Mortality evolution in Italy: the end of regional convergence?

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Abstract

In several European countries, life expectancy has progressed little in the past two decades. In this study, focused on Italy, we investigate whether "austerity" and health regionalization may have contributed to this outcome. We show that the succession of reforms to the Italian health system introduced since the 1990s closely corresponds to discontinuities in the evolution of regional life expectancies, halting or reversing their previous trend towards convergence. This holds for both sigma and beta convergence and for both genders, albeit earlier for females.

1 Introduction

Since the 2000s, progress in life expectancy has markedly slowed down in several European countries, such as UK, Switzerland, the Netherlands, Belgium, France and Germany (Franklin, Hochlaf, and Holley-Moore 2017; Murphy, Luy, and Torrisi 2019; Raleigh 2023).

Several possible explanations can be advanced for this slowdown, not all of them fully explored: for instance, population ageing, new flu variants, tempo effects[1], cohort effects[2], and migration flows. We submit that this list should be lengthened to include "austerity", i.e. the set of budget-control policies put in place after the 2008 economic crisis to limit, and possibly halt and reverse, public deficit. Not surprisingly, such policies affect the public resources devoted to health care. This, at least, is what happened in Italy, whose austerity policy began well before the onset of the Great Recession, following the financial crisis of the early 1990s. In those years, Italy was on the verge of defaulting on its large public debt[3] and the pressure of national and international investors was huge. In 1992, a "technical" government was charged with the responsibility of a series of draconian measures to bring national finances back under control. This also affected the national healthcare system: its budget was limited[4], and control was partly decentralized to local authorities, the

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[1]According to Luy et al. (2020) (p. 98), "*Tempo Effects (TE) emerge in death rates as soon as mortality is changing during the observation period. For example, when improvements in health and living conditions lead to a reduction in mortality, a certain number of deaths – which would have occurred under unchanged mortality conditions – are postponed to a later period. Such a postponement consequentially deflates the numerator of death rates by the number of avoided deaths, while the denominator is inflated by the same number of saved lives. Albeit these numbers are identical in absolute terms, they differ notably in relative terms. The number of deaths decreases by a much larger proportion than the number of the population at risk in the denominator increases. In this way, TE magnify the effect of the shifted number of deaths in the death rate. The larger the changes in mortality, the larger the magnification effect*". Obviously, the same occurs with variations of a positive sign.

[2]This holds especially for the UK. Compared to earlier and later generations, the UK birth cohorts of the 1930s (sometimes called "golden cohort") have had markedly high levels of survival, so much as to affect overall mortality metrics. With the progressive reduction of the survivors of this cohort, this effect has gradually diminished, and has virtually vanished nowadays.

[3]In September 2002, the Italian Lira, together with the British Pound, was forced out of the Exchange Rate Mechanism - ERM.

[4]The Italian National Health Service was created in 1978 and became fully operative in the 1980s. It was intended to provide universal and free health to the entire population, but costs mounted rapidly so that various forms of co-payment have been progressively introduced over time.

20 administrative regions in which the national territory is divided[5].

In 2001, a hefty constitutional reform reinforced the tendency towards "regionalization", and health fell under the joint responsibility of the central state, listing the so-called Minimum Levels of Care, and the regions, deciding on all practical matters concerning the regulation and organisation of health services, including the management of financial resources.[6]

These two reforms ended up by making the Italian healthcare system more fragile and fragmented, and in this study we hypothesize that this may be associated with the slower survival progress in the years following the Great Recession (Egidi and Elena Demuru (2018)). Between 1970 and 2008, life expectancy in Italy had increased along a more or less linear trend, with a slope of about 0.27, that is by almost three years of life (in e_0) every ten calendar years (t). In the post-crisis period (2008-2019), however, the gain declined substantially, to only two years (in e_0) every ten years (t; Salinari, Benassi, and Carboni 2023).

In this work, we analyse a specific part of this complex story: the evolution of Italian regional life expectancies between 1974 and 2019. We set out to show that the pre-existing tendency towards convergence halted, and in some cases reversed, in the reform years or shortly afterwards. The decision to use administrative regions as statistical units stems from the very nature of these reforms, which conferred regions more autonomy and decision-making power in the health field.

In 2011, Casacchia and Natale (2011), in their analysis of the evolution of regional life expectancies in Italy over the period 1974-2008, had already noted convergence, especially among males. However, they did not try to relate this to policies and reforms. Cavalieri and Ferrante (2020) did, and concluded that decentralization had probably favoured homogenization, i.e., convergence of regional life expectancies at birth. As we will show shortly, these conclusions run counter our own findings, and those of Montero-Granados, Dios Jimé.nez, and Martín (2007) for Spain, possibly because of their shorter period of investigation (1996 to 2016), or of their different methodology, or both.

We investigate more or less the same variables as Casacchia and Natale (2011), with two innovations. First, we cover a longer period, 1974 to 2019, which permits us to compare the pre-reform phase (before the 1990s) to subsequent years. Although data for even more recent years are also available, we excluded them from the analysis, because the outbreak of the Covid-19 pandemic affected the level and geographical distribution of mortality in Italy so profoundly as to obscure all other possible underlying causes.

Secondly, we apply not only beta and sigma convergence analysis, but also a more refined econometric technique, proposed by Bai and Perron (2003), to identify significant changes (or "structural breaks") in time trends. In our case, the time trend

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[5]Italian regions constitute the first level of territorial partition of the Italian state as well as public entities endowed with political and administrative autonomy, as stated by the Constitution of the Italian Republic.

[6]For an overview of the Italian health care system and its reforms, see Ferré. et al. (2014) and De Belvis et al. (2023)

of interest is that of regional convergence in survival, as measured by life expectancy at birth (e_0).

2   Data and methods

Our data come from the Italian regional life tables of 1974-2019, produced by IS-TAT, the Italian National Institute of Statistics. Of these tables, we considered e_0 separately by gender. The territorial units of our analysis are administrative regions, or NUTS 2. There are 20 of them, but as Valle d'Aosta and Molise are very small, we merged them with the neighbouring regions with which they were originally united: Piedmont and Abruzzo, respectively. This leaves us with 18 regions, the convergence of whose life expectancies we studied in two ways, beta-convergence and sigma-convergence, borrowing a methodology that was first developed in economics (Barro and Sala-i.-Martin 1990; Barro, Sala-i.-Martin, et al. 1991; Barro and Sala-i.-Martin 1992) and later exported to other disciplines, including demography (Hrzic et al. 2021).

The most intuitive approach to the study of convergence is to examine how a dispersion index changes over time: if dispersion decreases, sigma convergence occurs.

Let $e_{t,r}$ denote life expectancies at birth at a generic time t for a generic regions r, of which we have R=18. Following Hrzic et al. (2021), we used weighted variance $WVAR(e_t)$ as an index of dispersion:

$$WVAR(e_t) = \frac{1}{\sum_{r=1}^{R} P_{t,r}} \sum_{r=1}^{R} P_{t,r} \left(e_{t,r} - \overline{e}_t\right)^2,$$

where $P_{t,r}$ and $(\overline{e}_t)$ are the population and the weighted mean of e_t of each region r at time t, respectively.

Sigma convergence gives an idea of the evolution of survival variability across regions, but it misses some potentially important elements. For instance, in the extreme case of ranking reversal, with top regions becoming last and vice versa, dispersion could remain (almost) the same, falsely signalling that (almost) nothing changed. To overcome this potential limitation, following Barro, Sala-i.-Martin, et al. (1991), we also analysed the so-called beta convergence, checking whether regions with low initial values experience comparatively faster progress, thus catching up with the rest. The two analyses are complementary, and should be carried out jointly (Janssen et al. 2016), keeping in mind that "*beta-convergence is a necessary condition for the existence of sigma-convergence, while sigma-convergence might not accompany beta convergence*" (G.ä.chter and Theurl 2011).

Let us define the following quantity for a generic time series $y_0, \dots, y_T$:

$$\Delta_k y_t = y_t - y_{t-k},$$

with k denoting a generic time lag.

Ignoring weights, the existence of beta convergence can be assessed by looking at

the β parameter in the following model:

$$\frac{1}{T}\Delta_T e_{T,r} = \alpha + \beta e_{0,r} + \epsilon_r, \qquad r = 1, ..., R, \tag{1}$$

where $\frac{1}{T}\Delta_T e_{T,r}$ is the average annual increase in life expectancy between 0 (first year of observation, 1974) and T=45 (2019), across all regions r and ϵ_r is the error term. A statistically significant value of β indicates the presence of a process of convergence (if β is negative) or divergence (if it is positive) between 0 and T. We can use the value of life expectancy directly, and not its logarithm, as economists frequently do, because, unlike economic variables (such as the GDP), life expectancy usually follows a linear and not an exponential trend (Lee 2019; Oeppen and Vaupel 2002; White 2002). In fact, given the heterogeneity of Italian regions in terms of population size, we applied the population-weighted version of Model 1 minimising the function $\sum_{r=1}^{R} P_{0,r} \left(\frac{1}{T}\Delta_T e_{T,r} - \alpha - \beta e_{0,r}\right)^2$. We also created a second time series of beta coefficients, applying the weighted version of Model 1 to shorter (five-year) time intervals, to assess what happened within each sub period:

$$\frac{1}{k}\Delta_k e_{i,r} = \alpha + \beta_i e_{i-k,r} + \epsilon_r, \qquad r = 1, ..., R; \quad i = k, ..., T, \tag{2}$$

where $k+1$ identifies the length of the (fixed) time interval of analysis. In our case, for instance, where k=4 and we go back four years in time (e.g., from 2000 back to 1996), we work with (4+1=) 5 calendar-year intervals. The i subscript to β denotes the final year of the five-year period on which it was calculated. This leaves us with a time series consisting of $T-k+1$ partially overlapping components: $\boldsymbol{\beta} = (\beta_k, \ldots, \beta_T)$.

We wanted to test whether our β parameters behave like a shift model, initially oscillating around a certain mean c' and then, after a jump (or slump), around a different mean c''. Graphically, a generic shift model behaves as in Figure 1, and can be conceived as the juxtaposition of two different stationary series around their (different) means.

In our case, the shift signals a change in the intensity of the convergence process. If the sign of the average also changes, this indicates a passage from convergence to divergence (from negative to positive) or vice versa. In the simplest case, when there is only one break, our shift model can be described as follows:

$$\begin{aligned}
\beta_j &= c' + \epsilon_j; \qquad j = k, \ldots, \hat{j}, \\
\beta_j &= c'' + \eta_j; \qquad j = \hat{j}, \ldots, T.
\end{aligned} \tag{3}$$

The former equation represents the dynamics of the process up to $\hat{j}$ and the latter the dynamics after it, where $\hat{j}$ is a generic (possible) breakpoint. Note that ϵ_j and η_j need not be white-noise disturbances, as it is usually assumed in standard OLS models: for instance, they could follow an ARMA process.

Bai and Perron (2003)'s technique identifies structural breaks by systematically analysing all possibilities. After choosing a first potential breakpoint $\hat{j}$ we estimated the following model:

$$\beta_j = \gamma_0 + \gamma_1 B_j + \omega_j, \qquad j = k, \ldots, T, \tag{4}$$
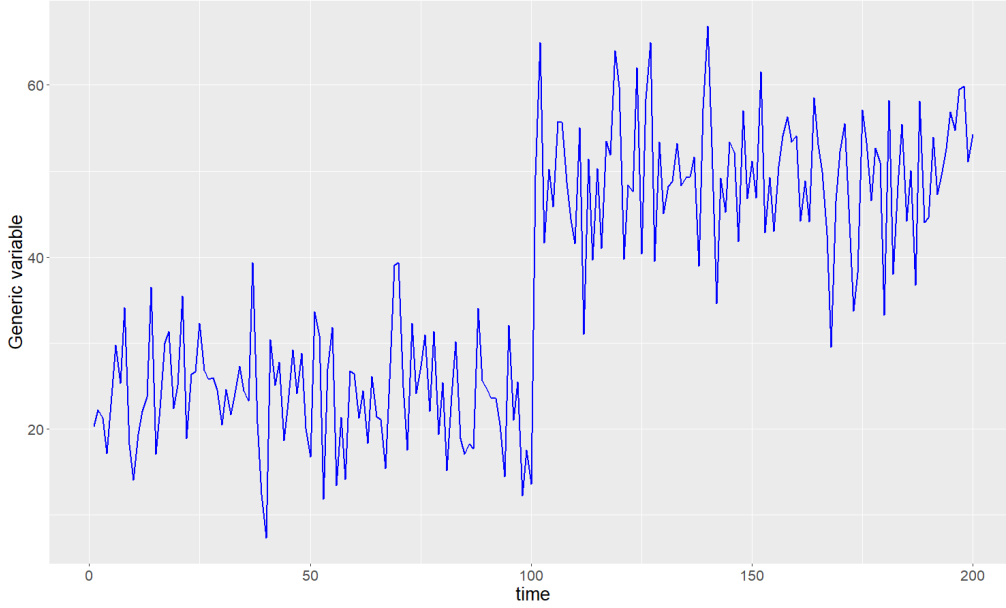
Figure 1: **Hypothetical trend of a shift model on simulated data**
Source: Source: authors' simulation

where

$$B_j = \begin{cases} 1 & \text{if } j \leq \hat{\hat{j}} \\ 0 & \text{if } j > \hat{\hat{j}} \end{cases},$$

γ_0 and γ_1 are coefficients, and ω_j the error terms. The sum of squared residuals measures the goodness fit of the model based on $\hat{\hat{j}}$.

Next, we chose a second potential breakpoint, say $\hat{\hat{j}}'$, then a third, $\hat{\hat{j}}'$, etc. and we proceeded until exhaustion of all possible breakpoints, repeating all the passages at each step. The breakpoints identifying a possible structural change in the series are those with the lowest sum of squared residuals.

Having identified a breakpoint, we checked whether the estimated β's behave like a shift model (Model 3) by running a unit-root test on the residuals of Model 4. If the test rejects the null hypothesis of non-stationarity, our assumption holds: before and after the breakpoint (i.e., at different levels), the series are stationary. To assess non-stationarity, we used the PP test (Perron 1988), which incorporates heteroskedasticity.

With a recursive method, it is also possible to identify the presence of multiple structural breaks, say m, for any possible combination of sub-periods between k and T. While this is extremely time consuming, the underlying intuition remains the same. This dynamic problem can be solved in steps, by identifying first the ideal one-break partition, then the ideal two-break partitions, etc. (Bai and Perron 2003). We performed this procedure, using the R library *strucchange* (Zeileis, Leisch, et al. 2002; Zeileis, Kleiber, et al. 2003; Zeileis 2006). We also performed a sensitivity analysis to make sure that the choice of different values for k would not bias our results (see Table 2).

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3   Results

In 1979 the life expectancy at birth in Italy was 75.9 and 69.6 years for females and males, respectively, and in 2019 it went up to 85.4 and 81, an increase of 12.4% and 16.7%, respectively.

Currently, life expectancy is lower in southern Italy, mainly because of a greater incidence of cardiovascular diseases (Petrelli et al. 2019) and higher smoking prevalence (Gallus et al. 2011). In Italy, as elsewhere, low social economic status goes along with higher death risks (Frova et al. 2021), but social disparities in mortality are more pronounced in the south. In 1974, however, the situation was somewhat different, with some southern regions enjoying higher survival than some northern ones. Figure 2 shows the spatial distribution of e_0 across Italian regions, separately by gender, for three years, 1974, 2019, the first and last year of our series, and 1990, when reforms in the Italian health system started to be introduced.

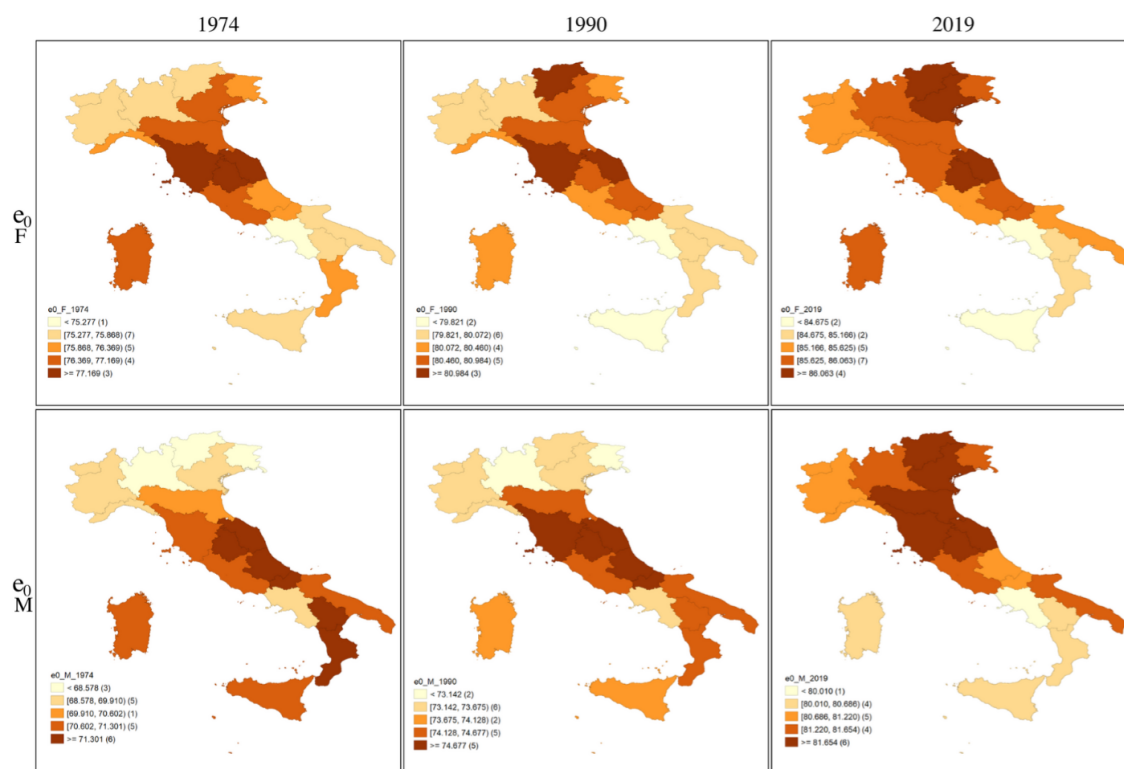The ranking of regional life expectancies changed between 1974 and 2019, and espe-

Figure 2: **Spatial distribution of e_0 by gender (F=females; M=males) in selected years**
Source: authors' calculations on ISTAT data

cially around 1990. Before then, that is before the start of the reforms, convergence seemed to prevail, but the process stopped or even reversed afterwards, as we measure more precisely in the following.

Figure 3 shows the evolution of life expectancy in the three traditional macro-territorial areas of Italy (North, Centre, South) between 1974 and 2019, along with the weighted variance of regional values, as a measure of sigma convergence, and

a special focus on 1990, our pivotal year. Between-region variability (right hand scale) strongly declined between 1974 and 1990, but barely changed afterwards. In the same period, life expectancy (left-hand scale) lagged behind in the South, and the distance from the rest of Italy increased for males.

To sum up, net of some differences by gender, the general message conveyed by
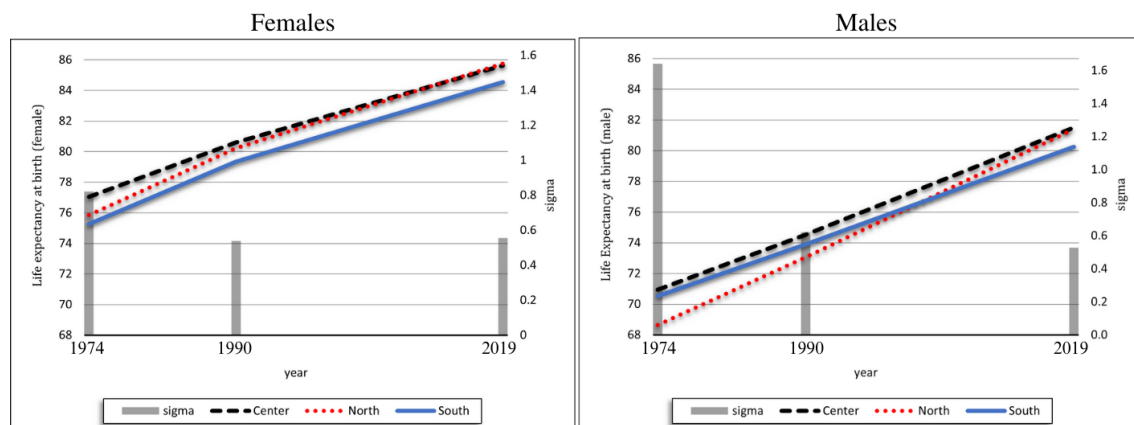

Figure 3: **Weighted averages of e_0 by macro-area (left-hand vertical scale), and sigma convergence of e_0 (right-hand vertical scale)**
Source: authors' calculations on ISTAT data

Figure 2 and Figure 3 is that sigma convergence has slowed down since the 1990s in Italy, with a change in the ranking of regions, to the advantage of the northern ones.

This conclusion is reinforced by the analysis of beta convergence which did occur over the entire period 1974-2019, and was apparently stronger for males than for females (Figure 4).

Figure 5 displays the evolution of the beta-convergence series estimated over five-year time intervals (Model 2), with their corresponding breakpoints (Model 3 and Model 4, with k=4). We estimated an earlier break for females in 1993 (1990–2001 95% CI), and a later one for males in 2001 (1999–2003 95% CI). These two breakpoints correspond to the two major health reforms mentioned earlier, although the reasons for the earlier occurrence of the break for females are still unclear. Consistently with expectations, these breakpoints separate an earlier phase of convergence (negative values of the beta coefficients) from a subsequent phase of relative stability (neither convergence nor divergence).

Figure 6 displays the sigma series together with the estimated breakpoints of Figure 5.[7] Consistently with expectations, these breakpoints separate an earlier phase of convergence (negative values of the beta coefficients) from a subsequent phase of relative stability.

Finally, we conducted the PP-test on the residuals of Model 4 for the beta series

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[7]We cannot apply here the same breakpoint-identification technique that we used for the beta series, because the sigma series do not show any clear trend.
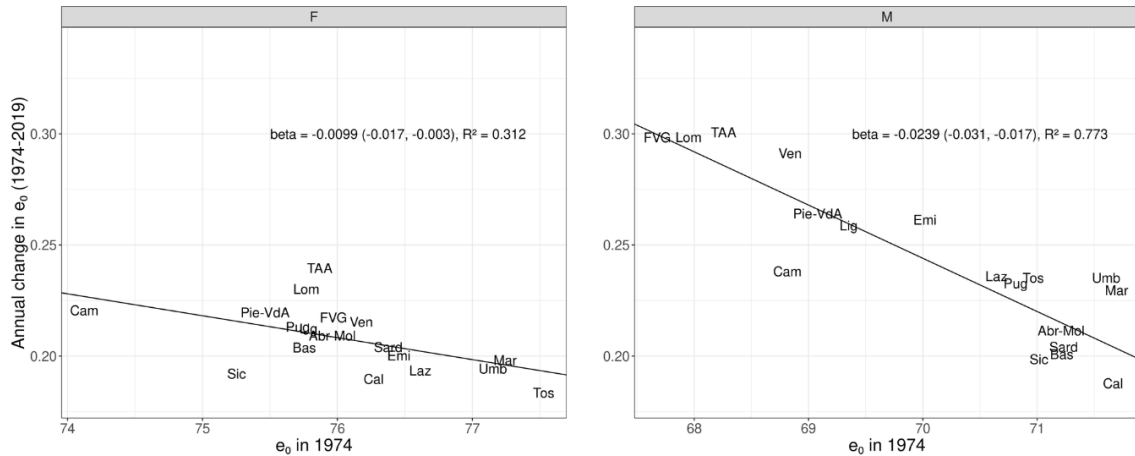
Figure 4: **Beta convergence for e_0, by gender**
List of the region abbreviations: Abr-Mol = Abruzzo-Molise; Bas = Basilicata; Cal = Calabria; Cam = Campania; Emi = Emilia-Romagna; FVG = Friuli-Venezia Giulia; Laz = Lazio; Lig = Liguria; Lom = Lombardia; Mar = Marche; Pie-VdA = Piemonte-Valle d'Aosta; Pug = Puglia; Sard = Sardegna; Sic = Sicilia; Tos = Toscana; TAA = Trentino Alto Adige / Südtirol; Umb = Umbria; Ven = Veneto
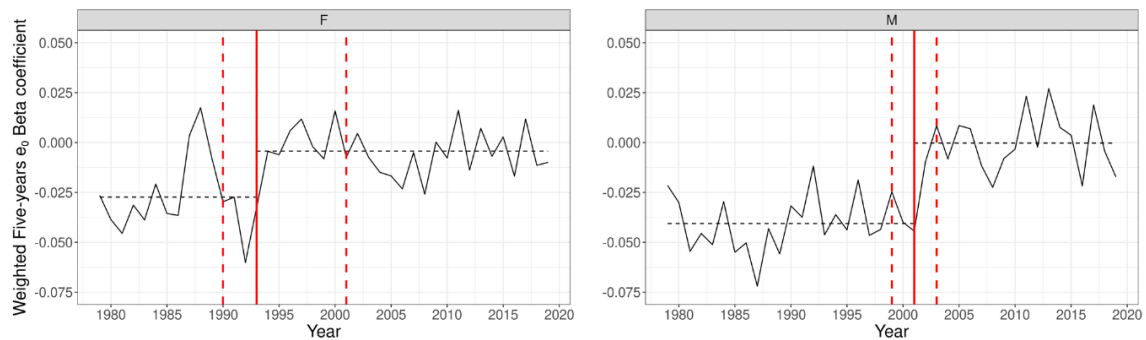Source: authors' calculations on ISTAT data

Figure 5: **Time series of the five-year beta convergence for e_0, by gender. Vertical lines represent our estimates of the structural breaks (continuous lines: point estimates; broken lines: 95% confidence intervals)**
Source: authors' calculations on ISTAT data

and in both cases the tests rejected the null hypothesis of non-stationarity. In other words, the assumptions we made in the quest for break points (Model 3) seem consistent with our data, and the beta series do behave like a shift mode (Figure 1). Table 1 shows the results of the PP-tests for each variable explored.

As a sensitivity analysis of the results obtained, we repeated Model 2, Model 3, and Model 4 for different lags (k=2, 3, 5, 6). Our results, reported in Table 2, are consistent with those presented in Figure 4, net of some variability inherent to this type of analysis. Most importantly, the slight differences that occasionally emerge do not affect the general picture of a significant change in the convergence process in conjunction with either of the two major health reforms of the Italian system discussed earlier (1993 and 2001).
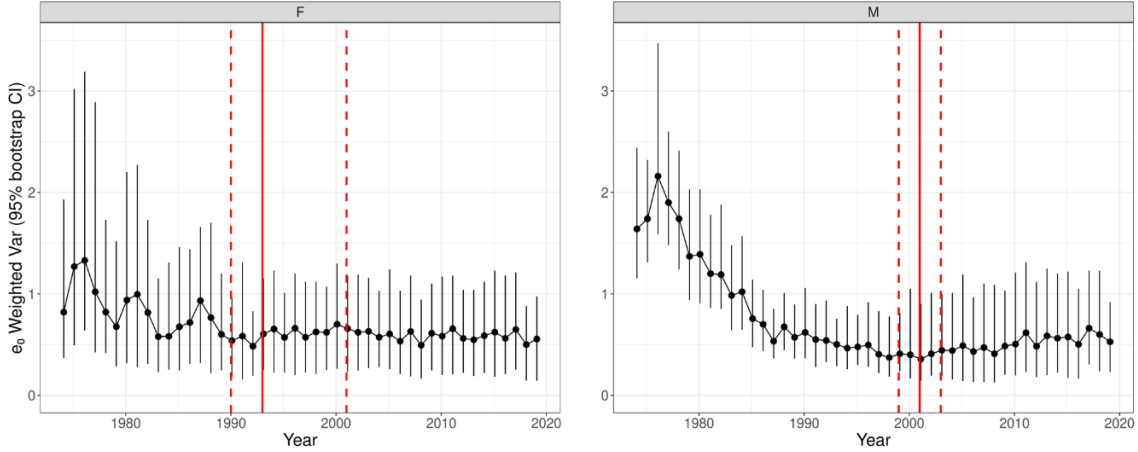
Figure 6: **Time series for sigma convergence of e_0, differentiated by gender. The vertical lines represent the structural breaks identified in the beta convergence time series**
Source: authors' calculations on ISTAT data

	test-statistics	truncation lag parameter[‡]	p-value
Females	-32.118	3	<0.01
Males	-41.109	3	<0.01

Table 1: **Results of PP-tests launched on the residuals of Model 4**
[‡]The truncation lag parameter is the number of past observations considered in the stationarity-test for each current period.
Source: authors' calculations on ISTAT data

k (Lag parameter)	Females		Males	
	Breakpoint	95% CI	Breakpoint	95% CI
2	-	-	1999	1996-2004
3	1985	1979-1992	2001	1999-2004
4	**1993**	**1990-2001**	**2001**	**1999-2003**
5	1995	1992-2001	2002	2001-2003
6	1995	1993-2002	2003	2002-2004

Table 2: **Structural breaks estimated in beta convergence for different values of k, with the corresponding confidence intervals (sensitivity analysis)**
Note: "-" indicates that no significant break was found. We remind our readers that $k+1$ (in years) is the length of the interval under study in that analysis. The case with $k=4$ ($k+1=5$) has been analysed above, in Figure 4
Source: authors' calculations on ISTAT data

4 Conclusion and discussion

In Italy, the process of convergence of regional life expectancies halted in the final decade of last century. Shortly later, in 2008, in correspondence with the onset of the economic crisis, the progress of survival slowed down markedly (Salinari, Benassi, and Carboni 2023).

Policy reforms and economic crises are not the sole potential causes of these evolutions. For instance, it could be argued that as Italy is one of the world countries where life expectancy is highest (currently, more than 80 years for men and slightly less than 85 years for women), this deceleration may be the inescapable consequence of approaching the limits of survival. However, whether these limits exist is still a matter of debate and in all cases they have not been identified yet (Dang et al. 2023). Besides, there are countries where life expectancy is even higher than it is in Italy, Japan for example, and where no marked slowdown in the progress of life expectancy has been detected.

Our hypothesis is that the reforms of the Italian health system that took place starting in the 1990s influenced this process. To test this hypothesis, we investigated the evolution of convergence in regional life expectancies. The econometric techniques that we used led us to identify the existence of significant discontinuities (or "structural breaks") in the convergence process, and these discontinuities emerged precisely in this period of reforms. In short, our hypothesis is not rejected by empirical data.

On the other hand, our hypothesis is not, and cannot possibly be, proved by our analysis, which is not intended to reveal the existence of causal links, in this case between systemic reforms and the evolution of regional survival (convergence or divergence, and at what speed). While this crucial link awaits more in-depth studies, our results merit consideration, we believe, for at least two reasons. First, they reveal, and temporally locate, a change of pace in regional survival that had gone unnoticed until now. Incidentally, as Felice, Andreu, and D.'Ippoliti (2016) show, the dynamic of convergence (or divergence) in life expectancy seems to anticipate economic fluctuations. Secondly, we offer a key to interpretation ("regionalizing" a national health system may jeopardize the health homogeneity of a country) that policy-makers may want to take into consideration when deciding on the future of national health systems.

References

Bai, Jushan and Pierre Perron (2003). "Computation and analysis of multiple structural change models". In: *Journal of applied econometrics* 18.1, pp. 1–22.

Barro, Robert J. and Xavier Sala-i.-Martin (1990). *Economic growth and convergence across the United States.*

— (1992). "Convergence". In: *Journal of political Economy* 100.2, pp. 223–251.

Barro, Robert J., Xavier Sala-i.-Martin, et al. (1991). "Convergence across states and regions". In: *Brookings papers on economic activity*, pp. 107–182.

Casacchia, Oliviero and Luisa Natale (2011). "Demographic and socioeconomic behaviour in the Italian regions: convergence and diversity." In: *Semestrale di Studi e Ricerche di Geografia, Dipartimento di Scienze Documentarie, linguistico-filologiche e geografiche, Sapienza Università di Roma.*

Cavalieri, Marina and Livio Ferrante (2020). "Convergence, decentralization and spatial effects: An analysis of Italian regional health outcomes". In: *Health Policy* 124.2, pp. 164–173.

Dang, Linh Hoang Khanh et al. (2023). "The question of the human mortality plateau". In: *Demographic Research* 48, pp. 321–338.

De Belvis, Antonio Giulio et al. (2023). "Italy: health system summary, 2022". In.

Egidi, Viviana and Elena Demuru (2018). "Impatto delle grandi crisi economiche su salute e mortalità: il caso italiano". In: *Annali di Statistica*, p. 57.

Felice, Emanuele, Josep Pujol Andreu, and Carlo D.'Ippoliti (2016). "GDP and life expectancy in Italy and Spain over the long run: A time-series approach". In: *Demographic research* 35, pp. 813–866.

Ferré., Francesca et al. (2014). "Italy: health system review". In.

Franklin, B., D. Hochlaf, and G. Holley-Moore (2017). "Public Health in Europe during the austerity years". In: *A research report from ICL-UK*. ICL-IK London.

Frova, Luisa et al. (2021). "Mortality and Covid-19". In: *Rapporto AISP 2021 L'eccezionalismo demografico* ((Eds.) Il Mulino, Bologna).

G.ä.chter, Martin and Engelbert Theurl (2011). "Health status convergence at the local level: empirical evidence from Austria". In: *International journal for equity in health* 10, pp. 1–13.

Gallus, Silvano et al. (2011). "Smoking prevalence and smoking attributable mortality in Italy, 2010". In: *Preventive medicine* 52.6, pp. 434–438.

Hrzic, Rok et al. (2021). "The short-term effects of european integration on mortality convergence: a case study of european union's 2004 enlargement". In: *European Journal of Population* 37, pp. 909–931.

Janssen, Fanny et al. (2016). "Sigma and beta convergence in regional mortality: A case study of the Netherlands". In: *Demographic Research* 35, pp. 81–116.

Lee, Ronald (2019). *Mortality forecasts and linear life expectancy trends.* Springer International Publishing.

Luy, Marc et al. (2020). "Life expectancy: frequently used, but hardly understood". In: *Gerontology* 66.1, pp. 95–104.

Montero-Granados, Roberto, Juan de Dios Jimé.nez, and José Martín (2007). "Decentralisation and convergence in health among the provinces of Spain (1980–2001)". In: *Social Science & Medicine* 64.6, pp. 1253–1264.

Murphy, Michael, Marc Luy, and Orsola Torrisi (2019). "Stalling of mortality in the United Kingdom and Europe: an analytical review of the evidence". In: *London, UK: London School of Economics*.

Oeppen, Jim and James W. Vaupel (2002). *Broken limits to life expectancy*.

Perron, Pierre (1988). "Trends and random walks in macroeconomic time series: Further evidence from a new approach". In: *Journal of economic dynamics and control* 12.2-3, pp. 297–332.

Petrelli, A. et al. (2019). "Atlante italiano delle disuguaglianze di mortalità per livello di istruzione". In: *Epidemiologia e Prevenzione* 43.1, pp. 1–120.

Raleigh, V.S. (Sept. 21, 2023). *Progress on implementing and using electronic health record systems: Developments in OECD countries as of 2021*. OECD Health Working Papers 160. Series: OECD Health Working Papers Volume: 160. DOI: 10.1787/4f4ce846-en. URL: https://www.oecd-ilibrary.org/social-issues-migration-health/progress-on-implementing-and-using-electronic-health-record-systems_4f4ce846-en.

Salinari, Giambattista, Federico Benassi, and Gianni Carboni (2023). "The Effect of the Great Recession on Italian Life Expectancy". In: *Population Research and Policy Review* 42.1, p. 3.

White, Kevin M. (2002). "Longevity advances in high-income countries, 1955–96". In: *Population and Development Review* 28.1, pp. 59–76.

Zeileis, Achim (2006). "Implementing a class of structural change tests: An econometric computing approach". In: *Computational Statistics & Data Analysis* 50.11, pp. 2987–3008.

Zeileis, Achim, Christian Kleiber, et al. (2003). "Testing and dating of structural changes in practice". In: *Computational Statistics & Data Analysis* 44.1-2, pp. 109–123.

Zeileis, Achim, Friedrich Leisch, et al. (2002). "strucchange: An R package for testing for structural change in linear regression models". In: *Journal of statistical software* 7, pp. 1–38.