Optimal board independence and non-strictly independent directors

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Abstract

We analyze whether firms fill the gap between their optimal board independence level and the recommended level of independence with non-strictly independent directors. We derive the consequences of such behavior in terms of the reaction of several board independence measures to optimal board independence determinants. We implement the analysis on a sample of Spanish listed firms from 2004 to 2012, where large controlling shareholders are predominant. Our results are not consistent with such behavior. Our results also suggest that ownership determinants of optimal board independence are the most relevant, and that formal independence requirements are of little value for firms.

Keywords: non-strict board independence, optimal board independence, formal independence requirements, corporate governance.

JEL classification: G30, G34, K22

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1. Introduction

From the regulatory point of view, board independence is recommendable to properly monitor managers and minimize the potential opportunism of management and controlling shareholders in a principal agent context. Codes and recommendations of corporate governance all around the globe promote board independence (Aguilera and Cuervo-Cazurra, 2009). Even mandatory rules such as the Sarbanes-Oxley act of 2002 in the US promote board independence forcing independence in the audit committee, and many code of best governance practices issuers, such as the New York Stock Exchange and Nasdaq, followed this tendency and even went further, requiring a majority of independents in the full board of directors. In the continental European concentrated ownership setting, board independence is also recommended as a device to prevent minority shareholders form rent expropriation activities by large controlling shareholders. See for example the 2005 Commission of the European Communities Recommendation of February 15, the French corporate governance code of listed corporations, the German corporate governance code, or the 2006 Spanish code of good governance (all codes amended in 2013).

However, recent theoretical advances address the endogenous nature of board composition, generating what can be told the optimal board independence theory (e.g. Hermalin and Weisbach, 1998, Raheja, 2005, Adams and Ferreira, 2007, Harris and Raviv, 2008, Kumar and Sivaramakrishnan, 2008). Although this is not a unified theory, these models suggest that friendly boards may also be optimal for shareholders value in some circumstances. For example, this value is maximized with less board independence when the cost of outsiders monitoring is high, such as in growth companies (e.g. Harris and Raviv, 2008), or when the CEO proved to be a rare commodity with special decision making abilities, whit good past firm performance (Hermalin and Weisbach, 1998). Other circumstances, such as the availability of relevant potential private benefits for managers are consistent with independent boards in order to optimize shareholders value (e.g. Raheja, 2005). It is relevant that these theoretical developments suggest the existence of a different optimal degree of board independence for each firm.

Indeed, advances in corporate governance focus the attention on the endogenous nature of corporate governance mechanisms (e.g., Coles et al., 2012, Wintoki et al., 2012). Firms select the optimal combination of corporate governance devices as to maximize shareholders value. One of these devises is board structure, board independence in particular. This endogenous nature is consistent with the contradictory empirical evidence found in previous literature regarding the effectiveness of board independence for value creation. Papers such as Byrd and Hickman (1992) or Cotter et al. (1997) found a positive effect on shareholders' interest. Other researchers found a negative relationship (Agrawal and Knoeber, 1996, Klein, 1998, Bhagat and Black, 2002), or no relation, such as Hermalin and Weisbach (1991), Mehran (1995) or Ferris and Yan (2007).

Taking into account the endogenous nature of board structure, Boone et al. (2007), Linck et al. (2008), Coles et al. (2008) and Lehn et al. (2009) study its determinants and found empirical evidence supporting the optimal board independence theory. Wintoki et al. (2012) sophisticate the econometric approach using dynamic panel data generalized method of moments estimators (GMM), finding that the endogeneity concern is especially relevant when firm's performance is the dependent variable, but not when board independence is the dependent. Exogenous shocks in board independence, such as changes in regulation (Duchin et al., 2010), or sudden deaths of independents (Nguyen and Nielsen, 2010), are used to identify its effect on shareholders' value, finding also consistent results with the optimal board independence theory.

Since corporate governance regulation and soft regulation (recommendations) generally use the one size fits all rule, the following question arises; are these recommendations really pushing firms toward the optimum level of board independence for shareholders interest?[1] Consistent with this regulation, firms indeed declare an increasing degree of board independence. For example, Gordon (2007) finds the average board independence increasing from approximately 20% to 75% from 1950 to 2005 in large US public companies. However, firms with an optimal board independence level lower than the recommended are exposed to the critique of regulators, shareholders advocates, and other agents if declare this lower level. As stated in Santella et al. (2006), rating agencies also account for the presence of a qualified number of independent directors as an element in agency rating outputs. Coles et al. (2008) documents that several of the largest pension funds in the world require a relevant role of independents to invest in a firm. To avoid this critique, and its consequences, these firms might appoint non-strictly independent directors to achieve the optimal level of real board independence at the same time that declare the recommended level. Wu (2004) documents that the public naming of companies having poor corporate governance by a large investment fund (The California Public Employees' Retirement System) cause these companies to change their corporate governance to meet the expected standards.

Several articles find non-strictly independent directors in the US, such as Hwang and Kim (2009), and Fracassi and Tate (2012) finding connections between the CEO and outside directors, or Cohen et al. (2012) identifying directors overly sympathetic to management. Consistent with the power of management to interfere on the appointment of directors (Romano, 2005), any director appointed after the CEO assumed office is

[1] There are exceptions such as the French code that recommends 50% of independents in widely held firms, and one third in firms with controlling shareholders. However, the proportion is high in all cases, one third is recommended in the Spanish code for all firms.

taken as non-strictly independent in Core et al. (1999) and in Coles et al. (2014). The focus of these papers is on the consequences of an uncontrolled agency problem, and find non-strictly independent directors related with bad practices of corporate governance. None analyze the role of the optimal board independence theory for non-strictly independent directors. However, other papers focus on formal requirements of independence to detect another kind of non-strictly independent directors. Santella et al., (2006, 2007) find that for a majority of independent directors there is not enough disclosure of information as to prove formal independence requirements in a sample of 40 Italian blue ships. Crespí-Cladera and Pascual-Fuster (2014) check a set of formal independence requirements in firms quoted in the Spanish Stock Exchange and also found a widespread presence on non-strictly independent directors. No empirical evidence of bad corporate governance practices is found related with these formally non-strictly independent directors. It is not tested in the Italian sample; it is tested with no significant results in the Spanish sample. Therefore, the optimal board independence theory jointly with a corporate governance regulation ignoring it might explain the existence of this last kind of non-strictly independent director.

The object of our research is to understand why firms have non-strictly independent directors in terms of formal independence requirements. We analyze Spain, where the managerial power origin is discarded given the empirical evidence in Crespí-Cladera and Pascual-Fuster (2014). Our paper provides empirical evidence to value whether the optimal board independence theory jointly with the one size fits all regulation in terms of board independence is a relevant reason to have such independents in the board of directors. If it is a relevant reason, current corporate governance recommendations and regulation on the level of board independence would not contribute to create firm value.

We analyze which are the consequences of the optimal board independence theory and regulation as the origin of non-strictly independents in terms of basic statistics and of the expected effect of the determinants of optimal board independence on the level of declared independent directors, strictly independent directors (on the basis of the formal independence criteria in Crespí-Cladera and Pascual-Fuster, 2014), and non-strictly independent directors. Then we test whether the data meets these predictions. We use the empirical model of Linck et al. (2008) to value the adjustment of our data to the optimal board independence theory determinants. We provide further empirical evidence on the optimality of the analyzed board structures studying its relation with firms' performance. Given the endogenous nature of board structure it should have no effect on performance once the optimum level is achieved (see also, Coles, et al., 2008, or Lehn et al., 2009). This endogeneity generates an econometric issue that is addressed with the GMM methodology introduced by Wintoki et al. (2012).

Our contribution to the literature is threefold; first we provide evidence against the optimal board independence theory jointly with regulation as the origin of non-strictly independent directors in terms of formal independence requirements. Second, we test the power of the optimal independence theory in a sample of firms with a natural low level of optimal board independence, that is, firms with high ownership concentration, typical in continental European countries, as opposed to the previous literature focused on the US market (Boone et al., 2007, Linck et al., 2008, Coles et al., (2008), Lehn et al. 2009, Wintoki et al, 2012). Indeed Kim et al. (2007) found a negative relation between board independence and ownership concentration for a sample of European countries. In our sample, ownership determinants of optimal board independence are the most relevant. Third, we provide empirical evidence supporting that firms analyze strictly and non-strictly independent directors according to the optimal board independence theory determinants. This suggests a low relevance of formal independence requirements since firms fix the proportion of non-strictly independents as if they provided real independence.

Next section presents the data and the methodology we use to provide empirical evidence of the optimal board independence theory jointly with corporate regulation as the origin of non-strictly independent directors. Section 3 presents the results, section 4 several robustness checks, section 5 discuss the results, and section 6 concludes.

2. Data and methodology

2.1. Institutional background

In Spain there are few mandatory rules on corporate governance, such that all firms must have an audit committee in their board of directors (by the Securities Market Act). Corporate governance is regulated with the “comply or explain” soft legislation of the Unified Code of Good Governance for listed companies. However, recommendations on corporate governance are relatively recent, the first code of corporate governance is from 1998 (Olivenza Code), six years after the Cadbury Report (December 1992). Since 2004 firms listed on the Spanish Stock Exchange have to publish a standardized Annual Report on Corporate Governance (ARCG), available on the web page of the *Comisión Nacional del Mercado de Valores* (CNMV) (the Spanish Securities and Exchange Commission), which allows the homogeneous comparison of corporate governance practices among firms.

As usual in corporate governance codes around the globe, board independence is promoted. The Spanish code recommends one third of independents on the board of directors, also that supervisory board committees should be chaired by an independent director, and that independents should represent the majority of the nomination committee. No matter the size of the firm, its ownership structure, or any other characteristic that could affect the optimal board independence. In comparison with US and UK firms, the average Spanish firm has powerful controlling shareholders. Consistently, regulators separate outside directors into proprietary directors, representing the interest of specific significant shareholders, and independent directors, representing minority shareholders. These two kinds of directors are perfectly identified in the ARCG, therefore, our measure of board independence is more precise than in other studies who measure it as the percentage of outsiders (e.g., Linck et al, 2008, Coles et al, 2008, Wintoki et al, 2012). Nguyen and Nielsen (2010) prove that independence is valuable, and that not all outside directors provide the same independence and therefore the same value to the firm.[2]

Finally, it is worth mentioning that since 2006 there is also a mandatory definition of an independent director, in force since 2007, with formal independence requirements, such as being appointed by the nomination committee of the board of directors. Firms may choose the level of board independence but directors declared as independents should meet this definition. These formal independence requirements try to discard as independents those outside directors with significant relations with the firm (others than the directorship), its managers, and its significant shareholders.

2.2 Data sources and sample selection

We obtain the data on corporate governance from the ARCG of each firm. Our sample is limited to firms traded into the main trading platform of the Spanish Stock Exchange, called SIBE, reporting the ARCGs with the same format. Our sample time period goes from 2004 to 2012. This generates a non-balanced panel data set with 1,107 observations, ranging from 116 in 2012 till 135 in 2007, representing 165 unique firms (see Table 1). In our analysis we need one year lagged stock return volatility and two year lagged accounting performance, therefore we delete 80 observations without this information. Missing lagged stock return observations are due to new listings into the Spanish Stock Exchange (41 observations), and to forced trading suspensions by the CNMV (8 observations, for example whenever a firm declares solvency problems). Missing lagged accounting performance observations are due to new created firms (26 observations), and to reporting of accounts modifications leaving periods shorter and longer than one year, generating non comparable accounting performance measures (3 observations). Whenever a firm changes its name we check its files in the CNMV (available in www.cnmv.es) and whenever it is due to mergers and acquisitions we analyze the resulting firm as a new firm.[3] We also drop 2 observations from a bank in crisis being managed by the Spanish regulator, generating a special corporate governance situation out of the focus of our research. Finally, 13 of the remaining firms have at least one year with a negative book value of shares. These are firms in crisis and we delete them since probably their corporate governance is not in equilibrium, and is determined by different fundamentals, other than the arguments of the main body of the optimal board independence theory. Almost 50% of these firms belong to the Real State industry, one of the most affected by the crisis in Spain. Our analysis of corporate board independence is based on 952 observations belonging to 140 different firms (Table 1 column 3).

[2] Boone et al. (2007) also analyze optimal board independence with a finer measure than the percentage of outsiders.

[3] This generates 20 of the 26 missing values due to new created firms. We repeated our analysis without this adjustment and results remain robust. Available on request.

Table 1 Firms' sample

This table shows the number of observations included in the analysis for each year analyzed. The first column show the number of firms listed in the main trading platform of the Spanish Stock Exchange called SIBE, which also release the Annual Report of Corporate Governance. Column 2 shows the number of firms once non usable observations are deleted. Non usable observations are those with no stock return data for the previous year and with no accounting performance for the previous two years. Finally in column 3 all observations of firms with a negative book value of shares in any year of the time sample are deleted. Our sample is a non-balanced panel data set and the last row shows the number of unique firms.

	(1)	(2)	(3)
Year	# Firms SIBE & ARCG	# Firms SIBE & ARCG & one year lagged stock returns & two year lagged accounting performance & valid Corporate Givernance data	# Firms SIBE & ARCG & one year lagged stock returns & two year lagged accounting performance & valid Corporate Givernance data & Book value of shares>0
2004	118	115	110
2005	119	118	113
2006	126	115	109
2007	135	112	104
2008	130	117	106
2009	124	119	107
2010	120	115	105
2011	119	109	100
2012	116	107	98
Total	1,107	1,027	952
# Unique firms	165	153	140

From the fiscal identification number on the ARCG we obtain the SEDOL number of each firm in the Bureau Van Dijk database on financial reports for Spain (SABI).[4] Then, the SEDOL number is used to identify each firm in the Thomson Financial database, where we obtain stock market data and annual financial reports. Industrial sector classification is obtained from the Spanish Stock Exchange (http://www.bolsamadrid.es).

2.3. The structure of the board, and non-strictly independent directors

In our final sample of 952 firm/year observations we use the eight formal independence criteria in Crespí-Cladera and Pascual-Fuster (2014) to classify directors declared as independents by firms as strictly independents and non-strictly independent directors (Table 2, Panel C).[5] Our sample is three years longer and confirms the reduction in the percentage of non-strictly independents over board size that reaches around 10% in 2011 and 2012 (Table 2, Panel A). The declared board composition is quite stable across time. There is a slight increase in the percentage of declared independent directors (from 33.3% in 2004 till 35.7% in 2012) and a slight decrease in the percentage of executives (from 20.7% in 2004 to 16.9% in 2012). Proprietary directors remain around 43% of board size. Directors qualified as "Others" are outside

[4] The SEDOL identifier (Stock Exchange Daily Official List) is assigned by the London Stock Exchange on request by the security issuer.

[5] However, over Crespí-Cladera and Pascual-Fuster (2014) we require not being executive director in the previous four years, not just in the previous year. This is consistent with the mandatory definition of an independent director released by the CNMV and in force since 2007.

directors not representing large shareholders and not qualified as independents by firms, and remain around 5% of board size. The overall information in Table 2, Panel A show that firms tend to replace non-strictly independents by strictly independents. This may be due to a stricter supervision of the CNMV since several of our independence criteria are included in the mandatory definition of independent directors (criteria 1, 3, 4, 5, 7, 8 and partially 6 since a directorship in a subsidiary is admitted to be qualified as independent). Board size is also stable across years around 11 members, as is also stable the percentage of firms with the CEO as the board chair (over half of the firms, Table 2, Panel A and B). A higher proportion of larger firms do have Chair-CEO duality, and, as usual, board size is higher in larger companies. Board composition is also different in large firms, with a higher proportion of declared independents and a lower proportion of proprietary directors, consistent with a lower ownership concentration among those firms. Firms of all sizes do have non-strictly independents, however with a slightly higher proportion in large and in small caps. Regarding the eight independence criteria used to classify independents as strictly and non-strictly independents, the first criterion, being proposed by the Nomination Committee, was the most relevant to generate non-strictly independents in 2004, but it is among the least relevant in 2012 (Table 2, Panel C). Firms do care about the recommended proposition system of independent directors (by the Nomination Committee in our case). However, the tenure of independent directors is almost as relevant in 2012 as was in 2004. There is a reluctance to replace independents with long tenures. It may be affected by the fact that the mandatory definition of an independent director does not take tenure into account, although regulators recommend short tenure. The sixth criterion, holding relevant positions in subsidiaries, also remains among the most problematic criterions (probably because it is just partially reflected in the mandatory definition of an independent director). The overall effect of these criteria is that firms declare 33.51% of independent directors when just 17.36% do meet all criteria for the whole period (35.74%, 25.93% respectively in 2012).

Table 2 Board structure

Percentage of firms where the CEO is also the chair of the board of directors, the average number of board members, and the mean percentage over board size of independent directors declared by firms, strictly independents (do meet our 8 independence criteria), non-strictly independents (do not meet any of the 8 independence criteria), executive directors, proprietary directors representing significant shareholders, and other directors (outsiders not representing any significant shareholders and not being qualified as independents). Panel A shows this information by years, and panel B by quartiles of firms according to market capitalization. Quartiles are recomputed every year. Panel C describes the 8 independence criteria we use to classify independents as strictly and non-strictly independents, and the mean percentage over board size of independents meeting each criterion. This information is provided every two years and for the overall sample. This information is for the 952 firm/year observations of column 3 in Table 1.

Panel A: by Year			% tipology of directors over board size					
Year	CEO-Chair	Board Size	Declared independents	Strictly independents	Non-Strictly independents	Executives	Proprietary	Others
2004	51.8%	11.10	33.30%	8.54%	24.77%	20.68%	42.92%	3.10%
2005	50.4%	11.09	33.65%	10.91%	22.75%	19.43%	43.93%	2.98%
2006	57.8%	11.12	32.73%	11.57%	21.16%	19.98%	43.94%	3.35%
2007	58.7%	11.44	31.46%	14.86%	16.60%	19.02%	45.27%	4.25%
2008	60.4%	11.85	33.33%	18.88%	14.45%	18.09%	44.46%	4.13%
2009	60.7%	11.57	32.92%	20.13%	12.79%	18.23%	44.55%	4.30%
2010	56.2%	11.58	34.15%	22.99%	11.16%	17.46%	43.79%	9.10%
2011	55.0%	11.57	34.54%	24.44%	10.09%	16.66%	43.52%	10.90%
2012	50.0%	11.26	35.74%	25.93%	9.81%	16.88%	42.75%	4.63%
Panel B: by Market Capitalization								
First quartile - largest	67.1%	14.63	39.40%	22.98%	16.42%	17.62%	37.48%	7.04%
Second quartile	63.9%	12.18	31.69%	16.07%	15.62%	18.43%	45.65%	5.19%
Third quatile	47.7%	10.18	29.65%	14.69%	14.96%	19.44%	47.66%	4.45%
Fourth quartile	44.1%	8.59	33.35%	15.75%	17.60%	18.67%	44.80%	3.85%
Overall	55.7%	11.39	33.51%	17.36%	16.15%	18.54%	43.91%	5.13%

Panel C: % Independent directors over board size meeting each independence criteria	Year					
Independence criteria	2004	2006	2008	2010	2012	Overall
Declared % Independent directors	*33.30%*	*32.73%*	*33.33%*	*34.15%*	*35.74%*	*33.51%*
[1] Proposed for appointment or renewal by the Nomination Committee [a]	12.84%	17.55%	26.93%	32.75%	35.46%	24.89%
[2] Tenure as independent director for up to twelve years	29.03%	27.79%	27.88%	28.66%	29.84%	28.20%
[3] Not having a significant business relationship with the company	31.71%	30.26%	31.21%	31.90%	34.47%	31.56%
[4] Not holding a directorship, to be a manager or an employee of significant shareholder or a shareholder with board representation	32.58%	32.34%	33.01%	33.84%	35.63%	33.09%
[5] Not having other relevant relationship (different than those in point 4) with significant shareholder or a shareholder with board representation	32.82%	32.39%	32.93%	33.96%	35.74%	33.18%
[6] Not being a director or executive in subsidiaries or associated companies	27.23%	28.14%	29.23%	29.87%	31.71%	29.05%
[7] Not to be a company as board director	32.64%	31.87%	32.44%	33.19%	34.77%	32.68%
[8] Not being executive director of the firm in the previous four years [b]	33.30%	32.64%	33.22%	33.93%	35.74%	33.42%

[a] In 2007 the CNMV (the Spanish Securities and Exchange Commission) modified the information requirements regarding director proposals. Firms must communicate who proposed every director, except for independent directors. Since 2007 we assume that all independent directors have been proposed by the nomination committee, except when this committee does not exist, or if the director has not been formally renewed and was not promoted by this committee before 2007.

[b] Our corporate governance data begins in 2004, therefore this criterion is affected till 2007.

2.4. Measurable consequences of non-strictly independents as a result of regulation and optimal board independence

The proportion of declared independents in the board of directors is the sum of strictly independent and non-strictly independent directors; therefore the variance of the percentage of independent directors may be decomposed in the following way;

$$\sigma_d^2 = \sigma_s^2 + \sigma_{ns}^2 + 2 \cdot \sigma_s \cdot \sigma_{ns} \cdot \rho_{s,ns}$$

where σ_d^2 is the variance of the proportion of declared independent directors, "s" refer to strictly independent directors, "ns" to no-strictly independent directors, and $\rho_{s,ns}$ is the correlation coefficient between the proportion of strictly and non-strictly independent directors.

If we assume that the declared proportion of board independence is 1/3 (the recommended level by the Spanish regulation) and firms fix the proportion of non-strictly independents as to reach this level;

$$DIND_i = SIND_i + NSIND_i = SIND_i + \left(\frac{1}{3} - SIND_i \right) = \frac{1}{3}$$

where $DIND_i$ is the declared proportion of independent directors in firm "i", $SIND_i$ of strictly independents and $NSIND_i$ of non-strictly independents. Then the variances of the proportion of strictly and non-strictly independents are equal, their correlation coefficient is -1, and the variance of the declared proportion of independents is zero;

$$\sigma_d^2 = \sigma_s^2 + \sigma_s^2 + 2 \cdot \sigma_s \cdot \sigma_s \cdot \rho_{s,ns} = 2 \cdot \sigma_s^2 + 2 \cdot \sigma_s^2 \cdot (-1) = 0$$

In a more realistic setting, where there are frictions impeding to reach exactly 1/3 (e.g. the number of independents must be an integer);

$$DIND_i = SIND_i + NSIND_i = SIND_i + \left(\frac{1}{3} - SIND_i + \varepsilon_i \right) = \frac{1}{3} + \varepsilon_i \qquad [1]$$

where ε_i is the deviation respect the desired 1/3 level. In terms of variance;

$$\sigma_d^2 = \sigma_s^2 + \left(\sigma_s^2 + \sigma_\varepsilon^2 - 2 \cdot \sigma_s \sigma_\varepsilon \cdot \rho_{s,\varepsilon} \right) + 2 \cdot \sigma_s \cdot \sqrt{\left(\sigma_s^2 + \sigma_\varepsilon^2 - 2 \cdot \sigma_s \sigma_\varepsilon \cdot \rho_{s,\varepsilon} \right)} \cdot \rho_{s,ns} = \sigma_\varepsilon^2$$

Given that the variance of the declared proportion of independents must be the variance of the deviation, we may compute the value of the correlation coefficient between strictly and non-strictly independents necessary to reach this value;

$$\rho_{s,ns} = \frac{\sigma_{\varepsilon}^2 - \sigma_s^2 - \left(\sigma_s^2 + \sigma_{\varepsilon}^2 - 2\cdot\sigma_s\sigma_{\varepsilon}\cdot\rho_{s,\varepsilon}\right)}{2\cdot\sigma_s\cdot\sqrt{\left(\sigma_s^2 + \sigma_{\varepsilon}^2 - 2\cdot\sigma_s\sigma_{\varepsilon}\cdot\rho_{s,\varepsilon}\right)}} \qquad [2]$$

The correlation coefficient reaches -1 just when there are no deviations. Otherwise it is higher and may be even positive if the variance of the deviation is high enough.[6] Regarding the variance terms, the lower is the variance of deviation the closer are the variances of the proportion of strictly and non-strictly independents, and the higher than the variance of the declared proportion of independents are both.

In the benchmark of the optimal board independence theory, if we assume small and zero mean deviations from the optimal level of board independence (there may be frictions generating this deviation, such as the integer nature of the number of independent directors), we may write;

$$IND_i = \beta\cdot X_i + e_i \qquad [3]$$

where IND_i is the proportion of independent directors of firm "i", X_i is a row vector with the value of each determinant of optimal board independence for firm "i", β is a column vector with the factor loadings of each determinant according to the optimal board independence theory, and e_i the deviation respect to the optimum in firm "i". If we assume that $SIND_i$ in equation [1] is fixed according to equation [3], we may obtain the expected relation between $NSIND_i$ and the board independence determinants. The factor loadings are the same than for $SIND_i$ but with the opposite sign;

$$NSIND_i = \left(\frac{1}{3} - SIND_i + \varepsilon_i\right) = \left(\frac{1}{3} - \left(\beta\cdot X_i + e_i\right) + \varepsilon_i\right) = \frac{1}{3} - \beta\cdot X_i + \left(e_i + \varepsilon_i\right)$$

Also, as a consequence of equation [1] the determinants of board independence should have no relation with $DIND_i$, since it is just 1/3 plus the deviation (ε_i).

In sum, if firms indeed fix strictly independent directors according to the optimal board independence theory and use non-strictly independent directors to fill the gap between strictly independents and the 1/3 recommended level, we should expect: i) A negative correlation coefficient between strictly and non-strictly independents, approaching -1. ii) The variance of strictly and non-strictly independents should be similar and higher than the variance of the declared proportion of independent directors. iii) The coefficients of the optimal board independence determinants should be the same but with the opposite sign in strictly and non-strictly independent directors, being the

[6] The correlation coefficient between strictly independents and the deviation must be also considered. This term gets relevance the higher is the variance of the deviation term, and the higher is this deviation the lower is the value of equation [1] to reflect the behavior of firms.

predicted sign by the optimal board independence theory just in strictly independents. iv) Optimal board independence determinants should have no explanatory power for the declared proportion of board independence (it is 1/3 plus an error term).

2.5 The determinants of the optimal board independence theory

The optimal board independence theory is based on the costs and benefits of board's monitoring and advising roles. We analyze it with the Linck et al. (2008) empirical model. However, it is indeed a theory of the structure of the board of directors and also has implications for board size. We also analyze it to provide a wider vision of its suitability in our data. The optimal board structure determinants are:

- **Firm complexity** in terms of the scope of business and of operating and financial structures. Independent directors may provide valuable expertise and connections to the firm, and complex firms should benefit more from these factors, resulting in bigger and more independent boards. Harris and Raviv (2008) predict that in some circumstances an increase in the importance of outsiders' information increases the optimal number of outsiders. Then a positive relation is expected with board size and independence. The proxies used for complexity are firm size, the relevance of debt in the capital structure, the number of business segments, and firm age.
- **Costs of monitoring and advising**. Theoretical models of Harris and Raviv (2008), Adams and Ferreira (2007) and Raheja (2005) suggest a negative relation between these costs and optimal board size and independence. These costs are assumed to be positively related to growth opportunities and information asymmetry between insiders and outsiders. We use market to book value of equity, and the spending in research and development to proxy growth opportunities, and stock return volatility for information asymmetry.
- **Private benefits**. Firms with more private benefits available for management benefit more from the monitoring of independent boards. The models of Harris and Raviv (2008), Adams and Ferreira (2007) and Raheja (2005) generate higher optimal independence the higher private benefits are. Therefore a positive relation is expected with board independence. We proxy these potential benefits with free cash flows (Jensen, 1986).
- **Ownership incentives**. The ownership structure is one of the main peculiarities of our sample. As can be seen in Table 3 it is highly concentrated. The average ownership of the largest shareholder is 34.91%, and on average the five largest shareholders hold more than 50% of the firm. The theoretical model of Raheja (2005) predicts smaller boards when insiders and shareholders incentives are aligned. Also this alignment reduces the need of outsiders to prevent insiders to take inferior projects.

As a consequence, the ownership of insiders, aligning incentives, should be negatively related with board size and independence. Also in the Raheja (2005) model, the ownership of outsiders reduces the monitoring costs (since it generates monitoring benefits) and therefore a positive relation is expected with the optimal board size and proportion of outsiders. However, in our sample, with proprietary and independent outside directors, the higher proportion of outside directors might mean higher proportion of independents (higher board independence) or higher proportion of proprietary directors (lower board independence). We conjecture that board independence is positively related with the ownership of independent directors, and negatively related with the ownership of proprietary directors. Finally, given the highly concentrated ownership structure we add a measure of this concentration as an additional determinant into the Linck et al. (2008) empirical model. We predict that the larger is the ownership of these controlling shareholders the higher is the control over managers (to align incentives) and the lower is the optimal board size and independence (consistent with the findings in Linck et al., 2008, Lehn et al., 2009, Dutching et al., 2010, and Kim et al., 2007). We measure directly the ownership of directors and proxy ownership concentration by the ownership of the three largest shareholders (its correlation with the ownership of the largest shareholder, the five largest shareholders, and all significant shareholders respectively is; 0.91, 0.97, 0.91).

- **CEO characteristics**. CEOs with higher perceived abilities are optimally allowed with less board independence in Hermalin and Weisbach (1998), who also argue that firms add insiders into the board as part of the CEO succession process. CEOs ability may be measured with the firm's past performance and with their tenure, since successful CEOs remain longer as CEOs. However, Raheja (2005) argues that the stronger the CEO is the more independent the optimal board is to prevent him from taking bad decisions for the firm. To detect this determinant we use a dummy variable identifying CEOs that also chair the board, since it is a measure of CEOs power not related to its abilities, at least directly. Past performance is measured by the average of the last two years industry adjusted return on assets. Finally, due to limits of the data reported on the ARCG we are able to obtain proxies of CEOs tenure and of the succession process just in firms with executives on the board. This reduces the sample in 66 observations, and therefore we estimate the models of board independence without and with these proxies. We compute CEO's tenure and proxy the succession process with a dummy variable identifying when CEOs tenure is over 30 years.[7]

[7] The CEO is not directly identified in the ARCG. We identify CEOs with the following procedure. It is the chair of the board of directors whenever firms declare CEO-chair duality (636 identifications over

Finally, we also consider year and industrial sector fixed effects. Board independence is measured as the percentage of declared independent directors, strictly independent directors, and non-strictly independent directors over the total number of directors, and board size as the log of the number of directors. The empirical models of board independence and board size are;

$$IND = \alpha + \beta_1 LogFirmSize + \beta_2 Debt + \beta_3 LogSegments + \beta_4 LogFirmAge + \beta_5 MTB + \beta_6 R\&D + \\ + \beta_7 RETSTD_{t-1} + \beta_8 FCF + \beta_9 SAPerformance + \beta_{10} CEO\_Chair + \beta_{11} ExDirectors\_Own + \\ + \beta_{12} IndDirectors\_Own + \beta_{13} PropDirectors\_Own + \beta_{14} C3 + \lambda \cdot IndustryDummies + \gamma \cdot YearDummies + \varepsilon \quad [4]$$

$$LogBoardSize = \alpha + \beta_1 LogFirmSize + \beta_2 Debt + \beta_3 LogSegments + \beta_4 LogFirmAge + \beta_5 MTB + \beta_6 R\&D + \\ + \beta_7 RETSTD_{t-1} + \beta_8 ExDirectors\_Own + \beta_9 IndDirectors\_Own + \beta_{10} PropDirectors\_Own + \beta_{11} C3 + \\ + \lambda \cdot IndustryDummies + \gamma \cdot YearDummies + \varepsilon \quad [5]$$

where;

- LogFirmSize = Log of market capitalization
- Debt = Long term debt / Total assets
- LogSegments = Log of the number of geographical segments
- LogFirmAge = Log of the number of years since the incorporation into the Thomson financial database
- MTB = Market value of equity / Book value of equity
- R&D = R&D expenditures / Total assets
- $RETSTD_{t-1}$ = standard deviation of monthly stock return over 12 months in the preceding year
- ExDirectors_Own, IndDirector_Own, PropDirector_Own = percentage of firm's shares held by executive directors, independent directors and proprietary directors respectively.
- FCF = free cash flow computed as operating income before depreciation minus total income taxes, interest expense, preferred dividends, and dividends on common stock, all divided by total assets (see Jensen, 1986, and Lehn and Poulsen, 1989).
- SAPerformance = average annual industry adjusted return on assets over two preceding years. Return on assets is the net income plus interest payments, net of tax effects, over the previous year total Assets.
- CEO_Chair = a dummy variable for CEOs chairing the board of directors.

1107 firms with ARCG, with two CEOs identified in 5 firm/year observations belonging to three firms). If there is no CEO-chair duality the CEO is identified as the highest executive in the board of directors (after the chair if he/she is an executive, 329 identifications, with two CEOs in 13 observations belonging to 8 firms). Whenever there are no higher executives on the board, we identify the CEO as the executive director belonging to the executive committee of the board of directors (20 identifications, with two CEOs for one firm in two consecutive years). Finally, whenever there are no higher executives and also no executives on the executive committee all executives are assumed to be the CEO (46 identifications, with multiple CEO identification in 8 firms; two CEOs for one firm in 12 firm/year observations, and three CEOs for one firm in three firm/year observations). The rest of firm/year observations with no identified CEO belong to firms with no executives on their boards (76 firm/year observations over 1107, belonging to 21 firms). In firms with multiple CEOs (35 firm/year observations) we compute their average tenure to proxy the CEOs tenure.

For firms with executive directors we also estimate the following model;

$$
\begin{aligned}
IND = {} & \alpha + \beta_1 LogFirmSize + \beta_2 Debt + \beta_3 LogSegments + \beta_4 LogFirmAge + \beta_5 MTB + \beta_6 R\&D + \\
& + \beta_7 RETSTD_{t-1} + \beta_8 FCF + \beta_9 SAPerformance + \beta_{10} CEO\_Chair + \beta_{11} ExDirectors\_Own + \\
& + \beta_{12} IndDirectors\_Own + \beta_{13} PropDirectors\_Own + \beta_{14} C3 + \beta_{15} LogCEOTenure + \beta_{16} Retirement + \\
& + \lambda \cdot IndustryDummies + \gamma \cdot YearDummies + \varepsilon
\end{aligned}
\quad [6]
$$

where “LogCEOTenure” is the log of CEO’s tenure, and “Retirement” is a dummy variable identifying whenever CEO’s tenure is over 30 years.

Table 3 show summary statistics of the variables considered in our analysis, also by quartiles of market capitalization and across years.[8]. The mean market capitalization is € 4,827 Million, that is considerably higher than the mean $ 1,624 Million in the Linck et at. (2008) sample, with approximately 7000 firms in the US from 1990 to 2004, also used in Wintocki et al. (2012). Even in our first year (2004) the average market capitalization is higher (€ 4,089 Million, Table 3, panel C). Firms in the second quartile, by market capitalization, do have a similar mean size than the average firm in Linck et al. (2008), and firms in our smallest quartile are comparable to their median firm (€ 117 Million). Therefore, their sample includes a higher proportion of smaller firms. Ownership structure is especially different in our sample (and in European continental economies) than in the US economy. Even with bigger firms, the mean ownership of all block holders in our sample is 57%, when it is 40% in Linck et al. (2008) US sample. It is high even in the largest firms of our sample (51%). The ownership of board directors is also considerable in our sample; its mean is 8.6% for executives, 0.32% for independents, and 13% for proprietary directors. Linck et al. (2008) report 1.7% aggregated ownership of non-executive directors, and 6% ownership of the CEO (medians are 0.97% and 0.11% respectively). Regarding the rest of firms’ characteristics, panel C in Table 3 show the effect of the crisis; Return on assets decreases over time, as the market to book ratio do. Our measure of free cash flow is around 3% of total assets, lower than the median 6% in the Linck et al. (2008) sample, but bigger than their average (-1.4%). Firm age, measured by the incorporation in the Thomson Financial database, is 16 years on average; it is 13 years in Linck et al., (2008). Finally board size reflects the bigger size of our firms, with an average of 11.3 members when it is just 7.5 in Linck et al. (2008), the percentage of firms with CEO chairing the board of directors is similar in both samples, and the proportion of executive directors is lower in our sample (18% versus 34%) probably due to the bigger size of our firms (Table 2, panel B).

[8] Given that any tendency in stock prices might distort these capitalization based subsamples, quartiles are computed every year.

Table 3. Descriptive statistics

Firm characteristics are the stock market capitalization, long term debt over total assets, the number of geographical segments, firms age (years since the incorporation into the Thomson financial database), market value over book value of equity, investments in research and development, the yearly standard deviation of month stock return (RETSTD), free cash flow over total assets, and return on assets. Firms' characteristics come from the Thomson Financial database. Ownership structure variables come from the ARCG and are the ownership of the largest shareholder (C1), of the three largest shareholders (C3), of the fifth largest shareholders (C5), of all large shareholders (those with an ownership large than 3% and board directors), of executive directors, independents, proprietary directors, and the ownership of the CEO for firms with executives on the board of directors (ARCG do not provide information on the ownership of non-director executives). Tenure data also come from the ARCG and is available just for firms with executives in their boards. Panel A provides descriptive statistics of all variables for the overall sample. Panel B provides the mean value of variables by quartiles of firms ordered by market capitalization. Quartiles are recomputed each year. Panel C provides the mean value by years every two years.

	Panel A: Overall sample					Panel B: Means by market capitalization quartiles				Panel C:Means by Year				
	# Obs	Mean	Std. Dev.	Min	Max	First (largest)	Second	Thirdth	Fourth	2004	2006	2008	2010	2012
Firms characteristics														
Market Capitalization (mill €)	952	4,827.20	12,250.98	7.95	104,544.90	16,819.08	1,925.17	515.69	117.35	4,089.41	6,261.24	4,239.23	4,305.65	4,025.24
Debt/Total Assets	952	0.20	0.17	0.00	1.22	0.27	0.21	0.20	0.14	0.17	0.21	0.21	0.20	0.22
# Geogrphical Segments	952	3.30	2.28	1.00	10.00	4.01	3.44	3.00	2.77	2.49	2.88	3.28	3.76	4.15
Firm age (# years)	952	16.04	5.20	5.00	25.00	17.66	16.37	15.41	14.75	13.28	15.04	15.75	17.33	19.07
MTB	952	2.68	3.59	0.11	47.41	3.75	2.94	2.38	1.66	3.03	4.28	2.08	1.84	1.86
R&D (thousand €)	952	2.35	22.96	0.00	322.01	0.01	3.95	5.05	0.35	1.66	3.01	2.82	1.86	1.87
RETSTD	952	0.09	0.05	0.01	0.74	0.08	0.09	0.10	0.10	0.06	0.08	0.11	0.09	0.12
Free Cash Flow/Total Assets	952	0.03	0.07	-0.97	0.38	0.04	0.04	0.03	0.02	0.04	0.04	0.03	0.03	0.03
ROA	952	4.42	7.35	-33.42	42.73	6.78	5.62	3.60	1.69	5.12	6.32	4.36	3.73	1.48
Ownership structure (%)														
C1	952	34.91	25.55	0.04	99.50	33.44	41.28	36.94	27.98	34.48	38.52	35.43	34.16	31.37
C3	952	48.86	24.42	0.04	99.50	46.78	53.67	50.79	44.20	47.59	51.46	49.56	48.80	46.46
C5	952	53.91	23.81	0.04	99.50	49.70	58.02	56.51	51.37	52.00	55.54	54.85	54.38	52.39
All large shareholders	952	56.89	23.95	0.04	99.81	51.01	61.07	59.84	55.61	54.03	57.28	58.57	58.23	55.56
Executive directors	952	8.65	19.46	0.00	96.91	3.73	8.62	13.22	9.01	10.82	12.45	6.45	7.50	5.42
Independents directors	952	0.32	1.03	0.00	12.31	0.26	0.34	0.30	0.38	0.32	0.33	0.31	0.35	0.28
Proprietary directors	952	13.38	20.17	0.00	99.50	8.04	13.94	14.45	17.06	10.52	10.69	15.01	14.67	15.81
CEO's ownership	886	7.33	18.56	0.00	96.91	2.93	5.36	12.35	9.19	9.58	11.44	4.68	5.58	3.92
Tenure (# years)														
Average of executive directors	886	9.26	7.35	0.00	43.50	8.74	9.57	9.73	8.95	8.55	8.44	9.16	10.05	9.89
CEO's tenure	886	11.36	10.31	0.00	52.42	11.68	11.71	11.12	10.84	10.16	10.46	11.41	12.21	12.02

3. Empirical results

3.1. Descriptive statistics and the recommended level of board independence

The recommended level of board independence may induce firms to fill the gap between their optimal level and the recommended one with non-strictly independent directors just if firms do want to meet the recommendation. Then, a first step is to detect whether firms do want to meet the recommendation. Since we cannot observe the intention of firms we classify a firm as wanting to meet the recommendation if on average their declared proportion of independents reaches 1/3. Approximately half of our observations belong to firms classified as wanting to meet the recommendation (see Table 4, panel A). However, almost all observations belong to firms with non-strictly independent directors (91.5%). It is a widespread type of corporate director among small and large firms (93.7% and 94.1% respectively in Table 4, Panel A). Therefore, the optimal board independence theory in conjunction with the recommended level of board independence is not able to explain the presence of non-strictly independents in a large fraction of our sample (63 firms with non-strictly independents classified as not wanting to meet the recommended level of independence, representing 46.5% of our observations). Firms classified as not wanting to meet the recommendation do indeed present a quite lower level of declared board independence (21% in front of 46.6% in firms meeting, and the difference is statistically significant, Table 4 Panel B). However, the declared level of board independence is substantially higher in firms with non-strictly independent directors than in firms without them (34.2% and 25.7% respectively, a difference also statistically significant, Table 4 Panel B) although this difference is reversed in 2012. Furthermore, among the 464 observations belonging to firms meeting the recommended level, 303 meet it thanks to non-strictly independent directors. Non-strictly independent directors seem to be quite relevant among firms wanting to meet the recommended level of independence, almost half of our sample.

Table 4. Firms with non-strictly independents and firms meeting the recommended level of independence

Firms are classified as meeting the recommended level of board independence whenever their average declared proportion of independent directors reaches 1/3 of the board. Firms are classified as with non-strictly independent directors whenever present non-strictly independents in any year. Panel A show, by year and market capitalization quartiles, the number of firms analyzed, and the number and the percentage of observations belonging to each type of firm. The last two columns show the number of observations belonging to firms meeting the recommended level of board independence just with strictly independent directors, and those who need non-strictly independent directors to meet the recommended level. Panel B show, by year and market capitalization quartiles, the average percentage of declared independent directors in all analyzed firms, in firms with non-strictly independent directors, in firms without non-strictly independent directors, in firms meeting the recommended level of board independence and in firms not meeting it. Coefficients in bold identify when it is rejected the null hypothesis of equal mean proportion of independents among firms having and not having non-strictly independents, and among firms meeting and not meeting the recommended level of independence with a 5% of significance level. The hypothesis is analyzed withy the t test of means comparison (see Hamilton, 2013).

Panel A

		# Firms	Firms with non-strictly		Firms meeting recommendend independence			
			# Obs	%	# Obs	%	# just with strictly indep	# with non-strictly indep
Years								
	2004	110	103	93.6%	53	48.2%	15	38
	2006	109	102	93.6%	50	45.9%	15	35
	2008	106	97	91.5%	51	48.1%	18	33
	2010	105	94	89.5%	54	51.4%	21	33
	2012	98	86	87.8%	51	52.0%	21	30
Market Capitalization quartiles								
	First - largest	237	223	94.1%	151	63.7%	77	74
	Second	238	222	93.3%	102	42.9%	19	83
	Third	239	203	84.9%	89	37.2%	37	52
	Fourth	238	223	93.7%	122	51.3%	28	94
All		952	871	91.5%	464	48.7%	161	303

Panel B

Mean % of declared independent directors

			Non-Strictly independents		Recommended level of independence	
		All firms	Firms with	Firms without	Firms meeting	Firms not meeting
Years						
	2004	33.3%	**35.0%**	**8.0%**	**48.5%**	**19.1%**
	2006	32.7%	**34.4%**	**8.3%**	**48.5%**	**19.4%**
	2008	33.3%	34.0%	25.6%	**45.6%**	**22.0%**
	2010	34.1%	34.2%	33.6%	**45.0%**	**22.7%**
	2012	35.7%	34.8%	42.2%	**46.6%**	**23.9%**
Market Capitalization quartiles						
	First - largest	39.4%	39.4%	39.7%	**49.9%**	**21.0%**
	Second	31.7%	32.2%	24.5%	**44.1%**	**22.3%**
	Third	29.6%	**31.3%**	**20.3%**	**45.9%**	**20.0%**
	Fourth	33.3%	33.8%	27.0%	**45.3%**	**20.7%**
All		33.5%	**34.2%**	**25.7%**	**46.6%**	**21.0%**

Furthermore, the variance of strictly and of non-strictly independent directors is higher than the variance of the declared proportion of independents in the subsample of firms classified as wanting to meet the recommended level of board independence (except for non-strictly in 2012, however the difference is not statistically significant from 2008), not when all firms are considered (see Table 5, Panel A). The null hypothesis of equal standard deviation of strictly and non-strictly independents is just rejected when all firms are considered. In addition, the correlation coefficient between strictly and non-strictly independents is negative in all samples and subsamples, but it is closer to -1 in firms wanting to meet the recommended independence level, although this difference is decreasing along years (Table 5, Panel B). Finally, firm size seems to be relevant, in smaller firms wanting to meet the recommendation there is the highest difference between the variance of strictly and of non-strictly independents with the variance of declared independents (also statistically significant), and the closest to -1 correlation coefficient between strictly and non-strictly. Since the optimal board independence is positively related to board size and the number of independents is a positive integer, it may me more difficult to meet the recommended level of board independence among smaller firms.

Table 5. Variability and correlation of independent directors

Firms are classified as meeting the recommended level of board independence whenever their average declared proportion of independent directors reaches 1/3 of the board. Panel A show, by years and market capitalization quartiles, for all firms and for firms meeting the recommended level of boar independence; the standard deviation of the percentage of independent directors over board size as declared by firms, just with strictly independent directors, and just with non-strictly independent directors. Panel B present the correlation coefficient between the percentage of strictly independent directors and the percentage of non-strictly independent directors, taking into account all observations and just observations belonging to firms meeting the recommended independence. The correlation is also computed by year and by market capitalization quartile subsamples. Coefficients in bold identify when the null of equal standard deviation of strictly and non-strictly independents is rejected with a 5% of statistical significance. * identifies when the null of equal standard deviation than the proportion of declared independent directors is rejected with 5% of statistical significance. The hypothesis is analyzed withy the F test of standard deviation comparison (see Armitage et al, 2002, 149-153)

Panel A: Standard deviation of the % of independent directors

	Al fims			Firms meeting recommended independence		
Years	Declared	Strictly	Non-strictly	Declared	Strictly	Non-strictly
2004	20.2%	**13.3%***	**20.2%**	14.0%	16.0%	20.8%*
2006	20.0%	**15.5%***	**19.0%**	15.3%	18.1%	22.8%*
2008	16.9%	15.8%	15.4%	13.3%	17.6%	17.3%
2010	16.7%	**16.6%**	**13.3%***	13.7%	17.2%	15.3%
2012	17.7%	**17.2%**	**11.6%***	15.5%	15.9%	13.0%
Market Capitalization quartiles						
First - largest	18.7%	**18.0%**	**15.1%***	14.2%	16.3%	17.0%*
Second	16.9%	15.0%	16.1%	14.4%	16.9%	18.1%*
Third	18.4%	16.5%	17.4%	14.5%	20.0%*	21.9%*
Fourth	17.6%	17.1%	18.9%	12.7%	18.9%*	22.1%*
All	18.2%	17.0%*	17.0%*	14.1%	18.3%*	19.7%*

Panel B: Correlation coefficient between the percentage of strictly and non-strictly independent directors

Years	All firms	Firms meeting recommended independence
2004	-0.3254	-0.7388
2006	-0.3445	-0.7434
2008	-0.4147	-0.708
2010	-0.3916	-0.6493
2012	-0.2922	-0.4412
Market Capitalization quartiles		
First - largest	-0.3769	-0.6359
Second	-0.4087	-0.665
Third	-0.4162	-0.7624
Fourth	-0.5249	-0.8175
All	-0.4221	-0.7272

3.2. The empirical model of optimal board independence

3.2.1 All firms

The empirical models of board independence and board size are estimated with firm fixed effects (equations [4], [5] and [6]) that also detect de industry fixed effects and therefore industrial sector dummies are not included. Inference is based on robust standard errors clustered by firm (Huber, 1967, White, 1980, 1982, and Petersen, 2009).

Our third prediction regarding the consequences of the optimal board independence theory jointly with the recommended level of board independence as the origin of strictly independent directors is to find the expected signs of board structure determinants when dependent variable is the proportion of strictly independents and the opposite sign when it is the proportion of non-strictly independents. Columns 1 to 6 of Table 6 present the estimation of the empirical models of board independence. Although several coefficients of explanatory variables present the opposite sign when the dependent variable is changed from strictly to non-strictly independents proportion (e.g. firm size or business segments) this is not the rule with statistically significant coefficients. In general the sign is the expected one according the optimal board independence theory with both dependent variables, the proportion of strictly and of non-strictly independents. Just firm age present statistically significant coefficients with the opposite sing, being with strictly independents the expected sing, probably consequence of firms replacing non-strictly by strictly independents as suggested also by the descriptive statistics in Table 2. The ownership of the largest shareholders is also statistically significant with both dependent variables but present the same and expected sign in both cases. Models of columns 2 and 5, Table 6, are with the strictly independents dependent variable, and just firm age and the ownership of the largest shareholders are statistically significant, both with the expected sing. Contrary to the optimal board theory as the origin of non-strictly independents, models of columns 3 and 6, with non-strictly independents as the dependent, present even a better fit, with 6 statistically significant variables in model 3 and 4 in model 6. Just in model of column 3 there are statistically significant coefficients with the unexpected sing; Performance and firm age, both with low statistically significance. The R^2 of models with non-strictly independents as the dependent variable is slightly higher than when it is the proportion of strictly independents. When we aggregate bot dependent variables in the declared level of board independence (columns 1 and 4 of Table 6), our fourth prediction is to find no explanatory power of board structure determinants; the overall fit in terms of R^2 is lower, but there are seven statistically significant coefficients and just one of them present an unexpected sign (MTB in column 4), although it is with low statistically significance. Overall, these results do not clearly support the optimal board independence theory and governance recommendations as the origin on non-strictly independents. Our results might be due to a poor empirical model of board independence, however the overall fit is substantial (R^2 higher than 18% in all models, it is 17% in Linck et al., 2008, with a much bigger sample, 8840 observations) and the sign of the statistically significant variables is in general the expected one according the optimal board independence theory. Furthermore, a broad analysis of our determinants of board structure, analyzing their explanatory power with board size as the dependent variable, also shows a reasonable fit. Although R^2 is just 11% (column 7 in Table 6, it is 44% in Linck et al., 2008, with 10636 observations), all statistically significant coefficients present the expected sing and the statistical significance is just 10% in one of the seven statistically significant coefficients. Then, our overall results provide evidence of firms taking into account the determinants of the optimal board independence (structure) theory, and do not support this optimal level jointly with the recommended level of board independence as the origin of non-strictly independents. We control the effect of any possible outlier (e.g. due to measurement error) winsorizing all explanatory variables (with percentiles 1% and 99%, and with percentiles 5% and 95%) and obtain qualitatively equivalent results, available on request.

Table 6. Board structure

The empirical models of optimal board independence (equations [4] and [6]) and of board size (log of # directors, equation [5]) are estimated with firm fixed effects. t statistics are in parenthesis and are computed with robust standard errors clustered by firm (Huber, 1967, White, 1980, 1982, and Petersen, 2009). Declared board independence (models 1 and 4) is decomposed into strictly board independence (models 2 and 5) and non-strictly independence (models 3 and 6). Debt is long term debt over total assets, LogSegments is the log of the number of geographical segments, MTB is the market value over book value of equity, R&D is R&D expenses over total assets, $RETSTD_{t-1}$ is the standard deviation of previous year monthly returns, FCF is the free cash flow scaled by total assets, SAPerformance is the two previous year's average industry adjusted return on assets, CEO_Chair identifies when the CEO chairs the board of directors, ExDirectors_Own (IndDirectors_Own, PropDirectors_Own) is the percent of shares held by executive directors (independent and proprietary directors, respectively), C3 is the percent of shares held by the three largest shareholders, LogCEOTenure is the CEO's tenure, Retirement is a dummy variable to detect CEO's with more than 30 years tenure. F is a test of the joint statistical significance of all explanatory variables. *** denotes significance at the 1% level; ** denotes significance at the 5% level; * denotes significance at the 10% level.

		% Independent directors						Board size	
	Prediction	Declared	Srtictly	Non-Strictly	Declared	Srtictly	Non-Strictly	Prediction	
		(1)	(2)	(3)	(4)	(5)	(6)		(7)
Log(Market Capitalization)	(+)	0.0033	-0.0063	0.0096	0.0048	-0.0039	0.0087	(+)	0.0538***
		(0.2909)	(-0.4931)	(0.6563)	(0.4533)	(-0.2948)	(0.5925)		(4.1605)
Debt	(+)	0.031	0.0021	0.0289	0.0273	0.005	0.0223	(+)	0.1844***
		(0.6459)	(0.0402)	(0.5248)	(0.5413)	(0.0903)	(0.372)		(2.6251)
LogSegments	(+)	0.014	-0.0165	0.0305***	0.0118	-0.0142	0.026**	(+)	0.0017
		(1.5165)	(-1.4483)	(2.6502)	(1.2647)	(-1.1903)	(2.0963)		(0.1008)
LogFirmAge	(+)	0.1061	0.3076***	-0.2016*	0.1398*	0.2767**	-0.1369	(+)	0.3199**
		(1.2496)	(2.8904)	(-1.6754)	(1.7234)	(2.5742)	(-1.2317)		(2.5326)
MTB	(-)	0.0027	0.0019	0.0008	0.0032*	0.002	0.0012	(-)	-0.0048
		(1.6029)	(0.9896)	(0.3168)	(1.9133)	(1.104)	(0.4832)		(-1.263)
R&D	(-)	-0.1523	-0.1321	-0.0202	-0.1227	-0.1069	-0.0158	(-)	-1.0307***
		(-0.4129)	(-0.2266)	(-0.0678)	(-0.3057)	(-0.1879)	(-0.0603)		(-6.5569)
$RETSTD_{t-1}$	(-)	-0.0013	0.0492	-0.0505	0.0296	-0.0023	0.0319	(-)	-0.0682
		(-0.014)	(0.3305)	(-0.3891)	(0.3044)	(-0.0141)	(0.2283)		(-0.5171)
FCF	(+)	0.0162	-0.0346	0.0509	0.0321	0.0031	0.0289		
		(0.1635)	(-0.5009)	(0.5106)	(0.3098)	(0.047)	(0.2944)		
SAPerformance	(-)	0.0013	-0.0004	0.0018*	0.0011	-0.0004	0.0015		
		(1.4534)	(-0.3889)	(1.853)	(1.3673)	(-0.3434)	(1.4668)		
CEO_Chair	(+)	0.0172	0.0149	0.0023	0.0155	0.0202	-0.0048		
		(0.8014)	(0.7897)	(0.1127)	(0.6464)	(1.0108)	(-0.2231)		
ExDirectors_Own	(-)	-0.0003	0.0002	-0.0005	0.0001	0.0003	-0.0002	(-)	0.0013
		(-0.6358)	(0.2172)	(-0.4825)	(0.264)	(0.3366)	(-0.1998)		(1.2485)
IndDirectors_Own	(+)	0.0401***	-0.0015	0.0415***	0.0405***	-0.0016	0.0421***	(+)	0.0087**
		(8.986)	(-0.3227)	(7.0307)	(9.0449)	(-0.3552)	(6.9598)		(2.4721)
PropDirectors_Own	(-)	-0.0006	0.0006	-0.0012**	-0.0004	0.0009	-0.0012**	(+)	0.0013**
		(-1.6184)	(1.0892)	(-2.2071)	(-0.9528)	(1.4068)	(-2.136)		(2.1952)
C3	(-)	-0.0023***	-0.001*	-0.0013*	-0.0025***	-0.001*	-0.0015**	(-)	-0.0018*
		(-3.5737)	(-1.8818)	(-1.7179)	(-3.9818)	(-1.9283)	(-1.9955)		(-1.753)
LogCEOTenure	(-)				-0.0016	0.0008	-0.0024		
					(-0.2327)	(0.1405)	(-0.3265)		
Retirement	(-)				-0.0575***	-0.0661	0.0086		
					(-3.0681)	(-1.2339)	(0.1468)		
Constant		0.124	-0.5856**	0.7096**	0.0327	-0.5266*	0.5594*		1.2656***
		(0.5877)	(-2.0669)	(2.3551)	(0.1618)	(-1.8506)	(1.9285)		(3.778)
Year fixed effects		Yes	Yes	Yes	Yes	Yes	Yes		Yes
# Obs		952	952	952	886	886	886		952
R^2		0.182	0.2603	0.2819	0.2105	0.2444	0.2686		0.1103
R^2 Adjusted		0.1626	0.2427	0.2649	0.1889	0.2226	0.2484		0.0921
F		6.4713***	4.4929***	7.7387***	7.9986***	4.0677***	7.4821***		7.0193***

3.2.2 Firms wanting to meet the recommended level of board independence

We replicate the analysis allowing a different coefficient of board structure determinants in firms classified as wanting to meet the recommended level of board independence. For this we add, as new explanatory variables, the multiplication of a dummy variable identifying firms classified as wanting to meet the recommendation

(MeetIR) with the determinants of board independence. Results, in Table 7, are not consistent with the optimal board independence theory as the origin of non-strictly independents in firms classified as wanting to meet the recommended independence level. Wald tests of the join statistical significance of the new variables just show significance when the dependent variable is the declared proportion of independents (at 5% level). Regarding individual variables, no statistically significant different coefficient is found for board structure determinants in firms classified as wanting to meet the independence recommendation when the dependent variable is the proportion of strictly and of non-strictly independents in models of columns 2 and 3. Just when the retirement and CEOs tenure variables are taken into account and strictly independents is the dependent variable (column 5, Table 7) there is a statistically significant different coefficient, it is the ownership of executives that has the expected sing just for firms wanting to meet the recommendation (0.0013-0.0033=-0.002), although a Wald tests does not reject a zero value. When the dependent is the proportion of declared independents (columns 1 and 4), there are three determinants (R&D, the ownership of proprietary directors, and C3 just in model of column 4) with a statistically significant different coefficient in firms classified as wanting to meet the recommendation, but just R&D present and overall unexpected sing in those firms (-4.128+4.1508=0.0228) in column 1, not in column 4 (-4.019+4.0068=-0.0122). However, a Wald test of the statistical significance of these sums is unable to reject zero value in both cases. In sum, even in firms classified as wanting to meet the recommended level of board independence, statistically significant board structure determinants present the expected sing in all our measures of board independence, except the retirement proxy in column 6 (non-strictly independents) and executive directors ownership in column 2 (strictly independents). Furthermore, the overall fit of the model is better when the dependent is the proportion of non-strictly independents (in terms of R^2 and of statistically significant coefficients with the expected sign). We also estimated the models of board independence in Table 7 just with the observations of firms wanting to meet the recommendation, and winsorized all explanatory variables (with percentiles 1% and 99%, and 5% and 95%), and the overall results remain in both cases. Results omitted to save space.

Table 7. Board structure and the recommended independence level

The empirical models of optimal board independence (equations [4] and [6]) ae estimated with firm fixed effects. t statistics are in parenthesis and are computed with robust standard errors clustered by firm (Huber, 1967, White, 1980, 1982, and Petersen, 2009). MeetIR is a dummy variable identifying firms classified as meeting the board independence level recommendation (those with an average percentage of declared independent directors reaching 1/3). See Table 6 for a description of explanatory and dependent variables. Wald F (xMeetIR) is a test of the joint statistical significance of all variables multiplied by MeetIR. *** denotes significance at the 1% level; ** denotes significance at the 5% level; * denotes significance at the 10% level.

	Prediction	Declared	Strictly	Non-Strictly	Declared	Strictly	Non-Strictly
		(1)	(2)	(3)	(4)	(5)	(6)
Log(Market Capitalization)	(+)	-0.0019	-0.012	0.0101	0	-0.0126	0.0125
		(-0.1503)	(-1.0299)	(0.8074)	(-0.0037)	(-1.0474)	(1.0823)
Debt	(+)	0.0356	0.0323	0.0032	0.0354	0.0252	0.0102
		(0.6893)	(0.6287)	(0.0716)	(0.6262)	(0.4433)	(0.217)
LogSegments	(+)	0.0045	-0.0133	0.0178	0.0004	-0.0156	0.016
		(0.4143)	(-1.2056)	(1.6413)	(0.038)	(-1.3926)	(1.4418)
LogFirmAge	(+)	0.0814	0.2358**	-0.1544	0.1038	0.209**	-0.1052
		(0.8915)	(2.309)	(-1.4435)	(1.1123)	(2.0059)	(-0.9762)
MTB	(-)	0.0018	0.0007	0.0011	0.0021	0.0014	0.0007
		(1.2691)	(0.3813)	(0.488)	(1.3494)	(0.8562)	(0.2903)
R&D	(-)	-4.128*	-0.0584	-4.0696	-4.019**	0.1389	-4.1579
		(-1.9433)	(-0.0172)	(-1.4106)	(-2.4257)	(0.0399)	(-1.3594)
$RETSTD_{t-1}$	(-)	0.0615	0.0354	0.0261	0.0912	0.0206	0.0706
		(0.5759)	(0.2536)	(0.2597)	(0.8074)	(0.1437)	(0.638)
FCF	(+)	-0.0559	-0.1153	0.0595	-0.0085	-0.0769	0.0684
		(-0.5329)	(-1.5097)	(0.4321)	(-0.0716)	(-1.3007)	(0.4656)
SAPerformance	(-)	-0.0001	-0.0018	0.0017	0.0006	-0.0015	0.002
		(-0.1113)	(-1.4314)	(1.3291)	(0.5676)	(-1.1124)	(1.5049)
CEO_Chair	(+)	0.0306	0.0011	0.0295	0.0313	0.0096	0.0218
		(1.6137)	(0.0566)	(1.4007)	(1.5151)	(0.4903)	(1.0655)
ExDirectors_Own	(-)	-0.0003	0.0011*	-0.0013***	-0.0002	0.0013**	-0.0015***
		(-0.5239)	(1.8252)	(-2.8248)	(-0.3357)	(2.3283)	(-3.3716)
IndDirectors_Own	(+)	0.0406***	0.0024	0.0383***	0.0398***	0.0021	0.0376***
		(20.4738)	(1.1639)	(14.5836)	(17.4653)	(0.9866)	(12.4914)
PropDirectors_Own	(-)	0	0.0006	-0.0006	0.0001	0.001	-0.0008*
		(0.0101)	(1.189)	(-1.5743)	(0.3164)	(1.6006)	(-1.9325)
C3	(-)	-0.0014***	-0.0006	-0.0009	-0.0013**	-0.0007	-0.0007
		(-3.0059)	(-0.9064)	(-1.285)	(-2.4728)	(-0.9917)	(-0.9193)
LogCEOTenure	(-)				0.0028	-0.0007	0.0035
					(0.4371)	(-0.1253)	(0.5616)
Retirement	(-)				-0.0226	-0.074***	0.0514***
					(-1.213)	(-2.7325)	(2.7155)
Log(Market Capitalization) x MeetIR		0.0141	-0.002	0.0161	0.0091	0.0059	0.0032
		(0.7269)	(-0.0733)	(0.5261)	(0.4965)	(0.2125)	(0.1055)
Debt x MeetIR		-0.0055	-0.0446	0.0391	0.0017	-0.0207	0.0224
		(-0.0575)	(-0.3728)	(0.2872)	(0.017)	(-0.1618)	(0.1614)
LogSegments x MeetIR		0.0199	0	0.0199	0.0219	0.0095	0.0124
		(1.0896)	(0)	(0.7648)	(1.1875)	(0.3404)	(0.4656)
LogFirmAge x MeetIR		-0.0355	0.1038	-0.1393	-0.0108	0.0636	-0.0744
		(-0.545)	(1.3441)	(-1.535)	(-0.1605)	(0.7944)	(-0.8406)
MTB x MeetIR		0.0054	0.0016	0.0038	0.0043	0.0003	0.004
		(1.3936)	(0.3061)	(0.6751)	(1.1175)	(0.0574)	(0.7676)
R&D x MeetIR		4.1508*	0.164	3.9868	4.0068**	0.0284	3.9784
		(1.9008)	(0.047)	(1.3778)	(2.2941)	(0.008)	(1.2978)
$RETSTD_{t-1}$ x MeetIR		-0.1015	0.0553	-0.1567	-0.1041	-0.0037	-0.1004
		(-0.6313)	(0.2037)	(-0.6647)	(-0.6138)	(-0.0124)	(-0.3953)
FCF x MeetIR		0.2583	0.2146	0.0436	0.1664	0.2567	-0.0903
		(1.3482)	(1.1926)	(0.2038)	(0.795)	(1.1991)	(-0.4108)
SAPerformance x MeetIR		0.0024	0.0022	0.0002	0.001	0.0016	-0.0006
		(1.3586)	(1.1253)	(0.0926)	(0.5086)	(0.707)	(-0.2913)
CEO_Chair x MeetIR		-0.0257	0.0317	-0.0574	-0.0376	0.0222	-0.0599
		(-0.5522)	(0.8583)	(-1.4968)	(-0.6971)	(0.5476)	(-1.4026)
ExDirectors_Own x MeetIR		-0.001	-0.0025	0.0015	-0.0008	-0.0033*	0.0025
		(-0.8246)	(-1.3544)	(0.7438)	(-0.635)	(-1.8223)	(1.3238)
IndDirectors_Own x MeetIR		-0.0043	-0.0267	0.0225	0	-0.0259	0.0259
		(-0.1477)	(-1.5947)	(0.653)	(-0.0015)	(-1.4252)	(0.6868)
PropDirectors_Own x MeetIR		-0.0023**	-0.0008	-0.0015	-0.0023**	-0.0015	-0.0007
		(-2.5403)	(-0.7273)	(-1.1062)	(-2.2646)	(-1.2397)	(-0.5132)
C3 x MeetIR		-0.0015	-0.0007	-0.0008	-0.0019*	-0.0004	-0.0015
		(-1.4194)	(-0.6961)	(-0.5471)	(-1.8377)	(-0.4222)	(-1.1065)
LogCEOTenure x MeetIR					-0.0051	0.0043	-0.0094
					(-0.3506)	(0.3515)	(-0.6326)
Retirement x MeetIR					-0.057	0.004	-0.061
					(-1.4519)	(0.0391)	(-0.6326)
Constant		0.2006	-0.4922	0.6928	0.121	-0.4013	0.5223*
		(0.9332)	(-1.6866)	(2.288)	(0.5871)	(-1.3624)	(1.7739)
Year fixed effects		Yes	Yes	Yes	Yes	Yes	Yes
N		952	952	952	886	886	886
R^2		0.2292	0.2815	0.316	0.2502	0.2657	0.2967
R^2 Adjusted		0.1989	0.2532	0.2891	0.2147	0.231	0.2634
F		37.9463***	5.1037***	16.7342***	36.8442***	4.9634***	13.1417***
Wald F (xMeetIR)		1.77**	1.01	0.98	1.75**	0.91	0.99

3.2.3. Firm performance and optimal board independence

Our previous results show no evidence of the optimal board independence theory jointly with corporate governance regulation as the origin of non-strictly independent directors. Furthermore, Tables 6 and 7 show firms reacting to the determinants of optimal board structure to set the overall declared board independence, strictly independence and non-strictly independence. However, since optimal board structures should have no effect on firm performance (e.g., Coles et al, 2008, Lehn, et al 2009, or Dutchin et al, 2010), we analyze the effect of our different board independence measures on firm performance to provide further evidence on the optimality of declared board independence and its decomposition among strictly and non-strictly independents.

Given that firm performance may affect corporate governance settings (e.g, it is optimal to allow a less independent board to successful CEOs with positive past performance records, Hermalin and Weisbach, 1998), firm fixed effects estimators may be biased when performance is the dependent variable and corporate governance variables the explanatory ones, we need to control for endogeneity. Indeed, Wintoki et al. (2012) found that firm fixed effects provide correct estimations of board structure models, but not of performance models, and propose the Dynamic System panel GMM estimator developed by Holtz-Eakin et al. (1988), Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998). With this econometric technique we address endogeneity in several terms; fixed unobserved heterogeneity, simultaneity, and the dependence of current board structure on past realizations of performance. However, although this technique is superior to OLS and panel data firm fixed effects in order to generate non-biased estimates due to endogeneity, still can generate biased estimations in the presence on time varying unobserved heterogeneity. Unfortunately, statistical tests may not detect potential misspecifications if the coefficient bias introduced by the misspecification falls below a certain threshold, around 25% in Wintoki et al (2012). Furthermore, the power of these tests is weaker in smaller samples.

Our dependent variable is performance, we measure it by the return on assets, and our key explanatory variables are our measures of board independence. Since the Dynamic System GMM estimator is biased in the presence of time varying heterogeneity our control variables are those time varying variables that may affect board independence and also firm performance. We follow Wintoki et al (2012) to select those variables adding the log of board size to a subset of variables used in equation [4] as follows;

$$\begin{aligned} Performance_t &= \alpha + \delta_1 Performance_{t-1} + ... + \delta_p Performance_{t-p} + \beta_1 IND + \beta_2 LogBoardSize + \\ &+ \beta_3 LogFirmSize + \beta_4 Debt + \beta_5 LogSegments + \beta_6 LogFirmAge + \beta_7 MTB + \beta_8 RETSTD_{t-1} + \\ &+ \beta_7 CEO\_Chair + \gamma \cdot YearDummies + \varepsilon \end{aligned} \quad [7]$$

where the definition of the control variables are as in equation [4]. However, we also take into account the other determinants of board independence considered in equations [4] and [6]. In the Dynamic System panel GMM estimations all explanatory variables are analyzed as non-strictly exogenous variables except firm age and the year dummy variables (strictly exogenous). One lag of firm performance is introduced to get its dynamics, it is sufficient based on OLS estimation of the performance models with different lag stricture specifications including industrial sector fixed effects. This methodology obtains the coefficients of the performance model with the simultaneous estimation of the model in differences and in levels. Instruments in the differenced equation are lags 2 to 6 of return on assets and of all non-strictly exogenous variables, and the first difference of strictly exogenous variables. Instruments of the equation in levels are lag 1 of the first difference of return on assets and of all non-strictly exogenous variables, and the level of the strictly exogenous variables. Our regressions are executed using xtabond2 in Stata, with the two steps estimator and the collapse option. This option reduces the number of instruments, since creates one for each variable and lag distance instead of one for each variable, lag distance and time period. Standard errors are modified with the Windmeijer (2005) small sample correction.

Table 8. Firm performance and board structure

Empirical models firm performance estimated with the Dynamic System GMM estimator (Holtz-Eakin et al., 1988, Arellano and Bond, 1991, Arellano and Bover, 1995, and Blundell and Bond, 1998). It is estimated in two steps and all instruments are collapsed. Standard errors are modified with the Windmeijer (2005) finite-sample correction. Performance (the dependent variable) is measured by return on assets (calculated as the net income plus interest payments, net of tax effects, over the amount of the previous year's total assets), LogBoardSize is the log of the number of board directors, see Table 6 for the rest of explanatory variables. Log(FirmAge) and year dummy variables are assumed strictly exogenous. AR(1) and AR(2) are tests for first-order and second-order serial correlation in the first-differenced residuals, under the null of no serial correlation. The Hansen test of over-identification is under the null that all instruments are valid. The Diff-in-Hansen test of exogeneity is under the null that instruments are exogenous (GMM refer to all non-strictly exogenous variables, and Exogenous instruments to strictly exogenous variables). The instruments used in the GMM estimation are: In the differenced equation: lags 2-6 of ROA and of all non-strictly exogenous variables, and the first difference of strictly exogenous variable; in the level equations: lag 1 of the first difference of ROA and of all non-strictly exogenous variables, and the level of the strictly exogenous variables. *** denotes significance at the 1% level; ** denotes significance at the 5% level; * denotes significance at the 10% level.

	Determinants of Equation [4]				Determinants of Equation [6]				Model of Wintoki et al. (2012)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ROA_{t-1}	0.3502***	0.3239***	0.3047***	0.3171***	0.4569***	0.4554***	0.4637***	0.4536***	0.556***	0.5267***	0.5006***	0.5157***
	(3.1284)	(2.852)	(2.7337)	(2.6113)	(4.3047)	(4.0428)	(4.478)	(4.4501)	(3.7513)	(4.4875)	(4.0809)	(4.626)
Declared Independents	-0.9559				-1.655				-1.4405			
	(-0.2687)				(-0.389)				(-0.469)			
Strictly Independents		-4.3856		-3.3958		-2.5537		-3.2888		-6.3803		-4.2242
		(-1.289)		(-0.8477)		(-0.7369)		(-0.7615)		(-1.481)		(-0.9401)
Non-strictly Independents			1.6767	1.2877			-0.0417	-1.4096			3.5608	1.701
			(0.404)	(0.2741)			(-0.0131)	(-0.2658)			(1.166)	(0.4841)
LogBoardSize									-2.7464	-0.9245	-0.3551	1.1135
									(-0.6778)	(-0.2779)	(-0.1182)	(0.3582)
Log(Market Capitalization)	1.453**	1.417**	1.3426***	1.4508***	2.0605***	2.0976***	2.0897***	2.0965***	2.3976***	2.2769***	2.2369***	2.1944***
	(2.5926)	(2.4631)	(2.3579)	(2.7443)	(3.4396)	(3.501)	(3.5022)	(3.8025)	(5.3799)	(4.2149)	(4.1717)	(3.9508)
Debt	3.5505	4.892	4.1564	4.786	4.2175	3.4297	2.6072	3.474	-4.3927	-3.6545	-4.5616	-4.8531
	(0.9873)	(1.3746)	(1.1007)	(1.2318)	(1.0166)	(0.7999)	(0.5832)	(0.7619)	(-0.9482)	(-0.6819)	(-0.9475)	(-0.9338)
LogSegments	0.713	0.5561	0.92	0.624	0.2885	0.3298	0.3401	0.2855	0.0415	-0.2181	-0.1453	-0.7517
	(1.0023)	(0.5395)	(0.8525)	(0.6825)	(0.2953)	(0.2811)	(0.2763)	(0.2694)	(0.029)	(-0.1738)	(-0.1026)	(-0.6065)
LogFirmAge	-1.2022	-0.7968	-0.6618	-0.6845	-0.7892	-0.7857	-0.6648	-0.8814	-2.0764*	-2.3023**	-2.056*	-1.9945**
	(-0.9167)	(-0.621)	(-0.4608)	(-0.4837)	(-0.6204)	(-0.6443)	(-0.5313)	(-0.671)	(-1.831)	(-2.1077)	(-1.7825)	(-1.9839)
MTB	0.422*	0.4373	0.4395*	0.4236	0.3664*	0.3727	0.3543*	0.3702	0.0456	0.054	0.1252	0.1169
	(1.6721)	(1.6408)	(1.6789)	(1.5799)	(1.7128)	(1.6494)	(1.7455)	(1.6413)	(0.1411)	(0.2153)	(0.546)	(0.537)
R&D	10.0596	11.9303	13.9466	12.3396	-0.46	0.0772	-2.6908	1.1331				
	(0.6179)	(0.7088)	(0.8858)	(0.7629)	(-0.0288)	(0.0038)	(-0.1424)	(0.0616)				
$RETSTD_{t-1}$	1.313	-2.0924	-0.6457	-0.3217	7.1699	1.7173	3.6065	3.6414	26.6753**	20.8498*	20.3465*	22.9217*
	(0.1257)	(-0.2133)	(-0.0638)	(-0.0301)	(0.5851)	(0.1477)	(0.3141)	(0.319)	(2.0417)	(1.6999)	(1.7362)	(1.9529)
FCF	74.0635***	77.0344***	76.7053***	76.4388***	59.9697***	61.5801***	58.3244***	61.7551***				
	(4.9036)	(4.688)	(4.8677)	(4.5693)	(4.6578)	(3.7827)	(4.1893)	(4.8283)				
SAPerformance	-0.046	-0.0449	-0.0238	-0.0353	-0.1008	-0.1189	-0.1148	-0.1131				
	(-0.4831)	(-0.4771)	(-0.249)	(-0.3808)	(-0.9141)	(-1.1093)	(-1.0248)	(-1.031)				
CEO_Chair	-0.9274	-0.5774	-0.5928	-0.5405	-0.6669	-0.7908	-0.8393	-0.8696	-0.1655	-1.2493	-0.8284	-1.1947
	(-0.7561)	(-0.4908)	(-0.4807)	(-0.4348)	(-0.5225)	(-0.6058)	(-0.6156)	(-0.6776)	(-0.1143)	(-0.8184)	(-0.5362)	(-0.7705)
ExDirectors_Own	-0.0081	-0.0034	-0.0021	-0.0014	0.0318	0.0357	0.036	0.0308				
	(-0.1356)	(-0.0526)	(-0.0404)	(-0.021)	(0.8067)	(0.7891)	(0.8848)	(0.7992)				
IndDirectors_Own	-0.2265	-0.2605	-0.297	-0.297	-0.4385	-0.4996	-0.4262	-0.4455				
	(-0.5321)	(-0.6803)	(-0.7681)	(-0.7319)	(-0.8915)	(-1.2689)	(-0.9612)	(-0.9049)				
PropDirectors_Own	-0.0282	-0.0138	-0.0195	-0.0135	0.0037	0.0055	0.0007	0.0056				
	(-0.8378)	(-0.3715)	(-0.5315)	(-0.3678)	(0.1373)	(0.1924)	(0.0229)	(0.2612)				
C3	0.0115	-0.0022	0.0161	-0.0012	-0.0265	-0.022	-0.0218	-0.0233				
	(0.3171)	(-0.061)	(0.3989)	(-0.0286)	(-0.5371)	(-0.4421)	(-0.4498)	(-0.4786)				
LogCEOTenure					-0.1591	-0.0686	-0.0903	0.0139				
					(-0.2755)	(-0.1078)	(-0.1515)	(0.0219)				
Retirement					3.31	3.9108	4.6407	3.6969				
					(1.014)	(1.0356)	(1.2652)	(1.0691)				
Constant	-7.8427*	-7.9961**	-9.6616**	-9.0356*	-12.028**	-12.2906***	-12.6145***	-11.8982**	-2.5089	-4.2493	-7.2878	-9.5204
	(-1.7605)	(-2.0475)	(-2.1822)	(-1.7912)	(-2.355)	(-3.2863)	(-2.8279)	(-2.3013)	(-0.3113)	(-0.6311)	(-1.2679)	(-1.4741)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# Obs	952	952	952	952	886	886	886	886	952	952	952	952
F	30.8752***	34.1892***	29.4733***	29.7128***	35.646***	29.4119***	27.0545***	29.308***	17.9414***	24.2775***	18.3888***	21.8279***
AR(1) test (p-value)	0.0003	0.0003	0.0005	0.0005	0.0003	0.0003	0.0002	0.0003	0.001	0.0007	0.0008	0.0005
AR(2) test (p-value)	0.4769	0.4573	0.433	0.4591	0.6965	0.764	0.7384	0.7619	0.2462	0.2775	0.2484	0.2712
Hansen test of over-identification (p-value)	0.516	0.585	0.525	0.53	0.369	0.369	0.429	0.449	0.711	0.492	0.484	0.449
Diff -in-Hansen test of exogeneity of GMM instuments (p-value)	0.815	0.909	0.94	0.891	0.396	0.621	0.569	0.505	0.605	0.558	0.579	0.292
Diff -in-Hansen test of exogeneity of Exogenous instruments (p-value)	0.662	0.515	0.516	0.578	0.608	0.525	0.581	0.621	0.957	0.251	0.302	0.271

Table 8 show the estimation of the performance models when the explanatory variables of equation [4] (models 1-4), and of equation [6] (models 5-8) are included as controls, and when just the explanatory variables in Wintoki et al. (2012) are considered (models (9-12). In each case board independence is measured as the percentage of declared independents, strictly independents and non-strictly independents. In models 4, 8, and 12 the proportion of strictly and non-strictly independents are included simultaneously. Results in Table 8 show that all our board independence measures do not affect firm performance, consistently with their optimality (and with results in Wintoki et al, 2012). Just when firm fixed effects are used (omitted to save space) statistically significant effects of board independence are detected, however probably these estimations are biased due to the endogeneity problem and manifests the need of the GMM estimation. The GMM estimations in Table 8 present correct values in all diagnostics tests; statistically significant auto correlation just of order one in the difference model, no over identification, and exogenous instruments. We also winsorized all explanatory variables (with percentiles 1% and 99%, and 5% and 95%) to control any problem with outliers, used return on sales as the performance measure to value the dependence of our results on the performance measure, and used just one observation every two years to control for persistence in corporate governance measures (Wintoki et al., 2012), and obtain robust results; board independence measures do not affect firm performance. Just with winsorized variables the proportion of strictly independents presents a statistically significant coefficient (negative) in model 2 of Table 8, not in models 4, 6, 10 and 12. Non-tabulated results available on request, not shown for space considerations.

4. Robustness checks

4.1. Different proxy variables.

We use different proxies to measure the determinants of optimal board independence. This may introduce changes in our results if alternative and valid proxies are used. Therefore, we estimate the models in Table 6 with different alternative proxies. There are some differences regarding the statistically significant variables, but the overall conclusions remain; all of our different measures of board independence seem to react with the expected sign to variations in the optimal board independence determinants, and ownership determinants remain as the most relevant. The R^2 statistics are also similar, achieving the highest value when the dependent variable is the portion of non-strictly independents and the lowest when it is the declared portion. Regarding ownership structure, a first trial has been to drop C3, since it is not among the explanatory variables in Linck et al. (2008), then it has been replaced by the ownership of the largest shareholder, of the five largest shareholders, and of all large shareholders. Firm age may be not related with firm complexity among mature firms, therefore, a first trial has been to drop it, and a second one to add its square value (to reach a maximum in terms of firm complexity), in the last case no firm age variable was statistically significant. The number geographical segments have been replaced by the number of different business activities (as reported in the Thomson Financial database) and by the sum of both. Firm size has been measured by sales instead of market capitalization, and performance by return on sales instead of return on assets, also the industry adjustment of performance have been done at subsector level instead of at sector level. Finally, regarding the CEO, its tenure have been measured by the average tenure of executive directors instead to measuring it directly on CEOs identified with our identification procedure, the retirement situation have been identified whenever the CEOs tenure is higher than 20 years instead of 30, and as in Linck et al. (2008) we replace the CEO_Chair variable by its lagged value (losing the first year of observations). We omit all these results to save space but are available on request.

4.2. Ownership determinants of board structure and independence criteria related to significant shareholders.

Ownership structure seems to be a relevant determinant of board independence, especially for non-strictly independents (Tables 6 and 7). Although it is consistent with the peculiarity of Spanish firms with a broad presence of controlling shareholders, this may be due to the independence criteria used to classify independents as non-strictly, mainly the relationship with significant shareholders; however our results remain when criteria 4 and 5 in Table 2 are not considered to classify directors as non-strictly independent, see Table 9. Even if non-strictly independents do not include independent directors related to significant shareholders, their presence is positively related with independent directors' ownership and negatively related with proprietary directors and with significant shareholders ownership. Results in Table 9 and in Table 6 do not differ qualitatively. Results in Table 7 also remain with these alternative measures of strictly and non-strictly independents, omitted to save space.

Table 9. Significant shareholders independence criteria and Board structure

Criteria 4 and 5 of Table 2 are not considered to compute strictly and non-strictly independence. Empirical models of optimal board independence (equations [4] and [6]) are estimated with firm fixed effects. t statistics are in parenthesis and are computed with robust standard errors clustered by firm (Huber, 1967, White, 1980, 1982, and Petersen, 2009). Declared board independence is decomposed into strictly board independence (models 2 and 3) and non-strictly independence (models 3 and 4). See Table 6 for a description of explanatory and dependent variables. Wald F (xMeetIC) is a test of the joint statistical significance of all variables multiplied by MeetIC. *** denotes significance at the 1% level; ** denotes significance at the 5% level; * denotes significance at the 10% level.. *** denotes significance at the 1% level; ** denotes significance at the 5% level; * denotes significance at the 10% level.

		% Independent directors			
	Prediction	Srtictly	Non-Strictly	Srtictly	Non-Strictly
		(1)	(2)	(3)	(4)
Log(Market Capitalization)	(+)	-0.006	0.0092	-0.0034	0.0082
		(-0.4612)	(0.6309)	(-0.2558)	(0.5581)
Debt	(+)	-0.0005	0.0316	0.0023	0.025
		(-0.0106)	(0.5802)	(0.0415)	(0.4223)
LogSegments	(+)	-0.0158	0.0298**	-0.0139	0.0257***
		(-1.3977)	(2.6041)	(-1.174)	(2.0915)
LogFirmAge	(+)	0.3066***	-0.2006*	0.2763**	-0.1365
		(2.8973)	(-1.6782)	(2.5975)	(-1.2449)
MTB	(-)	0.0015	0.0011	0.0017	0.0016
		(0.7671)	(0.458)	(0.8734)	(0.6098)
R&D	(-)	-0.0074	-0.1449	0.0109	-0.1335
		(-0.0101)	(-0.3387)	(0.0153)	(-0.3557)
$RETSTD_{t-1}$	(-)	0.0388	-0.0401	-0.0127	0.0423
		(0.264)	(-0.314)	(-0.0799)	(0.3051)
FCF	(+)	-0.0215	0.0377	0.0171	0.015
		(-0.2939)	(0.3818)	(0.2359)	(0.1545)
SAPerformance	(-)	-0.0005	0.0018*	-0.0004	0.0016
		(-0.4075)	(1.8546)	(-0.378)	(1.4883)
CEO_Chair	(+)	0.0142	0.003	0.0199	-0.0045
		(0.7523)	(0.1447)	(0.9912)	(-0.2088)
ExDirectors_Own	(-)	0.0002	-0.0005	0.0003	-0.0002
		(0.2054)	(-0.4716)	(0.3278)	(-0.1916)
IndDirectors_Own	(+)	-0.0012	0.0412***	-0.0012	0.0417***
		(-0.2539)	(6.9459)	(-0.2788)	(6.8723)
PropDirectors_Own	(-)	0.0006	-0.0012**	0.0008	-0.0012**
		(1.0782)	(-2.1943)	(1.3929)	(-2.1185)
C3	(-)	-0.001*	-0.0013*	-0.001*	-0.0015*
		(-1.8762)	(-1.6997)	(-1.9544)	(-1.9676)
LogCEOTenure	(-)			0.0003	-0.0019
				(0.0585)	(-0.2601)
Retirement	(-)			-0.0661	0.0086
				(-1.234)	(0.1467)
Constant		-0.5829**	0.7069**	-0.525*	0.5577*
		(-2.059)	(2.3629)	(-1.8517)	(1.9432)
Year fixed effects		Yes	Yes	Yes	Yes
N		952	952	886	886
R^2		0.2586	0.2824	0.2422	0.2694
R^2 Adjusted		0.2411	0.2654	0.2211	0.249
F		4.5183***	7.9007***	4.1287***	7.4924***

4.3. Simplifying explanatory variables, different sampling frequency and sample period, and excluding special industrial sectors

Following Linck et al. (2008) we use principal components analysis to extract a common factor from the proxies of complexity, except firm size than may detect other aspects such as visibility to investors and shareholders advocates, and a common factor form the proxies of cost of monitoring and advising. COMPLEX is the common factor of debt, firm age, and business segments with the highest eigenvalue. It reflects the common information in those variables; firm complexity. MONCOST is the common factor of the market to book ratio, research and development expenses and stock return standard deviation. These six variables are replaced by COMPLEX and MONCOST to estimate the models of Table 6 and we obtain equivalent results, also with the models of Table 7. In Table 10 column 1 we show the estimation of the model of equation [6] when the dependent variable is the proportion of non-strictly independent directors. This proportion reacts to variations of board independence determinants (mainly ownership measures) with the expected sing, not the opposite. All omitted results are available on request.

Corporate governance variables are quite stable across time, and our sample with one observation per year may have difficulties to capture variation in such variables (there is change from one year to the next in 48%-54% of observations in board independence measures, 54%-85% in ownership measures). Therefore, following previous literature (e.g., Linck et al., 2008, Wintoki et al., 2012) we estimate our models of board independence with just one observation every two years (then board independence measures change in 62%-70% of observations, ownership measures in 66%-93%). In addition we also estimate our models in the last period of our sample, from 2008 to 2012; beginning one year after the implementation of mandatory definition of independent directors (the proportion of non-strictly independents decreases over time and presents a high negative jump in 2007). In both cases, results leave our conclusions unaltered; ownership determinants are the most relevant ones, and all three measures of board independence seem to react to board independence determinants with the expected sing. Table 10 show the estimation of equation [6] when the dependent is the proportion of non-strictly independents, sampling every two years in column 2, and with just the last sample period in column 3. Non-strictly independence should react to board determinants with the unexpected sign if optimal board independence jointly with the recommended level of independence were the origin of non-strictly independents, it does not, although CEO_Chair is statistically significant (just al 10% level) and presents the unexpected sing in column 3. The rest of results are omitted to save space.

Financial companies (including insurance firms) are subject to a special regulation, and also a special supervisor such as the Bank of Spain for banks, therefore we compute the models of board independence without financial companies. Furthermore, due to the main role of the real state industrial sector in the recent crisis, with their relationship with banks, we also drop real state firms. In both cases, our results remain robust. With the proportion of non-strictly independents and equation [6], Table 10 shows the respective results in columns 4 and 5. There are no qualitative differences with results in Table 6, column 6. The rest of results (other measures of board independence and models of Table 7) are omitted for space considerations.

Table 10. Aggregate variables, sampling frequency, sample period and special industrial sectors

The empirical models of optimal board independence (equations [6]) are estimated with firm fixed effects. t statistics are in parenthesis and are computed with robust standard errors clustered by firm (Huber, 1967, White, 1980, 1982, and Petersen, 2009). Board independence is measured by proportion of non-strictly independent directors. COMPLEX (MONCOST) is the common factor of debt, LogFirmAge, and LogSegments (MTB, R&D, and RETSTDt-1) with highest eigenvalue. It is computed with principal components analysis. See Table 6 for a description of the rest of explanatory variables. Column 1 presents the results when six variables are replaced by COMPLEX and MONCOST. In column 2 there is one observation every two years (2004, 2006, 2008, 2010, 2012), and in column 3 just observations from 2008 to 2012. Column 4 show the results when financial firms are omitted, and Column 5 when real state firms are also omitted. *** denotes significance at the 1% level; ** denotes significance at the 5% level; * denotes significance at the 10% level.

		Non-Strictly independent directors				
	Prediction	Pincipal Components	Two years sampling	2008-2012	No Financial Firms	No Financial and Real State Firms
		(1)	(2)	(3)	(4)	(5)
Log(Market Capitalization)	(+)	0.0098	0.0059	-0.0075	0.007	0.0093
		(0.6664)	(0.3908)	(-0.5696)	(0.4669)	(0.5188)
Debt	(+)		0.0289	0.0897	0.0575	0.0673
			(0.3802)	(1.6164)	(1.0101)	(1.0759)
LogSegments	(+)		0.0476***	0.0173	0.0224*	0.0179
			(3.7413)	(1.5149)	(1.875)	(1.5268)
LogFirmAge	(+)		-0.1941	-0.1471	-0.1522	-0.1357
			(-1.6467)	(-1.2329)	(-1.4317)	(-1.1989)
MTB	(-)		0.0027	0.0056	0.0013	0.0013
			(0.9497)	(1.0847)	(0.5761)	(0.5229)
R&D	(-)		-0.1413	0.2078	-0.067	-0.007
			(-0.3439)	(0.665)	(-0.2532)	(-0.0226)
$RETSTD_{t-1}$	(-)		-0.0146	-0.2866***	-0.0071	-0.0474
			(-0.0699)	(-2.6646)	(-0.0491)	(-0.2954)
COMPLEX	(+)	0.0182*				
		(1.683)				
MONCOST	(-)	0.0037				
		(0.4613)				
FCF	(+)	0.0297	0.0386	0.0089	-0.0096	0.0743
		(0.3162)	(0.2943)	(0.0664)	(-0.1085)	(0.6591)
SAPerformance	(-)	0.0014	0.0016	0.0014	0.0017	0.0011
		(1.3997)	(1.5272)	(1.4323)	(1.6497)	(0.9984)
CEO_Chair	(+)	-0.0037	0.0073	-0.0206*	-0.0158	-0.0279
		(-0.1707)	(0.3494)	(-1.8966)	(-0.7649)	(-1.2506)
ExDirectors_Own	(-)	0	-0.0005	-0.0022***	-0.0001	0.0003
		(0.0024)	(-0.5222)	(-3.5197)	(-0.0626)	(0.2561)
IndDirectors_Own	(+)	0.0412***	0.0452***	0.0578***	0.0462***	0.0464***
		(6.5281)	(5.4862)	(6.3533)	(6.2062)	(6.0953)
PropDirectors_Own	(-)	-0.0012**	-0.0013**	-0.001***	-0.0012**	-0.0013**
		(-2.1445)	(-2.0683)	(-2.6548)	(-2.0189)	(-2.1464)
C3	(-)	-0.0013*	-0.0016	0.0005	-0.0016**	-0.0018**
		(-1.758)	(-1.368)	(0.6519)	(-2.1372)	(-2.3395)
LogCEOTenure	(-)	-0.0033	-0.0069	-0.0016	-0.0058	-0.0066
		(-0.4583)	(-0.9656)	(-0.2747)	(-0.7223)	(-0.7489)
Retirement	(-)	0.0117	0.0283	0.0091	0.0107	0.0067
		(0.1933)	(0.4875)	(0.0617)	(0.1518)	(0.0936)
Constant		0.2495***	0.708**	0.5644	0.6279**	0.5947*
		(2.7009)	(2.2879)	(1.6389)	(2.2166)	(1.9026)
Year fixed effects		Yes	Yes	Yes	Yes	Yes
N		886	492	473	758	705
R^2		0.2619	0.3117	0.2156	0.3272	0.3414
R^2 Adjusted		0.2448	0.2825	0.1809	0.3052	0.3182
F		7.0382***	6.557***	20.3521***	8.6521***	8.7***

4.4. Small firms

Previous literature found a special behavior of small firms regarding the structure of the board of directors, even after controlling for firm size (Linck et al, 2008). However, the recommended level of board independence is the same for all sized firms. Furthermore, given that optimal board size and independence is positively related with firm size, this recommendation may have stronger implications among small firms, if they want to meet the recommendation. Recall also that board size is an integer number. In section 3.1 we found that the correlation coefficient between the proportion of strictly and non-strictly independents is closest to -1 among small firms, lowest quartile in market capitalization, classified as wanting to meet the recommended level of board independence (SCMIR). Therefore, we measure whether board independence determinants have different coefficients in these firms (122 observations, belonging to 21 firms) adding as new variables the multiplication of a dummy variable identifying them (MeetIRSC) with these determinants.[9] We also find a different behavior in these firms; there are many coefficients statistically different in SCMIR firms than in the rest of firms (see Table 11). As shown by the Wald test, these new variables are jointly statistically significant in all estimated models. However, we do not find the coefficients of board independence determinants to be of the expected sing just when the proportion of strictly independents is the dependent variable. Although, performance (for all firms) and the market to book ratio (just for SCMIR firms) present the unexpected sign when the dependent variable is the proportion of non-strictly independents, the rest of statistically significant variables show the expected sing (Table 11, columns 3 and 6). As in the models of Tables 6 and 7, R^2 is the highest when the dependent variable is the proportion of non-strictly independents, and the lowest when it is the declared proportion. When the dependent variable is the declared proportion of independents, just the market to book ratio for all firms and research and development expenses for SCMIR firms present an unexpected sing, firm age have positive but statistically insignificant coefficient in SCMIR firms (column 1, 0.1332-0.0894=0.0438, p-value of Wald test 0.6), and the rest of statistically significant variables present the expected sing. Finally, when the dependent is the proportion of strictly independents 7 variables in the models of columns 2 and 5 present a statistically significant different coefficient in SCMIR firms, and generate an overall coefficient with the unexpected sing for most of the statistically significant variables, when just one of the statistically significant coefficients present the unexpected sing for the rest of firms (executive directors ownership). These results are inconsistent with the optimal board independence theory (fixing the level of strictly independents) jointly with independence recommendations to generate non-strictly independents, although confirm the special characteristics of

[9] The retirement variable multiplied by the MeetIRSC dummy variable is not included in columns 4 to 6 of Table 11 since there is just one SCMIR firm in the retirement situation, and generates perfect multicollinearity with the firm fix effect of this firm.

boards in small firms. We achieve similar results when models of board independence in Table 6 are estimated on the subsample of SCMIR firms, results available on request.

Table 11. Small firms wanting to meet the recommended level of board independence

Empirical models of optimal board independence (equations [4] and [6]) with firm fixed effects. t statistics are in parenthesis and are computed with robust standard errors clustered by firm (Huber, 1967, White, 1980, 1982, and Petersen, 2009). MeetIRSC is a dummy variable identifying firms in the lowest quartile of market capitalization classified as meeting the board independence level recommendation (those with an average percentage of declared independent directors reaching 1/3). See Table 6 for a description of explanatory and dependent variables. Wald F (xMeetIRSC) is a test of the joint statistical significance of all variables multiplied by MeetIRSC. *** denotes significance at the 1% level; ** denotes significance at the 5% level; * denotes significance at the 10% level.

	Prediction	Declared	Strictly	Non-Strictly	Declared	Strictly	Non-Strictly
		(1)	(2)	(3)	(4)	(5)	(6)
Log(Market Capital	(+)	-0.002	-0.0047	0.0027	0.0033	-0.007	0.0103
		(-0.1836)	(-0.4023)	(0.2189)	(0.3228)	(-0.6047)	(0.852)
Debt	(+)	0.0157	-0.0159	0.0316	0.0107	-0.0244	0.035
		(0.3197)	(-0.297)	(0.5846)	(0.2033)	(-0.4351)	(0.6034)
LogSegments	(+)	0.018*	-0.0191	0.0371***	0.0152	-0.0209	0.0361**
		(1.7808)	(-1.5597)	(2.8738)	(1.4394)	(-1.645)	(2.4855)
LogFirmAge	(+)	0.1332*	0.2939***	-0.1607	0.1246	0.2642**	-0.1396
		(1.7222)	(2.8719)	(-1.4624)	(1.575)	(2.5115)	(-1.2312)
MTB	(-)	0.0034**	0.0014	0.002	0.0034*	0.0019	0.0015
		(2.0827)	(0.8555)	(0.8472)	(1.9343)	(1.2129)	(0.6501)
R&D	(-)	-0.4933***	-0.679***	0.1857	-0.4326**	-0.6176***	0.185
		(-3.1211)	(-4.8335)	(1.0321)	(-2.4981)	(-4.6729)	(0.9977)
$RETSTD_{t-1}$	(-)	0.0223	0.0308	-0.0085	0.0214	0.0118	0.0096
		(0.2358)	(0.1985)	(-0.0691)	(0.2202)	(0.0724)	(0.0724)
FCF	(+)	-0.0337	-0.0729	0.0392	0.015	-0.0232	0.0382
		(-0.3657)	(-1.0931)	(0.4138)	(0.1415)	(-0.4054)	(0.373)
SAPerformance	(-)	0.0013	-0.0016	0.0029***	0.0012	-0.0019*	0.0031***
		(1.5293)	(-1.4469)	(2.9942)	(1.3193)	(-1.7628)	(2.7892)
CEO_Chair	(+)	0.0067	0.0007	0.006	0.0058	0.007	-0.0012
		(0.3279)	(0.0424)	(0.3065)	(0.2471)	(0.4061)	(-0.0588)
ExDirectors_Own	(-)	-0.0002	0.0012**	-0.0013***	0	0.0016***	-0.0016***
		(-0.3382)	(2.1651)	(-2.7546)	(-0.0093)	(2.9012)	(-3.1494)
IndDirectors_Own	(+)	0.0409***	-0.0012	0.0421***	0.0407***	-0.0004	0.0411***
		(9.8214)	(-0.2719)	(8.7921)	(9.867)	(-0.1077)	(9.1206)
PropDirectors_Owr	(-)	-0.0003	-0.0001	-0.0002	-0.0002	0.0002	-0.0004
		(-0.8245)	(-0.2014)	(-0.5415)	(-0.4004)	(0.3826)	(-0.9121)
C3	(-)	-0.0029***	-0.0014***	-0.0015**	-0.0029***	-0.0015***	-0.0014**
		(-5.2236)	(-2.9721)	(-2.4003)	(-5.1536)	(-3.0677)	(-2.1276)
LogExTenure	(-)				0.0025	-0.0006	0.0032
					(0.3564)	(-0.1219)	(0.4269)
Retirement	(-)				-0.0579***	-0.075	0.0171
					(-3.0647)	(-1.3946)	(0.2896)
Log(Market Capitalization) x Mee		0.0235	-0.0089	0.0324	0.0176	0.0141	0.0036
		(1.3348)	(-0.3528)	(1.1752)	(0.8177)	(0.5122)	(0.1128)
Debt x MeetIRSC		0.0049	0.0492	-0.0443	0.0429	0.1072	-0.0643
		(0.032)	(0.3396)	(-0.2876)	(0.2717)	(0.621)	(-0.3914)
LogSegments x MeetIRSC		-0.0115	0.0102	-0.0218	-0.0043	0.0364	-0.0408
		(-0.5708)	(0.3666)	(-0.722)	(-0.2168)	(1.4068)	(-1.3903)
LogFirmAge x MeetIRSC		-0.0894**	-0.0354	-0.0539	-0.0555	-0.0902	0.0347
		(-2.4826)	(-0.5875)	(-0.8278)	(-1.4763)	(-1.5762)	(0.6421)
MTB x MeetIRSC		0.0187*	-0.0181**	0.0369***	0.0174*	-0.0124	0.0298**
		(1.9764)	(-1.9935)	(2.7065)	(1.7793)	(-1.5068)	(2.0393)
R&D x MeetIRSC		4.5524***	9.0345***	-4.4821***	5.1699***	8.1541***	-2.9841*
		(6.1931)	(9.5966)	(-3.3777)	(4.3829)	(6.4654)	(-1.6725)
$RETSTD_{t-1}$ x MeetIRSC		-0.5434***	0.1591	-0.7025**	-0.6029**	-0.275	-0.3279
		(-2.7194)	(0.4162)	(-2.0572)	(-2.5003)	(-0.5786)	(-0.6974)
FCF x MeetIRSC		-0.0006	0.1681	-0.1687	-0.2693	0.1982	-0.4675
		(-0.0022)	(0.7921)	(-0.4876)	(-1.0513)	(0.5404)	(-1.4132)
SAPerformance x MeetIRSC		-0.0002	0.0038*	-0.004	0.0003	0.0044**	-0.004
		(-0.1246)	(2.3545)	(-1.567)	(0.1573)	(2.001)	(-1.5472)
CEO_Chair x MeetIRSC		0.1236**	0.0682	0.0555	0.1115**	0.0995*	0.012
		(2.3969)	(1.2606)	(0.9466)	(1.9949)	(1.7807)	(0.2272)
ExDirectors_Own x MeetIRSC		-0.0001	-0.0021**	0.002	0.0005	-0.0022*	0.0027
		(-0.1304)	(-2.2324)	(1.4831)	(0.4719)	(-1.7069)	(1.5875)
IndDirectors_Own x MeetIRSC		0.1017***	-0.0037	0.1054**	0.1048***	-0.0077	0.1124***
		(3.781)	(-0.0689)	(2.0955)	(4.425)	(-0.1745)	(2.8642)
PropDirectors_Own x MeetIRSC		-0.0007	0.0033***	-0.004***	-0.0003	0.0042***	-0.0046***
		(-0.8695)	(3.0044)	(-2.8555)	(-0.3388)	(3.1617)	(-3.0793)
C3 x MeetIRSC		0.0022	0.0025**	-0.0003	0.0016	0.0026*	-0.001
		(1.4916)	(1.9816)	(-0.1537)	(1.0691)	(1.9641)	(-0.6235)
LogExTenure x MeetIRSC					-0.0182*	-0.0052	-0.013
					(-1.7513)	(-0.2492)	(-0.5873)
Constant		0.1107	-0.5288*	0.6394**	0.0875	-0.4353	0.5228*
		(0.5805)	(-1.9497)	(2.2037)	(0.4607)	(-1.5892)	(1.7943)
Year fixed effects		Yes	Yes	Yes	Yes	Yes	Yes
N		952	952	952	886	886	886
R^2		0.2683	0.3273	0.3693	0.2811	0.3291	0.3466
R^2 Adjusted		0.2395	0.3008	0.3445	0.2479	0.2982	0.3165
F		743753.949	982124.376	1048.5157	432179.374	2321712.6	1598.5638
Walf F (xMeetIRSC)		25.1***	45.99***	14.15***	24.69***	33.79***	6.39***

4.5. Statistical methodology

We estimate the models board independence simultaneously when the dependent variable is the proportion of strictly independents and the proportion of non-strictly independents with the Seemingly Unrelated Regression (SURE) methodology (Zellner, 1962). This allows us to compute a Wald test under the null hypothesis that all the coefficients of board independence determinants in the non-strictly and strictly independents models are equal but with the opposite sign. This null hypothesis is rejected always with a significance level higher than 1% (Table 12). The models are estimated with feasible least squares allowing correlation between the error terms of both models.[10] Firm and year fixed effects are also considered. We estimate the models in Table 6 (equations [4] and [6]) and in Table 7 when a dummy variable identifying firms classified as wanting to meet the recommended level of board independence is multiplied by each board independence determinant. In the last case it is computed a Wald test where the null is on the total effect of a determinant, it is also clearly rejected. Furthermore, we also compute the Wald test for each board independence determinant and it is rejected for most of the determinants that where statistically significant in Tables 6 and 7. Although the estimated SURE models show some differences respect to Tables 6 and 7 in terms of statistically significant determinants, the overall conclusions remain; ownership determinants are the most relevant, and non-strictly independents tend to react with the expected sing.

[10] See Greene (2003), chapter 14, for a description of the Seemingly Unrelated Regressions model and its estimation.

Table 12. Wald test on strictly and non-strictly independents models

Wald test of the null hypothesis that coefficients of board independence determinants are equal when the dependent variable is the proportion of strictly and the proportion of non-strictly independents but with the opposite sign. It is implemented on the estimation with seemingly unrelated equations (SURE) methodology (Zellner, 1962) of a model for each of the dependent variables. The Wald test is computed for each board independence determinant and for all jointly. The test is computed when the SURE model is computed with the models in Table 6 and in Table 7. Also it has bet estimated with the board independence determinants in equation [4] and in equation [6]. For models in Table 7, Not MeetIR show the Wald test for firms classified as not meeting the independence recommendation level, MeetIR for firms classified as meeting (the test is on the overall coefficient of each determinant). Statistically significant coefficients in Tables 6 and 7 are in bold. *** denotes significance at the 1% level; ** denotes significance at the 5% level; * denotes significance at the 10% level.

	Models of Table 6		Models of Table 7			
	Equation [4]	Equation [6]	Equation [4]		Equation [6]	
			Not MeetIR	MeetIR	Not MeetIR	MeetIR
	χ^2	χ^2	χ^2	χ^2	χ^2	χ^2
Log(Market Capitalization)	0.25	0.52	0.06	1.5	0	0.8
Debt	0.85	0.65	0.69	0.33	0.64	0.49
LogSegments	**4.14****	**2.85***	0.24	5.84**	0	4.82**
LogFirmAge	**4.8****	**8.11*****	**2.66**	**0.74**	**4.12****	**2.89***
MTB	2.3	3.53*	0.74	5.05**	1.09	4.22**
R&D	0.16	0.11	1.42	**0**	1.43	0
$RETSTD_{t-1}$	0	0.17	0.42	0.17	0.85	0.02
FCF	0.08	0.29	0.61	4.16**	0.01	2.07
Performance	**3.84****	2.52	0.01	6.59**	0.32	2.13
CEO_Chair	2.62	2.06	5.32**	0.09	5.29**	0.14
ExDirectors_Own	0.54	0.1	**0.32**	**3.61***	**0.13**	**2.06**
IndDirectors_Own	**103.44*****	**112.81*****	**95.18*****	**12.3*****	**97.08*****	**14.07*****
PropDirectors_Own	**5.12****	**1.84**	0	**20.46*****	**0.15**	**14.61*****
C3	**48.01*****	**53.71*****	**10.21*****	**41.18*****	7.89***	47.12***
LogExTenure		0.19			0.34	0.19
Retirement		5.85**			0.44	**5.64****
All	201.29***	227.9***	132.23***	134.35***	140.78***	145.92***

Finally we also estimate our board independence models with the Dynamic System panel GMM estimator that accounts for any potential effect of past board independence on current values of board independence determinants. Based on different specifications of the lag structure of the dependent variable in models of Table 6 estimated with OLS (including also in industrial sector fixed effects), we find that one lag is sufficient to get the dynamics of board independence. As instruments in the difference equation we used lags 2 to 6 of non-strictly exogenous explanatory variables, and the first difference of the strictly exogenous variables (firm age and year dummy variables). In the levels equation, instruments were one period lagged difference of all non-strictly exogenous variables, and the level of the strictly exogenous variables. The ownership of independents remains as a main determinant of the proportion of independent directors, and just the declared and the strictly independents proportion show statistically significant determinants with the unexpected sing. However, there are fewer statistically significant coefficients than in Table 6. It is consistent with the inclusion of lagged board independence as an additional determinant of current board independence. Although, this may be also related to the smaller size of our sample than the Wintoki et al. (2012) sample (952 versus 20,003 observations). Our overall conclusions remain with this alternative methodology. Most of the results in this subsection are omitted to save space, but are available on request.

5. Discussion

Two critical points regarding our estimation of the empirical models of board independence are worth to be discussed. The first is that in Spain, given the high level of ownership concentration, the agency conflict between large and minority shareholders is especially relevant. We indeed address this concern in our empirical analysis since we increase the accuracy of the measure of board independence leaving proprietary directors, who defend the interest of particular large shareholders, out of this measure. Even the ownership of outside directors is divided into independents and proprietary directors, and our results are consistent with our prediction that just the ownership of independents increases optimal independence. Contrary to Linck et al. (2008) we find the expected sing of independents and proprietary directors' ownership in the model of board structure, they just measure the overall ownership of outsiders, and measure independence by the proportion of outside directors. The second point is related with the power of executives and of large shareholders as a potential alternative explanation for some of the results. For example, we expect a negative effect of large shareholders and of executives' ownership on optimal board independence. However, a sensible and alternative interpretation is that the negative effect is just the reflection of power abuse, against the interest of shareholders, or minority shareholders. Our empirical evidence, as in Linck et al. (2008), is not able to discard the abuse of power interpretation, although in our case the null effect of board independence measures on firms' performance is against this interpretation. Furthermore, previous empirical evidence on the same Spanish sample (three years shorter) in Crespí-Cladera and Pascual-Fuster (2014) discard non-strictly independents as the result of power abuse. No poor corporate governance practices are related to such independents. This increases the confidence of the interpretation of our results in terms of optimal board independence arguments. However, we cannot discard the power abuse explanation and we have to add some caution in our conclusions.

Finally, it is worth discussing some implications of the overall result of our research. Our empirical methodology is designed to detect the effect of firms filling the gap between their optimal level of board independence and the declared level with non-strictly independents. However, our empirical evidence is not consistent with this behavior. Then one question remains, why do Spanish firms have non-strictly independent directors in terms of formal independence requirements? Although we do not provide further empirical evidence, we conjecture that the reason is related to the history of corporate governance in Spain and to the real value provided by such formal independence requirements. If firms value more other director characteristics than formal independence requirements and those characteristics are scarce, the searching cost of another director with the same characteristics but with formal independence may be higher than the benefits of this formal independence. However, this does not explain why the presence of non-strictly independents was especially relevant at the beginning of our sample period and decreased over time (in 2004, on average 74.3% of declared independent directors were non-strictly independents). This may be explained by a late incorporation of corporate governance recommendations in Spain (with the Olivenza code in 1998, six years later than in the UK) and the initial few guidelines to classify directors as independents. A higher pressure of regulators on firms to meet formal independence criteria since 2007, with the mandatory definition of independent directors, is consistent with the replacement of non-strictly independents by strictly independents over years found in Table 2. Also with the higher relevance of formal independence criteria not included in the mandatory definition for the last years of our sample (Table 2, panel B). Probably, the pressure of regulators generated a higher relative value of formal independence.

Our empirical evidence is not consistent with a lack of value of directors' independence since firms react to the optimal board independence determinants. Furthermore, it is also inconsistent with the view that most of the independents are really not independent. As suggested in Duchin et al. (2010), if CEOs are always able to select friendly independents meeting formal independence criteria, then the level of declared board independence will have no material effect. However, we find firms reacting to optimal board independence determinants.

In sum, our research leaves the low value of formal independence requirements as the most plausible explanation for the presence of non-strictly independents in terms of these requirements. Further empirical research is needed to prove this explanation, left for future research. It may consist in analyzing the characteristics of independent directors, whether there are significant differences between strictly and non-strictly independents in terms of valuable characteristics from the point of view of firms, minority shareholder and large shareholders. This is relevant by itself, but more if we take into account the proliferation of formal independence requirements in different corporate governance codes and recommendations, such as in Spain, UK, or the NYSE listed company manual.

Finally, it is worth mentioning that our experiment is done once the managerial power (and large shareholders abuse) is discarded as the origin of these non-strictly independent directors. Formal independence requirements may be of higher value if other corporate governance mechanisms do not control the agency conflict.

6. Conclusions

Our research is motivated by the inconsistency of regulation on board independence, with one size fits all rules, and advances in corporate governance suggesting different levels of optimal board independence as a function of several firm characteristics. This may induce firms to fill the gap between optimal board independence and the declared level of independence with no-strictly independents. Alternatively, firms may use non-strictly independents to obtain friendly boards, as seems to happen regarding informal independence requirements in the US (e.g., Hwang and Kim, 2009). However, non-strictly independents in terms of formal requirements in

Spain are not related to abuses of managerial (or large shareholders) power (Crespí-Cladera and Pascual-Fuster, 2014), and corporate regulation ignoring the optimal board independence determinants could explain why firms have such independent directors. Therefore, our empirical research is designed to detect the consequences of such explanation in a sample of Spanish listed companies from 2004 to 2012. We derive the consequences of such behavior of firms in terms of variances and correlations of the proportion of declared, strictly and non-strictly independent directors, and in terms of the expected effect of optimal board independence determinants on such measures. Our results are inconsistent with firms filling the gap between the optimal level of board independence and the recommended level with non-strictly independents. Therefore, our first contribution is to discard this behavior of firms as the origin of non-strictly independents in terms of formal independence requirements.

However, the analysis of the relation between our measures of board independence and the determinants of optimal board independence provides further contributions to the literature on corporate board structure. Our second main contribution comes from the analysis of a sample of firms with highly concentrated ownership structures, common in continental European countries. Up to our knowledge, this is the first paper providing an empirical analysis of the optimal board independence theory in such highly concentrated ownership environment (outside the US). There we find that ownership structure determinants of optimal independence are the most relevant ones, concretely the ownership of independent directors is especially relevant. Interestingly the Spanish code of good governance recommends against remuneration of independent directors with the delivery of shares in the company, stock options, and other performance related instruments, except the delivery of shares when directors are obliged to retain them till the end of their tenure. Our third main contribution is to provide indirect empirical evidence of the value of formal independence requirements. Firms react to optimal board independence determinants to fix also the proportion of non-strictly independent directors, as if they provided real board independence. Therefore, suggesting a low value of formal independence criteria. Probably, other characteristics than the formal independence requirements are the main source of value provided by independent directors.

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