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Corporate governance effects on market volatility: Empirical evidence from Portuguese listed firms

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Abstract

Purpose – This study examines the relationship between internal corporate governance mechanisms and firm risk-taking. **Design/methodology/approach** – This research comprises a sample of 38 non-financial Portuguese firms listed on Euronext Lisbon, over the period from 2007 to 2017. To test the formulated hypotheses we use panel-corrected standard errors (PCSE) models. **Findings** – Our results provide evidence that, in the Portuguese context, bigger and younger firms, with larger boards of directors and a greater number of independent directors, present higher levels of systematic risk. Our results are consistent across the robustness checks. **Originality/value** – To the best of our knowledge, this is the first time that a robust incremental effect of board size on firm systematic risk is reported. This result contradicts the prevailing literature and opens up a new debate, from a financial markets viewpoint, on the benefits of larger boards of directors in terms of mitigating market volatility.

Keywords – directors; board; volatility; stock returns; independence

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1 Introduction

How firms' internal corporate governance mechanisms influence market volatility and how investors react to those mechanisms are relevant questions for managers and shareholders.

The literature focused on the effects of board independence and board size on firms' market risk allows us to identify some tendencies. Within the U.S. context, larger and more independent boards are beneficial in terms of decreasing market volatility (Pathan, 2009), while non-U.S. research presents mixed evidence (Huang & Wang, 2015; Nakano & Nguyen, 2012; Zhang, Cheong, & Rasiah, 2018). For these results, the literature presents conflicting theoretical premises.

Concerning board independence, Jiraporn and Lee (2018) developed two alternative hypotheses: i) the "risk-avoiding hypothesis," which is based on the assumption that board independence lowers the firm's risk levels by protecting shareholders from unnecessary risk-taking and forcing managers to define policies aligned with shareholders' interests; and ii) the "risk-seeking hypothesis," which assumes that board independence is a strong mechanism of corporate governance to prevent managers from adopting policies that reflect their risk aversion, thus increasing firms' risk-taking.

Concerning board size effects on firm risk-taking, there are two competing arguments: i) increasing the size of the decision-making group tends to reduce risk-taking behaviors (Moscovici & Zavalloni, 1969) and risky firms should work with larger boards because they need more guidance and monitoring actions (Coles, Daniel, & Naveen, 2008; Guest, 2008; Linck, Netter, & Yang, 2008); and, at the opposite pole, (ii) by adapting Jensen's (1993) argument, it is possible to say that ineffectiveness in the monitoring role of the board may not be related with its size, but with an excess of CEO power, directors' self-interest, lack of board expertise, and communication disruptions.

Our study is framed under these theoretical controversies and analyzes the effect of board independence and board size on firm risk-taking in the Portuguese context of Euronext Lisbon (EL). Portugal is a small economy in Southern Europe, with a small stock market characterized by high levels of ownership concentration and low levels of shareholder protection. Despite the size of the country, Portugal is relevant to research since it has privileged international relations with the South American, African, and Asian regions. Consequently, it is seen by many companies from those regions as an entry platform into the European market. Also, over the last years, Portugal has drawn attention from international companies belonging to the most developed stock markets as an attractive market for considerable investments in the areas of energy, banking, and technology.

The Portuguese stock market has been in operation for about two decades and, since it launched, corporate governance codes and firm governance practices have evolved. Vieira and Neiva (2019) and Lisboa, Guilherme, and Teixeira (2020) present the evolution of the corporate governance practices adopted by Portuguese firms and a compelling vision of the major changes that have occurred in the context of listed firms. According to Vieira and Neiva (2019), the prevailing governance model is the Latin model, where the governance structure is composed of a board of directors (BoD), or a sole director, and an audit committee or a statutory auditor. Additionally, the authors indicate that, over the past few years, there has been an increase in the proportion of independent directors and an increase in the proportion of women directors on BoDs. Lisboa et al. (2020) report that almost half of Portuguese listed firms are family firms, that the firms' remuneration plans for board members have increased their fixed component to around 75%, and that a small percentage of firms use stock options in their remuneration systems. Moreover, there has been a consistent increase of merger and acquisitions (M&A) operations and a growing presence of international institutional investors in shareholder structures.

According to our literature review, there are few studies published in indexed journals[1] that analyze the interactions between corporate governance mechanisms and market volatility in the Portuguese context. The research documents a negative effect of board independence on market risks for non-family firms (Vieira, 2014) and non-financial listed firms (Sá, Neves, & Góis, 2017). Madaleno and Vieira (2018) conclude that there is similarity between family firms and non-family firms with regard to the liquidity-volatility relationship.

Using a sample of 38 non-financial Portuguese listed companies comprising 418 firm-year observations, our results show that larger and more independent boards increase firm systematic risk.

Concerning the effects of board independence on corporate risk, our results confirm the "risk-seeking hypothesis," proposed by Jiraporn and Lee (2018), for

the effects of board size on firm systematic risk. This hypothesis states that board independence is a strong mechanism of corporate governance to prevent managers from adopting policies that reflect their risk aversion, thus increasing firm risk.

In terms of board size effects on corporate risk, our results are, to the best of our knowledge, new to the literature by documenting a robust finding that increasing board size promotes an increase of firm systematic risk. This result may support some of the theoretical arguments presented by Jensen's (1993) theory of constraints for a well-functioning board. Since the Portuguese stock market is very small, it is customary for executive managers and members of boards of directors to move from firm to firm. This scenario promotes an increase in social ties, which in turn affect executive and board decisions. Decisions that may collide with "friends' interests" can result in the exclusion of people from the restricted circle of executives and directors. As such, and in line with Jensen's (1993, p. 863) assumption, Portuguese firms' "emphasis on politeness and courtesy at the expense of truth and frankness in boardrooms is both a symptom and cause of failure in the control system."

This investigation contributes to the literature in various ways. First, to the best of our knowledge, we are the first to document that a larger board size increases corporate systematic risk. Second, this is the first investigation that simultaneously analyzes the effects of both board size and independent directors as the main explanatory variables for market volatility in continental Europe, namely in Portugal. Within the South European context, none of the studies (Aloui & Jarboui, 2018; Sá et al., 2017; Vieira, 2014) on this subject contemplate board size as a variable in their econometric models. Additionally, the literature devoted to the Portuguese context analyzes isolated market risk measures. Sá et al. (2017) studied total and idiosyncratic risks and Vieira (2014) examined systematic risk, while this study aggregates all those risk measures. Moreover, within the Portuguese context, the previous literature ends the analysis period in 2010, while we use data up to 2017. As such, this study incorporates a unique and hand-collected database with a sample period (2007-2017) not covered by the extant research, within the EL context. Third, it contributes to the increasing body of research that provides valuable information outside the U.S. context. Portugal is an example of a country where corporate governance codes are optional, which may indicate that the governance structure of public firms is more heterogeneous when compared to other countries. Finally, we add to the growing body of literature on financial risk effects (Lameira et al., 2013; Righi et al., 2019), this time analyzing the effect of board independence and board size on firm risk-taking.

The remainder of the paper is organized as follows. Section 2 presents the literature review and formulates the hypotheses. Section 3 presents the methodology. Section 4 presents and discusses the empirical results. Finally, Section 5 presents the conclusions.

2 Literature Review and Hypotheses

The impact of internal corporate governance mechanisms on firm performance accounts for a major stream of research in the finance field. Several corporate board attributes have been studied over the last decades (Cunha & Rodrigues, 2018), such as: i) board independence (Black, Carvalho, & Gorga, 2012; Coles, Daniel, & Naveen, 2014; Falato, Kadyrzhanova, & Lel, 2014); ii) board diversity (Farag & Mallin, 2017; Owen & Temesvary, 2018; Pathan & Faff, 2013); and iii) the effects of CEO attributes on market and accounting performance (Brodmann, Unsal, & Hassan, 2019; Fang, Francis, & Hasan, 2018; Nguyen, Hagendorff, & Eshraghi, 2018).

The literature that studies the effects of corporate governance mechanisms on firm performance includes a segment that focuses on specific measures related to firm risk-taking. Corporate risk-taking is generally gauged by three different measures of volatility associated with stock returns: total risk, idiosyncratic risk, and systematic risk (Jiraporn & Lee, 2018). The research on market volatility has studied a wide range of corporate governance mechanisms as its drivers, which can be grouped into four major antecedents of volatility: i) CEO characteristics (Cain & McKeon, 2016; Coles, Daniel, & Naveen, 2006; Ferris, Javakhadze, & Rajkovic, 2017); ii) board independence (Aloui & Jarboui, 2018; Bird, Huang, & Lu, 2018; Jiraporn & Lee, 2018; Sá et al., 2017; Vieira, 2014); iii) board diversity (Faccio, Marchica, & Mura, 2016; Poletti-Hughes & Briano-Turrent, 2019; Sila, Gonzalez, & Hagendorff, 2016); and iv) board size (Cheng, 2008; Huang & Wang, 2015; Nakano & Nguyen, 2012).

From our viewpoint, some lines from previous studies can be highlighted. First, CEO age is the only individual characteristic, from the executives' and directors' perspective, that presents a constant effect on market volatility. According to the literature, CEO age can

worsen market volatility, where the older the CEO, the lower the firm's risk (Jiraporn & Lee, 2018; Korkeamäki, Liljeblom, & Parternack, 2018; Serfling, 2014). Second, the influence of board independence depends on the context in which it is analyzed. While the majority of the U.S.-based research agrees on the benefits of board independence in terms of reducing stock returns volatility, the non-U.S. research presents an opposite effect. These results seem to indicate that the independent directors of U.S. firms carry out better monitoring of firms' risk-taking decisions. Third, the board size effect is more pronounced in the U.S. context. While in the U.S. environment a larger board promotes lower levels of volatility, outside the U.S. the evidence is mixed. Fourth, concerning firm characteristics, the studies generally conclude that firm leverage promotes higher market volatility, although firm age and size contribute to lower volatility.

2.1 Independent directors and market volatility

The association between director independence and market volatility is theoretically ambiguous. On one hand, director independence is seen by several authors as a real way to reinforce board monitoring, since independent directors are more inspired to obtain and maintain a good reputation in corporate leadership, and, consequently, they are more likely to exert board oversight than inside directors (Fama, 1980; Guo & Masulis, 2015). Also, Adams, Almeida, and Ferreira (2005) state that powerful CEOs tend to assume more risk in their decisions, which results in higher levels of volatility. These arguments are aligned with the "risk-avoiding hypothesis," developed by Jiraporn and Lee (2018), which is based on the assumption that board independence lowers a firm's risk levels by protecting shareholders from unnecessary risk-taking, and by forcing managers to define policies aligned with shareholders' interests.

On the other hand, board independence can have a positive impact on market volatility. According to Adams and Ferreira (2007), independent directors have limited access to firm-specific information and are faced with high costs of assessing its reliability, which results in reduced monitoring and effectiveness incentives. Also, Jiraporn and Lee (2018) present arguments for the so-called "risk-seeking hypothesis," which assumes that board independence is a strong mechanism of corporate governance to prevent managers from adopting policies that reflect their risk aversion, thus increasing firms' risk-taking.

However, the research about the effects of board independence on corporate risk policies involves an ongoing debate and presents mixed evidence. There is a body of research that asserts the positive effects of board independence in terms of reducing stock market volatility (Bird et al., 2018; Jiraporn & Lee, 2018; Pathan, 2009), another body that foresees increased stock market volatility (Huang & Wang, 2015; Sá, Neves, & Góis, 2017; Zhang, Cheong, & Rasiah, 2018), and a third block that reports an absence of independence effects on volatility (Cheng, 2008; Sila, Gonzalez, & Hagendorff, 2016). In line with the mainstream research that uses traditional measures of board independence (number of independent directors and percentage of independent directors), the few attempts to investigate the impact of individual characteristics of independent directors on volatility also report mixed evidence. While Jordan, Lee, and Bui (2012) argue that independent directors with foreign academic degrees contribute to decreasing market volatility, Minton, Taillard, and Williamson (2011) report that independent directors with financial expertise are detrimental to stock returns volatility.

As is customary, the research is mainly U.S.-based (Bird et al., 2018; Pathan, 2009) and generally shows that board independence is an important internal mechanism to reduce stock returns volatility. When we analyze non-U.S. research, the results appear to present a different conclusion. Zhang et al. (2018) investigate Chinese listed firms and find an increase in firm risk when board independence is higher. Within the European context, using a sample of French listed firms, Aloui and Jarboui (2018) reveal that independent directors have no significant impact on market volatility. On the other hand, Sá et al. (2017) analyze Portuguese non-financial listed firms and conclude that board independence has an incremental effect on total and idiosyncratic risks, while Vieira (2014) reports a similar association for systematic risk, but only for non-family firms. What seems to be an exception is reported by Nakano and Nguyen (2012), who investigate the Japanese public market and conclude that there are benefits of board independence. Based on the literature above, it seems that the research is starting to present a pattern. Independent directors in U.S. firms seem to play a better monitoring role, in terms of corporate risk policies, than independent directors in non-U.S. corporations. As we are analyzing Portuguese public firms, we expect

a positive relationship between board independence and market volatility. Thus, we postulate that:

Hypothesis 1 – Board independence is positively related to corporate risk-taking.

2.2 Board size and market volatility

According to the agency theory, managers are reluctant to assume risky projects out of concern for their well-being (Fama, 1980; Holmstrom, 1999), preferring not to take any risk. Mishra (2011) argues that better monitoring through large shareholders is related to higher risk-taking, concluding that agency conflicts have a relevant effect on risk across firms.

The view that risk is related to the complexity of the firm's procedures suggests that risky firms should work with larger boards because they need more guidance and monitoring actions (Coles, Daniel, & Naveen, 2008; Guest, 2008; Linck, Netter, & Yang, 2008).

In the context of behavioral finance, the size of the decision-making group tends to affect risk-taking (e.g., Moscovici & Zavalloni, 1969). At an opposite pole, Jensen (1993) highlights some constraints for a well-functioning board, namely, excess CEO power, directors' self-interest, information disruptions due to large firm complexity, lack of proper expertise on the board, and board culture.

According to our literature review, only three studies analyzed board size effects on market volatility, using board size as the main independent variable (Cheng, 2008; Huang & Wang, 2015; Nakano & Nguyen, 2012). Using a sample of 1,252 U.S. firms over the 1996-2004 period, Cheng (2008) concludes that there is a negative association between board size and stock returns volatility. In the same vein, Huang and Wang (2015) argue that a larger board size in Chinese firms is a promoter of lower levels of market volatility. Additionally, Nakano and Nguyen (2012) investigate the Japanese public firms listed on the Tokyo Stock Exchange from 2003 to 2007 and report a beneficial effect of board size on corporate risk-taking. With the exceptions of Jordan et al. (2012) and Zhang et al. (2018), the studies that analyze the effect of board size (as a control variable) on market volatility demonstrate a positive influence of this internal governance mechanism in terms of reducing corporate risk-taking (Minton, Taillard, & Williamson, 2011; Sila et al., 2016). Jordan et al. (2012) analyze this relationship in Korean public firms and document a non-significant association. Moreover, using a sample of Chinese firms, Zhang et al. (2018) report mixed and non-significant evidence on board size effects over market volatility, according to the econometric models run. The remaining body of research highlights the benefits of larger boards to market performance in the U.S. context over different industries, namely financial firms (Cheng, 2008; Minton, Taillard, & Williamson, 2011; Pathan, 2009) and non-financial firms (Sila et al., 2016). In sum, it seems that the benefits of larger boards are clear in the U.S. context, but still unclear in the Asian context (China and Korea), despite the same general tendency. According to these findings, we hypothesize that:

Hypothesis 2 – Board size is negatively related to corporate risk-taking.

3 Methodology

3.1 Sample and data

The sample comprises Portuguese firms listed on Euronext Lisbon, between 2007 and 2017. Euronext Lisbon is a small stock market that incorporates a total of 56 firms. Our study focuses on non-financial firms since financial firms have their own specific accounting and regulatory standards. For a similar reason, within the non-financial firms group, sports firms were excluded. From the universe of non-financial and non-sport firms we considered those who fulfilled the following criteria: i) the corporation should be listed on Euronext Lisbon during the period of the study and ii) all variables in the study should be available. As a result, the final sample encompasses 38 non-financial and non-sport listed firms comprising a total of 418 firm-year observations.

To conduct this study we collected data from different sources. To calculate the risk variables, we use financial market quotes, daily closing prices, and PSI-20 (the main Portuguese market index) closing data, available from the Yahoo Finance website. Corporate governance information was retrieved from the firms' corporate governance reports. Finally, accounting data were collected from the Bureau van Dijk (SABI) database.

3.2 Variables

As dependent variables, we adopt three different risk measures (total risk – TR, idiosyncratic risk – IR, and systematic risk - SR), used by Jiraporn and Lee (2018), Pathan (2009), and Sila et al. (2016). Table 1 shows that

Table 1
Variable Definitions

Variables	Definitions	References	Data Source
Dependent variables			
Total risk (TR)	The standard deviation of daily stock returns (natural logarithm of consecutive daily closing prices: ln (Pt/Pt-1)) in each year	Jiraporn and Lee (2018)	Yahoo Finance website
Idiosyncratic risk (IR)	The standard deviation of the residuals from the regression of daily stock returns on daily market returns	Jiraporn and Lee (2018)	Yahoo Finance website
Systematic risk (SR)	The coefficient of the market returns when daily returns are regressed on market returns	Jiraporn and Lee (2018)	Yahoo Finance website
Independent variables			
Independent Directors (IND)	The ratio of independent directors to the total number of directors on the board	Pathan (2009)	Corporate Governance Reports
Board Size (BS)	The natural logarithm of the total number of directors on the corporate board	Zhang, Cheong, and Rasiah (2018)	Corporate Governance Reports
Control variables			
Corporate Governance			
Independent Female Directors (FEM_IND)	The ratio of female independent directors to the total number of independent directors	Teodósio and Lisboa (2020)	Corporate Governance Reports
Female Directors (FEM)	The ratio of female directors to the total number of directors	Bernile, Bhagwat, and Yonker (2018)	Corporate Governance Reports
Firm Characteristics			
Firm Age (AGE)	The natural logarithm of the number of years since the constitution of the firm	Bradley and Chen (2015)	SABI database
Firm Size (SIZE)	The natural logarithmic of total assets	Ferris, Javakhadze, and Rajkovic (2017)	SABI database
Firm Growth (FG)	The annual rate of growth of sales	Faccio, Marchica, and Mura (2016)	SABI database
Cash Flow (CF)	The ratio of free cash flow to total assets	Jiraporn and Lee (2018)	SABI database
Return on Assets (ROA)	The ratio of net earnings to total assets	Zhang, Cheong, and Rasiah (2018)	SABI database
Tobin's Q (TQ)	The ratio of market value to total assets	Zhang, Cheong, and Rasiah (2018)	SABI database
Leverage (LEV)	The ratio of total debts to total assets	Sá, Neves, and Góis (2017)	SABI database

those measures were computed according to the procedures reported by Jiraporn and Lee (2018).

The main explanatory variables are associated with internal corporate governance mechanisms. The first independent variable is board independence (IND), measured as proposed by Pathan (2009), and the second is board size (BS), defined according to Zhang et al. (2018). The reason for using these variables is related to mixed evidence, provided by the research, of their effects on different measures of firm risk (Cheng, 2008; Sá et al., 2017; Sila et al., 2016; Zhang et al., 2018).

As control variables, we use other corporate governance measures as well as firm-specific characteristics. Concerning corporate governance, we consider the proportion of female independent directors among the total number of independent directors (FEM_IND),

following Teodósio and Lisboa (2020), and the proportion of female directors among the total number of directors (FEM), as according to Bernile, Bhagwat, and Yonker (2018). These variables may impact the results since the literature shows that female directors are generally more risk-averse than males when defining firm financial policies and affect market volatility differently (Bernile, et al., 2018; Perryman, Fernando, & Tripathy, 2016).

Regarding firm characteristics, we use firm age (AGE) and firm size (SIZE) since both variables are reported to influence a firm's risk levels (e.g. Zhang, et al., 2018). We capture firm growth (FG), as according to Faccio et al. (2016), by using the growth rate of sales due to its influence on market volatility (Ferris et al., 2017). Additionally, we use the ratio of free cash flow to total assets (CF), according to Jiraporn and Lee (2018), since firms with higher free cash flow are more vulnerable to agency conflicts (managers may opportunistically exploit the free cash flow). To account for profitability measures we consider the return on assets (ROA) and Tobin's Q (TQ) as they interact with firm risk-taking (Zhang et al., 2018). Finally, we include leverage (LEV), as according to Sá et al. (2017), since higher interest payments are an additional source of risk for a firm.

3.3 Empirical model

We examine our hypotheses by applying a panel corrected standard errors (PCSE), model. Given we have a panel data sample, we are employing data consisting of repeated time-series observations of fixed, cross-sectional units. PCSE assumes that disturbances are, by default, heteroscedastic and contemporaneously correlated across panels. It is an alternative to feasible generalized least squares for fitting linear cross-sectional time-series models when the disturbances are not assumed to be independent and identically distributed (i.i.d.). Our data sample is composed of non-financial and non-sports firms listed in Portugal. Therefore, each company has its error variance (panel heteroscedasticity) since the firms belong to different economic activity sectors and the error for one company may be correlated with the errors for other companies in the same year (contemporaneous correlation of the errors) due to market risk and shocks that happen and hit all companies.

While providing a rich amount of information, time-series cross-sectional data are likely to be characterized by complex error structures, which should be taken into account. The application of OLS (e.g., Sá et al., 2017) to data with non-spherical errors produces inefficient coefficient estimates, and the corresponding standard error estimates are biased. In contrast, generalized least squares produce coefficient and standard error estimates that are efficient and unbiased. For example, Greene (2000) notes that for a cross-firm comparison there may be variation in the scales of the variables in the model. It may also be realistic to expect a cross-sectional contemporaneous error correlation. Our model can be represented as follows:

$$Risk_{i,t} = \beta_1 IND_{i,t} + \beta_2 BS_{i,t} + \beta_3 FEM\_IND_{i,t} + \beta_4 FEM_{i,t} + \beta_5 AGE_{i,t} + \beta_6 SIZE_{i,t} + \beta_7 FG_{i,t} + \beta_8 CF_{i,t} + \beta_9 ROA_{i,t} + \beta_{10} TQ_{i,t} + \beta_{11} LEV_{i,t} + \varepsilon_{i,t} \quad (1)$$

Risk represents total risk (TR), idiosyncratic risk (IR), and systematic risk (SR). IND stands for the ratio of independent directors to the total number of directors, BS for board size, FEM_IND for the ratio of female independent directors to the total number of independent directors, FEM for the ratio of women directors to the total number of directors, AGE for firm age, SIZE for firm size, FG for firm growth, CF for cash flow, ROA for return on assets, TQ for Tobin's Q, and LEV for leverage. Moreover, i stands for the firm (i=1,…,38) and t for the year (t=2007,…,2017), and the error terms in the estimations are provided by ε.

4 Results and Discussion

4.1 Summary statistics and correlation analysis

Table 2 displays the summary statistics. The dependent variables TR and IR present close means and standard deviations. Our third dependent variable, SR, has significantly higher mean and standard deviation values. The mean of independent directors on the board is 18.3%, with a maximum of 77.8%. The mean board size is 8.9 directors, ranging from 2 to 25. The mean for female independent directors is 2.8% and the mean for females on the board of directors is 9.2%. Concerning firm age, the standard deviation (32.7) is almost as high as the mean (38 years). The mean logarithmic value of total assets is 19.7 and the mean cash flow is 2%. In terms of performance measures, the mean ROA is 1% and the mean TQ is 1.7%. The mean financial leverage is 47.7%.

Table 3 presents the Pearson's correlation coefficients among the variables used in the estimations and their

Table 2
Descriptive Statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
Dependent Variables					
TR	398	0.051	0.089	0.002	0.952
IR	399	0.046	0.087	0.002	0.942
SR	398	0.601	0.665	-4.340	3.733
Independent Variables					
IND	418	0.183	0.203	0.000	0.778
Board Size	418	8.864	4.887	2.000	25.000
Control Variables					
Corporate Governance					
FEM_IND	418	0.028	0.094	0.000	1.000
FEM	418	0.092	0.113	0.000	0.500
Firm Characteristics					
Firm Age	411	38.002	32.706	1.000	193.000
Firm Size	414	19.687	1.783	14.879	23.907
Firm Growth	409	2.882	12.359	-9.561	98.255
Cash Flow	414	0.020	0.219	-2.912	1.544
ROA	414	0.010	0.219	-2.912	1.437
TQ	407	0.017	0.105	0.000	0.879
LEV	414	0.477	0.312	0.000	2.517

Notes: TR - total risk; IR - idyosincratic risk; SR - systematic risk; IND - the ratio of independent directors to the total number of directors; BS - board size in absolute values; FEM_IND – the ratio of female independent directors to the total number of independent directors; FEM – the ratio of female directors to the total number of directors; AGE - firm age in absolute values; SIZE - firm size; FG - firm growth; CF - cash flow; ROA - return on assets; TQ - Tobin's Q; LEV - leverage.

Table 3
Pearson's Correlation Matrix

Variables	TR	IR	SR	IND	BS	FEM_ IND	FEM	AGE	FS	FG	CF	ROA	TQ	LEV
TR	1.000													
IR	0.985***	1.000												
SR	-0.046	-0.035	1.000											
IND	-0.234***	-0.234***	0.315***	1.000										
BS	-0.372***	-0.373***	0.270***	0.444***	1.000									
FEM_ IND	-0.087*	-0.086*	0.129***	0.374***	0.182***	1.000								
FEM	-0.005	0.008	0.034	-0.139***	0.009	0.177***	1.000							
AGE	0.170***	0.175***	-0.185***	-0.088*	-0.0873*	0.085*	0.080	1.000						
SIZE	-0.274***	-0.275***	0.265***	0.296***	0.430***	0.154***	0.046	0.094*	1.000					
FG	-0.071	-0.070	0.094	0.103**	0.048	0.037	-0.017	-0.076	0.077	1.000				
CF	0.008	0.010	-0.016	-0.111**	-0.0020	-0.128***	0.021	-0.025	0.040	-0.0991**	1.000			
ROA	-0.047	-0.044	-0.005	-0.086*	0.038	-0.118**	0.030	-0.040	0.065	-0.089*	0.994***	1.000		
TQ	-0.055	-0.059	0.068	0.278***	0.187***	0.017	-0.065	-0.292***	-0.212***	-0.017	-0.005	0.002	1.000	
LEV	0.219***	0.200***	-0.064	-0.160***	-0.135***	-0.089*	-0.136***	0.128***	0.069	-0.074	0.032	-0.014	-0.131***	1.000

Notes: TR - total risk; IR - idyosincratic risk; SR - systematic risk; IND - the ratio of independent directors to the total number of directors; BS - board size in absolute values; FEM_IND – the ratio of female independent directors to the total number of independent directors; FEM – the ratio of female directors to the total number of directors; AGE - firm age in absolute values; SIZE - firm size; FG - firm growth; CF - cash flow; ROA - return on assets; TQ - Tobin's Q; LEV - leverage. *,**,*** represent coefficient statistically significant at 10%, 5%, and 1%, respectively

respective significance values (already using the natural logarithm when applicable).

A common and relatively simple method employed for evaluating the degree of multicollinearity is to compute pairwise correlation coefficients. As Sá et al. (2017) argue, a rule of thumb is that pairwise correlation coefficients should not be more than 0.8 since multicollinearity may pose a serious problem.

However, the scores presented in Table 3, listing all pairwise correlation coefficients between the independent variables and including between dependent variables, shows that multicollinearity issues do not arise. Thus, multicollinearity is not likely to threaten the accuracy of the estimated impacts of corporate governance and firm-specific characteristics on total, idiosyncratic, and systematic risk.

We checked the multicollinearity problems by inspecting the tolerance/VIF values generated when estimating our model and the results confirm this preliminary analysis through the Pearson's correlation coefficient estimates.

The correlation matrix shows that older firms have smaller boards, less board independence, and a smaller proportion of female independent directors. Larger firms have larger boards, more independent boards, and more female independent directors. Table 3 also reveals a weak correlation between firm size and firm age, meaning that older firms are not necessarily the largest ones.

4.2 Main model

Table 4 presents the estimates obtained using different model specifications of Equation (1)[2]. In Hypothesis 1, we postulate that board independence would increase firm risk. As we can confirm in models 1, 2, and 5, this assertion was not confirmed when firm total risk is considered. These results (models 1 and 2) are in line with the majority of the literature (e.g. Bird et al, 2018; Nakano & Nguyen, 2012). Also, the results of our model 5 are similar to those reported by Aloui and Jarboui (2018) in the European context. Sá et al. (2017) report, for the Portuguese context, that an increase in independent directors contributes to an increase in total firm risk, which contradicts our findings. A possible explanation for the discrepancy between the results of our study and those of Sá et al. (2017) may lie in the fact that the latter authors used a very small sample, covering the years around the 2008 financial crisis, a period that seriously affected Portuguese firms' performance.

Models 6 and 7 demonstrate that board independence is a promoter of lower idiosyncratic risk, thus not confirming our hypothesis. This finding is in accordance with Pathan (2009) and Jiraporn and Lee (2018) but contradicts the results reported by Sá et al. (2017), for the Portuguese context. We believe that this new contradiction found in the Portuguese context is explained by the aforementioned argument.

Models 11, 12, and 15 confirm our hypothesis for firm systematic risk, meaning that more independent boards increase systematic risk. This result is in line with those of Vieira (2014) for the Portuguese context. However, in other national contexts, this finding is refuted by Pathan (2009) and Sila et al. (2016). Overall, Hypothesis 1 is only partially confirmed.

In Hypothesis 2, we expected a beneficial effect of board size in terms of reducing firm risk. Models 3, 4, and 5 confirm this assertion when total risk is considered. This result is aligned with all the literature we know of (e.g. Cheng, 2008; Minton et al., 2011; Pathan, 2009).

Models 8, 9, and 10 also confirm our predictions for idiosyncratic risk and support the results reported by Jiraporn and Lee (2018), Pathan (2009), and Sila et al. (2016).

Models 13, 14, and 15 do not support our assertion and, to the best of our knowledge, this is documented for the first time. Contradicting the prevailing research (e.g. Jiraporn & Lee, 2018; Pathan, 2009; Sila et al., 2016), we find that larger boards are promoters of higher levels of systematic risk, supporting Jensen's (1993) arguments about the potential inefficiency problems of large-sized boards. As those models show, board size is a strong predictor of increased systematic risk when compared with all the remaining variables.

Concerning the effects of the corporate governance control variables, all the models demonstrate that women's presence on the board of directors and the proportion of independent female directors are not related to any of the risk variables. These findings do not support those presented by Bernile et al. (2018) and show that women's representation on the boards of directors of Portuguese firms has no significant impact on the definition of firm risk-taking policies.

In terms of firm characteristics, firm age appears to be a relevant antecedent of firm risk since in all models (1 to 15) the correlation is significant. The positive

Table 4
PCSE Regressions

Dependent Variables	*Total risk*					*Idiosyncratic risk*					*Systematic risk*				
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*	*(13)*	*(14)*	*(15)*
IND	-0.043***	-0.041***			-0.023	-0.043***	-0.041***			-0.021	0.794***	0.757***			0.757***
Board Size			-0.021***	-0.021***	-0.019**			-0.021***	-0.021***	-0.019**			0.1653***	0.166***	0.102*
Control Variables															
Corporate Governance															
FEM_IND		-0.011			-0.018		-0.011			-0.019		0.207			0.067
FEM				0.033	0.029				0.039	0.036				0.206	0.419
Firm Characteristics															
Firm Age	0.016***	0.016***	0.017***	0.016***	0.016***	0.016***	0.017***	0.017***	0.016***	0.016***	-0.145***	-0.146***	-0.1559***	-0.159***	-0.150***
Firm Size	-0.001**	-0.001***	0.001	0.001	0.001	-0.001***	-0.010***	0.001	0.001	0.001	0.048***	0.049***	0.0408***	0.04***	0.035***
Firm Growth	0.000	0.000	-0.000	-0.000	0.000	0.000	0.000	-0.000	-0.000	-0.000	0.000	0.002	0.0029	0.003	0.002
Cash Flow	1.774***	1.773***	1.681***	1.687***	1.668***	1.712***	1.711***	1.617***	1.623***	1.601***	1.170	1.185	1.3353	1.366	1.901
ROA	-1.785***	-1.785***	-1.689***	-1.694***	-1.679***	-1.722***	-1.722***	-1.623***	-1.629***	-1.615***	-1.168	-1.176	-1.4098	-1.443	-1.904
TQ	0.042***	0.041***	0.0524***	0.053***	0.062***	0.037***	0.036***	0.048***	0.049***	0.057***	-0.129	-0.113	0.0291	0.035	-0.258**
LEV	0.003	0.002	0.004	0.006	0.004	-0.003	-0.003	-0.001	0.001	-0.001	-0.074	-0.071	-0.1166	-0.106	-0.049
R-squared	0.460	0.461	0.467	0.468	0.470	0.433	0.433	0.4340	0.442	0.444	0.525	0.525	0.5078	0.509	0.531
Wald chi2(.)	550.18	558.37	448.17	525.33	564.19	276.16	273.92	253.66	274.98	295.96	1946.93	2240.55	1557.56	1574.17	2008.94
Prob > chi2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes. TR - total risk; IR - idyosincratic risk; SR - systematic risk; IND - the ratio of independent directors to the total number of directors; BS - board size in absolute values; FEM_IND – the ratio of female independent directors to the total number of independent directors; FEM – the ratio of female directors to the total number of directors; AGE - firm age in absolute values; SIZE - firm size; FG - firm growth; CF - cash flow; ROA - return on assets; TQ - Tobin's Q; LEV - leverage.*,**,*** represent coefficient statistically significant at 10%, 5%, and 1%, respectively.

effect of firm age on increasing total risk (models 1 to 5) contradicts the findings reported by Bird et al. (2018), Cheng (2008), and Sila et al. (2016), but is in line with those documented by Huang and Wang (2015). Also, models 6 to 10 document a similar effect of age on idiosyncratic risk, finding no support for the results obtained by Sila et al. (2016). Models 11 to 15 reveal that firm age reduces firm systematic risk, which is now consistent with Sila et al. (2016). Overall, the results suggest that longer-lived companies tend to follow the market trend. The Portuguese market index is made up of 18 large companies, which directly affects the movement of the market index. Consequently, the probability of following market movements is high, approaching the market beta.

Concerning firm size, our results document that larger firms have higher systematic risk. Pathan (2009) and Sila et al. (2016) document the same effect across banks and non-financial firms in the U.S. context. Similarly, Vieira (2014) provides the same evidence for the Portuguese context. Our results are also consistent with the findings documented by Bowman (1979), Milicher and Rush (1974), and Ben-Zion and Shalit (1975). According to Nawaz et al. (2017) and Laeven, Ratnovski, and Tong (2016), larger firms have higher systematic risk than smaller enterprises due to market access and the economic risks they take. We speculate that larger firms are usually more internationalized and more exposed to external market volatility. As a result, larger firms incorporate in their systematic risk a premium for the additional international exposure risks (e.g. monetary, political, social, among others) in comparison with smaller firms with a lower volume of international activity.

The remaining control variables show that cash flow and Tobin's Q are associated with increased total and idiosyncratic risks (models 1 to 10). Larger firms with larger free cash flows are more vulnerable to agency conflicts as managers may opportunistically exploit the free cash flow (Jiraporn and Lee, 2018). Furthermore, the same models demonstrate that ROA decreases those risk levels. This expected association can be explained by the fact that higher results tend to calm investors, who bet on their maintenance in the future. Thus, expectations in the market play a significant role in relation to firm risk.

4.3 Robustness tests

To provide robustness to our findings, we ran the model of Equation (1) accounting for different measures of risk. We used GARCH as a volatility model and TRGARCH, IRGARCH, and SRGARCH as dependent variables. We measured GARCH total risk (TRGARCH) through the standard deviation of the GARCH variance series obtained through the application of the GARCH (1,1) model in each year. The GARCH idiosyncratic risk (IRGARCH) was generated from the GARCH estimation of the single-factor market model. By regressing daily stock returns on daily market returns we computed the standard deviation of the residuals from the regression and used it as representative of IR. Our third measure is systematic risk (SRGARCH), which was computed by using the coefficient of the market return when daily returns were regressed through GARCH on market returns. This coefficient represents the extent to which the firm's stock returns change in response to changes in market returns.

The PCSE models presented in Table 5 demonstrate that the influence of board independence and board size on the control of total and idiosyncratic risks is mostly lost despite the maintenance of the coefficient signs (models 1 to 5 and 6 to 10, respectively). These findings are now aligned with those reported by Cheng (2008) and Sila et al. (2016), for board independence, and with those documented by Zhang et al. (2018), regarding board size. As a result, we cannot confirm that larger and more independent boards are efficient corporate governance mechanisms to control the levels of total and idiosyncratic risks in the Portuguese context.

Models 11 to 15 are devoted to firm systematic risk. The results confirm the findings of our main model (Table 4) and document that board independence and board size are robust governance mechanisms that increase firm risk. These facts allow us to confirm that in the Portuguese context Jiraporn and Lee's (2018) "risk-seeking hypothesis" can be applied, which states that board independence is a strong mechanism of corporate governance to prevent managers from adopting policies that reflect their risk aversion, thus increasing firms' risk-taking. As a result, we can partially confirm our Hypothesis 1 and document that board independence increases firm systematic risk.

Due to the consistency of the positive coefficients of the board size effects on systematic risk, we can argue that larger boards are inefficient in the monitoring role due to possible excess CEO power, directors' self-interest,

Table 5
PCSE Regressions for GARCH Measures of Risk

Dependent variables	*Total risk GARCH*					*Idiosyncratic risk GARCH*					*Systematic risk GARCH*				
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*	*(13)*	*(14)*	*(15)*
IND	-5.185	-4.35			-1.896	-0.041***	-0.039***			-0.024	0.754***	0.701***			0.687***
Board Size			-1.173	-1.123	-0.816			-0.013	-0.013	-0.010			0.147***	0.147***	0.0860***
Control Variables															
Corporate Governance															
FEM_IND		-4.665			-7.921		-0.010			-0.023		0.297*			0.203
FEM				10.569**	11.019**				0.049	0.044				0.098	0.274
Firm Characteristics															
Firm Age	0.039	0.077	0.111	-0.031	-0.024	0.016***	0.016***	0.016***	0.016***	0.016***	-0.124***	-0.126***	-0.135***	-0.136***	-0.129***
Firm Size	0.157	0.152	0.212	0.167	0.170	-0.001***	-0.001***	-0.000	-0.000	-0.000	0.039***	0.039***	0.033***	0.033***	0.029***
Firm Growth	0.01	0.009	0.005	0.007	0.01	0.000	0.000	-0.000	0.000	0.000	0.002	0.002	0.002	0.002	0.002
Cash-Flows	-17.164	-17.511	-18.89	-17.31	-19.811	1.651***	1.650***	1.613***	1.62***	1.60***	1.543	1.565	1.627	1.64	2.149
ROA	16.349	16.531	18.571	16.857	18.755	-1.661***	-1.661***	-1.619***	-1.627***	-1.61***	-1.501	-1.512	-1.657	-1.67	-2.105
TQ	0.245	-0.103	-0.631	-0.324	0.365	0.037***	0.037***	0.036**	0.038**	0.047***	0.03	0.052	0.197*	0.199*	-0.066
LEV	0.473	0.403	0.748	1.287	0.996	0.006	0.006	0.008	0.010	0.009	-0.084	-0.079	-0.125**	-0.12**	-0.065
R-squared	0.051	0.052	0.047	0.058	0.064	0.411	0.411	0.41	0.413	0.416	0.576	0.578	0.55	0.55	0.584
Wald chi2(.)	25.91	25.87	34.34	24.8	22.56	336.8	339.9	295.83	385.31	386.76	1901.45	1740.36	1552.98	1560.78	2038.97
Prob > chi2	0.001	0.002	0.000	0.003	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes. TR - total risk; IR - idyosincratic risk; SR - systematic risk; IND - the ratio of independent directors to the total number of directors; BS - board size in absolute values; FEM_IND – the ratio of female independent directors to the total number of independent directors; FEM – the ratio of female directors to the total number of directors; AGE - firm age in absolute values; SIZE - firm size; FG - firm growth; CF - cash flow; ROA - return on assets; TQ - Tobin's Q; LEV - leverage.*,**,*** represent coefficient statistically significant at 10%, 5%, and 1%, respectively.

lack of board expertise, and communication disruptions (Jensen, 1993). Consequently, we cannot confirm our Hypothesis 2.

Concerning firm control variables, models 6 to 10 confirm our previous results that older firms present higher levels of idiosyncratic risk. Financial and performance controls (cash flow, ROA, and Tobin's Q) remain equally significant and with the same coefficient signs, when compared to our main model, presented in Table 4. Models 11 to 15 confirm the preliminary findings that older firms present lower levels of systematic risk but larger firms have a higher systematic risk

In sum, the results provided in Tables 4 and 5 robustly confirm, for the Portuguese context, that bigger and younger firms, with larger boards of directors and a greater number of independent directors, present higher levels of systematic risk.

5 Conclusion

This study analyzes the corporate governance effects on market volatility in the context of the Portuguese market, considering a sample of 38 non-financial Portuguese companies listed on EL in the period between 2007 and 2017. We created a panel data sample, employing data consisting of repeated time-series observations on fixed, cross-sectional units, and applying a panel corrected standard errors (PCSE) model.

The results of our research document that larger and more independent boards consistently increase firm risk. These findings provide support to Jiraporn and Lee's (2018) "risk-seeking hypothesis" and Jensen's (1993) theory on the constraints of well-functioning boards. Overall, in the Portuguese context, bigger and younger firms, with larger boards of directors and a greater number of independent directors, present higher levels of systematic risk.

This paper has some limitations. First, we focused on listed Portuguese firms, which may mean that our results are not extendible to other countries or private firms. Second, our sample is small, because of the size of the Portuguese stock market. Finally, we limited our analysis to a small number of firm corporate governance mechanisms.

Future research could investigate other European countries, and compare the results, to analyze their consistency in this regional block. Other corporate governance mechanisms should be used to extend the knowledge on the effects of firms' corporate governance practices in the role of monitoring firm market risk.

Notas

[1] Scopus or Web of Science (SSCI)

[2] We performed initial estimations applying winsorization of the variables. Still, the main results remained constant and we lost some observations in an already small sample, leading us to ignore this and present the results for the entire sample, in order not to lose consistency of the estimations.

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1st author: Definition of research problem; Development of hypotheses or research questions (empirical studies); Development of theoretical propositions (theoretical work); Definition of methodological procedures; Data Collection; Literature review; Analysis and interpretation of data; Manuscript writing.
2nd author: Definition of methodological procedures; Data Collection; Statistical analysis; Analysis and interpretation of data; Critical revision of the manuscript; Manuscript writing.
3rd author: Development of theoretical propositions (theoretical work); Critical revision of the manuscript; Manuscript writing.