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A Balanced Development? The Novel σ–μ Efficiency of Italian Regions

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2.1 Introduction

The concept of Local Economic Development (LED)—as opposed to economic growth—encompasses a variety of dimensions and stages (Feldman et al. 2016; Haller 2012; Todaro and Smith 2015; Thirlwall 2006). LED is intrinsically a multidimensional concept including aspects such as education, poverty, and health whereby "locally and regionally

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determined development models should not be developed independently of more foundational principles and values such as democracy, equity, internationalism and justice" (Pike et al. 2007). Moreover, it has been argued that 'development' is a process that involves the standards of living of societies and necessitates a balance between social and economic dimensions of regions, aiming at both a sustainable approach to production and the improvement in the quality of life of households (Huq et al. 2009). From a slightly different perspective, Ascani et al. (2012) pointed out how considerably high levels of unemployment and poverty testify that modern processes do not function solely on quantitative increases in activity, but that greater attention should be paid to social, cultural and human development within communities. Its multidimensionality, therefore, reverberates throughout both the development policies (Hansen 1965) and the measurement exercise (Greco et al. 2018). Interesting results emerge from the MAKSWELL (MAKing Sustainable development and WELL-being) frameworks work for policy analysis (www.makswell.eu) project which is a research project funded by the European Union's Horizon 2020 Programme with the aim to extend and harmonise the indicators able to capture the main characteristics of the beyond-GDP approach and to propose a new framework that includes them in the evaluation of the public policies. Indeed, preliminary findings of the projects highlight that 19 out of the 28 EU countries have put in place a framework to measure the well-being of their citizens according to a multidimensional perspective.

The measurement of the levels of LED, therefore, unavoidably goes beyond the Gross Domestic Product (GDP) and involves a variety of qualitative and quantitative measures in order to assess the extent to which the (GDP) growth translates into overall economic and social improvement. This is perhaps even more important in consideration

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of the 'local' perspective. Indeed, the GDP or equally the Gross Value Added (GVA) approach, are not able to capture either regions' income or regional productivity (Dunnell 2009). The mounting criticism about GDP and other one-dimensional measures of economic performance (Kuznets 1934; Kubiszewski et al. 2013; Costanza et al. 2009; Stiglitz et al. 2009) has paved the way for use of composite indices to measure the level of economic development (Greco et al. 2018). "The key aim of Social Indicators Research is to create an all-inclusive measure of quality of life in countries that is akin to Gross National Product in Economic Indicator Research" (Veenhoven 1996, p. 1). It is worth noticing that this evidence is in line with the general trend seeing composite indicators gaining astounding popularity in all areas of research (Greco et al. 2019a). For example, in Bandura (2005), over 400 official composite indices that rank or assess a country according to some economic, political, social or environmental measures are reviewed. More recently, Yang (2014) documents over 100 composite measures of human progress.

Within this general trend, the between-country perspective is coupled with within-country exercises aiming to measure the economic development at subnational levels. In accordance with this subnational perspective, in turn, emphasis is given to different aspects ranging from more precise ones such as 'competitiveness', for example, European Union (EU) Regional Competitiveness Index (RCI) (Annoni and Kozovska 2010; Dijkstra et al. 2011), to overall quality of life such as the Organisation for Economic Co-operation and Development (OECD)'s initiative 'How is life in your region?', proposing the Better Life Index (BLI) (OECD 2014). Overall, the subnational approaches share the aim to somewhat address the criticism about the neglected distributional aspects related to a single-country measure. Indeed, the substantial limits of a single value to represent the distribution of, for example, education, health and living standards, especially among vast countries (Sagar and Najam 1998; United Nations (UN) 2018), have been pointed out. Put differently, the uneven spatial distribution of the economic development within countries is deemed an aspect that can no longer be neglected. In this regard, an interesting initiative concerns the computation of the well-known Human Development Index (HDI) at subnational level (UN 2018). The Subnational Human Development Index (SHDI) aims to

measure the variation in human development among geographic regions within countries in a globally comparable way. Similarly, the EU (Bubbico and Dijkstra 2011) has realised a 'regional focus' analysing the Human Development Index (HDI) and Human Poverty Index (HPI) as published in the Fifth Cohesion Report (EC 2010) at regional level based on a slight variation of the methodology developed by the United Nations Development Programme (UNDP).

An important single-country attempt to measure economic development at the local level is represented by the Italian index called *Benessere Equo e Sostenibile* (BES, equitable and sustainable well-being) proposed by the ISTAT (*Instituto Nazionale di Statistica*). The BES (ISTAT 2018) offers an overall picture of the main economic, social and environmental phenomena through the analysis of a wide set of indicators divided into 12 domains. This experience is of particular interest because since 2016 the BES is part of the official stages of economic planning. Indeed, Law no. 163/2016 stated that a selection of BES indicators should contribute to defining those economic policies which largely affect some fundamental dimensions for the quality of life. In 2018, the Italian Economic and Financial Document (*Documento di Economia e Finanza*, DEF) considered the list of 12 BES indicators.[1] Consequently, the very recent DEF 2019 includes BES indicators[2] in reporting both the trend and the programmatic forecast of the effects of Italian budgetary policy.

Undoubtedly, the inclusion of a multidimensional measure of development alongside the mainstream GDP emphasises some interesting points about the aggregation procedure (especially in terms of weighting) and its representativeness. Indeed, all the attempts to measure (local) economic development according to a multidimensional perspective share issues regarding the aggregation of the multiple aspects considered. As Greco et al. (2018, p. 591) cogently point out,

> [...] mainstream composite indices of regional socioeconomic performance do not allow for differences in the weighting system and are

[1]While eight out of the 12 indicators were analysed in their recent evolution, the remaining four were estimated for the following three years.

[2]See http://www.mef.gov.it/documenti-allegati/2019/def/DEF_2019_Allegato_BES_16_04_19_H_19_30.pdf. Retrieved: 22/08/2019.

thus effectively maintaining an unwarranted mask of objectivity. They implicitly assume equal weighting, which may not be justified with respect to the preferences of different groups of individuals. The equal weighting assumption runs counter to a policy world that values local preferences, and hence runs counter to the seminal contributions founded on their importance. These relate to different preferences for sets of local public goods according to the Tiebout (1956) model and further developments in fiscal federalism building upon the work of Oates (1972).

In this regard, it is worth noticing that both the BES and the OECD BLI share the deliberate methodological choice of refusing to adopt a single weighting system, with different nuances. Indeed, the OECD proposes overcoming the weighting issue by (1) presenting a set of headline indicators[3] rather than a single composite index (OECD 2014) for 362 OECD regions and then (2) giving to the single user the possibility to set his or her own set of weights in order to get her personalised composite indicator. The BES, instead, does not allow achieving a single measure as each domain is presented separately. Arguably, both approaches, while avoiding the issue of providing a single set of weights, are potentially even more difficult to communicate to the public and decision-makers alike (Greco et al. 2018).

To the best of our knowledge, the work proposed by Greco et al. (2018) represents the first attempt to overcome the weighting issue by adopting the Stochastic Multiobjective Acceptability Analysis (SMAA) (Lahdelma et al. 1998) to the measurement of local economic development. Their work builds upon the possibility that the SMAA method allows considering the whole set of possible weights. However, the application of the SMAA method has pros and cons. On the one hand, it can make a substantial contribution to achieve a better balance in the trade-off between a composite index and a range of indicators as it allows for maximum variety in the relative evaluation of each dimension of development. On the other hand, it does not produce a single composite indicator value. Furthermore, the SMAA has been mainly (if not exclusively) used to provide ordinal information through probabilistic rankings or an

[3]Currently 11. See http://www.oecdbetterlifeindex.org/. Retrieved: 22/08/2019.

expected overall ranking. The aforementioned study of Greco et al. (2018) does not represent an exception in this respect.

Nonetheless, very recently Greco et al. (2019c) proposed the use of SMAA in an innovative way—called $\sigma-\mu$ *efficiency analysis* (hereafter $\sigma-\mu$)—in order to encapsulate a more holistic evaluation in a single value providing information about the magnitude of the performance of each alternative. The next section briefly illustrates the methodology proposing a possible application with reference to the measurement of LED. Section 2.3 will apply the methodology to the Italian regional case. Section 2.4 concludes.

2.2 The σ–μ Analysis as Applied to the Measurement of the Local Economic Development

As already noted, the consideration of multiple views in measuring the levels of LED according to a multidimensional perspective is a crucial issue, especially in order to highlight differences in the spatial distribution of benefits eventually arising from the narrower economic growth. Put differently, a multidimensional measure of LED should be able to consider not only the multiple dimensions of LED, but also the different views about the relative importance of each dimension of development. Although on the conceptual grounds the above argument is widely accepted, on the practical side a convincing methodological approach is far from being achieved. Composite indicators are the natural candidate to perform the task. Yet, the aggregation procedure(s) cannot achieve unanimity. It is worth stressing how this aspect is significant in the measurement of well-being related to different levels of development as shown by Greco et al. (2019b) by means of a 'multidimensional spatial model' using the data from the OECD BLI.

In this regard, the aforementioned $\sigma-\mu$ expressly stands "by the principle that a meaningful composite indicator should ideally reflect a multiplicity of viewpoints" (Greco et al. 2019c, p. 945), rejecting the idea of the allegedly representative agent in favour of the consideration

of the variety of preferences between citizens and/or clusters of them (e.g. practitioners, experts, households). Departing from the currently available methodology, however, the σ–μ is able to provide also a final single measure encapsulating both the multiple dimensions and the multiple preferences in a single measure of efficiency and, therefore, in the case at hand, of development. While the reader is referred to Greco et al. (2019c), especially section 3 at pp. 945–950 on which this section draws heavily, for the technicalities of the procedure, in what follows we report the intuition behind it with particular regard to the goal of the measurement of levels of LED.

The starting point of the σ–μ analysis is the outcome of a SMAA exercise applied to the normalised dimension of LED considered in the analysis (e.g. health, education, work conditions). Therefore, within the SMAA setting a random sampling of q vectors of weights $w_h = [\ w_{1h}, \ldots, w_{mh}\ ]$, with $h = 1, \ldots, q$, such that w_{ih} is non-negative for all i and for all h, and $w_{1h} + \ldots + w_{mh} = 1$ for all h is used to aggregate m dimensions. The q random extracted weight vectors w_h, $h = 1, \ldots, q$, constitute a representative sample of the whole set of feasible weights vector. They can be collected in the following $m \times q$ **RW** matrix:

$$\underset{m\times q}{\mathbf{RW}} = \begin{pmatrix} w_{11} & w_{12} & \cdots & w_{1q} \\ w_{21} & w_{22} & \cdots & w_{2q} \\ \vdots & \vdots & \ldots & \vdots \\ w_{m1} & w_{m2} & \cdots & w_{mq} \end{pmatrix}$$

Observe that we can assume that the feasible weight vectors w_h have to satisfy some constraints representing the importance assigned to the considered dimensions by the individuals of the considered population. For example, if the first dimension is at least as important as the second, that, in turn, is at least as important as the third and so on, the following constraints have to be satisfied:

$w_{1h} \geq w_{2h} \geq \ldots \geq w_{mh}$,
for all $h = 1, \ldots, q$.

Then, using the weight matrix **RW**, a composite indicator
$CI(\mathbf{x}_i, \mathbf{w}_h) = w_{1h}x_1 + w_{2h}x_2 + \ldots + w_{mh}x_m$
can be computed for each local economy (e.g. region) i and each weight vector w_h. Hence, the results can be ordered in the following $n \times q$ matrix **CI:**

$$\underset{n\times q}{\mathbf{CI}} = \begin{pmatrix} CI\,(\mathbf{x}_1, \mathbf{w}_1) & CI\,(\mathbf{x}_1, \mathbf{w}_1) & \cdots & CI\,(\mathbf{x}_1, \mathbf{w}_q) \\ CI\,(\mathbf{x}_2, \mathbf{w}_1) & CI\,(\mathbf{x}_2, \mathbf{w}_2) & \cdots & CI\,(\mathbf{x}_2, \mathbf{w}_q) \\ \vdots & \vdots & \ldots & \vdots \\ CI\,(\mathbf{x}_n, \mathbf{w}_1) & CI\,(\mathbf{x}_n, \mathbf{w}_2) & \cdots & CI\,(\mathbf{x}_n, \mathbf{w}_q) \end{pmatrix}$$

The following step consists in using the values collected in **CI**, for each economy i to compute the approximated values $\tilde{\mu}_i$ and $\tilde{\sigma}_i$ for the mean μ_i and the standard deviation σ_i of the composite indicator $CI(x_i, w)$ in the whole set of feasible weight vectors:

$$\tilde{\mu}_i = \frac{1}{q}\sum_{h=1}^{q} CI\,(\mathbf{x}_i, \mathbf{w}_h)\,,\ \tilde{\sigma}_i = \sqrt{\frac{1}{q}\sum_{h=1}^{q}\left(CI\,(\mathbf{x}_i, \mathbf{w}_h) - \tilde{\mu}_i\right)^2}.$$

These two—μ and σ—are the parameters of interest where μ_i is intended to be maximised, because it represents the average evaluation of the level of economic development of a local economy taking into account the variability of the weight vectors $\mathbf{w}$. Instead, σ_i has to be minimised, as it exhibits the instability in the overall evaluations of the LED achieved with respect to the variability of weights.[4] The economic rationale for this stems from the literature about inequality. Indeed, σ is the multidimensional projection of the inequality in the GDP economics discussion (Piketty 2014). Moreover, once interpreted within a neo-Benthamite beyond GDP perspective, σ is just a common measure of

[4]For a detailed discussion on this point including the economic rationale the reader is referred to Greco et al. (2019c, p. 946).

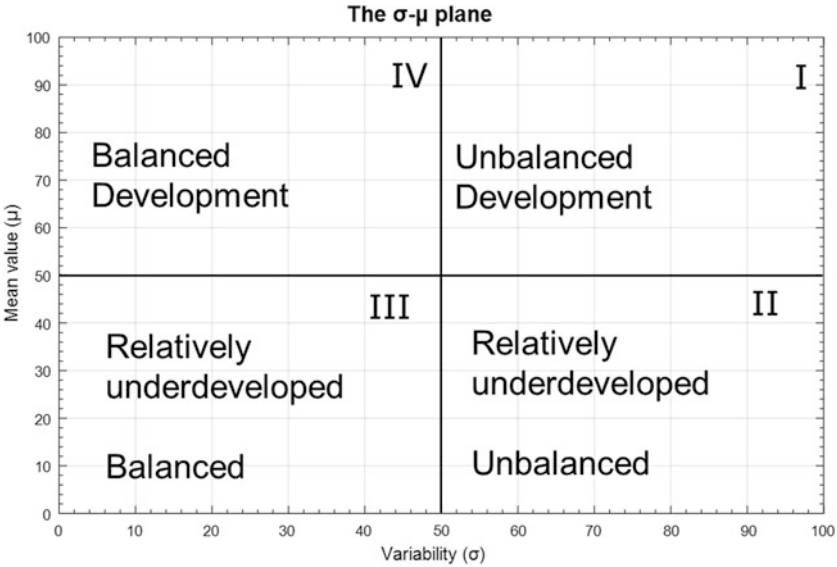

Fig. 2.1 The σ–μ plane of local economic development. (Source: adapted from Greco et al. (2019c))

inequality and, as such, has to be minimised (Atkinson 1970, 2015). The point can be further illustrated with the help of the following so-called $\sigma-\mu$ plane reported in Fig. 2.1 below.

In the above figure, quadrants I–IV refer to cases of economic development differing for both the overall performance (as measured by μ, reported on the y-axis) and the dispersion between the individual evaluations according to different sets of weights (as measured by σ, reported on the x-axis). Indeed, cases belonging to the first quadrant show relatively high levels of overall performance (i.e. above the threshold put at 50 for the sake of illustration); however, those relatively high levels of development are coupled with a relatively high degree of variability in the evaluations, due to different preferences about the importance of the considered aspects of development considered. This might be the case of unbalanced development where the policy focuses on a few dimensions while missing an overall harmonious development path. For example, Hansen (1965) pointed out as those persons who benefited most by Social

Overhead Capital may be unsatisfied and eventually migrate to other regions in the absence or in case of unsatisfactory levels of supplementary policy measures. Such a high variation might reflect just the preferences of those unsatisfied by the strong imbalance between implemented policies.

Quite symmetrically, cases reported in the second quadrant while sharing the above unbalance between different individuals in the considered population, are not able to overall perform as good as cases reported in the above I quadrant. It is worth recalling here how, in terms of local development, it has been argued that the unbalance between different dimensions is (not only an undesirable situation but also) a situation making the given local economy more vulnerable to shocks. Martin (2011, p. 14), for example, with reference to the UK, pointed out how an unbalanced development of the economy and, "especially the relative dependence on production industry, is generally regarded as having a major influence on the sensitivity of regional economies to recessionary shock".

The following quadrant (III) includes cases of balanced relative underdevelopment. Put differently, this quadrant refers to cases of relatively low levels of overall development coupled with a relative balance between the evaluations of different individuals in the considered population. Finally, the IV quadrant refers to the desirable balance between different components of economic development able to provide relatively high levels of overall performance. These cases, therefore, represent combinations of balanced development whereby the trade-off between the multiple components of economic development achieves a balance able to satisfy a variety of viewpoints potentially belonging to different stakeholders.

Undeniably, the comparative static reported in Fig. 2.1 can potentially be extended to include the dynamic case. That is to say, building upon Barro and Sala-i Martin's (1992) seminal contribution in terms of convergence in terms of GDP, a given set of local economies could be evaluated at regular intervals to check whether a more balanced multidimensional performance is occurring over time.

In both, static and dynamic cases, the σ–μ framework allows defining both a concept of Pareto–Koopmans dominance between local economies based on the uneven spatial LED and a set of local and global efficiency scores. Those scores, once applied to the case at hand, can be easily interpreted as a holistic score of LED.

As for the former, the σ–μ Pareto–Koopmans dominance relation on the set of economies to compare can be defined as follows: a unit $i \in I$ (the set of all units, local economies in case at hand) is σ–μ Pareto–Koopmans efficient if there is no convex combination of $\mu_{i'}$ and $\sigma_{i'}$ of the remaining units, $i' \neq i$, with a mean value μ that is not smaller, and a standard deviation σ that is not greater, with at least one of these inequalities being strict. It is worth noticing here that the above is just an extension of the Pareto-efficiency whereby for all $i, i' \in I$, unit i is Pareto dominating unit i' if $\mu_i \geq \mu_{i'}$ and $\sigma_i \leq \sigma_{i'}$, with at least one of the two inequalities being strict (and where a unit $i \in I$ is σ–μ Pareto-efficient if there is no other unit dominating it). The proposed extensive application allows for the possibility to combine different units. Then, the set of all Pareto efficient units constitutes the Pareto frontier and, similarly, the set of all σ–μ Pareto–Koopmans efficient units constitutes the σ–μ Pareto–Koopmans frontier.

Removing the first PKF from the set of units to be evaluated and computing again the PKF efficiency frontier for the remaining units results in the second σ–μ PKF (PKF_2), and so on until all PKFs have been computed. The recursive calculation of Pareto–Koopmans Frontiers (PKF) can be used to provide a more plausible benchmark for spatial units. Indeed, it might be argued that it makes little sense to compare a single spatial unit remote from the frontier to units belonging to the (first) frontier, as they could be potentially implausible benchmarks. Rather, comparing units that are closer in the σ–μ plane constitute a more realistic exercise. This can be the case, for example, of regions belonging to different areas in countries characterised by a significant spatial divide such as the UK or Italy. Consequently, our methodology allows for the comparison of units closer in terms of their development, even regardless of their spatial proximity. In any case, the efficiency is related to the

considered frontiers, so that we pass from one absolute to a relative concept of efficiency.

Moreover, taking into account the whole set of PKF(s), in turn, allows for both a 'local' and an 'overall' measure of efficiency. As for the former, it can be defined as follows:

$$\begin{aligned} &\delta_i^* = \text{Max}\,\delta \\ &s.t. \\ &\begin{cases} \alpha\mu_i - \beta\sigma_i \geqslant \sigma\mu_{i'} - \beta\sigma_{i'} + \delta, \forall i' \neq i \\ \alpha, \beta \geqslant 0 \\ \alpha + \beta = 1 \end{cases} \end{aligned}$$

To determine δ_i^* requires the solution of the above Linear Programming (LP) problem. In words, the LP problem verifies that once an evaluation $\alpha\mu_{i'} - \beta\sigma_{i'}$, with α, $\beta \geq 0$ and $\alpha + \beta = 1$,[5] is assigned to all units $i' \in I$, a pair (α, β) exists, for which unit $i \in I$ receives an evaluation—in our case in terms of multidimensional measure of economic development—that is not worse than the remaining local economies, $i' \neq i$, that is, $\alpha\mu_i - \beta\sigma_i \geq \alpha\mu_{i'} - \beta\sigma_{i'} + \delta$.

Once applied to the measurement of LED, δ_i^* can be interpreted as a measure of overall economic development of the local economy i. More in detail, while for the units belonging to the σ–μ PKF, it represents the margin that can be *subtracted* from the overall evaluation $\alpha\mu_i - \beta\sigma_i$ of the local economy i maintaining the maximality of its evaluation with respect to all other units $i' \neq i$, for all local economies $i \in I$ that *do not belong to* the σ–μ PKF. Consequently, the greater the absolute value of δ_i^*, the greater the margin that has to be *added* to $\alpha\mu_i - \beta\sigma_i$, in order to attain the evaluation $\alpha\mu_{i'} - \beta\sigma_{i'}$ of at least one unit belonging to the σ–μ PKF.

[5] It is worth noticing how the non-negative coefficient α for the mean $\mu_{i'}$ and the non-positive coefficient $-\beta$ for the standard deviation $\sigma_{i'}$ are coherent with the idea that $\mu_{i'}$ is intended to be maximised and $\sigma_{i'}$ is intended to be minimised. Therefore, the greater $\alpha\mu_{i'} - \beta\sigma_{i'}$, the better the unit i′ performs with respect to $\mu_{i'}$ and $\sigma_{i'}$.

As for the local multidimensional measure of economic development (δ_{ik},), for each PKF$_k$ and for each unit i it can be defined as follows:

$$\begin{aligned}
&\delta_{ik} = \text{Max } \delta \\
&s.t. \\
&\begin{cases}
\alpha\mu_i - \beta\sigma_i \geqslant \sigma\mu_{i'} - \beta\sigma_{i'} + \delta, \forall i' \in I \setminus \bigcup_{h=1}^{k-1} \text{PKF}_h \\
\alpha, \beta \geqslant 0 \\
\alpha + \beta = 1
\end{cases}
\end{aligned}$$

Hence, similar to the 'overall' case, the above Linear Programming (LP) problem checks whether there exists a pair (α, β), for which economy $i \in I$ receives an evaluation ($\alpha\mu_i - \beta\sigma_i$)—that is, once more, in the case at hand, a level of multidimensional local development—which is not worse than the analogous level of development of the rest of the units belonging to the k-th σ–μ Pareto–Koopmans efficiency frontier, or to a better σ–μ Pareto–Koopmans efficiency frontier. This happens if $\delta_{ik} \geq 0$. Instead, if $\delta_{ik} < 0$, then unit i belongs to a σ–μ PKF worse than PKF$_k$—that is, it belongs to a set of units characterised by a significant lower level of development. Put differently, similar to the global case, for the units in the k-th σ–μ PKF frontier or better, $\delta_{ik} \geq 0$ represents the margin that can be subtracted from the overall evaluation $\alpha\mu_i - \beta\sigma_i$ of the local economy i maintaining an evaluation that is superior to all economies in the k-th σ–μ PKF or worse.

Finally, in order to explicitly take into account the multiplicity of PKFs a 'global' development score, denoted by sm_i, reflecting the level of development of each local economy with respect to all frontiers can be defined as follows:

$$sm_i = \sum_{k=1}^{p} \delta_{ik}.$$

Hence, sm_i represents a more holistic measure of local development extending the classic concept of context-dependent DEA (Seiford and

Zhu 2003). The next section will apply this methodological framework to the multidimensional measurement of the development of Italian regions.

2.3 An Application to Italian Regions

This section shows how the σ–μ analysis can be applied to the measurement of levels of economic development of Italian regions. The Italian setting characterised by a marked and persistent North–South divide represents an interesting showcase for the measurement of the spatial divide according to a multidimensional perspective as proposed by the novel methodology at hand. Indeed, the analysis allows unveiling how the spatial divide in terms of GDP translates into an uneven economic development considering both the multidimensional nature of the spatial disparities and the multiplicity of preferences (or standpoints) from which those disparities can be considered. While the multidimensional approach to the spatial divide is in line with the extant literature (see, between others, Cannari et al. 2009; Torrisi et al. 2015; Stanickova and Melecký 2018), the consideration of a multiplicity of weights represents only a very recent contribution (Greco et al. 2018). Moreover, to the best of our knowledge, this is the first attempt to consider the multiplicity of weights at the same time as achieving a single global measure of regional economic development.

In order to apply the σ–μ analysis to the measurement of the level of development of Italian regions we consider the full set of variables collected along with the 12 main categories[6] (or, in ISTAT's terms, *domini*) and made available by the ISTAT within the BES initiative. It is worth noticing here that the BES initiative represents, to date, the most comprehensive attempt to measure well-being according to a multidimensional approach across the EU member states. Indeed, the 130 BES indicators represent the maximum number of indicators considered

[6]The categories are: health, education, working conditions, economic well- being, social relationships, quality of government and institutions, safety, individual wellbeing, heritage, environment, R&D, quality of public services (own translation). Available at https://www.istat.it/it/archivio/224669. Retrieved: 29/08/2019.

by national initiatives (with the seven Hungarian indicators representing the minimum number of dimensions considered).[7]

Table 2.1 reports the results of the analysis performed according to the methodology illustrated in Sect. 2.3 for each of the 20 Italian regions (with separate calculation also for the autonomous provinces of Trento and Bolzano). More in detail, the second column of Table 2.1 reports the overall performance (μ) achieved across different weights assigned to the considered 130 BES dimensions. The third column reports the dispersion (σ) across the different evaluation depending on the relative importance assigned to each dimension (i.e. weights assigned). The fourth column reports the single measure of (efficiency in terms of) economic development (*sm*). Columns from 5th to 12th report the relative performance of each region according to a set of eight different PKFs (δ_{ik}).

The figures concerning μ, σ, and *sm* are mapped in Figs. 2.2, 2.3, and 2.4, respectively.

The results concerning the overall performance according to the different weights (μ) substantially confirm the well-known North–South divide characterising the Italian case. Moreover, in line with Greco et al. (2018), the empirical evidence obtained according to the multidimensional perspective shows that the spatial divide in Italy is much wider than the one measured in terms of GDP. Put differently, the sharp spatial divide between northern and southern regions goes well beyond the strict (GDP) growth sphere to pervade all aspects of development, creating a generalised picture of relative underdevelopment. The widespread underdevelopment, in turn, unavoidably affects the whole development path contributing to the persistence of the spatial divide (Fujita 2007). This evidence is confirmed by the global measure of development reported, for the sake of completeness, in Fig. 2.4.

Moreover, by disentangling the spatial divide into the overall performance and the disparities arising from different preferences about the multiple dimensions of development, one can have insights about the depth of the divide both within and between regions. Generally

[7] See https://www.istat.it/it/files//2018/12/BES2018-intro.pdf and https://www.makswell.eu/attached_documents/output_deliverables/deliverable_1.1_draft.pdf. Retrieved: 29/08/2019.

Table 2.1 Results of the σ–μ analysis of regional economic development of Italian regions

Region	μ[a]	σ[a]	sm[b]	δ_i							
				(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Piemonte	0.16	−1.17	0.3894	−0.0012	0.0001	0.0015	0.0058	0.0274	0.0785	0.1293	0.1492
Valle d'Aosta	0.62	1.04	0.5035	−0.0107	−0.0102	0.0018	0.0156	0.0640	0.1151	0.1659	0.1858
Liguria	−0.03	−1.54	0.3440	0.0018	0.0018	0.0030	0.0067	0.0124	0.0630	0.1138	0.1336
Lombardia	0.6	0.39	0.5012	−0.0075	−0.0070	0.0017	0.0138	0.0622	0.1133	0.1641	0.1840
Trentino-AA	1.79	−0.42	1.0000	0.0048	0.0104	0.0935	0.1091	0.1575	0.2086	0.2594	0.2793
Bolzano	1.79	1.17	0.9967	0.0001	0.0105	0.0936	0.1092	0.1576	0.2087	0.2595	0.2794
Trento	1.66	−0.21	0.9875	−0.0014	0.0641	0.0831	0.0986	0.1471	0.1982	0.2490	0.2689
Veneto	0.42	−0.44	0.4499	−0.0040	−0.0031	0.0006	0.0035	0.0478	0.0990	0.1498	0.1696
Friuli-VG	0.86	−0.92	0.6149	−0.0004	0.0010	0.0190	0.0345	0.0830	0.1341	0.1849	0.2048
Emilia-R	0.43	0.3	0.4805	−0.0076	−0.0068	−0.0028	0.0484	0.0484	0.0996	0.1504	0.1702
Toscana	0.31	−0.7	0.4223	−0.0031	−0.0021	0.0004	0.0043	0.0389	0.0900	0.1408	0.1607
Umbria	0.15	−0.87	0.3801	−0.0028	−0.0015	0.0004	0.0043	0.0260	0.0772	0.1280	0.1478
Marche	0.07	−1.19	0.3638	−0.0014	0.0001	0.0015	0.0055	0.0199	0.0710	0.1218	0.1417
Lazio	−0.18	0.91	0.2873	−0.0124	−0.0107	−0.0094	−0.0057	0.0316	0.0511	0.1019	0.1218
Abruzzo	−0.56	−1.12	0.2228	−0.0021	−0.0003	0.0013	0.0023	0.0065	0.0206	0.0714	0.0913
Molise	−0.69	−0.76	0.1898	−0.0040	−0.0022	−0.0018	0.0036	0.0044	0.0099	0.0607	0.0806
Campania	−1.56	1.31	0.0238	−0.0145	−0.0127	−0.0123	−0.0105	−0.0077	−0.0040	0.0026	0.0113
Puglia	−1.27	−0.21	0.0932	−0.0068	−0.0050	−0.0046	−0.0028	0.0021	0.0038	0.0145	0.0343
Basilicata	−0.82	0.53	0.1768	−0.0105	−0.0087	−0.0084	−0.0066	−0.0023	0.0508	0.0508	0.0707
Calabria	−1.45	1.97	0.0191	−0.0178	−0.0160	−0.0157	−0.0139	−0.0111	−0.0073	0.0086	0.0199
Sicily	−1.7	1.72	0.0000	−0.0166	−0.0148	−0.0144	−0.0126	−0.0098	−0.0060	−0.0021	0.0000
Sardegna	−0.57	0.21	0.1928	−0.0089	−0.0071	−0.0066	−0.0041	0.0014	0.0196	0.0703	0.0902
North[c]	0.81	−0.25	1	0.0499	0.1703	–	–	–	–	–	–
Centre[c]	0.23	−0.81	0.5662	0.0017	0.1203	–	–	–	–	–	–
South[c]	−1.15	1.16	0	−0.0061	0	–	–	–	–	–	–

Source: Authors' elaboration on data from BES (ISTAT 2018)

[a]values are expressed as z-scores

[b]values are normalised in the [0, 1] interval

[c]Macro-areas composition reported in Appendix

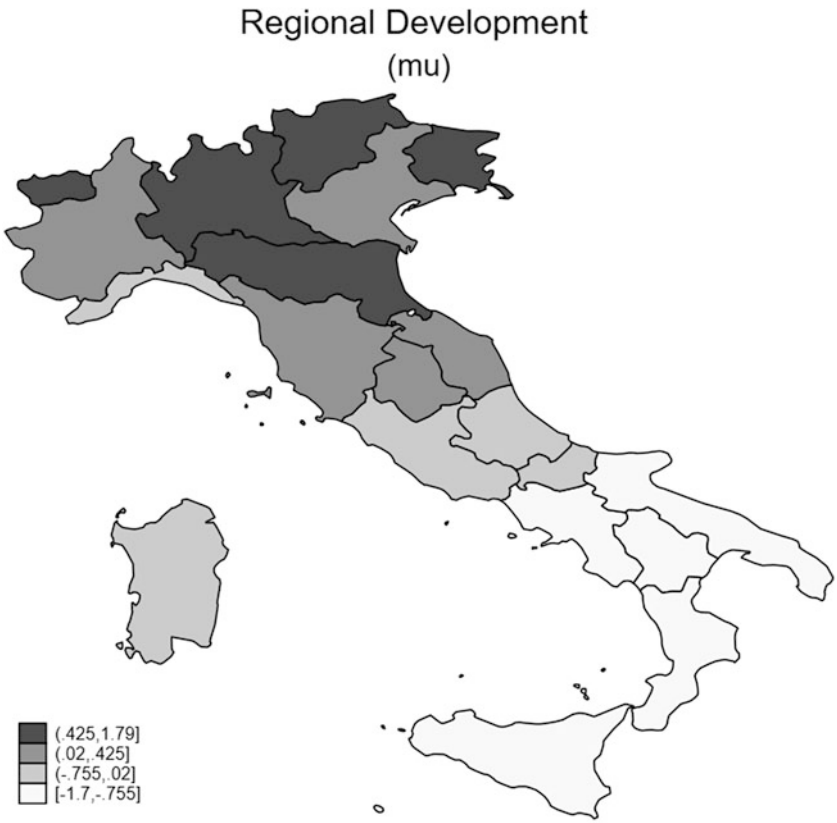

Fig. 2.2 Regional development (μ). (Source: Authors' elaboration on data from BES (ISTAT 2018))

speaking, Fig. 2.3 shows that the southern part of Italy is characterised by higher levels of σ. This evidence read through the lenses of the scheme introduced in Fig. 2.1 shows that the south is characterised by 'unbalanced relative underdevelopment (II quadrant)'. In other words, the southern part of Italy shows a low performance under both the μ and the σ measures considered here. Therefore, the level of development from which the southern citizens are benefiting is both (1) substantially lower than that of the northern counterpart and (2) unevenly distributed across its dimensions. It is worth stressing that this evidence is able to generate

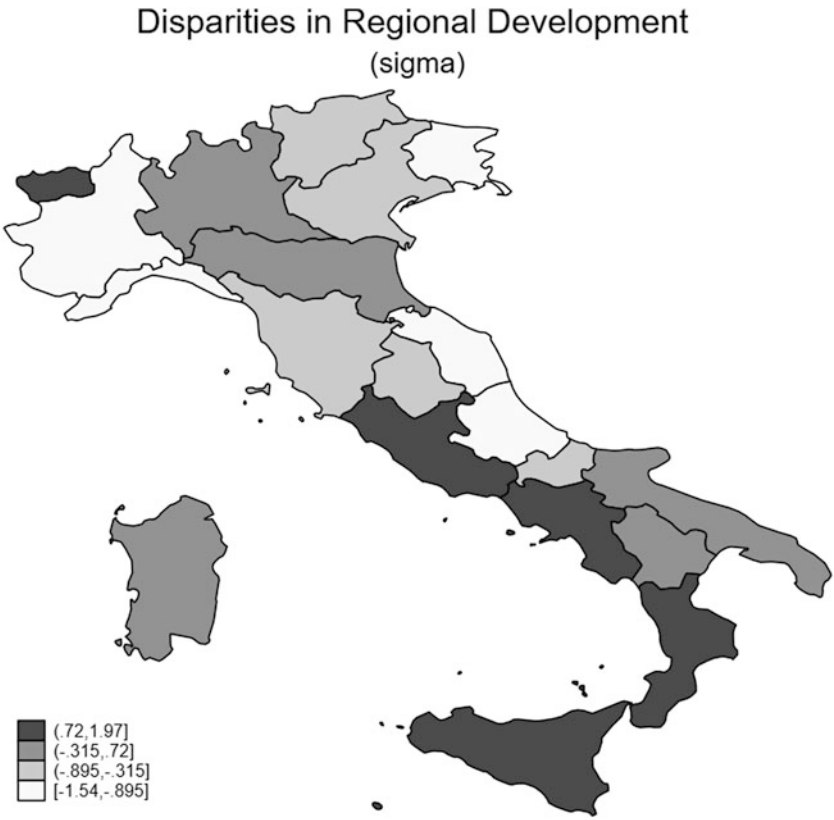

Fig. 2.3 Disparities in regional development (σ). (Source: Authors' elaboration on data from BES (ISTAT 2018))

differences in individual well-being that are much wider than those that can be detected by making reference to the allegedly representative agent using an equal weights framework to aggregate the multiple dimensions of (regional) economic development.

By continuing to make use of the scheme proposed in Fig. 2.1, a more granular picture does emerge in Fig. 2.5.

Indeed, by plotting the Italian regions in the σ–μ plane, it can be shown that Trentino-Alto Adige (with Bolzano, but excluding Trento) and Liguria belong to the first (highest) PKF. The above two regions

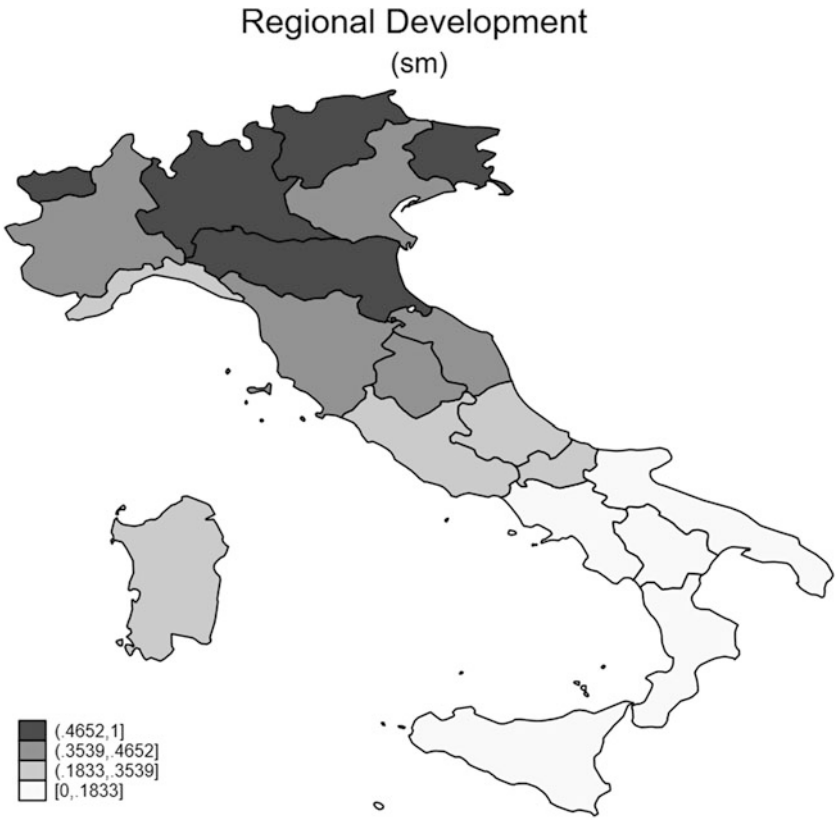

Fig. 2.4 Regional development (*sm*). (Source: Authors' elaboration on data from BES (ISTAT 2018))

(even if Liguria is a borderline case) along with Piemonte, Friuli, Marche, Toscana, Veneto and Umbria are the only eight regions out of the 20 Italian regions showing relatively high levels of development coupled with relatively low levels of dispersion across dimensions (i.e. 'balanced development', quadrant IV in Fig. 2.1), though spreading across four different PKFs. Quite interestingly, Lombardia —the Italian region with the highest level of GDP (about 381.000 million EUR in 2017[8]) belongs

[8]Eurostat, regional gross domestic product by NUTS 2 regions, retrieved: 01/09/2019.

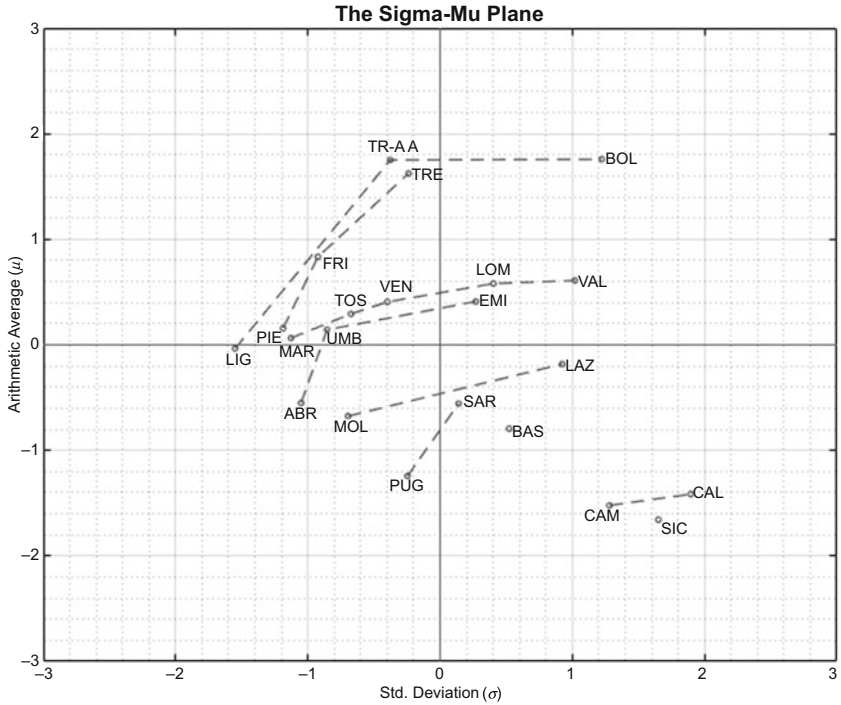

Fig. 2.5 The σ–μ plane of Italian regions. (Source: Authors' elaboration on data from BES (ISTAT 2018))

neither to the first PKF nor to the group of regions with balanced development. Indeed, Lombardia with Emilia Romagna and Valle d'Aosta are characterised by 'unbalanced development'. Similarly, the same province of Bolzano, even belonging to the PK1 is characterised by the same 'unbalanced development'. To what extent this evidence is linked with the (debated) trade-off between *growth and basic needs* (Hicks 1979) is difficult to ascertain and goes well beyond the scope of the current work. Nonetheless, the σ–μ approach seems to be an interesting methodological starting point for further research also in this regard.

None of the southern regions belong to either the I or the IV quadrants as a further confirmation of the aforementioned sharp spatial divide. Within the same pattern of relative development, however, different nuances can be detected. While Abruzzo, Molise and Puglia represent

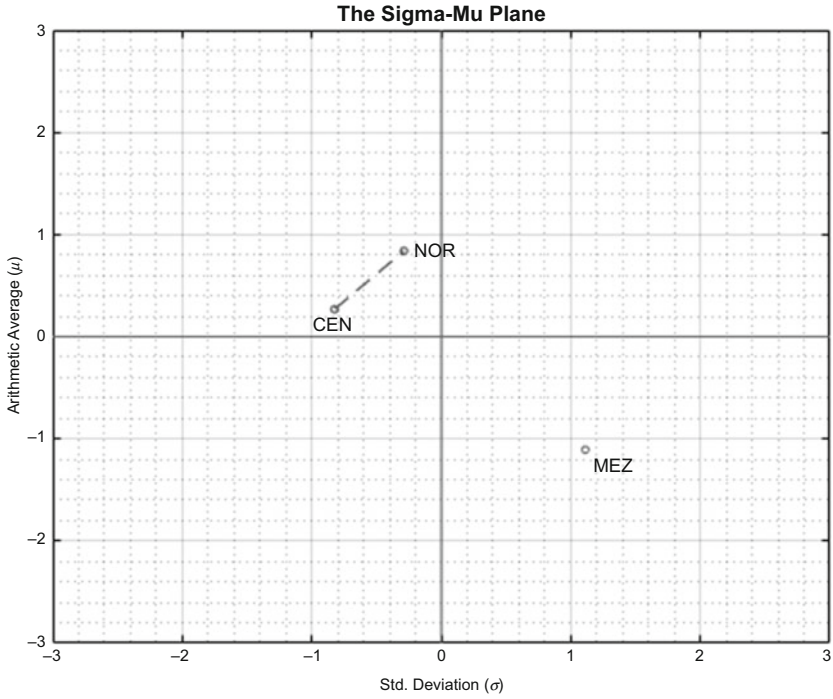

Fig. 2.6 σ–μ plane of macro-areas. (Source: Authors' elaboration on data from BES (ISTAT 2018))

cases of 'balanced relative underdevelopment', Sardegna, Basilicata, Campania, Calabria, and Sicily suffer from both relative underdevelopment and an imbalance between the different dimensions considered (i.e. 'unbalanced underdevelopment'). The same status characterises the central Lazio.

To further explore the Italian spatial divide, according to the proposed methodology, a tripartite perspective has been adopted considering the North, Centre and South macro-areas.[9] Such a choice by collapsing the 20 regions into three macro-areas allows for a sharper picture of the spatial development across Italy. Figure 2.6 graphically reports the results of the analysis for macro-areas.

[9]For macro-areas composition the reader is addresses to Appendix.

Figure 2.6 shows that in the tripartite scheme of Italian regional development (Bagnasco 1984), the divide between the Centre and the North is much smaller than the one separating the South from the rest of the country (Putnam 1993; Vecchi 2011). While the Centre and the North can be both grouped within the same PKF and can be characterised by a balanced development, the southern part of the country, overall, is sharply distant in a state of unbalanced development. It is worth stressing, once more, despite based on single two-dimensional space, that this result encompasses a number of dimensions, as high as 130. Therefore, it is able to provide a rather comprehensive picture of the Italian spatial divide.

2.4 Concluding Remarks

This work addressed the issue of measurement of LED according to a novel approach using the $\sigma-\mu$ method. Departing from the current common practice, the main tenets of the $\sigma-\mu$ method consists in considering the plurality of preferences in terms of dimensions of LED jointly with a single measure of overall performance. Furthermore, such an approach allowed separating of cases of balanced and unbalanced (under-)development. The analysis shows a more nuanced view of LED at the regional level. By disentangling the overall performance from the balance between the considered components the analysis does show potential for an important contribution in the field of spatial analysis at least to the extent that it allows unveiling complex patterns of uneven socio-economic performance. For instance, both Puglia and Sardegna sharing the same (higher) frontier, register a better performance than geographically confining regions such as Basilicata, Calabria, Campania, and the other big island Sicily, respectively. Besides, moving from the consideration that such a pattern is not fully confirmed in terms of GDP, the current σ–μ analysis seems to be able to methodologically contribute to the analysis concerning the existence of trade-offs and synergies between GDP and overall socio-economic performance.

Finally, a macro-areas analysis depicted a sharp spatial divide where the southern part of the country is significantly distant from the remaining part of the country according to a rather comprehensive point of view.

Therefore, by considering three separate macro-areas (North, Centre and South), the analysis shows that the divide is moving from the tripartite North–Centre–South division to a bipartite Centre/North–South one, even considering a much broader set of socio-economic indicators. Hence, it shows that the divide is much deeper and generalised than the extent to which it is captured by spatial differences in GDP only.

A.1 Appendix

North	
Piemonte	PIE
Valle d'Aosta	VAL
Liguria	LIG
Lombardia	LOM
Trentino Alto-Adige	TR-AA
Provincia Autonoma Bolzano	BOL
Provincia Autonoma Trento	TRE
Veneto	VEN
Friuli-Venezia Giulia	FRI
Emilia-Romagna	EMI
Centre	
Toscana	TOS
Umbria	UMB
Marche	MAR
Lazio	LAZ
South	
Abruzzi	ABR
Molise	MOL
Campania	CAM
Puglia	PUG
Basilicata	BAS
Calabria	CAL
Sicily[a]	SIC
Sardegna[a]	SAR

[a]Islands

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