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**Voluntary cybersecurity disclosure in the banking industry of Bangladesh:  
Does board composition matter?**

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# **Voluntary cybersecurity disclosure in the banking industry of Bangladesh: Does board composition matter?**

## **Abstract**

**Purpose** - Cybersecurity disclosure (CSD) provides users with valuable information and significant insights about a firm's susceptibility to cyber risk and its management. It is argued that the board of directors, with its oversight role, should be vigilant in managing cyber risk and disclosures. This study aims to measure the extent of CSD of the banking companies and examines the association between the characteristics of board composition (i.e., board size, board independence and gender diversity) and CSD.

**Design/methodology/approach** – This study adopted automated content analysis to find out the extent of CSD in the listed commercial banks of an emerging country, Bangladesh, where CSD is voluntary. Further, multiple linear regression is applied to determine the relationship between board composition and CSD.

**Findings** – The findings reveal an increasing trend of CSD over the sample period (2014-2020). The study confirms a significant positive relationship between board independence and CSD. The study also demonstrates that the higher presence of female directors on the board is associated with higher CSD. However, no consistently significant relationship is found between board size and CSD.

**Practical implications** – The study provides an overall understanding of current trends of CSD in the Banking sector of a developing country. Regulators may use our findings to understand the current level of CSD and assess the need for issuing guidance in this regard. The association between board composition and CSD has implications both for banks when selecting board members and policymakers when establishing requirements concerning board composition under corporate governance guidelines.

**Originality** - This is one of the very few studies in the context of an emerging economy where CSD is voluntary. The paper contributes to a narrow stream of research investigating CSD and its association with board composition. Notably, it contributes to understanding how board composition is associated with CSD in the banking industry, which is highly exposed to cyber risk.

**Keywords:** Cybersecurity disclosure, Board composition, Banking industry, Bangladesh

## **1. Introduction**

Cybersecurity disclosure is relatively a new agenda of corporate disclosures. According to the Center for Audit Quality (2017, p. 3), "given the high-profile nature of cyber-attacks on

corporations, both the demand for information related to cybersecurity and the need to facilitate robust conversations on these topics have grown exponentially across major stakeholder groups". The major news media often highlights the concern over cyber-attack (Pendley, 2018). Bourdon (2019) states that cybercriminals are breaching companies' cybersecurity frequently and stealing confidential data to get quick and unlawful financial benefits. Hence, there is an increasing stakeholders' demand for greater transparency from public companies in how they identify, measure, and manage cyber-risk (SecurityScorecard, 2021).

To address this escalating concern, every company should ensure robust cybersecurity governance and provide adequate disclosures on how cybersecurity is prioritised and managed. Krus (2012) argues that public companies should understand the importance of cybersecurity and go for appropriate disclosure on this issue. Such disclosures will allow the companies to demonstrate their accountability and engagement on this issue and build stakeholders' trust (EY, 2021). Haapamaki and Sihvonen (2019, p. 810) argue that companies should not only install effective cyber risk management programs but also provide timely and useful information about such initiatives to the stakeholders through 'cybersecurity reports' consisting of 'the management's description', 'the management's assertion' and 'the practitioner's opinion'. In recent years, regulatory bodies in the USA and Canada also highlighted the importance of cybersecurity disclosures and provided detailed guidance (Gao *et al.*, 2020; Héroux and Fortin, 2020; Radu and Smaili, 2021). As part of their oversight responsibilities, board members are expected to become more engaged and take a proactive role to understand and manage cybersecurity risks throughout their company (EY, 2018, 2021; Mohan *et al.*, 2021; Radu and Smaili, 2021). They should work with management in providing adequate and relevant cybersecurity disclosure [also referred to as cyber risk disclosure], which also provides 'transparency around how boards fulfil their cybersecurity risk oversight responsibilities' (EY, 2021, p.1).

CSD has also gained attention from accounting researchers lately. However, most of these recent studies (e.g., Gao *et al.*, 2020; Li *et al.*, 2018) are conducted in the US and Canadian contexts, where CSD is quasi-mandatory. Existing literature provides scant evidence about the CSD practices in the context of developing countries, which are at higher risk of being the target of cyberattacks (United Nations, 2011). Therefore, this study is conducted in the context of an emerging economy, where the CSD is a voluntary disclosure choice for the companies.

The objective of this study is to examine the extent of CSD in the banking companies of Bangladesh. The study also examines the association between board composition and CSD. Radu and Smaili (2021) contend that directors have a duty to ensure that the companies adopt appropriate cybersecurity measures to tackle cyber risk and warrant related disclosures. Although no sector is immune from cyber-attacks, this study's scope is focused on the banking sector because the risk of cyber-attack on banking and financial businesses are 300 times more than businesses in other industries (Mirchandani, 2018). Banks predominantly use various 'financial technology' (such as mobile and internet banking, paperless loan procedures, digital currencies, blockchain, IoT, AI etc.) to support their customers, which are highly vulnerable to the malicious activities of cybercriminals (Creado and Ramteke, 2020). Banks in Bangladesh are also highly exposed to cyber threats (Kundu *et al.*, 2018). In 2016, the central bank of Bangladesh – Bangladesh Bank (hereafter, BB in brief) had encountered a massive cyber-heist and lost US\$ 81 million. In a survey on the IT experts working in the financial institutions of Bangladesh, Siddique (2019) reports that these organisations suffer from cyberattacks through spam, malware and phishing that cause data and financial loss and business disruption. The key reasons behind these cybersecurity risks include failure to implement the cybersecurity policies and lack of awareness and expertise among employees and customers.

This study contributes to the literature in multi-fold ways. First, this study provides evidence of CSD trends in the context of an emerging economy, where CSD is a voluntary corporate reporting choice. In the recent study by Gao *et al.* (2020), there is a call to conduct further research on companies outside of the US to offer insight into CSD in different legal, political, and economic environments. Second, the focus of this study is on the banking industry, which is considered the most susceptible to cyber threats. Banks and financial institutions have been increasingly subject to cyber-attacks in recent times that hurt these institutions' balance sheets and reputations (Pearson, 2014; Skinner, 2019). Finally, drawing on agency theory and resource-based theory, this study hypothesises and examines the association between board composition and CSD. Consistent with Hillman and Dalziel (2003), we argue that the board of directors serves as a monitoring apparatus to minimise information asymmetry and represents a provision of 'intellectual resources' in the form of contemporary knowledge, expertise, and awareness to adopt voluntary reporting choices like CSD. To date, there is a dearth of research that examines the association between CSD and board composition.

The remainder of the article proceeds as follows. In the next section, the study highlights the cybersecurity issues in the banking industry of Bangladesh. After that, a summary of the

prior research on CSD is presented in section 3. In section 4, the study outlines the theoretical perspectives used, highlights the relevant literature on risk disclosures and board composition, and develops the hypotheses. A description of the research methodology follows this. Then the findings and discussion of the research are presented in section 6. In the end, the conclusion of the study is drawn.

## **2. Banking industry and cybersecurity: Bangladeshi context**

After the independence in 1971, the government of Bangladesh adopted socialism and nationalised all the banks (Mazumder and Sobhan, 2020). However, this concept of state-owned enterprises soon became intolerable because of their inefficiencies and operating losses (Ahmad, 1976). As a result, banks were privatised, and over the years, several new banks were established. Until the beginning of 2020, there are 30 commercial banks listed in the Dhaka Stock Exchange (DSE) [the oldest and the biggest stock exchange in Bangladesh]. Banks dominated the financial sector of Bangladesh because of an unreliable and extremely volatile capital market and the unavailability of financial instruments (Nguyen *et al.*, 2011). BB is the central bank of Bangladesh, and Bangladesh Securities and Exchange Commission (BSEC) is the market regulator of listed companies (including banks) with the sole authority to issue corporate governance guidelines.

Over the last half-decade, the banking companies of Bangladesh faced several cyber-attacks. Cybercriminals hacked the websites and accounts (and withdrew money), broke bank's network security and attacked ATM booths (Kundu *et al.*, 2018). For example, in 2015, several accounts of a commercial bank were hacked, and money was withdrawn. In another incident in the same year, the website of a government-owned commercial bank was hacked for a couple of hours. Notably, the cyber heist in the BB on 4th February 2016 was a highly organised cybercrime in the history of any central bank in the world (Mazumder and Sobhan, 2020). The notorious heist was an attempt from part of the cybercriminals to steal US\$ 1 billion. This attempt resulted in a successful theft of \$81 million. This heist got enough media attention both at the national and international levels. Accelerated digitalisation and advancement of e-banking in the banking sector in Bangladesh have increased the exposure to these cyber-attacks triggering both financial and reputation losses. Following the heist in 2016, the BB has taken a couple of initiatives to improve the internal cybersecurity platform, including training and awareness programmes and establishing a Cyber Security Unit (The Financial Express, 2021). The BB also provided several directives to commercial banks to warrant robust cybersecurity

arrangements to which each bank must adhere. Although the nation's banks have made some progress in cybersecurity in recent years, the sector is still highly vulnerable to cyber threats (Kundu *et al.*, 2018). In 2019, two commercial banks in Bangladesh further lost \$1.8 million (Dhaka Tribune, 2019). According to a study conducted by the Bangladesh Institute of Bank Management (BIBM), 50% of the banks in Bangladesh are at high risk of cybersecurity issues as they are still lacking expert IT professionals, network switches, next-generation firewalls, and Email gateways to safeguard their network security (Dhaka Tribune, 2019). Hence, the significance of cybersecurity governance and related disclosures to the stakeholders is of paramount importance in the Banking sector of Bangladesh.

### **3. Research on CSD: Literature review**

Cybersecurity disclosure has become an essential consideration as cyber-attacks have caused significant financial, reputational and legal implications for several companies in recent times (Gao *et al.*, 2020). However, there is a dearth of research in this area in the varied contexts. As summarised in **Table 1**, most of these studies are conducted in the US setting. The first attempt was made by Gordon *et al.* (2006) to examine the impact of the SOX Act on information security-related corporate voluntary disclosures. The authors reported that such disclosures were more pronounced after the SOX was enacted. Later, Gordon *et al.* (2010) found a positive association between voluntary information security disclosure and market value in another study. In 2011, the US Securities and Exchange Commission (SEC) issued indicative guidance on cyber risks disclosure, stating that public companies should disclose the risk of cyber incidents in their management's discussion and analysis (MD&A) if these issues are among the most significant factors that make an investment in the company speculative or risky.<sup>1</sup> Following such guidance, a handful of studies were conducted to assess the impact of such guidance on CSD. Although both Hilary (2016) and Gao *et al.* (2020) provided evidence that such symbolic guidance has led to an increase in such disclosure, Skinner (2019) was critical about the guidance and opined that the guidance failed to bring enhanced transparency to address the various public and private interests at stake. Gao *et al.* (2020) further established that CSD is significantly associated with general and industry-specific cybersecurity risk, company size and prior cyber security breach incidents. While assessing the relevance of cyber

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<sup>1</sup> The SEC's 2011 guidance can be considered a first attempt from any regulatory body in the global arena to demand CSD from public companies. Subsequently, the SEC issued best practices guidance in 2018 for cybersecurity risk disclosures, expanding on related guidance from 2011.

risk disclosures, Li *et al.* (2018) found that CSD is positively associated with future cybersecurity incidents. Recently, Calderon and Gao (2021) reported that the content (number of words) and language (readability and litigious language) of cybersecurity risk disclosures influence companies' audit fees.

Following the SEC's footsteps, Canadian Securities Administrator (CSA) emphasized the cybersecurity issued a notice in 2016 to the issuers, registrants and regulated entities guiding CSD (Radu and Smaili, 2021). Based on a content analysis of various Canadian companies' disclosures (e.g., annual information forms, annual and quarterly MD&A), Héroux and Fortin (2020) demonstrated that level of CSD is low, and the information is often generic. In a recent longitudinal study, Radu and Smaili (2021) showed a positive relationship between the presence and extent of CSD and the board's gender diversity in Canadian companies.

### **[INSERT TABLE 1 ABOUT HERE]**

The above discussion shows that prior studies are based on the developed economies, where CSD is compulsory. Developing and underdeveloped economies did not get much attention from CSD researchers. Perhaps, the only paper that focused on the corporate cyber risk disclosure of a developing economy is Mazumder and Sobhan (2020). The authors examined whether the cyber risk disclosure of the banking companies in Bangladesh changed due to the spill-over effect of the BB's cyber heist in 2016.

The present study is also based on the context of Bangladeshi banks. However, this study focuses on exploring CSD trends using longitudinal data and examining the relationship between board composition and CSD.

#### **4. Theoretical background and hypothesis development**

The board of directors should be vigilant about banks' exposure to cyber threats and play a proactive role in minimising cyber risk by adopting various security measures and ensuring adequate CSD (EY, 2021). Although the board's characteristics can be considered critical determinants of voluntary disclosures, there is hardly any study that has explored how board composition affects CSD. Hillman and Dalziel (2003, p. 383) argue that "boards of directors serve two important functions for the organisation: monitoring management on behalf of shareholders and providing resources". Following Hillman and Daiziel (2003), this study adopts a triangulation of agency theory and resource-based theoretical perspectives to develop



the initial expectations of the relationship between board composition and CSD, as depicted in **Figure 1.**<sup>2</sup>

According to agency theory, the board of directors is the key monitoring apparatus of managerial actions and corporate accountability. An effective board composition minimises information asymmetry between management and investors by providing adequate and relevant voluntary disclosures. Prince and Dwivedi (2013) mention that voluntary disclosures are critical to alleviating the problems of information asymmetry and agency conflicts. On the other hand, according to resource-based theory, a board of directors represents a valuable base of intangible resources to the management and firms in terms of value-creation characteristics like diverse views, awareness, skills, professional experience and leadership qualities, which enable the company to generate a new idea or adopt contemporary practices (Hillman and Dalziel, 2003; Pfeffer and Salancik, 2003; Tejedo-Romero *et al.*, 2017). Hillman and Dalziel (2003) contend that an individual is appointed to a board with an expectation that he/she will benefit the firm, *inter alia*, by providing advice, diminishing uncertainty, and enhancing legitimacy or public image. Diversely composed boards work effectively in minimising external uncertainties and seek to build the trust of stakeholders through enhanced voluntary disclosures (Abeysekera 2010). Therefore, it can be expected that a board with diverse composition brings intellectual resources that encourage voluntary disclosures practices like CSD.

**[INSERT FIGURE 1 ABOUT HERE]**

Based on the above theoretical arguments and relevant risk disclosure literature, this study develops the hypotheses between board composition and CSD in the following subsections:

#### ***4.1.CSD and board size***

The agency theory underpins that a large board is associated with effective monitoring of managerial actions, which can positively influence corporate disclosures (Elzahar and Hussainey, 2012). The increase in the board members leads to the enhanced alertness of the

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<sup>2</sup> Agency theory and resource-based theory provide complementary explanation to analyse the corporate behaviour (Mudambi and Pedersen, 2007). Several studies adopted these two theoretical perspectives together to examine the role of board characteristics on firm's performance and behaviours (e.g., Bhatt and Bhattacharya, 2015; Gabrielsson and Huse, 2005).

board regarding potential risks, which could propel related disclosures (Saggar and Singh, 2017).

Similarly, resource-based theory suggests that a large board usually represents directors with a pool of diverse expertise, knowledge base, opinions, and ability to monitor corporate activities, including disclosures (Abeysekera 2010; Adam *et al.*, 2005; Elzahar and Hussainey, 2012; Saggar and Singh, 2017). Large board will have more members with financial and accounting backgrounds, which will contribute to managerial decisions of voluntary disclosures (Elzahar and Hussainey, 2012). Elzahar and Hussainey (2012) note that bigger boards, because of their diversity of knowledge and expertise, can impact the quality of decision-making and collective control, resulting in a higher level of corporate disclosure. Hou and Moore (2010) contend that a larger board enhances managerial ability to seek relevant advice and make better business decisions. Adam *et al.* (2005) argue that a large board's diverse experience and insights enhance the firm's disclosure policy. Therefore, a large board is expected to play an essential role in increasing voluntary CSD.

A contrary theoretical proposition from agency theory is that small board size is more active and vibrant than large board (Jensen and Meckling, 1976). The disperse and non-integrated viewpoints in large boards often diminishes their effective monitoring capabilities (Jensen, 1993). Larger boards are more likely characterised by poor coordination, communication, monitoring and free-riding problems (Jensen, 1993). Therefore, a large board is expected to be ineffective, which, in turn, decreases firms' tendency to provide voluntary CSD.

Previous studies on risk reporting (e.g., Elzahar and Hussainey, 2012; Elshandidy *et al.*, 2013; Saggar and Singh, 2017) report that firms with larger boards provide more voluntary risk disclosures. In the Bangladeshi context, using evidence from banking institutions, Nahar *et al.* (2016) reported that board size has a significant positive relationship with credit risk and liquidity risk but no significant relationship with operational and other risks. However, the authors did not consider CSD in their study.

Given the theoretical predictions as well as empirical evidence, the study frames the first hypothesis as follows:

***H1. There is a significant positive (negative) relationship between board size and voluntary CSD in the listed commercial banks in Bangladesh.***

#### ***4.2.CSD and board independence***

According to agency theory, independent directors have more integrity with no or minimum personal conflict of interest and can thereby offer fair judgment without the managerial and non-managerial influences (Fama 1980, Fama and Jensen, 1983). They play a crucial role in resolving agency conflicts and minimising information asymmetry (Linsley and Shrives, 2006; Oliveira *et al.*, 2011). The presence of independent directors (also referred to as non-executive or outside directors) increases business transparency and disclosure (Kolsi, 2017; Terjesen *et al.*, 2009; Terjesen *et al.* 2016). Lopes and Rodrigues (2007) mention that independent directors have more incentives to demand transparency and accountability from top management to preserve their reputation and image in the industry. In many ways, independent directors suggest disseminating more information to ensure a 'balanced accountability process' (Nuskiya *et al.*, 2021, p. 371). Therefore, the increased presence of independent directors is expected to be associated with higher-level voluntary CSD.

Similarly, according to resource-based theory, independent directors carry more resources like relevant expertise, current knowledge, social networks, and legitimacy, affecting firms' behaviours and decision-making (Finkelstein *et al.*, 2009; Hillman and Dalziel, 2003; Pfeffer and Salancik 2003). They bring necessary supervisory skills and urgency to monitor, discipline and advise top management (Donnelly and Mulcahy, 2008; Saggar and Singh, 2017). Hence, it is more likely that independent directors with their up-to-date knowledge and experience will make the firms more transparent by adopting new and relevant disclosure practices like CSD.

Consistent with the above theoretical predictions, various studies support a positive effect of the presence of an independent director on risk disclosure (e.g., Elzahar and Hussainey, 2012; Lopes and Rodrigues, 2007). However, Saggar and Singh (2017) do not find any significant relationship between board independence and risk disclosure among Indian listed companies. Nahar *et al.* (2016) also fail to provide any conclusive evidence regarding the relationship between board independence and risk disclosures in the Bangladeshi context. Using evidence from listed banking institutions, they found no significant relationship between board independence and various categories of risk disclosures.

Based on the above theoretical expectations and prior empirical evidence, the study formulates the hypothesis as follows:

***H2. There is a significant positive relationship between board independence and voluntary CSD in the listed commercial banks in Bangladesh.***

#### **4.3.CSD and gender diversity in the board**

Gender diversity in the board refers to the presence of female directors in the boards of directors. The role of female directors over CSD can also be viewed through the lens of agency theory and resource-based theory (Terjesen *et al.*, 2009). Prior studies contend that female board members are more committed, diligent and independent (Cabedo and Tirado, 2004; Virtanen, 2012), which enhances effective monitoring and minimises agency conflicts. They are generally less self-interest-oriented (Coffey and Wang, 1998) and devoted to holding their organisation to higher ethical standards (Campbell and Mínguez-Vera 2008; Baker *et al.* 2020). Due to possessing a more trust-building leadership style and greater diligence in monitoring in comparison to male directors (Adams and Ferreira, 2009; Srinidhi *et al.*, 2011), the higher presence of female board members is found to minimise information asymmetry and improve corporate transparency and information environment (Abad *et al.*, 2017; Aribi *et al.*, 2018). Thus, it can be expected that firms with an increasing presence of female directors will ensure more CSD.

Similarly, according to resource-based theory, female directors bring their boards unique and valuable resources and relationships. They are different and often better than their male counterparts in terms of personality, experience, expertise, risk oversight, independence, innovativeness, leadership and communication style (Radu and Smaili, 2021; Tejedo-Romero *et al.*, 2017). According to Sagggar and Singh (2017, p. 386), “recruiting women on corporate board might carry a diversity of opinion and different prospects to board discussion”. Therefore, gender diversity can boost the combined intelligence and contribute to ‘increasing the pool of talent available for a company’s management and oversight functions’ (EC, 2011, p.7). Slovic *et al.* (1997) found that greater gender diversity can ensure better assessment and perception of risk and disclosure choices. Schubert (2006) argues and reports that women are relatively better than men at risk management and communication. Thus, firms with more female directors are expected to provide more CSD.

Although there is scant evidence regarding the impact of board gender diversity on risk disclosures, few studies (e.g., Ntim *et al.*, 2013, Sagggar and Singh, 2017) found a significant positive relationship between the presence of women on boards and firms’ risk disclosures. More specifically, using evidence from Canadian listed firms, Radu and Smaili (2021) recently documented that women on boards positively affect the presence and level of mandatory CSD only if the board has a critical mass of at least three women.

Based on the above theoretical perspectives and supporting literature, the study posits the following:

***H3. There is a significant positive relationship between the board's gender diversity and voluntary CSD in the listed commercial banks in Bangladesh.***

## **5. Research methodology**

### **5.1 Sample**

Cyber threats are among the most significant challenges that businesses have been facing recently. Although no sector is immune from cyber-attack, the banking sector is the most vulnerable (Mazumder and Sobhan, 2021; Skinner, 2019). Cyber-attack in the banking system is too frequent that it is considered as a top-most risk for the banking industry. On top of that, such risk exposure increases with the growing digitalisation of banking operations. Therefore, all the listed commercial banks operating in Bangladesh for the period 2014 to 2020 are taken as the sample for this study. The sample period starts from 2014 as the concept of CSD is relatively new in the global context. Prior studies (e.g., Gao *et al.*, 2020; Héroux and Fortin, 2020; Radu and Smaili, 2021) noted that CSD as a reporting practice became more pronounced between 2016 to 2018.<sup>3</sup> Also, as evidenced by Mazumder and Sobhan (2021), the focus on cyber risk governance and disclosures in Bangladesh got significant momentum after the BB heist in 2016. There are 30 commercial banks listed in DSE during the sample period. All the data are collected from the published annual reports available on banks' websites. Annual reports are considered the key source of corporate information (Gonidakis *et al.*, 2020; Rowbottom and Lymer, 2010). The final sample yielded 210 bank-year observations.

### **5.2 Empirical model specification**

In order to examine the relationship between CSD and board composition, a multiple linear regression model is used. The study estimates the following fixed-effect (year) regression model for testing the hypotheses framed in this study<sup>4</sup>:

$$CSD_{i,t} = \alpha_0 + \beta_1 BSIZE_{i,t} + \beta_2 BIND_{i,t} + \beta_3 BGDIV_{i,t} + \gamma_1 SIZE_{i,t} + \gamma_2 GROWTH_{i,t} + \gamma_3 PROFIT_{i,t} \\ + \gamma_4 LEV_{i,t} + \gamma_5 INST_{i,t} + \gamma_6 FOREIGN_{i,t} + \gamma_7 ISLAM_{i,t} + \sum_{j=1}^6 \delta_j Year_j + \varepsilon_{i,t}$$

<sup>3</sup> Although the US SEC provided indicative guidance on the CSD in 2011, interpretive and detailed guidance was issued on February 21, 2018 to promote explicit and robust CSD (Gao *et al.*, 2020; Héroux and Fortin, 2020). The guidance reinforces and carries more weight than the guidance provided in 2011 (EY, 2018). In 2016, CSA issued a notice guiding CSD to the issuers, registrants and regulated entities in the Canadian context (Radu and Smaili, 2021).

<sup>4</sup> Based on Breusch and Pagan Lagrangian multiplier (LM) test and Hausman test, the fixed-effect (year) estimation is preferred over pooled OLS and random effect estimations.

The subscript  $i$  denotes each bank, and subscript  $t$  denotes each year. The following sub-section provides the necessary description of the variables incorporated in the above regression model.

### **5.3 Variable measurement and description**

**Table 1** summarizes the measures used for the variables.

#### *5.3.1 Dependent variable: CSD*

In order to measure CSD, this study adopted an automated content analysis using 'Nvivo 12' software. Prior studies (see, e.g., Allini *et al.*, 2016; Elshandidy and Neri, 2015; Gao *et al.*, 2020; Li *et al.*, 2018; Mazumder and Sobhan, 2021; Saggat and Singh, 2017;) contend that the automated method is comparatively more accurate and reliable than the manual method of content analysis. We counted on related 'keyword' as a unit of analysis over alternative 'sentence-level analysis' as considering sentence as a unit of measurement may skip the possibility that differences in the use of grammar or sentence structure might lead to a different number of sentences irrespective of conveying the similar message by two different writers (Mazumder and Sobhan, 2021; Unerman, 2000). Moreover, counting sentences is relatively more burdensome and subjective than relying on relevant keywords as risk information remains merged with the mass piece of other information provided through the annual report (Beretta and Bozzolan, 2004; Mazumder and Sobhan, 2021). A list of 54 keywords<sup>5</sup> (see, Appendix 1) related to CSD is developed based on prior research (e.g., Gao *et al.*, 2020; Li *et al.*, 2018; Mazumder and Sobhan, 2021; Radu and Smaili, 2021) and annual reports review. To ensure the quality of the identification, we randomly selected 10% of our sample annual reports and manually confirmed that the content identified by keywords search was a valid cybersecurity disclosure.

#### *5.3.2 Research variables: Board composition*

As research variables, three attributes covering board size, board independence and board gender diversity are captured. Board size is measured by the total number of total directors in the bank and denoted as 'BSIZE'. Board independence is proxied by the percentage of

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<sup>5</sup> All the words/phrases are stemmed

independent directors in the board and denoted as 'BIND'. Gender diversity in the board is measured by the percentage of female directors on the board and indicated as 'BGDIV'.

### 5.3.3 Control variables

Based on prior studies, this study controls bank-specific financial characteristics like bank size, leverage, growth opportunity, and profitability. Bank size is considered as an important determinant of risk disclosures in prior literature (Abraham and Cox, 2007; Elzahar and Hussainey, 2012; Elshandidy *et al.*, 2018; Linsley and Shrivess, 2006; Radu and Smaili, 2021). Large listed banks are expected to have more stakeholders' pressure for voluntary CSD, and can afford additional costs of such disclosures. However, risk reporting literature highlights mixed of evidence including positive (Abraham and Cox, 2007; Linsley and Shrivess, 2006), negative (Campbell *et al.*, 2014) or no (Beretta and Bozzolan, 2004 ) significant relation between firm's size and risk disclosures. Next, this study controls bank's profitability (denoted as 'PROFIT'). CSD is expected to be positively correlated with profitability as banks with higher profitability tend to appease stakeholders and gain their confidence by providing more information on cyber security (Radu and Smaili, 2021). Such enhanced CSD could also help the banks with higher profitability to retain competitive advantage and secure profit in future. Leverage (denoted as 'LEV') is also controlled as banks with higher leverage are likely to provide more CSD due to greater pressure from financing (debt) stakeholders (Ben-Amar *et al.* 2017; Radu and Smaili, 2021). However, it can also be argued that firms with higher leverage may try to divert attention of the financing stakeholders to cyber risk by providing less or no CSD (Linsley and Shrivess, 2006; Oliveira *et al.*, 2018). Finally, this study uses the book-to-market ratio (denoted as 'GROWTH'), which represents a measure of a bank' opportunity for growth (Elshandidy and Neri, 2015). As growing firms are likely to experience greater information asymmetry and agency cost (Gaver and Gaver, 1993), banks with higher growth potentials may incline to reduce the information asymmetry between internal stakeholders and investors by providing extensive voluntary disclosures including CSD (Ben-Amar *et al.* 2017; Elshandidy *et al.*, 2018; Radu and Smaili, 2021). In contrast, it is also argued that it order to avoid increased proprietary costs and maintain business secrecy, firms with higher growth potential are less likely to disclose voluntary information (Chen *et al.*, 2014; Liu, 2015).

In addition to financial characteristics above, this study further controls ownership structure variables as external governance factors. Risk reporting and corporate governance literature suggests that ownership structure significantly influence the risk disclosure behaviour of firms.

Therefore, we control two types of ownership variables of the sample banks: institutional share ownership (denoted as ‘INST’) and foreign share ownership (denoted as ‘FOREIGN’). Prior studies (e.g., Donnelly and Mulcahy, 2008; Kamaruzaman *et al.*, 2019 ) claim that institutional investors play active role in minimising information asymmetry and demand greater voluntary disclosures as they possess relatively more business and technical know-how as well as bargaining power. In contrast, there is an argument that as institutional investors can negotiate with the firms to have direct access to private information. Hence, greater institutional ownership reduces the firms’ urgency to disclose voluntary information to the public (Laidroo, 2009; Rustam *et al.*, 2019). Likewise, it is usually believed that foreign investors are more concerned and demanding in terms transparency and disclosures of investee firms (Choi *et al.*, 2013). Prior studies (e.g., Khlif *et al.*, 2017; Rustam *et al.*, 2019) provide evidence that increasing presence of foreign ownership is also found to be positively associated with voluntary disclosure to reduce information asymmetry.

Finally yet importantly, prior studies (see, e.g., Mazumder and Sobhan, 2021) also argue that voluntary risk disclosures may differ between banks governed under Islami-shariah system and conventional banking system<sup>6</sup>. Hence, a dummy variable (denoted as ‘ISLAM’) is included to control any possible difference in CSD of sample banks due to Islamic-shariah orientation. A summary of how each of the variables are measured is provided in Table 2.

[INSERT TABLE 2 ABOUT HERE]

## **6. Empirical results and discussion**

### ***6.1 Descriptive Statistics and correlation matrix***

**Table 3** demonstrates the CSD over the sample period (2014-2020) among listed banks in Bangladesh. It clearly shows an increasing trend of mean CSD over the years. The findings is in consistent with the same reported by Gao *et al.* (2020) in the US context. It can be argued that growing cybersecurity concern globally in general and banking industry in particular has raised increasing awareness among listed banks in Bangladesh to consider this risk more

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<sup>6</sup> Unlike conventional bank, Islamic banks do explicitly claim that they operate following Islamic-shariah and banking model (For details, see Belal et al. 2019).



seriously and improve corporate disclosures to this end. However, relatively higher acceleration since the year 2016 could be attributed to BB's cyber heist in 2016, which has shaken the banking industry in Bangladesh and may have the consequent effect on the enhanced disclosures of cybersecurity in the annual reports of listed commercial banks. Mazumder and Sobhan (2021) also confirms that BB's cyber heist in 2016 caused a spill-over effect on increased cyber risk disclosures in the commercial banks in Bangladesh.

**[INSERT TABLE 3 ABOUT HERE]**

**Table 4** reports the descriptive statistics for all explanatory variables (both research and control variables) used in this study. The board of directors, denoted as 'BSIZE', represents the number of directors in the bank. On an average (mean), each board consists of approximately 14 directors with minimum 6 directors and maximum 21 directors. On an average, 19.48% of the total board member are categorised as independent directors (denoted as 'BIND'). The mean percentage of female members in the board (denoted as 'BGDIV') is 11.24%, which indicates that on average, one member out of each ten board members comes from the female gender. This is not surprising as there is a concern expressed in prior studies (see, e.g., Hossain *et al.*, 2021) on gender inequality in corporate world in the context of both developed and developing countries. The mean value of profitability, denoted as 'PROFIT', indicates that the average profitability is only 0.76%. The mean value of 'LEV' measuring the percentage of debt to total assets is over 95%. This high value is expected as banks mostly dependent on depositors' money for financing its businesses. The mean value of 'GROWTH' measuring the ratio of market to book value of equity is 1.043, which indicates the presence of minimum growth opportunity in the banking sector in Bangladesh. The average percentage of share ownership (denoted as 'INST') of banks by institutional investors is 19.02%. On the other hand, the average percentage of foreign ownership (denoted as 'FOREIGN') is only 5.41% with very high standard deviation of 13.62, which suggests a wider variation of foreign ownership across the banks. Finally, 20% of the sample banks in this study is operated under the Islamic-shariah system (denoted by a dummy variable 'ISLAM') as opposed to conventional banking system.

**[INSERT TABLE 4 ABOUT HERE]**

**Table 5** reports the Pearson's correlation matrix, which shows the pairwise correlation coefficients among the variables. As expected in hypothesis 1, the correlation between CSD and BSIZE is negatively significant at the 5% level. In addition, CSD is positively correlated BIND and BGDIV, at the 0.10% and 1% significance level respectively, which support both hypothesis 2 and hypothesis 3. None of the reported correlation coefficients between the explanatory variables is higher than the recommended threshold to consider the presence of multi-collinearity problem for subsequent regression analysis in section 6.2.<sup>7</sup>

[INSERT TABLE 5 ABOUT HERE]

### **6.2 Regression analysis**

**Table 6** shows the regressions results of research variables (BSIZE, BIND, BGDIV) and control variables (SIZE, GROWTH, PROFIT, LEV, INST, FOREIGN and ISLAM) on the dependent variable (CSD). The empirical model is well fitted with an adjusted *R*-squared of 42.2%. Besides, *F*-statistics are also statistically significant. All statistics are adjusted for the presence of heteroskedasticity, and dummies are included to address years' fixed-effect on CSD disclosures. The results shows a positive significant (at 5% significance level) relationship between CSD and 'BIND', which means that banks having greater percentage of independent directors in boards provide more disclosers on cybersecurity. This finding is in consistent with hypothesis 2 and supports the theoretical arguments of both agency theory and resource-based theory. Effective monitoring as well as pool of intellectual resources in the forms of contemporary idea, expertise and knowledge bring by independent directors in banking companies significantly contribute to the enhanced CSD. Consistent with prior studies on voluntary disclosure (e.g., Kolsi, 2017; Terjesen *et al.*, 2009; Terjesen *et al.* 2016), we establish that the increasing presence of independent directors in the banking companies brings greater transparency through CSD to deal with growing stakeholders concerns over cyber threats. This study also finds that there is a positive significant (at 5% significance level) relationship between CSD and 'BGDIV', which means that banks having greater gender diversity, measured by percentage of female directors in boards, are providing more information on cyber security. The results supports hypothesis 3, and consistent with the

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<sup>7</sup> A rule of thumb is that serious multicollinearity problem arises when the correlation coefficient between two variables exceeds 0.90.

findings reported in prior studies analysing gender diversity and risk disclosures (e.g., Burfawa et al., 2020; Ntim et al., 2013, Radu and Smaili,2021). Therefore, we can contend that gender diversity in the boards of banking companies minimises information asymmetry and brings critical resources to the firm in the form of diverse views, expertise, and risk awareness which positively influence the CSD. However, negative but insignificant relationship between ‘BSIZE’ and ‘CSD’ do not allow us to form any conclusion regarding the association between board size and CSD framed in hypothesis 1.

Regarding control variables, none of the control variable is found to be significantly associated with CSD except ‘INST’, which proxies the percentage of institutional shareholding in the firms. Consistent with prior studies (e.g., Laidroo, 2009; Rustam *et al.*, 2019), this result indicates that banks with greater presence of institutional ownership disclose less information on cybersecurity via annual report narratives.

[INSERT TABLE 6 ABOUT HERE]

### ***6.3 Further robustness and endogeneity check***

Now-a-days, researchers are increasingly relaxing the assumptions of independent and identical errors in dealing with linear regression model, and hence the use of heteroskedasticity corrected standard errors has become a ubiquitous exercise (Baum *et al.*, 2010; Petersen, 2009). Although allowing for heteroskedasticity corrected standard errors is warranted, the same may not sufficient (Baum *et al.*, 2010). Therefore, in order to check the robustness of the findings, this study further estimates the regression with one-way (bank-wise) and two –way (bank-wise and year-wise) clustering effects. Cluster-robust covariance matrix allows for ‘arbitrary correlations between errors within cluster of observations’ (Baum *et al.*, 2010, p.7). Cameron and Miller (2015) point out that regression estimation without controlling for clustering can lead to understated standard errors and overstated statistical significance. One-way (bank-wise) clustering adjusts the standard errors for the serial correlation, which could be a concern for a longitudinal panel data set like the one used in this study. The results are presented in **Table 7**, which demonstrates the relationships between board independence as well as board gender-diversity with CSD, respectively, are still statistically significant CSD at 5% significant level. Among control variables, growth opportunity of the banks is statistically significant,

though the Islamic-orientation of the banks does not hold the significant relation with CSD. Overall, there is no qualitative difference between the findings reported in Table 6 with initial findings in reported in Table 5. Subsequently, to check further robustness, the study runs the regression with two-way (bank-wise and year-wise) clustering, which adjusts for possible serial correlation within the firms as well as cross-sectional correlation across firms in the same period (Cameron *et al.*, 2011; Petersen, 2009; Sun *et al.*, 2018). As panel data structure variables in accounting and finance research are often cross-sectionally and serially correlated, Petersen (2009) and Sun *et al.* (2018) suggest to use two-way cluster-robust standard errors approach as a better alternative in handling panel data. As demonstrated in Table 6, the results are still consistent and support the hypotheses 2 and 3 of this study.

**[INSERT TABLE 7 ABOUT HERE]**

Another concern with regular linear regression model like pooled OLS model or fixed effect model is the presence of outliers, which could affect the relationship between the regressors and the response variable (Baum, 2013). This drawback could be minimised by using quintile (median) regression, which is based on conditional median function instead of conditional mean function. Contrary to conventional linear regression model, quintile (median) regression is also robust as it avoids assumptions linked to the error term's parametric distribution (Nuskiya *et al.* 2021). Therefore, this study re-estimates the relationship between CSD and regressor variables using quintile (median) regression. **Table 8** summarises the results, which confirm no qualitative difference in terms of direction as well as significance of the relationship between CSD and two board composition variables (BIND, BGDIV). Board size (BSIZE) is found to be negatively but insignificantly associated with CSD.

**[INSERT TABLE 8 ABOUT HERE]**

Another concern in empirical study is presence of endogeneity due to correlated omitted variables and reverse causality. In order to verify whether the relationship between CSD and board composition variables (BSIZE, BIND and BGDIV) is endogenously determined, this

study runs Durbin-Wu-Hausman test<sup>8</sup>. Based on Durbin score p value ( $p = 0.5795$ ) and Wu-Hausman score p-value ( $p = 0.6348$ ), we fail to reject the null hypothesis that these variables are exogenous. Therefore, this study confirms no apparent endogeneity issue for the dependent and independent variables of primary interest.

## 7. Conclusion

Limited empirical research on CSD motivates this current research. Notably, this study is unique because it explores the extent and determinants of CSD in banking companies in the context of an emerging economy, where CSD is voluntary. As the board of directors in the banks are expected to play a significant role in the overall risk governance mechanism (Nahar *et al.* 2016; Saggar and Singh, 2017), this study mainly focuses on how the board composition characteristics (i.e., board size, independence and gender diversity) determine the CSD in the listed commercial banks in Bangladesh. Based on theoretical arguments of agency theory and resource-based theory, this study posits that banks with larger (smaller) board sizes, higher presence of independent directors, and greater gender-diversified boards are likely to affect CSD positively. Based on longitudinal data for a 7-year (2014-2020), the study finds an increasing trend of CSD among listed banks in Bangladesh. The study provides evidence that banks with a higher percentage of independent directors on the board provide more CSD and vice-versa. In addition, the study also confirms that the percentage of female board members has a significant positive relationship with CSD. Consistent with the arguments of both agency theory and resource-based theory, we can contend that the independent directors and female directors ensure effective supervision and bring the resources like expertise, contemporary knowledge, risk awareness and accountability, which positively influence CSD practices. However, this study fails to conclude whether the size of the boards is consistently associated with enhanced CSD in the annual reports of listed banks.

The paper has limitations and hence suggests several avenues for future research. First, this study is conducted on listed commercial banks only and may not be generalised to other industries. Future research should be conducted on a larger sample consisting of firms from non-financial industries. Second, this study is based on automated content analysis and only addresses the quantity of CSD in terms of keywords count. Future research could be extended to do a more meaning-oriented analysis of CSD by doing discourse analysis of CSD narratives.

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<sup>8</sup> Also called augmented regression test or Hausman (1978) specification test for endogeneity.

Discourse analysis would enable the researcher to evaluate whether the language/tone of CSD is meaningful and informative to the stakeholders (Mazumder and Hossain, 2019) or the firms provide boilerplate disclosures over the years (Benneth, 2015). Future research may also explore other variables that impact the voluntary CSD in the companies and the economic consequences (e.g., the effect on the cost of capital, firm value) of CSD disclosures.

Despite having limitations, the authors believe that the study stands on its merit as it documents interesting preliminary evidence to the scant research on CSD in the context of an emerging economy. To the best of the authors' knowledge, this is the first study exploring the relationship between board composition and CSD in banking companies. Ideally, our study provides an impetus for further research in this fascinating area. Apart from the research implications, this study does have policy implications. The study indicates the present scenario of banks' CSD to the banking regulator (i.e., BB) and stock market's regulator (i.e., BSEC) to consider the prospects of issuing guidance either soft or hard to streamline the CSD in the broader interest of the stakeholders (including depositors and borrowers) and uphold public trust to the banking industry. Zaini *et al.* (2018) note that risk-related disclosure is one of the least popular categories to companies in emerging countries. The study also rationalises to the banks and corporate governance policymakers the significance of bringing more independence and diversity in board composition by increasing the presence of independent and female directors.

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## Appendix A

### List of keywords

“cyber” “cyber-risk” “cyber-threat” “cyber-attack” “cyber-security” “cyber-insurance” “online-security” “online-threat” “security-breach” “security-incident” “security-threat” “virus” “computer-virus” “system-security” “information-technology-security” “infosec” “technology-risk” “technology-threat” “information-technology-risk” “information-technology-threat” “malware” “ransomware” “crime-ware” “spyware” “key-logger” “keystroke-logging” “espionage” “data-breach” “data-security” “data-corruption” “corruption-of-data” “data-confidentiality” “confidentiality-of-data” “confidential-data” “hacking” “hacker” “data-theft” “computer-security” “network-security” “information-security” “intrusion” “phishing” “unauthorized-access” “social-engineering” “network-break-in” “ICT-risk” “ICT-security” “technology-risk” “technological-failure” “secured-way” “encryption” “decryption” “secure-network” “firewall”



**Table 1: A chronological overview of research on CSD**

<b>Prior Research</b>	<b>Context</b>	<b>Key findings</b>
Gordon <i>et al.</i> (2006)	The U.S. context	The study investigated the impact of the Sarbanes-Oxley (SOX) Act-2002 on the voluntary disclosures of information security activities. The findings reveal that SOX has a positive impact on such disclosures.
Gordon <i>et al.</i> (2010)	The U.S. context	This study provides evidence that voluntary information security disclosure is positively associated with the market value of sample companies.
Hilary <i>et al.</i> (2016)	The U.S. context	The study reported that SEC's 2011 guidance on cyber-risk disclosure has led to an increase in such disclosure but a modest one. The authors also concluded that disclosure on this topic is mostly boiler-plate.
Berkman <i>et al.</i> (2018)	The U.S. context	By examining the tone of cyber security disclosures, the study contends that a positive tone in cybersecurity disclosures is associated with higher market values and vice-versa.
Li <i>et al.</i> (2018)	The U.S. context	Examining the cybersecurity-related risk factors disclosed in 10-K filings, the authors show that the presence and length of such disclosures are related to future reported cyber incidents.
Skinner (2019)	The U.S. context	This study critically evaluated the SEC guidance on cyber risk disclosures. Analysing the content of 900 SEC filings made by the seven U.S. bank holding companies over a period of three years, the author argued that the SEC's guidance on cyber risk disclosure is inadequate to address the stakeholders' interests.
Gao <i>et al.</i> (2020)	The U.S. context	Using the sample of 112 publicly traded U.S. corporations between the fiscal year 2007 to 2018, the authors claim that the SEC's 2011 guidance to cyber security disclosure increased the level of disclosure. The study also reports that such disclosure is significantly associated with general and industry-specific cybersecurity risk, company size and prior cyber security breach incidents.
Calderon and Gao (2021)	The U.S. context	Based on a sample from 2005 to 2018, the authors found that companies' audit fees are influenced by the content (number of words) and language (readability and litigious language) disclosed in their cybersecurity risk disclosures.
Héroux and Fortin (2020)	Canadian Context	Analysing the contents of cybersecurity disclosures provided by the companies listed on the TSX 60 index between January 2017 and mid-2018, the study shows that CSD disclosure levels are low, generic and varied widely among the sample companies
Radu and Smaili (2021)	Canadian Context	Based on a sample of companies listed on the TSX 60 index over the period between 2014-2018, the study shows a positive association between the presence and level of cybersecurity disclosure and board gender diversity.
Mazumder and Sobhan (2021)	Bangladesh Context	The study confirms that the spill-over effects BB' cyber heist significantly increases the level of voluntary cyber risk disclosures after the cyber incident.

**Table 2: Variable Description**

<b>Variable</b>	<b>Measure</b>	<b>Description</b>
CSD	Cybersecurity Disclosure	Number of cyber security-related key words in the annual report narratives counted using automated content analysis (i.e. Nvivo 12 Software)
BSIZE	Board Size	Total number of directors in the board
BIND	Board Independence	Percentage of independent director in the board
BGDIV	Board Gender Diversity	Percentage of female director in the board
SIZE	Firm Size	Size of the bank measured by natural logarithm of number of employees <sup>9</sup>
GROWTH	Growth Opportunity	Ratio of market-to-book value of equity
PROFIT	Profitability	Percentage of net profit after tax to total assets
LEV	Leverage	Percentage of total debt to total assets
INST	Institutional Shareholdings	Percentage of total institutional shareholdings
FOREIGN	Foreign Shareholdings	Percentage of total foreign shareholdings
ISLAM	Islamic Shariah Governance	Dummy variable which takes '1' if the bank is operated following Islamic Shariah principle, otherwise '0'

<sup>9</sup> Size is measured by the natural logarithm of total number of employees instead of total assets (Becker-Blease *et al.* 2010). Natural log of total assets could lead to high structural multi-collinearity between 'SIZE' and 'LEV' measures in this study. However, alternative proxies of 'SIZE' (i.e., total assets, no. of employees, and no. of branches) do not change our key findings in this paper.

**Table 3: Cybersecurity disclosure (CSD) over the years from 2014 to 2020**

Year	Obs	Mean	Median	SD	Min	Max
2014	30	7.633	5.500	8.965	0	39
2015	30	9.667	7.500	7.270	0	26
2016	30	15.667	11.000	12.617	0	46
2017	30	21.933	18.000	17.421	1	91
2018	30	25.567	21.000	19.638	2	87
2019	30	35.567	30.500	25.069	5	104
2020	30	38.586	38.000	23.630	7	101
2014-2020	210	22.010	16.000	20.588	0	104

**Table 4: Descriptive Statistics**

Variable	Obs.	Mean	Median	Std. Dev.	Min.	Max.
BFSIZE	210	13.679	14.000	4.025	6.000	21.000
BIND	210	19.480	16.667	8.485	5.882	55.556
BGDIV	210	11.241	8.333	10.810	0.000	42.857
SIZE	210	7.963	12.496	0.620	6.122	9.832
GROWTH	210	1.043	0.802	1.164	-0.379	9.532
PROFIT	210	0.758	0.840	0.781	-4.250	2.360
LEV	210	95.732	92.641	17.423	87.390	203.544
INST	210	19.016	19.405	10.030	0.000	57.060
FOREIGN	210	5.410	0.320	13.617	0.000	67.260
ISLAM	210	0.200	0.000	0.401	0.000	1.000

**Table 5: Pearson's Correlation Matrix**

	CSD	BSIZE	BIND	BGDIV	SIZE	GROWTH	PROFIT	LEV	INST	FOREIGN	ISLAM
CSD	1										
BSIZE	-0.169*	1									
BIND	0.288***	-0.378***	1								
BGDIV	0.206**	-0.247***	0.263***	1							
SIZE	0.171*	0.184**	0.291***	-0.126	1						
GROWTH	-0.187	-0.041	0.279***	0.247***	0.224**	1					
PROFIT	0.067	0.240***	0.146*	-0.209**	0.353***	0.102	1				
LEV	-0.097	-0.305***	-0.074	0.265***	-0.506***	-0.171*	-0.846***	1			
INST	-0.159*	0.060	-0.152*	0.175*	-0.252***	-0.135	-0.037	-0.019	1		
FOREIGN	-0.077	-0.175*	0.155*	0.051	0.072	-0.092	-0.564***	0.655***	-0.216**	1	
ISLAM	-0.171*	0.204**	-0.049	0.062	-0.016	0.290***	-0.329***	0.400***	0.074	0.466***	1

(1) \*\*\*, \*\* and \* indicate statistical significance at 0.10%, 1% and 5%, respectively.

**Table 6: Results of Regression Analysis**

Variable	Model	
	coef.	t-stat
<b>Dependent variable: CSD</b>		
BFSIZE	-0.363	-1.11
BIND	0.525***	2.92
BGDIV	0.354***	3.01
SIZE	-0.515	-0.18
GROWTH	-2.351***	-2.75
PROFIT	2.068	0.84
LEV	-0.110	-0.57
INST	-0.491***	-3.90
FOREIGN	-0.138	-0.95
ISLAM	0.111	0.03
Constant	23.30	0.59
Year fixed effect	Included	
N	210	
adj. R-sq	0.422	
Prob > F	0.000***	

Note: (1) t-statistics are robust to heteroskedasticity corrected standard errors; (2) \*\*\*, \*\*, and \* indicate statistical significance at 1%, 5%, and 10%, respectively.

**Table 7: Results of Regression Analysis with Clustering Effects**

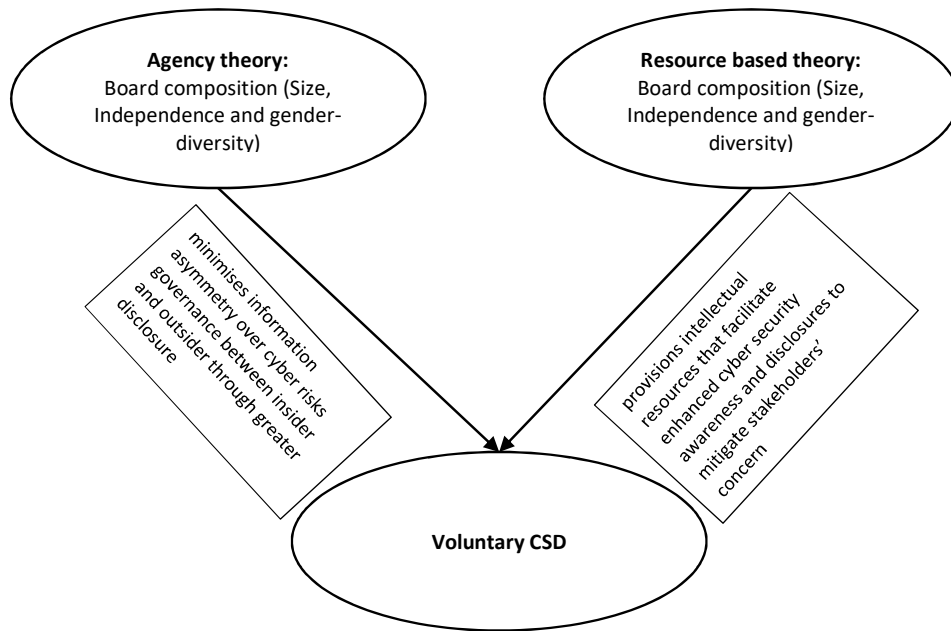
Variable	One-way clustering		Two-way clustering	
	coef.	t-stat	coef.	t-stat
<b>Dependent variable: CSD</b>				
BFSIZE	-0.363	-0.82	-0.363	-0.95
BIND	0.525**	2.13	0.525***	2.87
BGDIV	0.354**	2.17	0.354***	2.98
SIZE	-0.515	-0.13	-0.515	-0.16
GROWTH	-2.351	-1.59	-2.351*	-1.89
PROFIT	2.068	0.59	2.068	0.66
LEV	-0.110	-0.43	-0.110	-0.41
INST	-0.491***	-3.18	-0.491***	-2.77
FOREIGN	-0.138	-0.68	-0.138	-0.62
ISLAM	0.111	0.02	0.111	0.02
Constant	23.30	0.41	23.30	0.42
Bank-wise clustering	Yes		Yes	
Year-wise clustering	No		Yes	
Year fixed effect	Included		Included	
N	210		210	
adj. R-sq	0.422		0.422	
Prob > F	0.000***		0.000***	

Note: (1) t-statistics are robust to heteroskedasticity corrected standard errors and clustering effect(s); (2) \*\*\*, \*\*, and \* indicate statistical significance at 1%, 5%, and 10%, respectively.

**Table 8: Results of Quintile (Median) Regression Analysis**

<b>Variable</b>	<b>Model</b>	
	<b>coef.</b>	<b>t-stat</b>
<b>Dependent variable: CSD</b>		
BSIZE	-0.728	-1.42
BIND	0.401***	4.02
BGDIV	0.364***	4.83
SIZE	-2.832	-1.63
GROWTH	-2.548***	-3.28
PROFIT	0.895	0.53
LEV	-0.253**	-2.25
INST	-0.522***	-6.74
FOREIGN	-0.002	-0.02
ISLAM	2.90	1.18
Year fixed effect	Included	
N	210	
Pseudo R-sq	0.299	

Note: (1) \*\*\*, \*\*, and \* indicate statistical significance at 1%, 5%, and 10%, respectively.



**Figure 1: Conceptual framework used in this study**