



Board independence and firm performance: The moderating effect of institutional context



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ABSTRACT

This study proposes a new research approach to examine the relationship between board independence and corporate performance, measured by technical efficiency. Moreover, this paper examines the moderating role that institutional factors exert on this relationship through the legal system—the content of law and its enforcement. The research questions are examined using an international sample of 2185 firms from 2006 to 2015, applying truncated regression models for panel data and employing data envelopment analysis to examine efficiency as a measure of performance. This paper supports that board independence increases the firm's technical efficiency. Even more, greater legal and judicial protection exerts a positive moderating effect on the previous relationship by protecting private benefits for insiders, among other aspects. Thus, the positive impact of independent directors on efficiency is greater when firms operate in countries with a greater extent of law and enforcement. Our findings include endogeneity checks using instrumental variables.

1. Introduction

The separation between ownership and control brings with it a potential divergence of interests between shareholders and managers, the latter potentially adopting opportunistic behaviours to benefit their wealth, power and status. In this regard, corporate governance can be viewed as a control mechanism safeguarding the interests of shareholders (García-Sánchez, Rodríguez-Domínguez, & Frías-Aceituno, 2015; Kang, Cheng, & Gray, 2007). Among corporate governance tools, the board of directors is considered the central axis, key in generating and preserving investor confidence, providing better access to financing, reducing agency costs and thus improving the efficiency of the organizational structure (Berle & Means, 1932; Fama & Jensen, 1983; García-Sánchez & Martínez-Ferrero, 2017; Jensen & Meckling, 1976; Shleifer & Vishny, 1997).

In recent years, financial and accounting fraud, alongside bankruptcies in large companies, has led to a higher level of research on the ideal composition of the board as a mechanism for monitoring and supervising management, and its impact on business performance (Leung, Richardson, & Jaggi, 2014; Liu, Miletkov, Wei, & Yang, 2015; Terjesen, Couto, & Francisco, 2016; Zelenyuk & Zhaka, 2006). In this respect, a great many empirical studies have associated boards of directors with business results. The latter have been measured by accounting ratios or by market variables such as Tobin's Q (Bhagat &

Black, 2002; Campbell & Mínguez-Vera, 2008; Pletzer, Nikolova, Kedzior, & Voelpel, 2015; Rose, 2007). However, an interest in using technical efficiency as a measure of performance has recently been generated, based, on the one hand, on the fact that the transformation process is the core of business activity (Liu et al., 2015; Sheu & Yang, 2005; Terjesen et al., 2016) and, on the other hand, on the fact that this measure has a series of attributes and advantages (discussed later) that make it much more appropriate than traditional measures.

Examining board composition as a factor of firm performance, it appears that independence of this internal control mechanism, in the form of non-executive directors, guarantees the success of its functioning. However, there is no consensus regarding the relationship between independent directors and performance. Some studies have argued that the non-effectiveness of board independence, the complexity of the firm and limited information reduce firm performance (Agrawal & Knoeber, 1996; Bhagat & Black, 2002; Cavaco, Crifo, Rebérioux, & Roudaut, 2017; Cho & Kim, 2007; De Andres, Azofra, & Lopez, 2005; Haniffa & Hudaib, 2006; Terjesen et al., 2016). Nonetheless, several studies (Aggarwal, Erel, Stulz, & Williamson, 2010; Baysinger & Butler, 1985; Dahya, Dimitrov, & McConnell, 2008; Leung et al., 2014; Luan & Tang, 2007; Zhu, Ye, Tucker, & Kam, 2016) have demonstrated a positive relationship between board independence and efficiency as a measure of performance (Bozec & Dia, 2007; Hsu & Petchsakulwong, 2010; Liu et al., 2015; Tanna, Pasiouras, & Nnadi, 2011). Due to the

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absence of generalizable results, this paper will examine the relationship between board independence and firm performance to clarify the proposed impact.

This paper thus examines the relationship between board independence and efficiency, recognizing that the institutional context, represented by the legal system, can moderate this relationship. But how? This is due to the role played by the institutional environment in the behaviour of directors, thus affecting corporate performance. Differences in the environment transcend companies and their boards of directors (Denis & McConnell, 2003; Organization for Economic Cooperation and Development [OECD], 2017). In this respect, several studies assert that the legal origin of a country influences the effectiveness of the board of directors, the deterrence of opportunistic and inefficient management behaviours, and financial results (Defond & Hung, 2004; Kim, Kitsabunnarat-Chatjuthamard, & Nofsinger, 2007; Klapper & Love, 2004; La Porta, Lopez-de-Silanes, & Shleifer, 2006; La Porta, Lopez-de-Silanes, Shleifer, & Vishny, 2000, 2002). The stricter the legal and judicial mechanisms in place, the greater the likelihood that unethical practices will be detected by the market and that independent directors will have to bear additional costs arising from the impact of such practices on their professional reputation, and hence the possibility of their occupying similar positions in other companies.

Thus, in order to test the moderating role of the legal system in the impact of board independence on firm performance, we use a sample of 2185 international companies with data for the period 2006–2015. Technical efficiency is proposed as a performance measure determined using data envelopment analysis (DEA) and applying resampling methods and bootstrapping techniques in line with Simar and Wilson (1998). Board independence is represented by Blau's (1977) index. Truncated regressions, according to algorithm (1) proposed by Simar and Wilson (2007), are used to determine the relationship between board independence and efficiency, and the moderating effect of the content of law and enforcement. In addition, sensitive analysis is carried out to ensure the robustness of the findings by considering the possibility that the board independence variable is endogenous, for which regressions with instrumental variables (2SLS) are used.

The remainder of the paper is structured as follows. The following section summarizes the theoretical framework related to use of the efficiency concept as a measure of firm performance, the board of directors as an internal control mechanism—focusing on board independence—and, finally, the institutional context underpinning the proposed hypothesis. The subsequent section describes the research model, data and sample. The penultimate section presents the empirical results and a discussion of the findings, while the main conclusions are addressed in the final section.

2. Efficiency, board of directors and institutional context: research hypotheses

2.1. Efficiency as a measure of corporate performance and the board of directors

In recent years, the globalization of markets and an increase in business competitiveness have generated an uncertain economic environment, characterized by lower business survival. In this context, analysis of business performance is of great interest to academics and practitioners as it allows identification of negative patterns of behaviour in order to correct them and to improve the performance of a company.

Among the wide range of representative measures of firm performance, business profitability (measured by accounting ratios or market variables, such as Tobin's Q) and technical efficiency are the parameters most often used (Bhagat & Black, 2002; Campbell & Mínguez-Vera, 2008; García-Meca, García-Sánchez, & Martínez-Ferrero, 2015; Liu et al., 2015; Pletzer et al., 2015; Rose, 2007; Terjesen et al., 2016). However, technical efficiency can be considered a better estimator of

business performance, as the central axis of a company is its productive process. Thus, technical efficiency reveals the information needed to know how well things are being done (Sheu & Yang, 2005). In contrast, Tobin's Q, a measure that reflects the psychology of investors and the stock market, turns out to be very volatile. Also, incorporating disaggregated information from individual observations—for example, one day—does not allow a general evaluation of the results as a whole—for example, one year (Sheu & Yang, 2005). In countries with underdeveloped capital markets and with a very small number of firms, it is very difficult to make a market assessment because the information is limited; there is high variance of prices, resulting in less reliable forecasts, and this is reflected in Tobin's Q (Destefanis & Sena, 2007).

What is more, measures of profitability include information that starts from management decisions about when a good is depreciated and therefore the point at which new investment (investment myopia) is needed, while technical efficiency focuses on the productive process and does not contain this bias (Destefanis & Sena, 2007).

In short, technical efficiency is considered by some authors as less ambiguous than financial measures (Hill & Snell, 1989), the latter being extremely sensitive to differences in accounting methods or accounting manipulation of profits (García-Sánchez, 2010). Sometimes management is interested in participating in projects which, while they do not add value, enhance management, in which case technical efficiency is immediately affected (Destefanis & Sena, 2007). In addition, the efficiency measure captures the agency costs of the division between ownership and control. Finally, several studies mentioned by Sheu and Yang (2005) reveal that when calculating technical efficiency—and given the correlations—it is possible to determine the levels of and changes in productivity, profitability and share price. In this respect, Lehmann, Warning, and Weigand (2004) find that efficiency indices contribute significantly to explaining differences in profitability between firms.

In focusing on the concept of technical efficiency, it is necessary to consider the relationship between input and output, understood respectively as the factors of production used in a transformation process and the goods and/or services that are obtained as a result. Thus, efficiency (or technical efficiency) can be understood as the possibility of obtaining the maximum quantity of output with the same level of input, or maintaining a given level of output while minimizing the quantity of input. Production theory (Cobb & Douglas, 1928; Dillard, 1980) is based on the production function, understood as the mathematical representation that shows the greatest quantity of output that a company can produce from the quantity of input used (Seiford & Thrall, 1990).

This study focuses on examining the factors that affect this level of firm performance by using technical efficiency as a proxy. Among these, the board of directors provides the structure through which the company's goals are set, along with determining the means to achieve those objectives and promote performance monitoring; it promotes the efficient use of resources and, equally, demands to be held accountable for the administration of those resources (OECD, 2017).

In this regard, different theoretical approaches can be adopted when considering the role and influence of boards of directors. The great majority of studies adopt agency theory, which addresses the divergence of interests between shareholders and managers, with the board of directors mainly adopting a controlling role over managers. According to the agency perspective (the dominant framework), as one of the most important governance mechanisms, boards play a pivotal role in monitoring managers to reduce problems associated with the separation of ownership and control in public corporations (Fama & Jensen, 1983). The strategic role of boards has become increasingly important, going beyond the mere approval of strategic management decisions (Chen, Cheng, & Wang, 2015; Cuadrado-Ballesteros, Rodríguez-Ariza, & García-Sánchez, 2015; García-Sánchez & Martínez-Ferrero, 2017; Kim, Burns, & Prescott, 2009). The board must serve to reconcile management decisions with the objectives of shareholders and stakeholders, which can at times influence strategic decisions.

Therefore, the board's responsibilities extend beyond controlling and monitoring management, ensuring that it takes decisions that are consistent with the organization (Corten, Steijvers, & Lybaert, 2017; García-Sánchez & Martínez-Ferrero, 2017).

In contrast, several researchers have started from the perspective of stewardship theory, in which managers are recognized as collectivists, pro-organizational, reliable and motivated by the interests of shareholders; these managers define their success and satisfaction by performing a challenging job, with the possibility of exercising responsibility and authority, and thus achieving recognition from peers and bosses. In this scenario, the board of directors facilitates and contributes to the job of managers (Davis, Schoorman, & Donaldson, 1997; Donaldson & Davis, 1991; García-Meca et al., 2015). This field of research has also been approached from the perspective of the resource-based view (RBV), in which the board of directors is considered in terms of human and social capital, constituting a key resource for the company (Fuente, García-Sánchez, & Lozano, 2017). Owing to their functions of providing advice and engaging in communication, they facilitate strategic decision-making and access to key resources, and thus to attaining competitive advantage (García-Sánchez, 2010; Leung et al., 2014; Liu et al., 2015; Pugliese et al., 2009; Terjesen, Sealy, & Singh, 2009). Although exerting less impact, institutional theory is used above all when discussing the legitimacy that companies achieve by having diverse council and management positions (Terjesen et al., 2009) and using cognitive and behavioural approaches when seeking understanding of the cognitive contributions of the board, as well as the impact of its dynamics on strategic decision-making (Cuadrado-Ballesteros et al., 2015; García-Meca et al., 2015; Pugliese et al., 2009).

As agency theory is the most common frame of reference (Cuadrado-Ballesteros et al., 2015; Huse, 2000; Terjesen et al., 2016; Terjesen et al., 2009) the paper starts from this theoretical basis. From this perspective, when the owners (principals) of the companies delegate their authority to the managers (agents) so that they manage the companies and make decisions in their name, an agency relationship arises (Chen et al., 2015; Jensen & Meckling, 1976; Shleifer & Vishny, 1986). There is separation between the ownership and management roles, predominantly resulting in conflict in those cases in which managers have own interests that differ from those of owners; the latter wait to receive returns on their investment and aim to ensure that their funds are neither expropriated nor wasted on unprofitable projects. This is termed the agency problem (Berle & Means, 1932; Fama & Jensen, 1983; Jensen & Meckling, 1976; Shleifer & Vishny, 1997).

Although these problems should be reflected in the contract between shareholders and managers, it is impossible to include all possible situations that may arise in the relationship (Denis & McConnell, 2003; Shleifer & Vishny, 1997; Villaron-Peramato, Martínez-Ferrero & García-Sánchez, 2018). Moreover, the elaboration of such contracts, their supervision and the effort to enforce them implies so-called agency costs (Fama & Jensen, 1983). Agency problems involve the destruction of value and loss of business efficiency (Zelenyuk & Zhaka, 2006).

In this scenario, shareholders seek control mechanisms that allow them to limit the agency problem, maximize company performance, protect their interests and ultimately guarantee their profitability (Shleifer & Vishny, 1997)—namely corporate governance. To achieve the organization's objectives, corporate governance ensures the strategic orientation of the company, effective monitoring, accountability, investor confidence building, better access to external capital, a reduction in agency costs and, ultimately, improved organizational efficiency (García-Meca et al., 2015; John & Senbet, 1998; OECD, 2017).

Empirically, there are a number of studies that demonstrate a positive relationship between the quality and effectiveness of corporate governance and business performance (Bozec & Dia, 2007; Destefanis & Sena, 2007; Klapper & Love, 2004; Leung et al., 2014; Liu et al., 2015; Sheu & Yang, 2005; Terjesen et al., 2016; Zelenyuk & Zhaka, 2006).

Thus, acting on behalf of shareholders, directors are responsible for

hiring, clearing, controlling and dismissing top management, as well as monitoring and ratifying management decisions (Fama & Jensen, 1983; John & Senbet, 1998). In addition, they oversee the risk management system and compliance with legal mandates (OECD, 2017). All of this is done to preserve value for the shareholders and ensure an adequate return on their investments (Baysinger & Butler, 1985; Shleifer & Vishny, 1997) based on the balance of the demands of the different stakeholders in the company (García-Sánchez, 2010; García-Sánchez & Martínez-Ferrero, 2017). Overall, in this paper, we analyse the relationship between board independence as a control mechanism and the level of business efficiency as a firm performance proxy (García-Sánchez, 2010). The independence of the internal control mechanism guarantees the success of the organization's functioning.

2.2. Board independence and efficiency

Board independence is often linked to the presence of outside directors, who are non-management members of the board: executive or internal directors are those present on the management team. Independence is assumed to be closely related to the strength of the board (Beasley, 1996; Kang et al., 2007), because independent directors display greater objectivity and independence in their analysis of the management and behaviour of the company (Ibrahim & Angelidis, 1995). Board independence is viewed as a strong mechanism for monitoring the performance of managers and preventing opportunistic actions as a result of the greater motivation of such directors and their interest in supervising managerial actions and thus upholding the company's reputation (Fama & Jensen, 1983). What is more, owing to their status and image, their reputations depend on the quality of the job they do, this being especially focused on the sound monitoring of management (Fama, 1980; Fama & Jensen, 1983).

Empirically, several studies (Aggarwal et al., 2010; Baysinger & Butler, 1985; Dahya et al., 2008; Liu et al., 2015; Luan & Tang, 2007) have demonstrated a positive relationship between board independence and efficiency as a measure of performance (Bozec & Dia, 2007; Hsu & Petchsakulwong, 2010; Tanna et al., 2011). This positive relationship is justified by the fact that the greater psychological and financial independence of directors with respect to managers allows them to exercise their functions of monitoring, directing, supervising and evaluating management more effectively (Baysinger & Butler, 1985); it allows them to reduce agency costs and increase financial transparency (Chen et al., 2015; Cuadrado-Ballesteros et al., 2015; García-Sánchez, 2010), avoiding and eliminating conflicts between managers in a more impartial way (Fama & Jensen, 1983; Villarón-Peramato et al., 2018) as they have a broader perspective associated with their previous experience as managers and/or participating in other sources of advice (Baysinger & Butler, 1985). In this respect, for instance, Liu et al. (2015) found that independent directors have an overall positive effect on firm operating performance in China. Zhu et al. (2016), meanwhile, evidenced that empowering independent directors may lead to their more effective monitoring and therefore higher firm value.

However, there is debate concerning whether the participation of external directors affects business performance positively or negatively. On the one hand, based on a sample of Hong Kong firms, for instance, Leung et al. (2014) find no significant association between the independence of corporate boards and firm performance other than in family firms. On the other hand, a large number of studies (Agrawal & Knoeber, 1996; Bhagat & Black, 2002; Cho & Kim, 2007; De Andres et al., 2005; Haniffa & Hudaib, 2006; Terjesen et al., 2016) have shown that there is no positive (clear and/or broad) relationship between board independence and business performance measured by profitability, Tobin's Q and even efficiency (Callen & Falk, 1993; Rose, 2007). These results are based on arguments such as: (i) the external directors' relationship with the company is partial and does not allow them to have a sufficient understanding of the company's day-to-day business and therefore of the complexity of the company (Bhagat & Black, 2002);

(ii) they do not have access to all available information, which means their decision-making is not appropriate or timely (Cavaco et al., 2017); (iii) they lack knowledge of the business or the ability to monitor management actions (García-Sánchez, 2010); and (iv) they may involve the company in excessive monitoring, which is detrimental to its functioning (Baysinger & Butler, 1985).

From the above, and given the lack of consensus about the impact of board independence on firm performance, we propose the following alternative hypotheses: one proposes a positive impact and the second a negative relationship between independence and performance.

Hypothesis 1a. There is a positive relationship between board independence and efficiency as a measure of performance.

Hypothesis 1b. There is a negative relationship between board independence and efficiency as a measure of performance.

2.3. The moderating role of institutional factors

In the absence of generalizable results concerning board independence and corporate outcomes, this paper also aims to examine the moderating effect of certain institutional factors that may address this absence of solid and homogeneous conclusions.

One possible explanatory factor for the lack of agreement on the role of board independence with regard to corporate performance may be the part played by the institutional environment in the behaviour of directors. This can be determined by institutional theory, based on the notion that institutions operate according to the formal and informal rules of the game of a society or environment and its interactions (North, 1990). The concept of isomorphism is related to the acceptance of and adaptation to these social norms, according to which organizational action reflects a pattern of how to do things that, with the passage of time, becomes legitimate in the environment (Frias-Aceituno, Rodríguez-Ariza, & García-Sánchez, 2013; García-Sánchez et al., 2015; Martínez-Ferrero & García-Sánchez, 2017; Young, Stedham, & Beekun, 2000). Thus, at an economic level, this theory recognizes that companies operate within institutional contexts that affect their actions and expectations. That is, organizations operating in the same environment will adopt homogeneous behaviours, seeking greater compatibility and legitimacy—i.e. isomorphism (DiMaggio & Powell, 1983; García-Sánchez, Cuadrado-Ballesteros, & Frias-Aceituno, 2016).

Differences in the environment are the result of history, culture, politics, the legal system, standards, traditions and country-specific circumstances, which transcend companies and their boards of directors (Denis & McConnell, 2003; OECD, 2017), making some control mechanisms more effective in some settings than in others. Thus, there are differences, for example, in their composition: in some countries, there are one-tier or two-tier board systems (in which monitoring and management tasks are distributed), and in some cases there are additional committees assigned to carry out audits. Moreover, there are countries where the board has representatives of certain stakeholders, even more shareholders, like employees and/or creditors (De Andres et al., 2005; John & Senbet, 1998; OECD, 2017). For example, in France, the Netherlands and Norway, among others, there are generalized participation rights in the governing bodies of public and private companies due to the presence of trade unionists and workers' representatives. However, in other cases, the differences are reflected rather in the behaviours and patterns of the directors, resulting in them acting differently. In this respect, Denis and McConnell (2003), for example, show that in many European countries the role of the board is not prescribed by law, so the maximization of shareholder wealth may not be its only objective, while in other cases this is not so.

One way of advancing research, justifying the proposal of this paper, is to transcend the typical scenarios in which the independence

of the board has been studied and address the differences that appear in a large sample of countries and that affect the composition of the board and the characteristics of governance, among other aspects (Johnson, Schnatterly, & Hill, 2013). Taking previous research into account, differences between countries tend to focus on legal aspects (Frias-Aceituno et al., 2013; García-Sánchez et al., 2015; La Porta et al., 2000; Martínez-Ferrero & García-Sánchez, 2017). In this respect, despite focusing on the existence of ethical codes, using a sample of firms from 12 countries, García-Sánchez et al. (2015) obtain evidence that a greater presence of independent directors on the board leads to the existence of more complex codes of ethics. Moreover, there are significant differences between countries with high levels and countries with low levels of investor protection as regards the effectiveness of independent directors in constraining unethical behaviour by managers.

In this respect, numerous authors (e.g. Defond & Hung, 2004; Kim et al., 2007; Klapper & Love, 2004; La Porta et al., 2000, 2002, 2006) assert that the legal origin of a country—common vs. civil law—and a greater degree of protection for shareholders and creditors result in a lower level of concentration of ownership, greater development of capital markets, greater effectiveness of boards of directors, greater deterrence of opportunistic and inefficient management behaviours, and better financial results (i.e. Villarón-Peramato et al., 2018). In contrast, in the absence of legislation, shareholders seek by their own means to minimize agency conflict, resulting in less diversification of investment, restrictions on financing (through debt or capital) and the strengthening of governance mechanisms, causing agency costs that put less profitable firms at a disadvantage compared to firms in other environments (Aggarwal et al., 2010; Ball, Kothari, & Robin, 2000; García-Sánchez et al., 2015).

Another source of difference is determined by the level of compliance with laws as, in addition to the above points, firms can be penalized through the execution of the law, deterring the expropriation of shareholders' interests by executives—that is, we could affirm that both the legal origin, giving a greater degree of protection to shareholders and creditors, and a greater level of compliance with laws influence the efficiency of companies. Studies such as that conducted by Dahya et al. (2008) show that the level of protection for shareholders is positively correlated with the financial performance of companies. Kim et al. (2007) contrast this relationship between countries with higher shareholder protection rights, a lower concentration of ownership and more independent directors.

Three alternative scenarios are possible in relation to the moderating role played by the legal system with regard to external directors and the influence of advisers on business performance. In the first scenario—the least plausible—there would be a neutral effect, which would suppose that these directors play roles uniformly around the world and there would be no influence by the institutional environment. The other two scenarios involve considering systematic variations in the behaviour of directors derived from incentives in different institutional settings. The second scenario supposes a substitutive relationship between the mechanisms of corporate governance, which would lead, following Doidge, Karolyi, and Stulz (2001), to a negative relationship between the strength of the board of directors at firm level (board independence) and the laws at the country level (strong legal system). Thus, it would be expected that the directors of companies located in countries with a less protected legal system would adopt a more active role to mitigate the weakness of the legal system of the country of origin. With respect to the third scenario, several authors have found that differences between countries affect the policy of dividend payment, operating performance, the availability and cost of external financing, and market valuations (Beck, Demirgüç-Kunt, & Levine, 2003; Berkowitz, Pistor, & Richard, 2003; Claessens, Djankov, & Lang, 2000; Gompers, Ishii, & Metrick, 2003; Gul, Lynn, & Tsui, 2002; Lombardo & Pagano, 2000), as well as the quality of financial

information (Ball et al., 2000; Boonlert-U-Thai, Meek, & Nabar, 2006; Brown & Higgins, 2002; García-Meca et al., 2015; Leuz, Nanda, & Wysocki, 2003; Shen & Chih, 2005). From the above, in countries with weaker laws, the degree of flexibility of firms in influencing their own governance would probably be minor, which would imply a complementary effect.

In this paper, it is argued that the effect of the legal system on the ethical commitment of independent directors will be of a complementary nature because of the rational decisions that the directors take as economic agents. According to Ravina and Sapienza (2009), independent directors are economic agents whose decisions may be influenced by their own interests, which are conditioned by the institutional environment in which they operate (Bebchuk & Weisbach, 2012; García-Sánchez et al., 2015); thus, such an institutional context could impact on the functioning of the board as a control mechanism (La Porta et al., 2000). The institutional environment of those companies located in countries with strong protection will therefore be more conducive to directors engaging in greater intervention in the strategic direction and control of the management team. This is due to the fact that the managers of companies located in countries with less investor protection will have greater capacity to obtain private control benefits (Dyck & Zingales, 2004; Nenova, 2003), showing stronger opposition to those mechanisms that limit the behaviour of opportunists (Renders & Gaeremynck, 2007). In this respect, evidence is scarce. However, Klapper and Love (2004) find that firm-level governance and performance is lower in countries with weak legal environments, suggesting that improving the legal system should remain a priority for policymakers.

In line with this, the following further research hypotheses are proposed:

Hypothesis 2a. There is a positive relationship between board independence and corporate efficiency, this being reinforced in institutional contexts with a strong legal system.

Hypothesis 2b. There is a negative relationship between board independence and corporate efficiency, this being corrected in institutional contexts with a strong legal system.

3. Empirical research: data, variables and econometric models

3.1. Sample for analysis

The data for this study are the result of information availability in the Thomson One Analytic database for the period of analysis from 2006 to 2015. Firstly, archival data were collected from Thomson Reuters Eikon,¹ which includes the above-mentioned database. In this study, we took into consideration information on all the firms from the global benchmark stock indices from America, Europe, the Middle East, Africa (EMEA) and Asia, comprising 3594 companies from 31 stock indices. Use of an international data set is essential to evidence the effect of the institutional context, as it allows the observation of higher variability in the analysis of different legal systems (García-Sánchez & Martínez-Ferrero, 2017).

After excluding duplicated companies and observations with missing financial or economic information, a final sample of 10,279 firm-year observations (2185 firms) spanning ten years (2006–2015) was available to test the hypotheses. The firms were engaged in activities in different sectors and were from 24 different countries. The

¹ Thomson Reuters Eikon is a web-based investment research and analytics tool that provides financial data on some 60,000 public companies worldwide, including financial statements, analysts' reports, corporate governance, ownership data and company filings (for more, see <https://www.thomsononeim.com/>). This database is recognized worldwide and is commonly used in the accounting, financial and management research areas (i.e. Dave, Wadhwa, Aggarwal, & Seetharaman, 2013; Salloum, Jabbour, & Mercier-Suissa, 2017).

sample was unbalanced because not all companies were represented in all periods. Companies that had filed for bankruptcy and merged should be deleted to avoid changes in values and strategies. Because other firms could be delisted or created during the period of analysis, the sample for analysis is an unbalanced panel, and consequently no information is available for the period. Regarding this issue, one of the advantages of considering the panel data methodology is attrition bias. With cross-sectional data, these companies will not be examined. However, using an unbalanced panel data, they can be studied, mitigating attrition bias (Martínez-Ferrero & García-Sánchez, 2017).

Table 1 shows the sample distribution by country, year and industry. As we can see, the highest percentages are for the years 2010–2015 (> 69% of the observations). In relation to geographic diversity, 35.41% of the companies are from the USA. With regard to industry, those sectors with a higher presence are materials and capital goods.

3.2. Variable measurement

3.2.1. Dependent variable: technical efficiency

As already mentioned, technical or technological efficiency is part of the logic of inputs and outputs: in order to be efficient, the quantity of output produced must be maximized or the quantity of input minimized (Banker, Charnes, & Cooper, 1984; Bauer, Berger, Ferrier, & Humphrey, 1998). To measure efficiency over time, multiple methods have been developed, focusing on financial ratios, statistical regressions, parametric (or econometric) or non-parametric models and simulation models. Although each of these approaches has its advantages and disadvantages, this paper focuses on DEA for obtaining the efficiency indicator variable.

Taking into account the theoretical and applied importance of efficiency measurement, as well as the limitations of single input methods in evaluating output generation, Farrell (1957) proposed a radial measure that considers the different inputs and outputs involved in the transformation process, laying the foundation for the development of DEA models (Charnes, Cooper, & Rhodes, 1978). These mathematical models for measuring efficiency have the following advantages over other approaches.

- Financial ratios, although easy to calculate and commonly used, are adequate only in cases where there is just one input and one output. A disadvantage of this is that depending which input is used as the efficiency criterion, different results can be obtained. To have a measure of general efficiency for a company, more than one ratio should be considered (Thanassoulis, Boussofiane, & Dyson, 1996), or arbitrary assumptions need to be made about the weighting of inputs and outputs (Baik, Chae, Choi, & Farber, 2013; Charnes, Clark, Cooper, & Golany, 1984).
- Regressions and statistical methods have also been used in the evaluation of efficiency. However, these imply imposing a production function on the relationship between inputs and outputs, whereas DEA, being a non-parametric method, does not assume any particular form. Parametric models involve establishing a functional form between inputs and outputs, as well as the distribution of error, which can be chosen erroneously. These types of method divide all the boundary outputs of a decision-making unit (DMU) between actual inefficiency and random noise (Cullinane, Wang, Song, & Ji, 2006; Cummins, Tennyson, & Weiss, 1999). In addition, the DEA technique seeks to optimize each of the observations, while in regressions this is done at the general level (Charnes, Cooper, Golany, Seiford, & Stutz, 1985; Cooper & Tone, 1997; Seiford & Thrall, 1990).

DEA is a mathematical programme based on linear programming, non-statistical and non-parametric in nature—that is, it does not make assumptions about the distribution of inefficiencies or the form of the

Table 1
Sample distribution by country, industry and year.

Panel A. Sample by country		
Country	Frequency	Percentage
Australia	985	9.58%
Belgium	10	0.10%
Canada	1.281	12.46%
China	354	3.44%
Denmark	10	0.10%
Finland	30	0.29%
France	323	3.14%
Germany	256	2.49%
Hong Kong	227	2.21%
Ireland	128	1.25%
Italy	20	0.19%
Japan	857	8.34%
Luxembourg	20	0.19%
Netherlands	186	1.81%
New Zealand	53	0.52%
Norway	20	0.19%
Russia	144	1.40%
Singapore	195	1.90%
South Africa	120	1.17%
Spain	170	1.65%
Sweden	218	2.12%
Switzerland	220	2.14%
United Kingdom	812	7.90%
United States	3.640	35.41%
Total	10.279	100.00%

Panel B. Sample by year		
Year	Frequency	Percentage
2006	608	5.91%
2007	728	7.08%
2008	849	8.26%
2009	982	9.55%
2010	1.070	10.41%
2011	1.121	10.91%
2012	1.120	10.90%
2013	1.211	11.78%
2014	1.260	12.26%
2015	1.330	12.94%
Total	10.279	100.00%

Panel C. Sample by industry		
Industry	Frequency	Percentage
Automobiles & components	235	2.29%
Capital goods	1046	10.18%
Commercial & professional services	282	2.74%
Consumer durables & apparel	379	3.69%
Consumer services	322	3.13%
Diversified	259	2.52%
Energy	997	9.70%
Food & staples retailing	236	2.30%
Food, beverage & tobacco	466	4.53%
Health care equipment & services	446	4.34%
Household & personal products	157	1.53%
Materials	1344	13.08%
Media	383	3.73%
Pharmac., biotechnology & life	402	3.91%
Real estate	490	4.77%
Retailing	477	4.64%
Semiconductors & semic. equipment	185	1.80%
Software & services	474	4.61%
Technology hardware & equipment	315	3.06%
Telecommunication services	346	3.37%
Transportation	384	3.74%
Utilities	654	6.36%
Total	10.279	100.00%

production function to estimate the maximum output levels given the levels of input, or the minimum levels of input for output levels given by a DMU. This is done by delineating an efficient, deterministic, non-parametric production function, calculated in lengths and interpreted as the best practice of the company. This border is calculated from the input and output data of the individual organizations that make up the DMU, considering the extreme results (Cooper & Tone, 1997). The DEA model is as follows:

$$\min f_o = \frac{\sum_{i=1}^s V_i X_{io}}{\sum_{r=1}^s u_r Y_{ro}}$$

subject to:

$$\frac{\sum_{i=1}^m V_i X_{ij}}{\sum_{r=1}^s u_r Y_{rj}} \geq 1; \quad j = 1, \dots, n$$

$$u_r, v_i > 0; \quad r = 1, \dots, s; \quad i = 1, \dots, m$$

where, y_{rj} , x_{ij} (positive) are the outputs and inputs of the DMU j ; and u_r , $v_i \geq 0$ are variable weights—virtual weights—determined by the solution of the problem. Although in previous studies a great variety of inputs and outputs have been used to calculate the technical efficiency index (*Eff*), in this paper, following García-Sánchez (2010), for the inputs we have the number of employees (Burhop & Lübbbers, 2009), procurement costs and the amortization or depreciation of tangible and intangible assets, representing the annual use of fixed assets. As the output, the net business volume is used, which includes the sales or income generated by the main activity of the companies.

More concretely, to develop its activity, a firm, following Simar and Wilson (1998), uses p inputs ($x \in \mathbb{R}^+^p$) to produce q outputs ($y \in \mathbb{R}^+^q$) by means of a set of means of production ψ of physically achievable points (x, y) : $\psi = \{(x, y) \in \mathbb{R}^+^{p+q} \text{ can produce } y\}$. The efficiency measures for inputs and outputs respectively for a given point (x_k, y_k) are $\theta_k = \min \{\theta \mid \theta x_k \in X(y_k)\}$, $\beta_k = \max \{\beta \mid \beta y_k \in Y(x_k)\}$.

If $\theta_k = 1$ ($\beta_k = 1$), (x_k, y_k) , the firm is considered efficient. Otherwise, if $\theta_k \leq 1$, the DMU is inefficient and a difference of 1 would indicate the proportional reduction of input that could be achieved if y_k were produced efficiently (Baik et al., 2013; Cubbin & Tzanidakis, 1998; Dopuch, Gupta, Simunic, & Stein, 2003; Seiford & Thrall, 1990).

Because the DEA estimators obtained are of finite samples, the efficiency measure is sensitive to variations in the sample configuration. Bootstrapping is used as a tool that takes into account such sensitivity and is developed through repeated simulation of data generation processing (DGP) using resampling. From this, the original estimator is applied to each simulated sample. Thus, this paper includes application of the resampling method and bootstrapping techniques (García-Sánchez, 2010; Simar & Wilson, 2000). The complete bootstrapping algorithm is summarized in the following steps.

1. For each (x_k, y_k) $k = 1, \dots, n$, compute $\hat{\theta}_k$ by solving the following linear programming formula:

$$\hat{\theta}_k = \min \left\{ \theta \mid y_k \leq \sum_{i=1}^n \gamma_i y_i; \theta x_k \geq \sum_{i=1}^n \gamma_i x_i; \theta > 0; \sum_{i=1}^n \gamma_i = 1; \gamma_i \geq 0, i = 1, \dots, n \right\}$$

2. Using smoothing bootstrapping, a random sample of size n originates from $\hat{\theta}_i = 1, \dots, n$, where $\theta_{1b}^*, \dots, \theta_{nb}^*$

Employing the random generator:

$$\tilde{\theta}_i^* = \begin{cases} \beta i^* + h e i^* \text{ si } \beta i^* + h e i^* \leq 1, \\ 2 - \beta i^* - h e i^* \text{ otherwise} \end{cases}$$

smoothed pseudo-efficiencies are generated:

$$\theta_i^* = \bar{\beta}^* + \frac{1}{\sqrt{1 + \frac{h^2}{\sigma_\theta^2}}} \left(\hat{\theta}_i^* - \bar{\beta}^* \right), \text{ where } \bar{\beta}^* = \left(\frac{1}{n} \right) \sum_{i=1}^n \beta_i^*$$

3. Compute $X_b^* = \{(x_{ib}^*, y_i) | i = 1, \dots, n\}$, where $x_{ib}^* = \left(\frac{\hat{\theta}_i}{\sigma_{\hat{\theta}_i}} \right) x_i, i = 1, \dots, n$.
4. Estimate the bootstrap $\hat{\theta}_{k,b}^*$ of $\hat{\theta}_k$ for $k = 1, \dots, n$, resolving the theorem of linear programming from point 1.
5. Repeat steps 2 and 4 B times to provide a $k = 1, \dots, n$ set of estimates $\{\hat{\theta}_{k,b}^*, b = 1, \dots, B\}$.

For this paper—and in line with Simar and Wilson (1999) and García-Sánchez (2010)—the technical efficiency indexes are calculated from the estimator of returns to scale, output orientation and the bootstrapping procedure.

3.2.2. Independent variables

To measure the level of independent directors, the Blau (1977) index is used. This index has been especially used to measure the diversity of the board (whether of race, ethnicity, gender or experience), but can be extended to other characteristics because it is based on the qualitative differences of members belonging to a particular group (Campbell & Mínguez-Vera, 2008; Harrison & Klein, 2007; He & Huang, 2011). Methodologically, it meets the necessary criteria to be considered a good measure of relative independence so that it is not a negative and unlimited index (Miller & del Carmen Triana, 2009). Moreover, use of the Blau index is justified because the proportion of independents on the board does not strictly measure their degree of independence, although it may be a plausible measure, given the generalized imbalance regarding the participation of independents on boards.

The formula for calculation is $1 - \sum p_k^2$, where p is the proportion of members of a category $k - th$. This can take values from 0 to $(k - 1)/k$. Taking into account that independence takes two values (external vs. internal), $k = 2$, its maximum value will be 0.50, which indicates that the distribution of the members is equal between the categories. To avoid problems of endogeneity, this variable, *Indep*, is one period ahead ($t - 1$).

3.2.3. Moderating variables: institutional context

To reflect the institutional context of each country, the indicators take into consideration the legal origin of the country, the existence of laws for protecting shareholders' and debtholders' rights, and the level of law enforcement. In this respect, Porta, Lopez-de-Silanes, Shleifer, and Vishny (1998) show that the extent to which agency problems between insiders and outsiders can be mitigated depends on both the content of law and the quality of their enforcement.

In relation to the content of law, we measure the legal protection of minority shareholders against expropriation by insiders with the anti-self-dealing index proposed by Djankov, La Porta, Lopez-de-Silanes, and Shleifer (2008). This index captures regulation of firm self-dealing transactions in relation to disclosure, approval procedures for transactions, and the facilitation of private litigation when self-dealing is suspected. Creditor protection is proxied by the creditor rights index proposed by Djankov et al. (2008). This has four components representing the strength of legal protection granted to creditors: no automatic stay, secure creditors paid first, restrictions on reorganization and no management stay. In addition, we include the degree of capital market development identified by the stock market capitalization to gross development product (GDP) from the Financial Development and Structure Database of the World Bank. Countries with higher scores on this ratio are assumed to have more developed capital markets that favour investor protection.

To reflect the mechanism of law enforcement, we use three indexes: (i) the regulatory quality index, which captures the existence of policies

Table 2
Factorial analysis for legal system.

	ProtRights	Enforc	Mean	Std.Dvt.
Anti-self dealing index	0.859	0.018	0.64	0.18
Creditor rights index	0.765	0.004	1.59	1.08
Market development	0.662	0.301	108.75	51.30
Regulatory quality	0.186	0.976	88.68	12.49
Rule of law	0.007	0.993	89.14	12.73
Property rights	0.072	0.988	80.98	15.36
Variance accounted for = 80,12%				
Kaiser-Meyer-Olkin (KMO) measure of simple suitability			0.625	
Bartlett test of sphericity (Chi-square)			86030,01	
p-Value			0.000	

and regulations permitting and promoting private sector development; (ii) the rule of law, an assessment of the law and order tradition in the country, identifying the integrity of the legal system; and (iii) the degree of property rights, measuring the degree to which private property rights are protected by a country's laws and the degree to which its governance enforces these laws. The first two indexes are elaborated by the World Bank Group, the third by the Heritage Foundation.

These variables are grouped by factor analysis, the results of which are shown in Table 2. The Kaiser–Meyer–Olkin (KMO) measure of sample suitability is 0.625 (higher than the minimum value of 0.5) and the Bartlett test of sphericity is significant at the 99% confidence level. This means that results of the factor analysis provide an adequate basis for empirical examination (Hair, Black, Babin, Anderson, & Tatham, 1998). The results show that one factor, *ProtRights*, defines the content of the law, while *Enforc* represents the quality of enforcement. All of the variables have a positive loading on each factor.

In addition, to test the role of independent directors in each institutional environment, we interact the Blau index for independent variables with the two components. These interacted variables are labelled *Indep * ProtRights* and *Indep * Enforc*. As with the *Indep* variable, a time lag is applied to the variable to avoid problems of endogeneity, giving *Indep_{t-1}*.

3.2.4. Control variables

Previous studies analysing the role of board independence in business efficiency and performance have shown the influence of a set of factors that are here adopted as control variables, thus avoiding biased results. These factors included in our models are as follows. Firstly, we consider the size of the company (*Size*), calculated as the logarithm of total assets; larger firms in general may face higher agency costs (Rose, 2007). The level of leverage (*Leverage*), calculated as the ratio between debt and equity, is another mechanism of corporate governance that can affect the results of boards of directors. We also consider board size, measured by the number of directors (*Bosize*), as large boards of directors generally have more serious agency problems (García-Sánchez et al., 2015). Next, we take into account board activity (*Boactivity*), calculated as the number of annual meetings; although the results are inconclusive, some studies have shown that a greater number of meetings—dynamism of boards—yields more effective results, while other studies have shown that too many meetings reflects inoperative and wasted time (García-Sánchez et al., 2015). Finally, gender diversity (*Women*), calculated according to the previously detailed Blau index, is used to determine whether women's presence leads to heterogeneity on the board, leading to less efficiency in deliberating and making decisions (Walt & Ingley, 2003); alternatively, there are numerous financial reasons why diversity might improve business performance (Campbell & Mínguez-Vera, 2008; Erhardt, Werbel, & Shrader, 2003; Farrell & Hersch, 2005; Krishnan & Park, 2005; Mahadeo, Soobaroyen, & Hanuman, 2012; Post & Byron, 2015).

Finally, we also control for industry, year and country using dummy variables: for *Industry_j*, j represents the different sectors of activity in

which the companies in the sample operate; for *Country*_k, *k* represents the different countries in the sample; for *Year*_n, *n* represents the years of the sample; *Crisis* represents the period of financial crisis (2007–2009).

3.3. Models and technique of analysis

This research aims to examine the impact of board independence on firm performance and the moderating effect of the institutional context on this relationship. To test our research hypotheses, considering the interaction between independent directors and institutional factors, the following three models of analysis are proposed. In each model, the technical efficiency indicator is regressed on board independence (one period ahead [*t* – 1] to avoid the endogeneity problem), the two indicators associated with the institutional context and control variables. In Model 1, we include as an explanatory factor the interaction between board independence and the content of law. In Model 2, we include the interaction between board independence and the quality of law enforcement. Finally, in Model 3, we include the two previous interactions. Thus, the models estimated are as follows:

$$\begin{aligned}
 \text{Eff}_{it} = & \beta_0 + \beta_1 \text{Indep}_{it-1} + \beta_2 \text{ProtRights}_{it} + \beta_3 \text{Enforc}_{it} \\
 & + \beta_4 \text{Indep}_{it-1} \text{ProtRights}_{it} + \beta_5 \text{Size}_{it} + \beta_6 \text{Leverage}_{it} + \beta_7 \text{Bosize}_{it} \\
 & + \beta_8 \text{Boactivity}_{it} + \beta_9 \text{Women}_{it-1} + \sum_{j=10}^{31} \beta_j \text{Industry}_i \\
 & + \sum_{k=32}^{55} \beta_k \text{Country}_i + \sum_{n=56}^{65} \beta_n \text{Year}_i + \eta_i + \mu_{it}
 \end{aligned}$$

(Model 1)

$$\begin{aligned}
 \text{Eff}_{it} = & \beta_0 + \beta_1 \text{Indep}_{it-1} + \beta_2 \text{ProtRights}_{it} + \beta_3 \text{Enforc}_{it} \\
 & + \beta_4 \text{Indep}_{it-1} \text{Enforc}_{it} + \beta_5 \text{Size}_{it} + \beta_6 \text{Leverage}_{it} + \beta_7 \text{Bosize}_{it} \\
 & + \beta_8 \text{Boactivity}_{it} + \beta_9 \text{Women}_{it-1} + \sum_{j=10}^{31} \beta_j \text{Industry}_i \\
 & + \sum_{k=32}^{55} \beta_k \text{Country}_i + \sum_{n=56}^{65} \beta_n \text{Year}_i + \eta_i + \mu_{it}
 \end{aligned}$$

(Model 2)

$$\begin{aligned}
 \text{Eff}_{it} = & \beta_0 + \beta_1 \text{Indep}_{it-1} + \beta_2 \text{ProtRights}_{it} + \beta_3 \text{Enforc}_{it} \\
 & + \beta_4 \text{Indep}_{it-1} \text{Enforc}_{it} + \beta_5 \text{Indep}_{it-1} \text{Enforc}_{it} + \beta_6 \text{Size}_{it} \\
 & + \beta_7 \text{Leverage}_{it} + \beta_8 \text{Bosize}_{it} + \beta_9 \text{Boactivity}_{it} + \beta_{10} \text{Women}_{it-1} \\
 & + \sum_{j=11}^{32} \beta_j \text{Industry}_i + \sum_{k=33}^{56} \beta_k \text{Country}_i + \sum_{n=57}^{66} \beta_n \text{Year}_i + \eta_i + \mu_{it}
 \end{aligned}$$

(Model 3)

The econometric models used are based on dependence techniques for panel data. Use of a panel data set allows us to overcome the limitations of cross-sectional models, especially their low explanatory capacity, which is closely related to the period of analysis considered. Panel data models provide greater consistency and explanatory power by considering several time periods—that is, the possibility of studying the dynamics of cross-sectional populations. In addition, this technique allows us to control for unobservable heterogeneity, which refers to the particular characteristics of the firms included in the sample; these differ among firms but are invariant over time. These characteristics are difficult to measure because they are unobservable to researchers, but failing to take them into account could bias the results. Unobservable heterogeneity is controlled by modelling it as an individual effect, η_i . Thus, the error term in Models 1, 2 and 3, named ε_{it} , is broken down into two elements: η_i refers to the unobservable heterogeneity and μ_{it} refers to the classical disturbance term. Even more, over a time series analysis, panel data eliminate the bias of aggregation that arises when time series models are applied to characterize the behaviour of companies.

Regarding our technique of analysis, we take as our reference the work of Simar and Wilson (2007). They argue that given the distribution of the DEA estimator, it is necessary to estimate the three dependency models through a truncated regression for panel data, providing a better statistical inference (García-Sánchez, 2010). Truncated regression is used to model dependent variables for which some of the observations are not included in the analysis because of the value of the dependent variable. Some methods listed are quite reasonable for estimating models where the dependent variable is truncated, while others have either fallen out of favour or have limitations. For instance, one method is OLS regression, but it will not adjust the estimates of the coefficients to take into account the effect of truncating the sample, and the coefficients may be severely biased. This can be conceptualized as a model specification error (Heckman, 1979). For this, truncated regression addresses the bias introduced when using OLS regression with truncated data. Note that the variance of the outcome variable is reduced with truncated regression compared to the distribution that is not truncated. Also, if the lower part of the distribution is truncated, then the mean of the truncated variable will be greater than the mean from the untruncated variable; if the truncation is from above, the mean of the truncated variable will be less than the untruncated variable. Finally, censored regression is the other alternative. Sometimes the concepts of truncation and censoring are confused. With censored data we have all of the observations, but we don't know the true values of some of them; with truncation, some of the observations are not included in the analysis because of the value of the outcome variable. It would be inappropriate to analyse the data in our example using a censored regression model.

Concretely, by using this technique of analysis—truncated regressions for panel data—we use algorithm 1 proposed by Simar and Wilson (2007), which consists of the following steps:

1. Using the original data, compute $\hat{\delta}_i = \hat{\delta}(x_i, y_i | \hat{\psi}) \forall i = 1, \dots, n$ using $\hat{\delta}_0 = \max \{ \theta > 0 | \theta y_0 \leq Y_q, x_0 \geq X_q, i'q = 1, q \in \mathbb{R}^n \}$.
2. Using the maximum likelihood method, obtain an estimate $\hat{\beta}$ of β and of $\hat{\sigma}_\varepsilon$ of σ_ε , in the truncated regression of $\hat{\delta}_i$ on z_i in $\hat{\delta}_i = z_i \beta + \xi_i \geq 1$ using observations $m < n$ where $\hat{\delta}_i > 1$.
3. Repeat the following steps *L* times to obtain a set of bootstrap estimates $\mathcal{A} = \{ (\hat{\beta}^*, \hat{\sigma}_\varepsilon^*)_b \}_{b=1}^L$:
 - 3.1. For each $i = 1, \dots, m$, ε_i is determined from the truncated distribution $N(0, \hat{\sigma}_\varepsilon^2)$ to the left at $(1 - z_i \hat{\beta})$.
 - 3.2. For each $i = 1, \dots, m$, compute $\delta_i^* = z_i \hat{\beta} + \varepsilon_i$.
 - 3.3. Using the maximum likelihood method, estimate the truncated regression of δ_i^* in z_i , resulting in estimations $(\hat{\beta}^*, \hat{\sigma}_\varepsilon^*)$.
4. Using the bootstrap values in \mathcal{A} and the original estimations $\hat{\beta}^*$, $\hat{\sigma}_\varepsilon^*$, construe confidence intervals for each element of β and for σ_ε .

4. Results

4.1. Descriptive results

Table 3 displays the descriptive statistics and the correlations between variables used in this study. The efficiency score has a mean (standard deviation) of 0.782 (± 0.010). The measure of independent directors using Blau's (1977) index indicates that 30.8% of the board members are external. In respect of the control variables, on average, the boards sampled comprise 11 directors, around 30% of whom are women, and have eight meetings per year. Firm size has a mean value of around 5.2 (expressed in millions of euros), while 57% of companies are leveraged.

Table 3 presents the correlations among the selected variables, the *p*-values reported in parentheses. The dependent variable used to represent efficiency is shown to be positively correlated with independent directors. The correlation matrix shows low or moderate correlation among variables; in no case are high values obtained for the coefficients between the dependent and independent variables or between the independent variables. Thus, multicollinearity among these variables is not a severe problem.

Table 3
Descriptive statistics and bivariate correlation.

Panel A. Descriptive statistics		Mean	Std.dv.
Efficiency		0.782	0.010
Indep		0.308	0.155
Size		5.277	1.649
Leverage		0.569	0.201
Bosize		10.711	3.246
Boactivity		8.200	4.660
Wom		0.205	0.149

Panel B. Bivariate correlation matrix		1	2	3	4	5	6	7	8
1	Efficiency								
2	Indep	0.001 (0.125)							
3	ProtRights	-0.034 (0.021)	-0.017 (0.485)						
4	Enforc	0.009 (0.723)	0.301 (0.000)	0.002 (0.746)					
5	Size	-0.007 (0.735)	-0.095 (0.009)	-0.108 (0.009)	-0.097 (0.009)				
6	Leverage	-0.005 (0.739)	-0.056 (0.019)	-0.018 (0.485)	-0.102 (0.009)	0.136 (0.009)			
7	Bosize	0.042 (0.021)	-0.089** (0.009)	-0.089 (0.009)	-0.105 (0.009)	0.376 (0.000)	0.198 (0.009)		
8	Boactivity	-0.017 (0.485)	0.251 (0.000)	0.085 (0.009)	0.428 (0.000)	-0.093 (0.009)	-0.135 (0.000)	-0.230 (0.000)	
9	Women	0.044 (0.021)	0.033 (0.021)	0.169 (0.009)	-0.041 (0.021)	0.051 (0.019)	0.131 (0.009)	0.130 (0.009)	-0.039 (0.021)

N = 10,279 firm-year observations.
p-Values (in parentheses) are reported.

4.2. Multivariate results: the moderating effect of institutional context on the relationship between board independence and technical efficiency

Table 4 summarizes the results obtained from the three analytic models proposed: Model 1 includes the indicator variables of board independence, the content of law and the mechanism of enforcement, as well as the interaction between independence and the content of law. In Model 2, the interaction included is between independent directors and enforcement. Finally, in Model 3, both interactions are included in the same model.²

In Model 1, the results show that board independence is positively and significantly related to technical efficiency at the 99% confidence

² The fit information for the estimated models is determined by the log likelihood function, which controls the representativeness of each equation. Specifically, to establish the likelihood, a χ^2 test is conducted, determining the significance of the difference between the value of the log likelihood function of the model and only the constant and that of the full model. The null hypothesis is that the coefficients of all the variables included in the final model except the constant are equal to 0; the alternative hypothesis is that the coefficients are significantly different from 0. If the χ^2 probability associated with the test value is < 0.05, the null hypothesis should be rejected, accepting that the final ordinal model is significant from the econometric point of view (Hair et al., 1998). The level of representativeness is determined using the Wald test, which, according to the levels of significance obtained, leads to acceptance or rejection of the model in question. The p-values for all the models are statistically significant for a confidence level of 99%, which means that the equations adequately explain the firm efficiency examined.

For each explanatory variable, we report the estimated coefficient, standard error, Z-score and p-value associated with each coefficient. In addition, for each regression model, we include an additional parameter labelled *sigma*, which is equivalent to the standard error of estimate in OLS regression. Regarding the effect of the explanatory variables, the Z-score determines whether the coefficient of each of the independent and control variables considered independently has a value that is significantly different from 0—i.e. whether it has a real effect on the introduction and level of application of the codes of ethics. Here, the probability of occurrence should be < 0.05, the p-value.

level (coef. = 0.002, p-value < 0.01), supporting the assumption that independent directors increase corporate performance and so our hypothesis 1a: they maximize firm performance. Although neither of the variable indicators *ProtRights* or *Enforc* shows a significant impact on efficiency, the interaction effect between board independence and the legal protection of minority shareholders against expropriation by insiders is relevant; the indicator shows a positive and significant effect on efficiency at the 99% confidence level (coef. = 0.003; p-value < 0.01). Operating with coefficients, these results show that the independent directors of companies located in countries with a high content of law have a stronger significant and positive effect on efficiency (coef. = 0.002 + 0.003 = 0.005) than those in companies located in weaker legal environments (coef. = 0.002). This supports the assumption in our hypothesis 2a.

In Model 2, we again explore the effect of independent directors on efficiency: the positive and significant effect of this indicator on performance remains (coef. = 0.002, p-value < 0.01), in accordance with our hypothesis 1a. In this model, we also explore the moderating effect of the mechanism of law enforcement on this relationship. The indicator *Indep * Enforc* shows a positive and significant effect on efficiency at the 99% confidence level (coef. = 0.002; p-value < 0.01). Again, operating with coefficients, these results show that the independent directors of companies located in countries with a stronger judicial system have a stronger significant and positive effect on improving efficiency (coef. = 0.002 + 0.002 = 0.004) than those in companies located in weaker judicial environments (coef. = 0.002); again, this clearly supports our hypothesis 2a.

In Model 3, the results are similar. Firstly, and again according to our hypothesis 1a, board independence exerts a positive and significant influence on performance measured by efficiency (coef. = 0.020, p-value < 0.01), while the interactions between *Indep * ProtRights* and

Table 4
Efficiency, independency and institutional environments.

	Model 1		Model 2		Model 3	
	Coef.	z	Coef.	z	Coef.	z
	(std.err)	(p-Value)	(std.err)	(p-Value)	(std.err)	(p-Value)
Indep	0.002 (0.001)	2.620 (0.009)	0.002 (0.001)	2.650 (0.008)	0.020 (0.006)	3.310 (0.001)
ProtRights	−0.006 (0.004)	−1.600 (0.110)	−0.003 (0.002)	−1.270 (0.203)	0.002 (0.005)	0.470 (0.639)
Enforc	0.002 (0.002)	1.090 (0.275)	−0.007 (0.006)	−1.090 (0.274)	−0.002 (0.006)	−0.400 (0.691)
Indep * ProtRights	0.003 (0.001)	4.190 (0.000)			0.003 (0.001)	3.850 (0.000)
Indep * Enforc			0.002 (0.001)	2.650 (0.008)	0.002 (0.001)	2.590 (0.010)
Size	0.000 (0.000)	−2.220 (0.027)	0.000 (0.000)	−2.300 (0.022)	0.000 (0.000)	−2.310 (0.021)
Leverage	−0.020 (0.009)	−2.380 (0.017)	−0.019 (0.009)	−2.270 (0.023)	−0.018 (0.009)	−2.120 (0.034)
Bosize	0.010 (0.009)	1.130 (0.257)	0.003 (0.001)	4.170 (0.000)	−0.015 (0.012)	−1.210 (0.225)
Boactivity	−0.004 (0.005)	−0.770 (0.441)	−0.004 (0.005)	−0.780 (0.434)	−0.005 (0.005)	−1.040 (0.298)
Women	−0.058 (0.019)	−3.060 (0.002)	−0.058 (0.019)	−3.080 (0.002)	−0.050 (0.019)	−2.660 (0.008)
_cons	−0.570 (1.983)	−0.290 (0.774)	−0.674 (1.983)	−0.340 (0.734)	−0.615 (1.982)	−0.310 (0.756)
Industry	Controlled		Controlled		Controlled	
Country	Controlled		Controlled		Controlled	
Year	Controlled		Controlled		Controlled	
Crisis	Controlled		Controlled		Controlled	
Sigma	0.172 (0.001)	133.410 (0.000)	0.172 (0.001)	133.410 (0.000)	0.172 (0.001)	133.410 (0.000)

N = 10,279 firm-year observations.

Estimated coefficients and associated standard errors (in parentheses) are reported.

*Indep * Enforc* also exert a positive and significant impact on efficiency (coef. = 0.003, p -value < 0.01; coef. = 0.002, p -value < 0.01, respectively). Again, operating with coefficients for Model 3, in which we included the two interactions, the results support the following: (i) the independent directors of companies located in countries with a high content of law have a stronger significant and positive effect on improving efficiency (coef. = 0.020 + 0.003 = 0.023) than those in companies located in weaker legal environments (coef. = 0.020); (ii) the independent directors of companies located in countries with a stronger judicial system have a stronger significant and positive effect on improving efficiency (coef. = 0.020 + 0.002 = 0.022) than those in companies located in weaker judicial environments (coef. = 0.020). From the above, we support the complementary effect between board independence and the legal system on efficiency, both for the content of law and for law enforcement. This supports our [hypothesis 2a](#) about the reinforcing effect of institutional context on the positive impact of board independence on firm performance.

In respect of the control variables, the three models in general offer evidence of the positive influence of firm size on efficiency. However, firm leverage decreases efficiency. Nonetheless, the main finding is the negative impact of female directors on performance measured by efficiency. Similar to [Walt and Ingley \(2003\)](#), the presence of women on boards leads to greater heterogeneity on the board, leading to less efficiency in deliberating and making decisions and thus decreasing performance.

4.3. Sensitive analyses

Several sensitivity analyses are carried out to ensure the robustness of the findings. Firstly, this study follows the same procedure as that developed by [Liu et al. \(2015\)](#) by considering the possibility that the board independence variable is endogenous, for which regressions with

instrumental variables (2SLS) are used. It is necessary to select instruments that are related to board independence. A good instrument must meet two requirements: firstly, not being a weak predictor of the possible independent variable (in this case, board independence), and secondly—which is exogenous—not being correlated with the error term of the second equation. Based on prior literature, the instruments selected related to board independence are growth opportunities ([Booth & Deli, 1996](#)), information disclosure measured ([Chahine & Filatotchev, 2008](#)), ownership concentration ([Lefort & Urzúa, 2008](#)) and enterprise risk management ([Beasley, Clune, & Hermanson, 2005](#)). This study's instruments meet these requirements. Regarding the instruments' relevance, the F-statistic is equal to 4.14 (Prob > F = 0.004), while the Sargan and Basman tests (to test the instruments' exogeneity) do not allow rejection of the null hypothesis of exogeneity. Once these instruments have been tested as relevant and exogenous, the authors examine whether the board independence indicator is endogenous. Accordingly, the values of the Durbin chi-squared and the Wu–Hausman test are examined. Neither allows rejection of the null hypothesis of endogeneity; that is, the board independence indicator is not endogenous.

[Table 5](#) summarizes the results obtained from the three analytic models proposed, including endogeneity checks using instrumental variables. By checking endogeneity, our results are robust, supporting the assertion that board independence increases the firm's technical efficiency at the 99% confidence level in Models 1, 2 and 3 (coef. = 0.003, p -value < 0.01). With regard to the moderating effect of institutional factors, our results provide robust evidence as follows. In Model 1, 2SLS results show that the independent directors of companies located in countries with a high content of law have a stronger significant and positive effect on efficiency (coef. = 0.003 + 0.030 = 0.033) than those in companies located in weaker legal environments (coef. = 0.003). In Model 2, the independent directors of companies located in countries with a

Table 5
Sensitive analysis I. 2SLS results for efficiency, independency and institutional environments.

	Model 1		Model 2		Model 3	
	Coef.	z	Coef.	z	Coef.	z
	(std.err)	(p-Value)	(std.err)	(p-Value)	(std.err)	(p-Value)
Indep	0,003 (0,001)	4500 (0,000)	0,003 (0,001)	4560 (0,000)	0,003 (0,001)	4570 (0,000)
ProtRights	-0.005 (0,004)	-1260 (0,206)	-0.005 (0,002)	-2470 (0,013)	-0.006 (0,004)	-1410 (0,159)
Enforc	0,006 (0,003)	1820 (0,068)	0,006 (0,015)	0,380 (0,704)	0,005 (0,021)	0,260 (0,794)
Indep * ProtRights	0,030 (0,009)	3510 (0,000)			0,029 (0,010)	3030 (0,002)
Indep * Enforc			0,002 (0,001)	2740 (0,006)	0,002 (0,001)	2670 (0,008)
Size	0,000 (0,000)	-2370 (0,018)	0,000 (0,000)	-2260 (0,024)	0,000 (0,000)	-2190 (0,028)
Leverage	-0.805 (0,029)	-27,940 (0,000)	-0.790 (0,029)	-27,130 (0,000)	-0.790 (0,041)	-19,180 (0,000)
Bosize	-0.123 (0,085)	-1440 (0,150)	-0.075 (0,084)	-0.890 (0,373)	-0.073 (0,122)	-0.600 (0,552)
Boactivity	0,003 (0,006)	0,510 (0,612)	0,001 (0,006)	0,120 (0,905)	0,001 (0,007)	0,090 (0,932)
Women	-0.057 (0,013)	-4430 (0,000)	-0.057 (0,013)	-4350 (0,000)	-0.056 (0,013)	-4250 (0,000)
_cons	-0.001 (0,010)	-0.080 (0,938)	-0.001 (0,010)	-0.090 (0,932)	-0.001 (0,010)	-0.060 (0,954)
Industry	Controlled		Controlled		Controlled	
Country	Controlled		Controlled		Controlled	
Year	Controlled		Controlled		Controlled	
Crisis	Controlled		Controlled		Controlled	
R ²		17,258		17,205		17,204
Wald chi-square		75.36		76.05		76.81
p-Value		(0.000)		(0.000)		(0.000)

N = 10,279 firm-year observations.

Estimated coefficients and associated standard errors (in parentheses) are reported.

stronger judicial system have a stronger significant and positive effect on improving efficiency (coef. = 0.003 + 0.002 = 0.005) than those in companies located in weaker judicial environments (coef. = 0.003). Results are similar in Model 3 where we include both interactions.

Therefore, by checking the endogeneity problem using instrumental variables, we obtain robust results about the positive impact of board independence on firm performance and how greater legal and judicial protection, as an institutional factor, exerts a positive moderating effect on the previous relationship by protecting private benefits for insiders, among other aspects. Thus, the positive impact of independent directors on efficiency is greater when firms operate in countries with a greater degree of law and enforcement.

Secondly, to reinforce our evidence, we have considered that economic status might be important in explaining business efficiency. Campello, Graham, and Harvey (2010) argue that the global financial crisis had severe consequences for business. The extreme market conditions, characterized by liquidity shortfalls (Ivashina & Scharfstein, 2010), together with the uncertain nature and the conservative approach of financial institutions, arguing for more internal control, made it difficult to obtain lines of credit and access external capital.

The crisis was an exogenous event; therefore—focusing on the relationship between board independence and efficiency, as well as the moderating effect of the institutional context, prior to, during and after the crisis—it largely alleviates the endogeneity concerns that can arise in a panel data setting. We hypothesize that during the financial crisis, the greater the board independence, the higher firms' efficiency. Moreover, this relationship is higher in institutional settings with the strongest legal systems.

With the aim of examining our evidence for the crisis (2007–2009) and non-crisis periods, we split the sample into two groups to analyse the moderating effect of the legal system on the relationship between

board independence and performance during the crisis period; here, we only provide evidence for Model 3, which contains the two interactions with respect to legal factors.

From the crisis period subsamples in Table 6, it can be observed that the effect of independent directors remains positive and significant in both scenarios (coef. = 0.013, p-value < 0.01 for the non-crisis period; coef. = 0.031, p-value < 0.01 for the crisis period). That is, there is a superior effect during the crisis period, indicating a more conservative approach, avoiding any overinvestment strategy and improving efficiency. Moreover, the interactions with the two legal parameters are higher in the crisis period.

In this respect, and similar to the results in Table 4, employing coefficients during the crisis period: (i) the independent directors of companies located in countries with a high content of law have a stronger significant and positive effect on improving efficiency (coef. = 0.031 + 0.069 = 0.100) than those in companies located in weaker legal environments (coef. = 0.031); (ii) the independent directors of companies located in countries with stronger judicial systems have a stronger significant and positive effect on improving efficiency (coef. = 0.031 + 0.061 = 0.092) than those in companies located in weaker judicial environments (coef. = 0.031). However, during the non-crisis period: (i) the independent directors of companies located in countries with a high content of law have a stronger significant and positive effect on improving efficiency (coef. = 0.013 + 0.039 = 0.052) than those in companies located in weaker legal environments (coef. = 0.013); (ii) the independent directors of companies located in countries with stronger judicial systems have a stronger significant and positive effect on improving efficiency (coef. = 0.013 + 0.002 = 0.015) than those in companies located in weaker judicial environments (coef. = 0.013). From the above, it can be observed that there is a greater moderating effect of the legal system in the crisis period. The effect of board independence on performance is superior

Table 6
Sensitive analysis II. Efficiency, independency and institutional environments in crisis period.

	Normal period		Crisis period	
	Model 3	Model 3	Model 3	Model 3
	Coef.	z	Coef.	z
	(std.err)	(p-Value)	(std.err)	(p-Value)
Indep	0.013 (0.008)	1.770 (0.077)	0.031 (0.011)	2.730 (0.006)
ProtRights	0.000 (0.005)	0.030 (0.977)	0.005 (0.010)	0.550 (0.583)
Enforc	0.008 (0.008)	0.970 (0.331)	-0.023 (0.013)	-1.680 (0.092)
Indep * ProtRights	0.039 (0.018)	2.110 (0.035)	0.069 (0.029)	2.380 (0.018)
Indep * Enforc	0.002 (0.001)	2.330 (0.020)	0.061 (0.029)	2.070 (0.038)
Size	0.000 (0.000)	-3.320 (0.001)	0.000 (0.000)	1.650 (0.099)
Leverage	0.005 (0.011)	0.450 (0.656)	-0.027 (0.019)	-1.440 (0.150)
Bosize	0.003 (0.001)	3.340 (0.001)	0.002 (0.001)	1.570 (0.117)
Boactivity	-0.005 (0.006)	-0.780 (0.433)	-0.008 (0.010)	-0.770 (0.444)
Wom	-0.052 (0.017)	-3.120 (0.002)	-0.028 (0.028)	-1.000 (0.319)
_cons	-1.117 (2.100)	-0.530 (0.595)	-1.756 (9.414)	-0.190 (0.852)
Industry	Controlled		Controlled	
Country	Controlled		Controlled	
Year	Controlled		Controlled	
Sigma	0.170 (0.002)	112.840 (0.000)	0.175 (0.002)	71.180 (0.000)

N = 10,279 firm-year observations.

Estimated coefficients and associated standard errors (in parentheses) are reported.

under a stronger legal system and during the crisis period. We thus support the influence of the economic situation in explaining firm efficiency.

4.4. Discussion of results

From the above, our main results confirm the positive impact of independent directors on technical efficiency as a measure of corporate performance and the moderating effect of the institutional factor in this relationship: that is, there is a greater impact of board independence on efficiency under a greater content of law and stronger mechanism of enforcement. Our corroboration of *hypotheses 1a and 2a* shows that if these directors perform their duties in companies located in countries with greater legal and judicial protection, they may have greater incentives to monitor the managers, improving decision-making results. In addition, in institutional environments with weaker laws and justice, private benefits for insiders are higher and these persons may present greater opposition to the incorporation of corporate governance mechanisms aimed at limiting their discretionary powers.

In this respect, firstly, we support previous studies that defend the notion that corporate governance limits agency problems and maximizes corporate performance, supporting the positive link between the strength of the board and performance (Bozec & Dia, 2007; Klapper & Love, 2004; Liu et al., 2015; Sheu & Yang, 2005, among others). Moreover, despite the findings of some studies (Bhagat & Black, 2002; Cho & Kim, 2007; De Andres et al., 2005; Haniffa & Hudaib, 2006; Leung et al., 2014; Terjesen et al., 2016), our results confirm that independent directors display greater objectivity and independence in their analysis—similar to prior evidence from García-Sánchez and Martínez-Ferrero (2017)—increasing firm performance by providing superior monitoring, supervision and evaluation of the management

(Baysinger & Butler, 1985). Thus, we provide support for the previous literature that shows a positive association between independent directors as a board mechanism and performance (Dahya et al., 2008; Luan & Tang, 2007).

With respect to previous studies that examine the positive impact of board independence on firm performance, we reinforce their evidence in the following. Firstly, as was noted, we use alternative performance measures not based on accounting or market ratios—as Klapper and Love (2004), Liu et al. (2015), Luan and Tang (2007), Terjesen et al. (2016), among others; secondly, we expand our sample of analysis to international firms in contrast to previous studies focused on country or region analysis—i.e. Bozec and Dia (2007) for Canadian firms; Leung et al. (2014) for Hong-Kong firms; Liu et al. (2015) for Chinese's firms; and Luan and Tang (2007) and Sheu and Yang (2005) for Taiwanese firms. Overall, it is a research gap in international studies that this paper solves: we provide evidence for the inconclusive link between board independence and firm performance, even with additional measures of it. As Bozec and Dia (2007) pointed out, we contribute to the operational research literature while applying the DEA method to untraditional fields of research.

Nonetheless, the main difference and contribution with respect to prior literature is the examination of the institutional context as a moderating factor. Regarding the impact of the content of law and the mechanism of enforcement on performance, our findings support the following. On the one hand, similar to Defond and Hung (2004), Kim et al. (2007), La Porta et al. (2002) and Villarón-Peramato et al. (2018), among others, a greater degree of shareholder protection leads to greater effectiveness of the board and thus to superior financial performance. On the other hand, greater compliance with law positively influences firms' achievement of efficiency. We therefore add evidence to institutional theory and the notion of isomorphism developed by DiMaggio and Powell (1983) and expanded to management literature by Frías-Aceituno et al. (2013), García-Sánchez et al. (2015) and Martínez-Ferrero and García-Sánchez (2017), among others: we show that firms operating in similar contexts—in our case, under a strong legal system—adopt similar patterns of behaviour. With respect to these three studies that analyse the role of institutional context in sustainability strategic decisions, we expand them by examining firm performance measured by technical efficiency and by increasing the sample and period of analysis. Overall, differences in legal aspects modify the impact of board independence on performance.

Regarding the moderating effect of the legal system on the relationship between board independence and efficiency, our evidence adds support for the complementary effect. Despite the substitutive effect proposed by Doidge et al. (2001), our evidence shows that the impact of independence on efficiency is greater under a strong legal system; among other factors, in countries with higher shareholder protection, the presence of independence directors is greater (Kim et al., 2007). Based on this result, our study adds support to the findings obtained in previous studies, such as Beck et al. (2003), Berkowitz et al. (2003), Claessens et al. (2000), Frías-Aceituno et al. (2013), García-Sánchez et al. (2015), Gompers, Ishii, and Metrick (2001) and Gul et al. (2002), among others, which defend the complementary effect between corporate governance mechanisms and the institutional context.

With respect to these previous studies, we reinforce them by examining institutional context as a moderating factor in the relationship between board independence and firm performance. Concretely, we evidence that there is a complementary relationship between board independence as a corporate governance mechanism and the institutional protection of the country of origin. Previous studies examine this issue in relation to CEO turnover (Defond & Hung, 2004), integrated reporting (Frías-Aceituno et al., 2013), ethical codes (García-Sánchez et al., 2015), equity prices (Gompers et al., 2001) or audit quality (Gul et al., 2002). We support the complementary effect by expanding previous studies of firm performance, increasing the sample of analysis and examining a more recent period of analysis.

What is more, our study offers additional evidence concerning the relationships examined here, checking the endogeneity problem using instrumental variables and taking the economic situation as an important factor in explaining business efficiency. On the one hand, similar to Liu et al. (2015) for a sample of Chinese firms from 1999 to 2012, we corroborate that there is not an endogeneity problem between independent directors and firm performance and how they positively influence firm efficiency. In respect of the previous authors, we expand their evidence to an international sample of analysis from 2006 to 2015.

On the other hand, our results provide support for there being relevant differences according to the crisis or non-crisis period. Unlike Campello et al. (2010) and Ivashina and Scharfstein (2010), who argue that the global financial crisis had severe consequences for business, we provide evidence of the difference in crisis/non-crisis periods in terms of the moderating effect of the legal system on the relationship between board independence and efficiency. This moderating effect is superior during the crisis period. As Ivashina and Scharfstein (2010) argue, we show that the uncertain nature and the conservative approach of financial institutions, arguing for more internal control, led to a greater presence of independent directors and thus superior performance.

Finally, our findings are based on technical efficiency as a measure of corporate performance (Bozec & Dia, 2007; García-Sánchez, 2010; Hill & Snell, 1989) that explains differences in the performance of firms (Lehmann et al., 2004). As these authors suggest, technical efficiency—measured using DEA, resampling procedures and bootstrapping techniques—can solve some of the limitations of single input methods in evaluating output generation (for instance, financial ratios are adequate in cases where there is only one input and one output).

5. Concluding remarks

This study aimed to examine the impact of independent directors on firm performance and the moderating effect of the institutional context based on the legal system of the country of origin. Employing an international sample for the period 2006–2015, this paper provides evidence of the positive effect of board independence on efficiency as a measure of corporate performance. Moreover, greater legal and judicial protection as an institutional factor exerts a positive moderating effect on the previous relationship by protecting private benefits to insiders, among other aspects.

This paper contributes to the previous literature in several ways. The results of previous research on the relationship between board composition in terms of independence and business performance have been mixed: some report a positive relationship, others a negative or even non-existent association. These investigations have usually been carried out in specific contexts, with particular legal and cultural characteristics, which are not necessarily generalizable to all countries. Thus, research that transcends such contexts and explores new contexts is justified, as it can reveal why there are contradictory results. This paper constitutes a novel proposal in that it not only contemplates the context in which the aforementioned relationship is developed, but also assumes it as a moderating variable of the relationship. Methodologically, in contrast to previous studies that represent board independence through the percentage of independent directors over the total number of directors (i.e. Cuadrado-Ballesteros et al., 2015; García-Sánchez et al., 2015; Terjesen et al., 2016), this paper adopts the Blau index (1977) as a means of representation. Moreover, to obtain the measure of efficiency as a means of assessing corporate performance, the DEA method is proposed, applying resampling and bootstrapping techniques as in Simar and Wilson (1998).

Finally, this study adds exploratory evidence by using a panel data set (24 countries from 2006 to 2015), in contrast to previous studies that adopted a cross-sectional analysis (e.g. Bozec & Dia, 2007; Leung et al., 2014; Liu et al., 2015). Our approach allows comparison between countries and years. Thus, we contribute to the literature by adopting

an international approach encompassing 24 countries rather than a single-country or a two-region approach. Also, examining the period 2006–2015 rather than a single year has allowed us to update the time period hitherto analysed. What is more, our empirical evidence draws on a sample of 22 activity sectors. Methodologically, we employ econometric models based on dependency techniques for the panel data. We specifically use truncated regressions for the panel data, unlike previous studies that adopted configurational models or descriptive analysis (for example, survey instruments). The use of algorithm 1, proposed by Simar and Wilson (2007), is suggested for truncated regressions with a view to determining the relationship between board characteristics and efficiency. Even more, one of the main contributions of this paper is the checking of the endogeneity problem by using 2SLS instrumental variables, similar to Liu et al. (2015) for their study of Chinese firms.

This study presents a more precise process for gaining an understanding of the relationship between board independence, firm performance and the institutional context than that afforded by other methods. Understanding how board independence affects technical efficiency in contexts with stronger legal and judicial protection has certain implications for companies, managers, shareholders and stakeholders, as well as for policymakers and regulatory bodies, among others. In this regard, and as a practical implication, it must be highlighted that boards balance the number of external and internal directors with the aim of increasing their technical efficiency and thus enhancing their performance. The existence of outsiders introduces objectivity, ensuring interests beyond those of shareholders. There are implications for board directors in general and for independent directors in particular, who must be more concerned about the importance of the control and monitoring function of the board in reducing agency costs, beyond creating stakeholder value and increasing firm performance. Our evidence argues that there should be greater awareness of boards' independence in relation to increasing shareholders' wealth. For investors, our evidence can provide a tool for assessing the behaviour of their representatives on the board in terms of responsibility, as well as that of other outside members. Our results can further help managers to understand how the institutional context in which a firm operates influences performance. Moreover, for companies, it is fundamental to know how the different board compositions by which they are influenced limit (or not) managerial discretion and thus increase firm performance. Finally, our findings will be of interest to investors and public authorities seeking to assess the positive effects of board independence on performance, as well as to policymakers and regulators, who could make use of them to improve market transparency by introducing new requirements to increase the presence of independent directors on boards, especially in contexts with stronger legal and judicial systems.

Overall, this type of study is justified by the contributions it makes to different areas, namely: (i) business, as the results obtained here can serve as a basis for rationalizing the composition of boards of directors that the companies determine, all supported by concrete data on the impact on organizational performance; (ii) the political and legal scenario, as it allows us to highlight whether the recommendations, policies or laws generated effectively fulfil their purpose and enhance business results; and (iii) social, as the board composition will favour the transparency of business on the one hand and the participation of social groups that can be considered minorities but which constitute a large proportion of the population on the other.

Finally, we present some limitations of this study that open up new areas for future research. The first limitation is that the empirical evidence is conditioned on the availability of information for a specific set of countries and years: our sample is restricted to 24 countries and the last year used for the analysis was 2015. This limitation needs to be addressed in future research, increasing the number of countries and considering later years as data become available. In addition, our research does not take into account other possible variables that may

affect the relationship between board independence and firm performance, such as the role of ownership concentration, the cultural values of a firm, industrial conditions and so on. These variables can act as a control mechanism in this relationship. It could be interesting to include some of these variables in the future as they may affect the relationship between board independence and technical efficiency. In addition, further studies are needed to determine the relationships analysed in this paper, controlling for different corporate governance systems, cultural systems and other institutional contexts.

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