ITALY IS AGEING, WHO WILL TAKE CARE OF IT?[1]

Arianna Carra, Paola Maddalena Chiodini, Paolo Maranzano

Abstract. Italians are getting older and demand more and more attention on medical care. However, the need to curb public spending calls for a radical reorganisation of the Italian healthcare system. A study of the data available from the Istat - HFA (Health For All) data set reveals a general picture where it seems that supply is struggling to meet demand, pushing families towards a system of private care. A spatio-temporal regression model is presented to interpret the phenomenon and better understand the dynamics of the last two decades and better chart the future of our healthcare system. The resulting picture is that of a nation with different care needs per geographical area. The alpine areas and *Rome Capital* are the most important.

1. Dynamics and Structure in the evolutionary arc of the resident population of Italy

Demographic ageing seems to have become a significant topic of discussion in different areas. The phenomenon, which demographers have already noticed over the past decades, has long remained secluded in the classrooms of scholars and researchers. Only recently, when it has become an irreversible process, the subject of population ageing has begun to be the object of lively discussions. The situation has now reached a considerable weight in several spheres of interest, among all: social and family policies, pension, health, employment, savings, and consumption up to the environmental sphere (see, for example, Reynaud and Miccoli, 2016; Crescimanno *et al.*, 2009). The ageing of the population does not only concern Italy (European Commission, 2021) but in our country, it is also accompanied by the general demographic decline that has been underway for some years now. In fact, in the long path that we can follow starting from 1952, the amount of Italy's resident population has almost always grown year by year: we can appreciate an increase from over 47.5 million units at the beginning of the period to 60 million units at the beginning of 2014, after having passed the twenty years of 'stagnation' at the end of

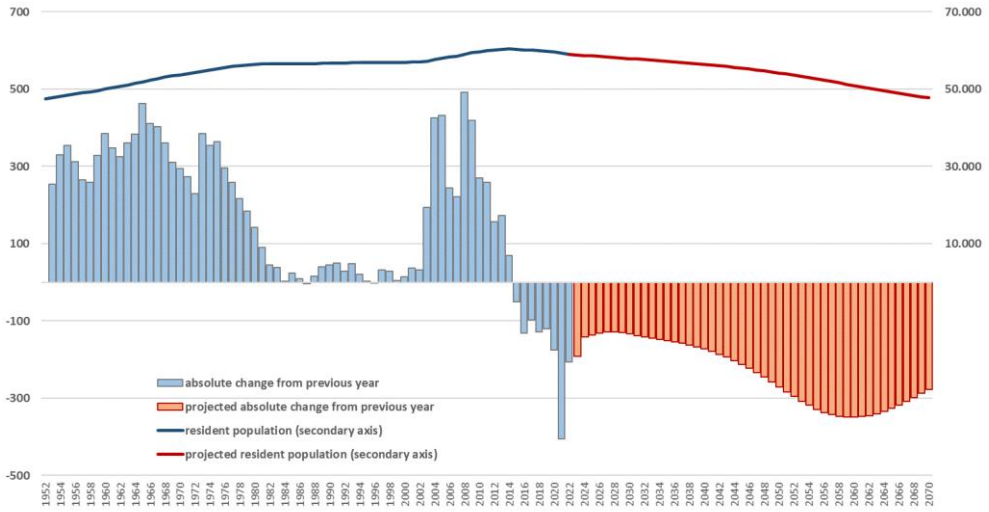
[1] The work is the joint responsibility of the authors. Paragraph 1 is attributed to Arianna Carra, paragraph 2 to Paola Maddalena Chiodini, paragraphs 3 and 4 to Paolo Maranzano, paragraph 5 is made by common effort of all the authors.

the 20th century. Subsequently, negative annual variations have occurred, which, within eight years, led to an overall decrease - accentuated in 2020 by the pandemic - of about 1.316 million units. If the hypotheses used for the construction of the 'median' forecast scenario by ISTAT (Istat, 2022) were actually verified, between 2023 and 2070, a further 11 million individuals would be lost, and the population would return to the levels of the 1950s (see Figure1).

Beyond the demographic decline that has begun, the profound structural change that has characterised the resident population needs to be focused on.

This is an epochal change: pandemics aside, progress in the fight against mortality has enabled ever larger contingents to reach old age, and at the same time, persistently low fertility levels have, in quantitative terms, reduced the younger part of the population.

Figure 1 – *Resident population on 1 January and changes from the previous year - Italy - 1952-2070 - absolute values (thousands).*



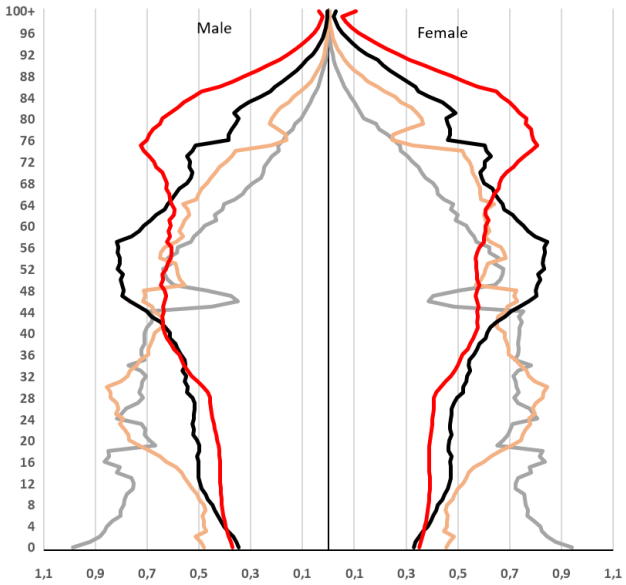
ISTAT data elaboration.

This phenomenon is also observable by the pyramid profiles by gender and age for some 'sample' years[2]. In 2022, almost a quarter of the population (23.8%) is at

[2] From the analysis of the consolidated data, 1965 appears to be as the year with the highest percentage of the population aged 0 (1.9%) and, moving 30 years forward, the effect of the continuing decline in fertility can be appreciated. The year 2022 shows the current state while, according to the data of the 'median scenario' of the demographic forecasts, the maximum values for the percentage of the population aged 65 and over and for the

least 65 years old; of this segment, 32.1% is already 80. In 2050, according to the 'median scenario' forecast, the percentage of over-65s would rise to 34.9 per cent, and the demographic old-age dependency ratio would indicate the presence of 65.3 individuals aged 65 or over potentially 'dependent' for every 100 persons considered to be of working age. From the Baby boom years, we have moved on to the beginning of the *Elderly boom* era, symbolically represented here by the age pyramid to 2050 (see Figure 2).

Figure 2 – *Age pyramids of the resident population as of 1 January 1965, 1995, 2022 and forecasts to 2050 - Italy - (percentage values).*



ISTAT data elaboration.

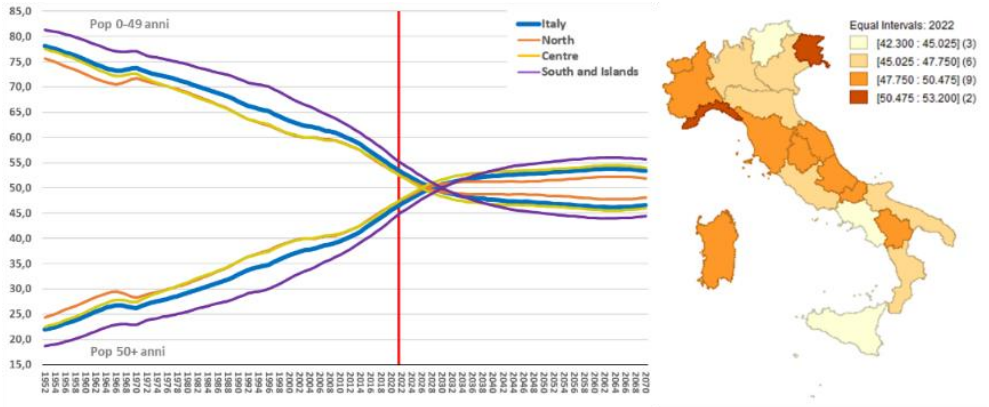
Even if fertility were to rise again in the future, given the current contingents of women of childbearing age (15 to 49), the number of births would still suffer. At the same time, until the 'heritage' of the past is exhausted, the *Baby boom* generations will continue on their way, first ageing and eventually dying out. Figure 3 compares, year by year, the percentages of individuals in the age groups up to 49 and from 50 onwards[3] and shows how the two aggregates are not only converging but also how,

demographic old-age dependency ratio, which is calculated by relating the population units aged 65 and over to the number of individuals aged between 15 and 64, would be reached during 2050: ID A= $\frac{P_{65+}}{P_{15-64}} \cdot 100$.

[3] Considering that 49 is the upper limit of childbearing age for women, the comparison is made, on a quantitative level, between individuals belonging to the first 50 generations and those belonging to the following ones, which,

in the future, the 'more mature' part will be numerically preponderant. Moreover, in some regions[4], the situation described is already a reality in 2022. These considerations give rise to the realisation that, in the absence of upheavals in migration or, in any case, of 'extreme' and external events and/or policies capable of affecting the structure and size of populations, the trend towards ageing and decline will continue in the years to come.

Figure 3 – *Population aged 0-49 and 50+ by Italy and Breakdowns (1952 to 2070) and proportion of individuals aged 50 and over in the regions (year 2022) - percentage values.*



ISTAT data elaboration.

2. Greater longevity comes at a price

'Italians are getting older and heading for extinction'. This is the hammering message one hears repeated by the media. The number of children is decreasing, and there is no adequate generational turnover. On the other hand, life has become much longer, and we have also learnt to take care of ourselves to the point that the new slogan is that at 60 or 70 people are still active and fit. So, when does old age begin? When can a person be called an elder? Maybe after the 70s? The third age no longer begins with the famous threshold of 65 years (more or less coinciding with retirement age) but at least a decade later.

---

although they include centenarians and the over-centenarians, can be considered the other 'half' of the range of human life variation.

[4] As of 1 January 2022, the proportion of over-50s is above 50 per cent in Liguria (53.2 per cent), Friuli-Venezia Giulia (50.6 per cent) and Sardinia (50.2 per cent) and is close to numerical parity with the under-49s in Piedmont (49.7 per cent), Molise (49.6 per cent), Umbria and Tuscany (49.4 per cent in both).

All these factors, which certainly make us happy, have, on the other hand, a considerable impact on the socio-economic fabric and especially on the health front. Keeping healthy entails a particular effort not only on the part of the individual, who must follow a healthy lifestyle but also on the healthcare system that must take on the care that the ageing individual needs with increasing intensity: greater longevity entails more visits and medical treatment and also greater consumption of drugs.

Is our healthcare system ready to support this growing demand for care? In a nutshell, is the demand (for care on the part of Italians) fully met by the public healthcare supply or must private supply also be used?

An analysis of the data offered by the Health For All-HFA5 database (source: Istat) immediately reveals certain behaviours. The analysis is conducted on a time series covering the last twenty-five years or so (1995-2019) net of the pandemic period. The Covid pandemic period was deliberately excluded as it represents a break in the time series with totally different dynamics linked to particular and unique factors that are not the subject of this work.

The picture that is defined is very clear. As early as 2000, a gradual growth in the number of older people (population over 80) began to be appreciated. The trend is the same in all Italian regions. Against this trend, on the other hand, is the contraction of the share of public health expenditure in total public expenditure to the same extent in every region. Similarly, the downsizing and reorganisation of public expenditure in the healthcare sector have led to a contraction in the number of beds in public hospitals in geriatric wards, although in different ways in various regions. If for the majority of the regions, the variation in the period considered seems to be contained (no more than 6 percentage points), the same cannot be said for Valle d'Aosta region where a negative variation of about 20 percentage points is recorded, followed by Veneto (-15 points), Abruzzo (-11 points), Trentino Alto Adige (-10.5 points) and Emilia Romagna (-9 points). (see Table 1).

All this suggests that the State's effort is in the direction to reorganise and rationalise the resources invested, so much so that the aim is not to offer more beds for elderly patients but rather to push in the direction of caring for the elders at home or at another type of facility that avoids hospitalisation. This is the new trend being observed concerning all age groups, i.e. hospitalisation is only aimed at severe cases that cannot be managed at home or on an outpatient basis. It is a standard view that care at one's own home can facilitate full recovery in a shorter time by finding the patient in a more hospitable family environment and also avoiding a sense of abandonment, especially in the case of elder patients (Banchero and Trabucchi, 2010, Di Rosa, Melchiorre and Lamura, 2010, Guaita and Casanova, 2010,

[5] Instructions for downloading the database Health For All-HFA are available at the following link: https://www.istat.it/it/archivio/14562

Melchiorre et al, 2010., Pesaresi, 2010, De Compadri et al, 2012, Fosti, 2012, Granata, 2012, Noto, 2012, Rice, 2012).

Table 1 – *Rate of hospital beds in geriatrics*.

Regione	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Piemonte	3.09	3.34	3.1	2.8	2.55	2.43	3.02	2.39	2.31	2.29	2.19	2.47	2.43	2.66	2.59	2.32	2.29	2.23	1.98	1.96	2	1.9	1.88	1.91
Valle d'Aosta	26.8	26.3	25.3	24.4	23.1	23.7	22	22.8	18.6	17	21.4	17.1	16.5	16.2	17.2	17.5	17.2	14.3	5.25	6.56	6.15	6.09	6.04	6.31
Lombardia	4.01	3.41	3.07	2.45	2.4	2.26	2.2	2.09	1.86	2.01	2.09	1.99	1.98	1.96	1.63	1.6	1.55	1.36	1.27	1.29	1.2	1.15	1.07	1.11
Trentino-Alto Adige	23.8	23.1	17.5	16.4	16.9	15.6	14.8	15.2	15	14.7	15.3	15.7	13.5	13.1	13	11.9	11.4	11.1	10.2	10	9.87	9.26	8.98	8.23
Veneto	24.6	22.8	21.3	19	17.2	15.5	14.4	13.2	12.6	12.1	12.3	12.1	10.6	10.4	10.7	10.8	10.4	9.76	10.1	9.57	8.91	8.63	8.78	8.51
Friuli-Venezia Giulia	1.98	1.96	1.95	1.94	1.56	1.19	1.17	1.19	1.17	1.37	0.95	0.93	0.85	0.84	0.83	0.83	0.81	0.63	0.62	0.65	0.8	0.8	0.79	0.78
Liguria	3.35	2.59	2.19	1.64	1.66	1.65	1.6	1.07	1.07	1.41	1.38	1.28	1.27	1.27	1.23	0.72	1.56	1.42	1.97	1.67	1.67	1.67	1.72	1.92
Emilia-Romagna	15.6	15	11.6	9.49	8.94	7.99	7.35	7.1	6.79	6.82	6.37	6.08	6.21	6.23	6.05	6.2	5.97	5.39	5.02	5.05	4.93	4.95	4.69	4.78
Toscana	2.94	2.31	2.12	2.03	2.7	2.65	2.51	2.16	1.92	1.81	1.75	1.64	1.47	1.17	1.48	1.13	1.27	1.14	1.22	1.3	1.77	1.82	1.7	1.59
Umbria	0.92	0.9	0.89	0.88	0.86	1.5	1.47	1.34	1.67	1.64	1.58	2.05	2.33	1.88	1.77	1.77	1.76	1.78	2.11	2.18	2.12	2.15	2.18	2.18
Marche	6.61	6.47	5.62	5.21	5	4.33	3.95	2.78	3.44	3.27	3.29	3.25	3.08	3	2.99	3.58	3.3	3.36	3.14	3	3.03	2.7	2.28	2.92
Lazio	5.98	5.05	5.39	3.89	3.39	3.38	2.75	2.25	2.32	3.03	2.79	3.19	2.88	2.29	2.28	2.14	2.15	1.91	1.88	1.92	1.99	2.27	2.04	1.91
Abruzzo	15.3	9.27	9.56	9.73	10.5	10.3	10.9	10	8.26	10.1	10.5	10.3	7.82	7.15	7.48	6.85	6.55	6.55	5.86	5.65	5.36	5.28	5.37	4.32
Molise	0	0	0	0	0	2.96	2.79	2.61	4.02	3.99	3.97	3.83	3.7	2.28	2.28	2.29	2.28	2.24	2.2	2.18	2.16	1.48	0.93	0
Campania	6	3.91	3.91	3.46	3.11	3.15	2.9	2.57	2.57	2.62	2.45	2.65	2.56	2.39	2.18	1.62	1.38	1.28	1.25	1.21	1.25	1.2	1.2	1.11
Puglia	12	12.3	11.7	10.2	9.33	9.08	8.08	7.89	7.6	6.98	6.74	6.42	6.03	6.12	5.83	4.93	4.81	3.89	3.54	3.79	4.47	4.02	4.19	4.02
Basilicata	9.63	7.93	7.17	6.71	6.56	6.44	6.32	6.21	6.12	6.04	5.41	4.64	4.64	5.48	5.49	5.49	4.53	4.45	4.37	4.31	4.75	5.95	4.66	4.64
Calabria	7.39	7.45	7.02	5.79	6.67	6.39	6.26	5.74	5.34	4.26	4.65	4.4	3.91	4.24	3.53	3.75	3.27	3.22	2.32	2.39	2.48	2.71	2.83	2.93
Sicilia	4.74	4.62	4.47	3.22	3.35	3.27	3.1	3.32	3.05	3.05	2.95	3.17	3.09	2.91	2.79	2.72	2.44	2.44	2.26	2.36	1.92	1.8	1.71	1.74
Sardegna	16.3	13.5	13.3	10.4	9.89	10.2	9.98	9.39	9.26	7.14	8.07	6.45	6.21	6.14	5.86	5.24	4.97	4.77	4.48	4.52	4.56	4.44	5.65	4.92

*Table notes: Hospital beds in geriatrics per 10,000 inhabitants aged 65 and over - HBgeriatrics/Pop65+*10.000 – HFA data. (Indicator code 7240)*

If, on the one hand, this postponement to the family unit makes it possible to ease the pressure on the national health system, on the other hand, it entails a managerial and economic burden for families, who have to deal with the problem of finding specialised health personnel to provide services at home (ADI Integrated Home Assistance, whether offered by the public health service or by private organisations) and all the non-specialised figures who can help manage the older person, mainly if not wholly self-sufficient (i.e. carers).

Table 2 – *Percentage specialist examinations (excluding dental) against the payment 65-74 -Male and Female*.

Macro area	2017	2018	2019	2020	2021
Italia	33.87	34.67	35.36	37.28	41.93
Nord	32.97	34.44	35.18	36.54	41.31
Centro	42.02	40.44	38.82	43.82	49.05
Mezzogiorno	29.93	30.65	33.19	33.92	37.6

Table notes: – Percentage of specialist visits with full payment or with full or partial reimbursement of insurance by age x per 100 specialist visits by age x HFA data. (Indicator code 7477).

Therefore, it appears that the central government's effort to sustain a growth trend in current per capita public health expenditure is insufficient to cover the growing demand for healthcare (Boscolo *et al*, 2022. Fenech, 2022., Giudice, 2022).

Table 3 – *Percentage specialist examinations (excluding dental) against payment over 75 - Male and Female.*

Macro area	2017	2018	2019	2020	2021
Italia	32.39	32.87	32.87	34.3	39.52
Nord	31.67	33.21	32.02	34.24	39.4
Centro	36.87	37.38	36.12	37.82	43.7
Mezzogiorno	30.48	28.73	31.89	31.66	36.47

Table notes: – Percentage of specialist visits with full payment or with full or partial reimbursement of insurance by age x per 100 specialist visits by age x HFA data. (Indicator code 7478).

This is confirmed, for example, by the progressive increase in the average number of patients per general practitioner, the considerable increase in the rate of drug consumption, a phenomenon that shows less and less variability between the different regions as the age of the population increases, and a significant increase in per capita health expenditure, again by households. So how are citizens, and especially senior citizens, treated in Italy? It seems evident that where the resources made available by the State are insufficient, the family resorts to private facilities and makes up for the failure of the public service by investing its own financial resources. This can be seen from the data provided by ISTAT (HFA dataset), which highlights how in the years following 2017, an increasing value of the percentage of specialist visits against payment can be appreciated (see Table 2 and Table 3).

3. Data analysis: a spatio-temporal approach

We propose an empirical analysis in which the household health expenditure is related to various demographic, socio-economic and health factors. The objective is to identify the relevant determinants that explain the temporal evolution of household expenditure across the Italian regions. In particular, we are interested in:

i. Understanding the role of public intervention in sustaining the overall expenditure of the families and reducing its burden;
ii. To check for geographical differences in household health expenditure after considering the national dynamics common to all regions.

We considered the following set of yearly variables[6] observed from 1998 to 2019 at the regional level:

[6] ▪ households expenditure for health (Indicator code 9032)
▪ share of public expenditure in healthcare (% of total expenditure) (Indicator code 9020)
▪ share of public hospital beds for elderly people (% of total hospital beds for older people) (Indicator code 7241)

- share of public expenditure in healthcare (% of total expenditure);
- share of public hospital beds for elderly people (% of total hospital beds for older people);
- share of people over 80 years old (% of the total population);
- the average amount of patience per doctor;
- rate of integrated home care assistance for people over 65 years old;
- rate of drug consumption for the whole population.

The household expenditure is investigated using a regression model belonging to the family of Generalized Additive Models or GAMs (Wood, 2017). The regression model is built in such a way as to address both the spatial and temporal evolution of the expenditure through a so-called spatio-temporal GAM. In addition, we take into account the positive skewness characterising the distribution of the data by using a Gamma distribution with a logarithmic link function for the response variable. The spatial trend is introduced in the model using a polynomial specification given by the linear combination of latitude and longitude of the regions' centroids, while the temporal trend is included by a smooth function evolving through the years. The main advantage of using GAMs is the ability to flexibly shape the relationship between the response and the covariates through smooth functions that represent the predictors as the summation of a basis expansion (Ramsay, 2005), typically splines. This is particularly relevant when modelling spatio-temporal tendencies. For example, in the case of spatial or temporal trends, the data are unlikely to show strongly linear trends but will instead be subject to smooth but non-linear patterns. In our application, intending to avoid imposing restrictions on the functional form of the model, we include each covariate as a smooth function, letting the data determine the linearity or non-linearity of the relationships.

Let us denote the generic Italian region as s=1, …, 20 and the generic year from 1998 to 2019 as t=1, …, 22. Also, let y_{st} be the household expenditure on health care for region s and time t. The GAM can be expressed as follows:

- share of people over 80 years old (% of the total population) (Processing of Istat data on the resident population: http://dati.istat.it/)
- the average amount of patience per doctor (Indicator code 7013)
- rate of integrated home care assistance for people over 65 years old (Indicator code 7023)
- rate of drug consumption for the whole population (Indicator code 7410)

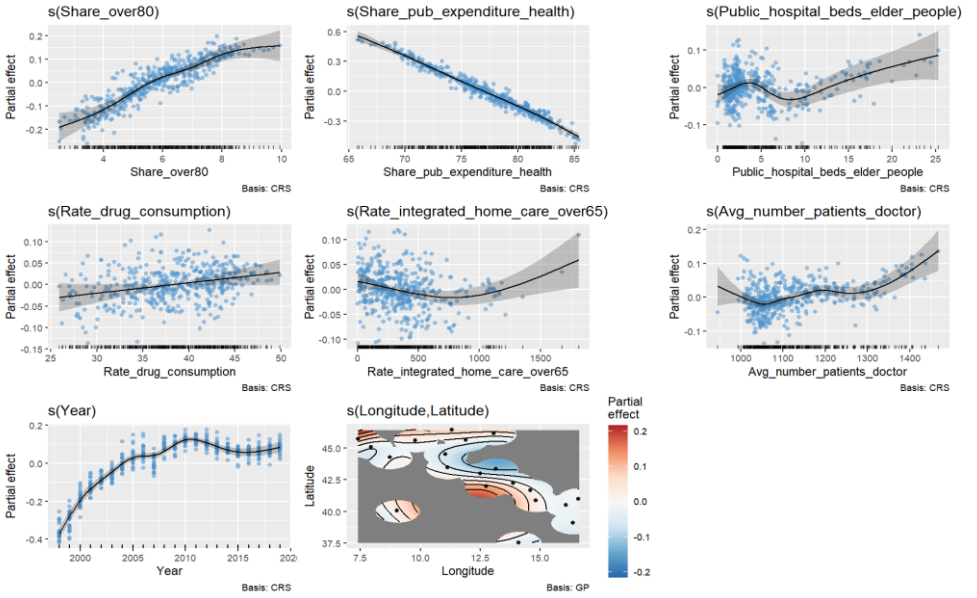
$$\begin{aligned}\log[E(y_{st}|X_{st})] = \ & \beta_0 + f_1(Share\_over80_{st}) \\ & + f_2(Share\_pub\_expend\_health_{st}) \\ & + f_3(Public\_hospital\_beds\_elder\_people_{st}) \\ & + f_4(Rate\_drug\_consumption_{st}) \\ & + f_5(Rate\_integrated\_home\_care\_over65_{st}) \\ & + f_6(Avg\_number\_patients\_doctor_{st}) + f_7(Year_t) \\ & + f_8(Longitude_s, Latitude_s)\end{aligned} \quad (1)$$

where y_{st} ~ *Gamma* and $f_j(x_j)$ with j=1,…,8 are smooth functions relating the covariate x_j with the response variable. Notice that $f_j(x_j)$ with j=1,…,7 are univariate smooth functions modelled as cubic regression splines, whereas f_8 is a bivariate smooth function describing the spatial trend through a Gaussian Process smoother with exponential covariance function.

4. Results

In Figure 4, we represent the partial effects of each covariate on household expenditure in health care. Partial effects can be interpreted as the contribution of each covariate to the prediction of the response variable when other covariates are held constant at their most typical value (i.e., the mean).

Figure 4 – *Estimated partial effects between household expenditure and each variable.*



The main findings can be summarised as follows:

- There is evidence of a statistically significant positive and almost linear relationship between the share of elderly people over 80 years old and private expenditure. Thus, household expenditure is directly proportional to the ageing of the population. This indicates that the burden of ageing is loaded (at least partly) on private expenditure;
- As the share of public expenditure on healthcare increases, private healthcare expenditure decreases proportionally and statistically significant. Considering that after 2008 the share of public health expenditure has fallen considerably (both at local and national levels), while private expenditure has been rising continuously, it seems clear that households are increasingly burdened with the cost of healthcare;
- the number of patients has a non-linear effect on private expenditure: estimates indicate that only when the average number of patients per doctor exceeds 1300 does healthcare expenditure appear to increase significantly. The estimate of 1300 patients per doctor could be interpreted as a critical threshold for the saturation of the healthcare system;
- the spatial trend suggests a 'Rome Capital effect' in which central Italian regions have higher household expenditure than the rest of the country.

5. Final remarks and further research

The model describes a nation divided by varying degrees of 'fatigue' in the national health care system. The most overstressed area is central Italy, probably influenced by the high degree of urbanisation of the capital city Rome.

By examining the data available through the implemented model, it has become clear that the pressure on the healthcare system is increasing in the face of an ageing population. However, the tendency to rationalise healthcare expenditure through mechanisms such as the reduction of geriatric beds and the increased use of ADI is only shifting more expenditure commitments in the healthcare chapter onto households. Again, considering the increased pressure on family doctors, it seems safe to say that the State has not yet managed to achieve the desired results in reorganising the healthcare system and is currently struggling to meet the growing demand for assistance from citizens.

Continuing along this path, the models used could be used to develop future scenarios regarding household expenditure on healthcare, as they could also be supported by analyses conducted using spatio-temporal autoregressive models such as CARs, for example. Finally, the opportunity to include further explanatory variables and to study the phenomenon at a finer territorial level could be considered.

References

BANCHERO A., TRABUCCHI M. 2010. Le cure domiciliari: caratteristiche e condizioni di successo. In *L'assistenza agli anziani non autosufficienti in Italia - 2° Rapporto.* Santarcangelo di Romagna (RN): MAGGIOLI, pp. 127-140.

BOSCOLO P.R., FENECH L., GIUDICE L., ROTOLO A. 2022. La gestione dei tempi di attesa in Italia durante e oltre la crisi Covid: le aziende, In *Liste e tempi di attesa in sanità. Innovazioni, soluzioni e sfide per le regioni e le aziende sanitarie italiane*. Milano: EGEA, pp. 43-68.

CRESCIMANNO A., FERLAINO F., ROTA F.S. 2009. Classificazione della marginalità dei piccoli comuni del Piemonte 2009. Torino, IRES, 2009, "Contributo di Ricerca" n. 235. Disponibile on line: https://core.ac.uk/download/pdf/199702292.pdf

DE COMPADRI P., LO MUTO R., GARATTINI L. 2012. Analisi costo-efficacia delle cure domiciliari. In *Proceedings Home Care. Le cure domiciliari nella medicina della complessità*, IV European Congress Homecare.

DI ROSA M., MELCHIORRE M.G., LAMURA G. 2010. I servizi domiciliari tra reti informali e assistenti familiari. In *L'assistenza agli anziani non autosufficienti in Italia -2° Rapporto.* Santarcangelo di Romagna (RN): MAGGIOLI, pp. 181-198.

EUROPEAN COMMISSION 2021. 2021 Ageing Report: Ageing populations and fiscal sustainability. Presentation in European Commission (2021), The 2021 *Ageing Report - Economic & Budgetary Projections for the EU Member States (2019-2070)*. Luxembourg: Directorate-General for Economic and Financial Affairs. https://economy-finance.ec.europa.eu/publications/2021-ageing-report-economic-and-budgetary-projections-eu-member-states-2019-2070_en

FENECH L. 2022. La gestione dell'attività ambulatoriale e il governo dei tempi di attesa: una visione di insieme delle evoluzioni in corso, In *Liste e tempi di attesa in sanità. Innovazioni, soluzioni e sfide per le regioni e le aziende sanitarie italiane*. Milano: EGEA, pp. 87-92.

FOSTI G. 2012. L'Assistenza Domiciliare in Italia. In *Proceedings Home Care. Le cure domiciliari nella medicina della complessità*, IV European Congress Homecare, pp. 39-40.

GIUDICE L. 2022. La gestione dei tempi di attesa in Italia: le misure a livello nazionale e regionale, In *Liste e tempi di attesa in sanità. Innovazioni, soluzioni e sfide per le regioni e le aziende sanitarie italiane*. Milano: EGEA, pp. 29-42.

GRANATA A. 2012. Il possibile futuro dell'Assistenza Domiciliare. In *Proceedings Home Care. Le cure domiciliari nella medicina della complessità*, IV European Congress Homecare, pp. 21.

GUAITA A., CASANOVA G. 2010. I bisogni e le risposte. In *L'assistenza agli anziani non autosufficienti in Italia -2° Rapporto.* Santarcangelo di Romagna (RN): MAGGIOLI, pp. 167-180.

ISTAT 2022. Previsioni della popolazione residente e delle famiglie | base 1/1/2021. *Statistiche Report*, Roma: Istat, https://www.istat.it/it/files//2022/09/REPORT-PREVISIONI-DEMOGRAFICHE-2021.pdf

MELCHIORRE M.G., DI ROSA M., CHIATTI C., LAMURA G. 2010. Italia ed Europa a confronto. In *L'assistenza agli anziani non autosufficienti in Italia -2° Rapporto.* Santarcangelo di Romagna (RN): MAGGIOLI, pp. 199-206.

NOTO V. 2012. La formazione: il sistema "Badandum" per caregiver e famiglie. In *Proceedings Home Care. Le cure domiciliari nella medicina della complessità*, IV European Congress Homecare, pp. 11-12.

PESARESI F. 2010. Dove va la realtà italiana. In *L'assistenza agli anziani non autosufficienti in Italia -2° Rapporto.* Santarcangelo di Romagna (RN): MAGGIOLI, pp. 141-166.

RAMSAY, J. O., SILVERMAN, B.W. (2005). Functional Data Analysis: Springer New York, NY.

REYNAUD C., MICCOLI S. 2016. La sfida dell'invecchiamento: successi e insuccessi in Italia. *Futuri*. https://www.futurimagazine.it/dossier/rivoluzione-demografica/sfida-invecchiamento-successi-insuccessi-italia/

RICE M. 2012. La gestione della cronicità: le prospettive dei sistemi sanitari in Europa. In *Proceedings Home Care. Le cure domiciliari nella medicina della complessità*, IV European Congress Homecare.

ROTOLO A. 2022. La rilevanza del fenomeno: trend e ordini di grandezza, In *Liste e tempi di attesa in sanità. Innovazioni, soluzioni e sfide per le regioni e le aziende sanitarie italiane*. Milano: EGEA, pp. 11-22.

TRABUCCHI M. 2012. La casa per l'anziano fragile. In *Proceedings Home Care. Le cure domiciliari nella medicina della complessità*, IV European Congress Homecare, pp. 5-8.

WOOD, S. N. (2017). Generalised additive models: an introduction with R (2nd ed.): chapman and hall/CRC.

Arianna CARRA, Istat - Ufficio territoriale Area Nord-Ovest: Piemonte e Valle d'Aosta, Liguria, Lombardia, carra@istat.it

Paola Maddalena CHIODINI, Università degli Studi di Milano-Bicocca, paola.chiodini@unimib.it

Paolo MARANZANO, Università degli Studi di Milano-Bicocca, paolo.maranzano@unimib.it