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Monitoring and evaluation of regional industrial sustainability: Evidence from Italian regions

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ABSTRACT

Industrial sustainability now appears to be moving up the management agenda in many organizations and thus countries, mainly focused on performance achieved at regional level. In this context, government becomes a significant driver of both environmental policy and technology innovation for firms, which are actually innovating their processes for improving the global sustainability of territories. However, these processes exhibit many difficulties linked to the presence of different guidelines, involved stakeholders and objectives in order to ensure a more sustainable territorial development. In order to evaluate industrial sustainability achieved at regional level, we propose a new approach based on a reappraisal of the classical SWOT analysis. By using multivariate analysis methodologies and a wider battery of indicators, this approach identifies homogeneous groups of regions and describes points of strength and weakness points for each one.

The results obtained, as well as evaluating the achievements of regional sustainable industrial policy, provide a guide for the establishment of regional policies, according to European directives.

1. Introduction

In recent years, environmental sustainability has become central to different policy objectives (Mouysset, 2014). Among these, the reduction of industrial emissions plays a central role in the sustainable development of the global system (Arbolino et al., 2017).

At the European level, this issue is particularly significant: on the one hand, due to the strong pollution levels within member states caused mainly by industrial activities; on the other, because European countries are among the most technologically advanced economies in the world (Liobikienė and Butkus, 2017). For these reasons, industrial sustainability has become a priority for the European Commission, in its economic and political agenda (Blazejczak et al., 2014).

With the EU 20/20/2020 package, the EU initiated several policies in order to reduce the impact of pollution by actively involving the industrial systems. This package defines three main green actions: i) 20% cut in greenhouse gas emissions; ii) 20% of EU energy from renewables; iii) 20% improvement in energy efficiency (European Commission, 2012; Pereira and da Silva, 2017).

Recently, this increasing interest from both academic researchers and practical policymakers towards sustainable activities in the industrial sector has had broad appeal to Industrial Ecology - IE - (Deutz and Ioppolo, 2015; Ordouei et al., 2016). According to Socolow et al. (1996, p. xvii), IE is "intended to mean both the interaction of global industrial civilization with the natural environment and the aggregate of opportunities for individual industries to transform their relationships with the natural environment". This framework incorporates the three pillars of sustainability: (i) producing goods at the minimum cost (economic principle); (ii) exploiting resources considering their quantity and their grade of depletion in order to preserve them as long as possible (environmental principle); (iii) granting social and gender equity (social principle) (Porrini and Striani, 2017). The achievement of this process requires the creation of efficient industrial ecosystems through the optimization of supply and consumption (material and energy) and the reduction of non-sustainable material usage (Frosch and Gallopoulos, 1989; Simboli et al., 2015). These trials are deeply influenced by external factors, such as the implementation of governmental policies (Costa et al., 2010; Huber, 2000) based on bottom-up, top-down or combined characteristics (Paquin and Howard-Grenville, 2012) and on a continuous active partnership with the business fabric (Aquilani et al., 2017).

These objectives have led to the implementation of the new regional development strategy, called "Smart Specialization Strategy" (Barca, 2009; Capello, 2014). It requires the involved regions to focus investments and actions on a limited set of priorities (niches), so it should be easier to develop their own excellence and increase global

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competitiveness while respecting financial, social and environmental sustainability principles, as well as the growth priorities of Europe 2020 (smart, sustainable and inclusive growth) (Carayannis and Rakhmatullin, 2014). To this end, four innovative aspects have been introduced: i) tailored actions in few sectors, ii) fundamental role of regions, iii) active participation of various stakeholders and iv) creation of monitoring mechanisms in order to foster "adaptive", "self-correcting" and "sustainable" development (Tiits et al., 2015; Szopik-Depczyńska et al., 2017, 2018).

However, monitoring regional industrial sustainability can be very complex, because of multiple objectives and stakeholders (Orenstein and Shach-Pinsley, 2017). Empirical literature has proposed different indices and indicators for the assessment of industrial sustainability, including social, economic and environmental determinants (Moldan et al., 2012; Rizzi et al., 2017; Singh et al., 2009). However, these measurements, which propose a ranking of the analysed observation, appear restrictive in offering accurate indications for policy makers. Moreover, the fuzzy concept of industrial sustainability leads to confusion. In our interpretation regional sustainable industry is about creating the conditions under which firms can operate to make a sustainable contribution to society and it is referred to the overall industrial activities within a region.

The growing complexity of the socio-economic system and the need to offer accurate indications to policy makers in order to allocate financial resources according to the requirements of the territory have made the evaluation processes more complicated (Arbolino et al., 2018a).

With the intention of evaluating the industrial activity achieved by the regions in term of sustainability - considering both exogenous constraints (derived from availability of public funds) and the actions of private firms, directly responsible for the output produced - we propose an alternative SWOT analysis, projected in a multidimensional approach to development (Flora and Arbolino, 2013). Starting from the definition of a large dataset of indicators capable of representing the analysed phenomenon, our approach is based first on statistical methodologies of multivariate analysis for defining homogeneous groups of regions and then on the identification of points of Strength and Weakness, based on the indicators characterizing these groups. The results obtained allow us to focus attention on the critical elements of the places concerned and can be useful for the development of territorial rebalancing policies, permitting identification of needs and potentials for economic and social development.

This new procedure means we can identify internal and external factors that are favorable and unfavorable to achieve the objective of sustainability. Furthermore, it aims at defining an original instrument to check and evaluate the quality of regional industrial policies and private actions and to provide tailored policy suggestions. The testing of the model is applied to Italian regions.

The alternative methodology differs from the usual one because: (i) it does not refer to a restricted set of indicators chosen on the basis of prior knowledge and studies, but identifies a wide range of indicators referring to regional industrial and production systems; (ii) the usual SWOT approach refers to a univariate data assessment, while we identified homogeneous groups of regions through multivariate analysis techniques; (iii) results created a regional map of weaknesses and strengths and helped us to suggest tailored policy interventions towards industrial and productive sustainability (Flora and Arbolino, 2013).

The paper is organized thus: following this introduction, the second section illustrates previous research into related problems; the third section discusses the methodology and the data used for the proposed approach; the fourth section presents the main results of the estimates on Italian regions. Conclusions are then drawn in the fifth section of the paper.

2. Literature review

The recognized importance of sustainability-related topics has produced studies about the efficiency of public policies, private industrial performance and the determinants of environmental performance (Almer and Winkler, 2017). Several International Organizations have introduced environmental issues into their programmes and goals, such as the European Union (European Commission, 2017) and the OECD (Wilson, 2015). According to Schoenefeld et al. (2016), the necessity of monitoring progress towards sustainability has led policymakers to recognize the difficulties of creating complete evaluation instruments. For this reason, several organizations have tried to propose approaches and methodologies for the evaluation of industrial and environmental policies, but also useful for the assessment of environmental programmes and projects. Among the main instruments provided, the EU mainly referred to: Cost-benefit analysis, Indicator analysis, Multicriteria analysis, Mapping analysis, Modelling and "The modus narrandi" (EEA, 2016). Other researchers have been focused on the definition of indices that summarize multidimensional sustainable aspects (Singh et al., 2009). As regards the local level, and thus leaving aside many national indexes, some of these assess the sustainability of specific processes and activities within firms - Eco-compass (DeSimone and Popoff, 2000), Environmental Assessment for Cleaner Production Technologies (Fijał, 2007), Composite Sustainable Development Index (Krajnc and Glavič, 2005), Composite Sustainability Performance Index (Zhou et al., 2006) and G-Score Method (Jung et al., 2001).

Further studies define the indices at regional and local level in order to evaluate industrial policies and performance from an environmental point of view: Environmental Quality Index (Bisset, 1988); Energy Sustainability Index (Brown and Ulgiati, 2002); Regional Environmental Sensitivity Index (Aps et al., 2016), Two Synthetic Environmental Indices (Deutz and Ioppolo, 2015); Indicators for Sustainability in Regions (INSURE Methodology) (van Zeijl-Rozema et al., 2011) and Micro-level Urban –Ecosystem Sustainability Index (Dizdaroglu and Yigitcanlar, 2016).

However, these indices consider several disaggregate features of sustainability, mainly offering a ranking of regional performances. The only index that evaluates the overall industrial regional performance at regional level, both from a public and private point of view, is Industrial Environmental Sustainability Index (IESI) (Arbolino et al., 2018b), which results a starting point to more punctual indications for policy makers.

Other research offers an analysis of the main determinants of production system sustainability at different levels: firms, industrial areas and regions. Labuschagne et al. (2005) and Dewulf and Van Langenhove (2005) introduced a framework to assess the sustainability of enterprises by identifying key factors affecting environmental performance. Analysing Italian industrial areas, Taddeo et al. (2017) identified technical (location, type of area, logistics support, etc.) and non-technical (relations, community involvement, market penetration, etc.) aspects as potential for environmentally sustainable development policy. Gallo (2016) proposed a new environmental approach (APEA model) for Italian industrial districts, based on few actions in line with the principles of Industrial Ecology: innovation, research and development, use of already available resources to save energy and investments in renewable sources.

Analysing Italian industrial system, Lucchese et al. (2016) underlined the importance of a new green industrial policy investing in environment, energy, knowledge, health and welfare to restore the production gap created by the Great Recession. Tan and Lu (2017) studied the sustainability systems of a group of Chinese regions, identifying the main role played by spatial factors and transmission capability in improving environmental, social and economic performance. Rizzi et al. (2017) created a set of determinants that influence sustainability, in terms of regional resilience, and identified a trade-off between economic and environmental results, suggesting the necessity of integrated