Journal of Finance and Business Studies, Vol. 1, 2024, 1-21

Board Structure and Risk-Taking in the Extractive Industry

Paul R. Kato[1]
Department of Banking and Financial Services
Institute of Finance Management

Abstract

This paper investigates the relationship between board structure and firm risk-taking in eight extractive firms listed in Nairobi Securities Exchange. The study uses five years of balanced panel data and fixed effects estimator design to examine the board structure and risk-taking (z-score). The results show board size is statistically significant and negatively associated with firm risk-taking, while gender diversity is statistically significant and positively associated with firm risk-taking. Additional evidence reveals the interaction between independent directors and gender diversity is positively related to risk-taking. This suggests that female board members are more independent. However, the results between independent directors and risk-taking are mixed. In addition, the study highlights practical implications for the policy reforms that require extractive firms listing in the stock exchanges to include female representation in the board. Finally, the study offers an understanding of the linkage between board structure and risk-taking in the extractive industry.

Keywords: Corporate governance, board structure, risk-taking, extractive firms

Introduction

Underperformance of the extractive industry to the socio-economic development is partly contributed by weak corporate governance, lack of transparency, corruption and greater risk-taking (Poncian and Kigodi, 2018; Mniwasa, 2019; Papyrakis et al., 2017; Poncian and George, 2015). Previous studies on corporate governance and risk-taking in the extractive industry have conducted limited investigation on board structure and risk-taking and therefore,

[1] Corresponding Author: paul.kato@ifm.ac.tz

limited contribution to socio-economic development (Gstraunthaler and Ulyanova, 2010) resulting into a literature gap (Chahyadi and Wineka, 2019; Cheng, 2008; Chong et al., 2018). The main objective of this study is to provide an understanding on corporate governance and risk-taking in the extractive industry. Specifically, the study examines whether the corporate board structure influences firm risk-taking in Kenya.

It is important to empirically analyse the extractive industry for the following reasons: first, the extractive industry promote sustainable economic and social development in developing countries–for instance, the amount of tax revenues generated and the number of jobs created by the industry; and second, the extractive industry operations are exposed to excessive risks (Yanting and Liyun, 2011) that can lead to project failures (Schroeder and Jackson, 2007). Therefore, this needs to be managed to safeguard the interest of shareholders.

The study uses firms from Kenya as an illustrative case for three reasons: First, Africa alone is largely the heart to the world's mineral reserves[2] and many extractive firms in Kenya have opened doors to the world. Second, corporate governance practices in Kenya are imperative and deemed to be at the infant stage and their execution is at a slow pace. Yet, the government of Kenya has unearthed several scandals in public owned institutions i.e. frauds, money laundering, office abuse, board incompetence and corruption[3]. All these uncalled management opportunistic behaviours are interesting and raise questions on the soundness of corporate governance in extractive industry.

The main findings show board size is negatively associated with firm risk-taking, consistent with the principal-agent model. This implies that risk can be increased in firms with smaller boards. The results also reveal that gender diversity is positive and statistically significant with risk-taking. The evidence suggests that the boards with greater female diversity are more risk averse; therefore, aggravating managers' risk aversion behaviour and leading to pursuing sub-optimal firm risky strategic decision making. The interaction between independent directors and gender diversity is positively related to risk-taking,

[2]See, http://www.worldbank.org/en/topic/extractiveindustries/overview, for the contribution of African rich natural resources to the world.

[3]https://www.unodc.org/documents/treaties/UNCAC/CountryVisitFinalReports/2015_09_28_Kenya_Final_Country_Report.pdf

implying the reduction of insolvency and likelihood to bankruptcy (Faccio et al., 2016). It should, thus, be argued that the female board directors' enthusiasms outweighed the roles of independent managers in pursuit of more risks. In contrast, the study has shown that the relationship between independent directors and risk-taking varies.

Subsequently, this study adds to the extant literature in at least four important ways. First, to my knowledge, it offers the first empirical evidence to link risk-taking and board structure in the extractive industry. Prior empirical evidence in the extractive industry found that: board size is higher in Russian oil and gas producers than in South African gold producers (Gstraunthaler and Ulyanova, 2010); corporate governance has no economic effect on petroleum firms performance in Pakistan (Nawaz and Ahmad, 2017); and CEOs whose compensation is more sensitive to stock return volatility have incentive to take more exploration risk and maintain lower hedge ratios in oil and gas producers (Rajgopal and Shevlin, 2002). Consistent with agency theoretic predictions, the risk management strategy helps to maximise shareholder value in North American gold mining industry (Tufano, 1996). In this perspective, the study adds to the literature on the understanding that corporate board structures are salient mechanisms in influencing firm risk-taking.

Second, the area of corporate governance literature inquiry on board attributes and firm risk-taking relation is limited and has no consensus (see, Chahyadi and Wineka, 2019; Cheng, 2008; Dbouk et al., 2020; Jiraporn and Lee, 2018). Studies on this relation focus on the developed countries and less interest has been given to developing countries (i.e. Sub-Saharan Africa). Third, the study contributes to the existing literature by considering risk-taking and the interaction terms of independent directors and the board of the female gender diversity on risk measures. Previously, empirical studies focused on directly connecting risk-taking proxies and board structure parameters (Cheng, 2008; Huang and Wang, 2015; Li, 2016). Finally, this study contributes to the literature by highlighting policy reforms that require listed extractive firms to mandate female board representation.

Literature Review and Hypotheses Development

Theoretical Framework Background

Earlier studies on board structure focused on firm performance and little research has examined board structure and risk-taking (Chong et al., 2018). Guided by classic convergence of interest agency theory (Jensen and Meckling, 1976), this research investigates the influence of board structure on firm risk-taking.

In corporate firms, the separation of ownership from control creates an agency problem. The agency problem is when the owners do not control their own firm rather employ another person, a manager (agent) to run it on their behalf. The agency theory advances that risk averse managers (agents) may not align their interest with those of the owners (Jensen and Meckling, 1976; Smith and Stulz, 1985). Following this, an effective board of directors will mitigate managers' agency conflicts to pursue their self-serving behaviours at the expense of shareholders. Jensen (1993) highlights three relevant board monitoring characteristics to include board size, board independence and board leadership. In this study, therefore, three hypotheses are developed as follows:

Board Size and Firm Risk-taking

Previous research that associates the board size and firm's risk-taking has mixed results (Chong et al., 2018). For instance, studies on board size and corporate risk-taking conducted in the US (Cheng, 2008) and Japan (Nakano and Nguyen, 2012) noted that larger boards do not result in lower risk-taking and many risky projects can be accepted during the screening stage. Further, Nakano and Nguyen (2012) showed that Japan board size effect on risk-taking is lower than in the US. The result differences were contributed by cultural and institutional environment setting of their respective countries.

Studies conducted in other countries found a negative association between board size and risk-taking; for example, China using publicly traded firms (Huang and Wang, 2015; Li, 2016), the US using banking industry (Minton et al., 2014; Pathan, 2009; Cheng, 2008; Kato, 2012) and the UK using FTSE 350 index firms (Mathew et al., 2016). These results are consistent with Jensen's (1993) who found smaller boards are preferable as they are more efficient and enhance risk-taking. In contrast, other studies found board size to be insignificant and irrelevant to risk-taking using UK financial firms (Akbar et al., 2017).

More recently, Chong et al. (2018) found that larger boards lead to greater financial risk; however, the risk can be reduced by the presence of independent directors. They also insisted that the presence of more independent directors and having an optimum board size can enhance firm performance. However, other scholars found that larger boards may play a critical advisory role in the risk management practices leading to firm value creation (Coles et al., 2008; Dalton et al., 1999).

To sum up, the findings from these studies are partly consistent with the agency theory advocating the role of board of directors to overcome managerial risk-aversion behaviour for shareholders wealth maximisation. Smaller boards are incentivised to pursue risky policy choices that converge with shareholders' interests. The arguments and discussion above suggest that the relevance of board size on firm risk-taking is unresolved issue–notwithstanding, smaller board is recommended.

Hypothesis 1: *A negative relationship will exist between board size and firm risk-taking.*

Independent Directors and Firm Risk-taking

Apparently, agency theory holds that independent directors are more objective and provide stronger monitoring for higher firm performance. Prior literature examining the nexus of board independence and firm risk-taking has reported mixed and contradicting evidence.

Some empirical evidence shows that board independence and risk-taking are positively related. This category of empirical evidence is in line with the conventional wisdom view that boards composed of majority independent directors promote higher managerial risk-taking, for instance, US firms (Cheng, 2008), European banks (Staikouras et al., 2007) and Chinese firms (Huang and Wang, 2015).

Other researchers noted a negative link between board independence and firm risk-taking; for instance studies from US financial services firms (Akhigbe and Martin, 2006; Jiraporn and Lee, 2018; Pathan, 2009), Japanese firms (Nakano and Nguyen, 2012), UK financial sector (Akbar et al., 2017), Chinese firms (Li, 2016) and Malaysian firms (Chong et al., 2018). Evidence from this group implies independent directors exhibit higher degree of risk aversion. This could be

contributed by different reasons. First, many of the executive compensation contracts make managerial compensation contingent on firm performance. Second, stringent governance can restrain managerial preferences from formulating corporate policies. Other studies find no relation between board independence and risk-taking (Cheng, 2008; Minton et al., 2014; Mathew et al., 2016).

Most recently, Dbouk et al. (2019) and Llanos-Contreras et al. (2021) reported that boards with well-connected CEOs and founders are associated with risk-taking. From the above discussion and the agency theorists' prediction, the link between independent directors and risk-taking is yet debateable.

Hypothesis 2: *A positive relationship will exist between the proportion of independent directors and firm risk-taking.*

Board Gender Diversity and Firm Risk-taking

Board diversity is important as people with different backgrounds provide varied opinions in the decision-making process. It has been documented that female board members differ from male ones in their choices and preferences in terms of risk perceptions, desired exposure to competition, altruistic behaviour, monitoring intensity and deceiving dimensions (Adams and Funk, 2012; Niederle and Vesterlund, 2007).

Evidence shows that female gender is negatively associated with firm risk-taking. Loukil and Yousfi (2016) found that female directors are less confident in making strategic corporate decisions, consistent with the conjecture that male directors being overconfident than their counterpart female (Elsaid and Ursel, 2011; Faccio et al., 2016; Gulamhussen and Santa, 2015; Huang and Kisgen, 2013, Levi et al., 2014). Female directors pursue less aggressive acquisition strategies (Levi et al., 2014) and female CEOs have lower leverage (i.e. financing choice), less volatile earning (i.e. investment choice) and higher survival probability (Faccio et al., 2016).

Critics of the perception that female directors are less confident argue that as female directors become confident and less risk averse, their contributions to corporate boards positively influence decisions that are for shareholders' interests (Loukil and Yousfi, 2016). With this position, various studies show a

positive link between female gender diversity and firm risk-taking; for instance the works by Ahern and Dittmar (2012), Adams and Ferreira (2009), Berger et al. (2014), Chong et al. (2018), as well as Adams and Funk (2012).

On the same note, Mathew et al. (2016) disclose that the female director representation in boards appears to be irrelevant to risk-taking. In this vein, it can be argued that the female directors' decision-making process can lead to risk-taking actions. Based on the contentions above, it is predicted that the interaction of female gender diversity and board independence directors' terms may enhance firm risk-taking. Following the views above, the representation of both female and large independent directors is for shareholders. These arguments lead to two hypotheses:

Hypothesis 3a: *A negative relationship will exist between a female gender and a firm risk-taking.*

Hypothesis 3b: *A positive relationship will exist between the interaction of female gender and independent directors and the firm risk-taking.*

Research Methodology

Sample Selection

Annual reports are obtained from the Nairobi Securities Exchange (NSE) website in Kenya. An initial sample size of 64 publicly traded listed firms as of 31st December, 2014 was obtained. Both financial and corporate governance data has been hand-collected from the financial statements. To arrive at the final sample, the following processes were employed: first, removing all firms that were not from extractive industry–a total of 56 non-extractive firms were excluded from the dataset; second, to qualify in the dataset, each firm should have data for the period of five years from 2010 to 2014–a minimum of three consecutive years of observation allows a robust check (Fosu et al., 2017). The critical motivation of the studied period was characterised by corporate governance practices, low accountability in boards, hike in money laundering wave and higher level of economic sabotages, thereby proposing that boards are indispensable to firm risk-taking. Therefore, the final sample had eight (8) extractive firms and covering 40 firm-year of usable observations. Variable construction is divided into two panels—variables associated with board structure and risk measures.

Measurements

Risk Measures

The primary dependent risk measures that the regression analysis used are the z-score and standard deviation of Tobin's Q. Z-score is defined as the inverse of the return on assets ratio (ROA) plus equity-asset ratio (E/A) divided by the standard deviation of return on assets δ (ROA). Previously, Z-score has been widely used in empirical literature to measure firm's financial risk i.e., insolvency, financial fragility and financial distress (Altman et al., 2017; Dbouk et al., 2020; Laeven and Levine, 2009; Roy, 1952).

The calculated z-scores are transformed into positive values by taking their absolute values. High z-score reflects low insolvency and vice versa. The standard deviation of Tobin's Q is expressed as the standard deviation of the book value of assets minus the book value of equity, plus the market value of equity scaled by the book value of assets (Kalsie and Shrivastav, 2016; Nakano and Nguyen, 2012; Yermack, 1996). To identify the underlying drivers of changes in the risk proxy, the study used a board structure.

Empirical Specification

To test the hypotheses developed between a board structure and firm risk-taking, the study used multivariate structural model; the specification used is fixed effects shown in equation (1). The application of the fixed effect framework over OLS is because it represents a common, unbiased estimator of controlling for omitted variables (unobservable heterogeneity) in a panel data (Hausman and Taylor, 1981). Thus, Hausman test was also conducted and the fixed effect model was chosen instead of the random effect model as the highest Prob>chi2 = 0.0215 across all regressions. If the p-value is small (less than 0.05), the null hypothesis is rejected. The fixed effects model has been broadly applied (Laeven and Levine, 2009; Linck et al., 2008; Yermack, 1996).

$$Risk_{it} = \alpha + \beta_1 BS + \beta_2 INDD + \beta_3 GENDER + \beta_4 INDD*GEN + \beta_5 LNTA + \beta_6 LEV + \beta_7 TENURE + \beta_8 Year.Dummy + \varepsilon \quad (1)$$

Where: $Risk_{it}$ is represented by z-score and standard deviation of Tobin's Q, while *i* and *t* represent the firm and time respectively.

Table 1: Definitions of Variables

Variables		Measures
Risk Measures		
Z-score		The return on assets plus equity assets ratio divided by the standard deviation of return on assets
Standard deviation of Tobin's Q		Standard deviation of the book value of assets minus the book value of equity, plus the market value of equity scaled by the book value of assets
Board Structure		
Board size (BS)	β_1	A total number of board of directors on the board
Independent director (INDD)	β_2	The percentage of board seats held by non-employee, former executive, or a relative of a current corporate executive of the firm and does not have substantial business relationships with the firm, either personally or through his or her main employer divided by the board size
GENDER	β_3	A dummy variable equals to 1 when there is at least one female on the board or otherwise 0
INDD*GEND	β_4	It measures the interactive term of percentage of independent directors (INDD) and gender dummy variable (GENDER)
Control Variables		
Natural log of total assets (LnTA)	β_5	Natural logarithm of total assets of a firm, a proxy for firm size
Leverage (LEV)	β_6	Total debts divided by total assets ratio
TENURE	B_7	This measures a number of years served by current CEO
Year dummies	B_8	It captures intertemporal variations in market conditions, tax effect and institutional framework effect during the period 2010-2014.

The centrality proxies as independent variables are on the coefficient estimates of board structure shown in Table 1 and they include board size (BS), board independence (INDD) and female directors (GENDER) (Cheng, 2008; Dbouk et al., 2020; Minton et al., 2014). The negative estimate BS on risk measures refers to the relevance of smaller boards in highlighting firm risk-taking, consistent with the hypothesis that a strong board positively affects the managerial risk-taking behaviour. The positive coefficients estimate of INDD on insolvency score indicates independent directors' incentives to engage in more risky strategic decisions. The positive parameters estimate of GENDER on standard deviation of Tobin's Q and the negative parameter estimate of

GENDER on z-score imply the way female are less risk averse regarding corporate investment decisions. This is true for the coefficient estimate of interaction of board independence and diversity independence board (β_4) on the firm risk-taking.

Next, coefficients β_5-β_8 stand for control variables for the firm size, leverage, CEO tenure and year dummies respectively. This is because these variables are aimed at controlling other sources of ex-ante heterogeneity, while the year dummy (β_8) variable captures inter-temporal variations in country market conditions, tax effects and firm industry differences. Finally, to correct for heteroscedasticity and serial correlation, this study used White's (1980) heteroskedastic standards errors. The analysis of data was performed using STATA software.

Empirical Results and Discussion

Descriptive statistics and pair-wise correlation matrix

The definitions for variables used in this study are presented in Table 2. Dependent, independent and control variables have also been defined. Table 2 portrays descriptive statistics for the extractive industry consisting of energy, petroleum and mining sectors listed in Nairobi stock exchange using year-end data over the period from 2010 to 2014. It is interesting to note that z-score (a risk measure) ranges from -1.773 to 9.157. The results show a high z-score (distance from the default point) that implies greater stability in the extractive industry. In contrast, Pathan (2009) and Laeven and Levine (2009) reported a distance from 2.24 to 211.31 and 1.56 to 5.14 z-score in banking firms respectively. Tobin's Q values range from 0.892% to 5.42%.

Table 2: Descriptive Statistics

Variable	N	Mean	Std. Dev.	Min	Max
Z-score	40	3.854	2.931	-1.773	9.157
Tobin's Q	40	0.892	1.222	0.084	5.418
BD	40	8.350	2.931	4.000	13.000
INDD	40	60.784	16.027	37.500	100.000
GENDER	40	0.550	0.504	0.000	1.000
TENURE	40	3.275	2.298	1.000	10.000
LEV	40	10.250	13.973	0.000	48.889
ROA	40	8.538	11.447	-37.860	26.130
LnTA	40	27.160	1.617	23.978	29.286

The findings show that a board size is between 4 and 13 directors, with a mean of 8 directors. The percentage of independent directors displays an average value of 61%. The mean value of female gender diversity made up to 55% of the directors in the extractive firms. For other variables, the mean, standard deviation, minimum and maximum values are indicated in Table 2.

Table 3 lists the pair-wise correlation matrix between explanatory variables at 5% level of significance. This matrix is intended to identify multicollinearity concern. The results show the largest correlations are between percentage of independent directors (INDD) and board size (BS) – (0.656); board size and firm size (LnTA) as well as leverage (0.836 and 0.756) respectively; and female gender diversity and firm size (0.530), therefore, making the results interpretation difficult. Accordingly, the highly correlated regressors are orthogonalised or replaced. Post-estimation variance inflation factor (VIF) test in every regression model is performed to confirm the variation from the benchmark of VIF=10.

Table 3: Correlation Matrix

Variable	BS	INDD	GENDER	TENURE	LEV
INDD	-0.656	1.000			
GENDER	0.543*	-0.662	1.000		
TENURE	0.286	-0.028	0.110	1.000	
LEV	0.756*	-0.418	0.452*	0.506*	1.000
LnTA	0.836*	-0.596	0.530*	0.044	0.476*

* Significant at the level of 5%

Board Attributes and Firm Fisk

In this section, the empirical results for equation (1) testing for the extent to which a board structure influences risk-taking in extractive industry are reported. Board attributes include board size, percentage of independent directors and female gender diversity.

Board Size, Independent Directors and Female Gender and Firm Risk

Table 4 reports the estimates of the model specification in six (6) columns in the fixed effects estimator. For each risk measure, three columns are presented. Systematically, columns (2) and (3) show that firm risk-taking is explained by board size (BS). Specifically, the results consistently indicate that the estimated BS is statistically significant (at 5% and 1% level) and negatively related to z-score

respectively. The results can be interpreted as smaller boards lead to higher managerial risk-taking behaviour, which increased the possibility of firm bankruptcy. The percentage of independent directors (INDD) in column (2) and tenure and firm characteristics in column (3) are controlled. Subsequent to this, in columns (2) and (3), the results on the estimated BS remain with earlier negative prediction. Besides, it is statistically significant. Contrastingly, in column (1), BS enters z-score negatively and it is insignificant.

Generally, the results on the link between board size and risk-taking are consistent with those reported by Cheng (2008), Huang and Wang (2015), Mathew et al. (2016), Minton (2014) as well as Nakano and Nguyen (2012) and are explained by agency theorists' prediction. Conversely, the findings are not in line with Chong et al. (2018), who showed that a larger board contribute to a greater financial risk. The negative relationship goes with the notion that small boards may encourage management to execute risk-increasing projects, analogous to the principal-agent theoretical framework prediction.

Robust t-statistics in parentheses * p<0.10, ** p<0.05, *** p<0.01

Table 4: Analysis of Z-score and Standard Deviation of Tobin's Q as a Function of Board Structure

Dependent Variable	**Z-score (1/Z)**			**Std. Dev of Tobin's Q**		
Independent Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
BS	-0.088	-0.166**	-0.188***	-0.083	-0.117	-0.137
	(-1.090)	(-2.569)	(-4.047)	(-1.202)	(-1.644)	(-1.358)
INDD		-0.021	-0.018		-0.009	-0.009
		(-1.731)	(-1.556)		(-1.750)	(-1.764)
GENDER			0.619**			-0.110
			(-2.426)			(-0.662)
TENURE			-0.062			0.082
			(-1.109)			(0.969)
LEV	-0.022	-0.037	-0.056	0.049	0.043	0.064
	(-0.819)	(-1.414)	(-1.642)	(1.142)	(1.036)	(1.033)
LNTA	0.257	0.137	0.264	-0.560	-0.612	-0.760
	(0.673)	(0.471)	(0.981)	(-0.955)	(-1.082)	(-1.093)
Intercepts & Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	40	40	40	40	40	40
R^2	0.194	0.376	0.477	0.183	0.211	0.280

In columns (4) and (6), the estimated coefficient on BS remains with earlier negative prediction sign, but insignificant on the standard deviation of Tobin's Q, the second measurement of firm risk, consistent with Akbar et al. (2017). Hence, the results cannot be directly construed as board size is irrelevant in promoting managerial risk-taking behaviour in the extractive firms. The argument that can be advanced to this position is that the board size influence is not homogenous across all firms. Based on the results presented in columns (2) and (3), *Hypothesis 1* is accepted.

Independent Directors and Firm Risk

In Table 4, columns (2), (3), (5) and (6), the results on the percentage of independent directors (INDD) and risk measures are negatively related and insignificant. These findings contradicts the empirical works by Akbar et al. (2017), Chong et al. (2018), Jiraporn and Lee (2018) and Nakano and Nguyen (2012). Moreover, the results are inconsistent with the positive direction evidence documented in Cheng (2008), Huang and Wang (2015) and Staikouras et al. (2007). Consequently, this empirical evidence cannot accept *Hypothesis 2*.

Table 4 in column (3) connects female gender diversity (GENDER) and risk-taking. With this regard, it is found that z-score and female gender diversity are positively associated at 5% significance level. A significant positive coefficient estimate on the GENDER illustrates that with female gender diversity on boards, the likelihood of a firm to default likelihood is far. That is, the higher the distance to default, the greater the firm stability and the lower probability of firm insolvency risk. Consistent with the less confident view by female gender, positive sensitivity reflects that female board directors are more risk averse to engage in aggressive strategies. These results support the existing empirical literature that female directors are more risk averse to corporate decision making (Faccio et al., 2016; Levi et al., 2014; Loukil and Yousfi, 2016). However, the results are contrary to the agency theory prediction and contradict the findings by Adams and Ferreira (2009), Adams and Funk (2012), Chong et al. (2018), among others, who showed that board females are less risk-averse and positively influence firm risk. Accordingly, *Hypothesis 3a* is supported. With this position on the hypothesis, further analysis is carried out in section five to validate the results.

Independent Directors and Female Gender Interaction and Firm Risk

In this section, the percentage of independent directors and female gender are interacted. Also, the new main variable, INDD*GEND term, is constructed and connected with firm risk measures. The findings from this analysis are shown in Table 5. In column (1), the estimate coefficient of INDD*GEND is statistically significant at 10% level and with a positive sign in z-score. The results explain that the interaction of these two board characteristics reduced the firm risk-taking that might have resulted in firm insolvency risk and bankruptcy possibilities. Therefore, *Hypothesis 3b* is not accepted.

Table 5: Analysis of Z-score and Standard Deviation of Tobin's Q as a Function of the Interaction of Independent Directors and Gender Diversity

Dependent Variable	**Z-score (1/Z)**	**Std. Dev. of Tobin's Q**
Independent Variable	**(1)**	**(2)**
BS	-0.185***	
	(-3.610)	
r_BS		-0.137
		(-1.323)
INDD	-0.054*	-0.011*
	(-2.034)	(-2.218)
GENDER		-0.280
		(-0.347)
INDD*GEND	0.105*	0.030
	(2.273)	(0.223)
TENURE	-0.063	0.082
	(-1.067)	(0.95)
LEV	-0.057	0.064
	(-1.647)	(1.017)
r_LnTA	0.427	
	(1.537)	
LnTA		-0.769
		(-1.068)
Intercepts & Year dummies	Yes	Yes
N	40	40
R^2	0.480	0.281

Robust t-statistics in parentheses * p<0.10, ** p<0.05, *** p<0.01

The above evidence translates that when boards are composed of independent directors and some females (at least one member), this firm strategic mix

negatively leads to risk-taking reduction in the extractive firms. With these findings, it may be logical to argue that female directors' interests outweighed independent director counterparts' interests, which, in turn, downsized the extent of firm risk-taking. The coefficient estimate of BS is negative in column (1), hence, comparable to that shown in Table 4. This evidence adds shore up to the *Hypothesis 1*.

Interestingly, in columns (1) and (2), the coefficient estimate of INDD is negative in both z-score and standard deviation of Tobin's Q, being at 10% significance level. That is, independent directors increased risk-taking in z-score directors (Akbar et al., 2017; Nakano and Nguyen, 2012) and reduced the same in standard deviation of Tobin's Q. This evidence is somewhat contradictory, thus, suggesting a more enquiry on this linkage.

Endogeneity Check

A cross-sectional regression of performance on board structure will be biased as changes in board of directors may arise from endogeneity concern in prior firm performance (Hermalin and Weisbach, 2003). This could be true for past firm risk-taking. To control this concern, the system of equations of two-stage least square (2SLS) is estimated, as in Agrawal and Knoeber (1996).

Table 6: Two Stage Least Square (2SLS): Standard Deviation of Tobin's Q, Board Size and Independent Directors

Dependent Variable	**sdQ**	**BS**	**INDD**
Independent Variable			
BS	-0.284		-0.049
	(-1.679)		(-0.011)
sdQ		-3.524	7.114
		(-1.679)	(0.481)
INDD	0.015	0.052	
	(0.220)	(0.198)	
GENDER	0.274	0.967	-15.384**
	(0.236)	(0.216)	(-2.632)
Tenure	0.114	0.403	0.395
	(0.929)	(1.283)	(0.177)
Intercepts and year dummies	Yes	Yes	Yes
N	40	40	40
R^2	0.131	.	0.416

Robust t-statistics in parentheses * p<0.10, ** p<0.05, *** p<0.01

In the system, standard deviation of Tobin's Q, proxying firm risk, board size and percentage of independent directors are treated as endogenous variables. Firm size is replaced by total debts and other variables like ROA are introduced in the system as instrumental variables. A test for validity and significance of total debt and ROA indicated F (2, 37) =15.13 at *p=0.000*. This is above the thumb-rule of F > 10. The results from the 2SLS are shown in Table 6. BS retained the same negative pattern, but it is insignificant. This evidence adds little support to those presented in Table 4.

Conclusion and Implications

The setting of this study is that the board of directors' risk-averse behaviour would reduce shareholders' wealth and impair their interests. Using eight (8) listed firms in Kenya over the period from 2010 to 2014, the relationship between board structure and risk-taking is shown. The board structure attributes comprised board size, board independence, and female gender diversity. To get valid results, the fixed effects estimator (Linck et al., 2008) and 2SLS (Agrawal and Knoeber, 1996) were used.

The findings indicated board size and risk-taking (z-score) are negatively associated, consistent to Huang and Wang (2015) and Minton et al. (2014). Negative coefficients estimate of board size accentuates that a smaller board increased firm risk-taking. The findings also indicated that the percentage of independent directors is negative and insignificant in both z-score standard deviation of Tobin's Q, contrary to the expected results. This entailed that independent directors did not attribute to risk-taking in the extractive industry, similar to the previous evidence (Akbar et al., 2017; Nakano and Nguyen, 2012).

Moreover, female gender diversity and the interaction between independent directors and female directors are positively related to z-score, suggesting that female directors are more risk-averse and less confident in corporate risk decision process (Chong et al., 2018; Levi et al., 2014).

Turning attention to the contribution and implication of the study, the synthesised empirical literature on corporate governance and firm risk-taking is narrow, with several gaps to fill (Chong et al., 2018; Gstraunthaler and Ulyanova, 2010). Consequently, this study contributes to the understanding of the board

structure influence on risk-taking. It was grounded by agency theory, which was previously applied to studies investigating corporate board structure, performance and risk-taking (Chong et al., 2018). It is reported that the same theory is relevant to research examining board structure and risk-taking in the extractive industry for least developed countries. This identified that female gender directors are more risk averse to pursue best interests that converge with their shareholders. In this perspective, it can be argued that reforms should be made to mandate more female directors on the board. Additionally, listed extractive firms in NSE are few, which resulted in small sample size. Given this challenge, findings in this study can be indiscriminate in Sub-Saharan Africa. For future research, this study can be extended to analyse other agency control mechanisms and risk-taking in the same industry.

References

Adams, R. B., & Ferreira, D. (2009). Women in the boardroom and their impact on governance and performance. *Journal of Financial Economics*, 94(2), 291–309.

Adams, R. B., & Funk, P. (2012). Beyond the glass ceiling: Does gender matter? *Management Science,* 58(2), 219–235.

Agrawal, A., & Knoeber, C. R. (1996). Firm performance and mechanisms to control agency problems between managers and shareholders. *Journal of Financial and Quantitative Analysis,* 31(3), 377–397.

Ahern, K. R., & Dittmar, A. K. (2012). The changing of the boards: The impact on firm valuation of mandated female board representation. *Quarterly Journal of Economics,* 127(1), 137–197.

Akbar, S., Kharabsheh, B., Poletti-Hughes, J., & Shah, S. Z. A. (2017). Board structure and corporate risk taking in the UK financial sector. *International Review of Financial Analysis,* 50, 101–110.

Akhigbe, A., & Martin, A. D. (2006). Valuation impact of Sarbanes–Oxley: Evidence from disclosure and governance within the financial services industry. *Journal of Banking and Finance*, 30(3), 989–1006.

Altman, E. I., Iwanicz-Drozdowska, M., Laitinen, E. K., & Suvas, A. (2017). Financial distress prediction in an international context: A review and empirical analysis of Altman's Z-score model. *Journal of International Financial Management & Accounting,* 28(2), 131–171.

Andrén, N. (2016). Corporate governance and firm performance: Evidence from the oil price collapse of 2014-15. Available SSRN 2835290.

Berger, A. N., Kick, T., & Schaeck, K. (2014). Executive board composition and bank risk taking. *Journal of Corporate Finance,* 28, 48–65.

Chahyadi, C., & Wineka, P. (2019). How Does CEO Career Origin Influence Firm's Risk-Taking? *Journal of Accounting and Finance,* 19(4), 77-96.

Cheng, S. (2008). Board size and the variability of corporate performance. *Journal of Financial Economics,* 87(1), 157–176.

Chong, L. L., Ong, H. B., & Tan, S.H. (2018). Corporate risk-taking and performance in Malaysia: the effect of board composition, political connections and sustainability practices. *Corporate Governance International Journal of Business in Society,* 18(4), 635-654.

Coles, J. L., Daniel, N. D., & Naveen, L. (2008). Boards: Does one size fit all? *Journal of Financial Economics,* 87(2), 329–356.

Dalton, D. R., Daily, C. M., Johnson, J. L., & Ellstrand, A.E. (1999). Number of directors and financial performance: A meta-analysis. *Academy of Management Journal*, 42(6), 674–686.

Dbouk, W., Fang, Y., Liu, L., & Wang, H. (2020). Do social networks encourage risk-taking? Evidence from bank CEOs. *Journal of Financial Stability*, 46(C), 1-41.

Elsaid, E., & Ursel, N. D. (2011). CEO succession, gender and risk taking. *Gender in Management,* 26(7), 499-512.

Faccio, M., Marchica, M. T., Mura, R. (2016). CEO gender, corporate risk-taking, and the efficiency of capital allocation. *Journal of Corporate Finance*, 39, 193–209.

Fosu, S., Ntim, C. G., Coffie, W., & Murinde, V. (2017). Bank opacity and risk-taking: Evidence from analysts' forecasts. *Journal of Financial Stability*, 33, 81–95.

Gstraunthaler, T., & Ulyanova, M. (2010). Corporate Governance in the Extractive Industry–Comparing Russian Oil and Gas companies and South African Gold Producers. *Corporate Ownership and Control,* 7(4), 62–73.

Gulamhussen, M. A., & Santa, S. F. (2015). Female directors in bank boardrooms and their influence on performance and risk-taking. *Global Finance Journal*, 28, 10–23.

Hausman, J. A. & Taylor, W. E. (1981). Panel data and unobservable individual effects. *Econometrica: Journal of the Econometric Society*, 16(1), 1377–1398.

Hermalin, B. E., & Weisbach, M. S. (2003). Boards of directors as an endogenously determined institution: A survey of the economic literature. *Economic Policy Review*, 9(1), 1-25.

Huang, J., & Kisgen, D. J. (2013). Gender and corporate finance: Are male executives overconfident relative to female executives? *Journal of Financial Economics*, 108(3), 822–839.

Huang, Y. S., & Wang, C. J. (2015). Corporate governance and risk-taking of Chinese firms: The role of board size. *International Review of Economics & Finance*, 37, 96–113.

Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics*, 3(4), 305–360.

Jensen, M. C. (1993). The modern industrial revolution, exit, and the failure of internal control systems. *Journal of Finance*, 48(3), 831–880.

Jiraporn, P., & Lee, S. M. (2018). How do Independent Directors Influence Corporate Risk-Taking? Evidence from a Quasi-Natural Experiment. *International Review of Finance,* 18(3), 507–519.

Kalsie, A., & Shrivastav, S. M. (2016). Analysis of board size and firm performance: evidence from NSE companies using panel data approach. *Indian Journal of Corporate Governance*, 9(2), 148–172.

Kato, P. R. (2012). Corporate governance, financial distress, and risk-taking in the USA banking sector. *[PhD Thesis, University of Leeds]*. https://etheses.whiterose.ac.uk/7526/.

Laeven, L., & Levine, R. (2009). Bank governance, regulation and risk taking. *Journal of Financial Economics*, 93(2), 259–275.

Levi, M., Li, K., & Zhang, F. (2014). Director gender and mergers and acquisitions. *Journal of Corporate Finance,* 28, 185–200.

Li, J. (2016). Board Advising, Risk-Taking, and Firm Performance. *Journal of Financial Risk Management*, 5(3), 149-160.

Linck, J. S., Netter, J. M., & Yang, T. (2008). The determinants of board structure. *Journal of Financial Economics*, 87(2), 308–328.

Llanos-Contreras, O., Arias, J., & Maquieira, C. (2021). Risk taking behavior in Chilean listed family firms: a socioemotional wealth approach. *International Entrepreneurship and Management Journal,* 17(1), 165-184

Loukil, N., & Yousfi, O. (2016). Does gender diversity on corporate boards increase risk-taking? *Canadian Journal of Administrative Sciences/Revue Canadienne des Sciences de l'Administration*, 33(1), 66–81.

Mathew, S., Ibrahim, S., & Archbold, S. (2016). Boards attributes that increase firm risk–evidence from the UK. *Corporate Governance,* 16(2), 233-258

Minton, B. A., Taillard, J. P., & Williamson, R. (2014). Financial expertise of the board, risk taking, and performance: Evidence from bank holding companies. *Journal of Financial and Quantitative Analysis*, 49(2), 351–380.

Mniwasa, E. E. (2019). Money laundering control in Tanzania: Did the bank gatekeepers fail to discharge their obligations? *Journal of Money Laundering Control,* 22(4), 796-835.

Nakano, M., & Nguyen, P. (2012). Board size and corporate risk taking: further evidence from Japan. Corporate Governance. *An International Review,* 20(4), 369–387.

Nawaz, K., & Ahmad, N. (2017). The effect of corporate governance and capital structure on firms' performance: Investigation on petroleum sector in Pakistan. *Journal of Independent Studies and Research*, 1(15), 51-67.

Niederle, M., & Vesterlund, L. (2007). Do Women Shy away from Competition. Men Compete Too Much. *The Quarterly Journal of Economics*, 122(3), 1067–1101.

Papyrakis, E., Rieger, M., & Gilberthorpe, E. (2017). Corruption and the extractive industries transparency initiative. *Journal of Development Studies*, 53(2), 295–309.

Pathan, S., (2009). Strong boards, CEO power and bank risk-taking. *Journal of Banking and Finance*, 33(7), 1340–1350.

Poncian, J., & Kigodi, H. M. (2018). Transparency initiatives and Tanzania's extractive industry governance. *Development Studies Research,* 5(1), 106-121.

Poncian, J., & George, C. (2015). Mineral Extraction for Socio-Economic Transformation of Tanzania: The need to move from papers to implementation of mining policy and law. *Journal of Social Science Studies*, 2(2), 160–175.

Rajgopal, S., & Shevlin, T. (2002). Empirical evidence on the relation between stock option compensation and risk taking. *Journal of Accounting and Economics*, 33(2), 145–171.

Ramdani, D., & Witteloostuijn, A. V. (2010). The impact of board independence and CEO duality on firm performance: A quantile regression analysis for Indonesia, Malaysia, South Korea and Thailand. *British Journal of Management,* 21(3), 607–627.

Roy, A. D. (1952). Safety first and the holding of assets. *Econometrica: Journal of the Econometric Society,* 20(2), 431–449.

Schroeder, B., & Jackson, J. A. (2007). Why traditional risk management fails in the oil and gas sector: Empirical front-line evidence and effective solutions. *AACE International Transactions*, RI11-RI16.

Smith, C. W., & Stulz, R. M. (1985). The determinants of firms' hedging policies. *Journal of Financial and Quantitative Analysis*, 20(4), 391–405.

Staikouras, P. K., Staikouras, C. K., & Agoraki, M. E. K. (2007). The effect of board size and composition on European bank performance. *European Journal of Law and Economics*, 23(1), 1–27.

Tufano, P. (1996). Who manages risk? An empirical examination of risk management practices in the gold mining industry. *Journal of Finance*, 51(4), 1097–1137.

White, H. (1980). Using least squares to approximate unknown regression functions. *International Economic Review*, 21(1), 149-170

Yanting, Z., & Liyun, X. (2011). Research on risk management of petroleum operations. *Energy Procedia*, 5(2011), 2330–2334.

Yermack, D. (1996). Higher market valuation of companies with a small board of directors. *Journal of Financial Economics*, 40(2), 185–211.