Towards (Spatially) Unbalanced Development? A Joint Assessment of Regional Disparities in Socioeconomic and Territorial Variables in Italy

Abstract

The present study assesses disparities in the spatial distribution of three indicators evaluating respectively economic growth (per capita value added), sustainable development (a sustainable development index composing 99 individual variables) and the quality of the natural capital (Environmental Sensitive Area Index composing 14 individual variables) in Italy. The analysis was carried out on three different geographical domains (3 divisions (north, central and south Italy), 20 administrative regions and 103 provinces) with municipalities as the elementary spatial unit. While the distribution of the three indicators was coherent across space, the coefficient of variation of the three indicators, taken as a proxy of regional disparities, showed a contrasting spatial pattern. Domains with higher average values of the sustainable development index showed a lower variability among the municipal units, possibly indicating a less divided territorial context. By contrast, income and natural capital disparities are decoupled from the average level of the respective indexes. Multivariate analysis identifies a north–south gradient reflecting the divide between competitive and economically-disadvantaged regions in Italy. Results provide an informative base to implement sustainability policies in countries characterized by persistent socioeconomic disparities.

Keywords: Territorial disparities, Sustainable development, Economy, Environment, Italy.

1. Introduction

Environmental trends - together with socio-demographic processes and economic factors - represent a crucial issue for spatially-balanced sustainable development (Tumpel-Gugerell and Mooslechner, 2003). Monitoring complex socio-environmental dynamics over time and space is an important challenge for science and may support the development of advanced policy strategies towards sustainability (Steer, 1998). The analysis of sustainable socio-environmental systems is a key target in multi-disciplinary research focusing on economic growth, environmental degradation and the related policy response (Briassoulis, 2011). Taken as a leading path of balanced development from both socioeconomic and environmental perspectives, sustainability is a normative concept and requires to be correctly implemented at all decision levels (Dinda, 2004; Stern, 2004; Galeotti, 2007). Once benchmarking conditions are identified for the various dimensions of sustainability (e.g. economic, social, ecological, cultural, institutional, political), normative criteria define the opportunity space for sustainable development (Lawn, 2003).

However, while sustainable development has meant, for a long time, how to reconcile economic growth with environmental quality, it is now widely recognized that a really sustainable and balanced development path should involve much more complex issues with social, economic and, especially, territorial relevance (Zuindeau, 2006). Environmental degradation coupled with socio-cultural divides and economic polarization may accelerate territorial unbalances which ultimately lead to increased social conflicts and prevents the sustainable development of entire regions (Kok et al., 2004; Iosifides and Politidis, 2005; Onate and Peco, 2005).

Key examples of the interplay between proximate causes and underlying factors of complex sustainable development paths have been provided analyzing jointly economic performances, social inequality, institutional policies and their relations with the quality of the environment (Singh and Singh, 1995; Chopra and Gulati, 1997; Steer, 1998; Barbier, 2000; Scherr, 2000; among others; for the specific issue of sustainable urban development see the review in Hassan and Lee, 2015). Within this perspective, sustainability has been related to a theoretical definition of dynamic balance among development domains

(Hamdouch and Zuindeau, 2010) and an additional condition has been added, that sustainable development should be defined as spatially balanced and consistent over time (Zuindeau, 2007).

In Europe, territorial cohesion is considered as a relevant policy issue and this objective has been regarded as a third dimension to most traditional policy targets such as economic and social cohesion (Tumpel-Gugerell and Mooslechner, 2003). At the same time, the increased pressure on ecosystems determined, especially over the most recent decades, a decline in the quality of the environment associated with the progressive loss in natural resources, the consequent reduction of ecosystem services and negative effects on rural, marginal and economically-disadvantaged areas (Salvati and Carlucci, 2011).

Although issues related to the unbalanced distribution of natural resources, economic polarization and social disparities revealed particularly complex to assess and to approach with effective policy strategies in Europe, economic-environmental gaps are particularly intense in traditionally-divided countries (Zuindeau, 2007) such as those from the northern Mediterranean area. The joint evaluation of economic and environmental divides requires a multidisciplinary approach based on the analysis of the interplay between regional processes and place-specific factors (Puigdefabregas and Mendizabal, 1998). Multivariate approaches proved to be useful to identify territorial development paths with deviations from an *a-priori* (or even dynamically) defined spatially-balanced condition (Salvati and Carlucci, 2011). At the same time, more effective policy strategies - mainly in the form of integrated assemblages of strategic environmental-economic measures (Briassoulis, 2011) - are necessary to promote a spatially-balanced development (Zuindeau, 2006).

However, empirical analyses devoted to assess socio-environmental disparities and the spatial variability of sustainable development paths are still scarce (Salvati and Carlucci, 2014). This represents a serious limitation for the development of spatially-balanced development strategies. Previous studies have analyzed the spatial relationship between the level of land vulnerability to degradation and socioeconomic conditions as depicted by a wide set of elementary indicators (see Salvati, 2014 and references therein). Results of these studies shed some light on the spatial linkages between economic-environmental dynamics and sustainable development paths on a local scale. The present paper contributes to this deserving issue illustrating an integrated analysis of economic, environmental and sustainable development disparities in Italy based on simple statistical tools with the aim to verify spatial convergence in the three dimensions. Italy represents a paradigmatic case study in Mediterranean Europe due to of the development divide between north and south Italy. Economic disparities in Italy reveal their wide-range impacts on the environment and involves socio-demographic processes acting on vastly different scales, from regional to local (Salvati and Zitti, 2008).

The approach proposed in this study was based on a multivariate analysis of three indicators assessing economic, social and environmental factors at a disaggregated spatial scale: per capita value added (taken as a proxy of economic development and territorial competitiveness), a composite index of Sustainable Development which considers together the three pillars of sustainability (environmental protection, social changes, economic growth) by integrating 99 individual variables - and the Environmentally Sensitive Area Index assessing the quality of natural capital based on 14 biophysical variables. Our study contributes to implement effective policies for a spatially-balanced, sustainable development in affluent but economically-polarized countries.

2. Methodology

2.1. Study area

Italy extends nearly 301,330 km^2. among which 23% is flat, 42% upland, and 35% mountains. The country is characterized by a relevant divide in socioeconomic conditions between northern and southern regions (e.g. Niedertscheider and Erb, 2014; Iuzzolino et al., 2013; Dallara and Rizzi, 2012; Floridi et al., 2011; Felice, 2010). Northern Italy is one of the most developed and affluent regions in Europe; it extends over the Po river valley being separated from central Europe by Alps. Central Italy, separated from northern Italy by the Apennines is an economically-polarized region with a marked urban-rural divide centred on Rome and Florence. Southern Italy, including the main islands of Sicily and Sardinia, lies backward, with an economic structure centred on low- and medium-income agriculture and traditional tertiary activities (constructions, commerce and the public sector) concentrated in the main urban centres (Naples, Bari, Palermo, Cagliari). As a consequence, Italy shows important regional disparities in variables such as population density, urban morphology, agricultural intensity and natural resource endowments (Salvati and Zitti, 2008).

2.2. Indicators

Three indicators at the same spatial scale (8101 municipalities) were used in the present study: (i) per-capita value added (euros) provided by Censis (2004) for 2002 (INC), (ii) a Composite Index of Sustainable Development (CISD) introduced by Salvati and Carlucci (2014) and (iii) the Environmentally Sensitive Area Index (ESAI) calculated according to Salvati (2014). Both the CISD and the ESAI refer to a time period encompassing the early-2000s since they are based on census variables collected primarily in the years 2000, 2001 and 2002. These indicators were selected to investigate different economic, social and environmental factors on a municipal scale: (i) a pure economic index (INC) as a proxy for economic development and territorial competitiveness, (ii) a pure environmental index (ESAI) quantifying the quality of natural capital based on various biophysical dimensions including soil, vegetation, climate and use of land and (iii) a composite index (CISD) integrating the three pillars of sustainability, i.e. environmental protection, social changes, economic growth. The variables collected in our dataset represent the most recent point in time with an enough large availability of socioeconomic indicators on a municipal scale in Italy. Changes in census techniques, the unavailability of some variables in the most recent years, the dissemination program for several variables overpassing 2015 prevented us to collect a comparable dataset for the last years.
The Composite Index of Sustainable Development (CISD) proposed by Salvati and Carlucci (2014) was based on a Factor Weighting Model composing 99 elementary variables that cover five general themes (Demography, Human capital, Local development and competitiveness, Quality of life, Rural development and environment) in turn subdivided into 14 research dimensions (Population structure, Territorial characteristics/urban structure, Education, Labour market, Economic structure, Tourism specialization, Income and wealth, Crime, Water management, Land tenure, Rural landscape, Crop intensity,

Quality and innovation in agriculture, Human capital in agriculture). The weight assigned to each indicator was determined using an objective weighting system based on a Principal Component Analysis (Khatun, 2009). The CISD ranges between 0 and 1 and shows a spatially complex distribution in Italy with a north–south gradient reflecting the socioeconomic disparities observed between competitive (northern) and disadvantaged (southern) regions. The outcomes of the CISD were validated using three independent variables and evaluated for stability using sensitivity to changes in the composing indicators (Salvati and Carlucci, 2014).

The Environmental Sensitive Area Index provides a multi-dimensional assessment framework of four thematic domains (climate quality, soil quality, vegetation quality and land-use quality) related to natural resource availability and environmental degradation processes in the Mediterranean region (Basso et al., 2000). The procedure uses a geometric average approach to compose fourteen variables (3 for climate quality, 4 for soil quality, 4 for vegetation quality and 3 for land-use/land management) into a score index ranging between 1 and 2. Higher values indicate decreasing quality of the natural capital and increasing phenomena of land degradation (see Salvati and Zitti, 2008 for the list of variables and technical details). The outcomes of the ESAI were validated on several sites in Portugal, Spain, Italy and Greece (see Lavado Contador et al., 2009 and references therein). Moreover, Ferrara et al. (2012) have tested the stability of the ESAI computing sensitivity-to-changes in the composing indicators.

2.3. Statistical analysis

Two descriptive statistics (average and coefficient of variation) for the three indicators described above (INC, CISD and ESAI) were calculated separately for different spatial domains: (i) 3 geographical divisions (northern, central and southern Italy), (ii) 20 administrative regions and (iii) 103 provinces (based on the 2001 administrative structure in Italy). The coefficient of variation is considered as a reliable *proxy* of territorial disparities in the studied variable (Salvati and Zitti, 2008). Moreover, to provide a comprehensive picture of regional disparities, minimum and maximum values together with the ratio of the range (max - min) to the average value for each of the three indicators were calculated for the 3 geographical divisions of Italy (see above). The use of three spatial domains allows to verify results' stability on different geographical scales and to overcome indirectly the Modifiable Area Unit Problem, i.e. the risk to obtain results varying with the boundaries of the elementary analysis unit. An additional analysis, based on pair-wise Pearson correlation coefficients, was run with the aim to verify that both average and coefficient of variation values for the three indicators were not affected by the number and size of municipalities in each region or province (all comparisons, $p > 0.05$)

A Principal Component Analysis (PCA) was run separately on two data matrices composed of six variables (average and coefficient of variation of the three indicators described above) and, respectively, 20 regions or 103 provinces, with the aim to summarize spatial patterns and territorial disparities in the selected indicators (Salvati and Zitti, 2009). As the PCA was based on the correlation matrix, the number of significant axes (m) was chosen by retaining the components with eigenvalue > 1. The quality of PCA outputs was checked by means of the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett’s test of sphericity. These tests indicate if the PCA is appropriate to analyze the original data. Regions (or provinces) were classified into distinct groups according to component scores.

3. Results

A preliminary analysis of the distribution of the three indicators in the three geographical divisions (north, centre, south) is reported in Table 1. The analysis outlines relevant spatial disparities for each indicator. Although with specific local-scale patterns, INC, CISD and ESAI showed a marked north-south gradient (Figure 1) with northern regions sharing, on average, higher income levels and better attainments in terms of both sustainable development and quality of natural capital. This result works against the belief that northern regions perform well in socioeconomic issues and badly in environmental ones, with the other way round for southern regions (Floridi et al., 2011).

While the difference in the average levels between geographical areas show a common behaviour for the three indicators, the coefficients of variation within areas show diverging patterns. The CISD coefficient of variation (CVs) increased from northern to southern Italy and the reverse pattern was observed for the ESAI (CVe). The highest coefficient of variation for per-capita value added (CVi) was found in northern Italy, the lowest in central Italy. Table 2 reports averages and coefficients of variation for the three indicators in the twenty Italian regions. Results of the analysis carried out at disaggregated spatial scales confirm the spatial pattern observed at the geographical division level.

The PCA carried out on the regional data matrix extracted two components with absolute eigenvalue > 1 and cumulative variance higher than 72% (Figure 2). Both Kaiser–Meyer–Olkin's and Bartlett's tests ($p < 0.001$) indicate the appropriateness of the PCA model. Component 1 accounted for 51% of the total variance and was associated negatively with average levels of INC and CISD and positively with CVs and the average ESAI (low scores of the ESAI mean good land quality). Taken together, the analysis confirms the aforementioned spatial pattern based on the north-south divide in Italy. As regards sustainable development, these results suggest that better performing regions are also more spatially-homogeneous, showing lower disparities in the CISD (as measured by the CVs) than regions with low CISD values. Component 2 extracted 21% of the total variance and assigned respectively a positive and negative loading to CVe and CVi. This indicates that higher disparities in natural resource quality were observed in regions with lower income disparities. As expected, CVi and CVe were uncorrelated with CVs suggesting a possible role of compensatory mechanisms of economic and environmental disparities in shaping the spatial distribution of the sustainable development index, possibly due to the linearity of the aggregation formula used to compute the CISD (Munda and Saisana, 2011).

Component 1 scores ordered the Italian regions along the north-south gradient (Figure 2). Southern Italian regions cluster along the positive side of component 1 and are characterized by the highest CVs values. Northern and central Italian regions cluster together along the component 1 negative scores and are characterized by above-average values of both per capita value added and the sustainable development index. However, they form two sub-groups along component 2 according to the spatial disparities observed respectively in the economic variable or in the environmental variable under investigation.

Figure 3 illustrates the results of the PCA run on the same variables calculated on a disaggregated spatial scale (103 provinces) in Italy. Component loadings confirm the findings illustrated above and show a coherent spatial pattern of INC and CISD contrasting with the spatial distribution of the CVs along component 1 (44% of the total variance). The CVi correlated negatively with component 2 (24% of the total variance). The main difference with the regional analysis lies in the spatial pattern of the ESAI and CVe. These variables showed a contrasting spatial distribution and are associated to both principal components. This reflects the importance of local-scale determinants in the distribution of natural capital. In fact, it could be much more difficult to identify a unique development path compatible with the three pillars of sustainability on the provincial scale (Dallara and Rizzi, 2012). Component scores ordered Italian provinces along the north-south gradient and identify central Italy as a region characterized by intermediate conditions in both sustainable development and environmental-economic dynamics in respect to north and south Italy.

4. Discussion

Taken as both positive and normative concept, sustainability was related to the dynamic balance among different dimensions (Zuindeau, 2007). Spatial equilibrium and consistency over time were defined as crucial conditions for sustainable development (Zuindeau, 2006). Regional disparities and human pressures threatening the natural capital have been seen as factors determining a deviation from a spatially-balanced development path. The multiple pre-conditions for a sustainable development require permanent assessment and an integrated policy response at vastly different geographical scales, from national to local (e.g. Neumayer, 2001).

This paper studies the economic-environment dynamics of local systems through high-resolution spatial partitions. We propose a multivariate approach which identified complex spatial patterns (i) in the environmental index at both local and regional scale, (ii) in the economic index, discriminating affluent from disadvantaged areas in the country, and (iii) in the relation between these two indexes, as reflected in the spatial distribution of the sustainable development index. Spatial patterns in the economic-environmental system are therefore interpreted in the light of consolidated gradients shaping the distribution of both natural and economic resources in Italy. The spatial divergence in the three indicators investigated reflects the economic gaps between Italian regions. Our study suggests that the spatial distribution of the three indicators is influenced by complex socioeconomic local contexts which reduce the effectiveness of sustainable development policies. Italy is a divided country with socioeconomic disparities exalted by the divergent dynamics of endogenous factors and non-sustainable development paths (Floridi et al., 2011). In such a context, the coordination of multi-scale (national, regional, local) and multi-target (economic, social, environmental) measures may substantially improve the effectiveness of sustainable development strategies (Briassoulis, 2011). Policies are increasingly required to reconsider the regional dimension in the sustainable development issue by identifying the relationship between environment-economic processes and spatially-balanced development paths .

The approach illustrated in the present study can be expanded to address complex ecological-economic problems. The framework presented here (i) sheds light on multidimensional, spatial processes seen from various disciplinary perspectives, (ii) integrates data from different sources and provides local stakeholders with analytical tools and indicators and (iii) identifies a representative pattern of regional disparities as a potential target for sustainable development policies. This paper finally outlines the role of long time series data and spatially-disaggregated indicators, which are vital to successfully apply multi-dimensional statistical techniques to socio-environmental problems.

5. Conclusions and future research lines

Studies like the present one have both cognitive (i.e. research) and normative (i.e. policy support) implications. Understanding the spatial patterns related with socioeconomic and ecological issues contributes to identify sustainable development paths and represents a meaningful tool for monitoring strategies and policy implementation in ecologically-fragile and economically-divided countries (Steer, 1998; Dumanski and Pieri, 2000; Zalidis et al., 2002, 2004; Veron et al., 2006; Nourry, 2008). The diachronic implementation of the analytical framework proposed here will provide a practical tool to assess the effectiveness of local-scale sustainable development policies.

6. References

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Table 1. Disparities in the spatial distribution of the three indicators (per-capita value added, sustainable development index, environmentally sensitive area index) by geographical division in Italy.

Region	Average	Min	Max	Coefficient of variation	Range/mean
			Per capita value added (INC)*		
North	10,221	1282	83,987	65	8.1
Centre	8,282	1668	40,123	52	4.6
South	5,606	810	41,190	58	7.2
Italy	**8,549**	**810**	**232,658**	**69**	**27.1**
			*Sustainable Development Index (CISD**)*		
North	0.39	0.02	1.00	15	2.5
Centre	0.34	0.11	0.57	17	1.4
South	0.26	0.00	0.49	19	1.9
Italy	**0.34**	**0.00**	**1.00**	**23**	**2.9**
			*Environmentally Sensitive Area Index (ESAI***)*		
North	1.338	1.156	1.569	5.6	0.31
Centre	1.353	1.202	1.563	5.3	0.27
South	1.398	1.229	1.628	4.6	0.29
Italy	**1.358**	**1.156**	**1.628**	**5.4**	**0.35**

* euros per-capita; ** score ranging from 0 to 1; *** score ranging from 1 to 2.

Table 2. Disparities in the spatial distribution of the three indicators (per-capita value added, sustainable development index, environmentally sensitive area index) by administrative region in Italy (N: North Italy, C: Central Italy and S: South Italy).

Region	*Average*			*Coefficient of variation*		
	Per-capita value added	Sustainable development index	Environmentally sensitive area index	Per-capita value added	Sustainable development index	Environmentally sensitive area index
Aosta valley (N)	9,343	0.36	1.319	0.82	0.14	0.039
Piedmont (N)	11,634	0.42	1.284	0.77	0.10	0.024
Lombardia (N)	10,737	0.39	1.352	0.66	0.13	0.059
Trentino Alto Adige (N)	9,641	0.43	1.270	0.47	0.12	0.031
Veneto (N)	10,934	0.41	1.378	0.43	0.11	0.055
Friuli Venezia Giulia (N)	9,683	0.39	1.322	0.58	0.11	0.057
Liguria (N)	8,405	0.33	1.302	0.59	0.15	0.040
Emilia Romagna (N)	11,638	0.41	1.389	0.43	0.15	0.047
Tuscany (C)	9,820	0.38	1.341	0.44	0.14	0.039
Umbria (C)	7,945	0.35	1.319	0.38	0.14	0.039
Marche (C)	9,357	0.37	1.402	0.38	0.12	0.058
Latium (C)	6,497	0.30	1.337	0.67	0.17	0.050
Abruzzo (S)	7,169	0.29	1.368	0.67	0.20	0.057
Molise (S)	5,467	0.27	1.385	0.79	0.19	0.048
Campania (S)	5,848	0.26	1.400	0.44	0.17	0.043
Apulia (S)	5,856	0.27	1.429	0.38	0.13	0.031
Basilicata (S)	4,990	0.27	1.399	0.52	0.16	0.037
Calabria (S)	4,647	0.24	1.359	0.53	0.17	0.038
Sicily (S)	5,327	0.24	1.428	0.51	0.19	0.044
Sardinia (S)	5,409	0.26	1.413	0.70	0.17	0.035