SUSTAINABILITY AND NON-FINANCIAL DISCLOSURE: A POSET'S APPROACH

Margaret Antonicelli, Filomena Maggino, Michele Rubino

1. Introduction

In recent decades, sustainability has been at the centre of both academic and public debate with very strong repercussions, especially in the corporate sphere. The need to seek a balance between economic, environmental, and social dynamics in favour of concrete and lasting development is the basis of the reference literature. Furthermore, together with the purely economic and business aspects, it assumes the concept of well-being declined in various aspects. According to the American Management Association (2007), companies are increasingly inclined to adopt sustainability guidelines, focus on human well-being and respect for the environment, develop values and implement relevant policies and practices. The issue of corporate sustainability has grown significantly in the last 4 years also due to the obligation imposed by Directive 2014/95 / EU for large companies to disclose non-financial information. Despite the importance of this issue, the metrics to quantify and evaluate the phenomenon are many and unfortunately in most cases they are not suitable for addressing the topic in a timely, correct, and truthful manner.

The various measurement attempts and the current lack of clarity that the aspects to be detected and assessed lead to a preliminary assessment of the company profiles in which to evaluate the fundamental aspects relating to the individual sections relating to sustainability present in the NFS: environmental, social, employees, respect for human rights, diversity, and the fight against corruption.

After having deepened and analysed the reference literature and the different areas in which this phenomenon is declined, this work aims to outline the company's peculiarities in the light of the assessment of sustainability.

The relevance of the subject has a counterpart of a methodological nature as the assessment of well-being involves the use of complex systems. This apparently second-order peculiarity has a significant impact on the evaluation process, because it questions the methodological paradigm with which this type of problem is usually faced, on the playing field of socioeconomics. As a result, they open new areas of research, both theoretical and applied. The dimensions of corporate sustainability were analysed through six systems of indicators. We reduce their complexity using

synthesis obtained with the Partially ordered set. Results highlight the differences among the dimensions of sustainability. Considering what was published by Consob, in compliance with Legislative Decree no.254 of December 2016, the study analysed the 204 Italian companies that have compulsorily published the non-financial disclosures, as having at least 500 employees or at least 40 million in revenues.

The results obtained show that the methodology used, and the indicator achieved were able to better grasp the multiple characteristics of the phenomenon, without ever underestimating the individual companies. Furthermore, it is evident that the methodology used has been able to better grasp the multiple characteristics of the phenomenon, without ever underestimating the company peculiarities relating to the topic analysed.

2. Theoretical background

Over the years, the issue of sustainability has assumed an increasingly central role in the academic debate (Baumgartner, 2014; Hopkins, 2017) and is defined in different ways according to the different perspectives of investigation. From a business point of view, sustainability represents a real business management philosophy that requires the conciliation and harmonization of different categories of economic, competitive and social objectives. Sustainability is the result of an action that generates synergies from mutual interconnections, according to the model of balance between the different company dimensions. The idea is that an organization must extend its focus beyond making profits, considering the impact of its operations on the community, society and the environment following the triple fund perspective: profit, people, and planet (Carroll, 1979).

Sustainability is closely related to corporate social responsibility (CSR) (Clark, 1916; Freeman, 1994, Carroll and Shabana, 2010) as it is the goal that the company must achieve. Starting from the stakeholder theory, the issue of CSR and sustainability has been extensively explored in the literature which has highlighted how companies can reap benefits in terms of performance. First, it is the pressures exerted by stakeholders that push companies to engage in social or environmental investments. Therefore, many companies can better manage the multiple forms of relationships they have with various types of stakeholders, such as environmental and social groups, employees, and customers (Freeman and Evan, 1990; Sharma and Vredenburg, 1998). Furthermore, socially responsible firms are more attractive to investors as they more easily preserve their value in times of crisis (Schnietz and Epstein, 2005; Barnett and Salomon, 2006). Thirdly, the positive impact of CSR can derive from the fact that the investments and projects that companies implement to be more socially responsible generate long-term positive effects (Shrivastava, 1995;

Russo, Fouts, 1997; Christmann, 2000). Finally, the adoption of sustainability policies helps companies to obtain legitimacy from the various stakeholders.

Sustainability is closely associated with communication tools used by companies to disclose information of a non-financial nature. Over the years there have been various reporting tools such as the social, environmental, and sustainability reports. At the same time, many professional organizations, such as Global Reporting Initiative (GRI), have developed a set of globally accepted sustainability reporting guidelines. The Directive 2014/95/ EU with which the European legislator imposed the obligation for large companies to disclose specific non-financial information is included in the context of the various tools for disclosing non-financial information by companies (Rubino, 2020).

3. Methodology

In the measurement and evaluation of socio-economic phenomena, one of the main critical points is the identification of the most appropriate statistical methods, ensuring that the analysis respects the nature of the phenomena, both from a conceptual and methodological point of view. Therefore, we chose the synthesis method that respects the nature of this phenomena, a non-aggregative method was used, the Partially Order Set, Poset (Maggino, 2017). This approach is based on the attempt to aggregate elementary indicators into synthetic indices that allow measurement of the latent characteristic of interest and permit the construction of rankings among statistical units.

The aggregation almost always takes the form of a weighted average of indicators constructed using models with latent variables or, more simply, by identifying the weights of the weighted average through heuristic procedures or with the help of experts, assuming in fact the latent unidimensionality of the phenomenon of interest and aggregation as a method of information synthesis (Fattore, 2013).

Very often, however, the problem of constructing synthetic indices collides with the technical impossibility of applying the usual aggregative synthesis procedures. Attempting to circumvent the problem by scaling algorithms does not necessarily improve the situation; on the contrary, there is a risk of adding another element of ambiguity to the results. The reality is that it is necessary to choose between two different approaches: either to look for even more sophisticated tools to transform ordinal data into numerical variables, or to tackle the issue of evaluation on other conceptual and methodological bases that go beyond the aggregative paradigm and allow to respect the ordinal nature of some data. The two fundamental steps in this second perspective are conceptual and formal: the first consists in posing evaluation as a problem of multidimensional comparison between the "well-being" profiles of

the individual company based on an advanced level of propensity for digitization and agility, the second in identifying the mathematical tools capable of making this comparison process operational (Fattore, Maggino, Greseling, 2011a).

Ordinal data are currently available, as in the case of this study, the synthesis of multidimensional systems of ordinal data using non-aggregated methods allows the construction of measures without aggregation of the scores of the basic indicators (Alaimo, 2020). As confirmed by the literature scientifically, Poset is a reference within this approach (Maggino *et al*., 2021) since it correctly leads to the synthesis of ordinal indicators.

The Poset provides concepts and tools that adapt in a very natural way to the needs of synthesis. This approach is based on profiles that represent the combinations of the scores of each statistical unit in the basic indicators considered. Therefore, Poset respects the nature of the data, and the construction of the synthetic indicator does not require any operation on the basic indicators (normalization, aggregation). Poset are the mathematical structure, $P = (X, \trianglelefteq)$, composed by a set X endowed with a partial order relation $\trianglelefteq$, i.e. a binary relation satisfying the properties of reflexivity, antisymmetry and transitivity (Davey and Priestley 2002; Neggers and Kim 1998; Schröder 2002):

1. $x \trianglelefteq x$ for all $x \in X$ (reflexivity);
2. if $x \trianglelefteq y$ and $y \trianglelefteq x$ then $x = y$, $x, y \in X$ (antisymmetry);
3. if $x \trianglelefteq y$ and $y \trianglelefteq z$, then $x \trianglelefteq z$, $x, y,z \in X$ (transitivity).

Let $k = |X|$ be the cardinality of X, the incidence matrix is a $k \times k$ boolean matrix Z summarizing the comparability relation $\trianglelefteq$, whose element for all $xi, xj \in X$

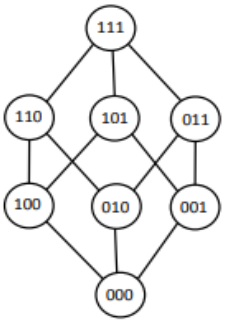
$$z_{ij} = \begin{cases} 1 \; if \; xi \trianglelefteq xj \\ 0 \; otherwise \end{cases}$$

for all $xi, xj \in X$. Consider two elements $xi , xj \in X$, the element xj covers the element xi , $xi \prec xj$, if xj dominates xi , $xi \trianglelefteq xj$, and there is no other element $z \in X, z \neq xi , xj$ such that $xi \trianglelefteq z \trianglelefteq xj$. A directed acyclic graph describes the cover relation $\prec$.

The Hasse diagram is the graphical representation of this graph, with the top-down orientation replacing the arrows in representing the edge direction.

The interpretation of the diagram is immediate: each node corresponds to a profile and two profiles are ordered (comparable) if and only if they are connected by a descending path (or, equivalently, ascending) (Fig.1). The pairs of profiles that are not connected by a descending/ascending path are called incomparable.

Figure 1 - *Example of a Hasse diagram of a Poset defined on three binary variables.*



Two nodes connected by a path are comparable by transitivity. An extension of P = (X,⊴) is a poset Pe = (X,⊴e) on the same set X but equipped with a partial order relation ⊴e extending the relation ⊴, therefore all the pairs of elements comparable in ⊴ are comparable in ⊴e and some pairs comparable in ⊴e are not comparable in ⊴. A linear extension of P is an extension of P where all the elements of the set X are comparable, therefore it is a complete (or linear) order obtained extending the initial poset. A poset usually has more than one linear extension. Let ΩP be the set of all the linear extensions of P. The mutual ranking probability (MRP) matrix of P is a k × k matrix MP = (m_{ij}), where m_{ij} is the fraction of linear extensions in ΩP such that the element x_i is dominated by the element x_j. We use posets to define the structure of comparability among units of multi-indicators systems (Fattore, 2013). Once the structure is defined, we can analyze it through mathematical tools.

4. Data

Considering all the Italian companies that in 2020 published the non-financial statement, in this work it was decided to use the sample made up of 204 Italian companies that in 20 20 compulsorily published the non-financial communication as having at least 500 employees or at least 40 million in revenues. As previously mentioned, the identification of the companies obliged to draw up this type of declaration is well defined and determined by Legislative Decree 254 of 2016. Furthermore, always in compliance with the legislative decree, the elements relating to each of the 6 mandatory areas of analysis of this declaration. Subsequently, after an initial content analysis on each individual declaration made in a computerized manner, a second (control and correction) was carried out manually.

The results obtained through the analysis of the content subsequently made it possible to transform the results into ordinal variables, with the attribution of the

following values: 0 in case of absent article, 1 in case of article treated only textually, 2 in case of article treated numerically, 3 in case of article treated both in textual and numerical way. 44 items were identified, divided as follows:

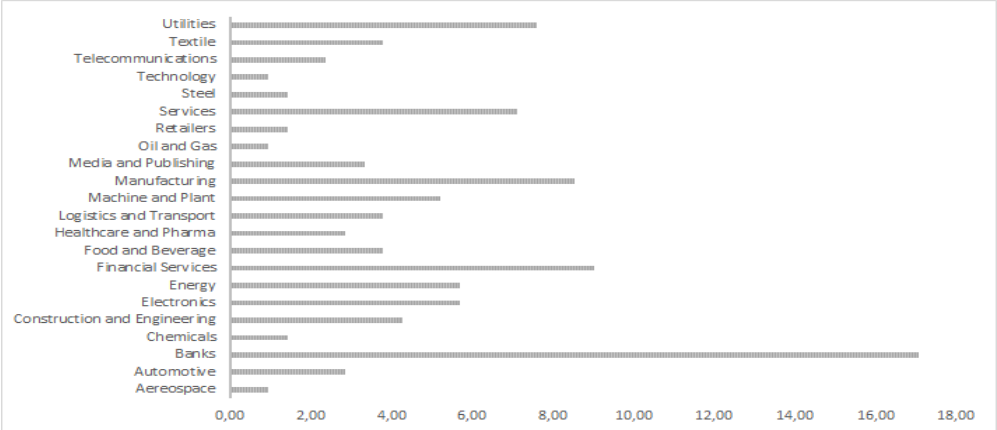
- environmental section: environmental policy, materials, water, energy, hazardous waste, external environmental certifications, compliance with environmental regulations, management of environmental risks;
- social section: involvement of local communities, evaluation of suppliers according to social criteria, negative social impacts on the supply chain and marketing policies, customer privacy, compliance with laws and regulations on social matters, evaluation of the impacts on health and safety by categories of products and services, political contributions, share of senior managers hired by the local community;
- section relating to employees: hiring and turnover, expected benefits for employees, adoption of parental leave policies, minimum notice period, occupational health and safety management system, identification of dangers and associated risks, promotion of employee health, average annual hours of training per employee, employee skills refresher and transition assistance programs, percentage of employees receiving periodic performance and career development reviews, career advancement prospects, retirement plans and defined benefits and other pension plans, ratios between a new employee's standard wage by gender and local minimum wage;
- section on diversity: gender diversity in governing bodies and among employees, ratio of basic salary and remuneration of women to men, composition of the board of directors and its committees by gender, selection criteria for members of the board of directors
- human rights section: incidents of discrimination and corrective measures taken, child labour cases, security personnel trained in human rights policies or procedures, investment agreements and significant contracts that include human rights clauses, management of internal rights risks human;
- section on the fight against corruption: operations assessed for the risks associated with corruption, communication and training on anti-corruption policies and procedures, confirmed episodes of corruption and actions taken, adoption of organizational models.

5. Result and discussion

Regarding some parameters of utmost interest in a statistical business approach, it's important to shows the main characteristics of our analysed sample. Before proceeding with the Poset analysis, it is essential to dwell on some purely corporate parameters of extreme interest for the purposes of the analysis. As mentioned, several times in the corporate literature, the sector is a fundamental parameter, especially in NFDs.

As can be seen from Figure 2, the most represented sector is the banking sector (17%), followed by those relating to financial services (9%), manufacturing (8.6%) and utilities (7.6%). This aspect is extremely important for the purposes of the analysis as it highlights how the banking and finance sectors, in addition to being the largest in terms of employees and revenues, are those whose transparency and sustainability declined in economic but above all social and ethical terms, it appears to be fundamental for entrepreneurial activities.

Figure 2 - *Distribution companies by sector, 2020*



Another extremely interesting variable is the region where the company is located. As you can see from Figure 3, the northern regions are those with the greatest presence of large companies in terms of revenues and employees and, therefore, obliged to draw up the non-financial disclosure.

This is a symptom of how even non-financial reporting, together with purely economic and entrepreneurial issues, have a strong territorial connotation in common, which confirms the presence of large and important companies in northern Italy.

Figure 3 - *Distribution companies for Italian regions, 2020.*

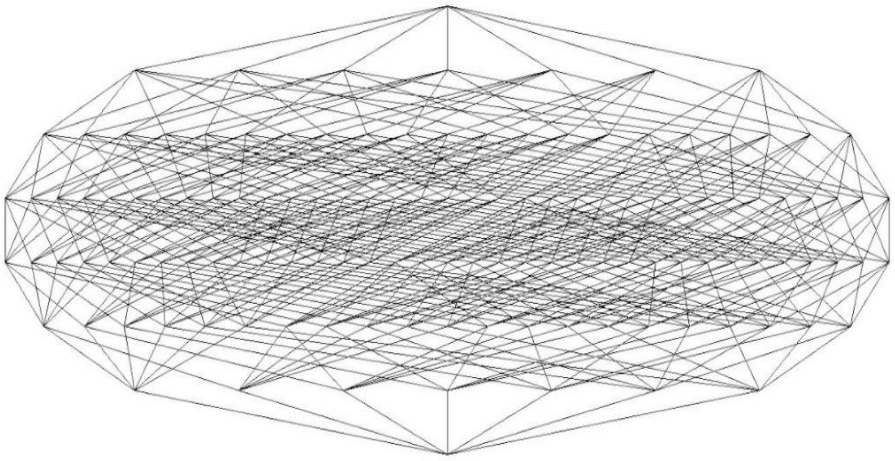
Consequently, it is essential that all the companies analysed are partially ordered differently in the various environmental, social, personnel, diversity, human rights, and fight against corruption dimensions. After defining the characteristics of the companies included in the sample in terms of parameters considered interesting, it is important to define the incidence matrix.

Then, we proceed to the construction of the Hasse diagram. This approach provides, given the values measured for each company and for each parameter analysed, to identify all the possible profiles that can be outlined as the sustainability indicator defined in our study.

By combining the six areas of analysis, in creating the sustainability index defined through the non-financial disclosure, 13,479 possible profiles have been identified. Each individual profile is the result of the combination of the value that the individual company has obtained for each of the six index areas analysed. In detail, items were analysed for each individual element of the sustainability index, as imposed by Legislative Decree 254 of 2016.

As can be seen from Figure 4, relating to the Hasse diagram for the sustainability index, the upper part shows the high and medium-high profiles, while the worst and medium-low profiles are shown below.

Figure 4 - *Hasse Diagram, Sustainable Index.*



In this type of statistical approach, the number of possible profiles that can be generated by combining the responses to each of the elements that make up the indicator does not coincide in most cases with the actual number of profiles that appear in the empirical analysis.

The presence of a high number of profiles identified for the sections relating to environmental, social and employee aspects shows a significant and not positive heterogeneity between companies in transparency and management towards stakeholders and policy makers.

A much less heterogeneous situation is found for the issue of gender equality addressed through the section on diversity. Regardless of the sector in which the company operates, unfortunately, the differentials in terms of female presence in decision-making bodies are still very high even if companies have clearly expressed their desire to reduce this gap through ad hoc actions. The wage gap is smaller where much has already been done but much still needs to be implemented.

The situation also seems optimal about the discussion and approach to the fight against corruption. Companies reach optimal levels of management of this aspect also because they are supported by various supporting laws. the characterizing aspect of this section is the strong link with the sector in which the company operates. For the banking and financial sector, the aspects linked to the fight against corruption are deeply felt and the management of the related risk is very articulated and well structured.

Apart from the difference between the possible profiles that we could have had from a theoretical point of view (given by the linear combination of the elements)

and the real profiles identified in our study, the apparent difference in the results between the six areas depends on an important difference in the parameters analysed and, as we will see later, on a situation of important incompatibility (Maggino, 2017) between companies in relation to the different area analysed.

Another essential element of the analysis is the identification of the thresholds. This phase of the analysis inevitably has a subjective component which, contrary to popular belief, is not necessarily a negative component. As this is a new and innovative approach, there is a lack of solid scientific literature on universal criteria for threshold identification. In consideration of this, we decided to adopt the approach defined by Arcagni et al. (2019). Analysing the poset, we identify for each of them a subset πl of profiles that are incomparable to each other (lower threshold); all profiles in πl or below an element of it are classified as dissatisfied. At the same time, we define another subset πc (upper threshold) such that the profiles in c or above one of its elements are identified as fully satisfied. The identification of medium-high and medium-low thresholds derives mainly from the fact that companies (especially due to the diversity of the sector in which they operate and therefore a very different approach to the six areas analysed) very often fail to reach high levels in the treatment of the various sections of the NFD.

6. Conclusion

Sustainability, and in particular the aspects relating to the business world, declined in all its aspects, is currently a very important issue in the life of a company both in economic terms and in terms of attractiveness and transparency towards stakeholders, customers, and policies. makers. However, despite the different legislative guidelines that regulate these aspects, especially those at the basis of the NFD, the subjectivity of management granted to companies still brings a lot of heterogeneity in the treatment and management of these aspects.

This study wanted, in this first phase using Poset, to highlight this extreme heterogeneity even among very similar companies in terms of activity and sector.

The next step will be the construction of a composite indicator which is also useful for assessing the impact of these essentially subjective and social aspects with company economic and budget parameters.

References

ARCAGNI A., BARBIANO DI BELGIOSO E., FATTORE M., RIMOLDI L. 2019. Multidimensional analysis of deprivation and fragility patterns of migrants in

Lombardy, using partially ordered sets and self-organizing maps, *Social Indicators Research*, Vol. 141, No. 2, pp. 551–579.

BAUMGARTNER, R.J. 2014. Managing corporate sustainability and CSR: A conceptual framework combining values, strategies and instruments contributing to sustainable development, *Corporate Social Responsibility and Environmental Management*, Vol. 21, No. 5, pp. 258-271.

BARNETT M.L., SALOMON R.M. 2006. Beyond dichotomy: The curvilinear relationship between social responsibility and financial performance, *Strategic Management Journal*, Vol. 27, No. 11, pp. 101-122.

CARROLL A.B. 1979. A three-dimensional conceptual model of corporate performance, *Academy of Management Review* 4, No. 4, pp. 497-505.

CARROLL, A.B. and SHABANA, K.M. 2010. The business case for corporate social responsibility: A review of concepts, research and practice, *International journal of management reviews*, Vol. 12, No. 1, pp. 85-105.

CLARK, J. M. 1916. The changing basis of economic responsibility, *Journal of political economy*, Vol. 24, No. 3, pp. 209-229.

CHRISTMANN P. 2000. Effects of 'best practices' of environmental management on cost advantage: The role of complementary assets, *Academy of Management Journal*, Vol. 43, No. 4, pp. 663-680.

FATTORE M. 2013. La valutazione statistica del benessere: ordinamenti parziali e nuovi paradigmi metodologici, *Statistica & Società/Anno 2, N. 2/Lavoro, Economia, Finanza.*

FATTORE M., MAGGINO F., GRESELIN F. 2011a. Socioeconomic evaluation with ordinal variables: integrating counting and poset approaches, *Statistica & Applicazioni, Partial Orders in Applied Sciences*, Special Issue 2011, 31- 42.

FREEMAN, R.E. 1994. The politics of stakeholder theory: Some future directions, *Business ethics quarterly*, Vol. 4, No. 4, pp.409-421.

FREEMAN R.E. and EVAN W.M. 1990. Corporate governance: A stakeholder interpretation, *Journal of behavioral economics*, Vol. 19, No. 4, pp. 337-359.

MAGGINO F., 2017. Developing indicators and managing the complexity, In: Maggino F, (Ed) *Complexity in society: from indicators construction to their synthesis.* Cham: Springer; pp. 87–114.

MAGGINO F., BRUGGEMANN R., ALAIMO L. S. 2021. Indicators in the framework of partial order, In Brüggemann R, Maggino F, Suter C, Beycan T, (Eds) *Measuring and understanding complex phenomena: indicators and their analysis in different scientific fields*. Cham: Springer; pp. 17–29.

HOPKINS, M. 2017. *CSR and Sustainability. From the Margins to the Mainstream: A Textbook*. London: Routledge.

RUBINO, M. 2020. *La disclosure sui rischi nell'informativa non finanziaria: Evidenze empiriche nel contesto europeo*. Milano: Egea.

RUSSO M.V. and FOUTS P.A. 1997. A resource-based perspective on corporate environmental performance and profitability, *Academy of Management Journal*, Vol. 40, No. 3, pp. 534-559.

SCHNIETZ K.E. and EPSTEIN M.J. 2005. Exploring the financial value of a reputation for corporate social responsibility during a crisis, *Corporate Reputation Review*, Vol. 7, No. 4, pp. 327-345.

SHARMA S. and VREDENBURG H. 1998. Proactive corporate environmental strategy and the development of competitively valuable organizational capabilities, *Strategic Management Journal*, Vol. 19, No. 8, pp. 729-753.

SHRIVASTAVA P. 1995. The role of corporations in achieving ecological sustainability, *Academy of Management Review*, Vol. 20, No. 4, pp. 936-960.

SUMMARY

Sustainability and non-financial disclosure: a Poset's approach

In recent decades, sustainability has become one of the main aspects of Non-Financial Disclosure (NFD), a type of mandatory reporting for large companies in terms of turnover and number of employees, reporting on social and environmental aspects. There are currently many metrics to evaluate this aspect, but in most cases, they are not suitable for addressing a phenomenon of such great importance in a timely and truthful manner. The relevance of the subject has a counterpart of a methodological nature since the assessment of well-being involves the use of complex systems of ordinal variables. This impacts on the evaluation process, because it calls into question the methodological paradigm with which this type of problem is usually faced. The statistical analysis carried out is based on two extremely important phases: both manual and computerized content analysis and the Partial Order Set.

The sample defined by Consob, in compliance with Legislative Decree no. 254 of December 30th 2016, is made up of 204 Italian companies obliged to register non-financial communication in 2020. The results obtained show that the methodology used has been able to better grasp the multiple characteristics of the phenomenon, without underestimating the individual companies in terms of different discussion of aspects related to sustainability.

Margaret ANTONICELLI, Università La Sapienza,
margaret.antonicelli@uniroma1.it
Filomena MAGGINO, Università La Sapienza, filomena.maggino@uniroma1.it
Michele RUBINO, Università Lum Giuseppe Degennaro, rubino@lum.it