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Regional well-being indicators and dispersion from a multidimensional perspective: evidence from Italy

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Abstract Interest in measuring well-being, as opposed to the more traditional economic indicators of growth, has increased significantly over recent years. This paper aims to contribute to the empirical literature on well-being indicators and dispersion across regions in terms of both quality of life and economic progress. Italian regions are used as case studies and 10 different multidimensional determinants of well-being are considered: culture and free time; education; employment; environment; availability of essential public services; health; material living conditions; personal security; research and innovation; and the strength of social relations. We calculated, by applying principal component analysis, synthetic indicators for each well-being determinant and for each region so as to generate—again, by means of the same methodology—an index of overall well-being. The study was conducted for every year over the period 2004–2010. Results clearly show that differences in well-being between regions are not necessarily in line with those based on per capita GDP, suggesting a need to give more attention to quality-of-life features of economic progress in public policy goals

We would like to dedicate this article to the memory of Giovanni Anania.

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and design. Furthermore, the paper looked at dispersion across regions and regional rank mobility over the same period. Italian regions have tended to become more similar in terms of well-being over time, but no evidence of significant intra-distributional mobility emerges.

JEL Classification D63 · I31 · O18 · R11

1 Introduction

Looking for suitable measures of well-being to assess people's quality of life is becoming more prominent on the agendas of governments and central institutes of statistics in several countries. An increasing number of programmes are being implemented in European countries. Since its introduction, GDP has been the most widely used indicator of a country's economic performance, and yet, it is also highly criticized as a measure of people's well-being. Indeed, GDP is a measure of production, but it ignores the undesirable side effects, such as pollution and environmental damage, which often accompany production growth. Furthermore, it does not include in its calculation a number of factors which significantly affect people's quality of life, for example, the quality of education, health care, the cultural and natural environment, social relations, personal safety, and decent housing (Fleurbaey 2009). Even worse, GDP may increase when children work and do not go to school or when there is growth in such criminal activities as drug peddling and prostitution. Thus, conflating market production statistics with quality-of-life evaluations may entail misleading conclusions about how well off people are (Stiglitz et al. 2009).

Unfortunately, whereas there are international standards for GDP calculation, a unique and universally accepted statistic for measuring well-being has not existed until now. As a consequence, due to the lack of suitable methods to measure the quality-of-life aspects of progress, economists have often engaged in analysing economic and social progress by focusing on production indicators, albeit they were aware that mixing the two aspects could lead to mistaken policy decisions (see, for instance, Kuznets 1934; Nordhaus and Tobin 1973; Osberg and Sharpe 2005).[1] Interest in the measurement of well-being has been increasing in the last two decades, not only in the academic world, but also in public policy programmes and debates. Thus, after halting beginnings, the quest for the measurement of well-being has acquired greater interest. However, despite the important literature on the subject, this remains an empirical, as well as a theoretical, challenge.

The empirical challenge comes with the difficulty of obtaining a universally accepted standard measure of the phenomenon, since well-being has a large spectrum of dimensions that should be investigated or quantified empirically. These dimensions range from material to relational features and from relational to subjective well-being, which includes the set of values and expectations of the individuals concerned. The theoretical challenge comes from the multifaceted aspect of the phenomenon, which

[1] The best-known alternative is the Human Development Index (HDI), which combines GDP per capita, literacy and average life expectancy into a single index.

is difficult to encapsulate within a single theory and, so, gives rise to a proliferation of theoretical approaches. Fleurbaey (2009) identifies four different approaches within which theoretical contributions can be grouped: (a) works aimed at obtaining a "corrected GDP" in order to take sustainability and nonmarket factors which influence well-being into consideration; (b) studies of the measurement of "gross national happiness"; (c) the "capability approach", proposed by Sen (1985, 2000), which states that progress does not coincide with a country's level of opulence, but rather with people's quality of life and freedom of choice; (d) the approach aiming at defining "synthetic indicators" which, in line with the UNDP Human Development Index, are based on the weighted average of indicators of different aspects of human well-being (UNDP 1990, 2010).[2]

The measuring of well-being has the difficult task of taking many questions into consideration. First, the number and the variety of well-being dimensions: which and how many domains should be considered? Secondly, the internal coherence of synthetic measures of different dimensions: how and to what degree are the different domains of well-being interrelated? Do they all have the same importance (weight) in defining well-being? How can we choose the appropriate weight for each dimension? Third, the relationships between the well-being indicators and the traditional economic indicators of production: does looking at well-being indicators rather than traditional economic growth indicators make any difference?

With these questions in mind, our aim in this paper is to contribute to the empirical literature on well-being measurement by considering Italy as a case study. First, in choosing the well-being dimensions, we try to limit arbitrariness to a minimum by considering the various insights which emerge from a recent project carried out by the Italian National Institute of Statistics (ISTAT) in conjunction with the National Council for Economy and Labour (CNEL). This project produced a database covering 12 dimensions of "Equitable and Sustainable Well-Being" (whose Italian acronym, BES, is used hereafter).[3] We then consider ten domains of well-being and calculate one synthetic indicator for each over the period 2004–2010, so combining a set of 57 variables at regional level by means of the principal component analysis. Unlike the BES report (CNEL-ISTAT 2013), we do not address the dimensions for which variables are not available at regional level or where data do not cover the same time interval.[4] On the other hand, in addition to the issues discussed in the BES report, we consider the "culture and free time" dimension in order to account for two phenomena, culture and sports, which have substantial consequences for people's well-being in terms of physical and psychological health, individual enjoyment, and leisure. Both these aspects are particularly relevant for the evaluation of a society's well-being because they determine externalities: cultural consumption and sport activities have been shown to foster civic participation, social capital, and social cohesion (Carlisle and Hanlon 2007; Diener 2009; Grossi et al. 2012).

[2] For a survey on the latter approach, see Bandura (2008), Stiglitz et al. (2009), Annoni and Weziak-Bialowolska (2012), Costanza et al. (2009). Bleys (2012) proposes a scheme for classifying 23 of the indicators available in the literature.

[3] The BES database is available at http://www.istat.it.

[4] These dimensions are: "subjective well-being"; "politics and institutions"; and "landscape and cultural heritage".

Secondly, our methodological strategy is to use the principal component analysis (hereafter PCA) in order to avoid subjective weighting schemes in building composite indicators. PCA is a multivariate statistical method for extracting synthetic measures from a set of variables by transforming them into a smaller number of variables, the principal components. These are given by the uncorrelated linear combinations of the original variables, whose variances are as large as possible. Furthermore, PCA enables us to evaluate the internal consistency of the indicators for each well-being dimension by analysing the structure of correlations between variables and other specific related tests, such as the measures of sampling adequacy and the Bartlett's test. We then use the partial synthetic indicators obtained in the first step to construct an overall index of well-being. This was not attempted in the BES report, yet is extremely useful because it allows synthetic analysis of the phenomenon. We finally analyse regional well-being dispersion and rank mobility across regions over the period by means of two nonparametric techniques, which are applied to both the partial and overall indicators. Then, we compare the dynamics of regional well-being with those of the traditional indicator of economic performance, the per capita GDP, in order to capture the differences in regional disparity trends when well-being is measured by just looking at the material and productive sphere and when a multidimensional perspective is, instead, adopted. Last, we investigate the contribution of each dimension to the overall well-being dispersion by implementing a regression-based decomposition.

Thus, the main new contributions of the present study are both conceptual and methodological. On a conceptual level, the study refers to a wider spectrum of domains and variables than has, until now, been used in the empirical literature on the measurement of well-being in Italy (Berloffa and Modena 2012; Capriati 2011; Felice 2007; Ferrara and Nisticò 2013; Iuzzolino et al. 2011; Murias et al. 2012) and for the period analysed, which covers the advent of the present economic and financial crisis. On the other hand, on a methodological level, this is the first paper, to the best of our knowledge, that uses principal component analysis in a two-step approach. We calculate single-domain sub-indices in the first step and the overall well-being indicator in the second step. This is done by using the sub-indices, which were previously calculated by means of the same methodology, as the new variables. Indeed, most of the existing empirical literature on measuring well-being relies upon either composite indicators calculated as weighted averages of variables and sub-indices (Berloffa and Modena 2012; Marchante et al. 2006; OECD 2011, 2013) or mixed statistical strategies that use principal component analysis to assess the internal coherence of the different domains and the weighted average of the partial indices to calculate the respective composite indicators (Annoni and Weziak-Bialowolska 2012).

The paper is structured as follows. Section 2 illustrates the data and methodology used. Section 3 illustrates the domains considered in the study and presents some preliminary results of the principal component analysis. In Sect. 4, the results of the partial and overall synthetic indices of well-being are discussed. Section 5 presents the analysis of regional disparity trends in terms of both partial and overall well-being indicators. Section 6 illustrates the results of the regression-based decomposition of well-being dispersion, and Sect. 7 concludes by discussing the results.

2 Data and methods

The data used in this study, i.e. the BES statistics (CNEL-ISTAT 2013) and the ISTAT-DPS database, a set of territorial indicators for development and cohesion policies, are extracted from ISTAT databases. The description of the variables used in the analysis, their definition and source are reported in Table 8 of the "Appendix".

The methodological strategy is to apply PCA in order to obtain partial and overall synthetic indicators of well-being. Then, two nonparametric statistics are used to assess well-being dynamics across Italian regions and regional intra-distribution mobility. Furthermore, a regression-based decomposition methodology is implemented in order to investigate the contribution of each partial indicator to the overall well-being dispersion across regions.

In order to prepare the data properly, all the variables used in the analysis are divided by the respective mean, before implementing principle component analysis in the first stage, with the aim of eliminating differences in the units of measurement while preserving differences in the variability present in each variable. Thus, the principal components are extracted from the variance–covariance matrix.

We follow a two-step approach to build our well-being indices. In the first step, the 57 original variables, grouped into 10 sets each of which describes a well-being domain, are reduced to synthetic indicators by the PCA. These are calculated for every year in the period 2004–2010 and for each Italian region. In the second step, we apply the PCA in order to extract an overall indicator of regional well-being (RWBI) from the synthetic indices, considered as a new series of variables. As in the first step, the principal components are extracted from the covariance matrix. On the whole, our results rely upon 77 applications of principal component analysis.[5]

We use the synthetic indicators of each domain and the RWBI to assess dispersion across Italian regions over the seven year period considered in the analysis and the regional dynamics in well-being ranking. Following the literature (Giannias et al. 1999; Marchante et al. 2006; Jordà and Sarabia 2014), the measure of dispersion that is used in the paper is the coefficient of variation calculated on the scaled values of the variables, which in our case are represented by the principal components extracted for each dimension and overall well-being:

$$sY^t_{n,d} = \frac{\left(Y^t_{n,d} - Y_{n,d\min}\right)}{\left(Y_{n,d\max} - Y_{n,d\min}\right)},$$

where $Y^t_{n,d}$ is the value of the nth principal component extracted for dimension d and year t; $Y_{n,d\min}$ and $Y_{n,d\max}$ are, respectively, the minimum and the maximum values of the nth principal component extracted for dimension d in the period under consideration.[6] $sY^t_{n,d}$ assumes values between 0 and 1.

[5] Before assuming the replicability of the current study and keeping only the first component, the cross-checking with the Kaiser criterion and the Scree test is always required.

[6] We find similar results by considering the minimum and maximum values of the principal component(s) extracted for each year.

If the coefficient of variation in T is lower (higher) than the coefficient of variation in t, with $T^{2010}_{=2005}$ and $T > t$, then regions have become more similar (different) over time.[7] Following O'Leary (2001), we also calculate the rate of change between the coefficient of variation at time T and year t, where a negative (positive) value implies lower (higher) dispersion.

Regional dynamics in well-being ranking are investigated by following the approach proposed by Boyle and McCarthy (1997), which assesses the extent of intra-distributional mobility over time by focusing on the change in each region's rank by using Kendall's index (Siegel 1956).[8] We consider the binary version of Kendall's index, which takes into account the concordance between the ranks in year T and the initial year (2004 in our case), for the different dimensions of well-being:

$$k_T = \frac{\text{Var}\left[AR\left(sY^T_{n,d}\right)_z + AR\left(sY^{2004}_{n,d}\right)_z\right]}{\text{Var}\left[2 * AR\left(sY^{2004}_{n,d}\right)_z\right]};$$

$$k_T = \frac{\text{Var}\left[AR\left(s\text{RWBI}^T\right)_z + AR\left(s\text{RWBI}^{2004}\right)_z\right]}{\text{Var}\left[2 * AR\left(s\text{RWBI}^{2004}\right)_z\right]}$$

where $AR\left(sY^T_{n,d}\right)_z$ is the rank of region z's indicator(s) of well-being dimension d in year T. Similarly, $AR\left(s\text{RWBI}^T\right)_z$ is the rank of the synthetic indicator of well-being for region z in year T. k_T ranges between 0 and 1: the closer the k_T is to zero, the greater mobility within the distribution is.[9]

As in Boyle and McCarthy (1997), we test the null hypothesis that no association exists between the ranks in year T and 2004. If the null hypothesis is rejected, we have no intra-distributional mobility over time. In the binary version of Kendall's index, the test statistic is the following:

$$\chi^2 = 2 * (S - 1) * k_T$$

[7] The literature refers to the long-run trend of the coefficient of variation as σ-convergence (Friedman 1992; Sala-I-Martin 1994): by adapting the Sala-I-Martin (1996) approach on GDP convergence across countries, regions are converging in the sense of σ if the dispersion of their well-being decreases over time. However, some authors assess convergence by referring to the mobility of units (countries or regions, for instance) over time within the given distribution of the relevant variable, known as β-convergence: if the relevant variable in regions which initially have a less advantageous position exhibits faster growth than the relevant variable in those regions that initially show higher values, there is absolute β-convergence. Although the concepts of σ and β-convergence are related, they do not always show up together: as a matter of fact, the existence of β-convergence is a necessary, but not sufficient, condition for the existence of σ-convergence. Mobility within the distribution (β-convergence) does not ensure that dispersion diminishes over time (σ-convergence), while on the other hand, σ-convergence implies (is sufficient for) β-convergence, but is not a necessary condition (Sala-I-Martin 1996).

[8] Some authors use Kendall's index of rank concordance as a nonparametric approach for assessing β-convergence, known as γ-convergence (Boyle and McCarthy 1997; Marchante et al. 2006).

[9] If more than one principal component is extracted for a dimension, we have more than one synthetic indicator for that ambit; for the RWBI, we have a single indicator.

This is distributed as χ^2 with $(S-1)$ degrees of freedom, where $S = 20$ is the total number of Italian regions.

Then, in order to compare the regional dispersion and ranking dynamics of well-being with those of the traditional indicator of economic progress, we also calculate the rate of change in the coefficient of variation and the Kendall index for per capita GDP.

Finally, we explore the factors underlying well-being dispersion by means of an econometric method, widely used in literature on wage discrimination (Blinder 1973) or income inequality (Cowell and Fiorio 2011). Literature on inequality decomposition is divided into two main strands: the first one based on "a priori approaches" and the second characterized by regression models. The first approach does not allow for a causal analysis as it is purely based on the analysis of the mathematical properties of inequality indices. The second approach relies upon recent regression-based works (Cowell and Fiorio 2011; Fiorio and Jenkins 2008; Fields 2003) which aim at overcoming the restrictions of the traditional methods.

This study refers to the regression-based inequality decomposition proposed by Fiorio and Jenkins (2008), as well as following the methodology proposed by Fields (2003). These approaches are based on a single-equation regression, build on the Shorrocks (1982) methodology and are aimed at providing a tool for understanding inequality, especially when the data are not sufficiently detailed to allow a structural model specification.

Our goal is to decompose the dispersion (inequality) of our synthetic well-being indicator (RWBI) into the contribution accounted for by each of the partial indicators. RWBI is obtained through a linear combination of the partial indicators, using the weights deriving from the principal component analysis.

Analogously,

$$\text{RWBI} = X\beta + \epsilon \tag{1}$$

where X is the vector of the partial indicators combined in RWBI, β is the vector of the coefficients and ϵ is a vector of residuals. This model can be written explicitly as:

$$\text{RWBI} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_d X_d + \epsilon \tag{2}$$

$$= \beta_0 + \theta_1 + \theta_2 + \cdots + \theta_d + \epsilon \tag{3}$$

$\theta k, (k = 1, \ldots, d)$ is given by the product of the regression coefficient and its variable. Fields (2003) suggests that the OLS estimate of (3) can be used for inequality decomposition.[10] Indeed, leaving aside the constant, Eqs. (2) and (3) have the same form as Shorrocks' (1982) equation when it is deriving the rules for inequality decompositions by factor components. On the basis of Shorrocks' axioms, it is possible to derive a single additive and exact decomposition rule, with one term for each factor. In this model, the decomposition rule does not depend on the inequality measure.[11]

[10] Alternatively, on the left side of the equation, one may see the predicted values of the RWBI. However, this does not make any difference in our analysis.

[11] The main disadvantage of this approach is that the effect on the dependent variable is related to the composite variables θ_d instead of X_d.

3 A brief description of the well-being dimensions and preliminary results

We consider 10 dimensions of well-being: culture and free time, education, employment, environment, essential public services, health, material living conditions, personal security, research and innovation, and social relations (Table 8 in "Appendix").

3.1 Culture and free time

Consumption of cultural goods and other leisure and free time activities provide benefits at both social and economic levels. They influence the growth of human capital, enhance social capital and relationships and improve the individual's mental and physical condition (Grossi et al. 2012; Konlaan et al. 2000; Hyppa et al. 2006; Bygren et al. 2009). Daykin et al. (2008) have carried out a review of the literature on the impact of participation in the performing arts on adolescents' behaviour and social skills. Similarly, sport influences well-being through its effect on physical and psychological health and the opportunity it offers for social interaction (Galloway 2006).

Seven variables are used to describe the culture and free time dimension of well-being (Table 8 in "Appendix"). Two indicators refer to reading: newspaper reading is measured as the percentage of people aged 6 and over who read newspapers at least once a week (C1) and book reading as the percentage of people who have read books in the previous 12 months (C5). Four indicators deal with attendance at cultural or leisure events, measured as the percentage of people aged 6 and over who, at least once in the last year, have been to theatrical performances (C2), live classical music concerts (C3), sport events (C4), or museums (C6). The last indicator is sport (C7), measured as the percentage of people aged 3 and over who declare they practice sports.

The first principal component accounts for 79 % of the total variance present in the seven original variables in the years 2004 and 2005, and 80 % or more in the following years (Table 1).[12] By implementing PCA, both the latent root criterion of retaining components whose eigenvalues are greater than the average of the eigenvalues and the Scree test suggest that just the first principal component will be retained (Fig. 1a; Table 1). Its correlations with all the original variables are positive, and so they show the expected sign.[13] We can thus consider the value of the first principal component as a synthetic index of the culture and free time dimension of well-being.

[12] The validation of the analysis is further assessed by verifying that, for each dimension, a) the structure of correlations meets the necessary threshold, with results from Kaiser's measure of sampling adequacy falling into the acceptable range (above 0.50) for each year, both for the overall set of variables and individual variables, and b) the Bartlett test shows that nonzero correlations exist (see Hair et al. 2014, 103). For the sake of brevity, we neither comment nor show the results of these tests, but they are available from the authors on request.

[13] The correlation matrix for each well-being dimension and detailed information on the results of the principal component analysis are available from the authors on request.

Table 1 Eigenvalues (λi) and average eigenvalue by dimension and by year

Component	2004	2005	2006	2007	2008	2009	2010
Culture and free time							
1	.269	.250	.248	.287	.293	.241	.242
2	.043	.034	.037	.033	.040	.034	.033
3	.012	.015	.012	.014	.015	.010	.013
4	.007	.008	.006	.007	.007	.009	.008
5	.005	.004	.004	.004	.004	.004	.005
6	.002	.002	.003	.002	.002	.002	.002
7	.001	.001	.001	.001	.001	.001	.001
Average λi	.048	.045	.045	.050	.052	.043	.043
Education							
1	.479	.716	.987	1.181	.568	.643	.643
2	.065	.068	.066	.075	.080	.101	.101
3	.015	.016	.012	.016	.012	.016	.016
4	.008	.010	.007	.006	.006	.005	.005
5	.001	.002	.001	.001	.003	.003	.003
Average λi	.114	.162	.215	.256	.134	.154	.154
Employment							
1	1.034	1.077	1.002	.970	1.019	.868	.854
2	.059	.064	.058	.056	.057	.057	.055
3	.024	.023	.029	.031	.033	.039	.048
4	.014	.008	.012	.021	.021	.025	.019
5	.005	.005	.003	.010	.006	.008	.007
6	.002	.002	.002	.002	.003	.002	.003
7	.000	.001	.001	.001	.001	.001	.001
8	.000	.000	.000	.000	.000	.000	.000
Average λi	.142	.147	.138	.136	.143	.125	.123
Environment							
1	4.110	3.863	4.529	4.261	4.031	3.829	2.937
2	.895	.794	.612	.811	.769	.613	.587
3	.637	.519	.506	.370	.359	.445	.390
4	.464	.372	.326	.253	.216	.230	.314
5	.238	.246	.247	.173	.156	.122	.165
6	.201	.199	.185	.107	.085	.086	.107
Average λi	1.091	.999	1.067	.996	.936	.888	.750
Essential public services							
1	1.259	1.678	1.510	1.370	1.561	1.761	1.890
2	.740	.568	.613	.348	.483	.392	.402
3	.392	.351	.271	.260	.322	.246	.349
4	.299	.237	.158	.156	.157	.143	.139
5	.093	.075	.102	.081	.095	.099	.120
6	.026	.028	.025	.054	.038	.034	.063

Table 1 continued

Component	2004	2005	2006	2007	2008	2009	2010
Average λi	.47	.49	.45	.38	.44	.45	.49
Health							
1	.199	.167	.168	.169	.160	.169	.163
2	.017	.035	.048	.090	.057	.027	.024
3	.005	.014	.011	.017	.018	.014	.011
4	.003	.005	.003	.002	.002	.002	.002
5	.00	.00	.00	.00	.00	.00	.00
Average λi	.045	.044	.046	.055	.048	.042	.040
Material living conditions							
1	.980	.895	.975	.967	.977	.864	.826
2	.029	.042	.032	.052	.043	.059	.050
3	.019	.017	.024	.028	.027	.017	.014
4	.006	.004	.008	.006	.004	.010	.010
5	.003	.003	.004	.004	.003	.002	.001
Average λi	.207	.192	.208	.211	.211	.190	.180
Personal security							
1	1.246	1.248	1.302	1.233	1.370	1.200	1.095
2	.794	.810	.694	.712	.654	.617	.660
3	.235	.194	.179	.135	.221	.193	.189
4	.067	.101	.082	.054	.064	.083	.093
5	.040	.047	.032	.037	.027	.042	.041
Average λi	.477	.480	.458	.434	.467	.427	.415
Research and innovation							
1	1.327	1.200	1.257	1.258	1.260	1.232	1.269
2	.306	.327	.260	.220	.206	.215	.185
3	.059	.070	.063	.054	.053	.067	.064
4	.046	.052	.048	.046	.049	.039	.041
5	.018	.015	.018	.023	.012	.009	.011
Average λi	.351	.333	.329	.320	.316	.312	.314
Social relations							
1	.472	.444	.449	.381	.449	.358	.353
2	.027	.026	.024	.022	.020	.017	.021
3	.008	.009	.009	.009	.008	.014	.009
4	.004	.005	.005	.005	.003	.005	.001
5	.002	.002	.001	.001	.001	.001	.001
Average λi	.103	.097	.098	.084	.096	.079	.077
Well-being							
1	5.977	6.178	6.024	5.519	5.922	5.369	4.550
2	4.056	3.839	4.514	3.934	3.959	4.037	3.392
3	1.303	1.164	1.531	1.197	1.076	.965	.795
4	.446	.487	.651	.795	.657	.633	.529

Table 1 continued

Component	2004	2005	2006	2007	2008	2009	2010
5	.347	.362	.469	.285	.550	.340	.349
6	.228	.191	.280	.127	.309	.222	.204
7	.147	.130	.130	.115	.165	.117	.086
8	.112	.069	.082	.066	.082	.057	.046
9	.069	.056	.029	.034	.059	.020	.019
10	.023	.012	.013	.023	.020	.018	.014
11	.007	.006	.010	.012	.016	.004	.007
12	.005	.005	.002		.009		
Average λi	1.060	1.042	1.249	1.009	1.069	1.071	.908

Source: elaborations on ISTAT data

3.2 Education

Education influences many important aspects of people's lives (Michalos 2008). A copious quantity of literature assesses the individual returns from education in terms of productivity and earnings (see Harmon et al. 2003 for a survey). Furthermore, education entails externalities which affect the progress of society in general (Lochner and Moretti 2004; Milligan et al. 2004; OECD 2010; Sianesi and Van Reenen 2003; Hanushek and Woessmann 2008). These studies find that more and higher-quality education are positively linked to better public health and environmental care, to greater respect for civil rights (lower crime and wider participation in political and community life), and to greater social cohesion. Some recent literature deals with private non-monetary returns on schooling (Yakovlev and Leguizamon 2012; Oreopoulos and Salvanes 2011; Vila 2000; Wolfe and Zuvekas 1997), indicating that higher levels of education may entail improvements in decision-making and, thus, in work satisfaction. Beyond this, they may also lead to greater individual prestige, health status and social relations, all of which are, in turn, likely to bring about greater well-being.

For the construction of the education index, we selected five variables (Table 8 in "Appendix").

Considering that education is compulsory up to lower secondary school level in Italy, we have focused our attention on two indicators relating to higher levels of educational attainment: the percentage of people aged 30–34 with tertiary education (E1) and the percentage of people aged 25–64 who have completed secondary education (E5). The first indicator is included among the targets set out in the Europe 2020 strategy, which aims to bring the share of people aged 30–34 with a university degree up to 40 % by 2020. The latter indicator is usually used in international comparisons to assess the level of formal education in a country's population (CNEL-ISTAT 2013). The acquisition of higher education is indicative of people's cognitive-cultural and professional-remunerative aspirations.

Two indicators are included to capture the problem of students' dropping-out of school. The first is the rate (share of population) of early leavers from education and training (E2), which is also a target indicator in the Europe 2020 strategy as an attempt

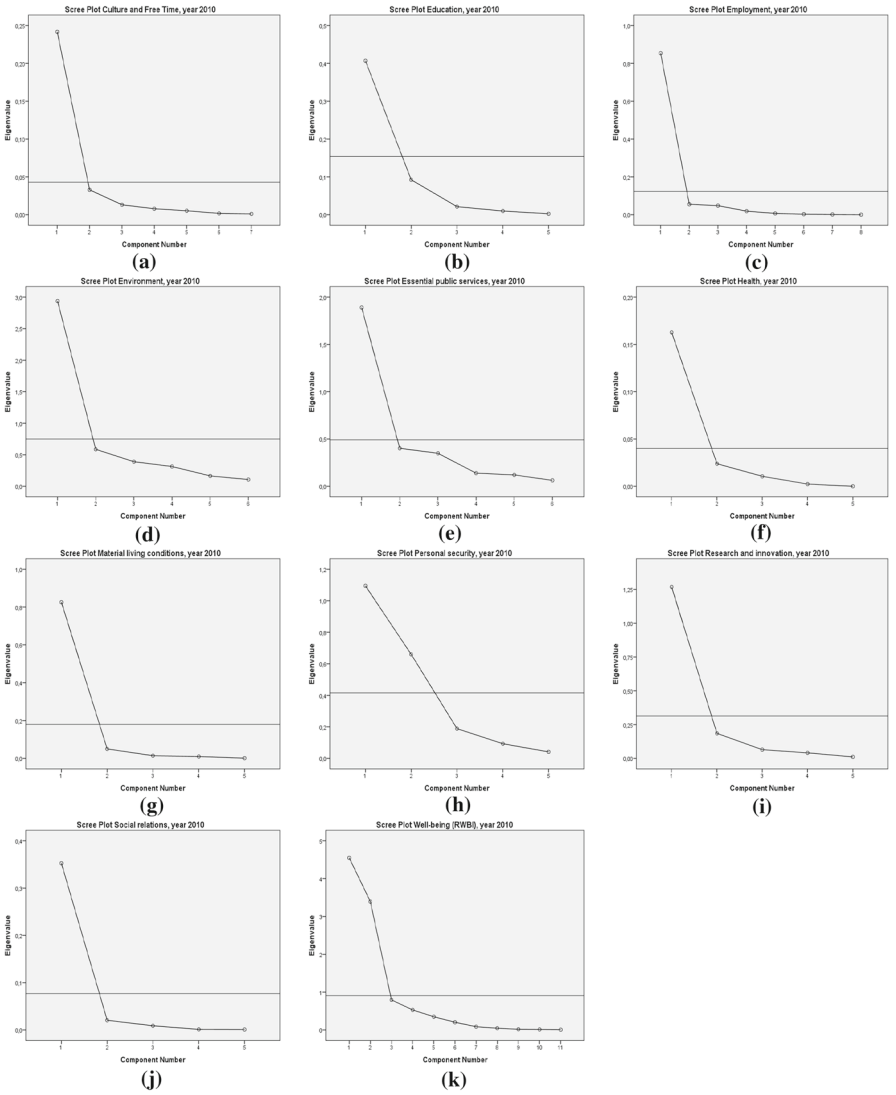

Fig. 1 Scree plots by well-being dimension. *Note* Scree plots and the Kaiser rule for all the other years considered in the analysis, which for the sake of brevity are not reported in the paper, are available from the authors on request

to reduce the proportion of dropouts in European countries to below 10 % by 2020. The second indicator is the rate (percentage of people) of upper secondary school leavers (E3). Another indicator used is the percentage rate of participation in lifelong learning (E4).

On the basis of both the Kaiser rule and the Scree test, only the first principal component is retained (Fig. 1b; Table 1). It explains 79 % of the total variance present in the five original variables in 2010 and assumes higher values in previous years (Table 2).

Table 2 Variance explained (%) for each well-being dimension and for the well-being synthetic index by year

	Nr. of variables	2004	2005	2006	2007	2008	2009	2010
Culture and free time	7	79	79	80	83	81	80	80
Education	5	84	88	92	92	85	84	76
Employment	8	91	91	91	89	89	87	86
Environment	6	63	65	71	71	72	72	65
Essential public services	6	45	57	56	60	59	66	64
Health assistance services (II C)	6	26	19	23		18		
Health	5	88	75	73	61	67	80	82
Material living conditions	5	96	93	94	92	93	91	92
Personal security	5	52	52	57	57	59	56	53
Less serious crimes (II C)	5	33	34	30	33	28	29	32
Research and innovation	5	76	72	76	79	79	79	81
Social relations	5	92	91	92	91	93	91	92
Regional well-being index	12[a]	47	50	44	46	46	46	46

Source: elaborations on ISTAT data
[a] The variables included in RWBI are 11 for the years: 2007, 2009 and 2010

It shows positive correlations with the percentage of people who have completed tertiary education (E1), participated in lifelong learning (E4), and the share of population who have completed their secondary education (E5), and negative correlations for the remaining two variables, i.e. the rate of early leavers from education and training (E2) and the rate of upper secondary school leavers (E3).

3.3 Employment

Employment is a crucial dimension in defining well-being, both from the perspective of individuals' opportunities to fulfil their job aspirations and to earn the money they require to satisfy their needs, personal ambitions and desires. Although the standard neoclassical theory assumes that a "disutility of work" exists, a number of studies show a negative impact of unemployment on individual satisfaction and well-being which is not simply caused by a loss of income (Rätzel 2012; Clark and Oswald 1994; Gerlach and Stephan 1996; Winkelmann and Winkelmann 1998; Clark 2003). Social status and self-esteem are closely linked to employment and income (Solow 1990). Having a job enables people to develop new competencies and relationships, which give them the opportunity to enrich their social capital (OECD 2013).

We selected eight indicators which describe the employment dimension of well-being (Table 8 in "Appendix"). The first is the employment rate (L1), the indicator commonly used to measure the availability of jobs. However, as in CNEL-ISTAT (2013), we calculated the employment rate for people aged 20–64 in order to consider the percentage of the employed population among those who are thought to have com-

pleted secondary school, so avoiding considering younger people who left school at the minimum legal level (lower secondary school in Italy) for economic or other reasons. To evaluate the lack of jobs, again in accordance with CNEL-ISTAT (2013), we use the non-participation rate (L2) instead of the usual unemployment rate. The share of currently employed people who have had temporary jobs for at least 5 years (L3) is used to capture job (in)security. Another important feature of employment which affects individual well-being is the incidence of irregular jobs which undermines the principle of equity that should guide labour relations (Solow 1990). This is considered in our analysis by means of the share of people employed in an irregular occupation (L4).

Gender inequality in job opportunities and difficulties faced by women in balancing life and work are captured, respectively, by the percentage ratio of female to male employment rate (L6) and the percentage ratio between the employment rate of women aged 25–49 with at least one child of compulsory school age (6–13) and the employment rate of women aged 25–49 without children (L5).

One of the variables used focuses on the problem of the incidence of long-term unemployment (L7), measured as the percentage of people looking for employment for more than 12 months. Long-term unemployment discourages job searching and has negative consequences on the quality of human capital, so making it even more difficult for people to find a job. The final variable is the youth unemployment rate (L8), a contentious issue in the agenda of Italian policy makers and a major societal concern.

The share of the variance present in the seven variables which is explained by the first principal component is quite high, ranging from 91 % for the years 2004–2006 to 86 % in 2010 (Table 2). Kaiser's rule and the Scree test indicate that it is appropriate to retain one component for further analysis (Fig. 1c; Table 1). The component matrix shows that correlations with the first principal component are positive for three variables (the employment rate–L1, the relative employment rate for women with children–L5, and the ratio of female employment to male employment rate–L6) and negative for the remaining indicators.

3.4 Environment

Environment is an essential aspect of well-being, above all because of its impact on human health and sustainability issues. For example, air and noise pollution, hazardous substances and contaminants have all been shown to be linked to ill health (Zivin and Neidell 2013). Furthermore, people derive pleasure directly from the natural beauty and liveability that a place offers, since biophysics affect our daily lives (Dodds 1997). Moreover, many derive satisfaction from society's attempting to combat the degradation of the planet and the over exploitation of natural resources (OECD 2013). Zivin and Neidell (2013) highlight three strands of the recent economic literature on the relationship between the environment and individual well-being: the effects of pollution on people's decisions about where to live (Chay and Greenstone 2005); the costs of avoidance behaviour, adopted by people as they attempt to avoid toxic exposure (Courant and Porter 1981; Harrington and Portney 1987); a number

of studies on the effects of environmental pollution on human capital, productivity, cognitive development and performance (Zivin and Neidell 2013; Lavy et al. 2012, among others).

The environmental index calculated on the basis of available data refers to those aspects of well-being which involve environmental quality and local liveability. We consider six variables (Table 8 in "Appendix"): three variables capture the first aspect and reflect the idea that environmental quality improves with the reduction in fertilizers used in agriculture per hectare of Utilized Agriculture Area (A1), the increase in the number of air quality monitoring stations in relation to the number of city dwellers (A2), and growth in the percentage of energy consumption provided by renewable sources (A4), while the other three variables refer to the dimension of local liveability, which improves as air pollution (A3), measured as the percentage of days in a year in which the level of PM10 was higher than the limit in regional capital cities, decreases. Local liveability is supposed to be enhanced as population density (A6) falls and the percentage of specially protected areas increases (A5). All variables are divided by their respective means before running PCA.

By applying Kaiser's rule and by looking at the Scree plots, only the first principal component was retained (Fig. 1d; Table 1). It explains a quota of the total variance which ranges from 63 % for 2004 to 72 % for 2008 and 2009. It is positively correlated with the monitoring of air quality, energy consumption covered by renewable sources and special protection areas, while it has negative correlations with fertilizers used in agriculture, air pollution and population density.

3.5 Essential public services

A key role in determining people's well-being is played by their access to essential services, such as the provision and quality of child and elderly care, water and electricity, and waste management. These services are ipso facto important for social and civic progress. Furthermore, they involve spillovers into other dimensions of well-being, for example, an increase in the availability of child and elderly care would facilitate women's participation in the labour market, whereas urban waste management protects and improves the quality of the environment. Striking regional disparities in the provision of these essential services are found in Italy. Notwithstanding the improvements after the unification of Italy, citizens who live in the Mezzogiorno still have to contend with central and local government services of much lower quantity, quality, accessibility and efficiency than those who live in the North (Cersosimo and Nisticò 2013).

We select six variables to assess the quality of essential services provided to citizens (Table 8 in "Appendix"). The first one regards health services and, in particular, the problem of long waiting lists for treatment (Q1), measured as the share of residents who give up the chance to consult a specialist or undergo therapeutic treatment because of the length of waiting lists. The percentage of differentiated urban waste collection out of total urban waste (Q2) captures the progress in recycling urban waste. Two indicators refer to the percentage of children up to age 3 using childcare services (Q3) and the share of elderly people who benefited from integrated home assistance services (Q4). The last two variables look at inefficiency in the provision of electricity

(Q5), measured as the average number per consumer of accidental long lasting power cuts, and in water supply (Q6), given by the percentage of households which report irregularities.

Before extracting principal components from the variance–covariance matrix, all variables are divided by their respective means. The Kaiser rule and the Scree plot test suggest retaining one component for 3 years (2007, 2009 and 2010) and two components for years 2004, 2005, 2006 and 2008 (Fig. 1e; Table 1). The varimax-rotated solution helps to interpret the first principal component as a synthetic indicator of essential public services other than health assistance services. Indeed, the variables representing the elderly who benefit from home integrated assistance (Q4) and waiting lists for specialistic visits and therapeutic treatment (Q1) load heavily on the second component, whereas the remaining variables load more on the first principal component.

The variance in the original variables that is explained by the first principal component ranges from 45 % in 2004 to 66 % in 2009 (Table 2). In the years 2004, 2005, 2006 and 2008, the cumulative percentage of variance explained by the two extracted components varies between 68 and 76 %. The first principal component is positively correlated with the percentage of differentiated urban waste collection (Q2), the percentage of children up to age 3 using childcare services (Q3) and the share of elderly people assisted at home (Q4). On the other hand, the elements of the component matrix are negative for the variables: waiting lists for treatment (Q1), break downs in electric power provision (Q5) and irregularities in water supply (Q6).

3.6 Health

Health is among the most important factors that people indicate as influencing their well-being (ONS 2011; WHO 2013; OECD 2013) and has been the dimension that authors have most commonly included when constructing composite well-being indicators since the pioneering initiative of the UNDP Human Development Index (UNDP 1990, 2010). Many studies state a two-way relationship between health and well-being. Mental and physical health influence professional and personal relationships as they free people from medical or other care needs and increase their probability of finding work and the likelihood they will participate in social activities. Conversely, improved quality of life increases the individual's attention to prevention and medical check-ups, enhances immune systems, increases longevity and reproductive health, and, in the case of disease, provides access to adequate care (Diener and Chan 2011; Dolan et al. 2008).

The health index is calculated from five basic indicators (Table 8 in "Appendix"): life expectancy at birth (H1), measured as the average number of years that a child born in a given calendar year can expected to live; the infant mortality rate (H2), i.e. deaths in the first year of life per 10,000 live births; the proportion of the population who are overweight or obese (H3), which is a major risk factor for a number of chronic diseases, including diabetes, cardiovascular diseases and cancer (WHO 2014; Darnton-Hill et al. 2004); sedentary lifestyle (H4), given by the percentage of people aged 14 and over who do not practice any physical activity, which, by contributing to obesity, causes the

same risks of chronic diseases, whereas there is evidence that physical activity reduces anxiety and depression (WHO 2010). Analogously, a balanced diet (H5), measured as the share of population aged 3 years and over who consume at least four portions of fruit and vegetables a day, is important for good health (Swinburn et al. 2004).

We implement principle component analysis by considering the value of each variable divided by the respective mean. When we apply the latent root criterion and look at the Scree plot, one component is retained, except for the years 2007, 2008 and 2009 for which the same rules indicated the choice of two components (Fig. 1f; Table 1). However, the component matrix obtained by means of the varimax rotation showed that only one variable (H2) loaded onto the second principal component, producing a variable-specific factor. Thus, we decided to extract just the first principal component for the three above-mentioned years, too. The quota of the total variance explained by the first principal component ranges from 61 % in 2007 to 88 % in 2004 (Table 2).

The first principal component is positively linked to life expectancy at birth (H1) and nutrition (H5) and has a negative association with the infant mortality rate (H2), overweight or obesity (H3), and sedentariness (H4).

3.7 Material living conditions

Material living conditions, determining people's ability to satisfy their needs and aspirations, are an essential component of well-being (OECD 2013). The index of material conditions is based on five variables (Table 8 in "Appendix"). We consider dimensions that can be summed up in monetary units and dimensions relating to aspects of daily life, such as housing. Among the first group of variables, we include not only the per capita household disposable income (M1), but also indicators of income inequalities (M2), measured as the ratio between the income of the richest 20 % of the population and that of the poorest 20 %, (M3) which measures the percentage of people at risk of relative poverty, and social distress (M4), given by the share of people living in a jobless households. What is more, the percentage of people living in houses with "structural problems" (M5) reflects social and economic disadvantage in material living standards, which, in turn, affects essential needs such as personal security, privacy, health and the quality of family relationships (OECD 2008). Each variable has been divided by its mean before implementing PCA. Scree plots and Kaiser's rule indicate that only the first principal component should be retained (Fig. 1g; Table 1). This always explains over 90 % of the variability present in the five variables considered (Table 2). The component matrix shows a positive correlation between the first principal component and the disposable household income per inhabitant (M1), whereas correlations are negative for the other variables.

3.8 Personal security

This dimension reflects the perceived threat to people's lives and personal freedom. The fear of being a crime victim has a negative impact on individual well-being as it causes anxiety and limits personal freedom (OECD 2013). There are still remarkable regional disparities in Italy as regards law enforcement and security: citizens who live

in Southern regions have twice the probability of those in the North-east of the country of being a victim of murder, extortion or robbery. Young people in southern regions are much more likely to be involved in crimes against persons or private property than their peers in the north-west of the country (Cersosimo and Nisticò 2013).

We selected five variables to describe the personal security dimension of well-being (Table 8 in "Appendix"). Four of these indicators are objective measures of the incidence of crimes: the burglary rate (T1); the pickpocketing rate (T2); the robbery rate (T3) and the homicide rate (T4). The fifth indicator is people's perception of the local crime risk (T5), a subjective measure of feelings about personal insecurity, calculated as the percentage of households that are particularly worried by the risk of crime. All variables are divided by their respective means before running PCA.

By implementing the usual tests for choosing the right number of components to retain, both the Scree plot and the Kaiser rule lead to the selection of two principal components every year (Fig. 1h; Table 1). The varimax rotation shows that the first principal component has two variables (T3 and T5) with high loadings, meaning that it mainly represents people's feelings of personal (in)security and their fear of being deprived of their property. The second principal component includes the remaining three variables which have significant loadings and is interpretable as the "less serious degree" of the local criminality context. The cumulative percentage of variance explained by the two components produced ranges from 74,5 % in 2006 to 82 % in 2007 (Table 2). The first principal component is negatively correlated with all the variables considered in the analysis, whereas the second principal component is negatively correlated with more violent crime (homicide rate). The two components extracted represent new variables which describe this well-being domain: hereafter, we refer to "personal security" when considering the first principal component, and "less serious degree of the local criminality context" as the variable given by the second principal component.

3.9 Research and innovation

Research and innovation represent basic components of social and economic progress. Many aspects of well-being are improved by research and innovation, often through the development of technologies across various sectors which interact with other well-being dimensions: for example, innovations in energy, transport and chemistry may influence environmental quality; new technologies enhance medical care and people's health; innovations in information and communications facilitate social relations and improve education methods, and so on. Research and innovation can also influence professional life and work satisfaction when they result in changes in workplace characteristics. The direct impact of innovation on subjective well-being remains, however, a rather unexplored field of study (Dolan and Metcalfe 2012), while the influence of research and innovation on economic well-being and competitiveness has received more attention (Annoni and Dijkstra 2013; Annoni and Kozovska 2010; Hong et al. 2012; Huggins and Davies 2006; McCann and Oxley 2012; Schwab and Porter 2008).

We selected five variables to describe this domain of well-being (Table 8 in "Appendix"). We consider the region's potential to innovate through data on R&D expenditure as a percentage of GDP (R1) and the patents registered per million inhabitants (R3). Two indicators describe research and innovation by looking at the region's potential to adapt to changing demand through the availability of human capital with technological skills: the R&D workers per 1000 inhabitants (R4) and graduates in Science and Technology per 1000 dwellers (R5). Finally, we consider the capacity to export (R2), measured as the percentage of the value of exported goods on GDP. In order to apply the PCA properly, all variables are divided by their average value. On the basis of the Scree test and the latent root criterion, only the first principal component is maintained (Fig. 1i; Table 1).

The share of total variance explained by the first principal component ranges from 72 % in 2005 and 81 % in 2010 (Table 2). It shows positive correlations with all the variables.

3.10 Social relations

Coleman (1990) defines social capital as the network of relationships between agents. The importance of social relations at individual and community level has been extensively investigated by social scientists (see Cersosimo and Nisticò 2008 for a survey). Social capital influences transaction costs and, thereby, efficiency by enhancing the level of trust between agents (Guiso et al. 2004) or generating shared values and community norms which support cooperative outcomes (Aoki 2001).

We describe the social relations domain of well-being by means of five variables (Table 8 in "Appendix"), two of which measure the quality of personal connections in terms of the share of people who are satisfied with their family (S1) and friend (S2) relationships. Instead, two further indicators rely on objective measures: the share of the population that have financed associations (S5) and the percentage of the population that performs volunteer work (S4) for associations or volunteer groups. The final indicator is a composite measure that ISTAT calculates by synthesizing the share of people aged 14 and over who have participated in social and cultural meetings, professional associations, trade unions, clubs or religious groups (S3). By looking at the Scree plot and by applying the Kaiser rule, just the first principal component is retained (Fig. 1j; Table 1). The first principal component explains over 90 % of the variance contained in the five original variables (Table 2). The component matrix reports positive correlations with the first principal component for all variables.

4 Results: partial and overall synthetic indicators of well-being

The results of principal component analysis show that differences in well-being are not necessarily in line with those based on standard economic indicators. In particular, for the education, environment and personal security dimensions of well-being, we find at least two Southern regions among the first five positions of the regional ranking which are, instead, at the bottom of the ranking in terms of per capita GDP. For the remaining dimensions of well-being (culture and free time, employment, essential

public services, health, material living conditions, research and innovation, less serious degree of local criminal context and social relations), results are consistent with the historical Italian divide between Northern and Southern regions, with the latter occupying the bottom positions (Table 3). Indeed, from a strictly economic standpoint, many indicators group Italian regions into more developed areas which are geographically clustered in the Centre-North of the country; although there are some important entrepreneurial successes and high-tech clusters (see Cersosimo and Viesti 2013), areas of economic backwardness are still common in the South.[14] Beyond the (economic) dualism between the two macro-areas, Italian regions differ in a number of other structural aspects which influence well-being (Cersosimo and Nisticò 2013).

If we look at changes in regional rankings between 2004 and 2010, we find that there is a general stability in terms of employment, whereas health and material living conditions deteriorated in most regions. In terms of culture and free time, essential public services, research and innovation domains, the number of regions which improved their rank is equal to those which lost positions. For the remaining dimensions (education, environment, personal security, social relations), the respective synthetic index describes a much more complex situation at regional level than that observed for the dimensions previously described, and although the first ten positions in the rankings are generally dominated by Northern regions, we also find Southern and Central regions, with their rankings changing from year to year. For these latter dimensions, we observe a higher regional dynamism than that observed before. Most regions worsened their position in terms of education and environment, whereas the opposite dynamics occurred for personal security and social relations.

Thus, we derive the synthetic regional well-being indicator (RWBI) by using as variables the values of the indices obtained by means of the principal component analysis for each individual dimension of well-being considered. As pointed out in the previous section, the intermediate synthetic indices are given by the value of the first principal component for eight out of ten well-being dimensions originally selected. As regards the essential public services domain, we have two indicators for the years 2004, 2005, 2006 and 2008, represented by the value of the first and the second principal components, respectively. Lastly, the security domain is described by two indicators, as there were two principal components extracted for all the period considered in the analysis.

By implementing the second-step PCA, Kaiser's rule and the Scree plot indicate that there were two components with eigenvalues greater than the mean in 2008 and in 2010, and three in the remaining years (Fig. 1k; Table 1). The cumulative variance explained by the components produced ranges of between 72 % in 2010 and 89 % in 2005.

However, the ultimate goal of this second-step PCA is to obtain a single synthetic indicator of well-being. We aim to calculate an indicator which synthesizes the greater part of the variability present in the partial indicators which emerge from the first step

[14] Italy is often looked at in terms of its sub-national areas. These are constituted by eight regions (Valle d'Aosta, Piemonte, Lombardia, Trentino-Alto Adige, Friuli-Venezia Giulia, Liguria, Emilia Romagna and Veneto) for the North; four regions for the Centre (Toscana, Marche, Umbria and Lazio) and eight regions for the South, or Mezzogiorno (Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria, Sicilia and Sardegna).

Table 3 Synthetic indicators by dimension and region (2010) and changes in rankings between 2004 and 2010

Position	Culture and free time			Education			Employment			Environment		
	Regions	2010	Δ Ranks (2010–2004)	Regions	2010	Δ Ranks (2010–2004)	Regions	2010	Δ Ranks (2010–2004)	Regions	2010	Δ Ranks (2010–2004)
1	Trentino-A.A.	3.52	0	Trentino-A.A.	0.68	0	Trentino-A.A.	−0.56	0	Valle d'Aosta	6.69	0
2	Friuli-V.G.	3.08	0	Marche	−0.11	−4	Valle d'Aosta	−0.70	0	Trentino-A.A.	3.25	0
3	Lombardia	3.02	−1	Veneto	−0.15	−1	Veneto	−0.80	−1	Molise	1.69	−5
4	Veneto	2.95	1	Calabria	−0.20	−4	Emilia-Romagna	−0.85	1	Basilicata	1.03	−2
5	Lazio	2.93	−2	Puglia	−0.53	−13	Lombardia	−0.86	0	Abruzzo	0.83	2
6	Valled'Aosta	2.90	−3	Emilia-Romagna	−0.60	1	Marche	−0.88	−2	Calabria	0.82	1
7	Emilia-Romagna	2.77	2	Piemonte	−0.73	−2	Friuli-V.G.	−0.89	1	Umbria	0.67	0
8	Toscana	2.76	2	Lazio	−1.01	1	Toscana	−1.05	−1	Sardegna	0.58	−3
9	Piemonte	2.71	1	Umbria	−1.03	6	Umbria	−1.13	−2	Friuli-V. G.	0.42	5
10	Liguria	2.70	0	Basilicata	−1.08	−2	Liguria	−1.14	0	Toscana	0.37	0
11	Marche	2.51	0	Friuli-V.G.	−1.12	9	Piemonte	−1.17	4	Liguria	0.12	2
12	Sardegna	2.49	−2	Liguria	−1.14	−3	Lazio	−1.57	−1	Sicilia	−0.03	−7
13	Umbria	2.44	1	Toscana	−1.17	2	Abruzzo	−1.65	1	Puglia	−0.06	−4
14	Abruzzo	2.37	1	Molise	−1.17	1	Molise	−2.27	0	Lazio	−0.27	0
15	Basilicata	1.95	−1	Abruzzo	−1.23	5	Sardegna	−2.38	0	Piemonte	−0.35	3
16	Molise	1.95	−2	Campania	−1.36	0	Puglia	−2.47	0	Marche	−0.38	3
17	Sicilia	1.94	−2	Lombardia	−1.39	3	Basilicata	−2.74	0	Emilia-Romagna	−0.51	−1
18	Calabria	1.94	−2	Valle d'Aosta	−1.54	1	Campania	−2.93	0	Veneto	−0.69	3
19	Puglia	1.83	2	Sardegna	−1.79	−1	Sicilia	−3.04	0	Lombardia	−0.73	−1
20	Campania	1.80	5	Sicilia	−2.00	1	Calabria	−3.52	0	Campania	−0.75	4

Table 3 continued

Position	Essential public services			Health			Material living conditions		
	Regions	2010	Δ Ranks (2010–2004)	Regions	2010	Δ Ranks (2010–2004)	Regions	2010	Δ Ranks (2010–2004)
1	Umbria	1.05	−10	Friuli-V.G.	−0.37	2	Trentino-A.A.	−0.55	−5
2	Friuli-V.G.	1.04	−8	Piemonte	−0.42	2	Emilia-Romagna	−0.72	1
3	Emilia-Romagna	1.01	1	Umbria	−0.61	−3	Veneto	−0.74	0
4	Valled'Aosta	0.71	3	Lombardia	−0.54	0	Lombardia	−0.78	2
5	Trentino-A.A.	0.69	1	Toscana	−0.34	−8	Valle d'Aosta	−0.79	−2
6	Marche	0.58	−1	Emilia-Romagna	−0.42	−5	Friuli-V.G.	−0.86	2
7	Liguria	0.48	−2	Trentino-A.A.	−0.20	−1	Toscana	−0.87	2
8	Lombardia	0.39	5	Liguria	−0.69	1	Liguria	−0.87	−2
9	Abruzzo	0.39	−3	Valle d'Aosta	−0.73	5	Umbria	−0.92	0
10	Basilicata	0.35	−4	Sardegna	−0.79	−2	Marche	−0.94	2
11	Veneto	0.25	5	Veneto	−0.45	2	Piemonte	−1.06	0
12	Piemonte	−0.27	4	Marche	−0.85	6	Lazio	−1.20	−1
13	Toscana	−0.60	8	Puglia	−1.21	−4	Abruzzo	−1.47	1
14	Lazio	−0.63	−1	Abruzzo	−1.22	1	Sardegna	−1.58	−1
15	Campania	−1.20	−2	Basilicata	−1.25	1	Molise	−1.80	1
16	Sardegna	−1.49	−2	Calabria	−1.30	−2	Basilicata	−2.20	0
17	Molise	−1.61	4	Molise	−1.22	1	Puglia	−2.25	0
18	Calabria	−1.68	−2	Sicilia	−1.51	1	Calabria	−3.15	0
19	Puglia	−1.76	3	Campania	−1.37	2	Sicilia	−3.20	−1
20	Sicilia	−2.32	1	Lazio	−0.87	1	Campania	−3.42	1

Table 3 continued

Position	Personal security			Research and Innovation			Social relations		
	Regions	2010	Δ Ranks (2010–2004)	Regions	2010	Δ Ranks (2010–2004)	Regions	2010	Δ Ranks (2010–2004)
1	Valled'Aosta	−0.53	−5	Emilia-Romagna	4.00	−1	Friuli-V.G.	3.67	−4
2	Basilicata	−0.58	1	Friuli-V.G.	3.91	−2	Toscana	2.68	−5
3	Molise	−0.73	1	Lombardia	3.38	0	Lombardia	2.55	−1
4	Marche	−0.88	1	Piemonte	3.36	3	Umbria	2.54	−5
5	Friuli-V.G.	−0.95	0	Veneto	3.17	0	Valle d'Aosta	2.52	−1
6	Abruzzo	−1.07	2	Trentino-A.A.	2.89	−5	Piemonte	2.49	−2
7	Sardegna	−1.12	0	Liguria	2.63	−3	Veneto	2.36	5
8	Veneto	−1.25	−2	Toscana	2.58	2	Trentino-A.A.	2.17	7
9	Umbria	−1.50	−2	Marche	2.46	0	Sicilia	2.15	−11
10	Toscana	−1.58	1	Lazio	2.09	3	Sardegna	2.01	−1
11	Trentino-A.A.	−1.63	3	Abruzzo	1.61	3	Emilia-Romagna	2.00	8
12	Emilia-Romagna	−1.70	−1	Umbria	1.58	0	Marche	1.91	2
13	Sicilia	−1.83	1	Campania	1.24	−1	Molise	1.87	−4
14	Lombardia	−2.32	0	Valle d'Aosta	1.21	1	Liguria	1.80	2
15	Piemonte	−2.43	−1	Sardegna	1.14	−2	Abruzzo	1.65	1
16	Lazio	−2.89	1	Basilicata	1.07	−2	Basilicata	1.58	3
17	Calabria	−3.18	0	Puglia	0.95	1	Calabria	1.58	−1
18	Liguria	−3.46	0	Sicilia	0.91	3	Puglia	1.34	2
19	Campania	−3.56	−1	Molise	0.57	0	Campania	1.26	0
20	Puglia	−3.78	1	Calabria	0.53	0	Lazio	1.14	5

Source: elaborations on ISTAT data

of the analysis in order to: (1) easily compare well-being in a multidimensional perspective at a regional level; (2) to observe the dynamics of well-being across regions during the time interval considered in the analysis. Thus, in accordance with economic research in fields other than well-being (Accetturo et al. 2014), we concentrate our attention on just the first principal component, whose value becomes the overall regional well-being index (RWBI).

The first principal component explains a percentage of the total variance which ranges from 44 % in 2006 to 49 % in 2005 (Table 2). The first principal component is positively correlated with all the indices of the different domains, thus confirming that it can indeed be considered a suitable overall indicator of regional well-being.

Results show that there is a sharp demarcation between the North and the South of the country. For each year, the first 10 positions are all occupied by Centre-North regions and the last 10 by the eight Mezzogiorno regions together with Liguria and Lazio (Fig. 2; Table 4).

The most evident feature of the dynamics of the well-being index over time is the lack of change in the five top and bottom positions of the rankings (Table 4). In 2004, the first five positions are occupied by Valle d'Aosta, Trentino, Friuli-Venezia Giulia, Emilia Romagna and Veneto and this remains unchanged throughout the whole period. Similarly, the same five regions occupy the bottom five positions at the beginning and at the end of the period. The regions that suffer most from a lack of well-being are Calabria and Campania, which alternate possession of the bottom rank, whereas the best performances in terms of well-being are found for Valle d'Aosta and Trentino throughout the whole period.

The final column of Table 4 presents the absolute variation of the rank for each region between 2004 and 2010. By looking at changes in the ranks of the regions between the beginning and the end of the period, we observe a substantial level of inertia of well-being in Italy, as shown by the list of regions (representing one-third of the total) whose variation in rank is equal to zero and which are flanked by the half of regions that moved upwards or downward by just one position. It emerges that eight regions (40 %) improve their relative rank, albeit six of them only by one position, over the period 2004–2010, and five regions are worse off, albeit only three of them lost more than one position. Umbria and Campania, which initially occupied, respectively, the tenth and the last position in the overall well-being ranking, record the highest improvement (of two positions). Toscana, which was in sixth position in 2004, shows the worst change in terms of its well-being ranking, slipping down by four positions, followed by Calabria and Molise which go down by two positions and Abruzzo and Valle d'Aosta which fall by just one place.

Figure 3 plots Italian regions by considering the well-being index on the *y*-axis and per capita GDP, divided by average GDP, on the *x*-axis, for 2004 (Fig. 3a) and for 2010 (Fig. 3b). It is worth noting the positive linear relationship between the two indices, as confirmed by the fairly high coefficient of correlation (0.79 in 2004 and 0.91 in 2010). This is not really surprising since per capita GDP and RWBI synthesize regional progress, albeit from different perspectives: the first from a productive standpoint and the latter from the multifaceted dimension of the quality of life. These results are consistent with the literature on comparisons by region of well-being indicators and GDP (Berloffa and Modena 2012; Ferrara and Nisticò 2013; Marchante et al. 2006).

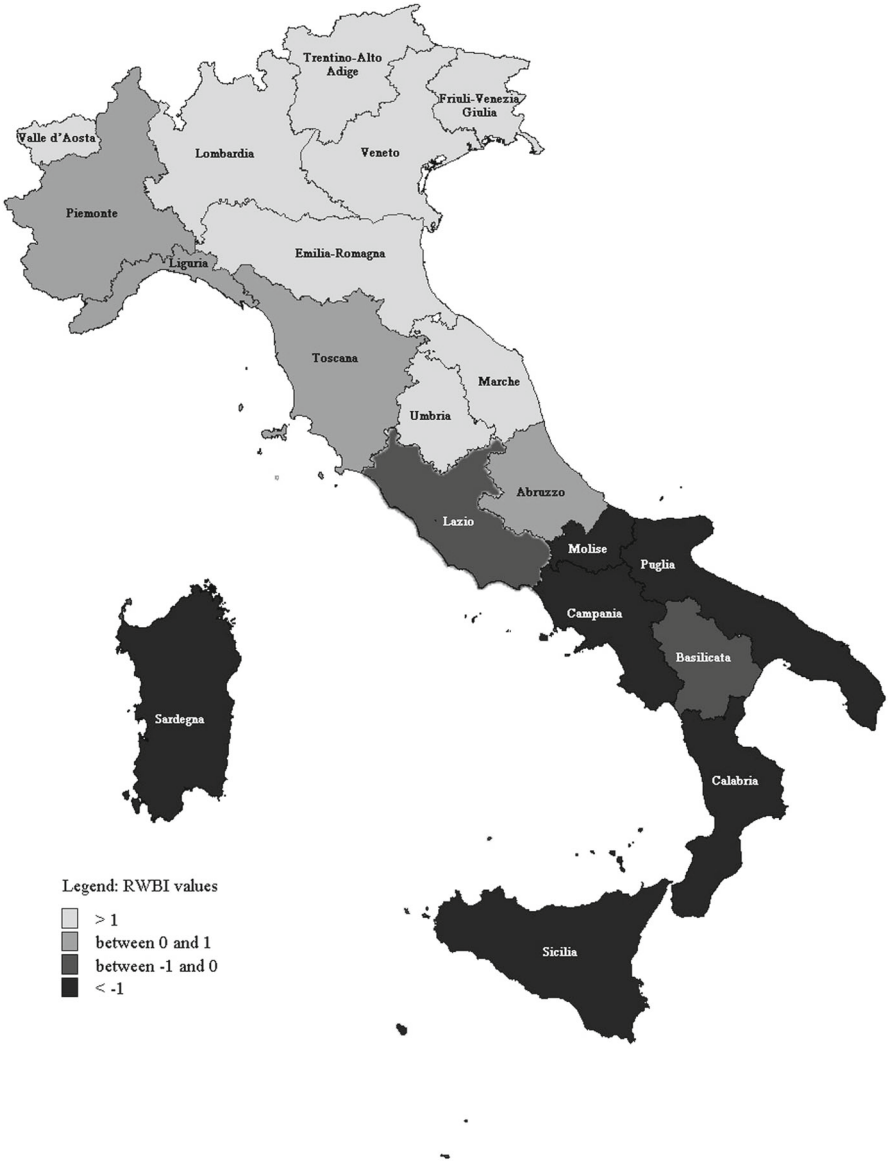

Fig. 2 Regional well-being index (RWBI) in the Italian regions (2010). *Source*: elaborations on ISTAT data

Moreover, Fig. 3 illustrates the substantially unchanged position of regions at the beginning and at the end of the period: those regions which are positioned lower left and those that occupy the upper-right of the figure for 2004 are still to be found in the same position for 2010. Furthermore, lagging Southern regions (Calabria, Sicilia, Campania and Puglia) are grouped even closer in 2010 in the lower left corner of Fig. 3, whereas the other Mezzogiorno regions moved towards positions that were

Table 4 Regional well-being index (RWBI) by region and year

Position	2004		2005		2006		2007	
	Regions	Index value	Regions	Index value	Regions	Index value	Regions	Index value
1	Valle d'Aosta	7.17	Valle d'Aosta	5.43	Valle d'Aosta	6.76	Valle d'Aosta	3.36
2	Trentino-A. A.	4.43	Trentino-A. A.	3.54	Trentino-A. A.	3.88	Trentino-A. A.	3.21
3	Friuli-V. G.	1.56	Friuli-V. G.	1.84	Friuli-V. G.	1.97	Emilia-Romagna	2.61
4	Emilia-Romagna	1.37	Emilia-Romagna	1.75	Emilia-Romagna	1.38	Friuli-V. G.	2.35
5	Veneto	1.12	Veneto	1.21	Veneto	0.99	Veneto	2.07
6	Toscana	1.05	Lombardia	1.09	Lombardia	0.76	Piemonte	1.62
7	Lombardia	0.80	Toscana	0.89	Umbria	0.73	Lombardia	1.43
8	Marche	0.73	Piemonte	0.83	Toscana	0.71	Toscana	1.10
9	Piemonte	0.70	Marche	0.74	Piemonte	0.61	Marche	0.93
10	Umbria	0.59	Umbria	0.50	Marche	0.49	Umbria	0.88
11	Abruzzo	0.54	Abruzzo	0.21	Abruzzo	0.45	Abruzzo	0.18
12	Liguria	0.21	Liguria	0.15	Liguria	0.15	Liguria	0.14
13	Lazio	−0.65	Lazio	−0.70	Basilicata	−0.63	Lazio	−0.37
14	Molise	−0.83	Molise	−1.27	Lazio	−0.86	Molise	−0.90
15	Basilicata	−0.99	Basilicata	−2.01	Molise	−0.97	Basilicata	−1.19
16	Sardegna	−1.29	Sardegna	−2.01	Sardegna	−1.32	Sardegna	−1.75
17	Puglia	−2.34	Puglia	−2.78	Puglia	−2.56	Puglia	−2.60
18	Calabria	−2.65	Sicilia	−3.77	Sicilia	−3.12	Calabria	−3.86
19	Sicilia	−2.99	Campania	−3.87	Calabria	−3.15	Sicilia	−3.99
20	Campania	−3.14	Calabria	−4.14	Campania	−3.85	Campania	−4.01

Table 4 continued

Position	2008		2009		2010		Δ (2010–2004)	
	Regions	Index value	Regions	Index value	Regions	Index value	Regions	Ranks
1	Valle d'Aosta	5.68	Valle d'Aosta	4.48	Trentino-A. A.	3.10	Toscana	4
2	Trentino-A. A.	4.11	Trentino-A. A.	3.44	Valle d'Aosta	2.81	Calabria	2
3	Friuli-V. G.	2.05	Friuli-V. G.	2.54	Friuli-V. G.	2.46	Molise	2
4	Emilia-Romagna	1.44	Emilia-Romagna	2.23	Emilia-Romagna	2.24	Abruzzo	1
5	Veneto	1.17	Veneto	1.68	Veneto	1.74	Valle d'Aosta	1
6	Lombardia	0.75	Lombardia	1.45	Lombardia	1.57	Emilia-Romagna	0
7	Umbria	0.70	Piemonte	1.04	Marche	1.18	Friuli-V. G.	0
8	Piemonte	0.56	Marche	0.89	Umbria	1.03	Lazio	0
9	Toscana	0.52	Liguria	0.77	Piemonte	0.87	Piemonte	0
10	Marche	0.48	Toscana	0.76	Toscana	0.85	Puglia	0
11	Abruzzo	0.23	Umbria	0.53	Liguria	0.79	Sicilia	0
12	Liguria	0.02	Lazio	−0.45	Abruzzo	0.17	Veneto	0
13	Molise	−0.56	Abruzzo	−0.54	Lazio	−0.09	Basilicata	−1
14	Basilicata	−0.59	Basilicata	−0.62	Basilicata	−0.86	Liguria	−1
15	Lazio	−0.83	Sardegna	−1.03	Sardegna	−1.25	Lombardia	−1
16	Sardegna	−1.37	Molise	−1.55	Molise	−1.47	Marche	−1
17	Puglia	−2.72	Puglia	−2.49	Puglia	−2.73	Sardegna	−1
18	Sicilia	−3.37	Campania	−3.38	Campania	−3.27	Trentino-A. A.	−1
19	Campania	−3.81	Sicilia	−3.41	Sicilia	−3.41	Campania	−2
20	Calabria	−4.16	Calabria	−4.13	Calabria	−3.70	Umbria	−2

Source: elaborations on ISTAT data

more similar, in terms of both well-being and per capita GDP, to a group of Centre-Northern regions (Umbria, Marche, Toscana, Lazio, Piemonte and Liguria). Finally, we find most of the Northern well off regions in the upper-right corner of Fig. 3, clustered much more tightly than in 2004. To summarize, it is worth pointing out that, when we consider GDP and multidimensional well-being jointly, well off, at one extreme, and lagging regions, at the other, remain encapsulated in their opposing position, whereas greater dynamism is experienced by regions which fall in the middle.

A number of interesting observations can be made by grouping regions by per capita GDP quartiles as this makes it even more evident that dynamism especially occurs in the middle groups (Fig. 4). First, it is worth noting that differences in the RWBI levels between regions falling in the first quartile (Campania, Calabria, Sicilia, Puglia and Basilicata) and those grouped in the second quartile of GDP (Sardegna, Molise, Abruzzo, Umbria and Marche) increased in 2010. Second, differences in RWBI levels between regions belonging to the third quartile (Liguria, Piemonte, Toscana, Friuli and Veneto) and well off regions in the fourth quartile (Lazio, Emilia Romagna, Valle d'Aosta, Lombardia and Trentino) decreased markedly in 2010. Even with the necessary caution, given the short time interval considered, these dynamics suggest that enhancements in well-being levels and reduction in regional disparities depend on agglomeration and require a minimum thresholds of social and economic resources in order to take place. Such patterns seem to capture the cumulative causation hypothesis stemming from Myrdal's theories of progress (Myrdal 1957). Following this latter strand of analysis, economic growth might be associated, especially in the short and medium terms, with increasing spatial inequalities as well off regions are in a better position to exploit opportunities generated by the positive phases of economic cycles.

5 Well-being dispersion across regions

In order to assess how much Italian regions differ in terms of well-being, from both a synchronic and a diachronic perspective, we calculated the coefficient of variation of Italian regions for both the RWBI index and the per capita GDP over the whole period and two sub-periods: from 2004 to 2007 and from 2008 to 2010 (Table 5).

Over the 7 years from 2004 to 2010, Italian regions became more similar in terms of well-being. As regards per capita GDP, the coefficient of variation decreased by 2 % over the entire period. The even larger change (−22 %) for RWBI highlights the fact that regions reduced their disparities in terms of well-being at a much faster rate than in per capita GDP, as is shown by the trend lines in Fig. 5.

If we look at the two sub-periods, we can see that, even though the rates of dispersion were negative for both indicators in the years 2004–2007, they had different signs in the following period (2007–2010). After 2007, disparities in per capita GDP increased slightly. A similar dynamic was to be found in all European regions, which shows a progressive narrowing of economic disparities up until 2007 and an opposite trend thereafter, as a consequence of the economic and financial crises (European Commission 2013). On the other hand, in terms of well-being, the immediate effect of the crisis on Italian regional disparities seems to have been a marked, albeit brief, rise in the coefficient of variation. This trend becomes fluctuating thereafter, albeit the

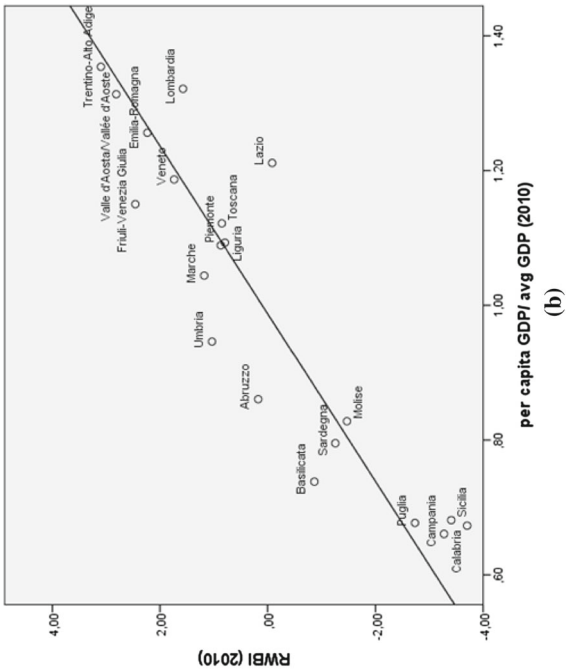

Fig. 3 Italian regions by per capita GDP and well-being index. *Source*: elaborations on ISTAT data

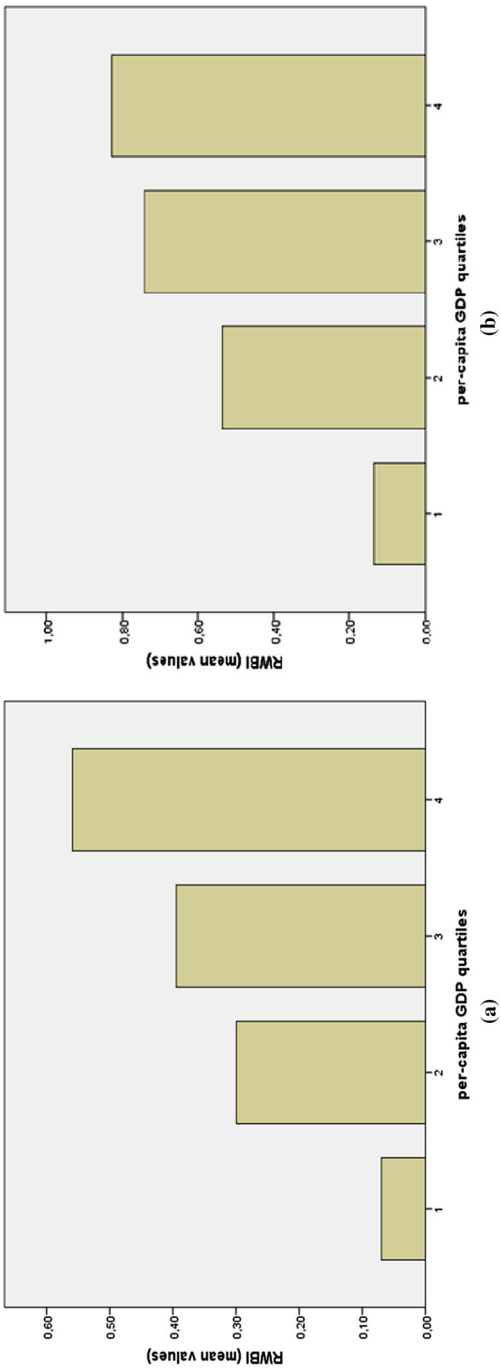

Fig. 4 RWBI by per capita GDP quartiles (standardized data). *Source*: elaborations on ISTAT data

Table 5 Coefficient of variation for each of the indices of well-being, for the overall index of well-being and for per capita GDP

	CV			CV rate of change			MIN		MAX	
	2004	2007	2010	2004–2007	2007–2010	2004–2010		Year		Year
Culture and free time	0.58	0.65	0.68	0.12	0.05	0.17	0.58	2004	0.70	2008
Education	0.70	0.50	0.60	−0.29	0.20	−0.14	0.42	2009	0.70	2004
Employment	0.55	0.55	0.49	0.00	−0.11	−0.11	0.49	2010	0.56	2008
Environment	1.68	1.75	1.24	0.04	−0.29	−0.26	1.24	2010	1.75	2007
Essential public services	0.64	0.50	0.52	−0.22	0.05	−0.18	0.48	2009	0.64	2004
Health	0.57	0.67	0.59	0.18	−0.13	0.03	0.45	2006	0.67	2007
Material living conditions	0.45	0.50	0.47	0.10	−0.06	0.03	0.45	2004	0.50	2009
Personal security	0.34	0.38	0.54	0.13	0.41	0.60	0.33	2005	0.54	2010
Research and innovation	0.75	0.77	0.73	0.02	−0.04	−0.02	0.73	2010	0.78	2006
Social relations	0.82	0.73	0.64	−0.10	−0.13	−0.22	0.64	2010	0.83	2005
RWBI	0.72	0.58	0.56	−0.19	−0.03	−0.22	0.55	2009	0.72	2004
Per capita GDP	0.73	0.71	0.71	−0.03	0.01	−0.02	0.71	2007	0.73	2004

Source: elaborations on ISTAT data

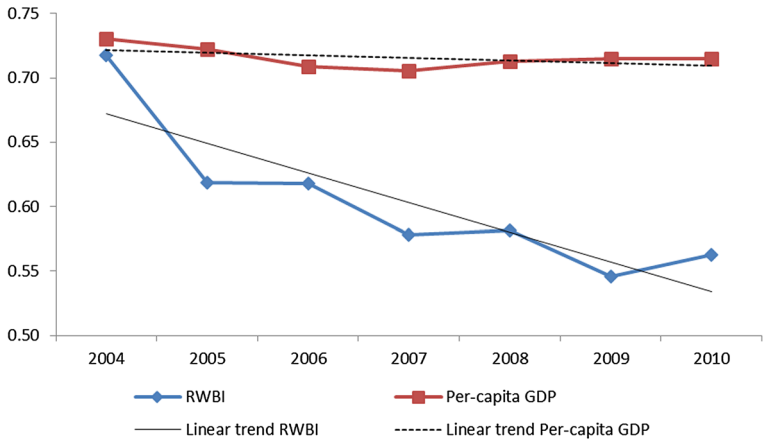

Fig. 5 RWBI and per capita GDP—coefficients of variation (2004–2010). *Source*: elaborations on ISTAT data

linear trend is decreasing, although at a less intense rate than in the first sub-period (2004–2007).

It is worth noting that, at the beginning of the period, both indicators had almost the same value for the coefficient of variation, and this was also the highest dispersion shown by Italian regions over the whole period. Similarly, they reached the minimum coefficient of variation in the same year (2007), coinciding with the advent of the global economic crisis, but at different levels: the minimum dispersion for overall well-being is significantly lower than for per capita GDP.

When considering the coefficient of variation for each partial indicator, we find that some of them exhibit a smooth increasing trend up until 2007 (personal security, material living conditions, labour and research and innovation) with upward intervals in the following years (personal security, labour and material living conditions), while research and innovation remain quite flat. With regards the other sub-indicators (culture and free time, health, essential public services, education, environment, and social relations), we observe fluctuations over the entire period (Fig. 6). This implies that there was no continuous decreasing trend of well-being dispersion in all its ambits. On the other hand, significant and increasing dissimilarities persist in some important dimensions such as security and culture and free time. A remarkable increase in dispersion also occurs for health over the first sub-period, but this slows down sharply afterwards, so reducing dispersion.

Conversely, the diachronic comparison between the end and the beginning of the period shows that dispersion for the six remaining dimensions of well-being (environment, employment, education, essential public services, social relations and research and innovation) definitely decreased.

However, two sub-indicators that do not show an overall negative rate of dispersion (material conditions and health) experienced a reduction in regional inequalities in the second sub-period.

Both the environment and social relation indices show a decreasing trend throughout the period, except for one upward adjustment, in 2007 for the first and in 2009 for

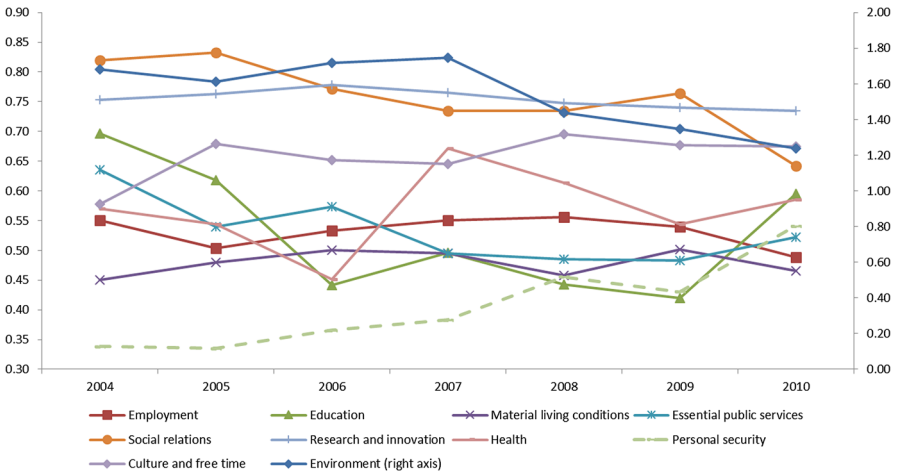

Fig. 6 Partial Indicators—coefficients of variation (2004–2010). *Source*: elaborations on ISTAT data

the latter. Notwithstanding this trend, they are, alongside culture and free time and research and innovation, the four well-being dimensions with the highest coefficient of variation for each year of the second sub-period.

We consider Kendall's index of rank concordance (Table 6) in order to investigate the regional dynamics over time within the cross-regional distribution of each dimension. Kendall's index tends to one for each dimension of well-being, as well as for the two indicators, RWBI and per capita GDP. Thus, there is no evidence of rank mobility within the distribution. This means that the decreasing trend of regional dispersion did not affect the relative positions of Italian regions much, although differences diminished over time. In other words, backward regions were not able to improve their conditions enough to modify their positions in the regional ranking. The results of the test of the hypothesis clearly confirm the absence of substantial intra-distributional mobility: the null hypothesis of no association between the ranks in different years (which means that mobility is negligible or absent) is always rejected with a significance level of at least 5 %. Indeed, we find that the result of non-mobility is even stronger in many cases, statistically significant at 1 %. This only happens for the environment indicator in 2009, for the education indicator in 2005 and 2007, and in every year for the other indicators (employment, material living conditions, social relations, research and innovation, personal security, culture and free time, RWBI and per capita GDP) except for essential public services and health, for which it only occurs in 2010.

In conclusion, neither significant improvements nor worsening occurred for the overall well-being indicator, the per capita GDP and each dimension index with respect to regional intra-distributional mobility over the studied period.

As noted before, the literature usually refers to the coefficient of variation and the Kendall index so as to assess, respectively, σ and γ convergence, albeit for a longer interval period than that considered in this study (cfr., infra, footnote 6). Even though the relationship between growth and regional disparities has been widely investigated, two main competitive hypotheses can be discerned in the literature: the neoclassical

Table 6 Kendall's index

Year	Culture and free time	Education	Employment	Environment	Essential public services	Health	Material living conditions	Personal security	Research and innovation	Social relations	RWBI	Per capita GDP
2004	1	1	1	1	1	1	1	1	1	1	1	1
2005	0.9774***	0.9632***	0.997***	0.9639***	0.9218**	0.9617***	0.982***	0.9739***	0.994***	0.9887***	0.9915***	1***
2006	0.9737***	0.9361**	0.997***	0.9444**	0.8767**	0.9684***	0.9617***	0.9846***	0.9812***	0.991***	0.9852***	1***
2007	0.9744***	0.9549***	0.9925***	0.903**	0.9293***	0.909***	0.9699***	0.9827***	0.9759***	0.9827***	0.9906***	1***
2008	0.9752***	0.894**	0.9932***	0.9293**	0.8519**	0.9556***	0.9812***	0.9594***	0.9722***	0.9789***	0.9825***	1***
2009	0.9782***	0.8353**	0.9887***	0.918**	0.8865**	0.9579***	0.9729***	0.9835***	0.9639***	0.9797***	0.9795***	1***
2010	0.9729***	0.8571**	0.9887***	0.9316**	0.8594**	0.9226**	0.9789***	0.9776***	0.9662***	0.9744***	0.9818***	1***

Source: elaborations on ISTAT data
* Reject null hypothesis at 10 %
** Reject null hypothesis at 5 %
*** Reject null hypothesis at 1 %

convergence theory, which developed from the pioneer work of Solow (1956), and the hypothesis of growth as a spatially cumulative process, which derives from the seminal contribution of Myrdal (1957). Our findings have some points in common with this latter view of progress, as leading regions maintain their position, while the decreasing trend of disparities is especially due to the greater dynamism occurring in region clusters that are near close to well off performing regions, suggesting that a cumulative causation process is working.

6 A regression-based decomposition of well-being dispersion

In view of the multidimensional nature of the well-being index, it is worth exploring the portion each indicator contributes in explaining total dispersion in RWBI by means of a regression-based decomposition (Fiorio and Jenkins 2008).[15] According to this methodology, the "residual" is the part of inequality that is unexplained by any of the factors that we have entered into regression. Table 7 and Fig. 7 report the relative share of each indicator in total inequality and the absolute value of the coefficient of variation for each partial indicator and for all the years considered. In 6 years out of seven, the residual term accounts for a large share of the inequality index.

Nonetheless, many of the factors included in the regression do offer considerable explanatory power in understanding total well-being dispersion. Environment explains a peak of 22 % of total inequality in 2004, though this falls to 1 % in 2008. This reflects the fact that the absolute contribution of environment to RWBI inequality falls, while, at the same time, total well-being inequality increases greatly over the period. Culture and free time and social relations are two relatively minor explanatory factors which never explain more than 4 % of total inequality. The efficiency of public services, represented by the double indicators of essential public services and health assistance services, plays an important role in explaining the total well-being inequality; they explain, respectively, 51 and 75 % in 2004, yet they both fall in the 2005–2009 period. In 2010, the essential public services domain represents 22 % of total inequality. The explanatory power of the less serious crimes index falls throughout the period, from 33 % of total inequality in 2004 to 1 % in 2008, before rising slightly again to 8 % in 2010. Education, employment, health, material living conditions, personal security and research and innovation explain a small amount of total dispersion (less than 10 % throughout the period).

7 Conclusions

Interest in finding a method to measure well-being, alongside the more traditional economic indicators of growth, has increased greatly in recent years. Scholars are aware that well-being is a multidimensional concept, so giving rise to the empirical challenge of obtaining suitable measures of the phenomenon which combine economic, social and environmental features. By considering Italy as a case study, we propose

[15] The coefficient of variation is also used in literature as a measure of inequality (Jordà and Sarabia 2014; Cowell and Fiorio 2011). We refer to both terms as synonyms.

Table 7 Regression-based decomposition of inequality in RWBI

	2004		2005		2006		2007	
	Coefficient of variation	CV indicator/ CV RWBI	Coefficient of variation	CV indicator/ CV RWBI	Coefficient of variation	CV indicator/ CV RWBI	Coefficient of variation	CV indicator/ CV RWBI
Environment	1.97	0.22	2.15	−0.10	2.00	0.10	1.19	0.03
Culture and free time	0.21	0.02	0.20	−0.01	0.20	0.01	0.21	0.01
Education	−0.85	−0.09	−0.97	0.05	−1.15	−0.06	−1.18	−0.03
Employment	−0.59	−0.06	−0.60	0.03	−0.59	−0.03	−0.61	−0.02
Essential public services	4.64	0.51	−2.23	0.11	−2.23	−0.11	−3.13	−0.08
Health assistance serv. (II C)	6.80	0.75	0.71	−0.03	1.03	0.05		
Health	−0.51	−0.06	−0.51	0.02	−0.45	−0.02	−0.28	−0.01
Material living conditions	−0.62	−0.07	−0.61	0.03	−0.62	−0.03	−0.65	−0.02
Personal security	−0.64	−0.07	−0.64	0.03	−0.63	−0.03	−0.60	−0.02
Less serious crimes (II C)	2.96	0.33	1.61	−0.08	5.18	0.26	1.61	0.04
Research and innovation	0.61	0.07	0.53	−0.03	0.55	0.03	0.54	0.01
Social relations	0.33	0.04	0.32	−0.02	0.33	0.02	0.30	0.01
Residual	−5.28E+13	−5.82E+12	2.34E+13	−1.12E+12	−3.95E+13	−1.95E+12	4.80E+13	1.24E+12
RWBI	9.08	1.00	−20.98	1.00	20.29	1.00	38.82	1.00

Table 7 continued

	2008		2009		2010	
	Coefficient of variation	CV indicator/ CV RWBI	Coefficient of variation	CV indicator/ CV RWBI	Coefficient of variation	CV indicator/ CV RWBI
Environment	2.22	0.01	2.26	0.11	2.70	0.13
Culture and free time	0.21	0.00	0.21	0.01	0.19	0.01
Education	−0.74	0.00	0.90	0.04	−0.68	−0.03
Employment	−0.60	0.00	−0.57	−0.03	−0.57	−0.03
Essential public services	−2.01	−0.01	−2.06	−0.10	−4.72	−0.22
Health assistance serv. (II C)	0.55	0.00				
Health	−0.41	0.00	−0.53	−0.03	−0.49	−0.02
Material living conditions	−0.65	0.00	−0.63	−0.03	−0.62	−0.03
Personal security	−0.66	0.00	−0.59	−0.03	−0.57	−0.03
Less serious crimes (II C)	0.93	0.01	0.93	0.04	1.62	0.08
Research and innovation	0.54	0.00	0.54	0.03	0.55	0.03
Social relations	0.32	0.00	0.29	0.01	0.29	0.01
Residual	−3.01E+13	−1.85E+11	–	–	2.90E+14	1.38E+13
RWBI	162.24	1.00	20.97	1.00	21.01	1.00

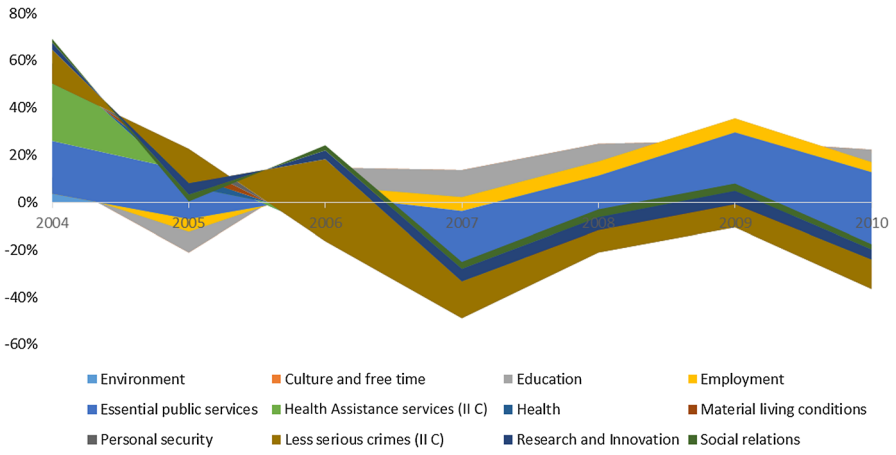

Fig. 7 Regression-based decomposition of inequality in RWBI. *Source*: elaborations on ISTAT data

a methodology for the construction of a synthetic measure of well-being which starts from the conceptual suggestions emerging from a recent national programme, the BES project. This programme, a joint initiative by the Italian National Institute of Statistics (ISTAT) and the National Council of Economy and Labour (CNEL), was launched in 2013 and aimed at the construction of a specific database for the measurement of a "fair and sustainable well-being". This paper takes the results of the BES project a step further by discussing the construction of a suitable multidimensional measurement of well-being for Italian regions. Our goal was threefold: to calculate synthetic indices for ten different dimensions of well-being by combining 57 different variables, mainly extracted from the BES database; to then use these partial synthetic indices to construct an overall indicator of well-being; finally, to assess well-being and per capita GDP dispersion across regions and changes in regional rankings over the period 2004–2010. With these aims in mind, we implemented a two-step principal component analysis in order to calculate, in the first step, single-domain indices and, in the second step, the overall regional well-being indicator, by using the 10 indicators previously generated. Regional dispersion on single-domain and overall well-being indices was investigated by means of the growth rate of the coefficient of variation, whereas the regional ranking mobility over time was assessed by means of a nonparametric technique, the Kendall index.

The results from principal component analysis illustrate that differences in well-being between regions are not necessarily in line with those based on per capita GDP. If we look at the different dimensions of well-being, we find at least two Southern regions among the first five position in the regional ranking in terms of education, environment and personal security domains, whereas the same regions are at the bottom of the ranking on the basis of GDP. On the other hand, results for the other dimensions (culture and free time, employment, essential public services, health, material living conditions, research and innovation and social relations) reflect the historical Italian divide between Northern and Southern regions, with the latter occupying the bottom positions. These findings highlight the fact that, besides the (economic)

dualism between the two macro-areas, Italian regions differ in a number of other structural aspects which influence well-being, suggesting that an in-depth investigation of quality-of-life aspects might depict a more realistic picture of a country's progress than simply the productive dimension. It emerges that regional well-being disparities are equally relevant, suggesting the need to pay more attention to the quality-of-life features of social progress in public policy goals and academic debate, which remain primarily focused on economic gaps.

However, the analysis in terms of dispersion shows that, both in terms of per capita GDP and overall well-being, Italian regions have tended to became more similar over time, but also that a gradual slowing-down of this process can be observed in recent years, since the start of the global economic crisis. Moreover, the reduction in disparities in terms of well-being occurs at a much faster rate than it does in terms of per capita GDP. Since the advent of the crisis, the two indicators, RWBI and per capita GDP, have had different convergence trends: disparities in GDP have increased slightly, whereas, in terms of RWBI, the effect of the crisis seems to have been an increase in the coefficient of variation. This has, however, been followed by a new recovering process, albeit a less intense one than in the first sub-period (2004–2007).

Moreover, our results show different dispersion patterns for each dimension of well-being, so highlighting the persistence of disparities across regions in important aspects of quality of life, such as personal security and culture and free time. Analogously, if we look at the entire time interval, the divergence across Italian regions increases slightly for the health and material living conditions domains, even though they experienced a substantial recovery in the period 2007–2010. Furthermore, in four of the dimensions—education, environment, essential public services and research and innovation—convergence is not a continuous process, although Italian regions are found to have been more similar at the end of the period than at the beginning. Finally, for two dimensions of well-being, employment and social relations, we find that dispersion across regions fell both over the entire study period and the two sub-periods considered.

The analysis of mobility among ranks within the distribution (γ-convergence) shows that the value of Kendall's index tends to one for each partial indicator, for the RWBI and for per capita GDP. This implies that the relative positions of the regions did not change substantially, even though our results indicate that regions became more similar over time, that is that the coefficient of variation decreased. Furthermore, the paper gives evidence, to be looked at with the necessary caution due to the short time interval considered, that between the primacy of leading regions and the disadvantage of lagging ones, a not negligible dynamism in well-being occurs for regions which fall into middle GDP percentiles. This suggests that multidimensional well-being entails some sort of agglomeration of resources and activity, in line with the cumulative causation hypothesis of progress originally proposed by Myrdal (1957).

The analysis points out the importance of considering a synthetic well-being index alongside GDP statistics: notwithstanding the fact that the two indicators show a high correlation, they present different trends in terms of regional convergence over time, so confirming that public policies aimed at just enhancing production levels may not necessarily give the same results in terms of quality of life improvements, as indicated by the recent literature on economic and social progress (Sen 2000; Stiglitz et al. 2009).

Furthermore, our findings also highlight the importance of carrying out a dimension-by-dimension analysis, as regional disparities exhibit different entities and dynamics in the various well-being domains, so providing implications for policy interventions. The decomposition analysis helps to identify the main drivers of regional inequalities in well-being, giving useful insights to policy makers. Indeed, our results clearly suggest that, besides seeking to equalize incomes, policy makers interested in reducing regional disparities should redesign public policies in order to achieve greater cohesion and closer convergence towards more equitable standards of living, intensifying efforts in those ambits where regional inequalities are wider. As indicated by the "Well-Being 2030" research project recently launched by the European Policy Centre and the European Commission (Theodoropoulou and Zuleeg 2009), this is not a simple task: due to their structural nature, improvements in most well–being dimensions need medium-to-long-run policies and a coordinated effort between different development institutions and agents, and across different levels of governance (central/local). Even so, concrete proposals of rigorous and synthetic measures of well-being, alternative to GDP, could certainly help policy makers achieve their targets.

Appendix

See Table 8.

Table 8 Well-being dimensions: indicators, definitions and sources (database subsections in parenthesis)

	Indicators	Definitions	Source
Culture and free time			
C1	Newspaper reading	Persons aged 6 and over who read newspapers at least once a week per 100 people with the same characteristics	i.stat (culture, leisure and time use)
C2	Theatrical performances	Percentage of persons aged 6 and over who have been to theatrical performances at least once in the last year	i.stat (culture, leisure and time use)
C3	Live classical music concerts	Percentage of persons aged 6 and over who have attended classical live music concerts at least once in the last year	i.stat (culture, leisure and time use)
C4	Sport events	Percentage of persons aged 6 and over who have attended sport events at least once in the last year	i.stat (culture, leisure and time use)
C5	Books reading	Persons aged 6 and over who read books in the previous 12 months per 100 people with the same characteristics	i.stat (culture, leisure and time use)
C6	Museums visits	Percentage of persons aged 6 and over who have visited museums at least once in the last year	i.stat (culture, leisure and time use)
C7	Sport	Percentage of persons aged 3 and over who practise sports	i.stat (culture, leisure and time use)

Table 8 continued

	Indicators	Definitions	Source
Education			
E1	People with tertiary education	Percentage of people aged 30–34 with tertiary education (ISCED 5 or 6)	BES (education)
E2	Rate of early leavers from education and training	Percentage of people aged 18–24 with only lower secondary school diploma (ISCED 2) and are not enrolled in a training programme	BES (education)
E3	Rate of upper secondary school leavers	Total school leavers within the first 2 years of upper secondary school as a percentage of the students enrolled in the second year of higher secondary school	ISTAT-DPS (education)
E4	Participation in lifelong learning	Percentage of people aged 25–64 participating in formal or non-formal educational programmes	BES (education)
E5	People with at least upper secondary education	Percentage of people aged 25–64 having completed secondary education (ISCED level not below 3a, 3b or 3c)	BES (education)
Employment			
L1	Employment rate	Percentage of employed persons aged 20–64	BES (work and life balance)
L2	Non-participation rate	Unemployed and potential labour force aged 15–74 (people not searching for a job during the previous 4 weeks but available for work) as percentage of labour force aged 15–74 and potential labour force aged 15–74	BES (work and life balance)
L3	Share of employed persons with temporary jobs for at least 5 years	Share of currently employed persons with temporary jobs for at least 5 years	BES (work and life balance)
L4	Share of workers in an irregular occupation	Percentage of workers not in compliance with labour, fiscal and pension laws	BES (work and life balance)
L5	Ratio between the employment rate of women aged 25–49 with at least one child of compulsory school age (6–13), and the employment rate of women aged 25–49 without children	Employment rate of women aged 25–49 with at least one child under compulsory school age (6–13) divided by the employment rate of women aged 25–49 without children	BES (work and life balance)

Table 8 continued

	Indicators	Definitions	Source
L6	Ratio of female employment rate to male employment rate	Ratio of female to male employment rate (%)	ISTAT-DPS (labour)
L7	Incidence of long-term unemployment	People looking for employment for more than 12 months as percentage of the total of people looking for employment	ISTAT-DPS (labour)
L8	Youth unemployment rate	People aged 15–24 looking for employment as percentage of the labour force aged 15–24	ISTAT-DPS (labour)
Environment			
A1	Fertilizers used in agriculture	Simple fertilizers (Nitrogen, Phosphorus, Potassium) used per hectare of Utilized Agriculture Area (in quintals)	ISTAT-DPS (environment)
A2	Monitoring of air quality	Number of air monitoring stations, per 100,000 inhabitants	ISTAT-DPS (cities)
A3	Air pollution	Number of days during which the level of PM10 was higher than the limit of 50 μg/m3 in regional capital cities [(days/365)*100]	BES (environment)
A4	Energy consumption provided by renewable sources	Electricity produced by renewable sources (GWh) as percentage of electricity internal gross consumption	BES (environment)
A5	Special Protection Areas	Percentage of regional land (ha) designed as Special Protection Areas	ISTAT-DPS (environment)
A6	Population density	Population per square kilometre of land area	I.stat (population)
Essential public services			
Q1	Waiting lists for treatments	Individuals who give up the chance to see a specialist or undergo therapeutic treatment (not dental) because of the length of waiting lists as percentage of residents	BES (quality of services)
Q2	Differentiated urban waste collection	Percentage of differentiated (recyclable vs non-recyclable) urban waste collection out of total urban waste	BES (quality of services)
Q3	Childcare services	Percentage of children up to age 3 using childcare services—day care centres, mini day care facilities or supplementary and innovative services—of which 70 % in day care centres, out of the total population aged up to 3 years	BES (quality of services)
Q4	Elderly assisted at home	Percentage of elderly people who benefited from integrated home assistance service (Adi) out of the total elderly population (aged 65 and over)	BES (quality of services)

Table 8 continued

	Indicators	Definitions	Source
Q5	Irregularities in electric power provision	Frequency of accidental long lasting power cuts (cuts without notice longer than 3 min), average number per consumer	BES (quality of services)
Q6	Irregularities in water supply	Percentage of households who report irregularities in water supply	BES (quality of services)
Gross domestic product			
GDP	Per capita GDP	Gross domestic product (GDP) at current market prices by NUTS 2 regions, euro per inhabitants	Eurostat (regional economic statistics)
Health			
H1	Life expectancy	Average number of years that a child born in a given calendar year can expect to live if exposed throughout life to the risks of death observed in the same year at different ages	BES (health)
H2	Infant mortality rate	Deaths in the first year of life per 10,000 live births	BES (health)
H3	Overweight or obesity	Standardized percentage of people aged 18 years and over who are overweight or obese (the indicator refers to the Body Mass Index—BMI)	BES (health)
H4	Sedentary lifestyle	Standardized percentage of people aged 14 years and over who do not practice any physical activity	BES (health)
H5	Nutrition	Standardized percentage of people aged 3 years and over who consume at least four portions of fruit and vegetables a day	BES (health)
Material living conditions			
M1	Disposable household income per inhabitant	Disposable household income on the total number of inhabitants	ISTAT (regional economic accounts)
M2	Disposable income inequality	Ratio of total equivalised income received by 20 % of the population with the highest income to that received by 20 % of the population with the lowest income	BES (economic well-being)
M3	People at risk of relative poverty	Percentage of persons at risk of poverty, with an equivalised income less than or equal to 60 % of the median equivalised income	BES (economic well-being)

Table 8 continued

	Indicators	Definitions	Source
M4	People living in jobless households	Percentage of individuals living in households with at least one component aged 18–59 years (with the exception of households where all members are full time students under 25 years) where nobody works or receives an occupational pension	BES (economic well-being)
M5	People suffering poor housing conditions	Percentage of people in overcrowded dwellings without basic facilities or with structural defects	BES (economic well-being)
Personal security			
T1	Burglary rate	Number of burglaries per 1,000 households	BES (security)
T2	Pickpocketing rate	Number of pickpocketings per 1,000 people	BES (security)
T3	Robbery rate	Number of robberies per 1,000 people	BES (security)
T4	Homicide rate	Number of homicides per 100,000 people	BES (security)
T5	Perception of crime risk	Percentage of households who are very much worried by the crime risk in the area where they live	ISTAT-DPS (legality and safety)
Research and innovation			
R1	R&D expenditure	R&D expenditure by Public Administration, Universities and public and private companies as percentage of GDP	BES (research and innovation)
R2	Capacity to export	Percentage of the value of the goods' exports on GDP	ISTAT-DPS (Internationalization)
R3	Patents	Number of patents registered by the European Patent Office per million inhabitants	BES-ISTAT-DPS (research and innovation)
R4	R&D workers	Researchers, technicians and other personnel involved in R&D in the Public Administrations, Universities, public and private companies, per 1,000 inhabitants	ISTAT-DPS (research and innovation)
R5	Graduates in Science and Technology	People aged 20–29 with degree in scientific and technological disciplines, per 1,000 inhabitants	ISTAT-DPS (research and innovation)
Social relations			
S1	Satisfaction with family relations	Share of population aged 14 and over who are very satisfied with their family relationships	BES (social relationships)
S2	Satisfaction with friendship relations	Share of population aged 14 and over who are very satisfied with the relationships with friends	BES (social relationships)

Table 8 continued

	Indicators	Definitions	Source
S3	Synthetic indicator of social participation	Based on the aggregation of the following indicators: People aged 14 and over who during the past 12 months have participated in meetings of associations, trade unions or professional associations or in activities, organized or promoted by religious or spiritual groups; have attended meetings of political parties	BES (social relationships)
S4	Volunteer work	Percentage of the population aged 14 and over who, in the past 12 months performed, non-paid volunteer work for associations or volunteer groups	BES (social relationships)
S5	Share of population who financed associations	Share of population aged 14 and over who in the past 12 months have financed associations	BES (social relationships)

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