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EXTENDED ABSTRACT

Environmental sustainability and firm performance: a multilevel analysis

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1. Introduction

In the contemporary industry competition, new forces are driving the value creation processes. The competitiveness of many companies bases on their capabilities to combine new technologies and new customers' values and needs (Porter and Kramer, 2011; Porter and Heppelmann, 2014). Policy makers and civil society are looking for the application of innovation in fields related to social and environmental sustainability together with resilient national infrastructures and new development paths (OECD, 2016).

The impelling issues related to climate change and environmental pollution have become universal concerns and the need to build up sustainable societies is challenging manufacturing firms as well (Agan et al., 2013; Roxas et al., 2017). So, firms,

producing and selling goods and services, need to face environmental issues in order to increase or just to maintain positive economic performance.

Under pressure from private and public stakeholders (Martín-de Castro et al., 2016), manufacturing firms, from micro to big size, are shaping their business models (Stubbs and Cocklin, 2008; Bocken et al., 2014) and their value creation processes (de Jesus Pacheco et al, 2018; Adeneye and Ahmed, 2015). As stressed by Jorge et al. (2015), the connection between environmental commitment and economic performance of manufacturing firms is a rich and controversial research field. For example, the literature concerning the impact of corporate social responsibility[1] or the implementation of environmental sustainability strategies on firms' performance reveals significant differences (Aguinis and Glavas, 2012).

In this debate, an underexplored field is about the engagement of small and medium sized enterprises (SMEs) in this 'green' transformation. Both threats and opportunities are still unclear for this type of firms (Hamann et al., 2017). Many different factors can indeed play as drivers or barriers to the commitment of SMEs for environmental issues. They include the productive resource constraints, the opportunity costs of environmental sustainability strategies, image and reputational factors, etc. (Larrán Jorge et al., 2015). Such factors can improve or make worse the economic performance of firms and their networks as well (Martín-de Castro et al., 2016).

In the SMEs literature, such factors are mainly explored at a firm level (Mazzandi and Zoboli, 2009; Biondi et al., 2000; Biondi et al. 2002). However, some of them have a systemic origin and a firm level impact. Therefore, to better understand the connection between environmental sustainability and economic performance of manufacturing SMEs is important to give a look at the green behaviour of the territories where such firms are located.

In this paper, we assess the impact of different levels of environmental quality and sustainability of both manufacturing and non-manufacturing local systems on the performance of the local manufacturing firms. Here, a multilevel perspective helps the

[1] In this work we adopt the definition of Adeneye and Ahmed (2015): "Corporate social responsibility defines the ability of a company to be socially responsible to the growth and development of the environment in which it operates" (ibidem, 152).

exploration of the following research question: is it important, in term of economic performance, for manufacturing SMEs to be embedded in an environmentally responsible area?

2. Green behaviour of territories: threat and opportunity for embedded manufacturing SMEs

Nations around the world are strongly challenged by the upsurge of climate changes, and the identification of new place-based policies able to support the exploration of new opportunities for a sustainable[2] development became more and more important. Many scholars and policy makers are indeed committed to identify policies able to promote technological shifts consistent with sustainable and inclusive growth in territories (Amison and Bailey, 2014; Andreoni and Chang, 2016).

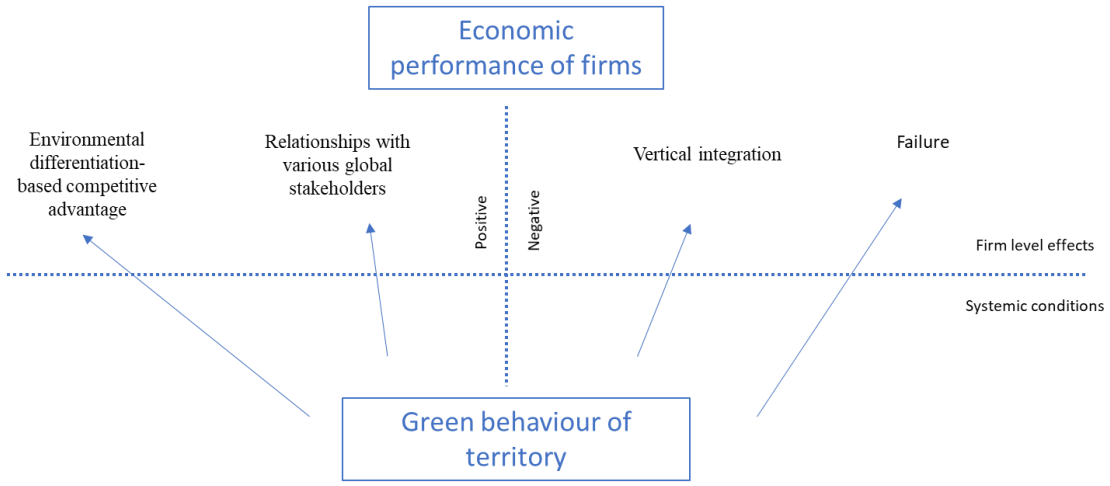
The green transformation of territories and their communities would imply a radical change to the whole economic system and provide new resources for the value creation processes. As stressed indeed by Porter and Kramer (2011), "business needs a successful community, not only to create demand for its products but also to provide critical public assets and a supportive environment" (*ibidem*, 7).

Productivity and competitiveness of firms committed to environmental sustainability issues, especially SMEs, are strongly interdependent with both public policies and the attitudes of the local societies in the places where firms implement their business. Such interdependence can have a positive or a negative face.

A green behaviour at a systemic level may have a double role in the definition of manufacturing firms' performance (Figure 1). First of all, the green behaviour of territories can allow the local firms to take advantage of local sustainable innovations or a green image, triggering higher revenues and new opportunities. It may indeed enable firms to implement an environmental differentiation-based strategy to increase their competitive advantage (Heikkurinen, 2010). Moreover, it increases the reputation needed for SMEs to maintain and enlarge their networks, managing better relationships with various global stakeholders (Larrán Jorge et al., 2015; Sayedeh et al., 2015). In this

[2] We refer here at three dimensions of the concept of sustainability: the economical dimension, the societal, and the environmental dimension.

regard, the green behaviour of territories may assure the embedded firms to take advantage of a 'place-based image' and avoid big investments in creating a green image at a firm level.



On the other hand, strong stakeholder pressures and radical policies may impose high costs to the local manufacturing firms that have to adjust their productive and organizational structures. It is an example the industrial district of Stoke on Trent (UK). The Clean Air Act (1957), which impinged on pollution problems produced by the traditional technologies of bottle kilns, "changed the face of the urban pottery industry nationally" (Miller, 2014). The forced introduction of tunnel kilns fired by gas and electricity implied huge investments, which were needed to substitute the bottle kilns. This triggered phenomena of vertical integration with a massive reduction in the number of small firms (Bellandi et al., 2018). In this scenario, the positive purpose of local stakeholders may undermine the economic sustainability of the population of manufacturing firms.

3. Methodology and data

To investigate how the environmental quality and sustainability of territories affects firm performance we use a multilevel or hierarchical model. One of the main advantages of this approach is that it allows to simultaneously consider the influence of micro and macro factors on the variation of the dependent variable. In other words, when explaining the differences in business performance, it is clear that the specific

characteristics of each firm play a very important role. But along with these individual traits, there are systemic characteristics that can also condition its performance, such as the here investigated environmental quality. In short, as suggested by Coleman (1990), systemic phenomena shape the evolution of the system itself through their influence on the behaviour of localized firms.

From a methodological point of view, the hierarchical structure of the sample (with firms nested within cities) violates the necessary assumption of independence of the observations in linear regression models. Multilevel analysis can overcome this problem, since it is able to estimate and to model the correlation between the units (firms) belonging to the same group (cities) (Rabe-Hesketh and Skrondal, 2008).

More specifically, it is probable that the performance of two firms i and i' located in the same city j is affected by common external factors. This is equivalent to saying that their respective error terms, ε_{ij} and $\varepsilon_{i'j}$, are not independent. Therefore, it is possible to decompose the error term ε_{ij} into two components: a component ζ_j specific to each city (and therefore constant for all firms located in the same city), and a second component μ_{ij} specific to each firm. Thus, under the simplest form of a random intercept model, the result is a regression model with a specific constant term for each city. This intercept ζ_j is a random parameter that is not estimated together with the fixed parameters of the model, but whose variance (τ) can be estimated together with the variance (σ) of μ_{ij} (for more details, see Raudenbush and Bryk, 2002).

With this hierarchical structure, our model takes the following form:

$$Y_{ij} = \beta_{0j} + \sum_1^p \beta_p X_{pij} + \mu_{ij}$$

where, Y represents the firm performance, as measured by productivity, (X) is a set of firm-level covariates, and the subscripts i and j represents the individual firm and the city, respectively. On the city level, the set of covariates (Z) are used to explain the variation of β_{oj} with the random parameter ζ_j:

$$\beta_{0j} = \gamma_{00} + \sum_1^q \gamma_{q0} Z_{qj} + \zeta_j$$

Combining both equations, we obtain a mixed-effects model in which ζ_j and μ_{ij} are the random part and are assumed to be mutually independent and to have zero means given the values of the explanatory variables (Snijders and Bosker, 2012):

$$Y_{ij} = \gamma_{00} + \sum_{1}^{q} \gamma_{q0} Z_{qj} + \sum_{1}^{p} \beta_p X_{pij} + \zeta_j + \mu_{ij}$$

$$Y_{ij} = (\gamma_{00} + \zeta_j) + \sum_{1}^{q} \gamma_{q0} Z_{qj} + \sum_{1}^{p} \beta_p X_{pij} + \mu_{ij}$$

Thus, this model can be considered a regression model with a random specific intercept ($\gamma_{00} + \zeta_j$) (Rabe-Hesketh and Skrondal, 2008).

As firm-level covariates we include variables which have been traditionally used in previous studies about the determinants of firm productivity, such as size, age, financial constraints and innovation capabilities. However, the focus of attention of this work is on the effect of contextual or systemic factors on firm performance, and, among them, our main interest is on the possible influence of the environmental behavior of the local system, including people, firms and public and private institutions. In this respect, the measurement of environmental quality and sustainability at a systemic level is the result of a previous work (Fuensanta et al., 2017). A specific index is adopted to take into account various aspects that can reflect different dimensions of the environmental behaviour of both the population of firms and the local community located in a given territory. This index can be a proxy of the green behaviour of territories and reflect their image in terms of green behaviour territories. The selected variables over the period 2011-2014 used to create the index are:

- the electric energy consumption per habitant,
- the water consumption per habitant,
- the proportion of separate waste collection,
- the use intensity of public transport,
- the air quality,
- the availability of air quality monitoring stations;
- the vehicle density,
- the proportion of vehicles that meet the Euro 4 or higher emissions standards,

- the availability of cycle paths and pedestrian areas.

The information contained in these variables has been summarized in a single indicator using the multivariate technique of Principal Component Analysis (PCA).

Finally, the multilevel model is estimated on a panel of firms located in 116 Italian cities between 2011 and 2014, using information from relevant databases, and taking into account the types of local system. More specifically, firm-level data have been obtained from the AIDA database (Analisi Informatizzata Delle Aziende) provided by the Bureau Van Dijk, while the information at the city-level comes from different data sources, mainly the ISTAT (Italian National Institute of Statistics) and the Finance Department of the Italian Ministry of Economy and Finance.

This regression model is still under test.

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