TECHNICAL DOCUMENT ON HEALTHCARE, EDUCATION AND LONG-TERM CARE MODELLING METHODOLOGY

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April 24th, 2025

AIReF
Independent Authority for Fiscal Responsibility

Independent Authority for Fiscal Responsibility

The Independent Authority for Fiscal Responsibility (AIReF) was created with the mission of ensuring strict compliance with the principles of budgetary stability and financial sustainability enshrined in Article 135 of the Spanish Constitution.

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1. INTRODUCTION

This technical document sets out the methodologies used to forecast the ratio of expenditure on health, education and long-term care to GDP in Spain for the 2070 horizon used in this Opinion. Compared with the technical document with the same title published together with the 2023 Opinion, the methodology used has not changed substantially. However, in order to make the methodology associated with the models easily accessible, it is reproduced in this document.

Although the methodology has not changed substantially, there has been a significant improvement. Specifically, the projection models for healthcare and education expenditure include a disaggregation that makes it possible to differentiate which part of the expenditure changes are due to population factors and which are due to non-demographic factors.

In addition, this document updates the data sources, main results and figures used in the projections made.

The document develops three different methodologies:

- **Methodology for estimating long-term healthcare expenditure**. The expected evolution of the main items of healthcare expenditure is estimated following a bottom-up approach. In this way, the methodology estimates the healthcare expenditure of each of the Autonomous Regions (ARs) in order to subsequently, by means of aggregation, calculate the total expenditure of the General Government (GG) Sector.
- **Methodology for estimating long-term education expenditure**. The evolution of the main items is estimated by considering educational expenditure by age group and the projected evolution of the population in each AR. Subsequently, by means of aggregation, total expenditure is calculated, also following a bottom-up approach.

- **Methodology for estimating long-term care expenditure**. Due to the characteristics associated with the roll-out of the System for Autonomy and Care for Dependency, an aggregate estimation approach associated with this expenditure function has been chosen.

The models are developed under a no-policy-change scenario in which the main, but not the only, determinant of the evolution of expenditure rests on the evolution of demographic factors.

In order to make the estimates consistent, the results of the models are developed on AIReF's medium-term forecasts for the 2024-2029 horizon as set out in the reports of November 5th, 2024 on the Medium-Term Structural-Fiscal Plan and on the Main Budgetary Lines and Draft Budgets of the General Government for 2025. The methodology described in this document is applied for the long term, from 2030 to 2070.

2. HEALTHCARE EXPENDITURE MODEL

Healthcare expenditure in Spain amounted to €98.62bn in 2023, 14.5% of the total expenditure of the GG, according to the report on the Classification of the Functions of Government (COFOG). Of this expenditure, 93.6% was made by the ARs, accounting for 36.6% of expenditure of this sub-sector. Since 2019, the starting year of the previous Opinion, healthcare expenditure has increased by €22.71bn, or 30%. The outbreak of the COVID-19 pandemic led to a substantial increase in expenditure, part of which was not subsequently reverted, becoming structural. This and other information on the expenditure of the AR sub-sector as well as the expenditure for each AR can be consulted on our AR Monitor Tool.

The results obtained from the model are projected on the medium-term forecasts made by AIReF by applying the growth rates calculated.

There are three distinct strategies for estimating and projecting the evolution of healthcare expenditure:

- **Models based solely on demographic projections**: These explain the evolution of expenditure solely as a consequence of changes in demographic factors.
- **Residual approach**: This method, proposed by the OECD in 1987, breaks down the growth in public healthcare expenditure into four explanatory

factors: the demographic factor, the coverage factor, the inflation factor, and a final factor whose contribution to the growth of public healthcare expenditure is determined residually and is referred to as the "average real per capita healthcare provision".

- **Proxy approach:** This is based on an econometric estimation of a set of explanatory variables for healthcare expenditure. One of the most widely used approaches in this methodological line is the analysis of the relationship between the growth of a country's wealth and healthcare expenditure, as shown in the works of Kleiman (1974) and Newhouse (1977).

The approach used in this methodology is mainly based on the aforementioned work by Newhouse, and is the approach also adopted by the European Commission in its Ageing Reports[1]. It is based on a cohort model which uses as a proxy for the growth of per capita expenditure not explained by demographic factors, the growth of GDP per capita and a value of the income-expenditure elasticity common to all the ARs which gradually decreases over the projection horizon.

This approach has three advantages:

- **It limits the increase in the weight of healthcare expenditure as a percentage of GDP.** The values of the income elasticity of expenditure indicated by the literature are greater than unity, and tend to be in the range between 1.15 and 1.35. This approach is also consistent with the elasticity values shown by the average of the ARs, an income elasticity-healthcare expenditure of 1.11 over the 2002-2019 horizon, which rises to 1.15 if the window is extended to 2023.

- **It provides a uniform projection horizon for the ARs as a whole.** The regression coefficients associated with income–expenditure elasticity vary significantly in the case of Spain depending on the time window considered, and different windows can even result in different orderings of elasticity values across ARs. Choosing a common elasticity value for all ARs avoids introducing additional divergences in expenditure trajectories that would lack economic justification.

- **It allows the analysis to focus on the effects of demographic factors**. There is clear evidence that demographic trends have a significant impact on healthcare expenditure levels. The use of a common elasticity across the ARs allows the impact analysis to focus on these effects, while still

[1] The 2024 Ageing Report

reflecting that economic growth will exert additional pressure on this expenditure item.

2.1. Sources of information

There are three main sources of information on public healthcare expenditure in Spain:

- **Public Healthcare Expenditure Statistics (EGSP)**: The EGSP is a statistical operation, included in the National Statistical Plan under the denomination of Satellite Accounts of Public Healthcare Expenditure, which has been conducted in Spain since 1988. The EGSP sets out economic classification criteria of the expenditure based on the budgetary concepts, functional classification criteria based on the Classification of the Functions of Government (COFOG) and a sectorial classification following the delineation of institutional sectors defined in the European System of National and Regional Accounts (ESA 95). The EGSP serves as the basis for implementing the System of Health Accounts, a statistical framework developed in accordance with the manual *A System of Health Accounts* published by the Organisation for Economic Co-operation and Development (OECD) in 2000.
- **System of Health Accounts (SHA)**: The SHA provides a set of interrelated tables that present healthcare expenditure and financing in a standardised format. The SHA was created with the dual purpose of providing a harmonised data collection structure for the purpose of international comparisons and as a model for redesigning and supplementing the National Health Accounts. The SHA estimates both public and private healthcare expenditure, as well as total expenditure on long-term care, and its main advantage lies in its international comparability.
- **COFOG:** Government expenditure by function, in National Accounts, according to the COFOG classification developed by the OECD and published by the United Nations, is incorporated into the ESA 2010 Transmission Programme. COFOG classifies the expenditure of the General Government sector and its sub-sectors recorded in the transactions defined in ESA according to the purpose for which the expenditure is used. It is a cross-classification of expenditure transactions by economic nature and by function, and is an important tool for public expenditure analysis, which is particularly useful for international comparisons. The information only covers the General Government Sector, as does the EGSP, although there may be slight discrepancies in the data due to differences in scope.

Bearing in mind that the aim is to set out a methodology with a bottom-up approach based on the expenditure of each AR, the greatest possible disaggregation of expenditure is required. Consequently, the main source of data for drawing up the methodology is the EGSP. However, given that AIReF's forecasts are made in national accounting terms, it is advisable to carry out an adjustment procedure between the two data series.

Together with public healthcare expenditure at AR level, which provides an aggregate level, it is necessary to establish a mechanism for allocating healthcare expenditure by age group and gender. Two data sources are used for this purpose:

- **Specialised Healthcare Activity Register (RAE-CMBD):** this register integrates administrative and clinical information on patients treated in various forms of specialised care. The consultation variables include basic data on the age and gender of the patient, the healthcare episode (discharge, intervention, visit) and clinical variables on diagnoses and procedures. These are supplemented by variables derived from the use of patient classification systems and cost estimates. The information is oriented towards understanding the demand for and morbidity treated by the specialised care system, as well as the functioning and care processes of specialised healthcare in Spain. Within the information provided by the RAE-CMBD, the Diagnosis Related Groups (DRGs) constitute a patient classification system that allows the different types of patients treated in a hospital to be related to the cost of their care.
- **National Health Survey (ENSE)**: a statistical operation of the Ministry of Health in collaboration with the National Statistics Institute (INE) under a cooperation agreement between the two bodies. The ENSE is a population-based survey targeting residents living in private households, with the primary aim of collecting data on health status and its determinants from the citizens' perspective. In the 2016–2017 edition, approximately 37,500 households were surveyed across 2,500 census tracts. The survey is conducted every five years and alternates every two and a half years with the European Health Interview Survey, with which it shares a set of harmonised variables. However, the most recent publication dates from 2017.

In addition, the population projections conducted by the INE provide a statistical simulation of the population that will reside in the ARs of Spain in the coming years if current demographic trends are maintained, broken down by age and gender according to basic demographic characteristics and taking as a starting point the population figures as at January 1st of the latest year available. It offers annual information with a projection horizon of 50 years for the national total and 15 years for the ARs and provinces, according to basic demographic characteristics, simulating the effects that the current demographic structure and demographic trends would have on the future population. This demographic information is adjusted to the demographic projections made by AIReF.

Lastly, AIReF's long-term GDP projections are used as a data source.

2.2. Projection methodology

The methodology is based on a no-policy-change scenario, meaning that potential regulatory and/or funding changes in the system are not considered. The only changes modelled are those resulting from shifts in demographic factors, morbidity and per capita income.

The methodology followed is divided into the following steps:

Step 1: Construct the population projections by AR, gender and five-year age group[2] up to the year 2070. To do this, we start from the population growth structure provided by the INE up to the 2039 horizon and adjust it to reflect AIReF's projections of the resident population in Spain.

Step 2: Convert the EGSP expenditure series by AR to construct a series based on five functional groups: Hospital Services, Specialised Care Services, Primary Care Services, Pharmaceuticals and Other. This conversion uses the functional breakdown provided by COFOG for the set of ARs.

Step 3. Establish the per capita expenditure associated with each of the established functions.

Step 4. Calculate the expenditure profiles by age and gender for each AR based on the distribution of the CMBD statistics (for hospital expenditure) and the National Health Survey (for other expenditure). The expenditure profiles are considered to evolve with GDP with an income elasticity of 1.2 that converges to unity in 2070.

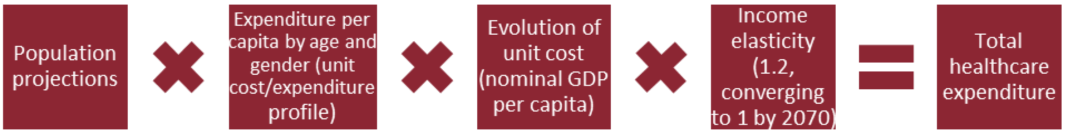
Step 5. Multiply the number of people in each gender and age profile by the corresponding expenditure profiles for each projection year.

Step 6. Add up all expenditure groups to obtain the total expenditure by AR for each projection year.

[2] With the exception of an individual age group for children under 1 year of age.

Step 7. Add up total costs of the ARs and project the total expenditure of the GG by applying the ratio between the two aggregates observed in the latest COFOG data year to each projection year.

FIGURE 1. METHODOLOGY FOR ESTIMATING HEALTHCARE EXPENDITURE



Source: AIReF

Step 8: **In addition, and as a key development compared with the previous publication**, the total growth in healthcare expenditure projected is broken down into two effects: growth attributable to demographic change and growth associated with all other factors.

FIGURE 2. BREAKDOWN OF GROWTH IN HEALTHCARE EXPENDITURE

Source: AIReF

The following methodological aspects should be considered:

- It is assumed that the behaviour of the different agents affecting healthcare expenditure remains constant over the projection horizon. In this regard, neither the behaviour of the expenditure agents nor that of the service providers is modified. This assumption implies, for example, that there is no change in the structure of public and private insurance coverage.
- Supply-side determinants of increased expenditure are not explicitly modelled. Determinants of expenditure such as R&D&I or the intensity of resources per medical act do not explicitly form part of the variables in the model, nor do other healthcare challenges highlighted in AIReF's Spending Reviews and other studies[3]. These challenges include the

[3] See the AIReF website, in the evaluation section, for the studies carried out: Study on Medicines Dispensed via Prescription (SR Phase I.I), Study on Hospital Expenditure in the National Health System: Pharmaceuticals and Investment in Capital Goods (SR

incorporation of innovative medicines, the expansion of services, technological updating and the management of healthcare staff. As mentioned, these determinants have not been explicitly modelled, but the introduction of an income elasticity of expenditure greater than one, as well as the expected reduction in morbidity, can be considered as an imperfect approximation of these variables.

2.3. Functional division of expenditure

The EGSP establishes a functional division into 7 distinct blocks:

- Hospital and specialised services
- Primary health services
- Public health services
- Collective health services
- Pharmaceuticals
- Transfer, prostheses and therapeutic appliances
- Capital expenditure

Of these items, the function with the greatest weight within the scope of public health service provision is hospital and specialised services, which accounted for 62.9% of total consolidated expenditure in 2022. In addition, pharmaceutical expenditure accounted for 15.4%, and primary health services for 14.1%. Together, these three items account for 92.4% of total expenditure. From a functional perspective, COFOG provides additional information on this functional breakdown by offering, for all ARs, expenditure data for hospital services. The use of COFOG thus enables a further breakdown of the most significant expenditure item. This breakdown is important for establishing the projection methodology, since the data provided by DRGs align more closely with hospital service expenditure than with specialised service expenditure.

Accordingly, and given the limited weight of the remaining functions, the following five-group functional classification is used:

- Hospital services

Phase I.II). AIReF has also conducted studies in the healthcare field commissioned by various Autonomous Regions.

- Specialised services
- Primary health services
- Pharmaceuticals
- Other

2.4. Projected expenditure on hospital services

Expenditure on hospital services refers to the healthcare received by those patients who are admitted to a hospital in a given period. As mentioned, the most complete source of data on expenditure associated with this type of service comes from the DRGs of the CMBD-RAE[4]. The metrics that can be obtained from this database are as follows:

- **Average cost**: This is the weighted average of the mean costs of the DRGs of all the cases in a given unit, group, provider or process. It is calculated by multiplying the number of cases of each DRG (and severity level since 2016) by its average cost and dividing by the total number of cases in that unit (hospital group, Autonomous Region, service, MDC, etc.).
- **Average weight**: Weighted average of the weights of the DRGs for all patients in a given unit, group or provider. It is calculated by multiplying the number of cases of each DRG (and severity level in APR-DRG) by its relative weight and dividing the sum by the total number of cases in that unit (hospital group, Autonomous Region, service, MDC etc.).

The information provided by the Ministry of Health allows for a breakdown of costs by gender, five-year age group and AR, which is projected onto expenditure on hospital services according to the following formula:

$$GH_0^{s,e,i} = (C_0^{s,e,i} * \frac{GH_0^{tot,i}}{C_0^{tot,i}}) \qquad [1]$$

Where:

$GH_0^{s,e,i}$ represents Hospital Expenditure by gender, five-year age group and AR in the reference year (2022).

[4] Until 2015, the costs correspond to the costs of the APR-DRG estimated in the NHS hospital cost estimation process. Each hospital episode is assigned the estimated cost for the corresponding APR-DRG. Since 2016, the average cost differs for each DRG and severity level.

$C_0^{s,e,i}$represents the Average Cost by gender and five-year age group of the AR in the reference year.

$GH_0^{tot,i}$ represents the total Hospital Expenditure of the AR in the reference year.

$C_0^{tot,i}$represents the sum of the costs per AR.

This expenditure is then distributed among the population in the age group to obtain the per capita cost by gender and AR:

$$GH_{pc,0}^{s,e,i} = \left(GH_0^{s,e,i} / pop_0^{s,f,i}\right) \quad [2]$$

Where:

$GH_{pc,0}^{s,e,i}$ represents Hospital Expenditure per capita by gender, age group and AR in the reference year.

$pop_0^{s,e,i}$ represents the population by gender, age group and AR in the reference year.

The next step is to project expenditure by incorporating income elasticity and morbidity compression:

$$GH_{pc,t}^{s,e,i} = GH_{t-1}^{pc,s,e,i} * (1 + \Delta Y_t^{pc}) * \varepsilon_t \ * m_t^f \quad [3]$$

Where:

ΔY_t^{pc}represents the growth of GDP per capita in nominal terms.

ε_t represents the income elasticity of health services, which is assumed to converge from 1.2 to 1 at the end of the projection horizon.

$$\varepsilon_t = \varepsilon_{2023} - (t - 2023) \cdot \frac{\varepsilon_{2023} - \varepsilon_{2070}}{2070 - 2023} \quad [4]$$

m_t^f is the estimated morbidity value by age group and gender associated with the period

Thus, for a given year "t" and for each AR, we have the following expression:

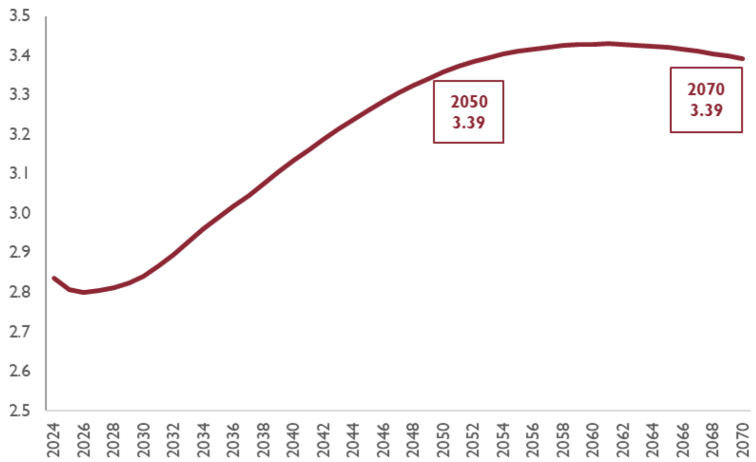
$$GH_t^i = \sum_f \sum_s GH_{pc,t}^{s,e,i} * Pop_t^{s,e,i} \quad [5]$$

Where:

$Pop_t^{s,e,i}$ is the population of each gender and age group in each AR in year t.

Using this methodology, expenditure on hospital services is estimated to reach 3.4% of GDP by 2050 and to stabilise at a similar level for the rest of the projection period.

FIGURE 3. EVOLUTION OF EXPENDITURE ON HOSPITAL SERVICES (% GDP)



Source: EGSP, SHA, COFOG and AIReF

2.5. Projected expenditure on specialised services and primary health services

The projection of both expenditure items follows a common methodology based on the 2017 National Health Survey.

The calculation of expenditure on these services for each of the ARs (i) takes into account the estimated usage profiles of consultations with primary care doctors and specialists in public services for each age group (f) and gender (s) provided by the 2017 National Health Survey. It is worth mentioning that, although the INE does not provide data broken down by AR, by using existing microdata it has been possible to obtain usage profiles differentiated by AR.

The first step in the calculation is to distribute the expenditure according to the intensity of use by age group and gender:

$$GS_{0,k}^{s,e,i} = \left(\frac{CS_{0,k}^{s,e,i}}{CS_{0,k}^{tot,i}} * GS_{0,k}^{tot,i}\right) \quad [6]$$

Where:

$GS_{0,k}^{s,e,i}$ represents Healthcare Expenditure (k=prim for primary and k=esp for specialised) by gender, five-year age group and AR in the reference year (2022).

$CS_{0,k}^{s,e,i}$represents the number of visits to the primary care physician or specialist by gender and five-year age group in the AR in the reference year.

$CS_{0,k}^{tot,i}$ represents the total number of visits to the primary care physician or specialist in the AR in the reference year.

$GS_{0}^{tot,i}$represents the total expenditure on specialised services or primary health services by AR.

This expenditure is then distributed among the population of the age group to obtain the per capita cost by gender and AR:

$$GS_{pc,k,0}^{s,e,i} = \left(GS_{0,k}^{s,e,i} / pop_{0}^{s,e,i}\right) \quad [7]$$

Where:

$GS_{pc,k,0}^{s,f,i}$represents per capita expenditure by gender, age group and AR in the reference year

The next step is to project expenditure taking into account income elasticity and morbidity compression

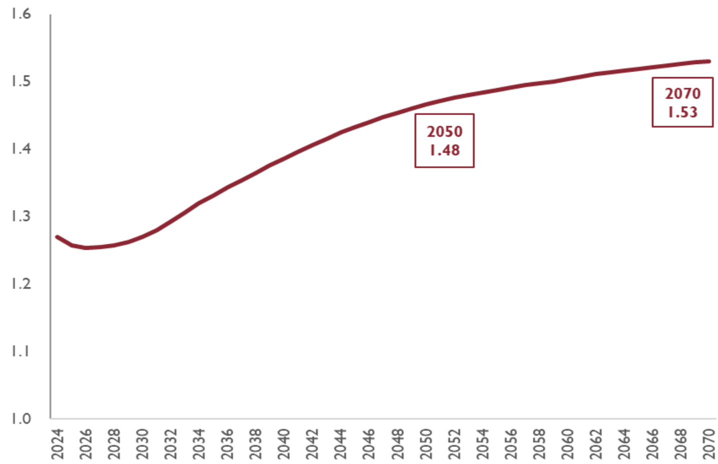
$$GS_{pc,k,t}^{s,e,i} = GS_{pc,k,t-1}^{s,e,i} * (1 + \Delta Y_{t}^{pc}) * \varepsilon_{t} \ * m_{t}^{f} \quad [8]$$

Thus, for a given year "t" and for each AR, we have the following expression:

$$GS_{t}^{i} = \sum_{f} \sum_{s} GS_{pc,k,t}^{s,e,i} * pop_{t}^{s,e,i} \quad [9]$$

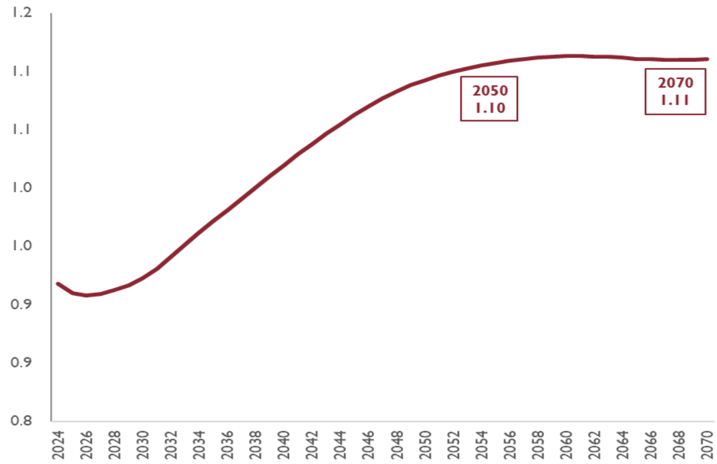
Based on these formulas, expenditure in 2050 is estimated at 1.5% of GDP for specialised care, remaining stable in 2070, and at 1.1% in both years for primary care.

FIGURE 4. EVOLUTION OF AVERAGE EXPENDITURE ON SPECIALISED CARE (% GDP)



Source: EGSP, SHA, COFOG and AIReF

FIGURE 5. EVOLUTION OF PRIMARY CARE EXPENDITURE (% GDP)

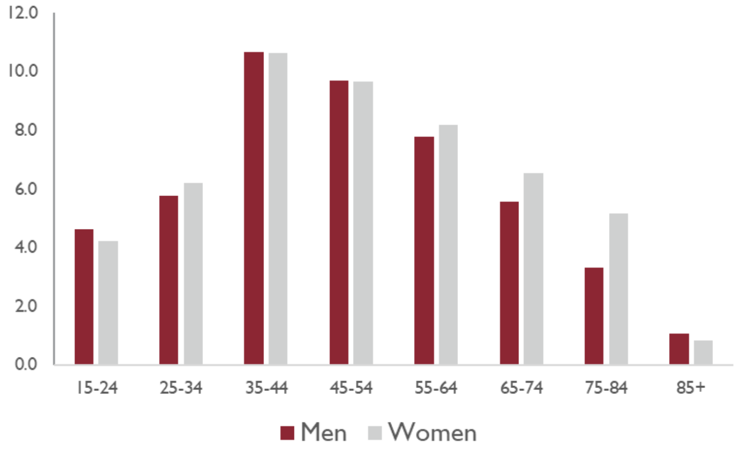


Source: EGSP, SHA, COFOG and AIReF

2.6. Projected pharmaceutical expenditure

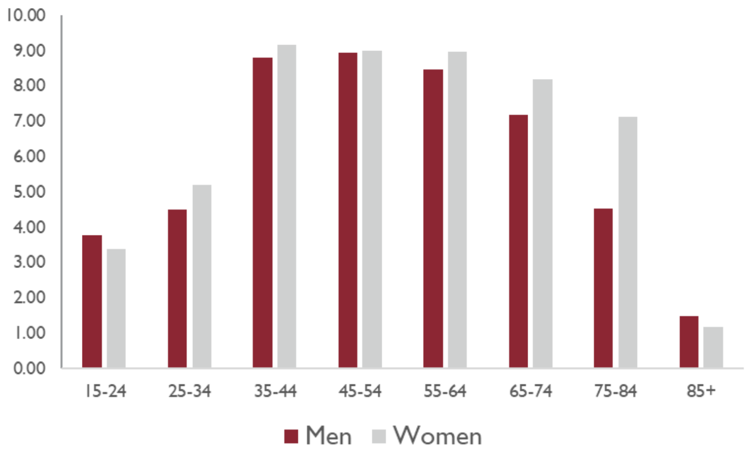
The projection of pharmaceutical expenditure uses the 2017 National Health Survey, following a methodology similar to that applied for the projection of expenditure on specialised services and primary health services, but with an additional adjustment. In the case of pharmaceutical expenditure, the National Health Survey provides data on whether medicines were consumed, and for individuals over the age of 15, it includes a breakdown of people who consumed medicines with and without a medical prescription.

FIGURE 6. DISTRIBUTION OF PRESCRIPTION MEDICINE USE BY GENDER AND AGE GROUP



Source: 2017 National Health Survey

FIGURE 7. DISTRIBUTION OF CONSUMPTION OF NON-PRESCRIPTION MEDICINES BY GENDER AND AGE GROUP



Source: 2017 National Health Survey

Women aged 55 and over show higher levels of medicine consumption, especially in the case of non-prescription medicines. Approximately 48% of medicines are consumed by men and 52% by women.

Based on this distribution of people consuming medicines, it is important to account for the differing levels of pharmaceutical expenditure generated by active individuals and pensioners, which is an important factor when allocating total expenditure. To do this, we start with the data provided by the Monitor of Results of the Madrid Health Service, which establishes "Expenditure through prescriptions per inhabitant and age group". Based on this data, the average expenditure of active people and pensioners can be approximated[5], yielding the following results:

- Average expenditure per active person = 89.97 euros
- Average expenditure per pensioner = 546.8 euros

These figures are consistent with the co-payment brackets applicable to the provision of medicines, which depend on an individual's classification as active or pensioner and their income level. If we look at the largest groups of people[6] in the different brackets, we find that pensioners with incomes between €18,000 and €100,000 pay 10% of the retail price with a ceiling of €18.52 per month, while active people with incomes between 18,000 and 100,000 euros pay 50% of the retail price. A preliminary indicator of the pharmaceutical expenditure ratio between active people and pensioners would therefore be 5. The value obtained from the Monitor, 7.57[7], is thus considered justified.

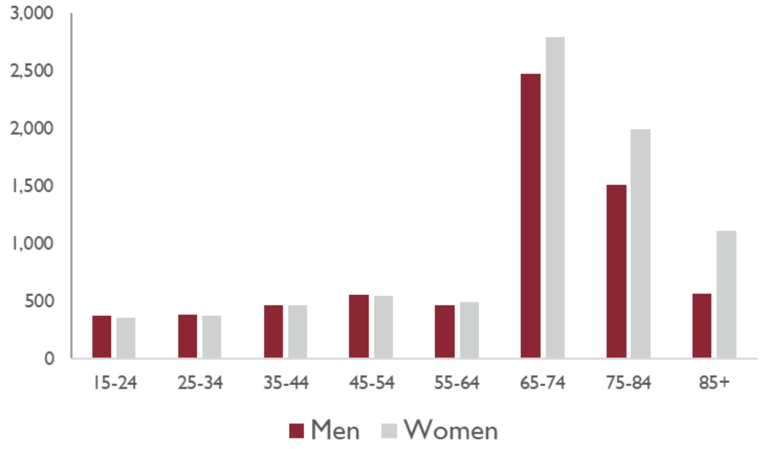
The next step is to weight the distribution of consumption obtained from the National Health Survey by the ratio of expenditure between active people and pensioners. Specifically, age groups over 64 are weighted by the derived ratio. This results in a distribution of total pharmaceutical expenditure that is concentrated among the population aged 65 and over. so that the over-64 age groups are weighted by the ratio obtained. This results in a distribution of total expenditure that is concentrated in the over-65 age groups.

[5] It is approximated by calculating a weighted average based on the different average expenditures in 2023 for each relevant age group and the number of individuals in each group according to demographic data.

[6] The following link provides a breakdown of the different co-payment brackets: Co-payment for prescribed medicine

[7] This value is consistent with the findings presented by Simó, J. (2015). Copago en farmacia de receta en la sanidad pública española: certezas, riesgos y selección de riesgos. *Revista Atención Primaria*, Vol. 47, No. 10.

FIGURE 8. DISTRIBUTION OF PHARMACEUTICAL EXPENDITURE



Source: 2017 National Health Survey and AIReF

It is this distribution of expenditure by age group that is used to apportion pharmaceutical expenditure.

Firstly, expenditure is broken down according to intensity of use by age group and gender.

$$GF_0^{s,e,i} = \left(\frac{DCF_0^{s,e,i}}{DCF_0^{tot,i}} * GF_0^{tot,i}\right) \qquad [10]$$

Where:

$GF_0^{s,e,i}$ represents pharmaceutical expenditure by gender, five-year age group and AR in the reference year (2022).

$DCF_0^{s,e,i}$ represents the weighted prescription consumption by gender and five-year age group of the AR in the reference year.

$DCF_0^{tot,i}$ represents the total weighted prescription consumption in the AR in the reference year.

$GF_0^{tot,i}$ represents total pharmaceutical expenditure by AR.

This expenditure is then distributed among the population of the age group to obtain the per capita cost by gender and AR:

$$GF_{pc,k,0}^{s,e,i} = \left(GF_{0,k}^{s,e,i} / pop_0^{s,e,i}\right) \qquad [11]$$

Where:

$GF_{pc,k,0}^{s,e,i}$ represents per capita pharmaceutical expenditure by gender, age group and AR in the reference year.

The next step is to project expenditure taking into account income elasticity and morbidity compression:

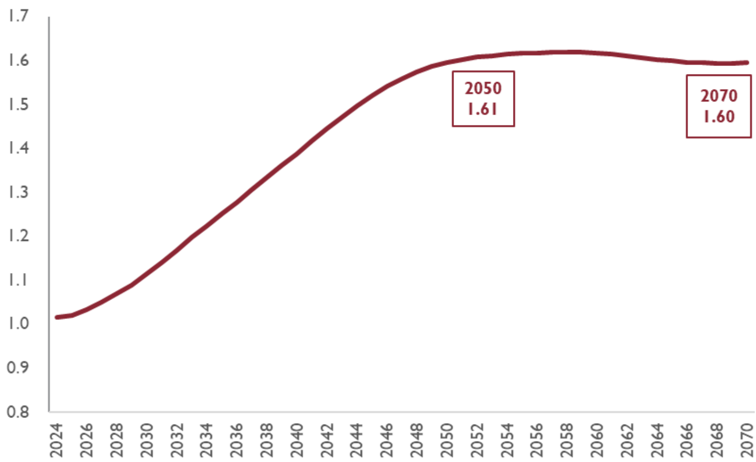
$$GF^{s,e,i}_{pc,k,t} = GF^{s,e,i}_{pc,k,t-1} * (1 + \Delta Y^{pc}_{t}) * \varepsilon_t \ * m^{e}_{t} \qquad [12]$$

Thus, for a given year "t" and for each AR, the following expression is obtained:

$$GF^{i}_{t} = \sum_f \sum_s GF^{s,e,i}_{pc,k,t} * pop^{s,e,i}_{t} \qquad [13]$$

Based on these formulas, it is estimated that pharmaceutical expenditure will reach 1.6 points of GDP in 2050 and will maintain this weight until 2070.

FIGURE 9. EVOLUTION OF PHARMACEUTICAL EXPENDITURE (% GDP)



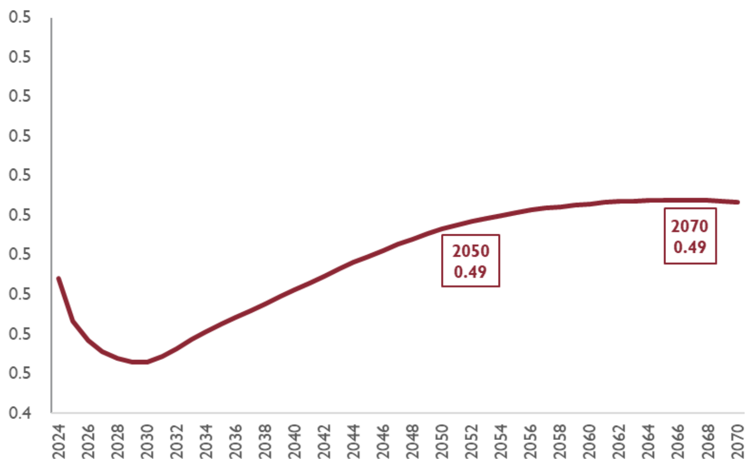
Source: EGSP, SHA, COFOG and AIReF

2.7. Projected expenditure on other health services

Several functions fall under this section — public health services, collective health services, transport, prosthetics and therapeutic appliances, and capital expenditure — although overall expenditure is less than 10%. Following the pandemic and with the use of Next Generation EU funds, there has been an increase in this item which is expected to be sustained in the coming years. In this regard, as AIReF's forecasts for the 2024-2029 horizon are used as the basis for the long-term projections, the effects of this investment effort in the coming years will be reflected in the final results. The AIReF Monitor on the RTRP shows the progress of these investments, which are mainly reflected in Component 18, *Renewal and expansion of the NHS*, first line of investment, *Investment in high technology in the NHS*; and in Component 17, *Science, technology and innovation*, in its sixth line of investment, *Healthcare: personalised and precision medicine*.

As for the methodology used, given the heterogeneity of the expenditure associated with these items, a simple approach has been chosen, in which expenditure levels are updated taking into account per capita income growth and income elasticity in the same terms as mentioned above. However, in this section morbidity compression is not applied and therefore expenditure is not constrained by this variable.

FIGURE 10. EVOLUTION OF OTHER HEALTHCARE EXPENDITURE (% GDP)

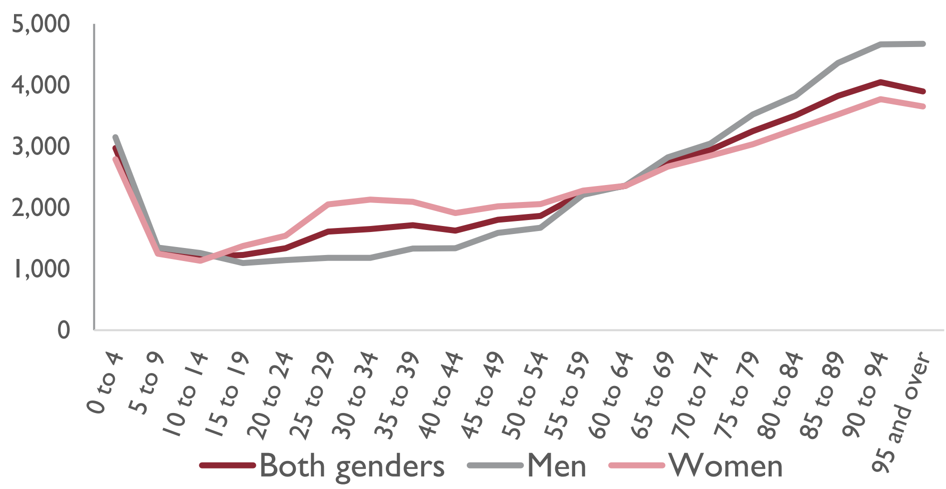


Source: EGSP, SHA, IGAE (COFOG) and AIReF

2.8. Total healthcare expenditure for the General Government

The models described above are based on projecting a unit per capita expenditure for each type of healthcare expenditure. By aggregating the different types of expenditure, a healthcare expenditure profile by age group and gender is obtained.

FIGURE 11. HEALTHCARE EXPENDITURE PROFILE BY GENDER AND AGE GROUP (PER CAPITA). 2022

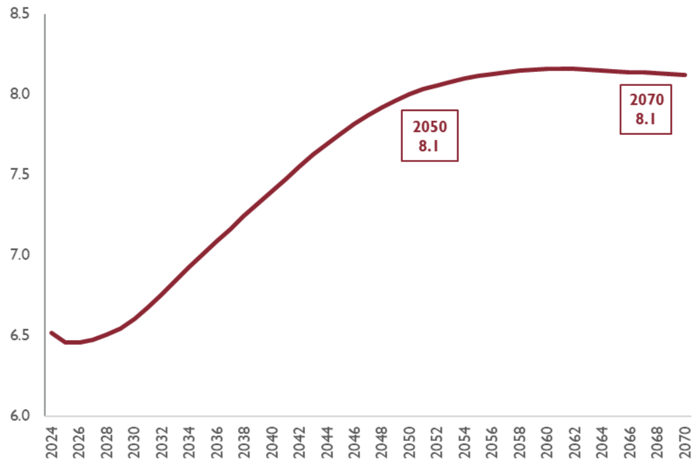


Source: AIReF

This expenditure shows a similar profile for both genders, except in two age ranges. The first is the range between 20 and 45, where women's unit expenditure is much higher due to maternity-related expenditure. The second divergence occurs after the age of 75, where men's per capita expenditure is higher. These differences aside, the profile decreases after the first year, stabilises, and then begins a moderately upward trend from age 30, which becomes more pronounced after age 50. For the oldest age group, per capita expenditure decreases.

Once the five types of healthcare expenditure by age and gender have been projected for the different ARs, the estimate of total expenditure by the GG is made by aggregation and taking into account the weight of AR healthcare expenditure in total expenditure.

FIGURE 12. EVOLUTION OF TOTAL HEALTHCARE EXPENDITURE (% GDP)

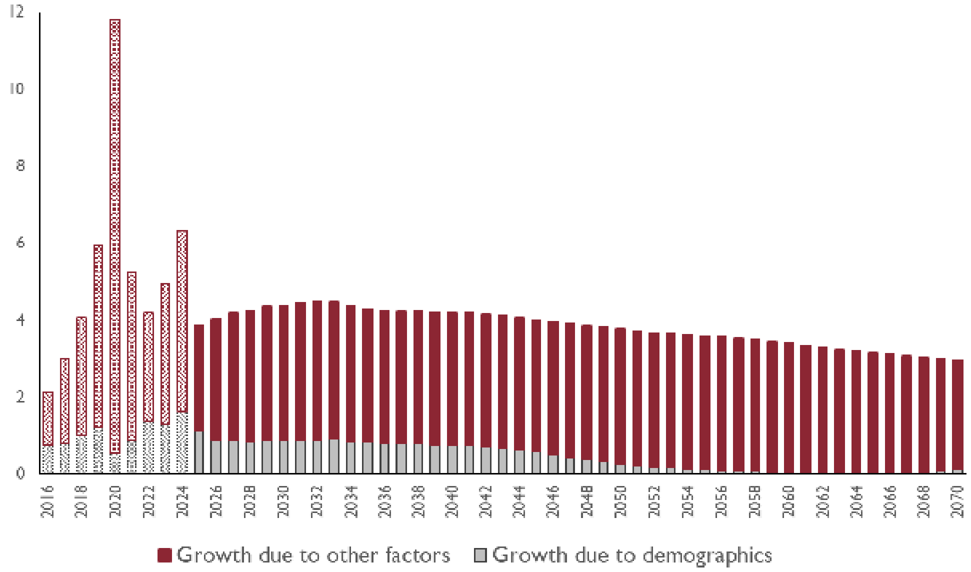


Source: IGAE (COFOG) and AIReF

2.9. Disaggregation of healthcare expenditure growth

From 2016 to 2023, the average growth in healthcare expenditure was 5.2%. Of this increase, demographic changes contributed 1%, while the remaining 4.2% was attributable to other factors. The model projects a progressively decreasing contribution from demographics — falling to zero from 2060 onward — and a more stable contribution from other factors.

FIGURE 13. EVOLUTION OF HEALTHCARE EXPENDITURE GROWTH BY FACTOR (% CHANGE)



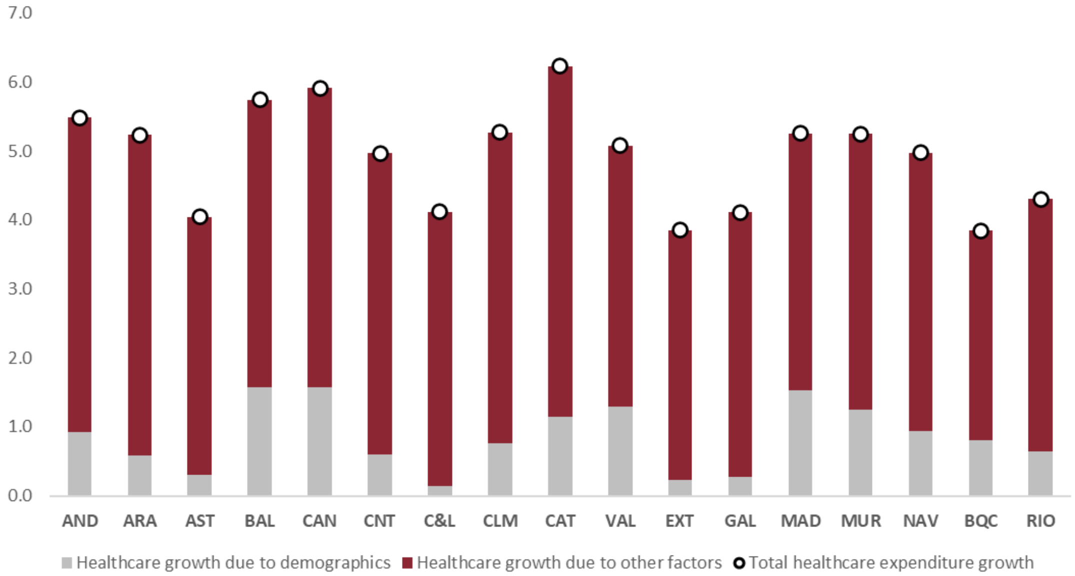
Source: EGSP, IGAE (COFOG), INE and AIReF

In the distribution of average growth between 2016 and 2023 by AR, two groups can be observed: in Catalonia, the Canary Islands, Andalusia, the Balearic Islands, Castile-La Mancha, Madrid, Aragon, Murcia, Valencia, Cantabria and Navarre, healthcare expenditure grew on average close to or above 5%. In Castile and Leon, Galicia, Asturias, Extremadura and the Basque Country, average growth was around 4%.

As regards the contribution of demographics, in those ARs with the largest population increases - the Canary Islands, the Balearic Islands, Madrid, Valencia and Catalonia - demographic changes during this period accounted for more than 1% of the average growth in healthcare expenditure. In contrast, in regions such as Castile and Leon, Extremadura, Asturias, and Galicia, despite population ageing, the loss of residents under the age of 65 resulted in a limited demographic contribution to healthcare expenditure growth (between 0.1% and 0.3%)

Non-demographic factors have resulted in above-average growth in healthcare expenditure in Catalonia, Andalusia, Aragon, Castile-La Mancha, Cantabria and the Canary Islands; around the average — 4.2% — in the Balearic Islands, Castile and Leon, Murcia and Navarre; and below 4% in the other ARs, with the Basque Country being the AR in which these factors have contributed the least (3%).

FIGURE 14. GROWTH IN HEALTHCARE EXPENDITURE BY AR AND FACTOR. AVERAGE 2016-2023 (% CHANGE)



Source: EGSP, IGAE (COFOG), INE and AIReF

3. EDUCATION EXPENDITURE

Education expenditure is the second largest sub-sector item, accounting for approximately 24% of the total. This and other information on the expenditure of the AR sub-sector, as well as for each AR, can be consulted on our AR Monitor Tool.

The projection of long-term education expenditure has been carried out using as a reference the theoretical principles used in the projection of healthcare expenditure, adapting them according to the specificities of this type of expenditure and the availability of information. The steps taken to construct the projections can be summarised as follows:

- **Step 1 (common to the previous exercise):** Construct the population projections by AR, gender and age group up to 2070. To do this, we start from the population growth structure provided by the INE up to the 2035 horizon and adjust it to reflect AIReF's projections of the resident population in Spain.
- **Step 2:** Divide the expenditure by educational stages according to the information available. In this block, a distinction is made between expenditure on State schools and State-subsidised private schools.
- **Step 3:** Determine the expenditure per student for each educational stage.

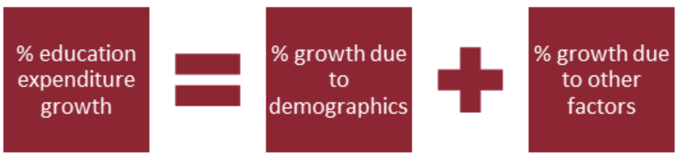
- **Step 4:** Establish the evolution of the net enrolment rates (NERs) for each non-compulsory educational stage, based on the levels observed in the reference year. For each year of the projection horizon, the number of students per educational stage is calculated by taking into account the evolution of the NER and of the population in the corresponding age group. The cost per student is updated according to the evolution of per capita income.
- **Step 5:** For each projection year, multiply the number of students by the expenditure per student in each educational stage.
- **Step 6:** For each projection year, all expenditure groups are added together to obtain the total expenditure by AR.
- **Step 7:** For each projection year, the total expenditure of the ARs is added up and the total expenditure of the GG is projected, taking into account the expenditure ratio in the most recent COFOG data year.

FIGURE 15. METHODOLOGY FOR ESTIMATING EDUCATION EXPENDITURE

Source: AIReF

- **Step 8: In addition, and as an improvement on the previous publication,** the total projected growth in education expenditure is broken down into two effects: growth resulting from demographic changes and growth attributable to other factors.

FIGURE 16. BREAKDOWN OF EDUCATION EXPENDITURE GROWTH



Source: AIReF

Similarly to the projection of healthcare expenditure, the following methodological aspects should be considered:

- The **behaviour of the different agents affecting education expenditure** is assumed to **remain constant over** the projection horizon. In this regard, neither the behaviour of expenditure agents nor that of service providers changes. This assumption implies, for example, that there is no change in the proportion of students studying in State schools, State-subsidised private schools or private schools.

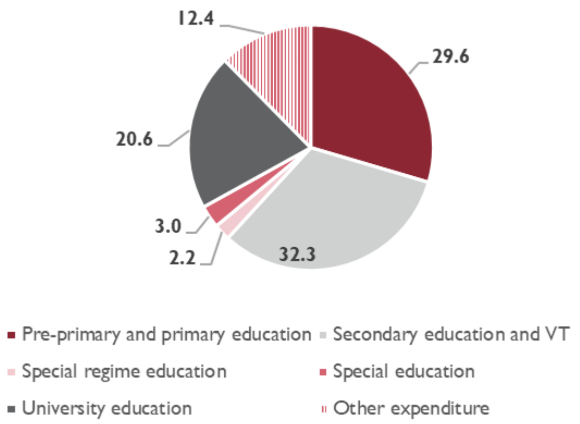
- **Supply-side determinants of increased expenditure are not explicitly modelled**. Expenditure determinants such as changes in student/classroom or teacher/classroom ratios are not explicitly included in the variables of the model, nor are other structural challenges that will have an impact on the evolution of this sector, as AIReF's evaluations have shown[8]. However, the growth in expenditure per student linked to the evolution of per capita income can be considered as an imperfect approximation of these variables.

3.1. Sources of information

The main source of information comes from the Ministry of Education, Vocational Training and Sport, which provides statistics on students and teachers and on expenditure incurred. There are shortcomings, however, in the disaggregation of expenditure by educational stage, for example, pre-primary education is not separated from primary, nor are secondary education and upper secondary and vocational training separately reported.

Education expenditure in 2022 is distributed as follows:

FIGURE 17. DISTRIBUTION OF EXPENDITURE ON EDUCATION. 2022



Source: Ministry of Education, Vocational Training and Sport

[8] See the AIReF website for studies commissioned by Autonomous Regions: Study of the Andalusian Public University System, Study on the Financing Model of the University of Zaragoza, Study on the Castile and Leon Public University System and Study on the Efficiency of Non-University Public Education Expenditure on Human Resources in the Balearic Islands.

Three aspects of this division stand out:

- Expenditure on pre-primary and primary education on the one hand, and on secondary education and vocational training on the other, are aggregated; accordingly, the distribution of expenditure on the different educational stages cannot be specified in greater detail.
- Pre-school and primary education and secondary education and vocational training together account for 78% of total expenditure on non-university education.
- Of the rest of the expenditure, expenditure on special education and expenditure on special regime education stand out for their qualitative importance[9].

Taking these considerations into account, the total expenditure on education is divided into six blocks:

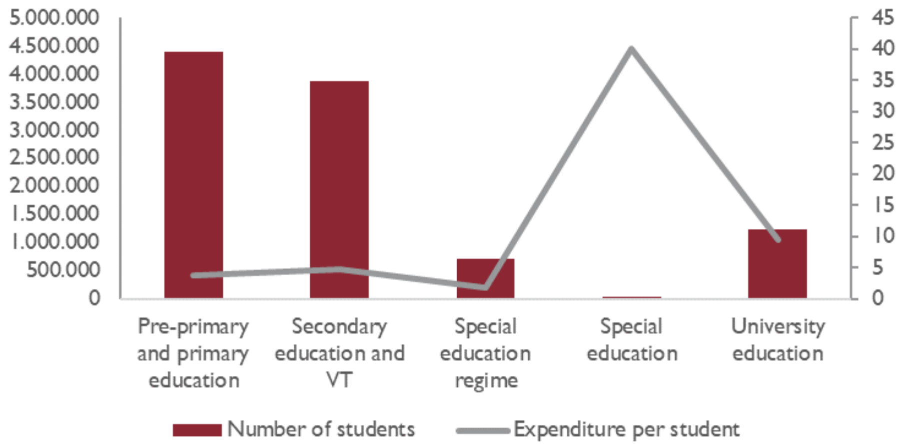
- Expenditure on pre-primary and primary education
- Expenditure on secondary education and vocational training
- Expenditure on special education
- Expenditure on special regime education
- Expenditure on university education
- Other

3.2. Cost projection methodology

The starting point is the determination of the cost per student associated with each educational stage. The figure below shows the differences in expenditure per student and total number of students for the different stages considered:

[9] Special Education refers to programmes designed for students with special educational needs, while Special Regime Education covers specific courses such as music, dance, languages and sport.

FIGURE 18. STUDENTS AND EXPENDITURE PER STUDENT



Source: Ministry of Education and Vocational Training

The figure shows that expenditure per university student is almost twice as high as expenditure per non-university student.

The projection exercise then consists of updating the costs and multiplying them by the number of students:

$$GE_t^{k,i,m} = \sum_{e,m} pop_t^{e,i} * tne_t^{e,i} * prop_m * r_0^{k,i} * \left(\frac{GE_0^{k,i}}{N_0^k} * (1 + \Delta Y_t^{pc})\right) \qquad [14]$$

Where

$GE_t^{k,i,m}$ represents the expenditure on education per educational stage (k) associated with each AR (i) at time t for State schools and State-subsided private schools (m).

$pop_t^{fk,i}$ represents the population in the age group (fk) associated with the educational stage (k) by AR (i)

$tne_t^{fk,i}$ represents the net enrolment rate of the age group associated with the educational stage (k) by AR (i). In the case of pre-primary education, it is considered that the first stage will converge to 75% from its current values and the second stage to 100%.

$prop_m$ represents the proportion of students in State schools (m=pub) or State-subsidised private schools (m=conc) out of the total number of students.

$r_0^{k,i}$ represents the adjustment factor associated with the number of repeaters present in the different educational stages.

$GE_0^{k,i}$ represents the Total Expenditure associated with the educational stage (k) in the AR (i) in the reference year (2022).

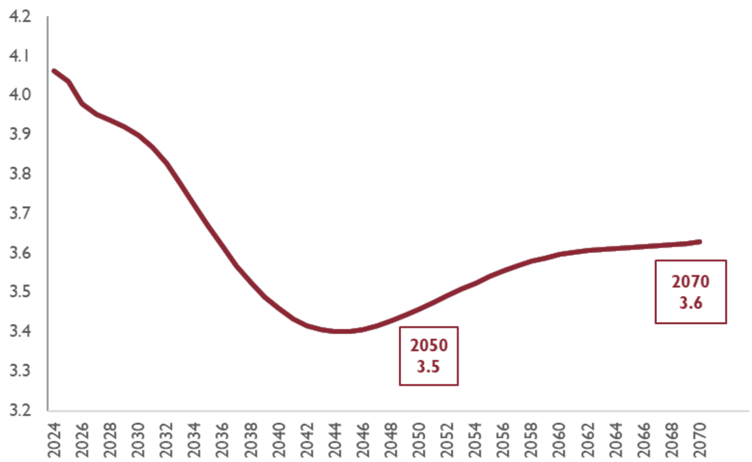
N_0^k represents the number of students enrolled in the educational stage (k)

As for the methodology used for the "other" group, given the heterogeneity of the expenditure associated with these items, it has been decided to update the expenditure in line with the growth in per capita income, in the same way as for healthcare expenditure.

3.3. Total education expenditure for the General Government

Once the six types of expenditure have been projected for the different ARs, the estimate of total expenditure of the GG is made by aggregation and taking into account the weight of education expenditure in the total expenditure of the AR.

FIGURE 19. EVOLUTION OF TOTAL EDUCATION EXPENDITURE (% GDP)

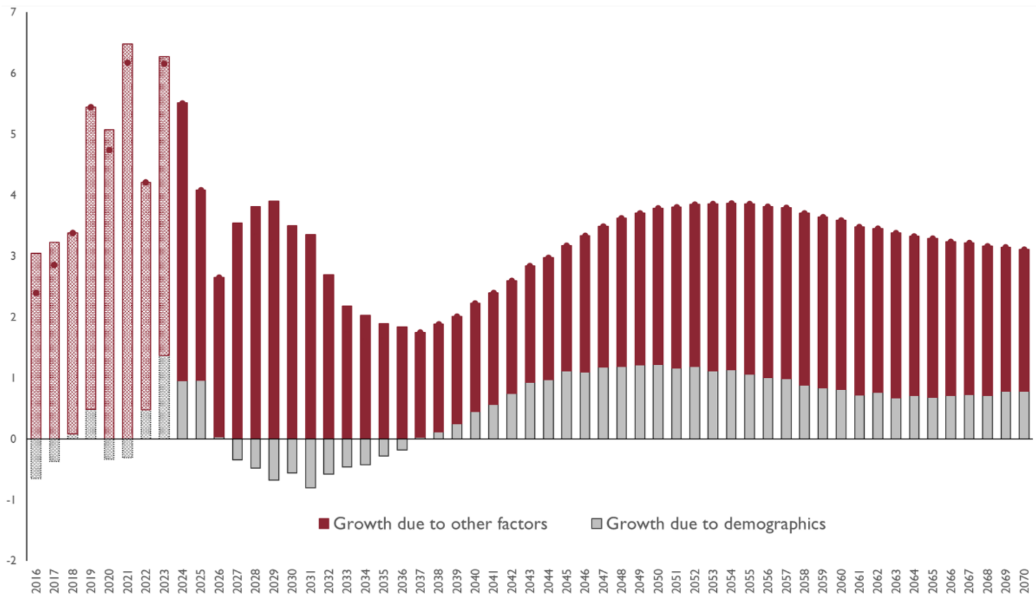


Source: IGAE (COFOG) and AIReF

3.4. Disaggregation of education expenditure growth

From 2016 to 2023, the average growth in education expenditure was 4.4%. In this increase, changes in student numbers have contributed 0.1% and all other factors have contributed 4.3%. The model projects a progressively decreasing contribution of student numbers until 2037, conditioned by demographics. From that year onwards, a progressive increase in the contribution of this factor is expected, which is forecast to fall again as from 2050, stabilising in the last years of the period.

FIGURE 20. EVOLUTION OF THE GROWTH OF EDUCATION EXPENDITURE BY FACTORS (% CHANGE)



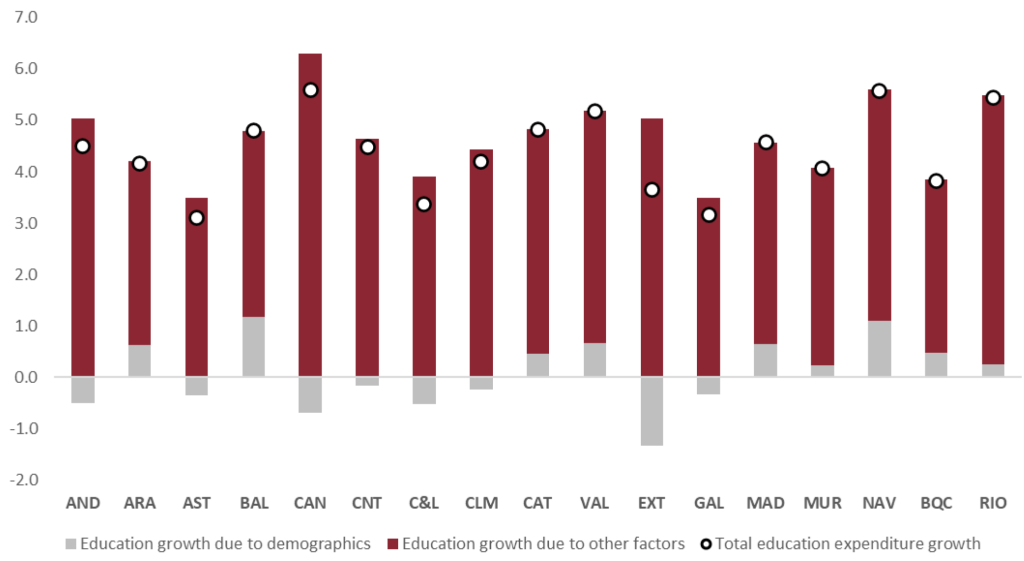
Source: Ministry of Education, Vocational Training and Sport, IGAE (COFOG), INE and AIReF

In the distribution by AR, the average growth between 2016 and 2023 can be observed in two groups of regions: in the Canary Islands, Navarre, Rioja, Valencia, the Balearic Islands, Catalonia, Madrid, Andalusia and Cantabria. expenditure on education grew on average above the mean; while in Aragon, Castile-La Mancha, Murcia, the Basque Country, Extremadura, Castile and Leon, Galicia and Asturias the average growth was below the mean.

With regard to the contribution of demographics, it can be seen that in the ARs of Extremadura, the Canary Islands, Castile and Leon, Andalusia, Asturias, Galicia, Castile-La Mancha and Cantabria, changes in the number of students in the period contributed negatively to the average growth of total expenditure. In contrast, in ARs such as the Balearic Islands and Navarre, the contribution of demography has been higher than 1%.

Non-demographic factors resulted in growth in education expenditure of over 5% in the Canary Islands, Rioja, Extremadura and Andalusia; around 4.5% in the Canary Islands, Castile-La Mancha, Catalonia, Valencia and Navarre; and between 3.5% and 4% in the other ARs.

FIGURE 21. GROWTH IN EDUCATION EXPENDITURE BY AR AND FACTOR. AVERAGE 2016-2023 (% CHANGE)



Source: Ministry of Education, Vocational Training and Sport, IGAE (COFOG), INE and AIReF

4. LONG-TERM CARE EXPENDITURE

The projection of long-term care expenditure has been carried out using as a reference the theoretical principles used in the projection of healthcare and education expenditure, adapting them to the specific features of this type of expenditure and to the lower availability of information. A further challenge is that this type of care is often provided informally.

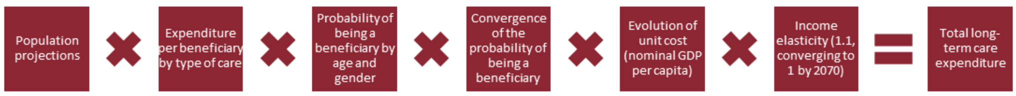
The steps carried out for the construction of the projections are summarised below:

- **Step 1 (common to all three models):** Construct the population projections by AR, gender and age group up to the year 2070. This is based on the population growth structure provided by the INE up to the 2039 horizon and is adjusted to reflect AIReF's projections of the resident population in Spain.
- **Step 2:** Due to the scarcity of detailed data until recently, long-term care expenditure is estimated without distinguishing between types of care, although it is broken down by AR. Recent extensions to IMSERSO's publications, which have not been incorporated in this analysis, could help generate categories within this expenditure model, which is an option to be explored for future publications.
- **Step 3:** Establish the probability of being a beneficiary in the base year for each age group and determine a convergence of the number of beneficiaries to include those who have applied and have been authorised but are not yet receiving the benefit and those who have

applied and have not yet received a response, but by probability would be entitled to the benefit. The convergence of beneficiaries would take place over 30 years.

- **Step 4:** Estimate the cost per beneficiary and AR. This will be updated with the evolution of GDP per capita and with an income-cost elasticity per beneficiary that will initially be 1.1 but will converge linearly to unity in 2070.
- **Step 5:** For each projection year, the probability of being a beneficiary is multiplied by the population group and gender (separated by AR).
- **Step 6:** The expenditure obtained in each AR is added up for the different population groups and gender to obtain the total expenditure.

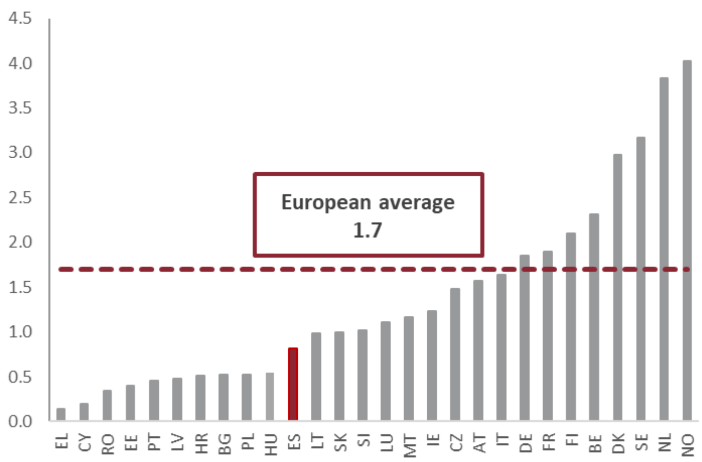
FIGURE 22. METHODOLOGY FOR ESTIMATING LONG-TERM CARE EXPENDITURE



Source: AIReF

Spain currently has long-term care expenditure at 0.8% of GDP, well below the EU average.

FIGURE 23. LONG-TERM CARE EXPENDITURE IN POINTS OF GDP



Source: AR2024

Similarly to the projection of healthcare and education expenditure, the following methodological aspects should be considered:

- It is assumed that the number of beneficiaries will increase in the manner described in Step 6.
- **Supply-side determinants of increased expenditure are not explicitly modelled**. Determinants of expenditure such as changes in cash benefits or the number of hours allocated per beneficiary are not explicitly included in the model variables. However, the growth in expenditure per beneficiary linked to the evolution of per capita income implicitly captures these factors.

4.1. Sources of information

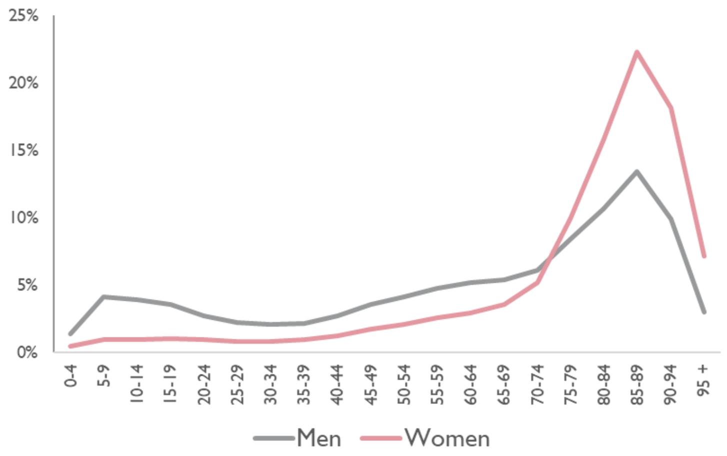
The sources of information on aggregate long-term care expenditure are the System of Health Accounts, which includes three categories related to care (HC.3, HC.R.6 and HC.R.7 are considered long-term care expenditure, although only the first two are taken into account in this analysis as the third is associated with pension expenditure), and the information provided by IMSERSO and the ARs.

With regard to data on the number of beneficiaries, the most common ways of classifying dependency would be by the degree of difficulty in performing basic activities of daily living (BADL) and instrumental activities of daily living (IADL). In addition to the difficulty of identifying the number of beneficiaries, a methodological change in the System of Health Accounts has meant that public expenditure on people who only need assistance for IADL but not for BADLs is no longer considered long-term care.

In recent years, IMSERSO has published more information on beneficiaries, benefits and costs. However, information on funding and expenditure by type of benefit in each AR remains incomplete. Total expenditure on long-term care is divided into four blocks (cash benefits, telecare, home help services and day and night centres) although due to lack of data, the estimate is made for the total expenditure in each AR.

The 2023 data indicate that there are in total a higher number of female beneficiaries than male (63% vs. 37% of the total), concentrated in the older age brackets. However, for the age brackets below 70, there is a higher percentage of men than women beneficiaries, possibly due to the lower risk aversion of men compared with women. The gender differences in the older age groups are mainly due to two factors: women have traditionally acted as informal carers for men and women have a longer life expectancy, which increases the likelihood of needing care throughout their lives.

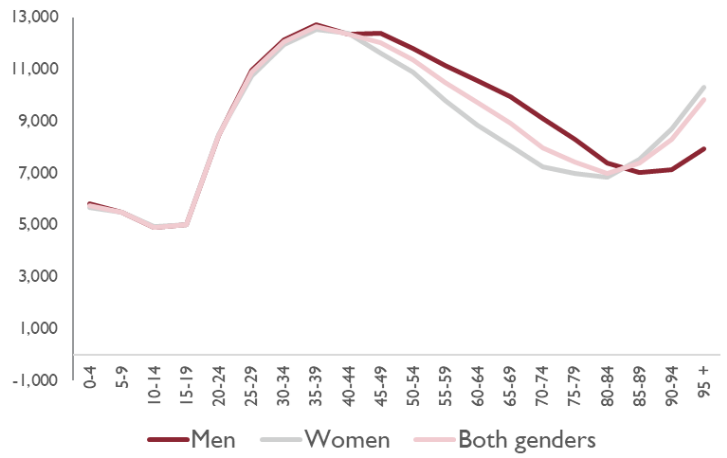
FIGURE 24. LONG-TERM CARE BENEFICIARIES BY AGE GROUP AND GENDER. 2023



Source: IMSERSO and ARs

When analysing the average cost by age of long-term care beneficiaries, the average cost by age is higher in the middle-age bracket than in the older age brackets. This is because people in need of care in these age groups tend to have a higher level of disability. The differences in the average cost by gender are concentrated in older age groups, where the cost for women rises substantially as the degree of dependency increases.

FIGURE 25. COST PER BENEFICIARY OF LONG-TERM CARE BY AGE AND GENDER. 2023



Source: IMSERSO and ARs

4.2. Cost projection methodology

The starting point is the determination of the cost per beneficiary per AR, by gender and age. To do this, an estimate of the probability of being a beneficiary of each type of service is added. The baseline number of beneficiaries for each year in the projection horizon is calculated as the probability of being a beneficiary multiplied by the population in that age and gender group.

The projection exercise then consists of updating the costs with GDP growth plus an income elasticity and multiplying it by the number of beneficiaries:

$$GCLD_t^i = \sum_{s,e} pop_t^{s,e,i} * (ProbB_t^{s,e,i} * Conv_t) * \left((1 + \Delta Y_t^{pc}) * e_t\right) \quad [15]$$

Where

$GCLD_t^i$ represents Long-term care expenditure by AR (i) associated at time t

$pop_t^{s,e,i}$ represents the population of gender (s) and age group (e) of the AR (i).

$ProbB_t^{s,e,i}$ represents the probability of being a care beneficiary by gender (s), age group (e) and type of expenditure (k).

$Conv_t$ represents the convergence factor of the number of beneficiaries.

Y_t^{pc} represents per capita GDP

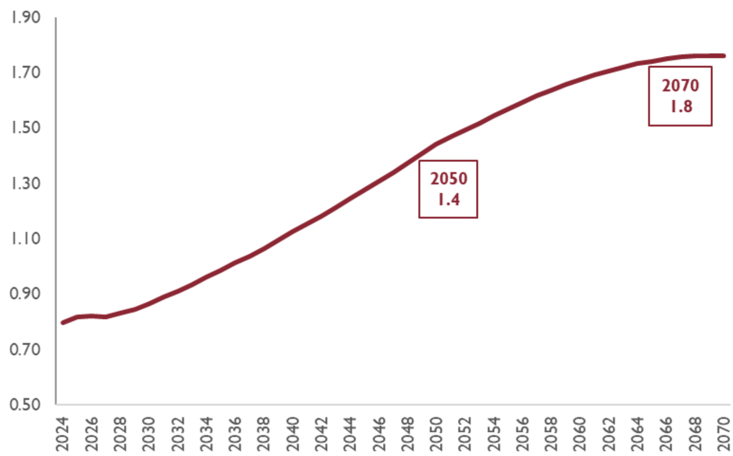
ε_t represents the income-cost elasticity of long-term care, which converges linearly from 1.1 to 1 at the end of the projection horizon.

$$\varepsilon_t = \varepsilon_{2023} - (t - 2023) \cdot \frac{\varepsilon_{2023} - \varepsilon_{2070}}{2070 - 2023} \quad [16]$$

4.3. Total long-term care expenditure for the General Government

Once the expenditure for the 17 ARs has been projected, the estimate of the total expenditure for the GG is made by aggregation.

FIGURE 26. EVOLUTION OF LONG-TERM CARE EXPENDITURE (% GDP)



Source: SHA, IGAE and AIReF

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