specific residual data from the growth accounting exercises listed above are not used to prevent forecasting forward possibly atypical and unsustainable expansions of current public health expenditures arising from systemic catch-up and unprecedented sector expansion associated with the rapid economic growth of the Celtic tiger period. This residual will be subject to two scenarios.

In scenario 1, the residual remains constant over the entirety of the forecast period (2013-2035). This is referred to as the “no policy change” scenario. The second scenario entails a linear reduction in residual cost growth to zero in 2035. This “policy change” scenario implicitly assumes that high cost growth engenders a concerted policy response to reduce excess cost growth not associated with demography or income changes.

4. RESULTS

This section outlines the results of the projection exercise described above in two specific respects. The first subsection focuses on the specific demographic costs pressures arising from population growth and expansions in costly cohort populations under the morbidity expansion and morbidity compression scenarios. This analysis is undertaken for the M1F1 and M2F2 population projections produced by the Central Statistics Office.

The following subsections present the results from the more holistic model incorporating demographic, income and residual components. These results are subject to analyses under a series of assumptions concerning the prevalence of morbidity in elderly cohorts, forecasts of population, the responsiveness of health demand to changes in income and variations in the residual component of cost growth reflecting factors such as technological change and relative prices.

The results will be presented first for the central projection with income elasticity of 0.8 and population projection M1F1. These central scenarios are divided by the evolution of the residual. In scenario 1, the residual component of cost growth remains a constant 1.5 per cent. Scenario 2 presents a case where, implicitly, policy action has been taken to curb cost increases due to non-demographic and non-income factors.

These results are then subject to sensitivity analyses wherein income elasticity is assumed to equal 1 or 0.6 for the four central scenarios for population projection M1F1. This exercise is repeated for CSO scenario M2F2 for all three elasticity values (1, 0.8 and 0.6). This population scenario also effects forecast economic growth affecting expenditure growth through the income per capita channel as well as effecting overall real GDP levels and hence current public health expenditure as a function of real output.

[5] The growth decomposition in the two studies cited pertains to total real public health spending (it includes capital spending), while the decomposition undertaken for the purposes of this study relates to current expenditure. As current spending dominates total expenditures, it is assumed that current expenditure growth accounting would produce estimates largely commensurate with those listed here.

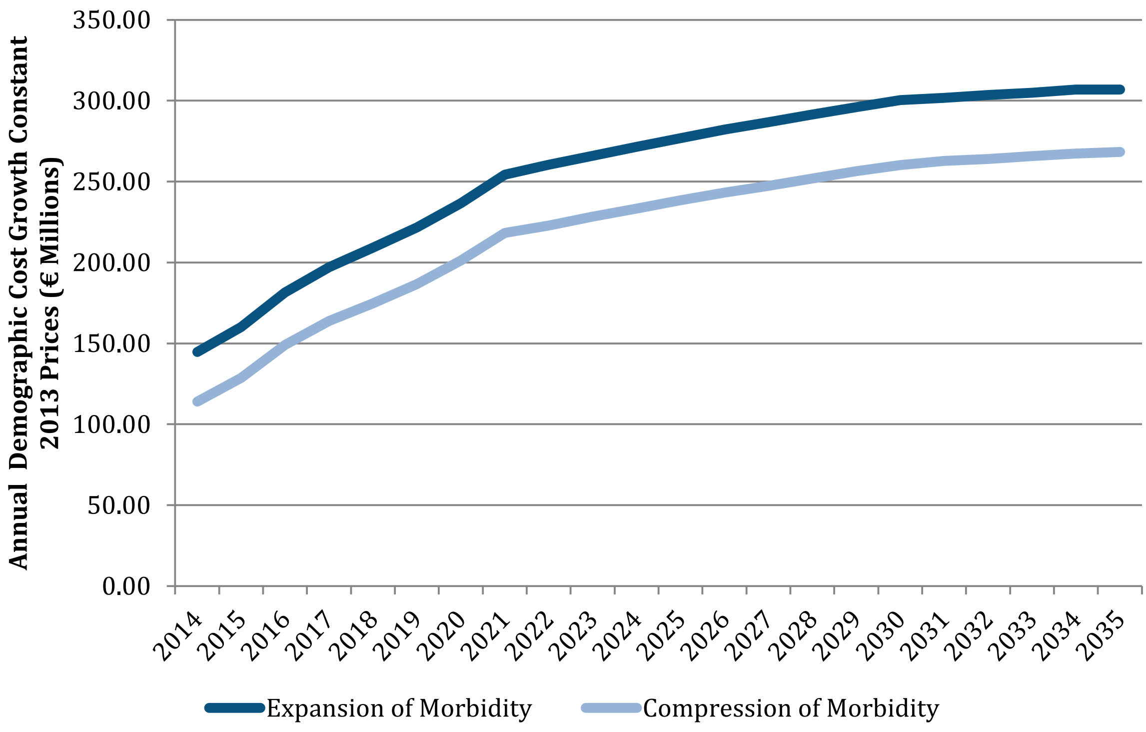
The third and final subsection will present results concerning the expected broad composition of health spending by age group.

4.1 *Fiscal Pressure pertaining to Changes in Demography*

The direct annual costs arising from an expanding and ageing population were calculated under 4 scenarios corresponding to the two population projections and a consideration of an expansion or compression of morbidity for each. The resultant increases in current health expenditures are displayed in summarised form in Table 1, while the Figures 3 and 4 display the full annual euro cost growth series to 2035. These calculations abstract from increases in health provision occurring due to income or residual factors. The cost pressures outlined in the following are expressed in constant 2013 euro.

The demographic cost pressure varies substantially according to population projection and morbidity schema. For CSO population scenario M1F1 average cost growth increases as time progresses for both morbidity models. The postulation of expanded morbidity sees increases in current public health expenditures (in constant 2013 Euro) due to demography rise from an average of approximately €152 million annually between 2013 and 2015, to some €307 million in the period 2033-2035. The corresponding increases when morbidity compression is assumed range from €121 million to €268 million. In both cases demographic cost increases slow in the late 2020s as the population stabilises.

Figure 3: Real Annual Demographic Cost Growth from Demographic Pressures M1F1

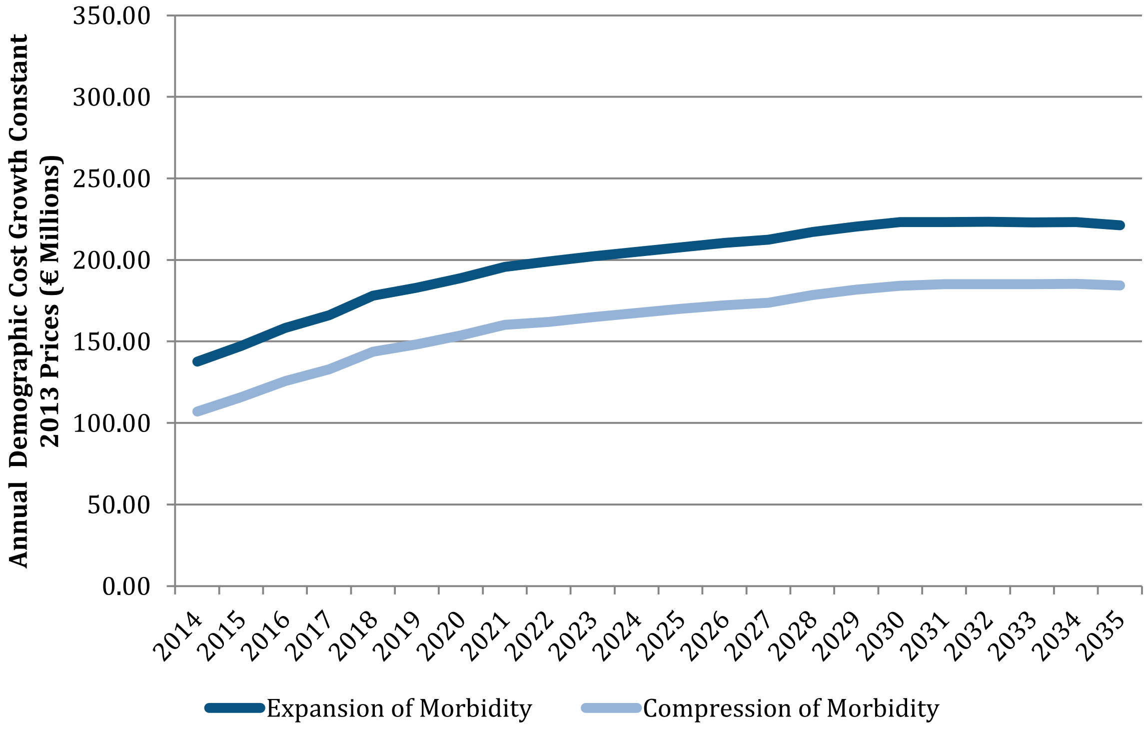


Note: Each data point represents the demographic cost pressure relative to the previous year in real terms. 2015 refers to demographic costs in excess of 2014 costs.

Demographic cost pressure under scenario M2F2 is more modest. Under assumptions of morbidity expansion, average annualised cost increases from expansions of population and changes in the demographic composition of the Irish population increase from €142 million between 2013 and 2015 to a maximum of €223 million in 2030-2032. Similarly, utilising the morbidity compression model for the same set of population projections, annual demographic costs are forecast to rise from €111 million to €185 million between 2030 and 2032.

The same information is also presented as average annual current public health expenditure cost growth in Table 1. Cost growth is approximately 1 per cent annually in all cases for the years 2013 to 2015 (0.85-1.16 per cent). These growth rates diverge however with time under the varying assumptions of each model. Cost growth reaches a maximum of 1.79 per cent between 2025 and 2027 under assumptions of morbidity expansion and M1F1 assumptions of fertility and net migration. This declines to 1.68 per cent in the final years of the forecast period. Morbidity compression for the same population assumptions entails cost growth reaching a maximum of 1.59 per cent annually between 2027 and 2029, declining slightly to 1.53 per cent by the period 2033 to 2035.

Figure 4: Real Annual Demographic Cost Growth from Demographic Pressures M2F2



Under different assumptions of population growth and demographic composition, growth is more modest (Figure 4). Assuming morbidity expansion, cost growth is highest between 2027 and 2029 at 1.39 per cent which subsequently declines to an average of 1.3 per cent between 2033 and 2035. The morbidity compression scenario maximum coincides with the previously elucidated scenario at the lower level of 1.18 per cent. Cost growth ranges between 1.11 per cent and 1.16 per cent for all other years between 2020 and 2035.

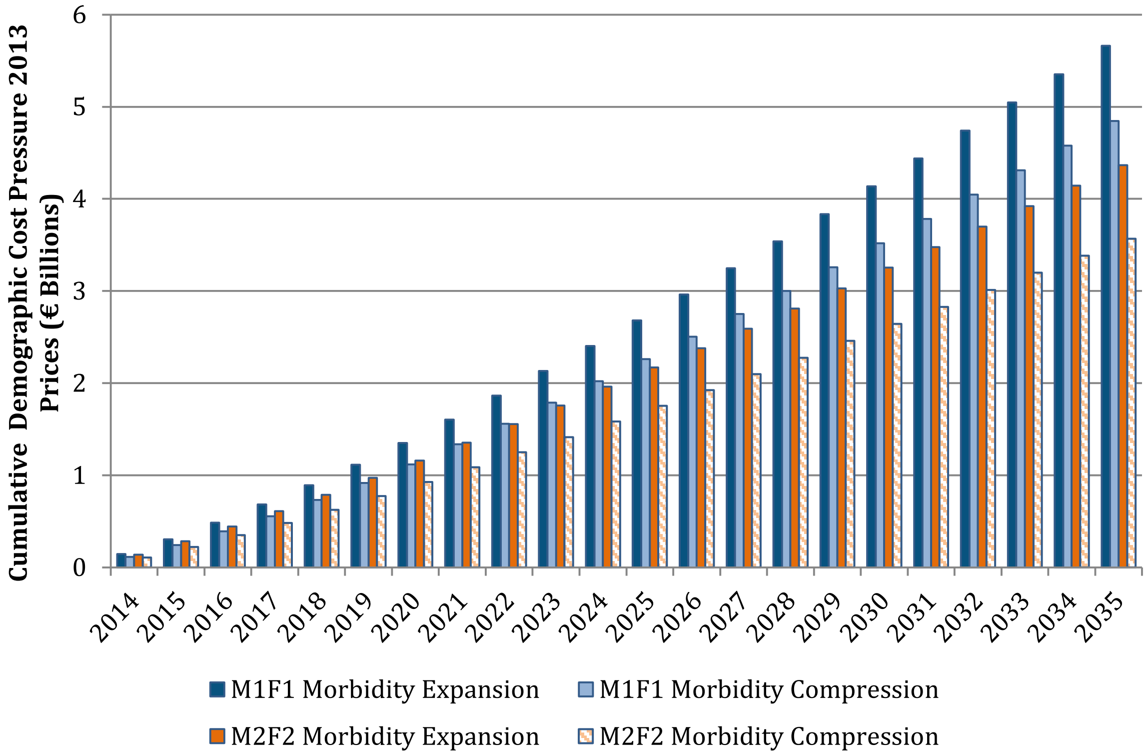
Table 1: Average Real Annual Direct Demographic Cost Pressure

Years (Inclusive)	*Million € Spending Pressure (at 2013 prices)*				*% Overall Annual Expenditure Growth due to demographics*			
	Morbidity Expansion		**Morbidity Compression**		**Morbidity Expansion**		**Morbidity Compression**	
Population Projection	*M1F1*	*M2F2*	*M1F1*	*M2F2*	*M1F1*	*M2F2*	*M1F1*	*M2F2*
2013-2015	€152.37	€142.42	€121.35	€111.40	1.16%	1.08%	0.92%	0.85%
2016-2018	€195.91	€167.46	€162.53	€134.16	1.44%	1.24%	1.21%	1.00%
2019-2021	€237.49	€189.23	€202.03	€154.01	1.67%	1.35%	1.44%	1.11%
2022-2024	€265.95	€202.07	€228.21	€164.80	1.78%	1.38%	1.56%	1.15%
2025-2027	€281.94	€210.23	€243.00	€171.96	1.79%	1.38%	1.58%	1.16%
2028-2030	€295.92	€220.25	€256.14	€181.40	1.78%	1.39%	1.59%	1.18%
2031-2033	€303.43	€223.18	€264.15	€185.17	1.73%	1.35%	1.57%	1.16%
2034-2035	€306.85	€222.16	€267.87	€184.82	1.68%	1.30%	1.53%	1.13%

Figure 5 displays the cumulative cost pressures exerted by each of the two morbidity scenarios assuming population size and composition evolves according to M1F1 and M2F2. Cost growth is largest for the morbidity expansion scenario for population projection M1F1, which exceeds €1 billion in real terms in 2019 and approaches €6 billion (€5.66 billion) by the end of the forecast period. Under projection M1F1 assuming compression of morbidity, cumulative costs are over €1 billion from 2020 onwards, and reach €4.85 billion in 2035.

Cumulative projected cost pressure related to demographic change is in all cases lower under M2F2, which appears largely the result of its lower overall estimates of population (concentrated among younger cohorts that constitute the majority of migrants). Morbidity expansion results in cumulative costs that exceed €1 billion in 2020 and reach €4.37 billion by 2035. Morbidity compression under this scenario induces the lowest demographic pressures. These pressures amount to €3.57 billion at 2013 prices in 2035, attaining €1 billion in 2021.

Figure 5: M1F1 Cumulative Real Demographic Cost Pressure at 2013 Prices



Note: Cumulative pressures assume that the previous year's demographic pressure goes unaddressed and costs increase additively. All estimates are in real rather than nominal terms. Estimates of cumulative demographic pressure at current prices require adjustment to account for inflation.

4.2 *Central Projections of Current Public Health Expenditure 2013-2035*

Table 2 presents the forecasts of current public health spending in constant 2013 euro and as a portion of GDP for both morbidity regimes on the assumption that the residual component of cost growth remains a constant 1.5 per cent per year (no policy change).

Given an expansion of morbidity (additional life years are spent ill and the relative portion of life spent in good health declines), expenditure rises from approximately €13.08 billion in 2013 to €23.62 billion in 2025. This corresponds to a rise in spending as a percentage of GDP from 7.29 per cent to 8.66 per cent. Costs increase a further €13.75 billion over the following decade, reaching €37.37 billion by 2035, at which stage expenditure as a function of GDP rises to 10.20 per cent of GDP. Alternatively, morbidity compression sees costs rise more modestly, to €23.01 billion or 8.44 per cent of GDP in 2025. Costs reach €35.80 billion by 2035 or 9.77 per cent of GDP.

Table 3 presents results from scenario 2, in which policy makers have taken steps to curb residual cost growth associated with what are believed to supply side factors such as increases in costs due to technological change, relative prices and inefficiencies arising from the structure of the health system, from 1.5 per cent annually to zero by the end of the forecast period. As such, these forecasts represent more optimistic projections.

Assuming expansion of morbidity, costs rise to €22.43 billion by the mid-2020s, equivalent to 8.23 per cent of forecast GDP. Cost increases to 2035 are more modest, growing only slightly faster than per capita GDP and hence the economy at large. Costs increase in the following decade by a further €9.18 billion reaching €31.61 billion in 2035 (8.63 per cent of projected GDP).

Table 2: Forecast Real Current Public Spending Scenario 1 (No Policy Change)

Year	*Billion € Spending (at 2013 prices)*		*% of GDP*	
	Morbidity Expansion	**Morbidity Compression**	**Morbidity Expansion**	**Morbidity Compression**
2013	€13.08	€13.08	7.29%	7.29%
2014	€13.92	€13.89	7.37%	7.35%
2015	€14.88	€14.82	7.44%	7.40%
2016	€15.69	€15.58	7.53%	7.48%
2017	€16.44	€16.29	7.64%	7.57%
2018	€17.19	€17.00	7.75%	7.67%
2019	€17.97	€17.73	7.87%	7.77%
2020	€18.80	€18.51	7.99%	7.87%
2021	€19.67	€19.32	8.12%	7.98%
2022	€20.58	€20.17	8.25%	8.08%
2023	€21.54	€21.07	8.38%	8.20%
2024	€22.55	€22.02	8.52%	8.32%
2025	€23.62	€23.01	8.66%	8.44%
2026	€24.74	€24.05	8.81%	8.56%
2027	€25.91	€25.14	8.96%	8.69%
2028	€27.14	€26.29	9.11%	8.82%
2029	€28.42	€27.48	9.26%	8.96%
2030	€29.77	€28.73	9.42%	9.09%
2031	€31.17	€30.03	9.57%	9.23%
2032	€32.63	€31.39	9.73%	9.36%
2033	€34.15	€32.80	9.89%	9.50%
2034	€35.73	€34.27	10.04%	9.63%
2035	€37.37	€35.80	10.20%	9.77%

As in scenario 1, cost growth is reduced on assumptions of morbidity compression (or "healthy ageing"). Current public expenditure in 2025 is 8.01 per cent of GDP in 2025 (€21.85 billion). In 2035, public spending is €30.27 billion or 8.26 per cent of GDP. This represents the most optimistic projection for the evolution of current public expenditures, as spending as a percentage of GDP increases by less than a per cent relative to its 2013 value (0.97 per cent of GDP). Annual forecast results for scenario 2 are presented in table 3.

These scenarios demonstrate the sensitivity of the projection set to underlying assumptions, particularly, assumptions regarding the evolution and response to residual components of health cost growth. The difference between the equivalent morbidity assumptions is over €5 billion in both cases, while differences between ageing assumptions within each scenario range from the more modest €1.34 to €1.57 billion.

Table 3 Forecast Real Current Public Spending Scenario 2 (Policy Change)

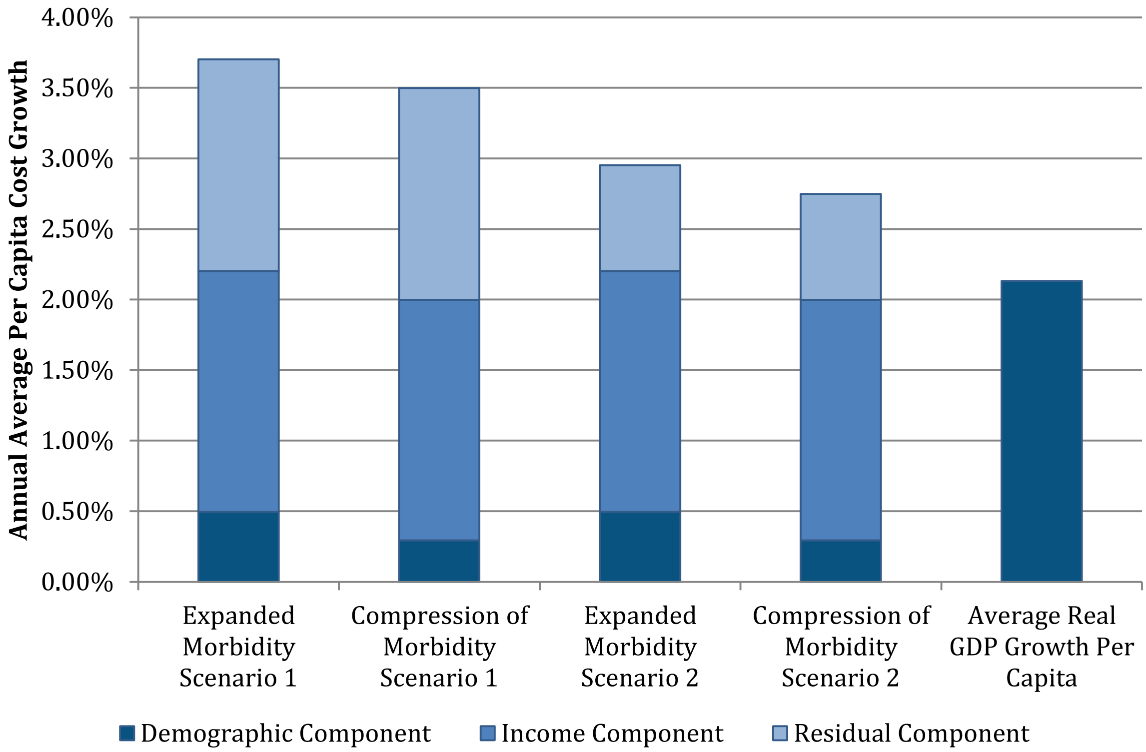
Year	*Billion € Spending (at 2013 prices)*		*% of GDP*	
	Morbidity Expansion	**Morbidity Compression**	**Morbidity Expansion**	**Morbidity Compression**
2013	€13.08	€13.08	7.29%	7.29%
2014	€13.92	€13.88	7.36%	7.35%
2015	€14.85	€14.79	7.42%	7.39%
2016	€15.63	€15.52	7.50%	7.45%
2017	€16.33	€16.19	7.59%	7.52%
2018	€17.02	€16.83	7.68%	7.59%
2019	€17.73	€17.49	7.76%	7.66%
2020	€18.46	€18.17	7.85%	7.73%
2021	€19.21	€18.87	7.93%	7.79%
2022	€19.98	€19.58	8.01%	7.85%
2023	€20.77	€20.32	8.08%	7.91%
2024	€21.59	€21.08	8.16%	7.96%
2025	€22.43	€21.85	8.23%	8.01%
2026	€23.29	€22.65	8.29%	8.06%
2027	€24.17	€23.45	8.36%	8.11%
2028	€25.07	€24.28	8.41%	8.15%
2029	€25.98	€25.11	8.47%	8.18%
2030	€26.90	€25.96	8.51%	8.21%
2031	€27.83	€26.82	8.55%	8.24%
2032	€28.77	€27.68	8.58%	8.25%
2033	€29.71	€28.54	8.60%	8.26%
2034	€30.66	€29.40	8.62%	8.27%
2035	€31.61	€30.27	8.63%	8.26%

Figure 5 displays average annual cost growth in per capita current public health spending for the two ageing assumptions within each scenario relative per capita real GDP growth. It shows that, in all cases average cost growth exceeds average real GDP growth, implying an expansion in the relative portion of total output apportioned to current public health expenditures

It is also clear that the demographic composition component of per capita cost growth is small relative to income and residual growth factors, never exceeding 17 per cent of cost growth. Demographic pressure arising from an expanding population is not included in this decomposition as it pertains to per capita health costs and is captured, as such, in resultant calculations of total expenditure. Income growth is the largest single factor in all cases, accounting for between 46 per cent and 62 per cent of cost growth. The relative contribution of the residual costs growth factor ranges from 25 per cent to nearly 43 per cent of health cost growth.

The largest comparative reductions in per capita cost growth occur, as a result, when steps are taken to curb residual cost growth, rather than between morbidity regimes. Average cost growth is 0.75 per cent lower in both residual reduction scenarios relative to scenario 1, falling from 3.70 and 3.50 per cent in scenario 1 under morbidity expansion and compression respectively, to 2.95 and 2.75 per cent under otherwise equivalent assumptions. This compares with an average cost reduction of 0.21 per cent between expanded and compressed morbidity scenarios.

Figure 6: Decomposition of Real Average per Capita Current Health Expenditure Cost Growth 2013-2035



Note: Each component of cost growth display amounts to the average value attributable to that component over the forecast period.

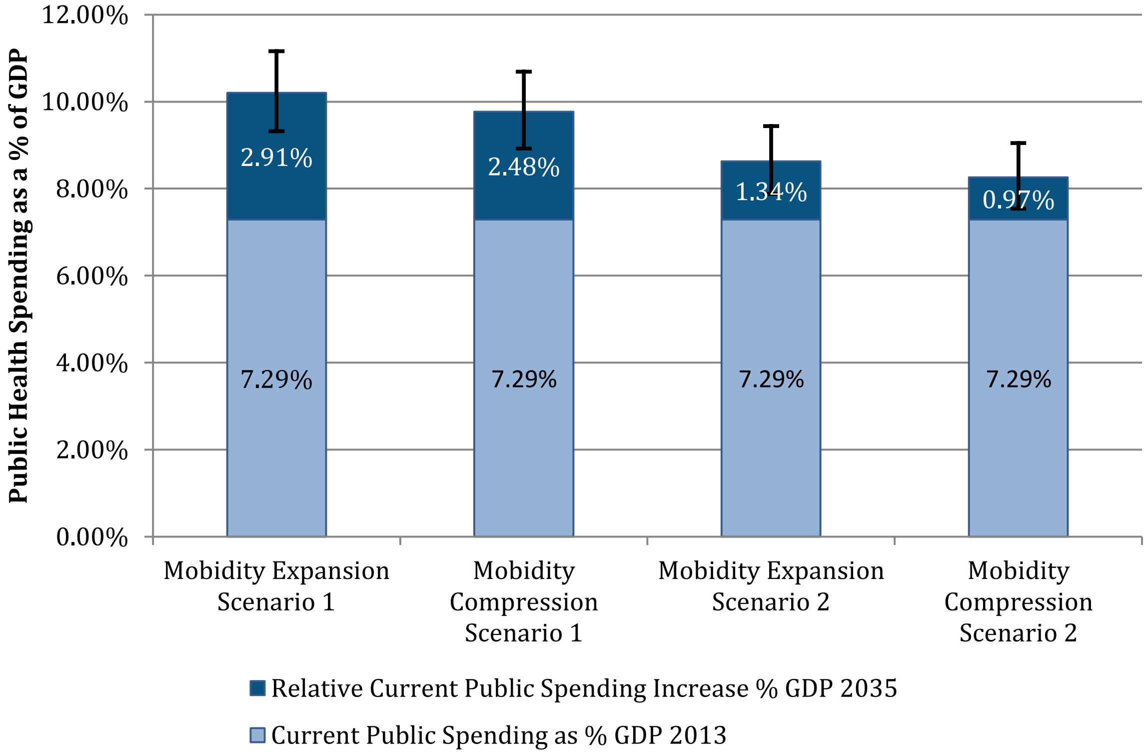
4.2 *Sensitivity Analyses of Projections of Current Public Health Expenditure 2013-2035*

The assumptions underlying the central projections were adjusted to assess their sensitivity to them and determine a range of values across each forecast estimate. In the first instance, the assumed income elasticity value of the central projection set was changed so as to alternately decrease and increase the responsiveness of health demand to income. The income elasticities used were 0.6 and 1. This was done for all four projection scenarios presented in the previous section.

The full results are displayed in table B2 in Appendix B and summarised in GDP terms in figure 6. Expenditure in 2013 euro at the end of the forecast period is found to range between €34.14 and €40.89 under morbidity expansion and residual scenario 1, which amounts to between 9.32 and 11.16 per cent of forecast GDP in 2035. Under residual scenario 2, the forecast range extends from €28.86 billion (7.78 per cent of GDP) to €34.6 billion (9.44 per cent of GDP).

The range of estimates is slightly lower when morbidity compression is considered. 2035 spending assuming constant annual residual cost growth lies between 8.92 and 10.69 per cent of forecast GDP (€32.70 to €39.18 billion). Under scenario 2, this range is €27.63 billion to €33.14 or between 7.54 and 9.05 per cent of 2035 estimates of real GDP.

Figure 7: M1F1 Projections 2035 Sensitivity Analysis according in Income Elasticity



Note: The stacked columns display the estimate of current public health spending in 2035 from the four central projection scenarios as a function of forecast GDP and the deviation from relative spending as a percentage of GDP from the forecast baseline 2013 (displayed in dark blue here). The error bars display the sensitivity range due to variation of income elasticity. The lower bar represents an elasticity of 0.6, and the upper bar shows estimates from an income elasticity of 1.

The second sensitivity analysis assessed the impact of differing forecasts of population growth and changes in the demographic composition of the population (table B3 Appendix B and Figure 6) relative to the central forecast set. As mentioned in section 3, these projections entail changes to rates of cost growth from changes in the size and distribution of cohorts within the population and changes in the rate of economic growth, and hence the size of the economy.

In all cases, the expenditure in 2013 euro has decreased slightly. In Scenario 1, 2035 spending levels are €36.81 billion and €35.17 billion for assumptions of expanded and compressed morbidity respectively, declines of approximately €600 million in each case relative to the standard scenario set.

These declines still result in in increases in expenditure relative to economic output, due to slowed economic growth resulting from slower employment growth. Spending as a percentage of GDP goes from 10.20 per cent and 9.77 per cent under expanded and compressed morbidity in the standard scenario set to 10.41 per cent and 9.95 per cent under population scenario M2F2 in 2035.

Similarly, expenditure declines by approximately half a billion euro under assumptions of residual component decline relative to the same assumptions in the central scenario set (scenario 2). Expenditure as a portion of national economic output increases from 8.63 per cent to 8.81 per cent of GDP given unchanged gender and age cost profiles. Under morbidity compression's assumptions of reductions in elderly cost profiles, current public health expenditure represents 8.26 per cent of output in 2035 in scenario 2 of the central projection set, relative to 8.42 per cent under population projections M2F2.

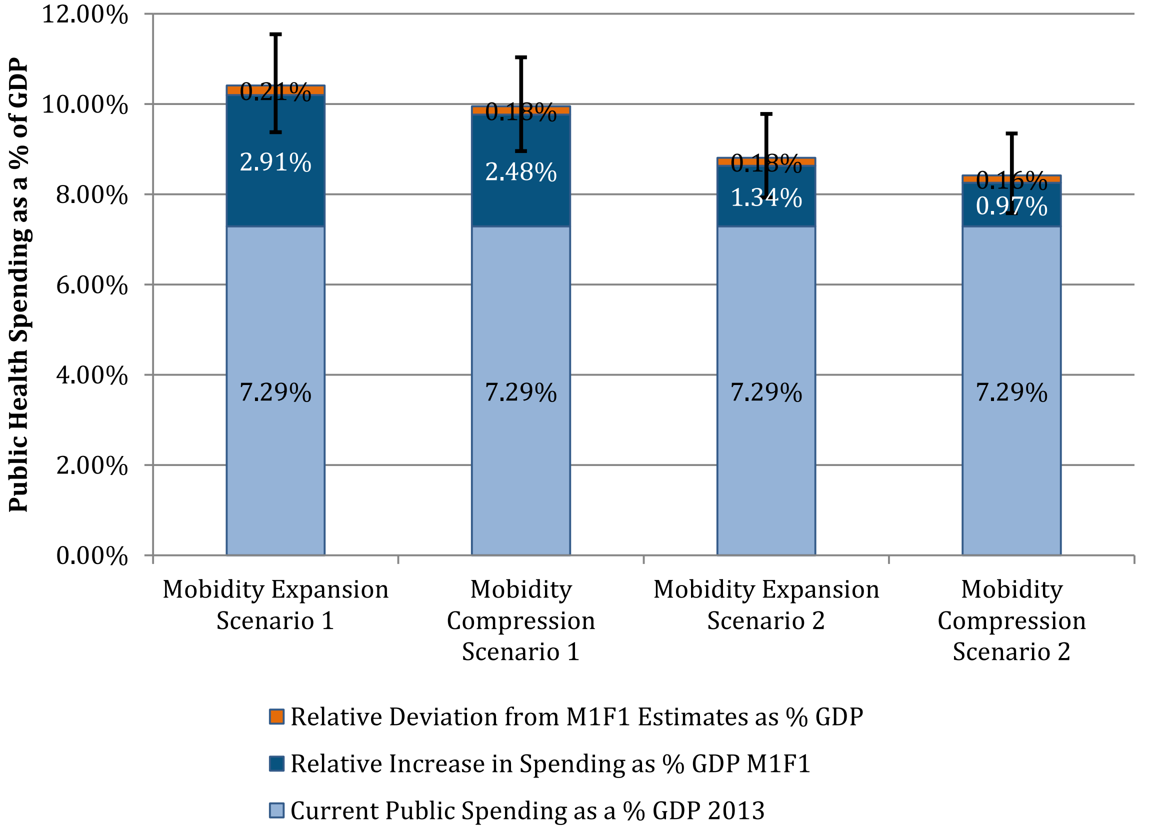
M2F2 estimates were themselves subjected to a variation in the income elasticity values underpinning each forecast in the adjusted central forecast set. The full set of forecasts for each combination of morbidity, income elasticity and annual residual growth scenario are displayed in table B4 (Appendix B) and the estimate range as a function of GDP is represented by error bars about a central estimate in Figure 7.

Under morbidity expansion, the range of expenditure estimates lies from €33.16 to €40.83 billion or between 9.38 and 11.55 per cent of GDP in 2035 if the residual component of cost growth remains constant. Under residual scenario 2, expenditure as a percentage of forecast GDP is between 7.93 and 9.78 per cent, or between €28.04 and €34.58 at constant 2013 prices.

Under conditions of morbidity compression, estimates lie between 8.96 and 11.04 per cent of projected output or €31.68 to €39.03 billion when residual cost growth remains constant over the forecasts. Under residual scenario 2, as elsewhere, estimates are substantially lower, between 7.58 and 9.35 per cent of anticipated GDP in 2035. This amounts to €26.79 to €33.05 billion in real terms.

Sensitivity analyses produce a range of forecast estimates that are consistent with the central scenario set, although the range is extended somewhat. In aggregate however, these sensitivity analyses show that forecasts are sensitive to the underlying assumptions in the projection model. The full range of estimates lies between 7.54 and 11.5 per cent depending on the evolution of various factors.

Figure 8: M2F2 Projections 2035 Sensitivity Analysis according in Income Elasticity



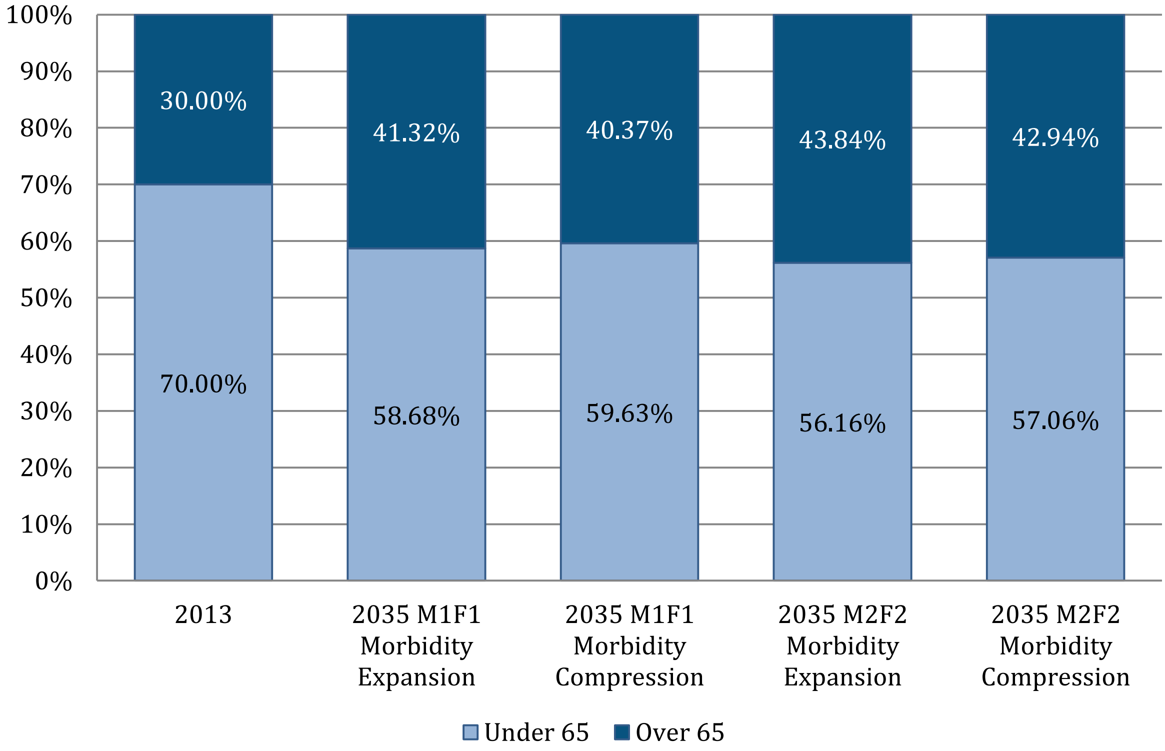
Note: The stacked columns display the estimate of current public health spending in 2035 from the four central projection scenarios given population forecast M2F2 as a function of forecast GDP and the deviation from relative spending as a percentage of GDP from the forecast baseline 2013. The orange bar shows the difference between central estimates given different forecasts of population (M2F2 vs M1F1). The error bars display the sensitivity range due to variation of income elasticity for these new estimates at M2F2. The lower bar represents an elasticity of 0.6, and the upper bar shows estimates from an income elasticity of 1.

4.3 Changes in Composition of Current Public Health Expenditures

Figure 8 displays the composition of spending by broad age group for assumptions of morbidity and differing projections of population in 2015, compared to baseline 2013 estimates.

In all cases, the percentage of total current public expenditure attributable to the over 65 age group expands from 30 per cent in 2013 to over 40 per cent in 2035. This effect is most pronounced under assumptions of decreased fertility and migration, as although infant children are costly as a cohort, costs decline rapidly following early infancy. Migrants are also disproportionately young individuals. Under projection M2F2, the relative portion of the population aged 65 and over is larger.

Figure 9: Age Decomposition of Current Health Expenditure Cost Growth



Note: It is assumed in all cases that non-demographic cost drivers affect the costs of all cohorts uniformly.

5. CONCLUSION

All forecasts presented in the previous section entail increases in current public health expenditures due to demographic, income and residual cost pressures. It should be stressed that the forecast results are sensitive to model assumptions regarding population changes, the responsiveness of health demand to income changes, life expectancy, economic growth, changes in technology and relative cost, as well as morbidity. Complex dynamic relationships are likely to occur between model inputs. Notably, economic growth and health are thought to be related through a number of interlinkages (Bloom and Canning, 2008). Similarly, factors captured within the residual cost growth factor such as technological advance and relative price effects, are probably endogenously determined. Notwithstanding these issues and the inherent uncertainty surrounding projections generally, they are of use in formulating the likely progression of cost growth in response to policy.

This model projects that cost pressures arising from the expansion and changing demographic composition of the Irish population will result in annual cost pressures that approach €200 million in 2019. Annual demographic pressures never reach €200 million under assumptions of morbidity compression and modest population growth in M2F2. In all other modelled cases however, the costs of accommodating demographic changes are projected to increase to between €200 and €300 million over the remainder of the forecast period.

Cumulative demographic pressures exceed €1 billion at 2013 prices between 2019 and 2021. By the end of the forecast period, real cumulative pressures range between €3.6 and €5.7 billion depending on the forecast evolution of the population and the incidence of morbidity. While the former is largely subject to overall macroeconomic developments related to the business cycle that are both hard to forecast and control, morbidity may be effected by changes in policy including revenue raising measures that alter health incentives and greater investment in preventative care as well as healthy living programmes.

The full model also forecasts expansions in current public health costs in absolute real euro terms and relative to overall forecast economic output. These estimates range between 7.54 and 11.55 per cent of GDP in 2035 depending on underlying assumptions concerning population, the responsiveness of health demand to income changes and residual cost growth. A higher likelihood is placed on forecasts at the upper end of this range as lower estimates require an unlikely confluence of parameter assumptions and successful policy action. A baseline estimate of 10 per cent of forecast GDP appears reasonable on a no policy change basis.

In all cases, the proportion of health expenditures incurred by cohorts aged 65 and over increased substantially. This suggests that increasing resources will have to be assigned to healthcare over the next two decades to address cost pressures and that, to remain effective, the public health system will have to change in structure to accommodate the healthcare needs of the elderly population. This also implies that significantly increased investment will be required in targeted regions of the health service.

It is clear from the full model that the largest cost savings are likely to be gained through concerted policy efforts to restrain residual cost growth associated with supply side factors. This may prove difficult to achieve in practice, given difficulties applying systems of organisation and cost control according to international best practice to complex existing structures that are themselves the result of decades of settlements between stakeholders.

As mentioned in the introduction, substantial sustained underinvestment in system capacity has likely negatively affected systemic efficiency given capacity constraints. Capital investment is not considered within this study, as historical trends display a large degree of volatility. This historic underinvestment may result in overestimates of forecast cost growth if steps are taken to ameliorate current capacity constraints and subsequent current expenditures are thus utilised more cost effectively. Similarly, Ireland's current "duplicate system" is thought to entail substantial transfers to private sector providers from public expenditure (Finn and Hardiman, 2011). Reforms targeting these subsidies may further restrain expenditure growth and reduce health inequalities arising from a two-tier system.

International expenditure comparisons, such as Eurostat's Classification of Functions of Government (COFOG) data, may point to other broad areas of the health service which merit reforms. For example, Ireland appears as an outlier in EU terms in the area of outpatient service (3.3 per cent of GDP relative to an EU unweighted average of 1.7 per cent).[6] Other

[6] Eurostat COFOG data is compiled using the European System of National Accounts (ESA 2010) framework. This differs in classification from the estimates produced by the CSO utilised for base estimates of current public expenditure in 2013. The use of a consistent accounting framework across countries remains useful, however, for cross country comparisons.

commentators point to the possible reduction of comparatively high input costs (such as expenditures on drugs) as a potential source of efficiency gains (Brick, Gorecki and Nolan, 2012).

The results of the presented model should also be considered in the broad context of debt and expenditure rules mandated by the European Union and domestic fiscal rules. These rules are not explicitly considered within the forecast model.

In particular, the expenditure benchmarks stipulate that expenditure growth must not exceed medium term potential growth under conditions of revenue neutrality (Oireachtas Library and Research Service, 2015). As current health expenditure growth is projected to outpace GDP growth over the forecast period, these rules imply that additional revenue raising measures will be required if current levels of public expenditure elsewhere are to be maintained in real terms.[7] While not factored into this model, expenditure growth in health will likely induce increased costs in other governmental sectors independent of direct demographic effects.

In this way, the future development of the national health system falls within a broad debate about the nature and scope of an envisaged public service. These forecasts assume that allotted expenditure expands to adapt to cost pressures, but the validity of this assumption is largely dependent on the prevailing political climate. Failure to address these pressures will amount to an effective political choice to increase healthcare rationing and accept higher levels of unmet demand.

An informed and effective public debate will require greater access to and expanded collection of disaggregated data concerning the level and incidence of medical costs. Moreover, further study is merited to construct forecasts models based on patient utilisation across service areas. These developments should inform public discourse as to how we adapt our health service to accommodate the disparate forces acting upon it in a manner that balances equity with efficiency.

[7] Further constraints on expenditure growth exist due to other stipulations of The Stability and Growth Pact. Ireland's non-compliance with the structural deficit rule implies further fiscal consolidation that limits expenditure growth to less than the medium term growth rate over the next few years under current projections. For further discussion see NERI (2015), *Quarterly Economic Observer Summer 2015* and NERI (2012), *Information Note on the EU Fiscal Compact Treaty*.

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7. APPENDIX A

Table A1: Decomposition of Per Capita Current Public Health Spending (System of Health Accounts) 2003-2012

Country	Average Per Capita Real Current Public Health Expenditure Growth	Average Demographic effect	Average Income Effect (Income Elasticity=0.8)	Residual	
				Income Elasticity=0.8	Income Elasticity=1
Austria	2.14%	0.42%	1.00%	0.72%	0.47%
Belgium	2.49%	0.24%	0.69%	1.56%	1.39%
Denmark	2.12%	0.18%	0.27%	1.66%	1.60%
Finland	2.97%	0.58%	0.78%	1.61%	1.41%
France	1.31%	0.49%	0.46%	0.36%	0.25%
Germany	1.64%	0.63%	1.18%	-0.17%	-0.47%
Greece (2009-2012)	-9.45%	0.12%	-5.83%	-3.74%	-2.28%
Ireland (2004-2012)	3.95%	0.25%	0.08%	3.62%	3.61%
Luxembourg	1.83%	-0.03%	0.57%	1.30%	1.16%
Netherlands	7.41%	0.46%	0.72%	6.24%	6.06%
Portugal(2003-2011)	0.29%	0.46%	-0.09%	-0.08%	-0.13%
Spain	3.16%	0.26%	-0.23%	3.13%	3.19%
Sweden	2.81%	0.14%	1.71%	0.96%	0.53%
Overall	***1.74%***	***0.33%***	***0.10%***	***1.32%***	***1.29%***

Source: CSO (2015) Ireland's System of Health Accounts, Annual Results 2013 (Preliminary), EUROSTAT System of Health Accounts Current Expenditure, CSO Population and Labour Force Projections 2016-2046 (2013), NERI Quarterly Economic Observer Winter 2015, OECD (2013), 2012 Ageing Report European Commission Age/Gender Cost Profile and Author's Calculations

Note: The sum of demographic, income and residual effects may not equal average per capita real current public health expenditure growth due to rounding. Irish data utilise the new System of Health Accounts (2011) while other countries current public expenditures are recorded according to the older System of Health Accounts (V 1.0). These differences are due to the availability of extended data and are not thought to substantially impact results.

Demographic effects are calculated on the assumption of constant cost profiles or morbidity expansion. The residual component may, as a result, be biased downwards, though this effect is likely small.

Table A2: Decomposing Growth in Public Health Spending (1995-2009)

Country	Real Health Spending (per capita in 2005 PPP USD) (Average annual % change)	Age Effect	Income Effect (Income Elasticity=0.8)	Residual	
				(Income Elasticity=0.8)	(Income Elasticity=1)
Australia	4.1%	0.4%	1.7%	1.8%	1.4%
Austria	3.3%	0.4%	1.3%	1.5%	1.2%
Belgium	4.2%	0.4%	1.2%	2.7%	2.4%
Canada	2.6%	0.6%	1.3%	0.8%	0.5%
Chile	7.7%	0.6%	2.2%	4.8%	4.3%
Czech Republic	4.2%	0.6%	2.3%	1.4%	0.8%
Denmark	3.7%	0.2%	0.8%	2.7%	2.5%
Estonia	6.1%	0.6%	3.9%	1.8%	1.0%
Finland	4.1%	0.6%	2.0%	1.5%	1.1%
France	1.6%	0.5%	0.9%	0.3%	0.0%
Germany	1.7%	0.6%	0.8%	0.2%	0.0%
Greece	5.9%	0.6%	2.7%	2.5%	1.8%
Hungary	2.0%	0.5%	2.1%	-0.6%	-1.1%
Iceland	3.1%	0.4%	2.0%	0.9%	0.4%
Ireland	6.5%	0.3%	2.9%	3.3%	2.6%
Israel	1.6%	0.4%	2.4%	-1.2%	-1.7%
Italy	3.1%	0.6%	0.4%	2.1%	2.0%
Japan	2.7%	1.2%	0.8%	0.7%	0.5%
Korea	11.0%	1.1%	3.1%	6.5%	5.7%
Luxembourg	1.9%	0.1%	2.3%	-0.5%	-1.1%
Mexico	2.5%	0.5%	1.1%	1.0%	0.7%
Netherlands	5.2%	0.5%	1.4%	3.3%	2.9%
New Zealand	6.3%	0.4%	0.3%	5.5%	5.5%
Norway	3.5%	0.1%	1.3%	2.1%	1.7%
Poland	6.9%	0.7%	3.6%	2.6%	1.7%
Portugal	4.6%	0.6%	1.5%	2.4%	2.0%
Slovak Republic	6.3%	0.6%	3.6%	2.1%	1.3%
Slovenia	3.0%	0.8%	2.1%	0.2%	-0.3%
Spain	3.4%	0.5%	1.5%	1.4%	1.0%
Sweden	3.2%	0.2%	1.6%	1.4%	1.0%

Table A2 Continued: Decomposing Growth in Public Health Spending (1995-2009)

Country	Real Health Spending (per capita in 2005 PPP USD) (Average annual % change)	Age Effect	Income Effect (Income Elasticity=0.8)	Residual	
				(Income Elasticity=0.8)	(Income Elasticity=1)
Switzerland	2.9%	0.4%	0.9%	1.6%	1.4%
Turkey	7.7%	0.5%	2.6%	4.5%	3.9%
United Kingdom	4.6%	0.2%	1.5%	2.8%	2.5%
United States	3.6%	0.3%	1.1%	2.3%	2.0%
Brazil	4.8%	0.6%	1.2%	2.9%	2.6%
China	11.2%	0.6%	7.3%	3.0%	1.3%
India	6.6%	0.3%	4.2%	2.0%	1.0%
Indonesia	8.0%	0.5%	1.9%	5.5%	5.0%
Russian Federation	3.7%	0.4%	3.3%	0.1%	-0.6%
South Africa	3.1%	0.4%	1.6%	1.2%	0.8%
OECD Total Average	4.3%	0.5%	1.8%	2.0%	1.5%
BRIICS Average	6.2%	0.5%	3.2%	2.5%	1.7%
Total Average	***4.6%***	***0.5%***	***2.0%***	***2.0%***	***1.5%***

Source: OECD (2015)

Table A3: Decomposing Growth in Public Health Spending (1981-2002)

Country	Health Spending	Age Effect	Income Effect (Income Elasticity=1)	Residual
Australia (1981-2001)	3.6%	0.4%	1.8%	1.4%
Austria	2.2%	0.1%	2.1%	0.0%
Belgium (1995-2002)	2.9%	0.4%	1.7%	0.6%
Canada	2.6%	0.4%	1.7%	0.6%
Czech Republic (1993-2002)	2.7%	0.4%	2.8%	-0.4%
Denmark	1.3%	0.1%	1.7%	-0.5%
Finland	2.6%	0.3%	2.1%	0.2%
France	2.8%	0.2%	1.6%	1.0%
Germany	2.2%	0.2%	1.2%	1.0%
Greece (1987-2002)	3.4%	0.4%	1.3%	0.8%
Hungary (1991-2002)	1.5%	0.3%	2.8%	-1.5%
Iceland	3.5%	0.1%	1.5%	1.9%
Ireland	3.9%	0.1%	4.9%	-1.0%
Italy (1988-2002)	2.1%	0.7%	1.7%	-0.1%
Japan (1981-2001)	3.8%	0.4%	2.2%	1.1%
Korea (1982-2002)	10.1%	1.4%	6.1%	2.4%
Luxembourg	3.8%	0.0%	3.9%	-0.1%
Mexico (1990-2002)	4.5%	0.7%	0.5%	2.4%
Netherlands	2.6%	0.3%	1.9%	0.3%
New Zealand	2.7%	0.2%	1.5%	1.0%
Norway	4.0%	0.1%	2.5%	1.5%
Poland (1990-2002)	3.1%	0.5%	3.2%	-0.6%
Portugal	5.9%	0.4%	2.6%	2.8%
Slovak Republic (1997-2002)	2.1%	0.5%	4.2%	-1.5%
Spain	3.4%	0.3%	2.3%	0.8%
Sweden	1.5%	0.1%	1.7%	-0.4%
Switzerland (1985-2002)	3.8%	0.2%	0.8%	2.9%
Turkey (1984-2002)	11.0%	0.3%	2.3%	8.3%
United Kingdom	3.4%	0.2%	2.3%	1.0%
United States	4.7%	0.1%	2.0%	2.6%
Average	***3.6%***	***0.3%***	***2.3%***	***1.0%***

Source: OECD (2006)

8. APPENDIX B

Sensitivity analyses (outlined in Section 4.2) are displayed below. Table B1 provides a glossary for the notation used within results table B2 and B3. Tables B2 to B4 show annual expenditure forecasts across the forecast period for various combinations of morbidity, income elasticity and residual cost growth for the two population scenarios M1F1 and M2F2.

Table B1: Glossary of Notation, Tables B2 and B3

Description	Notation
Expansion of morbidity	M_E
Compression of morbidity	M_C
Income Elasticity of Health Demand of 0.8	E1
Income elasticity of Health Demand of 1	E2
Income elasticity of Health Demand of 0.6	E3
Residual cost growth is constant at 1.5% annually	R1
Residual cost growth declines from 1.5% annually to 0 by 2035	R2

Table B2: Income Elasticity Sensitivity Analyses for Central Projection Set

Year	M_E,E2,R1		M_E,E2,R2		M_E,E3,R1		M_E,E3,R2		M_C,E2,R1		M_C,E2,R2		M_C,E3,R1		M_C,E3,R2	
	Billion €	% of GDP	Billion €	% of GDP	Billion €	% of GDP	Billion €	% of GDP	Billion €	% of GDP	Billion €	% of GDP	Billion €	% of GDP	Billion €	% of GDP
2013	13.08	7.29	13.08	7.29	13.08	7.29	13.08	7.29	13.08	7.29	13.08	7.29	13.08	7.29	13.08	7.29
2014	14.05	7.43	14.04	7.43	13.80	7.30	13.79	7.30	14.02	7.42	14.01	7.41	13.77	7.29	13.76	7.28
2015	15.16	7.57	15.13	7.56	14.60	7.30	14.58	7.28	15.10	7.54	15.07	7.53	14.54	7.26	14.51	7.25
2016	16.08	7.72	16.02	7.69	15.30	7.34	15.24	7.32	15.97	7.67	15.91	7.64	15.20	7.30	15.14	7.27
2017	16.92	7.86	16.81	7.81	15.97	7.42	15.86	7.37	16.77	7.79	16.66	7.74	15.82	7.35	15.72	7.30
2018	17.76	8.01	17.59	7.93	16.63	7.50	16.47	7.43	17.56	7.92	17.39	7.84	16.45	7.42	16.28	7.35
2019	18.64	8.16	18.38	8.05	17.33	7.59	17.09	7.49	18.39	8.05	18.14	7.94	17.10	7.49	16.86	7.39
2020	19.56	8.32	19.20	8.16	18.07	7.68	17.74	7.54	19.25	8.19	18.90	8.04	17.79	7.56	17.46	7.42
2021	20.52	8.47	20.04	8.27	18.84	7.78	18.40	7.59	20.16	8.32	19.69	8.13	18.51	7.64	18.07	7.46
2022	21.55	8.63	20.92	8.38	19.65	7.88	19.07	7.64	21.12	8.47	20.51	8.22	19.26	7.72	18.69	7.49
2023	22.63	8.80	21.82	8.49	20.50	7.98	19.77	7.69	22.14	8.61	21.35	8.31	20.05	7.80	19.33	7.52
2024	23.77	8.98	22.76	8.60	21.39	8.08	20.48	7.74	23.21	8.77	22.22	8.39	20.88	7.89	19.99	7.55
2025	24.97	9.16	23.73	8.70	22.33	8.19	21.20	7.78	24.33	8.92	23.11	8.48	21.75	7.98	20.65	7.57
2026	26.25	9.35	24.72	8.80	23.31	8.30	21.94	7.81	25.52	9.09	24.04	8.56	22.66	8.07	21.33	7.59
2027	27.58	9.54	25.74	8.90	24.33	8.41	22.69	7.84	26.77	9.26	24.98	8.64	23.60	8.16	22.01	7.61
2028	28.99	9.73	26.79	8.99	25.39	8.52	23.45	7.87	28.09	9.43	25.95	8.71	24.59	8.25	22.71	7.62
2029	30.47	9.93	27.86	9.08	26.50	8.64	24.22	7.89	29.46	9.60	26.93	8.78	25.62	8.35	23.41	7.63
2030	32.02	10.13	28.95	9.16	27.66	8.75	24.99	7.91	30.91	9.78	27.94	8.84	26.70	8.45	24.11	7.63
2031	33.64	10.33	30.05	9.23	28.86	8.87	25.77	7.91	32.42	9.96	28.96	8.90	27.81	8.54	24.82	7.62
2032	35.33	10.54	31.17	9.30	30.11	8.98	26.54	7.92	34.00	10.14	29.99	8.94	28.97	8.64	25.53	7.61
2033	37.11	10.74	32.31	9.35	31.41	9.09	27.32	7.91	35.65	10.32	31.03	8.99	30.17	8.73	26.23	7.60
2034	38.96	10.95	33.45	9.40	32.75	9.21	28.09	7.90	37.38	10.51	32.09	9.02	31.41	8.83	26.93	7.57
2035	40.89	11.16	34.60	9.44	34.14	9.32	28.86	7.88	39.18	10.69	33.14	9.05	32.70	8.92	27.63	7.54

Source: See Table 1.

Note: Assumptions concerning the evolution of the residual, the evolution of costs by age group and demographic forecasts (M1F1) are identical to the central projections presented in section 4.2. For each of the four scenarios income elasticity was adjusted to equal 1 (E2) and this was repeated for elasticity value 0.6 (E3).

Table B3: Population Sensitivity Analysis for Central Projection Set M2F2

Year	M_E,E1,R1		M_E,E1,R2		M_C,E1,R1		M_C,E1,R2	
	Billion €	% of GDP	Billion €	% of GDP	Billion €	% of GDP	Billion €	% of GDP
2013	13.08	7.29	13.08	7.29	13.08	7.29	13.08	7.29
2014	13.92	7.37	13.91	7.36	13.89	7.35	13.88	7.35
2015	14.88	7.43	14.85	7.42	14.81	7.40	14.78	7.39
2016	15.68	7.53	15.62	7.50	15.58	7.48	15.52	7.45
2017	16.44	7.64	16.33	7.59	16.29	7.57	16.18	7.52
2018	17.18	7.75	17.02	7.68	16.99	7.67	16.83	7.59
2019	17.97	7.87	17.73	7.76	17.73	7.77	17.49	7.66
2020	18.80	7.99	18.46	7.85	18.51	7.87	18.17	7.73
2021	19.68	8.12	19.22	7.93	19.33	7.98	18.87	7.79
2022	20.58	8.26	19.98	8.02	20.17	8.09	19.58	7.86
2023	21.53	8.40	20.77	8.10	21.05	8.21	20.30	7.92
2024	22.53	8.54	21.58	8.18	21.98	8.34	21.05	7.98
2025	23.59	8.69	22.41	8.26	22.97	8.46	21.81	8.04
2026	24.70	8.85	23.27	8.33	24.00	8.60	22.60	8.10
2027	25.87	9.01	24.14	8.40	25.08	8.73	23.41	8.15
2028	27.10	9.17	25.04	8.47	26.22	8.87	24.23	8.20
2029	28.39	9.33	25.96	8.54	27.42	9.01	25.07	8.24
2030	29.74	9.50	26.89	8.59	28.67	9.16	25.92	8.28
2031	31.05	9.68	27.74	8.65	29.87	9.32	26.69	8.32
2032	32.41	9.86	28.60	8.70	31.12	9.47	27.46	8.36
2033	33.82	10.04	29.45	8.75	32.43	9.63	28.23	8.38
2034	35.29	10.23	30.30	8.78	33.78	9.79	29.00	8.41
2035	36.81	10.41	31.15	8.81	35.17	9.95	29.76	8.42

Source: See Table 1.

Note: This analysis uses the same underlying assumptions as the central scenario set regarding residual cost growth, income elasticity and the evolution of per capita costs by age group. These projections differ due to the use of population projection M2F2 which affects the cohort (and overall population) size as well as economic growth (see Section 3).

Table B4: Income Elasticity Sensitivity Analyses for Central Projection Set Population M2F2

Year	M_E,E2,R1		M_E,E2,R2		M_E,E3,R1		M_E,E3,R2		M_C,E2,R1		M_C,E1,R2		M_C,E2,R1		M_C,E2,R2	
	Billion €	% of GDP	Billion €	% of GDP	Billion €	% of GDP	Billion €	% of GDP	Billion €	% of GDP	Billion €	% of GDP	Billion €	% of GDP	Billion €	% of GDP
2013	13.08	7.29	13.08	7.29	13.08	7.29	13.08	7.29	13.08	7.29	13.08	7.29	13.08	7.29	13.08	7.29
2014	14.05	7.43	14.04	7.43	13.80	7.30	13.79	7.29	14.02	7.42	14.01	7.41	13.77	7.28	13.76	7.28
2015	15.16	7.58	15.13	7.56	14.60	7.29	14.57	7.28	15.10	7.54	15.07	7.53	14.53	7.26	14.50	7.25
2016	16.09	7.72	16.03	7.69	15.29	7.34	15.23	7.31	15.98	7.67	15.92	7.64	15.19	7.29	15.13	7.26
2017	16.94	7.87	16.83	7.82	15.94	7.41	15.84	7.36	16.79	7.80	16.68	7.75	15.80	7.34	15.70	7.29
2018	17.79	8.02	17.61	7.95	16.60	7.49	16.44	7.41	17.59	7.93	17.42	7.86	16.41	7.40	16.25	7.33
2019	18.68	8.18	18.43	8.07	17.29	7.57	17.05	7.47	18.43	8.07	18.18	7.96	17.05	7.47	16.82	7.37
2020	19.62	8.34	19.27	8.19	18.01	7.66	17.68	7.52	19.32	8.21	18.97	8.07	17.73	7.54	17.40	7.40
2021	20.62	8.51	20.14	8.32	18.77	7.75	18.33	7.57	20.26	8.36	19.79	8.17	18.43	7.61	18.00	7.43
2022	21.66	8.69	21.03	8.44	19.55	7.84	18.98	7.61	21.22	8.52	20.61	8.27	19.15	7.69	18.59	7.46
2023	22.75	8.87	21.95	8.56	20.37	7.94	19.64	7.66	22.25	8.68	21.46	8.37	19.91	7.77	19.20	7.49
2024	23.91	9.07	22.90	8.68	21.23	8.05	20.32	7.70	23.33	8.85	22.34	8.47	20.71	7.85	19.82	7.52
2025	25.14	9.26	23.89	8.80	22.12	8.15	21.01	7.74	24.48	9.02	23.26	8.57	21.54	7.94	20.45	7.54
2026	26.44	9.47	24.91	8.92	23.07	8.26	21.72	7.78	25.69	9.20	24.20	8.67	22.41	8.03	21.10	7.56
2027	27.81	9.68	25.97	9.04	24.05	8.37	22.44	7.81	26.97	9.39	25.17	8.76	23.32	8.12	21.75	7.57
2028	29.26	9.90	27.05	9.15	25.08	8.49	23.17	7.84	28.32	9.58	26.18	8.86	24.27	8.21	22.42	7.58
2029	30.79	10.12	28.17	9.26	26.16	8.60	23.91	7.86	29.74	9.78	27.20	8.94	25.26	8.31	23.09	7.59
2030	32.40	10.35	29.31	9.37	27.28	8.72	24.66	7.88	31.24	9.98	28.25	9.03	26.29	8.40	23.76	7.59
2031	33.95	10.59	30.35	9.46	28.38	8.85	25.35	7.90	32.67	10.19	29.20	9.11	27.30	8.51	24.38	7.60
2032	35.56	10.82	31.40	9.56	29.51	8.98	26.03	7.92	34.16	10.40	30.16	9.18	28.34	8.63	24.99	7.61
2033	37.25	11.06	32.46	9.64	30.69	9.11	26.71	7.93	35.72	10.61	31.12	9.24	29.42	8.74	25.60	7.60
2034	39.01	11.31	33.52	9.72	31.90	9.25	27.38	7.94	37.34	10.82	32.08	9.30	30.53	8.85	26.20	7.59
2035	40.83	11.55	34.58	9.78	33.16	9.38	28.04	7.93	39.03	11.04	33.05	9.35	31.68	8.96	26.79	7.58

Source: See Table 1.

Note: Assumptions concerning the evolution of the residual and the evolution of costs by age group are identical to the central projections presented in section 4.2. Here, the sensitivity of central projections for population projections M2F2 to adjustments in income elasticity is presented. For each of the four scenarios income elasticity was adjusted to equal 1 (E2) and this was repeated for elasticity value 0.6 (E3).