Assessing corporate governance quality: substance over form

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Abstract

After the 2008 global financial crisis and corporate scandals, assessing and improving corporate governance quality (CGQ) is essential. This paper proposes a different approach to evaluate CGQ, to overcome the conceptual and methodological limits of the previous rating systems. It tries to go beyond the objectives of the existing models by suggesting an alternative operating model, (aligned with the new CG guidelines) that provides a concise index for monitoring and decision-making. Using a Fuzzy Expert System (FES), the authors propose a formalized model that: (1) represents all the factors (structural and behavioral) that affect the quality of corporate governance in terms of practical and objective decision-making procedure; (2) is a flexible and useful management tool for supporting the "Board review" and assessing the increase in CGQ associated with particular decisions; (3) supervisors can use to assess CG adequacy by replacing or integrating the experts' opinions with interviews/questionnaires filled in by directors and managers or through direct observation, as recently suggested by EBA/ESMA ~~(Eba/Cp/2016/17, 2016a, Eba/Cp/2016/16, b)~~. This paper

highlights the importance of behavioral features and group dynamics in corporate governance and represents them in an integrated model together with other structural and organizational elements.

AQ1

AQ2

AQ3

Keywords

Corporate governance quality
Rating systems
Decision support system
Fuzzy logic expert system
Board review
Behavioral corporate governance

1. Introduction

The 2008 global financial crisis and corporate scandals questioned the effectiveness of current structures and processes of Corporate Governance (CG). Substance over form, an organic view of value creation over micro-interests, competent and active directors over status symbol mandates, business-driven boards and governance processes over compliance-driven models: these are the long-awaited breakthroughs in CG. In the financial industry, governance weaknesses, emerged during the economic crisis, brought about new rules and standards aimed at enhancing, among others: shareholder activism and minority shareholder protection; an active risk management and internal control; board composition in terms of independence, diversity, and skills-mix; directors' commitment and transparency of the selection process; remuneration systems and management incentives. Some of these provisions have been progressively transferred to non-financial sectors through the code movement, aimed at promoting corporate fairness, transparency, and accountability. Beyond the formal structural provisions, more and more suggestions were introduced to enhance the constructive debate within boardroom, director activism and effective decision-making processes. Also, a stream of research (Huse 2007; Schwizer et al. 2014; Shefrin 2007) focuses on the consequences of behaviors undertaken by Chief Executive Officers (CEOs), non-executive directors and, more generally, on the relationships between key players in the CG system,

group dynamics and decision-making processes.

Assessing the quality of CG and making decisions about the way to improve it are complex tasks to solve, because this event is multidimensional. In this scope, the need to assess the quality of CG summarizing the heterogeneous dimensions of the phenomenon in a rating has become important for many reasons: enable companies to merely assess the quality of their own governance and signal their governance quality to stakeholders; allow for more accurate investment decisions, especially for institutional investors; mitigate agency problems between managers and shareholders and reduce conflicts of interest between minority shareholders and majority shareholders or between external and internal stakeholders. Recently, in the financial world, the assessment through the scoring of the Corporate Governance Quality (CGQ) (EBA 2014) has been considered particularly important in the evaluation of capital adequacy by the supervisors.

For these reasons, a vast academic literature is attempting to combine individual governance elements into a single rating of the overall quality of CG (see Gompers et al. 2003; Daines et al. 2010; Drobetz et al. 2004; Brown and Caylor 2006); for a review (Bhagat et al. 2008). At the same time, the CG ratings generated by commercial firms have been successful. Here follow some of the most widespread rating systems [for details see Donker and Zahir (2008) and Louizi and Kammoun (2016)]: the CG Quotient, the Accounting and Governance Risk (AGR), the CG Score (CGS) and The Corporate Library (TCL). The usefulness of rating systems, although widely recognized, is today still affected by several limits.

First, in spite of the increasing importance given to organizational and decision-making processes, and to individual and group behaviors, these variables are usually not considered when governance is assessed through indexes. The above-mentioned rating systems, although able to process a large number of variables relevant to the quality of CG, fail to give the due importance to some behavioral variables. These variables mainly refer to group dynamics and people (director activism and innovation and governance culture), and sometimes to the effective functioning of the Board of Directors (BoD) (relationship between BoD and management, committees' effectiveness and directors' activity and commitment).

Second, the rating systems are not meant to be support tools for business decisions: they do not allow the system to adjust to the specific environment

in which the firm operates and do not support what-if analysis. Many ratings are difficult to apply to contexts other than those for which they were created, but a valuable credit rating of CG should provide some degree of flexibility.

Third, difficulties are also associated with weighting the components of such rating systems and, often, with their transparency and replicability. Academic CG indices equally weight governance indicators, counting the number of positive and negative aspects of governance. Also, care should be taken in determining the final score: the variables can interact and some of them are likely to be substitutes rather than complements (Bhagat et al. 2008; Misangyi and Acharya 2014). The CG ratings generated by commercial firms, compared to the academic CG indices, weight governance indicators differently and take into account market trends and the variation in governance practices across industries (Daines et al. 2010). However, the exact variables and calculation of the previous ratings are proprietary, and so the assessment is a black box. The weights of various components derive from the quantitative analysis of the relationship between governance choices and firm performance based on the commercial firm's expertise, but they remain undisclosed. The way in which different components are weighted is highly questionable: traditional econometric methodologies identify various and often contradictory weights and relationships between explanatory variables of governance quality (Donker and Zahir 2008).

Finally, concerning commercial CG ratings, "the absence of cross-sectional correlation is consistent with high degree of measurement error in the rating processes across firms" (Daines et al. 2010), and some agencies do not act independently on the grounds of possible conflicts of interest (Donker and Zahir 2008). The lack of transparency regarding value drivers and how they are integrated implies the possibility that commercial providers may manipulate the data. Indeed, potential conflicts of interest may affect rating agencies: these may receive incentives to assign good ratings to their governance consulting clients and to rated companies whose investment managers purchase research and advisory services from the same rating agencies (Vo 2008).

The purpose of this paper is to propose an alternative approach to evaluating CG quality (CGQ) by using a fuzzy expert system (FES) able to overcome many of the conceptual and methodological limits as mentioned earlier. From a theoretical point of view, the aims of previous models are overcome by proposing an operating model, aligned with the new CG guidelines, which

provides a concise index for monitoring and decision-making processes. Unlike prior CGQ rating systems, the authors include variables that are deemed essential not only by corporate governance codes, but also by the most evolved EBA/ESMA standards: board dynamics, control culture, diversity, overconfidence, relationship with management, and critical debate (EBA/ESMA 2016a, b; ~~BCE~~ ECB 2017; ~~Corporate Governance Code~~Borsa Italiana 2015). From a methodological point of view, the characteristics required for the measurement of CGQ lead to the choice of a FES, mainly for the opportunity to assess both qualitative and quantitative variables. Furthermore, the FL (Fuzzy Logic) is a suitable instrument for solving complex problems such as a large number of variables (input), data that are not being constantly supplied, non-numerical data, ignorance of the function describing the model and nonlinearity of the function itself. A FES supports decisions because it provides the decider with an aggregate view of the problems taken into account, by reproducing the decision tree of experts. In this sense, the final decision depends on many attributes typical of the problem itself. FL has been recently used in the context of comparative management (Fiss 2011; Schneider et al. 2010). In the scope of CG, the Fuzzy methodology has been mainly used for classification/comparative aims (Teng et al. 2011; Castro et al. 2013). To the best of the authors' knowledge, this is the first study that applies FL to create a general CGQ rating based on experts' opinions, and that evaluates structural and behavioral variables, thus providing a decision support system focused on CGQ. This research is closely related to the strand of literature focused on CGQ and more specifically on its assessment. The authors believe that this study has implications from both a theoretical and a managerial point of view. From an academic point of view, it contributes to the widening of the understanding of the CG measurement. From a managerial perspective, this model is primarily an internal management tool because it can support board reviews and assess the increase in CGQ in conjunction with particular decisions. Supervisors can also use it for assessing CG adequacy by replacing or integrating the experts' opinions with interviews/questionnaires filled in by directors and managers or through direct observation as suggested by EBA/ESMA (2016a, b). Further fields of application are rating the CGQ of listed or unlisted companies, identification of weaknesses, strengths and additional information to use for decision-making purposes, rewarding and compensating directors, evaluating and comparing results in terms of CGQ of different corrective actions, and helping decision makers to make strategic decisions. The subjects that might be interested in this kind of tool include boards and managers, supervisors, rating

agencies, investors (shareholders, bondholders), financial analysts, and rating agencies.

The paper is structured as follows. Section 2 reviews the prior research on governance rating systems and Fuzzy logic applications. Section 3 discusses the most critical factors that can affect CG quality. Section 4 focuses on the research methods and illustrates how the FES model was built. Section 5 tests the final model on real data from five companies listed on the Italian stock exchange with a comment of the results. In Section 6 the authors conclude the paper with the implications and a summary of the benefits and uses of this approach compared to earlier rating systems.

2. Prior research

2.1. Prior research on governance rating systems

Academics, professionals, and consultants have all proposed various models for evaluating CGQ. The models emerged from diverse sources reflect the differing viewpoints of their authors concerning the conceptualization of CGQ, the scope of the assessment and the legal and industrial context into which the system has been built and applied.

Compared to the most well-known academic CGQ rating systems and under the perspective of behavioral CG, this model aims to assess CGQ in terms of effective and objective decision-making process. From a conceptual point of view, the model, unlike the previous ones, captures topics considered essential according to the new regulatory guidelines and recommendations (Eba/Esma 2016a; b; BCEECB 2017; Corporate Governance CodeBorsa Italiana 2015) for boards: independence of mind, competence and experience, commitment, critical debate and diversity. Although this study mainly refers to the Italian context, most of the analyzed variables reflect principles and best practices that are common to governance codes and rules also in force in other countries (role of the board, its composition, independence, internal committees and appointment of directors). The goal is the evaluation of both internal and external governance at a firm level. It can be a useful tool for carrying out board reviews and monitoring the effectiveness of governance as required by governance codes and recent recommendations. Furthermore, the assessment is based on an innovative methodology that gives it a general connotation, regardless of any industrial or legal contexts of application.

Unlike the US-based Gompers et al. (2003) governance index (G-index),

which focuses on the resistance of firms to external control mechanisms, this index focuses on the quality of a firm's internal structures, processes, and dynamics. The market for corporate control in the US is a mechanism for disciplining managers. In many other countries, the role of internal CG mechanisms is more important. Furthermore, the GI is simply the sum of points for the presence (or absence) of each provision. As in the case of Gompers et al. (2003) and Bebchuk et al. (2008) build a US entrenchment index (E-index) that is oriented towards the evaluation of the external governance. The E-index is based on six provisions relative to staggered boards, limits to shareholder amendments to by-laws, supermajority requirements for mergers, and supermajority requirements for charter amendments, poison pills, and golden parachute arrangements. The score, ranging from 0 to 6, is based on the number of these provisions that the company has in a given year or month. The E-index assesses the efficacy of particular firm defenses as being composed by anti-takeover provisions. Drobetz et al. (2004), create a rating system to assess the stringency of a broad set of governance practices and attitudes for German public companies. The application within a single jurisdiction make it particularly country-specific. Most of the proxies included in this CG rating (CGR) represent recommendations of the German CG Code. The authors consider various governance dimensions, such as board matters, minority rights, general governance commitment, transparency, and auditing, without disclosing detailed items. Klaer and Love (2004) construct a CG index using information produced by the Credit Lyonnais Securities Asia (CLSA). The authors adopt a total of 57 questions and many items recall contents of several CG codes (for example the link between remuneration for executives and the value of shares, the independence of the chairman and the presence and independence of nominating, audit and remuneration committees, the composition of the board in terms of non-executive directors, the diversity of the board, the ease of access to voting methods and the right to call general meetings for all equity holders, etc.). Nevertheless, this index overlooks more competences and dynamics of discussion within the board than does the model proposed in this paper. Once again, each question is constructed so that each 'Yes' answer adds one point to the governance score. Similarly, Khanchel (2007), constructs a US index composed of attributes compliant with many provisions of CG codes which focuses on three dimensions: the board of directors, the board committees, and the audit committee (board size, outside directors, board meetings, separate chair/CEO, existence of a compensation committee, existence of a nominating committee, meetings of the nominating committee,

meetings of the compensation committee, existence of an audit committee, audit committee size, audit committee meetings, reputation of auditor, members' financial expertise, etc.). However, this index omits any mention of disclosure practices, diversity, critical debate and other behavioral dimensions of the board. Brown and Caylor (2006) propose a firm-specific governance index based on both internal and external governance factors ("Audit", four factors; "Board of directors", seventeen factors; "Charter/bylaws", seven factors; "Director education", one factor; "Executive and director compensation", ten factors; "Ownership", four factors; "Progressive practices", seven factors; "State of incorporation", one factor). This index, more than the previous ones, captures many current criteria and recommendations by corporate codes in terms of board structure and composition and boards' and committees' effective functioning, but fails to deal with behavioral dimensions and processes (such as selection processes). On the other hand, unlike the above-mentioned firm-level rating systems, De Nicolò et al. (2008), propose an outcome-based corporate-governance index at a country level based on accounting and market data. The proposed index is a simple average of three proxy measures of outcomes of CG in the dimensions of accounting disclosure and transparency.

Many organizations and institutions also provide CG ratings. Some of the most significant and best-known CG rating agencies are: RiskMetrics/Institutional Shareholder Services (RM/ISS) which first offer Corporate Governance Quotient and later, GRId. Also, Standard and Poor's (S&P) sells CGS, while Governance Metrics International (GMI), is involved in supplying AGR, as well as, more recently, GMI Ratings (in 2013, GMI, Audit Integrity and TCL merged in GMI Ratings). Governance rating systems assess governance practices of public companies through an increasing number of, often interrelated, input variables (225 variables based on 61 rating criteria for ISS, 600 variables based on seven categories for AGR, 120 variables for TCL, 80 governance factors for CGS). They assess the adherence of governance practices to regulatory and stock market listing standards and, in addition to that, to rating criteria aimed at promoting governance mechanisms that are viewed as proxies of strong CG. By the CGQ construct used in the model described in this paper, many variables processed in the previous rating systems are considered outputs rather than determinants of effective CG and board decision-making processes. Our system does not recognize the following variables referring to:

- The topic of executive compensation and shareholder rights, in particular,

takeover provisions (i.e., Board missions, Board interlocks, Audit Committee size) processed by GMI, GCS and RM/ISS.

- The presence of mechanisms relative to related-party transactions (included in GMI).
- Some variables under the topic of external Shareholders' rights (i.e., "One share—one vote—one dividend") and the issue of the quality and content of information disclosed to the public (i.e., time and access to information disclosure) processed by GCS and GMI.
- Cumulative voting under the topic external Shareholders' rights, Election of auditors and Audit Committee missions (considered by CGS and RM/ISS).

On the other hand, the system takes into account variables relative to organizational and decision-making processes and to individual and group behaviors that are not usually found in the previously mentioned rating systems (or differently measured):

- Originality of Board organization.
- Alignment to best practices (compliance with CG Code).
- Control culture.
- Diversity in directors' education.
- Diversity in directors' experiences.
- CEO overconfidence/reputational gap.
- Relationship between BoD and management.
- Monothematic meetings.
- Critical debate (Directors' participation in Board discussions).
- Formal market-oriented selection process.
- Average length of Board meetings.

2.2. Prior applications of the fuzzy methodology

The fuzzy methodology has been applied to various management fields, such as supply chain management (Peidro et al. 2010; Pitchipoo et al. 2013), management control (Cassia et al., 2005; Shu et al. 2014), marketing (Li 2000; Bijan Fazlollahi 2001) and project management (Salehi 2015; Choi 2010; Choi and Ahn 2010).

More specifically, a Fuzzy Expert System (FES) is applied by ~~Magni~~ Malagoli et al. (2007), to rate and rank firms and identify a price for the target firm. Magni et al. (2006a, b), propose a method of firm valuation based on fuzzy logic and expert systems. The output of the system indicates the value-creation power of the firm. Marchi et al. (2014), using FES as an evaluative tool, create and test an International Market Selection decision process. Veltri et al. (2015), using FES, develop a method to measure intellectual capital (IC) in firms involved in strategic alliances. More recently, Venturelli et al. (2017) propose a plan for the sustainability-assessment of a business based on a FES.

In the scope of CG, Teng et al. (2011) apply the tool of FL to design an approach that rates the level of application of CG in which Financial Disclosure (FD) and Board Structure (BS) are used as key input variables. The authors declare that 'fuzzy math' functions in spreadsheets can formally incorporate significant additional information into valuation reports and help mitigate the limitations of the traditional valuation approach (McKee 2004). Uddin et al. (2010), consider more variables in defining CG. Their paper proposes a general algorithm using Fuzzy C Means to categorize companies into four groups (Excellent, Good, Average, and Poor), in terms of their achievements across different variables: the board of directors, the chief financial officer, head of the internal audit and company secretary, audit committee, external auditors. This methodology is preferred to traditional statistical methods because in comparative research there is a large number of potential explanatory variables and a small number of cases. Recently, another paper (Castro et al. 2013) uses a fuzzy set/qualitative comparative analysis to provide evidence that, within each of the stylized national CG models, multiple bundles of firm-level governance practices lead to high firm performance (return on equity—ROE). Authors show the complementarity and functional equivalence between CG practices. Finally, they prove that there can be heterogeneity ("differences in kind") in corporate governance practices within each stylized model of CG. The variables considered as causal conditions are board independence, information disclosure,

remuneration disclosure, performance-related compensation, employee loyalty, efficient market for corporate control. Bell et al. (2014), using a fuzzy set theoretic methodology, show how the level of investor valuation of firms is the same when a company adopts different mixtures of monitoring and incentive-based CG mechanisms. Zeitoun and Pamini (2011), using a Fuzzy-set Qualitative Comparative Analysis, demonstrate essential associations between high-involvement human resource practices and CG (the presence of relational shareholders, owner-managers, union recognition, and collective disputes procedures).

3. Theoretical background and experts' opinions

An expert system is a tool meant for replicating the way of reasoning of one or more experts. The FES model relies heavily on the knowledge and competence of experts. The first step is the design of a conceptual model to measure the governance quality for listed companies. Starting from the output of the model, that is the object of the evaluation (CGQ), the authors determined ideal (theoretical) model inputs by reasoning backward and making use of knowledge from specific literature. Information useful to drawing the decision tree was obtained by combining variables from existing literature with variables suggested by a focus group composed of seven experts: five independent directors of listed public companies and two academics, in a survey structured in different stages, with a marginal (non-directive) intervention of the moderator. One of the two academics, a full Professor at an Italian University, is recognised as an expert in this field. He is well placed in the technical-scientific community that deals with studying the phenomenon considered, he is a member of the Board of Directors of a bank listed on Borsa Italiana S.p.A. and of the Board of statutory auditors of several financial intermediaries. This super-expert was asked to identify other experts who he believes have real expertise and useful information. A full Professor (member of the Board of Directors of a company listed on Borsa Italiana S.p.A) was chosen together with other five independent directors, members of Nedcommunity (the Italian Association of non-executive and independent Directors, members of the governing bodies and control of companies). Nedcommunity is a member of ecoDa, European Confederation of Directors' Associations.

This section presents the experts' opinions and the theoretical framework underlying the conceptual model created. The authors started from the assumption that the boards have the basic responsibility to ensure sustainable

improvements in corporate valuations. The success of a board depends on making sound judgments in numerous situations that involve balancing different interests as: short term versus long term, risk versus reward, ethical considerations versus market practices, effective oversight versus motivating management, and competing interests of different stakeholders. In this model the authors define CGQ in terms of an effective and objective decision-making process, in an attempt to represent all the critical factors that can affect it. The experts identify three primary determinants of the CGQ: board structure; effective functioning of the board; group dynamics and people.

3.1. Board structure

Given that CG tends to focus on the protection of shareholders and stakeholders, ownership structure and concentration play an essential role in CG effectiveness (Shleifer and Vishny 1997). Although the relationship between ownership and performance is highly debated, and given the broad evidence of a positive impact of controlling shareholders on firm profitability and value (La Porta et al. 2000; Bhasa 2006), the experts focus on the presence of institutional investors, such as activist shareholders able to enhance the firm's performance. This process is carried out by leaning on the management, usually regarding governance issues and/or corporate strategy and specific transactions, possibly accompanied by "speaking up" at shareholder meetings, and by an active role in the appointment of "minority" directors (Belcredi and Enriques 2014; Karpoff 2001). Therefore, a negative score is given to the presence of a primary shareholder and a highly positive sign to the presence of domestic and international institutional investors, who often have hedge funds in the firm's capital. Minority protection schemes reduce the risk of private benefit extraction by the controlling shareholders, thereby increasing the firm's market value and making it easier to attract new capital (European Commission 2007). For example, since 2005, Italian listed companies have been required to implement a voting system (slate voting) which ensures that at least one member of the BoD is appointed out of a list of candidates to be submitted by minority shareholders. The by-laws shall identify the threshold (in terms of percentage of the issuer's capital stock) that is required for minority shareholders to be entitled to submit a list; such threshold shall not be more than 2.5% of the issuer's capital stock. However, fixing a threshold lower than that required can be regarded as an example of best practice concerning the protection of minority shareholders. Therefore, the experts consider with a negative sign the legal-threshold, while they

appreciate if the company applies a proportional scheme for the appointment of minority directors, rather than a majoritarian system (Bianchi et al. 2014).

3.1.1. Board composition

According to the principles stated in the main CG codes, and the rules more recently introduced in financial regulation at least at the European level, the experts represent board composition and its monitoring effectiveness in terms of size, independence (expressed by the percentage of independent and minority directors), diversity, gender and nationality, and board duality (when a CEO also holds the position of the chairman of the board). Focusing on board size, some authors (Guest 2009; Lipton and Lorsch 1992) maintain that when a board has too many members, they inevitably take on a purely symbolic role and their activities become disjointed from management processes. The experts follow this stream and consider large boards less efficient. Board duality produces a risky power concentration, while a more definite separation of responsibilities between CEO and chairman (that is higher if the latter is non-executive) can eliminate conflict areas such as the recruitment of independent directors, long-term succession planning, executive compensation and CEO performance evaluation (Larcker and Tayan 2011). A greater board independence (i.e., a balance between executives and independents on boards)—and a higher presence of minority directors —whether they are independent or not—ensure the effectiveness of the independent directors in maintaining objectivity in board decisions. Independent non-executive directors on the board would help to monitor and control the opportunistic behavior of the management (Eisenhardt 1989; Mahoney and Mahoney 1993). The role of independents can be enhanced, if they are coordinated and represented by a lead independent director (Italian CG Code, 2014). The experts, therefore, consider the percentage of independent directors as a positive driver of board effectiveness and decision-making procedures, while the presence of minority directors would provide further evidence of the quality of minority protection schemes adopted by the company. Most of the recent legislative initiatives are based on the idea that the presence of women on boards could significantly influence the quality of the CG system. Diversity in the boardroom can enhance the quality of governance processes, leading to a broader perspective in decision-making, reducing the group-thinking phenomena, and finally increasing creativity and innovation (Cox 1991; Robinson and Dechant 1997). Also, Directors' nationality can be another driving factor for diversity, resulting in a change in

the composition of the board of directors. Too big of a culture gap among board members may increase the likelihood of cross-cultural communication problems and interpersonal conflicts (Cox 1991). On the other hand, the presence of foreign nationals is likely to give the company a competitive edge, especially in international markets. It would encourage the protection of shareholders' rights, thus steering clear of any form of managerial entrenchment (Oxelheim and Randøy 2003). So, the experts emphasise in a positive manner the fact that a large number of women and foreign nationals are board members.

3.2. Effective functioning of the Board

Board organization and work processes contribute to the quality of decision-making and to a higher engagement of all members in monitoring the strategic processes of the company. The number of meetings and their length can be used as proxies of the board activity (usually, boards should be informed at least on a quarterly basis about corporate events that require board attention). The quality of the information that the board gets is another key driver of its effectiveness. Some factors that could have a substantial impact on the quality of a board's decisions are: the timely identification of relevant information including benchmarks and valid options, the understanding and testing of various hypotheses, and the consideration of the possible effects that assumptions might have on various shareholders. One or more directors and/or the chairman of the board himself may ask the Managing Directors to allow specific executives of the issuer or of the companies belonging to its group, (responsible for the management areas relevant to the board agenda), to participate in the meetings of the board, so as to provide additional information regarding the agenda itself. Also, the presence of committees (groups of members who indicate the responsibilities of the directors) appears to have a positive effect on corporate performance. The explanation for this may be found in the increasing complexity of the tasks to be performed that require the creation of ever more complex organizational structures (Klein 1998). Many CG Codes recommend that companies have audit committees, remuneration and nomination committees to oversee the audit of financial statements, set salaries for executive officers and directors and develop a proper selection process for top managers and board members. Given the advantage of a committee-based board structure, the experts positively rate the fact that a company chooses to introduce committees even if not directly required by a Code to deal, for instance, with strategy, Corporate Social

Responsibility, compliance, or ethics. The Ethical Committee and the CSR Committee were suggested by the CG Code in the latest version of July 2015 for larger companies. The Code also suggests that companies that evaluate not to set up the CSR Committee relay sustainability issues to one of the other committees. The committees should be composed by, at least, a majority of independent directors to mitigate any agency problems (Reddy et al. 2010). In any case, directors must commit to their role by assuring, first of all, regular attendance to BoD and committee meetings, and avoiding multi-directorships. The limited time available to the non-executive directors makes it extremely difficult for them to influence strategies (Mintzberg 1990). A final aspect to which the experts tribute high relevance, concerning board structure and effectiveness, is the annual board review, aimed at evaluating the performance of the BoD itself and of its committees, as well as their size and composition. Also, it assesses professional competence and experience, gender of its members and directors' tenure. Although compensation schemes and incentive systems are considered a central topic in CG literature and, in some sectors (e.g., the banking industry, according to CRD IV European Directive), are subject to new regulatory provisions, they are not included in this analysis. The reason for this is that the financial crisis has put the industry's compensation policies and incentive models under severe scrutiny. This choice is justified by the fact that sound remuneration policies can be considered an output rather than a determinant of an effective CG and Board decision-making.

3.3. Group dynamics and people

Despite an effective board structure, organization and high levels of board independence, the governance and decision-making processes of firms can be negatively affected by lack of skills, passive or shareholders/CEO-compliant attitude shown by directors, poor board coordination, and other factors that can influence and hinder their long-term success. Behavioral features of CG are considered increasingly relevant both by regulators and practitioners and have been included, over time, in new rules (i.e., for the banking industry after the crises) and CG Codes. A research stream, which is complementary to the more structure-oriented one, tries to deal with behavioral biases in CG, such as CEO overconfidence and group thinking (Shefrin 2007). Authors face, however, some difficulties in the empirical analysis of those phenomena, since the examination of group dynamics and personal relationships would need field research through direct observation of board meetings. The authors try

here to overcome those limitations, by including in the model proposed skills and behaviors that represent some typical board features affecting group dynamics and thereby the rationality of board decision-making. Lipton and Lorsch (1992) maintain that many boards often operate poorly and hardly ever take on a critical position towards management decisions. This is mostly due to senior management's influence in selecting non-executive directors. Shivdasani and Yermack (1999) support this view and also note a negative connection between senior management's clout in the director recruitment process and monitoring ability of the board. The procedure for the selection and appointment of new directors should, therefore, ensure that the resulting board composition reflects the mix of skills and expertise necessary to conduct the company's activities. The experts posit that an effective board is the result of a robust selection process, which follows a market-based approach, where the Nomination Committee or the BoD itself performs a market search of their future members, according to a prior evaluation of the desired skill mix, given the firm strategy and business complexity. A high average age of board members is considered as a proxy for a low board turnover, that negatively affects board engagement since older boards seem to be associated with significantly lower performance (Wegge et al. 2008). The experts consider diversity in terms of prior experience and education as a positive driver of board effectiveness (see Conner and Prahalad 1996). The experts assess behaviors, considering three aspects: activism and innovation, governance culture and disclosure. Board activism and innovation capability are determined by low CEO overconfidence, measured by the reputation gap between CEO and independent directors, as in Schwizer et al. (2014); by the level of participation of individual directors in board discussions; by the turnover of board members (inversely represented by their tenure). In fact, boards are less likely to exert control over strategic decision-making on behalf of shareholders when they lack formal or social independence from CEO and management (see Wade et al. 1990). Governance culture depends on the operational effectiveness (for instance monothematic meetings focused on strategy, risk management, etc.) and on the level of involvement of internal control functions in governance processes and BoD work processes (control culture). Finally, the model proposed represents disclosure by the level of compliance with CG codes and the quality of public reporting on CG, contained in annual reports and companies' websites (see Di Battista et al. 2014).

4. Research method and model

This section aims to illustrate the research framework and methodology employed to address the research purpose.

4.1. Analysis tools

A FES combines the capacity of an expert system (ES) to simulate the decision-making process of expert individuals with the vagueness of human reasoning, through the FL ~~(~~ [for a description of the fuzzy expert systems see Magni et al. (2006a, b)]. An ES is equipped with an interface allowing for the communication between the user and the program in the most natural way possible. Behind the interface, the computer program works on a knowledge base in which the information and decision-making processes of the experts are stored. The knowledge base consists primarily of facts and rules encoded in blocks of type IF (condition) → THEN (action), which try to describe the universe of possible actions ~~(effects?)~~ upon the occurrence of certain situations. The processing of the information contained therein is done via an inference engine, the active part of the system. The different degrees of truth that can be obtained between the completely false (zero) and the completely true (one) are described by the introduction of a function $\mu(x)$, (membership function or term), which associates a value in the range [0, 1] to each element x in a universe set U. A fuzzy set Z_A associated with the subset A is the set of ordered pairs: $Z_A = \{(x, \mu_z(x)) \mid x \in A, \mu_z(x) \in [0,1]\}$. This definition associates a real number $\mu_z(x)$ between 0 and 1 to each element x of A, thus indicating the degree of truth of the elements of A; in this way, it is possible to identify each fuzzy set with its membership function and to use these two concepts in an alternative way (Bojadziev and Bojadziev 1997).

4.2. The model

The construction of the model followed the steps described below:

- Identification of variables and their characteristics;
- System layout;
- Determination of weight in Aggregation Structure;
- Building of the rule blocks and choice of the aggregators;
- Generic tests (technical, school cases);

- Tests on real data of five Companies;
- Sensitivity analysis/robustness check.

4.2.1. Identification of variables and their characteristics

A first physical meeting of the experts was aimed at determining the characteristics of the system. Initially, as described previously, the experts determined the ideal (theoretical) model inputs. For each input variable the source, the type and the number of terms were determined according to the experts' opinions. Table 1 shows the list of initial variables, with some information.

Table 1

Input variables

Label	Input variables	Number of terms	Type	Source
Audit	Audit Committee	2	Qualitative (yes/no)	Annual repo CG
AuditRiskMee	Number of meetings of the Audit/Risk Committees	3	Quantitative	Annual repo CG
AvAgeBoard	Average age of Board members	3	Quantitative	Annual repo CG
AvAttendA_R	Average attendance to Audit/Risk Committee's meetings	3	Quantitative	Annual repo CG
AvAttendBoD	Average attendance to BoD's meetings	3	Quantitative	Annual repo CG
AvAttendN_R	Average attendance to Nomination/Remuneration Committee's meetings	3	Quantitative	Annual repo CG
AvLengBMee	Average length of Board meetings	3	Quantitative	Annual repo CG
BoardDuality	Board duality	2	Qualitative (yes/no)	Annual repo CG
BoardReview	Annual Board review	3	Qualitative	Annual repo CG
BoardSize	Board size	2	Quantitative	Annual repo CG/Website

Label	Input variables	Number of terms	Type	Source
BoardTurnov	Innovation/Board turnover	2	Quantitative	Annual repo CG
BoDManRel	Relationship between BoD and management	2	Qualitative	Experts/sub evaluation
CEOoverconf	CEO overconfidence/reputational gap	2	Quantitative or qualitative (depending on data availability)	Citation ana using Factiv database or experts/subj evaluation
CGcode	Alignment to best practices (compliance with CG code)	3	Qualitative	Annual repo CG
Control_Risk	Control and Risk Committee	2	Qualitative (yes/no)	Annual repo CG
ControlCulture	Control culture	2	Qualitative	Experts/sub evaluation
CriticalDebate	Critical debate (Directors' individual participation to Board discussions)	3	Qualitative	Experts/sub evaluation
DirectorsEdu	Diversity in Directors' education	2	Qualitative (yes/no)	Annual repo CG
DirectorsExp	Diversity in Directors' experiences	2	Qualitative (yes/no)	Annual repo CG
ElectionSys	Majoritarian versus Proportional election system	2	Qualitative	By laws
FemaleDirect	Female Directors (% on total)	3	Quantitative	Annual repo CG
ForeigInstInv	Foreign institutional investors	2	Quantitative	Annual repo
ForeignDirect	Foreign Directors (% on total)	2	Quantitative	Annual repo CG
IndAudit_Risk	Audit/Risk Committee composed entirely of independent Directors	2	Qualitative (yes/no)	Annual repo CG
IndipDirect	Independent Directors (% on total)	3	Quantitative	Annual repo CG/website
IndNom_Rem	Nomination and Remuneration Committee (independent Directors)	2	Qualitative (yes/no)	Annual repo CG
InstInv	Institutional investors	2	Quantitative	Annual Rep

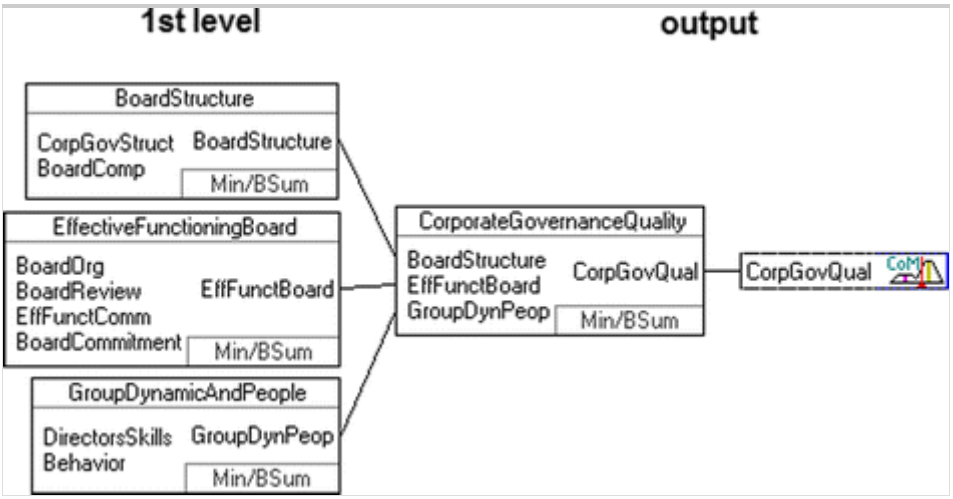
Label	Input variables	Number of terms	Type	Source
LeadIndDir	Lead Independent Director	2	Qualitative (yes/no)	Annual repo CG
MarketDisclo	Market disclosure	3	Qualitative	Experts/sub evaluation
MinorDirect	Minority Directors (% on total)	3	Quantitative	Annual repo CG
MonotheMee	Monothematic meetings	2	Qualitative	Experts/sub evaluation
Nom_Rem	Nomination and Remuneration Committee	2	Qualitative (yes/no)	Annual repo CG
Nomination	Nomination Committee	2	Qualitative (yes/no)	Annual repo CG
NomRemMee	Number of meetings of the Nomination/Remuneration Committees	3	Quantitative	Annual repo CG
NumberBMee	Number of Board meetings per annum	3	Quantitative	Annual repo CG
OfficeHeldA	Average number of offices held by Board members	3	Quantitative	Annual repo CG
OfficeHeldM	Maximum number of offices held by Board members	3	Quantitative	Annual repo CG
OtherComm	Originality of Board organization (other committees)	2	Qualitative (yes/no)	Annual repo CG
OwnConcent	Ownership concentration/weight of the main shareholder	3	Quantitative	Annual repo
QualityInfo	Quality of information supplied to BoD	2	Qualitative	Experts/sub evaluation
Remuneration	Remuneration Committee	2	Qualitative (yes/no)	Annual repo CG
Risk	Risk Committee	2	Qualitative (yes/no)	Annual repo CG
SelectionProc	Formal market-oriented selection process	2	Qualitative (yes/no)	Annual repo CG
Threshold	Slate voting threshold	3	Quantitative	By laws

4.2.2. System layout

The decision tree represents the logical path of an expert who examines throughly the problem. It can be cut open in different levels of aggregation starting from the final assessment. The aggregations of the first level identify the macro-themes leading to the final assessment; their subsequent breakdown leads up to the initial inputs. The decision tree model, in its final part, is shown in Fig. 1.

Fig. 1

The aggregation of the intermediate variables at first level



Reading the tree from right to left, starting from the output variable “CorpGovQual” (CGQ), in the first level the three dimensions determining the quality assessment of CG can be recognized: the Board structure, the Effective functioning of the Board and the Group dynamic and people sections. The evaluation of each section is expressed by a variable (intermediate) that has the same name as the section which, in turn, can be considered the output variable of a sub-system of evaluation of the section. Intermediate variables (int. var.) are another one of the benefits of FES; through their values, in fact, it is possible to visualize the interim evaluations, following the formation of the final score. This process allows to easily identify the characteristics and inadequacies of the company evaluated, narrowing the field to any corrective action. The list of int. var. and the output variable of the system are in the Table 2.

Table 2

Intermediate and output variables

Label	Intermediate variables
ActivismInnov	Activism and innovation
Activity	Board activity
Behavior	Behavior
BoardCommitment	Board commitment
BoardComp	Board composition
BoardOrg	Board organization
BoardStructure	Board structure
CommEffectiv	Committees' effectiveness
CommIndipend	Committees' independence
Committees	Committees
CorpGovStruct	CG structure
DCommittment	Directors' commitment
DirectActivity	Activity of Directors
DirectorsSkills	Directors' skills
Diversity	Diversity
DiversitySkills	Diversity of skills
EffFunctBoard	Effective functioning of the Board
EffFunctComm	Effective functioning of the committees
GovCulture	Governance culture
GroupDynPeop	Group dynamic and people
HybridComm	Hybrid committees
Indip_Monitor	Independence and monitoring
InfoAsymm	Information asymmetry
MinorityShaProtec	Minority shareholders' protection
MonoComm	Monothematic Committees
OwnershStructure	Ownership structure
Transparency	Transparency

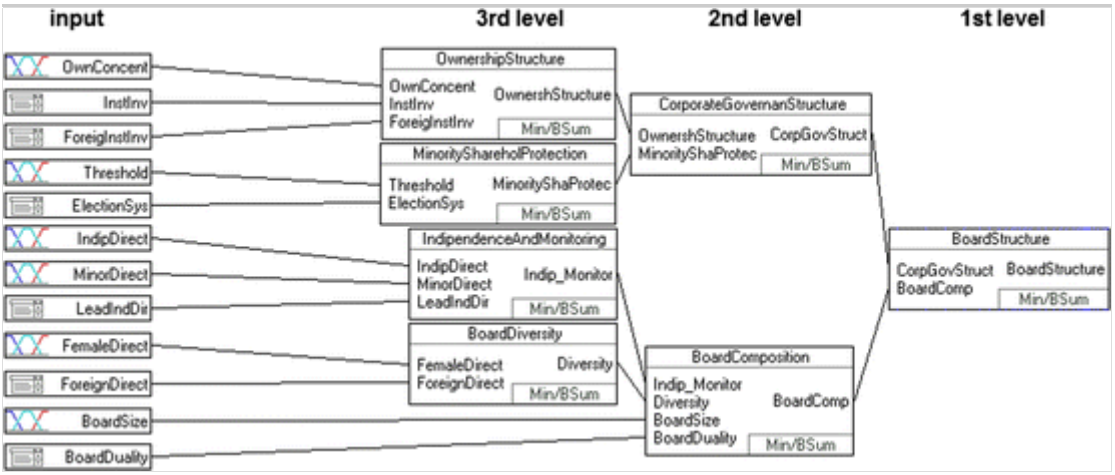
Label	Intermediate variables
Label	**Output variables**
CorpGovQual	CG quality

AQ4

Both the int. var. and the output var. are set to provide a score between 0 and 100. Below, the authors listed the layouts of the three sections determining the intermediate variables of the first level of the figure. In this section (Fig. 2), the Board Structure form is examined. Its development may be considered in two ways. The first way is to read it as an autonomous decision-tree with its inputs and intermediate variables of first, second and third levels. The second one is seen as a continuation of the tree in Fig. 1 where an apparent initial input is, in fact, the output of a new branch of the decision tree, which is more developed than it appears in Fig. 1. The authors chose the former because the decision tree design is too complex to be entirely explained and its illustration is less readable. It gives information on the evaluation of the CG structure, regarding the ownership structure and minorities' protection measures, and board composition in terms of independence, diversity, size and power concentration (Board duality). The ownership structure depends on ownership concentration (that is the weight of the main shareholder—percentage on capital) and on the presence of institutional investors and foreign institutional investors. Drivers of minorities' protection measures are the slate voting threshold (the lower the threshold, the higher the protection) and the election system (majoritarian vs. proportional). Drivers of independence are independent Directors and minority Directors (the percentage of the total) and the presence of a lead independent ~~d~~ Director. Diversity depends on the percentage (of the total) of female Directors and the presence of foreign Directors.

Fig. 2

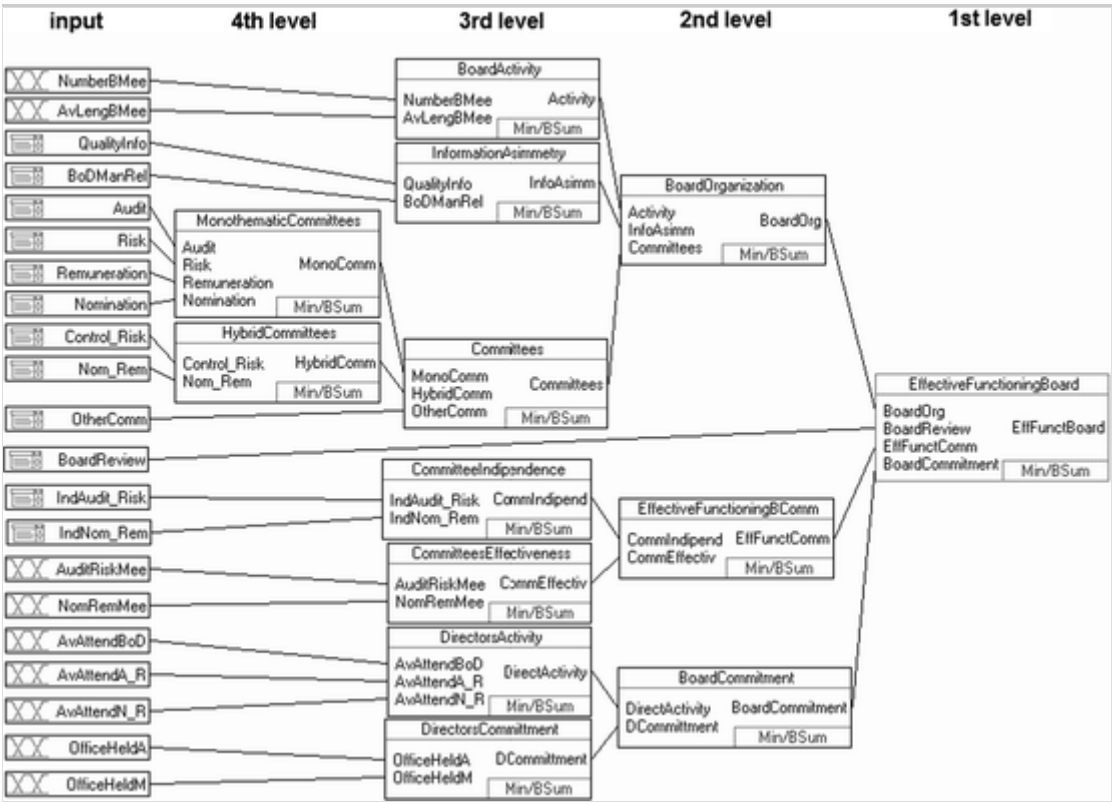
The section of Board structure



In the following section (Fig. 3) the authors follow the previously illustrated idea and consider the primary drivers of an effective functioning of the board, such as Board organization, the effective functioning of Committees, the commitment of Directors and the Annual Board Review. Board organization depends on Board activity, information asymmetry, and Committees. Board activity is a function of the number of board meetings per annum and their average length. Information asymmetry is a function of low/high quality of information supplied to the BoD and intensity of the relationship between BoD and the management. The quality of the Committee structure depends on the presence of Monothematic Committees, Hybrid Committees and other Committees (including the Ethical Committee or the CSR Committee), and on the proxy for originality of Board organization. Effective functioning of committees is affected by Committee independence (in turn influenced by Audit/Risk Committees and Nomination and Remuneration Committees entirely composed of independent Directors) and Committees' effectiveness (determined by the number of meetings of the Audit/Risk Committees and the number of meetings of the Nomination/Remuneration Committees). Board commitment depends on Directors' activity (in turn assessed through the number of Board meetings per annum and average length of Board meetings) and Directors' commitment (in turn assessed through the average number of offices held by board members and a maximum number of offices held by board members).

Fig. 3

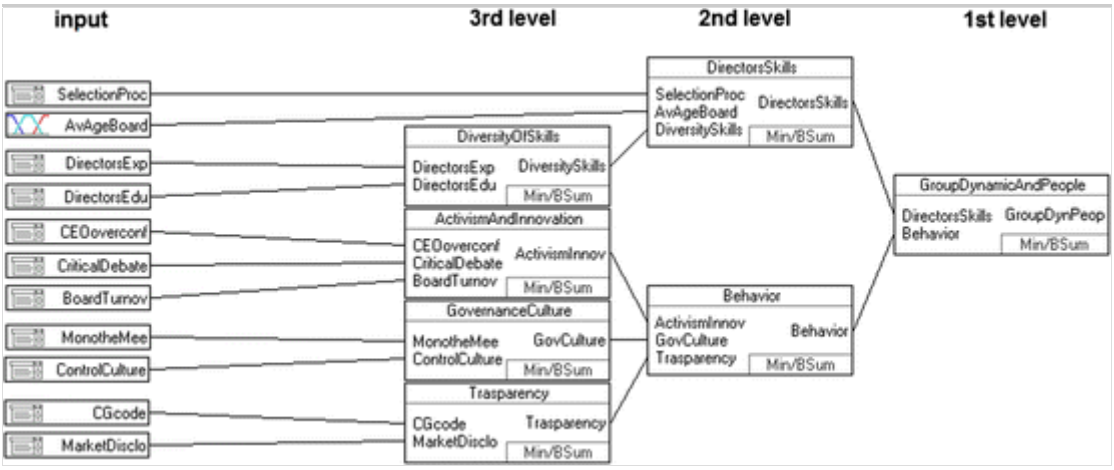
The section of effective functioning of the Board



In the third section (Fig. 4) the authors consider Group dynamics and people by rating directors' skills and behaviors. Directors' skills depend on the formal market-oriented selection process, on the average age of board members and diversity of skills (in turn assessed by diversity in Directors' experiences and diversity in Directors' degree). Behaviors are assessed through the level of activism and innovation, governance culture, and transparency. Activism and innovation are indicated by the reputational gap between CEO and independent Directors, the critical debate or Directors' participation in Board discussions and Board turnover. Governance culture depends on the presence of monothematic meetings and control culture (involvement of control functions in the Board works). Transparency is indicated by the level of compliance with CG Code and the type of market disclosure.

Fig. 4

The section of group dynamic and people



4.2.3. Determination of weight in aggregation structure

For eliciting parameters to be used in aggregations generating int. var., the authors adopted an NGT type approach (Delbecq and Van de Ven 1971; Delbecq et al. 1975), but not with a conventional protocol. In this approach, the experts were brought together only after making some choices, to reduce the time for discussion and finalization of the meeting. In the first phase of the NGT approach, some spreadsheets that reproduce the decision tree were given to the experts who were asked to complete the required information for each intermediate variable: number of terms and defining points to be used for the continuous variables; number of options for the categorical variables (qualitative); monotonicity of the input with respect to int. var. (an increase in the value of the input makes the evaluation of the int. var. increase); absolute importance of the input in the decision-making process (not reported for int.var.) and, finally, relative importance of the input in the aggregation (weight). In Table 3 an example is given of the variable “Ownership structure.”

Table 3

Information obtained by the experts for the construction of the int. var.: “ownership struct

Input variable	Type	Def. points	Monotonicity	Absolute importance	Number of terms
Ownership concentration/weight of the main shareholder	%	5, 15, 25	Decreasing (dec.)	Medium	3
Institutional investors	Categorical	Yes, no	Increasing (inc.)	High	2 (no, yes)

Input variable	Type	Def. points	Monotonicity	Absolute importance	Number of terms
Foreign institutional investors	Categorical	Yes, no	Increasing (inc.)	High	2 (no, yes)

After receiving all the files, the authors completed some statistics on their answers by preparing preferences to be submitted to the experts for the final discussion (the physical meeting), in which the opinions converged in the weights used. The results (Tables 4, 5, 6, 7, 8) are listed below.

Table 4 The last column of this table does not match the original version. The lines of the last column must be merged. I can't correct this file, see the attached file or the original pdf file

The weights: final aggregation

1st level int. var.	Monotonicity	Weight	Output
Board structure	Inc.	1/3	CG quality
Effective functioning of the Board	Inc.	1/3	
Group dynamic and people	Inc.	1/3	

Table 5 The last column of this table does not match the original version. Many lines of the last column must be merged (1°- 2°; 3°-4°-5°-6°; 7°-8°). Please see the attached file or the original pdf file

The weights: first level intermediate variables

2nd level int. var.	Definition points	Monotonicity	Weight	1st level int. var.
CG structure	Int. var.	Inc.	1/3	Board structure
Board composition	Int. var.	Inc.	2/3	
Board organization	Int. var.	Inc.	1/4	Effective functioning of the Board
Effective functioning of the committees	Int. var.	Inc.	1/4	
Board commitment	Int. var.	Inc.	1/4	

2nd level int. var.	Definition points	Monotonicity	Weight	1st level int. var.
Annual Board review	None, survey-no consultant, interview-external consultant	Inc.	1/4	
Directors' skills	Int. var.	Inc.	2/5	Group dynamic and people
Behavior	Int. var.	Inc.	3/5	

Table 6 The last column of this table does not match the original version. Many lines of the last column must be merged (1°-2°; 3°-4°-5°-6°; 7°-8°-9°; 10°-11°; 12°-13°; 14°-15°-16°; 17°-18°-19°). Please see the attached file or the original pdf file

The weights: second level intermediate variables

3rd level int. var.	Definition points	Monotonicity	Abs. imp.	Weight	2nd level int. var.
Ownership structure	Int. var.	Inc.		1/2	CG structure
Minority shareholders' protection	Int. var.	Inc.		1/2	
Board size	9, 13	Dec.	Medium	1/7	Board composition
Independence and monitoring	Int. var.	Inc.		2/7	
Board Diversity	Int. var.	Inc.		2/7	
Board duality	Yes, no	Dec.	High	2/7	
Board Activity	Int. var.	Inc.		2/7	Board organization
Information asymmetry	Int. var.	Inc.		2/7	
Committees	Int. var.	Inc.		3/7	
Committee independence	Int. var.	Inc.		2/3	Effective functioning of the committees
Committees' effectiveness	Int. var.	Inc.		1/3	

3rd level int. var.	Definition points	Monotonicity	Abs. imp.	Weight	2nd level int. var.
Directors' activity	Int. var.	Inc.		2/3	Board commitment
Directors' committment	Int. var.	Inc.		1/3	
Formal market-oriented selection process	Yes, no	Inc.	High	2/5	Directors' skills
Average age of Board members	50, 55, 65	Dec.	Medium	1/5	
Diversity of skills	Int. var.	Inc.		2/5	
Activism and innovation	Int. var.	Inc.		2/5	Behavior
Governance culture	Int. var.	Inc.		2/5	
Transparency	Int. var.	Inc.		1/5	

Table 7 The last column of this table does not match the original version. Many lines of the last c be merged. Please see the attached file or the original pdf file

The weights: third level intermediate variables

4th level intermediate variables	Definition points	Monotonicity	Abs. imp.	Weight	3 v
Ownership concentration/weight of the main shareholder	5, 15, 25 (%)	Dec.	Medium	1/6	O st
Institutional investors	Yes, no	Inc.	High	1/3	
Foreign institutional investors	Yes, no	Inc.	High	1/2	
Slate voting threshold	0, 1, 2.5 (%)	Dec.	High	1/2	M sl p
Majoritarian versus proportional election system	Majoritarian, proportional	Inc.	High	1/2	

4th level intermediate variables	Definition points	Monotonicity	Abs. imp.	Weight	3 v
Independent Directors (% on total)	20, 35, 50 (%)	Inc.	High	2/5	In ar m
Minority Directors (% on total)	0, 5, 10 (%)	Inc.	High	2/5	
Lead independent director	Yes, no	Inc.	Medium	1/5	
Female Directors (% on total)	20, 25, 30 (%)	Inc.	High	2/3	B D
Foreign Directors	Yes, no	Inc.	High	1/3	
Number of Board meetings per annum	6, 8, 10	Inc.	Medium	1/2	B A
Average length of Board meetings	1.5, 2.5, 3 (h)	Inc.	Medium	1/2	
Quality of information supplied to BoD	Low, high	Inc.	High	1/2	In as
Relationship between BoD and management	Low, high	Inc.	High	1/2	
Monothematic Committees	Int. var.	Inc.		1/2	C
Hybrid committees	Int. var.	Inc.		1/4	
Other Committees	Yes, no	Inc.	High	1/4	
Audit/Risk Committee entirely composed of independent Directors	Yes, no	Inc.	High	1/2	C in
Nomination and Remuneration Committee entirely composed of independent Directors	Yes, no	Inc.	High	1/2	
Number of meetings of the Audit/Risk Committees	4, 8, 12	Inc.	High	2/3	C ef
Number of meetings of the Nomination/Remuneration Committees	0, 2, 3	Inc.	High	1/3	
Average attendance to BoD’s meetings	70, 80, 90 (%)	Inc.	High	1/2	D ac
Average attendance to Audit/Risk Committee’s meetings	70, 80, 90 (%)	Inc.	High	1/4	

4th level intermediate variables	Definition points	Monotonicity	Abs. imp.	Weight	3 v
Average attendance to Nomination/Remuneration Committee's meetings	70, 80, 90 (%)	Inc.	High	1/4	
Average number of offices held by Board members	0, 1, 5	Dec.	Medium	1/3	D c
Maximum number of offices held by Board members	2, 3, 5	Dec.	High	2/3	
Diversity in Directors' experiences	$< 3, \geq 3$	Inc.	High	2/3	D sk
Diversity in Directors' education	Same degree: $< 30, \geq 30$ (%)	Dec.	High	1/3	
CEO overconfidence/Reputational gap	Low, high	Dec.	High	5/12	A in
Critical debate (Directors' individual participation in Board discussions)	Low, some individuals, high and widespread	Inc.	High	5/12	
Innovation/Board turnover	$< 15, \geq 15$ (years)	Inc.	High	1/6	
Monothematic meetings	Yes, no	Inc.	High	2/3	G cu
Control culture (level of engagement of the control functions/risk management in the Board works)	High, low	Inc.	High	1/3	
Alignment to best practices (compliance with CG Code)	Partial, partial justified, overall	Inc.	High	1/2	T
Market disclosure	Low-formal, standard, specific	Inc.	High	1/2	

Table 8

The weights: fourth level intermediate variables

Input	Definition points	Monotonicity	Abs. imp.	Weight	4th level int. var.

Input	Definition points	Monotonicity	Abs. imp.	Weight	4th level int. var.
Audit Committee	Yes, no	Inc.	High	1/4	
Risk Committee	Yes, no	Inc.	High	1/4	Monothematic Committees
Remuneration Committee	Yes, no	Inc.	High	1/4	
Nomination Committee	Yes, no	Inc.	High	1/4	
Control and Risk Committee	Yes, no	Inc.	High	1/2	Hybrid Committees
Nomination and Remuneration Committee	Yes, no	Dec.	High	1/2	

4.2.4. Rule blocks and aggregators

The structure of the weights and information on monotonicity were useful for preparing rule blocks by mathematical procedure, later tested by some of the experts. In Table 9 an example is given of the variable “Ownership structure”.

Table 9

Rule block for the Int. Var.: “ownership structure”

#	IF “OwnConcent” is	IF “InsInv” is	IF “ForeigInstInv” is	THEN “OwnershStructure” is
1	Medium versus high	False	False	Very_low
2	Low	False	False	Low
3	Low versus medium versus high	True	False	Medium_low
4	High	False	True	Medium_low
5	Low versus medium	False	True	Medium_high
6	High	True	True	High
7	Low versus medium	True	True	Very_high

In the first part (input aggregation) of the Fuzzy Inference Rule, the t-norm Min (Mamdani and Assilian 1975) was used. This section determines the degree to which the IF-part of the rule is satisfied. In the next step (results aggregation), if more than one rule is activated for the same term, the authors use the t-conorm of Lukasiewicz called BSUM that sums up the degrees of membership of the activated rules for the same term, up to the limit of one (Von Altrock 1997).

5. Results and discussion

The system is technically described in Table 10.

Table 10

Project description

Input variables	44
Output variables	1
Intermediate variables	27
Rule blocks	28
Rules	2587
Membership functions	284

5.1. Test and results

After various technical tests, some “school cases” were discussed for a first operative test, using input combinations built on the idea of reaching a particular level, and later of optimizing some parameters in the case of unsatisfactory output levels. The multiple case studies method was chosen as the most suitable for adequate testing of the reliability of the model. The final model was tested with real data from five companies A, B, C, D, E listed on the Italian stock exchange: public data and less accessible information was given by non-executive directors of the same companies. To verify the reliability of the subjective assessment made by an independent director of the evaluated company, the authors asked him to document the evaluations by the results of the Board review. For example, if he declared that the control culture (level of engagement of control functions/risk management in the board’s activities) was high, he was then asked about the satisfaction level of the control/risk committee’s contribution that emerged from the Board review.

Table 11 shows the input data of the system for the five companies (last five columns) and the extremes of the range used (first two data columns); if the min value is higher than max, the monotonicity of the input is obviously decreasing. These latter values test the use of extremes in the final score where min and max are the extremal values of the range of uncertainty of the variables.

Table 11

Input data

Input variables							
Input data (company)	**Min**	**Max**	**A**	**B**	**C**	**D**	**E**
Independent Directors (% on total)	20	50	66.67	25	35.71	54.54	27.27
Originality of Board organization (other committees)	0	1	1	0	0	0	0
Minority Directors (% on total)	0	10	33.33	0	0	0	9.09
Average age of Board members	65	50	60	65	60	52	58
Annual Board review	0	2	2	0	1	1	1
Ownership concentration/weight of the main shareholder	25	5	31.24	76	50.39	60	59.38
Board duality	1	0	0	0	0	0	0
Alignment to best practices (compliance with CG Code)	0	2	2	0	0	2	2
Control culture	0	1	1	1	0	1	1
Female Directors (% on total)	20	30	22.22	25	28.57	36.36	36.36
Diversity in Directors' experiences	0	1	1	1	1	1	1
Diversity in Directors' education	1	0	0	0	1	0	1
Board size	13	9	9	12	14	11	11
Foreign Directors (% on total)	0	1	1	0	0	0	0
Audit Committee	0	1	1	1	0	0	0
Control and Risk Committee	0	1	0	0	1	1	1

Input variables

Input data (company)	Min	Max	A	B	C	D	E
Audit/Risk Committee entirely composed of independent Directors	0	1	0	1	1	1	1
Number of meetings of the Audit/Risk Committees	4	12	15	11	8	10	8
CEO overconfidence/Reputational gap	1	0	1	0	1	1	1
Relationship between BoD and management	0	1	1	1	0	0	0
Foreign institutional investors	0	1	1	0	1	1	1
Institutional investors	0	1	1	1	1	1	1
Lead independent director	0	1	0	0	0	1	1
Maximum number of offices held by Board members	5	2	3	8	9	5	13
Average number of offices held by Board members	5	0	0.56	2	3	2	4
Nomination Committee	0	1	0	0	0	0	0
Nomination and Remuneration Committee	1	0	0	1	1	1	1
Nomination and Remuneration Committee (independent Directors)	0	1	1	0	0	1	1
Number of meetings of the Nomination/Remuneration Committees	0	3	6	6	3	5	5
Monothematic meetings	0	1	1	1	0	1	1
Critical debate (Directors' individual participation in Board discussions)	0	2	1	1	1	2	2
Average attendance to Audit/Risk Committee's meetings	70	90	95	100	80	100	80
Average attendance to BoD's meetings	70	90	97.67	90	74	80	95
Average attendance to Nomination/Remuneration Committee's meetings	70	90	100	100	90	100	90

Input variables							
Input data (company)	**Min**	**Max**	**A**	**B**	**C**	**D**	**E**
Formal market-oriented selection process	0	1	1	0	0	1	0
Quality of information supplied to BoD	0	1	1	1	0	1	0
Market disclosure	0	2	2	1	0	1	1
Remuneration Committee	0	1	1	0	0	0	0
Risk Committee	0	1	0	0	0	0	0
Number of Board meetings per annum	6	10	14	12	7	10	14
Average length of Board meetings	1.5	3	3	3.5	2.5	2	2
Majoritarian versus Proportional election system	0	1	1	0	1	0	0
Slate voting threshold	2.5	0	0.5	2.5	0	2.5	2.5
Innovation/Board turnover	0	1	1	0	0	1	0

The general a priori judgment by the experts of the governance system in the five entities highlighted different levels of substantive compliance with the best practices, in terms of minority protection, board composition, mix of skills, group dynamics, etc. The values assumed by intermediate variables, useful for the analysis, are shown in Table 12, and the final results are displayed in Table 13. The final assessment of the CGQ of the five companies is 86.4 out of 100 for the first company (A), 46.7 for the second (B), 40.9 for the third (C), 70 for the fourth (D) and, finally, 58.46 for company C.

Table 12

Values assumed by intermediate variables, useful for the analysis

Intermediate variables							
Values of intermediate variables	**Min**	**Max**	**A**	**B**	**C**	**D**	**E**
Ownership structure	0	100	80	40	80	80	80
Directors' activity	0	100	100	100	48	80	80
Activism and innovation	0	100	33.3	66.7	16.7	66.67	50

Intermediate variables

Values of intermediate variables	Min	Max	A	B	C	D	E
Board activity	0	100	100	100	37.5	62.5	62.5
Hybrid committees	0	100	33.3	0	33.3	33.33	33.33
Monothematic committees	0	100	50	16.7	0	0	0
Directors' commitment	0	100	61.1	18.8	12.5	18.75	6.248
Directors' skills	0	100	83.3	33.3	41.7	93.33	45
Behavior	0	100	75	62.5	0	75	75
Board composition	0	100	77.8	47.6	52.8	78.57	76.72
Board structure	0	100	80.9	37.5	58.7	62.5	60.57
Board commitment	0	100	90.7	79.2	38.1	58.34	41.66
Independence and monitoring	0	100	80	6.67	21	60	64.44
Governance culture	0	100	100	100	0	100	100
Group dynamic and people	0	100	77.8	44.4	27.8	84.44	55.56
Diversity of skills	0	100	100	100	100	100	100
Board Diversity	0	100	48.1	33.3	57.1	66.67	66.67
Committees' effectiveness	0	100	100	93.7	75	87.5	75
Effective functioning of the committees	0	100	75	68.7	50	100	100
Committee independence	0	100	50	50	50	100	100
Minority shareholders' protection	0	100	87.5	0	50	0	0
Board organization	0	100	87.5	62.5	18.8	37.5	25
Effective functioning of the Board	0	100	93.8	51.9	38.3	63.89	58.33
Committees	0	100	57.1	14.3	14.3	14.29	14.29
Information asymmetry	0	100	100	100	0	50	0
CG structure	0	100	91.7	16.7	66.7	33.33	33.33
Transparency	0	100	100	25	0	75	75

Table 13

The final results of the model

Output							
Evaluation score	**Min**	**Max**	**A**	**B**	**C**	**D**	**E**
CG quality	0	100	**86.4**	**46.7**	**40.9**	**70**	**58.46**

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The company with the highest score (A) won an award for its governance model in the last 3 years: in fact, the values of the three primary determinants of the final score are all high (Board structure: 80.9, Effective functioning of the Bo: 93.8 and Group dynamic and people: 77.8), showing a good balance among the structural, organizational and behavioral dimensions. The second one, (B), is a company characterized by a low level of free float, with a majority system, and only one minority shareholder in the board, that is dominated by a few shareholders with low skills. The score value of the CGQ (46.7) reflects a situation where the board structure and, in particular, the CG structure, expressive of the ownership structure and protection of minority shareholders, is weak (16.7). Company C was criticized by minority shareholders because of governance weaknesses. This company, in particular, can not ensure a balance of power in favor of a more active and dynamic governance. In fact, despite the higher scores achieved on structural and organizational items – mainly driven by purely compliance reasons – the score in “Group dynamic and people” is poor: it is the lowest value in relation to that of the same variable in the other four companies. In the scope of this dimension/variable, the “behavior” variable has a very low value (0) and, in turn, the determinants of the latter have very low values (“Activism and innovation”: 16.7, “Governance culture”: 0 and “Transparency”: 0). These results confirm the authors’ expectations. Company D is controlled (60%) by a company which is mainly administered by independent directors. It also has a board mostly composed of independent directors, thus ensuring an effective functioning of the board. In this case, despite the good structure and the effectiveness of the board, the high score of the CGQ is mainly due to the “Group dynamic and people” variable (84.44), in turn, conditioned positively by the “Behaviour” (75) and “Directors’ skill” (93.33) variables. Out of the five, the authors included one company (E) listed on the STAR segment of the Italian stock exchange, which is dedicated to midsize companies with a

capitalization of less than 1 billion euros.[1] The interesting result is that this small business, characterized by effective board dynamics and director's commitment, obtained a final high score (58.9) which is higher than that of the older and larger companies listed on MTA[2] (B and C). The last two businesses distinguish themselves uniquely by having a high formal compliance with governance standards. The result confirms the strength of this model, based on an integrated assessment of structural and behavioral aspects of CG. The final ranking of CGQ in the five companies (Table 13) is consistent with the general statements expressed by the experts at the beginning of the study. Although some formal features, reflecting regulatory provisions or compliance with the CG Code, are common throughout the sample (e.g., committee independence, skill diversity), the five cases show many relevant differences in most other CG practices, particularly in those regarding board activity and functioning, directors' commitment, and group dynamics.

5.2. Robustness check

A decision is robust when it remains valid despite the changing data from which it was taken. To check the goodness of the choices made in the model, the sensitivity analysis was performed by an OaT (On-at-a-Time) approach: the final score was assessed with *reference* Delete the italics to any variation for each variable of the model (Borgonovo et al. 2003). Because of the non-linearity intrinsic to the model, the entire range of variations has been considered for each input (Saltelli et al. 2008). To test the robustness of the model, the ability of the model to work on scenarios and the reliability of the Experts/subjective evaluations, some simulations were made starting from the values of the five companies in the test. In this way, besides evaluating the consistency of the monotonicity and the correct amplitude levels, the authors tried to get operational information, through the analysis of the sequence of input int. var. activated. Some sensitivity analyses were graphically illustrated in the form of scenarios for two of the five companies.

Company A (Figs. 5, 6) has obtained a high final score. One of the lowest values is that of int. var. "Board diversity". The latter results from the aggregation of two input: "Female Directors" and "Foreign Directors". To the first input all values were assigned within its range, keeping constant the remaining inputs. The authors observed a variation of the output, excluding and then including the presence of "Foreign Directors". In the first simulation (Fig. 5), it can be noted that starting from the real value of 22.22%, an

improvement is obtained in the output when exceeding 24%; the increasing monotony of the evaluation is respected for all var. int. of the next level, with the proper levels.

Fig. 5

Sensitivity analysis: first simulation for company A

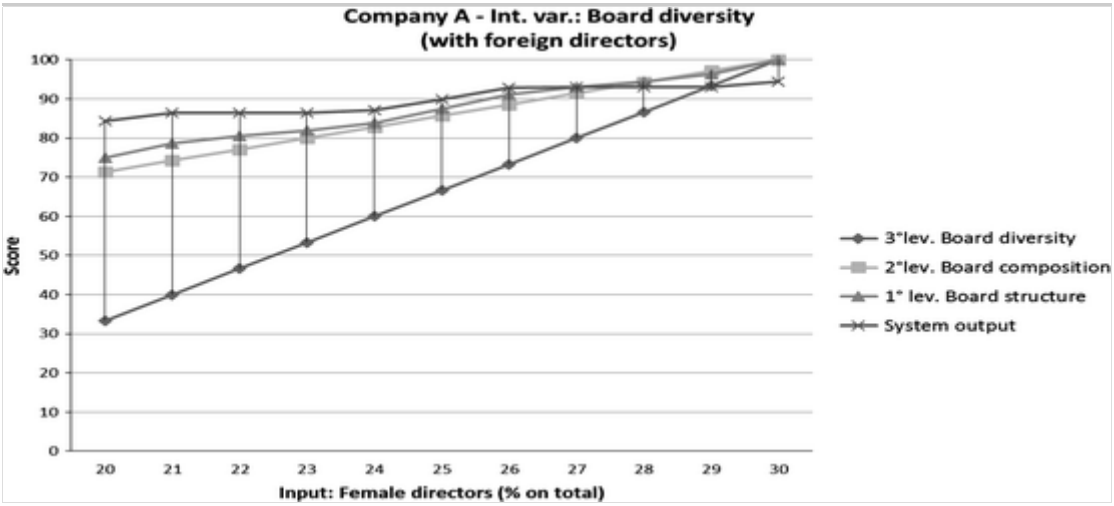
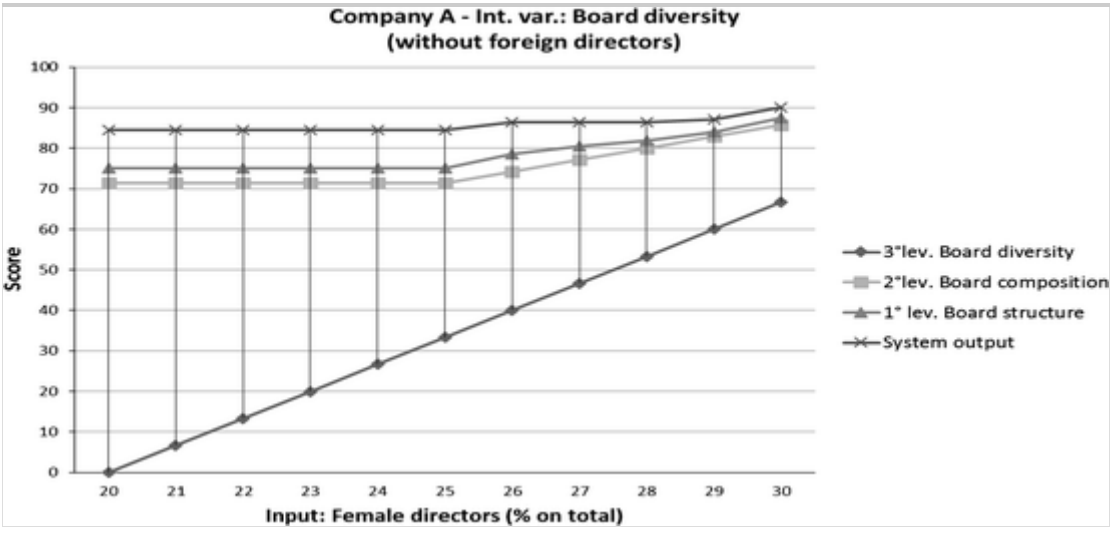


Fig. 6

Sensitivity analysis: second simulation for company A

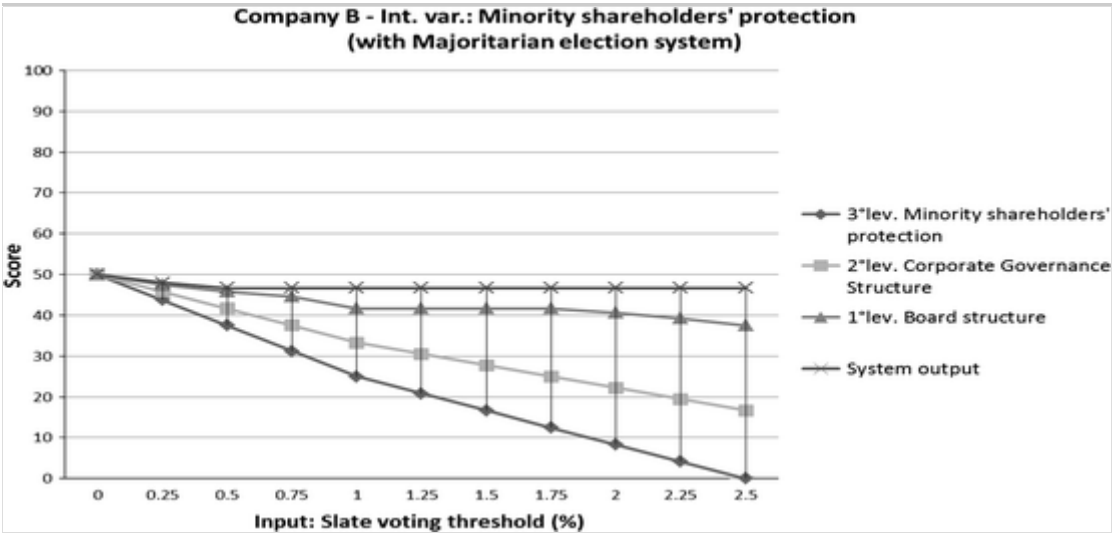


In the second simulation (Fig. 6), the same variation in the first input, assuming that Company A does not have foreign Directors reduces the evaluation on all levels. The two following simulations relate to the levels of Company B and show the impact on the assessment of an input with a decreasing monotonicity. The int. var. “Minority shareholders’ protection”,

composed by the var. “Slate voting threshold” at 2.5% and the var. “Election system” indicating a majoritarian election system, has the lowest rating. In the simulation (Fig. 7), by lowering the threshold below the 0.5%, and with the same conditions, an improvement of the assessment can be obtained. It may also be noted the correct change in the int. var., the evaluation of which decreases with the increase of the level of the input.

Fig. 7

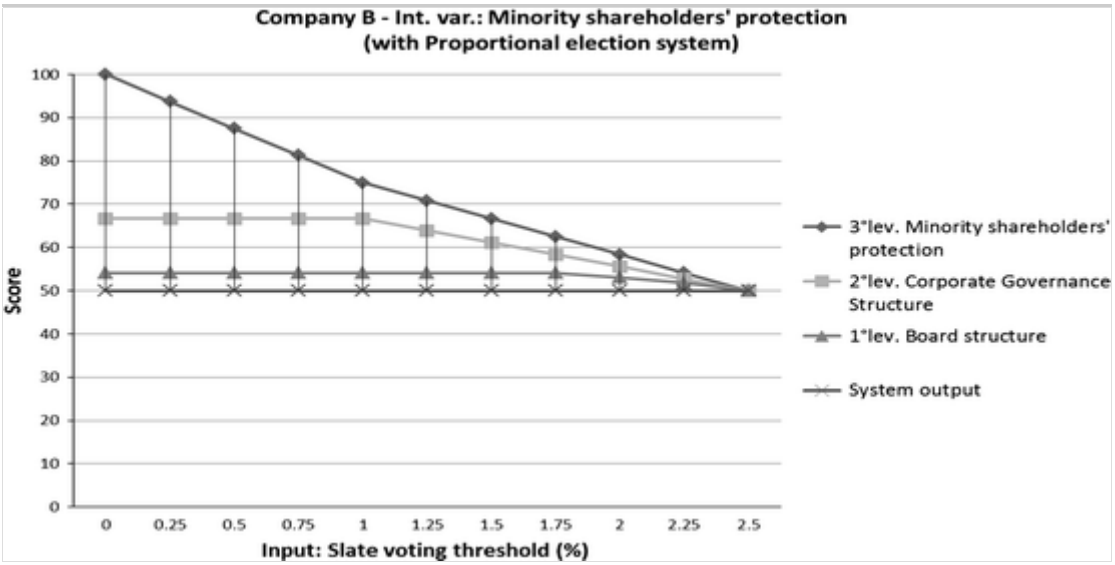
Sensitivity analysis: first simulation for company B



The next simulation (Fig. 8) shows how, by varying the elective system from majoritarian to proportional, and the threshold from 0 to 2.5%, the final evaluation varies slightly, reflecting the experts’ guidance for this combination of levels: under these conditions it is necessary to act on other variables to improve the rating.

Fig. 8

Sensitivity analysis: second simulation for company B



6. Conclusions and implications

CGQ today is a major concern for organizations, and the effort to construct a good index of CGQ, by academics as well as enterprises, is considered urgent. Despite the fact that the usefulness of rating systems is now widely recognized, they are affected by several limits. In particular, these systems do not include some behavioral variables of great importance that mainly refer to the group dynamics and people, and do not support decision analysis and internal management. The purpose of this paper is to propose an alternative approach to assessing CGQ, which is able to overcome the conceptual and methodological limits of the commercial and academic rating systems. The characteristics required for the measurement of CGQ lead to the choice of a FES. The outcome is a formalized model which, unlike the other indices: (1) represents all the most important factors that affect the quality of CG, in terms of effective and objective decision-making, not only by considering structural aspects of governance but also soft and behavioral issues; (2) facilitates the work of people who make decisions: knowing and reconstructing the determinants of the CGQ intermediate indicators composing the final CGQ index allows managers to understand the weaknesses in the value chain of the CG and use the information for decision-making purposes; (3) finally, all the knowledge needed to build the system (in particular, rules and weights for aggregation) is “collected” by the experts, on the basis of their own experience and knowledge. The robustness of the model, its ability to work in various scenarios and the reliability of the Experts/subjective evaluations have been verified through sensitivity analysis. The final model was tested on the real data from five companies listed on the Italian stock exchange.

The final ranking of CG quality in the five companies is consistent with the general statements expressed by the experts at the beginning of the study and reflects the companies' CG reputation on the market. The model described is alternative to those in existing literature and in practice.

Compared to previous rating systems, the fuzzy expert system proposed in this work can combine measurement and management perspectives, as well as qualitative and quantitative data, to consider the 'vague' interactions between CG variables and to express the most recent concept of CGQ. More specifically, the authors' model:

- Enables companies and managers to improve CGQ through better understanding of contemporary governance issues. Indeed, it takes into account the contextual contingency among evaluation criteria: for example, a high percentage of independent directors will be judged differently, if there is a low critical debate or a poor diversity of skills. Expert evaluation of multiple attributes is represented through the use of a rule base ~~(Durkin 1993)~~, that is, a collection of IF–THEN statements expressing expert opinions on given attributes. The representation of contextual contingencies is facilitated by expressing opinions as statements rather than relative comparisons.

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- Informs users about the impact of a particular management's decision and evaluates alternative corrective measures without having to acquire other information from the rating agencies (such a practice raises questions about possible conflicts of interest and the validity of the generated ratings—see Vo 2008).

- Provides suitable procedures for applying a judgment (based on a multicriteria evaluation) in a replicable and explainable way, indicating areas of strengths and weaknesses;

- Allows users to expand the scope and scale for CGQ. The FES introduces several input variables and changes the rules, connecting them to intermediate variables at any time. Furthermore, the experts' choices are transparent at any given step: by changing definition points or other rules the model can be adapted to different regulatory, statutory, and operational frameworks. For example, by changing the definition points relating to legal thresholds (0, 1, 2, 5%—see Table 7) or board size (9,

13—see Table 6), without changing the structure of the system (rules, weights, etc.), it can be quickly adapted to different regulatory requirements.

- Reduces models' imprecision: the experts find it easier to use expressions such as low, high, partial or overall to evaluate a group of attributes rather than a precise scale. Furthermore, many criteria concern hard-to-quantify measures on an accurate scale. Assessing CGQ implies dealing with both certain and uncertain attributes and sentences. In fact, sentences such as "Control culture is high (or low)" or "Quality of information supplied to BoD is low (or high)" are intrinsically fuzzy (the "lowness" of the level of engagement of the control functions/risk management in the board work or quality are matters of degree). Fuzzy logic contributes to formalizing linguistic attributes such as "low", "high", "good", "adequate" and so on.

This paper has important implications. First, from a managerial perspective, it supports the board review, provides a decision support system and allows managers to optimize their actions to improve CGQ. From a policy perspective, it highlights the importance of behavioral features and group dynamics in CG and represents them in an integrated model together with other structural and organizational items. Second, it offers a view on the substantive compliance to corporate governance best practices, as defined by CG Codes, by revealing functional aspects of the effectiveness of decision-making processes. Third, it provides a model for the assessment of Board dynamics without the need of direct on-site observation, since it is constructed according to the opinion of experts who are members of the companies' boards, thus replicating a partial internal board review. Finally, it can also be used by supervisors for assessing CG adequacy by replacing or integrating the experts' opinions with interviews/questionnaires filled in by directors and managers or through direct observation as recently suggested by EBA/ESMA (2016a, b).

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[1] STAR listed companies voluntarily adhere to and comply with the following strict requirements: high transparency and high disclosure requirements; high liquidity (free float of minimum 35%); CG in line with international standards (i.e., a set of rules that determine the

company's management).

[2] Borsa Italiana's Main Market (MTA) is mainly designed for medium-sized and large companies that are planning to raise financial resources in order to fund a growth project.