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Heterogeneity in Independent Non-Executive Directors' Attributes and Risk-Taking in Large Banks

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Abstract:

The extant literature suggests that complex firms can benefit from independent non-executive director (INED) quality. To address the issue of INED quality, we look at heterogeneity in the independent non-executive directors' (INEDs') attributes and explore whether this is related to risk-taking behaviour in large banks. We gather novel, hand-collected, director-level data for approximately 2,400 independent non-executive directors (INEDs) of 185 global large banks from 35 countries for the period of 2004–2016, concluding that heterogeneity in INEDs' gender, financial expertise, and board tenure all influence risk-taking behaviour. Employing several identification strategies, we show that the cause seems to be heterogeneity in the INEDs' attributes, as channelled through information asymmetry. We also find that heterogeneity in the INEDs' attributes significantly mitigates bank risk-taking in the post-2009 period. Our study contributes to the literature on both the benefits of INEDs and director heterogeneity.

JEL Classification: G34, G21
Keywords: Independent non-executive director (INED), Attributes heterogeneity, Risk-taking, Large banks.

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1. Introduction

The role of board independence is elaborated in the guidelines of the Bank of International Settlements (BIS; e.g., Blinko et al., 2020).[2] The extant literature on board governance also highlights the role of board independence. The dominant view in the literature is that greater board independence safeguards effective board monitoring (Rosenstein and Wyatt, 1990; Kumar and Sivaramakrishnan, 2008; Crespi-Cladera and Pascual-Fuster, 2014). However, the literature reports quite contradictory results concerning the relationship between board independence and risk-taking (e.g., Mace, 1971; Hermalin and Weisbach, 1998; Zajac and Westphal, 1996; Shivdasani and Yermack, 1999; Fracassi and Tate, 2012; Francis, Hasan, and Wu, 2012; Adams and Mehran, 2012; Vallascas et al., 2017), thus leaving open the question of whether and when independent non-executive directors (INEDs) are beneficial, while posing a challenge to popular policy formulations concerning the inclusion of large numbers of INEDs.

Adams (2012) argues that greater independence might be counterproductive in more complex and opaque institutions, such as banks and other financial institutions. John, Masi, and Paci (2016) suggest that the effect of INEDs could be detrimental to the bank if it goes beyond a limit; therefore, the 'quality' of INEDs could be an important instrument rather than the number of INEDs. In the same vein, Nguyen and Nielson (2010) emphasise the importance of independent non-executive directors' (INEDs') abilities, expertise, and skills. Likewise, Mehran, Morrison, and Shapiro (2012) suggest that the effectiveness of the board of directors is more likely to be influenced by quality than by numbers alone. However, the literature on INEDs' that looks at attributes other than numbers is scarce. Thus, it is an open question to explore whether the quality attributes of INEDs matter for risk-taking in banks.

[2] In a recent international survey of bank board composition requirements in 19 jurisdictions around the world, Blinco et al. (2020) report that all included requirements for independent non-executive directors (INEDs), but there was large variation in the required numbers, ranging from a majority to one-third (or giving a specific number). Given this now common regulatory focus on INEDs, it is understood that the attributes of INEDs have a significant effect on risk-taking in banks. We hope to bridge the gap between the typically insignificant effects of board independence cited in the literature and the great value placed upon them in regulatory frameworks.

The *quality* of INEDs is difficult to interpret. However, *heterogeneity* in INEDs' attributes is easier to observe and could be an interesting area of research, as heterogeneity can be beneficial in many ways. Although a few studies hint at a downside to heterogeneity in terms of potential communication and coordination problems in complex firms (Anderson et al., 2011; Coles et al., 2008),[3] the benefits of boardroom heterogeneity is strongly emphasised in the extant literature. For example, Hambrick et al. (1996) show that top management teams that are diverse in terms of functional background, education, and company tenure exhibit a larger propensity for action. West and Anderson (1996) also associate team heterogeneity with innovativeness. Furthermore, Keck (1997) shows that short-tenured and heterogeneous teams can better address environmental complexities and turbulent environments. Li and Wahid (2018) conclude that tenure-diverse boards exhibit superior monitoring performance. Nonetheless, there are no studies addressing heterogeneity in INEDs' attributes and risk-taking in banks, which this study aims to do.

The aim of this study is to examine the impact on bank risk-taking of heterogeneity in INEDs' attributes. We use a novel, hand-collected dataset of approximately 2,400 INEDs from 185 large global banks in 35 countries for the period of 2004–2016. We find that a larger proportion of INEDs enhances risk-taking in large banks. However, heterogeneity in three of the INEDs' attributes (i.e., gender, financial expertise, and tenure) mitigates risk-taking in large banks. In the same vein, we show that an independent non-executive director (INED) heterogeneity index significantly reduces risk-taking. We show that the causality between INEDs and risk-taking stems from heterogeneity in INEDs' attributes, either due to the individual effects of heterogeneity on three different INED attributes or because the INED heterogeneity index is related to the risk-taking behaviour of the INEDs. Causality is established using several identification strategies for addressing endogeneity and robustness checks. Our results show that information asymmetry is the channel

[3] Anderson et al. (2011) identify a scarcity of research on the performance effects of board-director heterogeneity that goes beyond gender diversity, and they construct an index for heterogeneity that comprises six board characteristics (e.g., age, gender, and education). They find a valuation premium for board heterogeneity in complex firms. Coles et al. (2008) also show that complex firms that have greater advising requirements usually have larger boards and more INEDs. They show that firm value increases with board size for complex firms and the relationship is driven by the number of INEDs. The findings of the study challenge the notion that restrictions on board size and management representation on the board increase firm value.

by which heterogeneity in INEDs' attributes influences risk-taking. Furthermore, we show that heterogeneity in INEDs' attributes has increased in the post-2009 period and the interaction between post-2009 and the INED heterogeneity index (Post-2009*INED heterogeneity index) significantly mitigates risk-taking. Nonetheless, we also show that the INED heterogeneity index significantly reduces firm performance as a consequence of the risk-averse strategy caused by heterogeneity in the INEDs' attributes.

This study makes several contributions to the existing knowledge. First, this is the first study to show that INED quality can be measured by heterogeneity in INEDs' attributes. The study makes important contributions to the INED quality debate by explaining how INED quality emerges from heterogeneity in specific attributes. Previous studies (e.g., Adams, 2012; John, Masi, and Paci, 2016; Nguyen and Nielson, 2010; Mehran, Morrison, and Shapiro, 2012) indicate that INED quality is the most important factor, but none of these studies explored INED quality. The data concerning the three attributes of a large number of INEDs are analysed, and the findings indicate that the causality behind a risk-averse strategy is heterogeneity in the INEDs' attributes.

Second, we make an important contribution to the discussion of gender heterogeneity amongst INEDs and risk-taking in banks. Prior studies have investigated the effects of the percentage of female directors in the boardroom as a whole (i.e., including both executive and INEDs; e.g., Campbell and Minguez-Vera, 2008; Levi, Li, and Zhang, 2014; Bohren and Staubo, 2014; Adams and Ferriera, 2009). Following the critical mass theory of Kristie (2011), Liu, Wei, and Xie (2014) conclude that the voices of female directors are only heard when women are present in greater numbers. We show that such gender heterogeneity among INEDs results in a more risk-averse strategy.

Third, we provide important evidence for a link between heterogeneity of INEDs' financial expertise and risk-taking in banks. There are only a few studies on board members' financial expertise and its impact on risk-taking, and these studies demonstrate that board members' financial expertise positively influences

risk-taking (see e.g., Aebi, Sabato, and Schmid [2012] for US banks; Hau and Thum [2009] for German banks; and Minton, Taillard, and Williamson [2014] for US banks). Our study explores the heterogeneity in financial expertise among INEDs and finds significant negative associations between INEDs' financial expertise and bank risk-taking. Thus, unlike the extant literature, this study indicates that greater *heterogeneity* in INEDs' financial expertise results in a more risk-averse strategy.

Fourth, we make an important contribution to the discussion on the link between INED tenure heterogeneity and bank risk-taking. Several prior studies have suggested problems with director tenure that is either too long (see e.g., Canavan, Jones, and Potter, 2004; Lipton and Lorsch, 1992; Vafeas, 2003) or too short (see e.g., Kosnik, 1990; Mallette and Fowler, 1992). However, we investigate the associations between tenure heterogeneity amongst INEDs and risk-taking in banks. The earlier studies largely conclude that moderate tenure is positive for the board, but this is inevitably confusing because the term 'moderate' requires explanation. Our results are straightforward, in that the heterogeneity of board tenure amongst INEDs is found to mitigate bank risk and to negatively influence risk-taking.

The rest of this paper is organised as follows. Section 2 analyses the extant literature and Section 3 describes the data-gathering and methodology of this study. Section 4 reports the main empirical results of this study, the results of the endogeneity tests, and the robustness checks. Section 5 concludes the paper.

2. Related Literature

The literature on board independence for banks emphasises shareholder incentives. Bank shareholders may have incentives to take risks, due to a moral hazard problem and their limited liability (Galai and Masulis, 1976; Jensen and Meckling, 1976; John et al., 1991). Like equity holders in general, bank shareholders can be viewed as holding a call option on the firm's value, with an exercise price equal to the total amount of debt outstanding. If the interest rate is not accurately priced to reflect this risk, bank shareholders can exploit the underlying call option by increasing the asset risk of their bank (Galai and Masulis, 1976). However,

banks are highly levered, compared to other firms (i.e., the theoretical call option is closer to being at-the-money and therefore with a higher vega), thus this problem of risk-shifting can be more significant for banks than it is for other firms. As a result, bank shareholders may have strong incentives to make risky investments to maximise their potential benefits, at the cost of deposit insurance or bailout support. Consequently, highly independent boards are most likely to be supportive of high risk-taking activities due to a more favourable shareholder attitude.

Prior studies of board independence have largely focused on the number of INEDs. In contrast, this study explores heterogeneity in INEDs' *attributes*, including their gender, financial expertise, and tenure. Prior literature on risk-taking suggests that female executives are more cautious than their male counterparts when making corporate decisions (e.g., Levi, Li, and Zhang, 2014; Huang and Kisgen, 2013) and engage in fewer risk-taking activities (Gulamhussan and Santa, 2015). Prior studies have also provided support for the positive effects of female executives, who are associated with more diligent monitoring of audit efforts (e.g., Adams and Ferreira, 2009; Gul, Srinidhi, and Tsui, 2008) and thought to bring new perspectives and experience to the boardroom (Hillman, Shropshire, and Cannella, 2007), which substitutes for weak corporate governance (see e.g., Gul, Sirinidhi, and Ng, 2011). The existing literature primarily focuses on the proportion of female directors in the boardroom as a whole, rather than amongst the INEDs alone, and the results are mixed. For example, Campbell and Minguez-Vera (2008), Levi, Li, and Zhang (2014), and Liu, Wei, and Xie (2014) all find positive relationships between the percentage of female directors and firm performance, while Adams and Ferriera (2009), Ahern and Dittmar, (2012), and Bohren and Staubo (2014) report a negative relationship between increased gender diversity on a board and firm performance. Sila et al. (2016) find no relationship between female board representation and equity risk. Carter, D'Souza, Simkins, and Simpson (2010), in turn, failed to reveal any relationship, and they conclude that females in the boardroom are treated as tokens, with their monitoring abilities suffering due to this lack of power.

Applying critical mass theory (Kristie, 2011), Liu, Wei, and Xie (2014) find that a larger number of female directors is significantly (positively) related to firm performance in Chinese firms. In the same vein, Ben-Amar et al. (2017) demonstrate that gender heterogeneity is associated with a reduced carbon footprint for the firm. In a recent paper, Karavitis et al. (2021) conclude that the presence of independent female corporate board members is associated with lower spreads on loans granted to the firm by the banks. Furthermore, Radu and Samili (2021) identify a positive influence of gender heterogeneity on cyber disclosure, and Arnaboldi et al. (2021) show a negative impact of gender diversity on bank misconduct. Based on the above findings, we hypothesise that greater heterogeneity in gender amongst INEDs is associated with more cautious risk profiles for the banks.

Since the 2008-09 financial crisis, there has been much academic debate concerning both the complexity of the financial instruments used by banks and financial institutions prior to the crisis and the benefits of financial expertise among bank board members, as well as their roles in the crisis. For example, Aebi, Sabato, and Schmid (2012; US banks) and Hau and Thum (2009; German banks) find that a higher percentage of directors – on the board and supervisory board, respectively – with a financial background (i.e., directors with familiarity with and understanding of complex financial instruments) was associated with poorer bank performance or larger losses during the financial crisis. However, Minton, Taillard, and Williamson (2014) explored the association between the financial expertise of INEDs and the banks' risk-taking behaviour and performance. They find that, in the run-up to the financial crisis, financial expertise was positively associated with both balance-sheet and market-based measures of risk, but weakly and negatively associated with firm performance, while after the crisis, lagged financial expertise had a strong negative association with performance. Thus, our conjecture is that high levels of heterogeneity in INEDs' financial expertise are associated with less risk-taking by the banks.

Board tenure is often considered a sign of board vigilance. However, excessively long-tenured directors may develop friendships with the CEO, which may be detrimental to board monitoring and the protection of shareholders' interests (see e.g., Canavan, Jones, and Potter, 2004; Lipton and Lorsch, 1992; Vafeas, 2003). Furthermore, directors who are early in their tenure may not make the best monitors either, due to a reluctance to 'rock the boat' and a lack of familiarity with their responsibilities (Kosnik, 1990; Mallette and Fowler, 1992). Vance (1983) and Salancik (1977) argue that a moderately long tenure is desirable for better board monitoring due to directors' learning curves. Prior studies have considered the issues around INED tenure, with several concluding that the tenure of outside directors is a matter of concern (e.g., Johnson, Daily, and Ellstrand, 1996; Kosnik, 1990; Zahra and Pearce, 1989), but a long tenure might be only a matter of pride (Canvan, Jones, and Potter, 2004). In a study of 324 firms, out of a possible 2,000 US Fortune firms, Musteen, Datta, and Kemmerer (2010) find an inverted-U shaped relationship between the average tenure of INEDs and corporate reputation. Based on the prior literature, our conjecture is that banks with greater heterogeneity in their INEDs' tenure have fewer high-risk projects.

We construct an INED attributes' heterogeneity index to consider heterogeneity in gender, financial expertise, and board tenure. As conjectured for these three attributes individually, we expect that a high score on the INED heterogeneity index will be associated with lower risk-taking, as greater heterogeneity may be associated with higher quality INEDs, as indicated in the previous literature (e.g., John, Masi, and Paci, 2016; Nguyen and Nielson, 2010; Mehran, Morrison, and Shapiro, 2012), as well as mitigating information asymmetry (Bernile et al., 2018).

3. Data and Method

3.1 Data

This study is based on a sample of large, listed, commercial banks and bank holding companies (BHCs), with accounting data available in BankFocus by Bureau van Dijk, market data available in Thomson Reuters Eikon, and board data available in BoardEx, governance reports, and annual reports. We take an

initial list of the top-500, global, listed financial institutions. Following Beltratti and Stulz (2012), we screen the financial institutions based on three criteria: (a) an asset size of at least 10 billion dollars at the end of the fiscal year 2004 (from the BankFocus database); (b) financial institutions that are loan givers (i.e., loan/total assets ratio greater than 20%); and (c) financial institutions that are deposit takers (i.e., deposit/assets ratio greater than 10%). After screening, we identify unique financial institutions by manually checking the BvD ID, ISIN code, ticker symbol, and website address for each bank to avoid double counting.[4] We filter the remaining financial institutions, keeping those with the codes C1, C2, or C*[5] and with available governance data for at least three years, which we collect from annual reports and governance reports and via searches of the companies' websites.[6] This gives a sample of 185 commercial banks and BHCs, including approximately 2,400 firm-year observations for INED attributes (e.g., gender, financial expertise,[7] and board tenure) over the period from 2004 to 2016, for 35 countries. A country-wise distribution of banks is reported in Table 1. A large number of the banks in the sample are from Japan and the United States, amounting to 23% and 15%, respectively, of the total number of observations. In fact, Japan and the United States have predominantly large, listed banks, unlike countries such as China, Brazil, Chile, India, and Mexico. Recent studies of large banks have provided similar pictures for Japanese and US banks. Thus, the high concentration of these two countries in the sample is consistent with Beltratti and Stulz (2012), Erkens, Hung, and Matos (2012), Vallascas, Mollah, and Keasey (2017), and Srivastav,

[4] In some cases, BankFocus reports merged banks as separate entities after the M&A events, which cause double counting; so, we manually checked whether separate entities were reported for our sample banks.

[5] The BankFocus database offers six accounting consolidation codes: C1, C2, U1, U2, C*, and U*. The accounting consolidation codes C1, C2, and C* indicate that the financial statements of the parent bank are consolidated with its subsidiaries, but the financial statements of the parent bank are not consolidated with its subsidiaries for the codes U1, U2, and U*. Thus, un-consolidated statements do not offer a complete financial picture of those banks.

[6] We hand-collected financial expertise data entirely from annual reports. However, gender, tenure, board size, number of INEDs, and CEO power variables for US, UK, and some European banks were collected from BoardEx, though the majority of the data for these items were hand-collected from annual reports.

[7] Following Guner, Malmendier and Tate (2008) and Minton, Taillard and Williamson (2014), we defined every individual independent director as a financial expert if they fulfilled any of the five criteria (and thus assigned them 1 – all others were assigned 0). The criteria were as follows: the independent director had i) held an executive position at a banking institution (former bank executive); ii) held an executive position at a nonbank financial institution (executive of nonbank financial); iii) held a finance-related position (such as chief financial officer [CFO], accountant, treasurer, vice president [VP] finance) of a nonfinancial firm (finance executive of a non-financial); iv) held an academic position in a related field (professor of finance/economics/accounting); or v) worked as a hedge fund or private equity fund manager or venture capitalist (professional investor). We hand-collected the data for INEDs' financial expertise from annual reports and governance reports and via searches of the companies' websites and calculated the proportion of INEDs with and without financial expertise (using the five criteria).

Keasey, Mollah, and Vallascas (2017). For the remainder of the sample, no individual country's observations account for more than 5% of the total.

Insert Table 1 about here

3.2 Methodology

To achieve the objectives of the study, we aim to identify heterogeneity in INED gender, financial expertise, and board tenure. Following Radu and Samili (2021) and Ben-Amar et al. (2017), we construct a Blau index for 'INED gender heterogeneity'; and we construct a Blau index for 'INED financial expertise heterogeneity', following Fang et al. (2018). However, we propose the 'INED tenure heterogeneity' variable as the standard deviation of INED board tenure, following Schopohl et al. (2021), Bernile et al. (2018), and Talavera et al. (2018).

First, we test whether heterogeneity in the INEDs' attributes has an effect on risk-taking, by employing the following equation:

$$\text{Risk-Taking}_{it} = \alpha_0 + \beta_1 * \text{INED Gender Heterogeneity}_{it} + \beta_2 * \text{INED Financial Expertise Heterogeneity}_{it} + \beta_3 * \text{INED Tenure Heterogeneity}_{it} + \beta_4 * \text{INED}_{it} + \gamma X_{it} + \text{Country \& Year FE} + e_{it} \quad (1)$$

We use the three heterogeneity measures explained above as explanatory variables. *Risk-taking* is measured by idiosyncratic risk or default risk and *INED* measures the proportion of INEDs in the board in a given year. *X* is a vector of control variables from four categories: *governance controls*, such as board size and CEO power (long-tenured internal CEOs in both CEO and Chair roles); *bank-level controls*, such as log of total assets, return on assets, market risk (systematic risk or beta), loan to deposit ratio, and income diversity; *cross-country controls*, such as GDP growth and

IFRS adoption dummy;[8] and finally, *cross-country regulation and supervision controls*, from Barth, Capiro, and Levine (2006). The model also includes country and year fixed effects (FE).

Second, we estimate an otherwise similar model in which we have replaced the three heterogeneity measures with an INED heterogeneity index:

$$\text{Risk-Taking}_{it} = \alpha_0 + \beta_{1*}\ \text{INED Heterogeneity Index}_{it} + \beta_2 * \text{INED}_{it} + \gamma X_{it} + \text{Country \& Year FE} + e_{it} \quad (2)$$

In constructing the INED heterogeneity index, we follow Bernile et al. (2018). We standardise INED gender heterogeneity, INED financial expertise heterogeneity, and INED tenure heterogeneity using their means and standard deviations for scaling ('STDZ' refers to the standardised forms of these) and then equally weight each of the three attributes. That results in the INED heterogeneity index are defined as follows:

INED Heterogeneity Index = STDZ (INED Gender Heterogeneity) + STDZ (INED Financial Expertise Heterogeneity) + STDZ (INED Tenure Heterogeneity) (3)

Equations (1) and (2) may suffer from potential endogeneity related to several right-hand side variables. The system generalised method of moments (GMM) estimator proposed by Blundell and Bond (1998) is suitable for dealing with endogeneity issues through the use of appropriate instruments. This is achieved by combining the moment conditions from the first-differenced and levels equations. The Blundell and Bond (1998) system estimator we employ has two advantages over other dynamic panel data methods – most notably, over the difference-in-difference (DiD) estimator proposed by Arellano and Bond (1991). First, as long as the instruments are valid, the GMM estimator exhibits higher levels of consistency and

[8] The IFRS foundation describes that IFRS as aiming to bring transparency, strength, and accountability and to contribute to economic efficiency (www.ifrs.org). Until early 2018, 166 countries and jurisdictions had adopted IFRS standards. To capture cross-country variation in these issues, we used an IFRS dummy in our model.

efficiency. Second, unlike the difference estimator, the system GMM estimator permits the use of time-invariant (or highly persistent) variables in our specifications. This approach is particularly useful when we estimate the impact of INEDs' attributes on risk-raking. The instruments were chosen to comply with the identification of the GMM estimation method. We achieve this by exploiting the first lag difference of bank characteristics as instruments in the levels equation and the second of bank characteristics as instruments in the difference equation. This approach means that we treat all bank characteristics as endogenous covariates, while treating the country and macro controls as strictly exogenous.

The validity of our approach relies on two assumptions (which we confirm to be valid for each of our estimations). First, for the instruments to be valid, they must be uncorrelated with the error term. We use the Hansen *J*-statistic of over-identifying restrictions to test this assumption (where statistically insignificant values confirm the validity of the instruments). Second, the system GMM estimator requires stationarity in the post-instrumentation error terms. This implies the absence of second-order serial correlation in the first-difference residual. We employ the m_2 statistic developed by Arellano and Bond (1991) to test for the lack of second-order serial correlation in the first-difference residual. An insignificant m_2 statistic indicates that the model is correctly specified. Nevertheless, we also employ OLS and FE models for robust estimations (see Table 11, Panel A and Panel B).

Table 2 below presents summary statistics for our variables. All financial variables are winsorised at the 1st and 99th percentiles to lessen the impact of extreme observations and remove any data coding errors. The table reports the number of observations, means, standard deviations, minimums, quarter 1, medians, quarter 3, and maximum values of the variables used in this study. The mean (median) of the INED is 0.5362 (0.5625), which is consistent with Vallascas, Mollah, and Keasey (2017). The mean and median values of INED gender heterogeneity are 0.1538 and 0.0000; INED financial expertise heterogeneity, 0.2949 and 0.3750; INED tenure heterogeneity, 2.5726 and 2.3845; and the INED heterogeneity index, 0.1095 and 0.1933. These values are consistent with relevant studies, such as Radu and Samili (2021), Ben-

Amar et al. (2017), Fang et al. (2018), Schopohl et al. (2021), Talavera et al. (2018), and Bernile et al. (2018). The proxies for risk-taking and other control variables are relatively similar to those reported by similar studies in the field.

Insert Table 2 about here

A Pearson's pairwise correlation analysis for the risk-taking and heterogeneity of the INED attributes and control variables is reported in Table 3. Although the coefficients between risk-taking proxies and INED (fraction of independent non-executive directors) are positively significant, the coefficients between risk-taking proxies and INEDs' heterogeneity variables (e.g. INED gender heterogeneity, INED financial expertise heterogeneity, INED tenure heterogeneity, and the INED heterogeneity index) are negative (significant). These univariate results support shareholders' incentives view that the INEDs serve the shareholders, but the heterogeneity in INEDs' attributes compromise the shareholders' incentive view. The correlation coefficients between the repressors is not high, which suggests that the models are free from multicollinearity.

Insert Table 3 about here

4. Empirical Results

4.1 Heterogeneity in the INEDs' Attributes and Bank Risk-Taking – Baseline Results

Following the arguments of John, Masi, and Paci (2016), Nguyen and Nielson (2010), and Mehran, Morrison, and Shapiro (2012), we investigate whether heterogeneity in INEDs' attributes affects the risk-taking behaviour of their banks. We begin our investigation by looking at the relationship between the proportion of INEDs, the heterogeneity of INEDs' attributes and risk-taking behaviour of banks. Accordingly, we employ **Equation (1)** to test the relationship between the proportion of INEDs, the heterogeneity of INEDs' attributes and bank risk-taking. We use *idiosyncratic risk* and *default risk* as the

proxies for risk-taking. The results are reported in Table 3. The lag values of risk-taking are significantly positive, indicating the importance of controlling for the dynamics of risk-taking in our empirical analysis. We control for endogeneity using a two-step system, GMM instrumental variable model, under a dynamic panel data setting, as in Wintoki, Linck, and Netter (2012). This approach does not normally require external instruments, as it relies on lagged values of the endogenous variables as instruments in the difference equation and on the first-difference of the same variables in the level equation. This method is especially appropriate when controlling for forms of dynamic endogeneity that arise when an explanatory variable is correlated with past values of the dependent variable, as is often the case in governance studies (Wintoki, Linck, and Netter, 2012). The Hansen J test of over-identification restrictions and the m_2 test of second-order autocorrelation are not significant, supporting the validity of the selected instruments and the GMM estimator. We control for firm-level characteristics, including governance and cross-country controls, and include regulation and supervision in all models.[9]

We begin our analysis by emphasising the basic functional relationship between the proportion of INEDs and risk-taking. We report the results for the relationship between the proportion of INEDs and risk-taking in Models 1-2. As expected, we find that the proportion of INEDs is positively related to risk-taking, indicating that a larger number is INEDs is associated with greater risk-taking by the banks. These results provide support for the shareholders' incentives view, which states that INEDs serve shareholders' best interests through risk-taking activities (Galai and Masulis, 1976). Next, we investigate whether heterogeneity in INEDs' attributes supports or challenges the shareholder incentive view of risk-taking in banks. Accordingly, we run the relationship between heterogeneity in three INED attributes and risk-taking. The results are reported in Models 3-4. We find that INED gender heterogeneity mitigates risk-taking behaviour. These results are in line with the finding that female executives are more cautious than male executives when making corporate decisions (e.g., Levi, Li, and Zhang, 2014; Huang and Kisgen, 2013),

[9] We also estimated the results using OLS and FE models, and the results were fully consistent with GMM results in terms of sign, albeit OLS and FE coefficients were not always as significant as the GMM coefficients. We report the results in Table 11 (Panels A & B).

hence engaging in fewer risk-taking activities (Gulamhussan and Santa, 2015). Risk-averse behaviour is evident in the INED gender heterogeneity results.

We also find that the INED financial expert heterogeneity significantly mitigates risk-taking, indicating that greater heterogeneity in INEDs' financial expertise on the board is associated with greater risk aversion and less risk-taking by the bank. Minton, Taillard, and Williamson (2014) show that a larger proportion of financial experts on the board enhances risk-taking incentives due to shareholder incentives, and this is similarly true for the proportion of INEDs. However, we provide evidence of the reverse: namely, heterogeneity in INEDs' financial expertise mitigates the risk-taking incentives of INEDs.

Our results also indicate a negative relationship between heterogeneity in INEDs' tenure and risk-taking, indicating that greater heterogeneity in INED tenure is associated with lower rates of risk-taking. Our results contribute new knowledge to the debate around board tenure and bank risk-taking. Several studies have shown that the tenure of outside directors is a matter of concern (e.g., Johnson, Daily, and Ellstrand, 1996; Kosnik, 1990; Zahra and Pearce, 1989) but that a long tenure might be only a matter of pride (Canvan, Jones, and Potter, 2004). Excessively long-tenured directors may develop friendships with the CEO, which may be detrimental to board monitoring and the protection of shareholders' interests (see e.g., Canavan, Jones, and Potter, 2004; Lipton and Lorsch, 1992; Vafeas, 2003). However, directors early in their tenure may not make the best monitors either, due to a reluctance to 'rock the boat' and a lack of familiarity with their responsibilities (Kosnik, 1990; Mallette and Fowler, 1992). Vance (1983) and Salancik (1977) argue that a moderately long tenure is desirable for better board monitoring due to the directors' learning curves. Overall, the results for the three INED attributes indicate a causal relationship with heterogeneity in INEDs' attributes, as this is also found to mitigate risk-taking behaviour (see Models 3-4).

Finally, we estimate a model for bank risk-taking using the combined INED heterogeneity index (**Equation [2]**). The results are reported in Models 5-6. We find that the INED heterogeneity index significantly

mitigates risk-taking, confirming that the causality originates from heterogeneity in the INEDs' attributes. Our results indicate the type of attributes that may be important for mitigating risk and may, therefore, be helpful for improving the financial stability of the banking system.

Consideration of the board-level control variables reveals that the larger the board, the lower the bank's level of risk-taking. Similarly, powerful CEOs seem to be more risk-averse, indicating that they serve managers' interests, rather than those of shareholders. Among firm-level variables, accounting profit is found to be negatively correlated with risk-taking. Larger banks engage in less risk-taking behaviour. Mixed effects are observed for other firm and country controls.

Insert Table 4 about here

4.2 Heterogeneity in the Attributes of Independent Non-Executive Directors (INEDs) and Bank Risk-Taking – Post-2009 Impact

As discussed earlier, Vallascas, Mollah, and Keasey (2017) demonstrate that there has been an increase in board independence in the post-2009 period. We test whether the shift towards board independence has had an impact on the heterogeneity of INEDs' attributes. We reveal that INED heterogeneity has increased during post-2009 period, which is reflected in the INED heterogeneity index (see **Figure 1**). Accordingly, we examine the effect of INED heterogeneity in the post-2009 period. We run **Equation (2)** using a post-2009 dummy and its interaction with the INED heterogeneity index. The results are reported in Table 5. The find that the interaction between post-2009 and the INED heterogeneity index (post-2009*INED heterogeneity index) is negatively (significant) related to risk-taking. These results indicate that greater INED heterogeneity in the post-2009 period has significantly mitigated risk-taking in the period. This supports the view that heterogeneity in INEDs' attributes has increased aftermath of the 2008-2009 crisis, which has mitigated risk-taking in the post-2009 period. In effect, we see that heterogeneity in the attributes of INEDs during the post-2009 period has significantly changed the behaviour of INEDs. Table 5 also

shows that the return on assets has had a negative and significant effect on risk-taking, whereas the other variables have not been significant during the post-2009 period.

Insert Table 5 about here

4.3 Heterogeneity in the Attributes of Independent Non-Executive Directors (INEDs) and Bank Performance

Having showed that heterogeneity in the attributes of INEDs mitigates risk-taking in banks, we investigate whether this heterogeneity has also affected firm performance. Table 6 reports the results for the INED heterogeneity index and firm performance in Models 1-2. We use *buy* and *hold return* and *price/book-value ratio* as proxies for market performance. We begin our investigation by looking at the general relationship between the proportion of INEDs and firm performance. As expected, we find that a larger proportion of INEDs is associated with higher bank performance, indicating that the former serves shareholders' incentives. In line with Pathan and Skully (2010), we argue that bank shareholders may benefit from more INEDs because such directors serve shareholders' incentives through greater shareholder protection.

However, we find a significant negative relationship between the INED heterogeneity index and performance (see Models 5-6). In effect, our results indicate that heterogeneity in INEDs' attributes compromises the shareholders' incentive view and results in lower bank performance (see Models 3-6). These results are very much in line with our prior findings on risk. As reported in Table 4, heterogeneity in the attributes of INEDs mitigates risk-taking in banks, leading to more risk-averse strategy (see Models 3-6). As there should be a link between risk and return on financial markets, our results tell an internally consistent story of greater heterogeneity in INED attributes resulting in boards choosing lower-risk strategies, resulting in lower returns (i.e., poorer performance).

Among the board-level control variables, powerful CEOs seem to be more risk-averse and contribute to reducing banks' performance, indicating that powerful CEOs do not serve shareholder interests. Among the firm-level variables, market risk is positively related to market performance, bigger banks show lower firm performance, and IFRS adoption seems to have a negative relationship with bank performance.

Insert Table 6 about here

4.4 Endogeneity Concerns

Endogeneity raises serious concerns for the causal relationship between heterogeneity in INED attributes and risk-taking for banks. First, we address the endogeneity issue by using an instrumental variable (IV) approach. Second, we pursue a natural experiment by using a propensity score matching (PSM) approach and use deaths of INEDs as an exogenous event.

4.4.1 The Instrumental Variable (IV) Approach

We estimate an instrumental variable (IV) model by using 2SLS regressions with contemporaneous explanatory variables. Adams and Mehran (2012) observe that it is challenging to identify appropriate instruments in governance studies. However, we overcome this issue by identifying the most appropriate instruments. Our first instrument is motivated by the argument concerning supply of INEDs (Knyazeva, Knyazeva, and Masulis, 2013; Anderson, Reeb, Upadhyah, and Zhao, 2011). We assume that the larger the city population in the bank's headquarter city, the larger the supply of INED candidates with heterogeneous attributes would be. Thus, we use the log of the population of the city in which the bank's headquarter is located as the first instrument. Our second instrument, the logarithm of the size of the newspaper circulation in the country where the bank is headquartered, takes inspiration from Vallascas, Mollah, and Keasey (2017). Support for the second instrument also comes from Dyck and Zingales (2004). We argue that a wider newspaper circulation indicates greater media influence in the country, which can motivate banks to recruit more diverse INED members for their boardrooms. The results are reported in Table 7.

The INED heterogeneity index is instrumented using the logarithm of the population in the city in which the bank is headquartered and the logarithm of the newspaper circulation in the country of the bank's headquarter. A significant (positive) relationship between the INED heterogeneity index and the instruments – as well the endogeneity test results – supports the validity of the instruments in the IV model. As expected, we find that the INED heterogeneity index is significantly negatively correlated with risk-taking proxies. These results are in line with our baseline findings that INED heterogeneity mitigates risk-taking. The relationships between risk-taking and other governance and control variables remain similar to the baseline model reported in Table 4. Thus, we conclude that the negative relationship between INED heterogeneity and risk-taking is unlikely to be driven by endogeneity concerns and the causality rather stems from heterogeneity in the INEDs' attributes.

Insert Table 7 about here

4.4.2 Difference-in-Difference (DiD) Analysis – Quasi-Natural Experiment

We also run a DiD model, using the loss of an INED as an exogenous shock in a quasi-natural experiment, following Nguyen and Nielson (2010). In the first instance, we consider cases in which a bank has lost an INED who was not replaced until the next annual general meeting (though we are unable to confirm whether the losses were due to sudden death or resignation).[10] We argue that the loss of an INED who is not replaced until the next annual general meeting is an exogenous exit that reduces heterogeneity. In the initial screening, we identify 191 cases of the loss of an INED. We employ a DiD approach on a propensity score matched sample to identify the impact of an exogenous exit on bank risk-taking.

Following Amin et al. (2020), we create a dummy variable for the exogenous exit of INEDs that equals 1 if there is a loss of an INED in any year (and 0 otherwise). We define our treatment group as the banks that

[10] Due to limited access to daily multilingual newspapers and news channels across the 35 countries, it was impossible for us to verify the reasons for the losses of the INEDs.

had experienced at least a loss of an INED, and the control group consists of banks that had not experienced the loss of an INED at any point in time. The banks in our control group are similar to the treatment banks in other dimensions. For PSM, we used all the right-hand-side variables in Equation (1) as matching criteria. The control group is matched with the treatment group based on criteria measured a year prior to the loss of the INED, thus avoiding any endogenous selection of variables. We restrict our analysis to non-missing values for all matching and outcome variables for risk-taking (*idiosyncratic risk* and *default risk*). We then estimate the propensity scores using a probit model, where the dependent variable is 'INED exogenous exit' and the explanatory variables include all the right-hand-side variables from Equation (1), based on the propensity score using the nearest neighbour matching with a caliper of 0.01.

The matched pairs are used for the DiD estimation, using regression analysis to estimate the effect of the exogenous exit of INEDs on risk-taking between the pre-matched and post-matched periods. We assume that the outcome variable should follow parallel trends in both the treatment and control banks, so the changes between the treatment and control groups following the exit are not simply due to converging or diverging trends. We report the results for the balancing properties of the treatment and matched groups (control) prior to the treatment for our two risk measures in Table 8 (Panel A: Idiosyncratic risk; Panel B: Default risk). After the matching exercise, we are able to successfully match 96 cases for idiosyncratic risk and 97 cases for default risk. The balancing results in Panels A and B show that the treated and control banks are comparable prior to the treatment effect, and the matching process eliminates any major differences between these banks.

We assume that the changes between the pre-matched period and the post-matched period, between the treatment and control banks, can be reasonably attributed to the exogenous loss of the INEDs; hence, the exogenous loss of INEDs affects the supply and the heterogeneity of the INEDs. Accordingly, we run regression models to assess the effect of the exogenous loss on risk-taking, comparing treatment minus control banks and pre-shock minus post-shock years. We report the regression results in Panel C (Table 8).

We find that the exogenous exit of an INED positively affects both proxies of risk-taking (idiosyncratic risk and default risk). This indicates that risk-taking increases due to a shortage in the supply of INEDs, as this shortage decreases heterogeneity in the post-shock period. The use of country FE ensures that the DiD variation isolated is purely due to pre and post differences in the bank. We find strong support for our key hypothesis that heterogeneity in the attributes of INEDs significantly mitigates bank risk-taking. The findings of our DiD analysis suggest that the reduced INED heterogeneity due to the loss of an INED is related to increased bank risk-taking; hence, the results support the view that the negative association between INED heterogeneity and risk-taking is unlikely to be driven by endogeneity concerns.

Insert Table 8 about here

4.4.3 Other Robustness Checks

4.4.3.1 Heckman Two-Stage Method – Sample Selection Bias

Although we have addressed endogeneity issues in various ways, a remaining concern is that the choice of sample banks for the study was not random and the selected banks may have more INED heterogeneity than an average bank. We address this potential sample selection bias with the use of a two-stage Heckman selection model, using data for the study. In the first stage, we run a probit model to estimate the probability of higher INED heterogeneity, using the logarithm of the city population in the city in which the bank is headquartered as the exogenous variable and the INED heterogeneity dummy as the dependent variable. We assign 1 for the dummy if the INED Heterogeneity Index takes a value that is higher than its median value, otherwise 0. We assume that a larger city population may be related to a better supply of INED candidates, which would allow the banks to ensure greater INED heterogeneity. We estimate the inverse Mills ratio (IMR) from the first-stage model and include it in the second-stage model to control for self-selection bias. Similarly, we run a GMM estimation in the second stage to compare our results with the baseline results in Table 4. The results are reported in Table 9. As expected, the log of the city population is significantly (positively) related to the INED heterogeneity dummy, indicating the validity of the exogenous variable. Following Schopohl et al. (2021), we control for self-selection bias through the IMR

and find that our primary results remains in line with the baseline estimations. Thus, we argue that the results are less likely to be driven by any self-selection bias.

Insert Table 9 about here

4.4.3.2 Channel Analysis

This section examines whether INED heterogeneity – as channelled through information asymmetry – affects a bank's risk-taking. For this purpose, we follow two procedures: first, we examine the direct association between INED heterogeneity index and information asymmetry; and second, we re-investigate the association between heterogeneity in INEDs' attributes and bank risk-taking, based on information asymmetry. We measure information asymmetry using the dispersion of analysts' forecasts (Mattei and Platikanova, 2017)[11] and Amihud's illiquidity (Cui, Jo, and Haejung, 2018; Fu et al., 2012).[12] We expect negative relationships between the INED heterogeneity index and information asymmetry proxies, as INED heterogeneity should reduce information asymmetry through the more varied viewpoints and greater access to information. We also predict stronger negative relationships between the INED heterogeneity index and information asymmetry for banks with a greater dispersion of analyst forecasts and for banks with high Amihud illiquidity.

We report the results in Table 10. Panel A presents the results for information asymmetry and the INED heterogeneity index. We find that INED heterogeneity significantly reduces information asymmetry. We present the results for high-low information asymmetry and INED heterogeneity in Panel B. As expected, we find that the coefficients are negative and significant for highly asymmetric environments. We also find

[11] Like Mattei and Platikanova (2017), we estimated dispersion in the analysts' forecasts using this model: $Dispersion = \frac{Standard\ deviation\ of\ EPS\ forecasts}{Beginning-of-fiscal-year\ stock\ price} \times 100$

[12] Like Cui, Jo, and Haejung (2018) and Fu et al. (2012), we estimated Amihud's illiquidity using this model: Illiquidity = $\frac{|ret_t|}{\$volume_t}$

that there are significant differences between high and low asymmetric environments (see Chi squared statistics). Overall, these results indicate that the risk-averse behaviour of INEDs is channelled through the mitigation of information asymmetry.

Insert Table 10 about here

4.4.3.3 Omitted Variables and Reverse Causality

An omitted variable problem could have created problems in our study due to unobservable, time-invariant, bank characteristics. Vallascas, Mollah, and Keasey (2017) stress that a fixed effect model on a panel dataset helps by reducing omitted variable problems due to unobservable time-invariant bank characteristics, as well as removing cross-sectional variation across banks. Accordingly, we apply fixed effect models to run Equation (2), and the results are reported in Table 11 (Panel B). The results are consistent with our baseline estimations in Table 4. Another important concern is the endogeneity of several right-hand-side variables. As explained earlier, we follow Wintoki, Linck, and Netter (2012) by applying the two-step system GMM model of Blundell and Bond (1998) to address endogeneity in the study.

Reverse causality is a key source of endogeneity in the study. Although the concern for reverse causality is mitigated by our fixed effect specification based on lagged values of the explanatory variables (Table 11: Panel B), we conduct additional tests to assess the robustness of our results. First, we re-estimate our baseline models with 1-year and 2-year lags, following Boone et al. (2007), Faleye et al. (2014), Faleye (2015), and Vallascas, Mollah, and Keasey (2017). These studies show that historical values are largely predetermined, hence regressing the dependent variables with potential endogenous explanatory variables should resolve the reverse causality problem. We report the results in Table 11 (Panel A: OLS model; Panel B: FE model; Panel C: GMM model). These results are in line with our baseline findings, even though the coefficients for the FE and OLS models are not as significant as those for the GMM model. Overall, our results remain the same after addressing the omitted variable and reverse causality issues.

Insert Table 11 about here

5. Conclusions

Recent academic literature has cast doubt on the role of INEDs. Most prior studies have suggested that the proportion of INEDs alone is not a sufficient metric for 'good governance', suggesting that the characteristics of the INEDs are also important. Many researchers propose that INEDs' expertise and skills are sources of effective board monitoring, and since there is heterogeneity in such skills, the pure number of INEDs is a poor measure. The literature on the attributes of INEDs that matter for risk-taking is scarce. This is the first study to examine *heterogeneity* in several such attributes and the impact on risk-taking in large banks.

With an examination of novel, director-level data for approximately 2,400 INEDs of 185 global large banks from 35 countries for the period of 2004 to 2016, we find that heterogeneity in INEDs' attributes mitigates risk-taking behaviour. We show that the risk-averse strategies of INEDs channels through asymmetric information. This risk-averse strategy adversely affects firm performance. The risk-averse strategy has been more pronounced in the post-2009 period.

Our results have significant implications for board monitoring through heterogeneity in INEDs' attributes. In particular, large global banks that are interested in reducing risk should scrutinise their INEDs and select boards with more heterogeneous attributes to gain the full benefits of their monitoring roles. The results of this study have important implications for policymakers in the banking sector. Future researchers should consider the effects of the whole board – specifically, how heterogeneity amongst INEDs and executive directors relates to risk-taking.

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Table 1
Sample Distribution

This table reports the distribution of the banks by country.

Country	Banks	Observations	Percent	Av. Bank Size (bn $)
Australia	5	65	3	571
Austria	3	39	2	136
Belgium	2	26	1	481
Brazil	2	26	1	311
Canada	6	78	3	443
Chile	1	13	1	44
China	10	130	5	847
Denmark	2	26	1	315
France	2	26	1	2003
Germany	5	65	3	1047
Greece	4	52	2	99
Hong Kong	1	13	1	76
Hungary	1	13	1	44
India	5	65	3	110
Indonesia	1	13	1	36
Israel	4	52	2	70
Italy	5	65	3	572
Japan	43	559	23	137
Korea Republic	3	39	2	297
Kuwait	1	13	1	55
Malaysia	3	39	2	57
Mexico	1	13	1	51
Norway	1	13	1	305
Portugal	3	39	2	91
Saudi Arabia	5	65	3	42
Singapore	3	39	2	210
South Africa	3	39	2	97
Spain	5	65	3	619
Sweden	3	39	2	461
Switzerland	2	26	1	790
Taiwan	8	104	4	76
Thailand	3	39	2	50
Turkey	4	52	2	78
United Kingdom	8	104	4	1588
USA	27	351	15	349
Total	**185**	**2405**	**100**	

Table 2
Descriptive Statistics
This Table reports the descriptive statistics of all variables

Name of the Variables	Definition of Variables	Observation	Mean	Std. Dev.	Minimum	Maximum	p25	p50	p75
Bank Risk-taking and Performance Proxies									
Idiosyncratic Risk	Idiosyncratic risk (Volatility) is the annualized standard deviation of the residuals from the market model.	2352	0.0149	0.0086	0.0055	0.0600	0.0100	0.0104	0.0200
Default Risk	Default risk is 1/Z-score. Z-score is the distance to default estimated as average return on assets plus capital to assets ratio divided by the standard deviation of return on assets.	2306	0.6012	1.0359	0.0600	5.3965	0.1300	0.2075	0.4521
INED Attributes Heterogeneity									
INED Gender Heterogeneity	We construct a Blau index for gender heterogeneity of independent non-executive directors by following Radu and Samili (2021) and Ben-Amir et al. (2017).	2000	0.1538	0.1705	0.0000	0.5000	0.0000	0.0000	0.3200
INED Financial Expertise Heterogeneity	We construct a Blau index for financial expertise of independent non-executive directors by following Fang et al. (2018).	2136	0.2949	0.1970	0.0000	0.5000	0.0000	0.3750	0.4688
INED Tenure Heterogeneity	By following Schopohl et al (2021), Bernile et al. (JFE 2018), Talavera et al. (2018), we use standard deviation of independent non-executive directors' board tenure as independent directors' tenure heterogeneity.	1966	2.5726	1.1876	0.5051	7.6832	1.7064	2.3845	3.2971

INED Heterogeneity Index	By following Bernile et al. (2018), we normalize INED Gender Heterogeneity, INED Financial Expertise Heterogeneity, and INED Tenure Heterogeneity by its mean and standard deviation (i.e. STDZ) for scaling and equally weighting each of the three attributes to construct an INED Heterogeneity Index.	1822	0.1095	1.8278	-4.0923	6.9218	-0.9947	0.1933	1.2715
Bank Governance Variables									
INED	Fraction of independent directors in the board (no of Independent Directors/Board Size	2267	0.5362	0.2960	0.0000	1.0000	0.3077	0.5625	0.7778
Board Size	Number of board members	2350	13.3468	4.1131	4.0000	31.0000	10.0000	13.0000	16.0000
Log of Board Size	Log of the number of board members	2350	2.5470	0.2961	1.7918	3.3322	2.3026	2.5649	2.7726
CEO Power	We construct a composite index for the CEO's power by following the procedure below for three selected CEO variables: (a) If CEO-Chair role duality exists, then 1, otherwise 0. (b) If the CEO is internally recruited, then 1, otherwise 0. (c) If the board tenure of the CEO is more than median CEO tenure, then 1, otherwise 0. Finally, we divide the number by 3, so the value of the index ranges between 0 and 1.	2328	0.1609	0.3675	0.0000	1.0000	0.0000	0.0000	0.0000
Bank-Level Controls									
Return on Assets	Return on Assets is estimated as Net Income/Average Total Assets	2248	0.5972	0.7597	-1.8427	3.0908	0.2100	0.4229	0.9517
Market Risk	Systematic Risk (Beta)	2352	0.6607	0.1520	0.1380	0.9383	0.5881	0.6800	0.7600
Total Assets	Total Assets (b$)	2029	298.9498	551.6131	11.9225	3473.0880	34.5437	69.7895	255.4275
Log of Total Assets	Log of Total Assets (proxy for firm size)	2029	4.6049	1.3719	2.4784	8.1528	3.5422	4.2488	5.5429

Loan to Deposit Ratio	This is a bank liquidity proxy; it is the bank loans to deposits ratio.	2300	97.6623	95.4635	0.6047	2111.5420	72.6153	82.8272	105.3882
Log of Loan to Deposit Ratio	Log of Loan to Deposit Ratio	2300	4.4090	0.6983	0.6180	5.5959	4.2852	4.4167	4.6577
Income Diversity	Income diversity is diversity of income measured as the absolute value of the difference between net interest income and other operating income scaled by total operating income.	2151	3.4499	12.4579	-23.1800	292.3400	0.3498	1.2400	3.3400
Log of Income Diversity	Log of Income Diversity	2151	0.6985	0.7657	1.4980	3.1566	0.2525	0.6297	1.1313
Country-Level Controls									
IFRS Adoption	IFRS adoption is a dummy variable. We assign 1 if the country has adopted IFRS, 0 otherwise.	2350	0.4532	0.4979	0.0000	1.0000	0.0000	0.0000	1.0000
GDP Growth Rate	Growth rate of gross domestic product (GDP).	2325	2.0236	2.8672	-5.5000	10.4000	1.0316	2.0004	3.2380
Activities Restrictiveness	The sum of the ratings of the ability of banks to engage in the business of securities, insurance, and real estate. The degree of restrictiveness for each of these activities is rated from 1 to 4 (‘‘Unrestricted = 1 = full range of activities can be conducted directly in the bank; Permitted = 2 = full range of activities can be conducted, but some or all must be conducted in subsidiaries; Restricted = 3 = less than full range of activities can be conducted in the bank or subsidiaries; and Prohibited = 4 = the activity cannot be	2279	7.6580	1.6186	3.0000	12.0000	7.0000	8.0000	8.0000

	conducted in either the bank or subsidiaries.'' Barth, Caprio, Levine (2006). A higher number indicates greater restrictiveness.								
Capital Stringency	The sum of dummy variables or assigned values of questions (by default, 1 if it equals ''yes'' and 0 otherwise.): ''(1) Is the minimum capital-assets ratio requirement risk weighted in line with the Basel I guidelines? (2) Does the minimum ratio vary as a function of an individual bank's credit risk? (3) Does the minimum ratio vary as a function of market risk? (4) Before minimum capital adequacy is determined, which of the following are deducted from the book value of capital? Market value of loan losses not realized in accounting books? (5) Unrealized losses in securities portfolios? (6) Unrealized foreign exchange losses? (7) Is the fraction of revaluation gains allowed as part of capital less than 0.75? (8) Are the sources of funds to be used as capital verified by the regulatory/supervisory authorities? (9) Can the initial disbursement of subsequent injections of capital be done with assets other than cash or government securities? (1 if it equals ''no'' and 0 otherwise.) (10) Can initial disbursement of capital be done with borrowed funds? (1 if it equals ''no'' and 0 otherwise.)'' Barth, Caprio, Levine (2006). A higher number indicates greater stringency.	2235	5.9399	1.6569	3.0000	10.0000	5.0000	5.0000	7.0000

Supervisory Power	The sum of dummy variables or assigned values of questions (by default, 1 if it equals ‘‘yes’’ and 0 otherwise.): ‘‘(1) Does the supervisory agency have the right to meet with external auditors to discuss their report without the approval of the bank? (2) Are auditors required by law to communicate directly to the supervisory agency any presumed involvement of bank directors or senior managers in illicit activities, fraud, or insider abuse? (3) Can supervisors take legal action against external auditors for negligence? (4) Can the supervisory authority force a bank to change its internal organizational structure? (5) Are off-balance sheet items disclosed to supervisors? (6) Can the supervisory agency order the bank’s directors or management to constitute provisions to cover actual or potential losses? (7) Can the supervisory agency suspend the directors’ decision to distribute dividends? (8) Can the supervisory agency suspend the directors’ decision to distribute Bonuses? (9) Can the supervisory agency suspend the directors’ decision to distribute management fees? (10) Who can legally declare – such that this declaration supersedes some of the rights of shareholders – that a bank is insolvent: bank supervisor, court, deposit insurance agency, bank restructuring, asset management agency or other. (bank supervisor = 1; deposit insurance agency = 0.5; bank restructuring or asset management agency = 0.5; 0 otherwise.) (11) According to the Banking Law, who has authority to intervene – that is, suspend some or all ownership rights – in a problem bank? Bank supervisor, court, deposits insurance agency,	2262	11.7958	1.9149	6.0000	16.0000	11.0000	12.0000	13.0000

	bank restructuring, asset management agency or other. (bank supervisor = 1; deposit insurance agency = 0.5; bank restructuring or asset management agency = 0.5; 0 otherwise.) (12) Regarding bank restructuring and reorganization, can the supervisory agency or any other government agency supersede shareholder rights? Bank supervisor, court, deposit insurance agency, bank restructuring, asset management agency or other. (Bank supervisor = 1; deposit insurance agency = 0.5; bank restructuring or asset management agency = 0.5; 0 otherwise.) (13) Regarding bank restructuring and reorganization, can the supervisory agency or any other government agency remove and replace management? Bank supervisor, court, deposit insurance agency, bank restructuring, asset management agency or other. (Bank supervisor = 1; deposit insurance agency = 0.5; bank restructuring or asset management agency = 0.5; 0 otherwise.) (14) Regarding bank restructuring and reorganization, can the supervisory agency or any other government agency remove and replace directors? Bank supervisor, court, deposits insurance agency, bank restructuring, asset management agency or other. (bank supervisor = 1; deposit insurance agency = 0.5; bank restructuring or asset management agency = 0.5; 0 otherwise.)'' Barth, Caprio, Levine (2006). A higher number indicates greater power.								
Private Monitoring	The sum of dummy variables or assigned values of questions (by default, 1 if it equals ''yes'' and 0 otherwise.): ''(1) a. Is an external audit a	2250	9.0274	1.1195	6.0000	110.0000	8.0000	9.0000	10.0000

	compulsory obligation for banks? b. Are auditors licensed or certified? (1 if a = 1 and b = 1, 0 otherwise.) (2) What percentage of the top ten banks are rated by international credit rating agencies (e.g., Moody's, Standard and Poor)? (1 if it equals 100%; 0 otherwise.) (3) How many of the top ten banks are rated by domestic credit rating agencies? (1 if it equals 100%; 0 otherwise.) (4) a. Is there an explicit deposit insurance protection system? b. Were depositors wholly compensated (to the extent of legal protection) the last time a bank failed? (1if a = 0 and/or b = 0, 0 otherwise.) (5) Does accrued, though unpaid interest/principal enter the income statement while the loan is still performing? (6) Does accrued, though unpaid interest/principal enter the income statement while the loan is still nonperforming? (1 if it is No; 0 otherwise.) (7) Are financial institutions required to produce consolidated accounts covering all bank and any nonbank financial subsidiaries? (8) Are bank directors legally liable if information disclosed is erroneous or misleading? (9) a. Is subordinated debt allowable as part of capital? b. Is subordinated debt required as part of capital? (1 if a or b equals ''yes'') (10) Are off balance sheet items disclosed to the public? (11) Must banks disclose their risk management procedures to the public? (12) Are bank regulators/supervisors required to make public formal enforcement actions, which include cease and desist orders and written agreements between a bank regulatory/supervisory body and a banking organization?'' Barth, Caprio, Levine (2006). A								

	higher number indicates greater private monitoring.								

Table 3
Correlation analysis

This table presents Pearson pairwise correlation matrix for the variables in the study. A detailed description of these variables is included in Table 2. ***, **, and * indicates that the coefficient is statistically significant at 1%, 5%, and 10% levels.

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
(1) Idiosyncratic Risk	1.0000						
(2) Default Risk	0.0735***	1.0000					
(3) INED Gender Heterogeneity	-0.0674***	-0.0628***	1.0000				
(4) INED Financial Expertise Heterogeneity	-0.0556**	-0.0589**	0.0909***	1.0000			
(5) INED Tenure Heterogeneity	-0.0680***	-0.0543**	-0.0835***	0.1289***	1.0000		
(6) INED Heterogeneity Index	-0.0631***	-0.0672***	0.5597***	0.6801***	0.5863***	1.0000	
(7) INED	0.0413**	0.0385*	0.2150***	0.1414***	0.0613***	0.2433***	1.0000
(8) Log of Board Size	-0.0344*	-0.0504**	0.1923***	0.0297	-0.1033***	0.0619***	-0.1147***
(9) CEO Power	-0.0153	-0.0016	0.0064	0.0556**	0.0348*	0.0560**	0.0462**
(10) Return on Assets	-0.2146***	-0.1394***	0.1358***	0.0182	-0.0001	0.1277***	0.0908***
(11) Log of Total Assets	-0.0486**	-0.0186	0.1450***	-0.0061	0.0219	0.0783***	0.0820***
(12) Income Diversity	-0.0975***	0.2917***	-0.1598***	-0.0797***	-0.0001	-0.1233***	-0.0768***
(13) Loan to Deposit Ratio	-0.0432**	-0.1351***	0.1915***	-0.0488**	-0.1098***	0.0202	0.0463**
(14) IFRS Adoption	0.0301	-0.0065	0.2997***	0.0568***	-0.1032***	0.1332***	0.0390*
(15) GDP Growth Rate	-0.2461***	-0.0581***	0.0505**	0.0585***	0.0444**	0.0797***	0.0879***
(16) Activities Restrictiveness	-0.1100***	0.0077	-0.1266***	0.0423*	0.0357*	-0.0100	-0.0083
(17) Capital Stringency	-0.0095	0.0305	0.3060***	0.1116***	-0.0295	0.2159***	0.1236***
(18) Supervisory Power	-0.0083	-0.0340	-0.1956***	-0.0076	0.0600***	-0.0705***	0.1024***
(19) Private Monitoring	-0.0979***	-0.0804***	0.1039***	0.0465**	0.0639***	0.1597***	0.0769***
		(8)	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**
(8) Log of Board Size		1.0000					
(9) CEO Power		-0.0123	1.0000				
(10) Return on Assets		-0.0289	0.0584***	1.0000			
(11) Log of Total Assets		0.0830***	-0.0221	0.0136	1.0000		
(12) Income Diversity		-0.0272	0.0359*	-0.0931***	-0.0534**	1.0000	
(13) Loan to Deposit Ratio		0.0827***	-0.0278	0.0667***	0.0482**	0.0624***	1.0000
(14) IFRS Adoption		0.1586***	-0.0532***	0.0860***	0.0313	-0.1524***	0.1183***
(15) GDP Growth Rate		-0.0627***	-0.0582***	0.1847***	0.0107	-0.0676***	-0.0444**

(16) Activities Restrictiveness	-0.1136***	0.0881***	0.1177***	-0.0720***	-0.0056	-0.1754***
(17) Capital Stringency	-0.0069	0.0520**	0.0981***	0.0183	-0.0934***	0.0535**
(18) Supervisory Power	-0.2283***	0.0166	0.0774***	-0.0745***	-0.0133	-0.1343***
(19) Private Monitoring	-0.1725***	0.1936***	0.2166***	-0.0159	0.0094	-0.0605***
	(14)	**(15)**	**(16)**	**(17)**	**(18)**	**(19)**
(14) IFRS Adoption	1.0000					
(15) GDP Growth Rate	0.0222	1.0000				
(16) Activities Restrictiveness	-0.2920***	0.0976***	1.0000			
(17) Capital Stringency	0.2462***	0.0463**	0.0451**	1.0000		
(18) Supervisory Power	-0.2564***	0.0183	0.2923***	0.1335**	1.0000	
(19) Private Monitoring	-0.2259***	0.0156	0.2979***	0.1333***	0.2854***	1.0000

Table 4
INED attributes heterogeneity and bank risk-taking – Baseline Estimations

This table reports the effect of INED attributes heterogeneity on bank risk-taking. Risk-taking proxies are Idiosyncratic (unsystematic) risk and Default risk (1/z score). INED attributes heterogeneity variables are INED Gender Heterogeneity, INED Financial Expertise Heterogeneity, and INED Tenure Heterogeneity. INED Gender Heterogeneity is a Blau Index for gender. INED Financial Expertize Heterogeneity is a Blau index for financial expertise. INED Tenure Heterogeneity is the standard deviation of INEDs board tenure. INED Heterogeneity Index is a standardized index of three INED attributes heterogeneity. INED is the fraction of INEDs in the boardroom (i.e., No of INEDs divided by board size). Board Size is the natural Log of Board Size. CEO Power is the composite index for CEO Power. Return on Assets is estimated as Net Income/Average Total Assets. Total Assets if the Log of Total Assets and it represents the bank size. Income diversity is diversity of income measured as the log of absolute value of the difference between net interest income and other operating income scaled by total operating income. Loan to Deposit ratio is the log of loan to deposit ratio and it represents bank's liquidity position. IFRS adoption is a dummy for IFRS adopted countries and this variable captures the level of financial transparency and disclosure. GDP Growth rate represents the economic growth of a country. We include four country-level bank regulation and supervision variables from Barth, Caprio, Levine (2006). These variables are Activities Restrictiveness, Capital Stringency, Supervisory Power, and Private Monitoring. Activities Restrictiveness is the ability of banks to engage in the business of securities, insurance, and real estate. Capital Stringency is the level of capital stringency. Supervisory Power is the power of bank supervisory agencies. Private Monitoring is the power of private monitors. A detailed description of these variables is included in Table 2. T statistics are reported in parentheses. *** (**, *) indicates significance at the 1 (5, 10) percent levels, respectively.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Variables	Idiosyncratic Risk	Default Risk	Idiosyncratic Risk	Default Risk	Idiosyncratic Risk	Default Risk
INED Gender Heterogeneity			-0.0075***	-0.0818**		
			(-20.3009)	(-2.4171)		
INED Financial Expertise Heterogeneity			-0.0003*	-0.2409***		
			(-1.6900)	(-18.2646)		
INED Tenure Heterogeneity			-0.0019***	-0.1786***		
			(-21.7305)	(-20.4963)		
INED Heterogeneity Index					-0.0050***	-0.0593***
					(-4.1901)	(-11.1215)
INED	0.0019***	0.1806***	0.0004**	0.0886***	0.0009**	0.0720**
	(3.0634)	(3.6695)	(2.0593)	(4.0479)	(2.2017)	(2.2450)
Board Size	-0.0011***	-0.0046	-0.0010***	-0.0208	-0.0010***	-0.0923**
	(-2.8265)	(-0.1020)	(-6.7762)	(-1.2266)	(-3.3243)	(-2.3170)
CEO Power	-0.0006**	-0.0175	-0.0005***	-0.0348***	-0.0003	-0.0485**
	(-2.2057)	(-0.7376)	(-4.4578)	(-4.2991)	(-1.0628)	(-2.4378)
Return on Assets	-0.0017***	-0.1976***	-0.0018***	-0.1558***	-0.0016***	-0.1575***

	(-9.2189)	(-14.6434)	(-24.2436)	(-34.6127)	(-8.3946)	(-15.6995)
Total Assets	-0.0001***	-0.0023	-0.0000	-0.0142***	-0.0001	-0.0132***
	(-2.8932)	(-0.7276)	(-0.6484)	(-19.1443)	(-1.2905)	(-4.4577)
Income Diversity	-0.0011***	0.4606***	-0.0012***	0.4839***	-0.0008***	0.5009***
	(-6.2182)	(32.0366)	(-24.1845)	(73.5609)	(-7.5180)	(51.2383)
Loan to Deposit Ratio	0.0004*	-0.1982***	0.0010***	-0.2329***	0.0005***	-0.1734***
	(1.6923)	(-5.6109)	(13.9636)	(-18.4113)	(3.0866)	(-7.2075)
IFRS Adoption	0.0005***	0.0526***	0.0012***	0.0851***	0.0009***	0.0654***
	(4.1707)	(5.3490)	(18.3436)	(20.6898)	(6.5209)	(6.6897)
GDP Growth	-0.0004***	0.0034	-0.0005***	-0.0020**	-0.0005***	-0.0040*
	(-9.5986)	(1.2660)	(-25.6860)	(-2.4398)	(-13.9203)	(-1.9380)
Activities Restrictiveness	-0.0006***	0.0213**	-0.0007***	0.0298***	-0.0006***	0.0361***
	(-5.9336)	(2.1007)	(-23.5161)	(9.0327)	(-4.7149)	(3.9095)
Capital Stringency	-0.0003***	0.0176**	0.0000	0.0253***	-0.0000	0.0340***
	(-3.2163)	(2.2205)	(0.4358)	(10.4522)	(-0.4976)	(5.3416)
Supervisory Power	0.0002***	0.0075	0.0001***	0.0017	0.0002***	-0.0000
	(3.3056)	(0.8792)	(3.6453)	(0.7577)	(3.8613)	(-0.0017)
Private Monitoring	-0.0003**	-0.0183	0.0002***	-0.0036	-0.0002	-0.0087
	(-2.3546)	(-1.3472)	(3.0870)	(-0.9199)	(-1.6072)	(-0.7047)
Idiosyncratic $Risk_{t-1}$	0.2437***		0.2419***		0.2692***	
	(54.5575)		(92.3652)		(58.5024)	
Default $Risk_{t-1}$		0.3439***		0.3549***		0.3378***
		(7.3456)		(31.8554)		(11.8083)
Constant	0.0223***	0.8249***	0.0197***	1.0459***	0.0175***	0.0046**
	(8.8314)	(2.8531)	(22.5957)	(10.7629)	(6.4193)	(2.0183)
Observations	1,435	1,464	1,152	1,168	1,152	1,168
Country & Year FE	Yes	Yes	Yes	Yes	Yes	Yes
AR(1)-p-value	0.0000	0.0000	0.0000	0.0010	0.0080	0.0010
AR(2)-p-value	0.5270	0.6830	0.4580	0.4450	0.4040	0.4710
Hansen J-p-value	0.7280	0.8330	0.9650	0.9760	0.6130	0.4540

Table 5
Post-2009 effect of INED attributes heterogeneity on risk-taking

This table reports the Post-2009 effect of INED Heterogeneity Index on bank risk-taking. Risk-taking proxies are Idiosyncratic (unsystematic) risk and Default risk (1/z score). INED Heterogeneity Index is a standardized index of three INED attributes heterogeneity. INED is the fraction of INEDs in the boardroom (i.e., No of INEDs divided by board size). Board Size is the natural Log of Board Size. CEO Power is the composite index for CEO Power. Return on Assets is estimated as Net Income/Average Total Assets. Total Assets if the Log of Total Assets and it represents the bank size. Income diversity is diversity of income measured as the log of absolute value of the difference between net interest income and other operating income scaled by total operating income. Loan to Deposit ratio is the log of loan to deposit ratio and it represents bank's liquidity position. IFRS adoption is a dummy for IFRS adopted countries and this variable captures the level of financial transparency and disclosure. GDP Growth rate represents the economic growth of a country. We include four country-level bank regulation and supervision variables from Barth, Caprio, Levine (2006). These variables are Activities Restrictiveness, Capital Stringency, Supervisory Power, and Private Monitoring. Activities Restrictiveness is the ability of banks to engage in the business of securities, insurance, and real estate. Capital Stringency is the level of capital stringency. Supervisory Power is the power of bank supervisory agencies. Private Monitoring is the power of private monitors. A detailed description of these variables is included in Table 2. T statistics are reported in parentheses. *** (**, *) indicates significance at the 1 (5, 10) percent levels, respectively.

Variables	(1) Idiosyncratic Risk	(2) Default Risk
INED Heterogeneity Index*Post-2009	-0.0014***	-0.1104**
	(-2.9814)	(-2.4795)
Post-2009	-0.0015***	-0.0154**
	(-3.1970)	(-2.3881)
INED Heterogeneity Index	0.0009**	0.1059***
	(2.4217)	(2.8363)
INED	-0.0014**	0.0303
	(-2.5141)	(0.3635)
Board Size	-0.0003	-0.0004
	(-0.4438)	(-0.0056)
CEO Power	0.0007	-0.0177
	(1.2985)	(-0.3434)
Return on Assets	-0.0015***	-0.1483***
	(-3.7728)	(-5.3027)
Total Assets	-0.0001	0.0080
	(-0.6972)	(1.3711)
Income Diversity	-0.0003	0.4870***
	(-0.9267)	(13.3578)
Loan to Deposit Ratio	0.0005	-0.1852***
	(1.5748)	(-3.1889)
IFRS Adoption	0.0015***	0.0347
	(6.5971)	(1.3683)
GDP Growth	-0.0004***	-0.0016
	(-4.6418)	(-0.2324)
Activities Restrictiveness	-0.0003**	-0.0005
	(-2.0597)	(-0.0230)

Capital Stringency	-0.0001	0.0072
	(-0.5253)	(0.5426)
Supervisory Power	0.0003**	0.0043
	(2.2255)	(0.3419)
Private Monitoring	-0.0001	0.0313
	(-0.3498)	(1.2360)
Idiosyncratic $Risk_{t-1}$	0.2674***	
	(31.7800)	
Default $Risk_{t-1}$		0.2512***
		(4.1215)
Constant	0.0133***	0.4360
	(3.3027)	(0.9279)
Observations	1,152	1,168
Country & Year FE	Yes	Yes
AR(1)	0.0010	0.0010
AR(2)	0.4400	0.6260
Hansen J (p value)	0.7810	0.8750

Table 6

INED attributes heterogeneity and bank performance

This table reports the effect of INED attributes heterogeneity on bank performance. Bank performance proxies are Buy and Hold Return (BAH) and Price-to-Book Value Ratio (P/B). INED Heterogeneity Index is a standardized index of three INED attributes heterogeneity. INED is the fraction of INEDs in the boardroom (i.e., No of INEDs divided by board size). Board Size is the natural Log of Board Size. CEO Power is the composite index for CEO Power. Market risk is the beta coefficient from the market model. Total Assets if the Log of Total Assets and it represents the bank size. Income diversity is diversity of income measured as the log of absolute value of the difference between net interest income and other operating income scaled by total operating income. Loan to Deposit ratio is the log of loan to deposit ratio and it represents bank's liquidity position. IFRS adoption is a dummy for IFRS adopted countries and this variable captures the level of financial transparency and disclosure. GDP Growth rate represents the economic growth of a country. We include four country-level bank regulation and supervision variables from Barth, Caprio, Levine (2006). These variables are Activities Restrictiveness, Capital Stringency, Supervisory Power, and Private Monitoring. Activities Restrictiveness is the ability of banks to engage in the business of securities, insurance, and real estate. Capital Stringency is the level of capital stringency. Supervisory Power is the power of bank supervisory agencies. Private Monitoring is the power of private monitors. A detailed description of these variables is included in Table 2. T statistics are reported in parentheses. *** (**, *) indicates significance at the 1 (5, 10) percent levels, respectively.

Variables	(1) Buy and Hold Return (BAH)	(2) Price-to-Book Value Ratio (P/B)
INED Heterogeneity Index	-0.0352***	-0.0628***
	(-7.3091)	(-15.8205)
INED	0.0381*	0.2387***
	(1.7828)	(7.6942)
Board Size	-0.0164	-0.1136***
	(-1.1624)	(-4.2411)
CEO Power	-0.0289**	-0.0561***
	(-2.3432)	(-3.0839)
Market Risk	0.0910**	0.4799***
	(2.2398)	(9.9599)
Total Assets	-0.0296***	-0.1209***
	(-12.6971)	(-30.5555)
Income Diversity	0.0020	-0.0226**
	(0.2845)	(-2.3712)
Loan to Deposit Ratio	-0.0035	0.0937***
	(-0.4485)	(4.9176)
IFRS Adoption	-0.0662***	-0.0296***
	(-8.7120)	(-2.9766)
GDP Growth	0.0010	0.0075***
	(0.7216)	(3.7600)
Activities Restrictiveness	0.0175***	-0.0117*
	(5.0558)	(-1.7360)
Capital Stringency	0.0319***	0.0571***
	(10.4761)	(11.6227)
Supervisory Power	-0.0185***	-0.0087**
	(-6.5403)	(-2.3284)

Private Monitoring	0.0221***	0.0365***
	(5.2148)	(4.2886)
Buy and Hold Return$_{t-1}$	0.1589***	
	(4.1057)	
Price-to-Book Value Ratio$_{t-1}$		0.2769***
		(22.8122)
Constant	0.3049***	1.4475***
	(3.5047)	(8.9233)
Observations	1,169	1,075
Country & Year FE	Yes	Yes
AR(1)-p-value	0.0000	0.0000
AR(2)-p-value	0.4660	0.3480
Hansen J-p-value	0.6230	0.7080

Table 7

Regression estimates using two-stage instrumental variable (IV) model

The table presents the results of the 2SLS regressions. Columns 1&3 show the first-stage regression where INED Heterogeneity Index is the dependent variable. The instrumental variables are City Population and Newspaper Circulation. City Population if the log of bank headquarters city population. Newspaper Circulation is the log of newspaper in circulation in the country of bank's headquarter. Columns 2&4 report results for second stage models for risk-taking proxies (Idiosyncratic Risk and Default Risk). Other right hand side variables remain the same as the baseline model. A detailed description of these variables is included in Table 2. T statistics are reported in parentheses. *** (**, *) indicates significance at the 1 (5, 10) percent levels, respectively.

	Idiosyncratic Risk		Default Risk	
	First Stage	Second Stage	First Stage	Second Stage
Variables	INED Heterogeneity Index	Idiosyncratic Risk	INED Heterogeneity Index	Default Risk
City Population	0.1661***		0.1646***	
	(4.1400)		(4.2800)	
Newspaper Circulation	0.1895***		0.1796***	
	(3.1800)		(4.0100)	
INED Heterogeneity Index		-0.0080**		-0.3692***
		(-1.9773)		(-3.5294)
INED	1.3623***	0.0017**	1.3511***	0.4511***
	(7.3300)	(2.2343)	(7.7100)	(2.6091)
Board Size	0.4843***	-0.0007	0.4666***	-0.1644
	(2.8400)	(-0.4815)	(2.7500)	(-1.4490)
CEO Power	-0.04062	0.0003	-0.0183	-0.0218
	(-0.3300)	(0.4855)	(-0.1500)	(-0.2978)
Return on Assets	0.01387	-0.0022***	0.0026	-0.1745***
	(0.2600)	(-5.3008)	(0.0500)	(-5.2994)
Total Assets	0.0332	-0.0003***	0.0299	-0.0119
	(1.4900)	(-2.6120)	(1.3400)	(-0.8487)
Income Diversity	-0.2582***	-0.0017*	-0.2531***	0.6337***
	(-3.3400)	(-1.8990)	(-3.1800)	(11.1320)
Loan to Deposit Ratio	-0.0350	0.0014**	0.0256	-0.1846***
	(-0.3700)	(2.3220)	(0.3200)	(-3.9236)
IFRS Adoption	0.4739***	0.0004	0.4393***	-0.0842
	(3.9800)	(0.6821)	(3.9400)	(-1.1527)
GDP Growth	0.02819	-0.0006***	0.0296	-0.0236**
	(1.3700)	(-4.2275)	(1.5900)	(-1.9956)
Activities Restrictiveness	0.0439	-0.0008***	0.0377	0.0111
	(1.0100)	(-2.9516)	(1.0500)	(0.5040)
Capital Stringency	0.07336**	0.0001	0.0820**	0.0113
	(2.2400)	(0.2175)	(2.5300)	(0.5241)
Supervisory Power	-0.18577***	0.0000	-0.1840***	0.0572**
	(-6.4800)	(0.1124)	(-6.4200)	(2.3865)
Private Monitoring	0.2592***	0.0002	0.2482***	-0.1321***
	(4.6900)	(0.5986)	(4.6100)	(-3.0261)

Constant	-6.8272***	0.0223***	-6.8880***	2.4642***
	(-5.9400)	(3.2537)	(-6.1500)	(3.4280)
Observations	1,205	1,205	1,221	1,221
Adj R-squared	0.2044	0.1010	0.1984	0.2780
Country & Year FE	Yes	Yes	Yes	Yes
Endogeneity test:				
Wu-Hausman F-statistic	10.5842***		24.9667***	
Overidentification test:				
Sargan Chi^2 statistic	0.9945		0.5718	
Weak instrument test:				
Anderson-Rubin Wald Chi^2	17.5212***		16.5466***	

Table 8
INED attributes heterogeneity and bank risk-taking – Diff-in-Diff analysis

This table reports the results for a quasi-natural experiment by using the changes of risk-taking following exogenous exit of INEDs. Panels A&B show the balancing properties of treatment and control banks. We employ propensity score matching (PSM) method for matching the treatment and control groups based on exogenous exit of INEDs. Panel C reports the regression results for the difference in propensity score matched sample between treatment-control groups and pre-post shock. The key variable of interest in the regression is an exogenous exit dummy for INEDs. The right hand side variables remain the same as the baseline model. A detailed description of these variables is included in Table 2. T statistics are reported in parentheses. *** (**, *) indicates significance at the 1 (5, 10) percent levels, respectively.

Panel A: Balancing table for propensity score matching – Outcome Variable: Idiosyncratic Risk

	Treatment group		Control group		*t*-test
Variables	N	Mean	N	Mean	Treatment - Control
INED Heterogeneity Index	96	.55659	96	.48037	0.3200
INED	96	.60438	96	.61694	-0.3600
Board Size	96	2.5365	96	2.5257	0.2800
CEO Power	96	.28125	96	.28125	0.0000
Return on Assets	96	.76388	96	.87129	-0.7900
Total Assets	96	18.822	96	18.736	0.2700
Income Diversity	96	1.0203	96	1.0666	-0.7300
Loan to Deposit Ratio	96	4.3463	96	4.4244	-0.8300
IFRS Adoption	96	.54167	96	.59375	-0.7300
GDP Growth	96	2.1693	96	2.4485	-0.7600
Activities Restrictiveness	96	7.9896	96	8.0833	-0.4700
Capital Stringency	96	6.6979	96	6.7865	-0.3500
Supervisory Power	96	11.864	96	11.9600	-0.3700
Private Monitoring	96	9.3646	96	9.2604	0.6700

Panel B: Balancing table for propensity score matching – Outcome variable: Default Risk

	Treatment group		Control group		*t*-test
Variables	N	Mean	N	Mean	Treatment - Control
INED Heterogeneity Index	97	.5470	97	.53334	0.0600
INED	97	.60588	97	.6230	-0.4900
Board Size	97	2.5359	97	2.5239	0.6400
CEO Power	97	.27835	97	. .25773	0.3200
Return on Assets	97	.76236	97	.88739	-0.7500
Total Assets	97	18.8040	97	18.6350	0.4900
Income Diversity	97	1.0250	97	1.0532	-0.6300
Loan to Deposit Ratio	97	4.3477	97	4.3228	0.2200
IFRS Adoption	97	.54639	97	.43299	1.5800
GDP Growth	97	2.2015	97	2.5252	-0.9100
Activities Restrictiveness	97	7.9897	97	8.2784	1.5400
Capital Stringency	97	6.7216	97	6.7258	-0.0200

Supervisory Power	97	11.8860	97	12.1250	-0.9100
Private Monitoring	97	9.3608	97	9.4021	-0.2700

Panel C: Diff-in-Diff analysis

Variables	(Treatment – control) & (post-pre)	(Treatment – control) & (post-pre)
	Idiosyncratic Risk	Default Risk
INED Exogenous Exit	0.0202***	0.0799***
	(2.8494)	(3.8232)
INED Heterogeneity Index	-0.0013***	-0.0193**
	(-4.6231)	(-2.4079)
INED	0.0048**	0.3577***
	(2.5829)	(3.8329)
Board Size	-0.0002	-0.4491***
	(-0.1240)	(-3.8509)
CEO Power	-0.0008	-0.0377
	(-0.6629)	(-0.7386)
Return on Assets	-0.0003	-0.2101***
	(-0.5128)	(-2.6973)
Total Assets	0.0003*	-0.0260***
	(1.8617)	(-2.8623)
Income Diversity	0.0024***	0.4596***
	(4.2807)	(5.0470)
Loan to Deposit Ratio	0.0001	-0.3124***
	(0.3023)	(-4.9940)
IFRS Adoption	-0.0001	-0.0231
	(-0.1770)	(-0.5874)
GDP Growth	-0.0010***	-0.0320**
	(-6.7225)	(-2.2792)
Activities Restrictiveness	0.0000	0.0508***
	(0.2727)	(3.0409)
Capital Stringency	-0.0013***	0.0804***
	(-6.0637)	(3.1705)
Supervisory Power	-0.0005**	-0.0326
	(-2.3110)	(-1.5146)
Private Monitoring	-0.0001	0.1084***
	(-0.5226)	(2.8090)
Constant	0.0163***	2.2780***
	(4.2408)	(3.0796)
Observations	96	97
Adj. R-squared	0.2528	0.1271
Country & Year FE	Yes	Yes

Table 9
Heckman two-stage model for sample selection bias

This table reports the results for Heckman two-stage model. In the first stage, we use an INED Heterogeneity Dummy for the Probit model. We assign 1 for the dummy if the INED Heterogeneity Index takes a value that is higher than its median value, otherwise 0. Log of city population is an exogenous variable in the Probit model. In the second stage, we include the inverse Mills ratio (IMR), which was estimated from first stage model, and run a GMM estimation with the same specification as in the baseline model. Other bank level and country level variables remain the same in both models. A detailed description of these variables is included in Table 2. T-statistics are reported in parentheses. *** (**, *) indicates significance at the 1 (5, 10) percent levels, respectively.

	Stage 1	Stage 2: GMM	
	Probit	(1)	(2)
Variables	INED Heterogeneity Dummy	Idiosyncratic Risk	Default Risk
City Population	0.0671**		
	(2.3636)		
INED Heterogeneity Index		-0.0050***	-0.0456***
		(-5.0112)	(-12.7237)
INED	0.3168***	0.0033**	0.0074**
	(2.7929)	(2.0048)	(2.2677)
Board Size	0.1959	-0.0010***	-0.0708**
	(1.6180)	(-2.6702)	(-2.4867)
CEO Power	0.0593	-0.0008***	-0.0125**
	(0.6984)	(-2.7585)	(-1.9991)
Return on Assets	-0.0049	-0.0020***	-0.1864***
	(-0.1300)	(-13.3003)	(-18.9690)
Total Assets	0.0190	-0.0001***	-0.0116***
	(1.2545)	(-3.6295)	(-6.5817)
Income Diversity	-0.0421	-0.0016***	0.3553***
	(-0.7319)	(-12.0661)	(31.9398)
Loan to Deposit Ratio	0.0524	0.0011***	-0.1218***
	(0.8503)	(7.8685)	(-6.5807)
IFRS Adoption	-0.0210	0.0007***	0.0888***
	(-0.2805)	(5.7149)	(9.1802)
GDP Growth	0.0154	-0.0005***	-0.0082***
	(1.2818)	(-14.4692)	(-5.0367)
Activities Restrictiveness	0.0798***	-0.0008***	0.0380***
	(3.1824)	(-7.3047)	(5.2278)
Capital Stringency	0.0546**	0.0000	0.0245***
	(2.3997)	(0.3044)	(5.6260)
Supervisory Power	-0.0875***	0.0002***	-0.0073
	(-4.2897)	(3.6902)	(-1.5059)
Private Monitoring	0.1002***	0.0002*	0.0046
	(2.8457)	(1.8136)	(0.6252)
IMR		-0.0190***	-0.2790***
		(-2.8779)	(-3.6401)

Idiosyncratic Risk$_{t-1}$		0.2636***	
		(61.2602)	
Default Risk$_{t-1}$			0.2645***
			(41.5579)
Constant	-2.9291***	0.0182***	0.1420
	(-3.6030)	(6.3017)	(1.0477)
Observations	1,573	997	1,020
Wald Chi2	80.2800***	-	-
Pseudo R2	0.0400	-	-
Country & Year FE	Yes	Yes	Yes
AR(1)	-	0.0000	0.0000
AR(2)	-	0.5130	0.2050
Hansen J (p value)	-	0.6720	0.3040

Table 10

Channel analysis for information asymmetry

The table reports test results on information asymmetry channel. Panel A presents regression results for the effect of INED Heterogeneity Index on different measures of information asymmetry (e.g. Analysts' Forecast Dispersion and Amihud Illiquidity). Analysts' Forecast Dispersion and Amihud Illiquidity measures are defined in Section 4.4.3.2. Panel B reports regression results for the effect of INED Heterogeneity Index on risk-taking in both high information asymmetry and low information asymmetry conditions. Higher than median value of information asymmetry proxies are defined as high information asymmetry and lower than median value of information asymmetry proxies are defined as low information asymmetry. A detailed description of these variables is included in Table 2. T statistics are reported in parentheses. *** (**, *) indicates significance at the 1 (5, 10) percent levels, respectively.

Panel A: INED Hetero Index, Analysts Forecast Dispersion, and Amihud Illiquidity

	Analysts Forecast Dispersion	Amidud Illiquidity
INED Heterogeneity Index	-0.5127***	-0.0070***
	(2.6000)	(3.8600)
Firm controls	Yes	Yes
County Controls	Yes	Yes
Adj R-squared	0.0527	0.0385
Observations	946	1,238
Country & Year FE	Yes	Yes

Panel B: INED Heterogeneity Index and risk-taking partitioned by Analysts' Forecast Dispersion and Amidud Illiquidity

	Idiosyncratic Risk				Default Risk			
	High Dispersion (>median)	Low Dispersion (<median)	High Illiquidity (>median)	Low Illiquidity (<median)	High Dispersion (>median)	Low Dispersion (<median)	High Illiquidity (>median)	Low Illiquidity (<median)
	(1)	(2)	(3)	(4)				
INED Heterogeneity Index	-0.0006**	0.0003	-0.0008***	0.0004***	-0.0485**	0.0053	-0.0561***	0.0082
	(-2.0100)	(1.6300)	(2.6000)	(2.5800)	(-1.8000)	(0.2400)	(-2.6900)	(0.4600)
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj R-squared	0.1562	0.2261	0.1782	0.1353	0.1988	0.1487	0.2146	0.1794
Observations	726	501	515	712	741	504	525	718
Chi2	2.7100*		7.0500***		3.0200*		6.1800**	
Country & Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 11

INED attributes heterogeneity and bank risk-taking - Additional Specifications for Omitted Variable and Reverse Causality

This table shows the results of additional tests for the effect of INED attributes heterogeneity on bank risk-taking. Panel A reports the results for OLS models in level, Lag 1 and Lag 2. Panel B reports the results of fixed effect models in level, Lag 1 and Lag 2. Panel C reports the results for a dynamic panel data models estimated via the two-step GMM estimator proposed by Blundell and Bond (1998) with Lag 1 and Lag 2. Our baseline model already presents the results for the level variables using GMM model and hence, we don't report the level variables in this table. Risk-taking proxies are Idiosyncratic (unsystematic) risk and Default risk (1/z score). INED Heterogeneity Index is a standardized index of three INED attributes heterogeneity. INED is the fraction of INEDs in the boardroom (i.e., No of INEDs divided by board size). Board Size is the natural Log of Board Size. CEO Power is the composite index for CEO Power. Return on Assets is estimated as Net Income/Average Total Assets. Total Assets if the Log of Total Assets and it represents the bank size. Income diversity is diversity of income measured as the log of absolute value of the difference between net interest income and other operating income scaled by total operating income. Loan to Deposit ratio is the log of loan to deposit ratio and it represents bank's liquidity position. IFRS adoption is a dummy for IFRS adopted countries and this variable captures the level of financial transparency and disclosure. GDP Growth rate represents the economic growth of a country. We include four country-level bank regulation and supervision variables from Barth, Caprio, Levine (2006). These variables are Activities Restrictiveness, Capital Stringency, Supervisory Power, and Private Monitoring. Activities Restrictiveness is the ability of banks to engage in the business of securities, insurance, and real estate. Capital Stringency is the level of capital stringency. Supervisory Power is the power of bank supervisory agencies. Private Monitoring is the power of private monitors. A detailed description of these variables is included in Table 2. T statistics are reported in parentheses. *** (**, *) indicates significance at the 1 (5, 10) percent levels, respectively.

Panel A: OLS Models

Variables	(1) Idiosyncratic Risk	(2) Default Risk	(3) Idiosyncratic Risk	(4) Default Risk	(5) Idiosyncratic Risk	(6) Default Risk
	Level		**Lag 1**		**Lag 2**	
INED Heterogeneity Index	-0.0002*	-0.0351***	-0.0002	-0.0403***	-0.0000	-0.0520***
	(-1.7112)	(-2.6100)	(-1.2838)	(-2.9903)	(-0.0324)	(-3.6986)
INED	0.0014	0.1284	0.0022**	0.0578	0.0024**	0.0492
	(1.5461)	(1.4945)	(2.2129)	(0.6796)	(2.4067)	(0.5611)
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country Controls	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.0141***	0.6864***	0.0146***	0.8268***	0.0141***	1.0257***
	(5.8293)	(3.0369)	(5.6588)	(3.6439)	(5.2346)	(4.3145)
Observations	1,790	1,757	1,617	1,606	1,448	1,449

Adj. R-squared	0.0155	0.0074	0.0190	0.0080	0.0203	0.0138
Country & Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Panel B: FE Models						
Variables	(1) Idiosyncratic Risk	(2) Default Risk	(3) Idiosyncratic Risk	(4) Default Risk	(5) Idiosyncratic Risk	(6) Default Risk
	Level		**Lag 1**		**Lag 2**	
INED Heterogeneity Index	-0.0004*	-0.0146*	-0.0003	-0.0134	-0.0004	-0.0013
	(-1.8566)	(-1.6992)	(-1.3241)	(-0.6086)	(-1.3960)	(-0.0567)
INED	0.0006	0.3565***	0.0021*	0.2649**	0.0025*	0.2057*
	(0.4777)	(3.2818)	(1.7195)	(2.5073)	(1.9126)	(1.8761)
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country Controls	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.0285***	0.8911**	0.0252***	1.1853***	0.0221***	2.0978***
	(6.6387)	(2.2015)	(5.3748)	(2.9473)	(4.4020)	(4.9517)
Observations	1,790	1,757	1,617	1,606	1,448	1,449
Adj. R-squared	0.0108	0.0072	0.0075	0.0046	0.0053	0.0083
Country & Year FE	No	No	No	No	No	No
Panel C: GMM Models						
Variables			(1) Idiosyncratic Risk	(2) Default Risk	(3) Idiosyncratic Risk	(4) Default Risk
			Lag 1		**Lag 2**	
INED Heterogeneity Index			-0.0013***	-0.0758***	-0.0005***	-0.0989***
			(-9.6539)	(-11.8621)	(-3.8476)	(-9.2345)
INED			0.0013***	0.0786*	0.0010**	0.1520***
			(3.0934)	(1.7790)	(2.3730)	(2.8729)
Bank Controls			Yes	Yes	Yes	Yes
Country Controls			Yes	Yes	Yes	Yes
Constant			0.0138***	0.3449	0.0166***	0.6253**
			(5.3176)	(1.2750)	(6.9508)	(2.1431)
Observations			1,110	1,124	1,000	1,015

Country & Year FE	Yes	Yes	Yes	Yes
AR(1)	0.0080	0.0020	0.0100	0.0140
AR(2)	0.1720	0.297	0.1500	0.2590
Hansen J (p value)	0.6730	0.4650	0.4980	0.5700

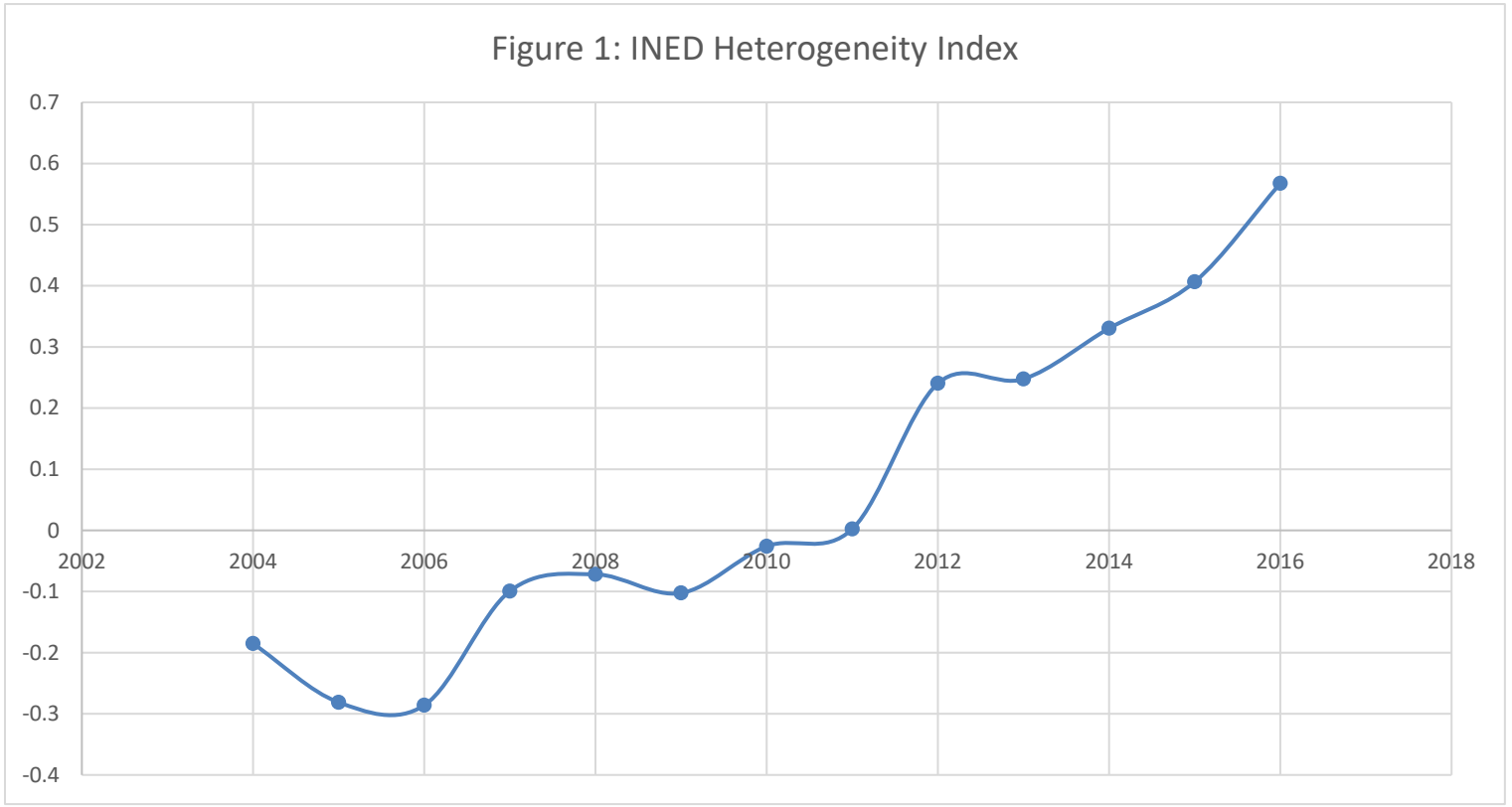
Figure 1: INED Heterogeneity Index
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
2002
2004
2006
2008
2010
2012
2014
2016
2018