



Research article

The impact of risk governance structure on bank risk management effectiveness: evidence from ASEAN countries

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ABSTRACT

This study analyzes the effectiveness of bank risk management in ASEAN countries and examines the specific role of risk governance in enhancing a bank's risk management effectiveness. Our results show that the risk management effectiveness of banks in ASEAN countries is low. Furthermore, by focusing on the insolvency risk, credit risk, and operational risk management of banks in ASEAN countries, the dynamic panel models using the two-step GMM method provide evidence that risk governance structure and its effectiveness positively correlate with risk management effectiveness in banks. Based on our findings, the regulators can establish the guidelines related to risk governance to manage a bank's risk management activities and maintain bank stability.

1. Introduction

After the 2008 financial crisis, more and more researchers and regulators paid attention to the corporate governance of banks because poor governance was thought to be one of the causes of this crisis. Orazalin and Mahmood (2019) find that better corporate governance practices led to better bank operating performance after the period of financial crisis. The changes in corporate governance guidelines or codes over time had a significant influence on corporate governance practices and therefore improved the bank's operating performance. However, which corporate governance structure is appropriate for banks is still debated. Financial policymakers around the world try to make the guidelines for banks to restructure corporate governance and provide many policies to constrain bank risk. In many recent policy documents, comprehensive risk management frameworks are outlined along with recommended governance structures (BCBS, 2015; FSB, 2013). One common recommendation is to "put risk high on the agenda" by creating respective structures. That is the reason more and more banks establish a risk committee to increase the percentage of independent members, financial and accounting experts, on the Board of directors' audit committee... However, the regulators in ASEAN¹ countries applied these international guidelines related to risk governance in different ways (Nguyen, 2022b). For example, some

regulators in Thailand, Indonesia, Malaysia, Singapore, Philippines, and Vietnam require the existence of a stand-alone risk committee, which is not required in other countries. Or Malaysian and Thailand regulators require at least three independent directors in the audit committee but Indonesian regulator only requires at least two (Nam and Lum, 2006). Banks in ASEAN countries, as well as other countries around the world, do not have the consistent direction to structure their risk governance effectively. Based on this reason, many previous studies attempted to find how to increase the effectiveness of risk governance. Some of them provide evidence that corporate governance affects bank risk. Many studies focus on the board of directors because they are responsible for several roles in financial institutions, and one of their most important roles is managing institutional risks. The board should approve and monitor the application processes of internal controls, the liquidity plan, and capital adequacy assessment for the bank. Pathan (2009) finds that a strong board can increase bank risk, but CEO power can prevent it. Minton et al. (2011) state that the "financial expertise of independent directors on the board is positively associated with bank risk. Besides the board of directors' structure", Nguyen and Dang (2020) provide evidence that an appropriate audit committee structure and external audit quality can constrain bank risk-taking and maintain bank stability. Aebi et al. (2012) and Aljughaiman and Salama (2019) also find the important role

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¹ ASEAN include 10 countries: Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam.

of the CFO and risk committee in constraining bank risk-taking. [Abid et al. \(2021\)](#) and [Nguyen \(2022a\)](#) provide evidence that risk governance plays an important role in controlling bank risk.

However, pursuing the objective of constraint risk-taking can harm the bank. For example, [Liu and Sun \(2021\)](#) find that a large board with a more independent member can constrain bank risk-taking. However, using a broad panel of large U.S. bank holding companies over the period 1997–2011, [Pathan and Faff \(2013\)](#) provide evidence that both board size and independent directors decrease bank performance. Most of the previous studies focused on the oversight risk-taking role of bank risk governance structure, while the risk management effectiveness is also very important. Banks should consider both risk and performance when structuring their corporate governance. The risk-return trade-off is a common financial concept that most academics and market practitioners utilize. Prior studies agree that the role of risk management is to ensure a high-risk-high return in decision-making ([Aljughaiman and Salama, 2019](#); [Sun and Liu, 2014](#)). Although researchers and practitioners usually refer to the main objective of corporations as maximizing return, the precise objective statement should be “to maximize return for a certain level of risk”. Corporations should acknowledge the importance of returns and adhere to good risk management. Many examples illustrate the effects of poor management practices by corporations, in which they ignored the risk aspects of their operations, leading to catastrophic financial consequences. This concept of risk management is particularly critical in the banking industry due to its crucial role in regulating and organizing the whole financial system. During the 2008 financial crisis, banks were blamed for taking excessive risks due to their weak risk management systems and lack of solid corporate governance ([Kirkpatrick, 2009](#)). [Tao and Hutchinson \(2013\)](#) argue that the failure of one financial institution in the crisis was likely contagious to others, and hence, increased the probability of their failures. [Aebi et al. \(2012\)](#) discuss the growing need for strong risk management techniques and structures after the 2007 and subprime US crises. In response to these studies, various regulators and organizations have pressured the boards of directors and senior management executives at leading financial institutions to improve their governance and risk management structures to withstand such shortcomings ([Van Greuning and Iqbal, 2007](#)). The objectives of this study are to evaluate the effectiveness of risk management activities of banks in ASEAN countries and investigate the impact of risk governance structure on bank risk management effectiveness. By focusing on the bank risk governance structure, i.e. the corporate governance structure of banks related to risk management activities ([Nguyen, 2022b](#)), this study will contribute to the literature in several ways.

First, by investigating the high risk-high return relation, we will assess the effectiveness of risk management activities of commercial banks in ASEAN countries. Current empirical analysis shows that risk management effectiveness in the banks of ASEAN countries is not high, so they should reconsider their current risk management system. It is important because ASEAN, in the near future, is forecasted to be the fifth largest trading region globally, and its weight in the global financial system is increasing. Any adverse shock to the financial sector in these countries may have a contagious effect on other countries due to higher financial openness ([Moudud-Ul-Huq et al., 2018](#); [Dang and Nguyen, 2021b](#)). Moreover, bank risk in these countries can be higher than in developed countries ([Nguyen, 2021a](#)). Therefore, if risk management activities of these banks are not effective, they may be adversely affected to global financial system.

Second, risk governance can constrain risk-taking activity and prevent bank risk, which the current literature has addressed ([Bai and Elyasiani, 2013](#); [Nguyen, 2022a](#); [Pathan, 2009](#); [Raouf and Ahmed, 2020](#); [Sun and Liu, 2014](#)). This does not mean they can enhance risk management effectiveness (high risk-high return relation). This study contributes to the literature by examining the impact of risk governance structure on a bank's risk management effectiveness. Our results show that audit committee size and independence are positively associated with

operational risk management effectiveness. Likewise, financial and accounting experts on audit committees are positively associated with credit risk management effectiveness. However, audit committee size is negatively associated with credit risk management effectiveness, and the existence of a stand-alone risk committee as well as external audit quality are positively associated with insolvency risk management effectiveness.

Third, as an extension of our analysis, we will investigate the impact of risk governance effectiveness on overall bank risk management effectiveness by using a risk governance effectiveness index. Our findings emphasize the important role of risk governance in the oversight of risk management activities in the banking sector, which previous studies have not focused on.

Finally, to the best knowledge, the study is one of the first to date to investigate the role of risk governance in three kinds of risk management including insolvency risk, credit risk, and operational risk. This is important because corporate governance may not affect all kinds of risk management activity in the same way. This study shows that deciding the size of the audit committee is a trade-off between the effectiveness of credit risk management and operational risk management.

The rest of this study is divided into the following sections: Section 2 discusses the background of the study. Then, Section 3 presents the conceptual framework. We present the literature review and hypotheses development in Section 4. Further, in Section 5, we present the research design including research data, variable measures, and empirical model/estimation method. Next, we explain the results and discussions in Section 6. Finally, Section 7 concludes by discussing policy implications.

2. Background

After the 2008 financial crisis, regulators in the ASEAN countries revised their code and guidelines to structure bank corporate governance and control bank risk, but these guidelines are very different among these countries ([Nguyen, 2022b](#)). Regarding risk management activities, regulators in the ASEAN offer different risk management requirements, and the banks applied in many ways. This can lead to ineffective risk management by banks. First, national supervisors in the ASEAN region typically specify a minimum reserve requirement. State Bank of Vietnam, Bank of the Lao PRD, and National Bank of Cambodia have mainly used these reserve requirements as a key tool for managing liquidity risk while other countries in ASEAN go beyond that. As another sample, the period of liquidity risk management report is different among countries. While the Monetary Authority of Singapore and Bank Indonesia require monthly reports, the Bangko Sentral ng Pilipinas requires yearly reports. Note that Bank of the Lao PRD and National Bank of Cambodia do not set the period of reporting and leave each bank to decide according to their business profile. In general, ASEAN countries do not seem to have found a way to control and improve the efficiency of bank risk management.

[Figure 1](#) presents the average risk, including insolvency risk (Zscore), credit risk (NPLS) and operational risk (DROA), and risk governance effectiveness (RGEI) of all countries from 2010 to 2019.² The figure shows that banks' insolvency risk is fluctuating while credit risk and operational risk tend to decrease over the years. The risk governance effectiveness does not change much over time, the value of RGEI ranges from 4.1 to 4.7. This shows that the risk governance effectiveness of banks in the ASEAN region has not improved much since the 2008 crisis. [Figure 2](#), which presents the average risk and risk governance effectiveness by country, shows that insolvency risk in some countries such as Myanmar, Lao, and Cambodia is higher than in other countries. While Thailand, Philippines, and Malaysia have the highest credit risk, and Indonesia, Cambodia, and Thailand have the highest operational risk. These indicate that the level of risk may not depend on the financial development of each country. Furthermore, Brunei, Cambodia, and Vietnam have the highest level of risk governance effectiveness while

² We start at 2010 because some countries are the lack data before this year.

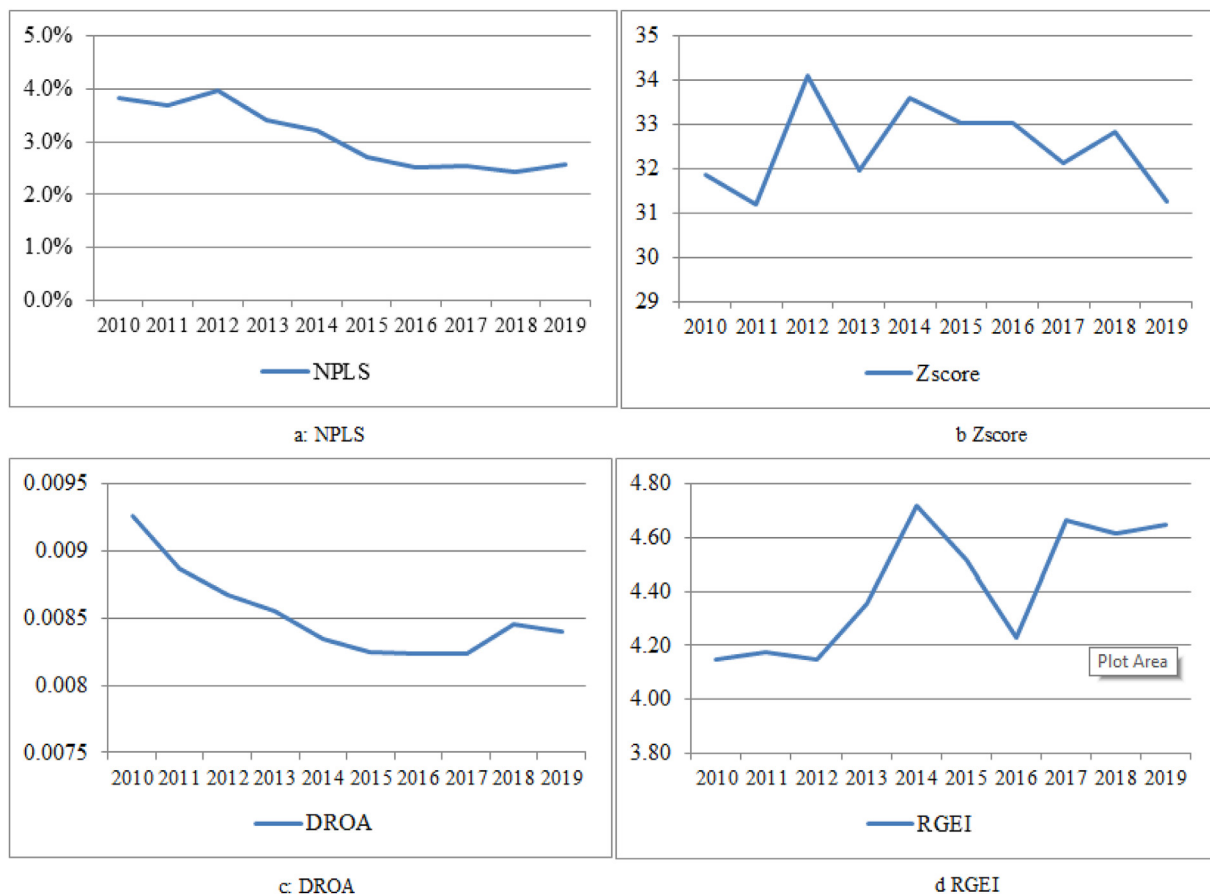


Figure 1. Average risks and risk governance effectiveness of banks by year. Source: calculating by authors.

other countries do not have much difference. Preliminary analysis shows that differences in regulatory and policy across countries related to corporate governance of banks can lead to differences in levels of risk and risk management effectiveness of banks in the ASEAN countries. While many previous studies agree that appropriate corporate governance plays an important role in oversight risk and risk management (Abid et al., 2021; Sun and Liu, 2014; Nguyen, 2021b).

3. Theoretical framework

Agency theory indicates that bank shareholder's and manager's interests may not be the same (Amihud and Lev, 1981; Amihud et al., 1983; Demsetz and Lehn, 1985; Smith and Stulz, 1985; Sullivan and Spong, 2007; Nguyen, 2020). Regarding risk management activities, bank shareholders always want managers to take high risks with high return projects. However, bank managers may not want to take high risks because that may affect their job. As a result, bank managers tend to accept low-risk projects and are less concerned with high returns from these projects. Meanwhile, the effectiveness of bank risk management is shown through the high risk-high return relationship (Aljughaiman and Salama, 2019; Sun and Liu, 2014), the agency problem can reduce the effectiveness of bank risk management. Corporate governance, therefore, is expected to increase bank risk management effectiveness because it is an effective solution to reduce agency problems (Caprio and Levine, 2002; Dang and Nguyen, 2021a).

In addition, the option theory indicates that the option value of share may increase with volatility and bank managers may form the intention of taking on a risky project without having considered the project's possible returns. In other words, the management might end up taking some high-risk, low-return investments. On the other hand, the

management may also become excessively conservative in their risk-taking due to the board of directors being more assertive with limiting risk. Managers may then not accept "high risk-high return" projects. Pertaining to option theory, it is noteworthy that levels of risk-taking do not impact a bank's risk management effectiveness unless financial performance is considered. The fact that a firm undertakes a low-risk strategy does not necessarily indicate that it exhibits good practice (Aljughaiman and Salama, 2019; Sun and Liu, 2014). According to the trade-off between risk and return, risk management is effective if risk-taking positively relates to a firm's financial performance. Regarding the relationship between corporate governance and risk management effectiveness, corporate governance was found to play an important role in the oversight and control of manager behaviors (Liang et al., 2013; Pathan, 2009). Thus, an appropriate corporate governance structure and its effectiveness can help banks increase risk management effectiveness.

4. Literature review and hypothesis development

This study focuses on six compositions of risk governance derived from the oversight risk management roles of an audit committee, a risk committee, and an external audit.

An audit committee plays a crucial role in the corporate governance of banks. An audit committee is responsible for assisting the board of directors in assessing the adequacy and effectiveness of the bank management's recommendations regarding material risks related to the performance of the strategic and material activities of the bank; the bank's risk management framework and practices; the bank's compliance with legal and regulatory requirements; and those concerning the bank's responsibilities over the execution of operational activities as related to monetary policy. Sun and Liu (2014) provide evidence that an audit

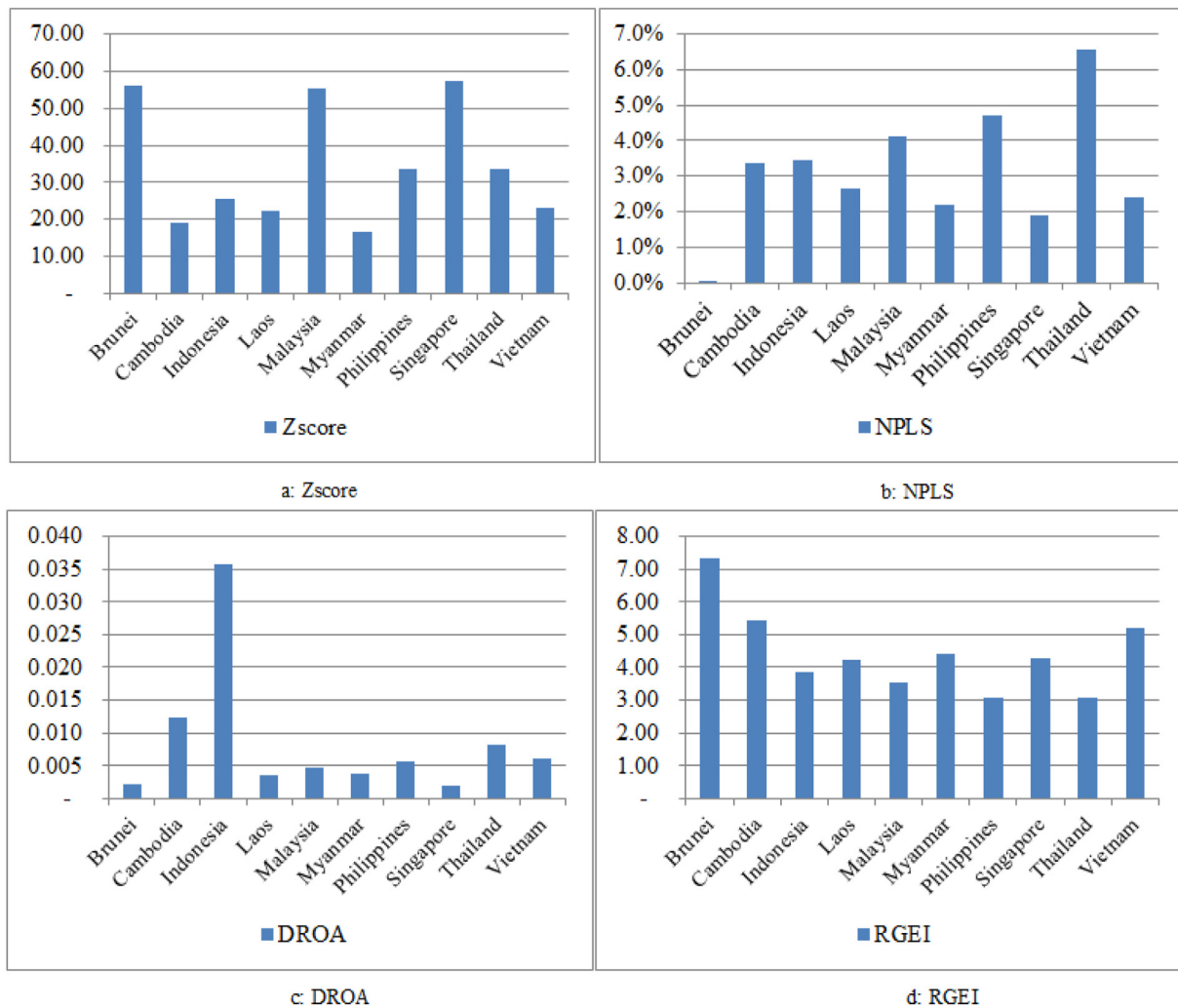


Figure 2. Average risks and risk governance effectiveness of banks by country. Source: calculating by authors.

committee plays an important role in the oversight of bank risk-taking and management activities; therefore an audit committee structure may affect risk management effectiveness.

Some previous studies found that large corporate governance may reduce management performance. Guest (2009) find that a large board has weak monitoring roles. Similarly, Cheng et al. (2008) provide evidence about a positive relationship between small board size and firm performance. Based on the stewardship theory, Kalsie and Shrivastav (2016) also find a negative relationship between a large board and firm performance. Besides board size, a large audit committee may reduce its oversight role. Nguyen and Dang (2020) find that a large audit committee reduces bank stability. Based on these discussions, we propose the first hypothesis as follows:

H1. Audit committee size is negatively associated with risk management effectiveness.

Independent director is important in corporate governance of both non-financial and financial firms. Using international samples, Aggarwal et al. (2009) and Dahya et al. (2008) find a positive relation between board independence and non-financial firm value. In banking sectors, Pathan (2009) finds that independent director on Board, which is used to measure a strong board, positively relates to bank risk and Mollah and Liljebloom (2016) find board independence to enhance both bank performance and solvency. These findings indicate that independent directors on Board can enhance the bank's high risk-high return (risk

management effectiveness). However, Board usually plays an oversight risk management role through audit committee (Sun and Liu, 2014; Dang and Nguyen, 2022). We expect that independent directors on audit committee can enhance bank's risk management effectiveness; Therefore, we propose the second hypothesis as follows:

H2. The proportion of independent directors on audit committee is positively associated with risk management effectiveness.

Accounting and financial expertise is also an integral part of corporate governance as stipulated in the literature. Minton et al. (2014) discovered that financial expertise among independent directors of U.S. banks is positively related to bank risks in both balance-sheet and market-based measures. Sun and Liu (2014) stated that accounting and financial experts on audit committee can increase their effectiveness in oversight risk-taking. The effect of financial expertise is more pronounced when the audit committee is more powerful or when the audit committee members face higher risks (Lee and Park, 2019). We propose the third hypothesis as follows:

H3. The proportion of financial and accounting expertise on audit committee is positively associated with risk management effectiveness.

In addition, the meeting frequency of board and its committee was also found to be important in bank management. Liang et al. (2013) find that frequent board meeting is an indication of the proactive characteristic of the board of directors. This can boost bank performance in China.

In like manner, Xie et al. (2003) have been able to prove that audit committee meeting frequency can enhance internal control system quality and then reduce earning management activities. These studies imply that a higher meeting frequency of audit committee can help them work more effectively. Since the audit committee has an oversight risk management role, it is envisaged that audit committee's meeting frequency can enhance risk management effectiveness. Accordingly, the fourth hypothesis is proposed as follows:

H4. The frequent meeting of the audit committee is positively associated with risk management effectiveness.

The external audit is also an important component of risk governance. The external auditors submit their reports to the audit committee where both parties discuss and harmonize important issues, such as management's errors, irregularities, and fraud; problems or obstacles in the internal control process; and problems related to the preparation of financial statements or financial reporting. World-Bank (2016) reports that "External auditors work does contribute to the effective supervision of banks. External audit and bank's supervisors possess complementary skills and knowledge. External auditors may participate in the supervisory process by performing additional work at the request of the supervisors, providing reasonable or limited assurance on a range of areas such as: internal controls, IT systems, risk management, or prudential returns. The reporting of external auditors to supervisors helps to strengthen the supervisory process." No doubt, external audit plays a crucial role in oversight bank risks (Bley et al., 2019; Elamer et al., 2021). Jiraporn et al. (2008) indicated that the recent scandals at Enron, WorldCom, and Elsewhere have generated a negative public perception that earnings by management are utilized opportunistically by firm managers for their own selfish benefits, rather than for the benefits of all stockholders. Kim et al. (2003) noted that "the Big 4 exercise more effective control when managers have incentives to manipulate upward earnings". Therefore, this type of auditor is able to monitor and detect opportunistic managerial behavior (Bratten et al., 2013) and become significant in risk governance. We expect that the effectiveness of external audit can help strengthen risk governance in oversight risk management. Thus, the fifth hypothesis is as follows:

H5. Quality of external audit is positively associated with risk management effectiveness.

Finally, after the 2008 financial crisis, the risk committee's responsibilities and activities have increased. Regulators have put a surplus of pressure on banks to create a separate risk committee that has full responsibility for overall risk in the banks. The risk committee is a sub-committee of the board, and it specializes entirely in managing risks. The committee's responsibilities include advising the board on overall risk tolerance, risk appetite, and risk policies. In addition, they also monitor the senior management's application of the risk strategies set by the board of directors. They report to the BOD and/or CEO regarding this issue. Furthermore, the risk committee communicates directly with the risk management enterprise department (Base-I-Committee-on-Banking-Supervision, 2015). The risk committee should discuss the business units' performance, their compliance with risk appetite, and risk restrictions set by the BOD with senior management through regular meetings (FSB, 2013). The risk committee is responsible for providing recommendations relating to optimal risk strategies as well as overseeing the "risk management framework" implementation. Some prior studies also found that a risk committee existence can reduce bank risk (Aljughaiman and Salama, 2019; Bhuiyan et al., 2020). Therefore, we expect the risk committee to be able to enhance bank risk management effectiveness and propose the sixth hypothesis as follows:

H6. Stand-alone risk committee existence is positively associated with risk management effectiveness.

Besides risk governance structure, we also expected that risk governance effectiveness can enhance risk management effectiveness generally. Previous studies found that corporate governance effectiveness generally enhances bank risk disclosure (Elamer et al., 2020a,b; Elamer

et al., 2019), which may increase risk management effectiveness. Raouf and Ahmed (2020) find that the strength of risk governance structures can maintain bank stability. Furthermore, Aljughaiman and Salama (2019) provide evidence that risk governance effectiveness can prevent risk-taking behavior. Therefore, we propose the final hypothesis as follows:

H7. Risk governance effectiveness is positively associated with risk management effectiveness.

5. Research design

5.1. Research data

To observe the impact of risk governance structure on bank risk management effectiveness, we collected most of the financial variable data from the Bank Focus (Bureau van Dijk) for the period from 2002 to 2019. Most banks did not publish their annual reports before 2002. Therefore, we could not collect corporate governance information before this time. Based on the list of banks in the Bank Focus database, we excluded all banks with no financial data. Then we continued to exclude banks without corporate governance information. Our final data includes 104 banks in the ASEAN region (including Brunei, Indonesia, Vietnam, Cambodia, Philippines, Myanmar, Laos, Thailand, Singapore, and Malaysia). We hand-collected from the financial statement and other sources published by banks any missed data from Orbis Bank Focus. Data on bank risk governance was hand-collected from banks' annual reports and countries' stock exchange websites. Table 1 presents our data distribution, the final data collected is unbalanced panel data consisting of maximum 1,207 observations.

5.2. Variable measures

5.2.1. Bank performance measures

Based on previous studies (Iannotta et al., 2007; Chen et al., 2018; Phan et al., 2020), we use two traditional measures of bank financial performance. First, we use the return on assets ratio (ROA) as a measure of bank profitability. ROA ratio is calculated as the income divided by the total assets from each year and collected on Bank Scope. The second bank's financial performance variable is the return on equity ratio (ROE), which is used as the robustness test.

5.2.2. Bank risk measures

This study focuses on three kinds of risks relevant to measuring a banking institution's viability: insolvency risk, credit risk, and operational risk. First, existing literature on insolvency risk typically uses the Z-score, a widely used measure of a bank's insolvency risk (Houston et al., 2010; Laeven and Levine, 2009; Nguyen, 2020). Z-score combines a bank's buffers (capital and profits) with the risks they face (measured by

Table 1. Research data distribution.

Countries	Banks selected	Percentage	Number of observations	Percentage
Brunei	1	1.0%	6	0.5%
Thailand	16	15.4%	220	18.2%
Myanmar	3	2.9%	7	0.6%
Philippine	17	16.3%	175	14.5%
Malaysia	9	8.7%	121	10.0%
Laos	3	2.9%	16	1.3%
Vietnam	37	35.6%	436	36.1%
Indonesia	8	7.7%	85	7.0%
Cambodia	7	6.7%	95	7.9%
Singapore	3	2.9%	46	3.8%
Total	104	100.0%	1207	100.0%

the standard deviation of returns). The Z-score measures the number of standard deviations a return realization must fall into to deplete equity. It is estimated as follows:

$$Z - score = \frac{ROA + ETA}{sd(ROA)} \tag{1}$$

where ETA is the equity-to-asset ratio. ROA and sd (ROA) are return on assets ratio and standard deviation of return on assets ratio respectively. Based on Eq. (1), the Z-score is the number of standard deviations by which a bank's return on assets has to fall before the bank becomes insolvent. Thus, the higher the Z-score, the lower the bank's insolvency risk.

The second category of risk, credit risk, is the possibility of a loss resulting from a borrower's failure to repay a loan or meet contractual obligations. This type of risk is also a conventional measure in commercial banks' operations. Traditionally, it refers to the risk that a lender may not receive the owed principal and interest, which results in an interruption of cash flow and increased costs for collection. To measure credit risk, we use the ratio of non-performing loans (NPLs) to the total loans. A lower ratio indicates that the bank's borrowers are less likely to default on their loans, thereby indicating a more stable institution.

Third, operational risk is faced by all types of banks. Operational risk is measured by the variability of the rate of return. This rate of return is influenced by general factors of the market and the economy, such as inflation, exchange rates, business cycles and firm-specific factors. Overall risk indicates the uncertainty of a firm's operating income flow, and we measure it using standard deviations of ROA (Miller and Bromiley, 1990; Sun and Chang, 2011). Higher standard deviations indicate more instability in the bank's profitability as well as the bank's performance over time. A higher measure thus indicates greater overall risk.

5.2.3. Risk governance structure and risk management effectiveness measure

First, audit committee size (ASIZE) is measured as the total audit committee members reported at the end of the year. In case the banks do not have audit committee in a year, the value of ASIZE in this year is zero. This measure was used in some previous studies (Sun and Liu, 2014; Nguyen and Dang, 2020; Nguyen, 2021a).

Second, bank audit committee independence (ACIN) is measured by dividing the total number of independent members in the audit committee by the total number of members. Independent director information can be collected from a bank's annual report, as well as from other sources. This measure was also used in some previous studies (Nguyen and Dang, 2020; Nguyen, 2021a).

Third, financial and accounting professionals on the audit committee (FAEA) were measured as the ratio of members with finance or accounting expertise on audit committee to the total number of members. We expect that an audit committee with a higher proportion of finance and accounting experts can enhance the effectiveness of risk governance. Based on previous studies, we determine the financial or accounting expertise of those who have experience or a degree in these areas (Nguyen, 2022b; Suprianto et al., 2017).

Fourth, based on Vafeas (1999), the audit committee meeting frequency (ACMF) is measured by the number of audit committee meetings in a year, including both offline and online meetings. The more the audit committee meets, the busier they are and therefore are expected to operate more efficiently.

Fifth, the existence of "stand-alone risk committee" (SARC) is a dummy variable which is 1 if the bank has "stand-alone risk committee" otherwise it is 0. We collected most of the risk committee's information on the bank's annual report and only considered banks having a "stand-alone risk committee" and if the term "risk" in their board committee is included in their annual reports, such as "Board Risk Committee", "Risk Policy Committee", "Risk Management Committee", or "Risk and Assets Committee" and "Risk and Compliance Committee".

Finally, the external audit quality (EXAQ) is a dummy variable which is 1 if "Big 4" audit firms provide external audit service for the bank. "Big

4" audit firms include the four largest firms providing audit services in the world, i.e., Ernst and Young, KPMG, Price Waterhouse Cooper, and Deloitte. Banks choose the Big 4 to provide external audit services to indicate that they have the high quality of external audits. Kim et al. (2003) find "the Big 4 exercise more effective control when managers have incentives to manipulate earnings upward" indicating that they can increase the effectiveness of firm's control mechanism. Furthermore, they could provide higher quality service based on their perceived competence and independence (Khurana and Raman, 2004). The high external audit quality can also make audit committee perform their role more effectively (Dang and Nguyen, 2021a).

To measure risk governance effectiveness, we develop the risk governance effectiveness index (RGEI) that consists of nine risk governance of Nguyen and Dang (2022) which is presented in Table 2. These characteristics were mentioned in Basel-Committee-on-Banking-Supervision (2015), FSB (2013), and found to have relation to risk management in literature. It is necessary to consider the effectiveness of the risk governance in general, because, besides six risk governance structure variables, some other factors can also affect the risk management effectiveness. For example, the studies find higher effectiveness of women in the monitor role. Carter et al. (2003) find a statistically significant positive relationship between the percentage of female directors and nonbank firm value. Gul et al. (2011) report an increase in earnings quality correlated to the presence of female audit committee members suggesting female audit committee members are more effective at oversight than their male counterparts. Firms with a higher number of audit committee meetings have less financial restatement (Abbott et al., 2004) and are associated with a lower incidence of earnings management (Xie et al., 2003), indicating that the busy audit committee can enhance its effectiveness. We apply nine characteristics of risk governance based on international regulations and findings of previous studies. Although many of the underlying characteristics in RGDEX are continuous, these are transformed into binary or dummy variables because the theory does

Table 2. Definition of the Risk governance effectiveness index (RGDEX) variable.

Variables	Calculation
RGEI = BOSDEX + BIDDEX + ACSDEX + ACIDEX + FADEX + AMFDEX + FACDEX + SRCDEX + BIG4DEX	
1. BOSDEX	"Value is one if the value of board size is lower than the median board size of the data in year t, zero otherwise"
2. BIDDEX	"Value is one if the proportion of independent directors on the board is higher than median percentage of independent directors of the data in year t, zero otherwise"
3. ACSDEX	"Value is one if the value of audit committee size is lower than the median audit committee size of the data in year t, zero otherwise".
4. ACIDEX	"Value is one if the proportion of independent directors on the audit committee is higher than median proportion of independent directors of the data in year t, zero otherwise"
5. FAMDEX	"Value is one if the proportion of finance and accounting member on the audit committee is higher than median proportion of independent member of the data in year t, zero otherwise"
6. AMFDEX	"Value is one if the number of audit committee meeting is higher than median meeting of the data in year t, zero otherwise"
7. FACDEX	"Value is one if the proportion of female member on the audit committee is greater than median proportion of independent member of the data in year t, zero otherwise"
8. SRCDEX	"Value is one if the bank has risk committee in year t, zero otherwise"
9. BIG4DEX	"Value is one if the bank use Big 4 audit service in year t, zero otherwise"

not strongly suggest a linear relation. Therefore, this study does not impose a linear relation on the data. Moreover, such binary transformation facilitates the construction of the overall index.

5.2.4. Other control variables

Bank size (BASI): Large banks generally set up many branches and thus have diversified geographies and may also have diversified income. Some previous studies find that large banks with complex activities have multiple and overlapping layers of hierarchy; therefore, they may suffer from agency problems (Laeven and Levine, 2007). However, the large banks could take advantage of these opportunities and achieve marginal cost savings, especially as markets develop (DeYoung et al., 2013). Supporting this argument, Bertay et al. (2013) show that there is a positive relationship between bank size and return because large banks are subject to greater market discipline.

Bank age (BAAG): Young banks normally focus on increasing their market share rather than on improving profitability (Athanasoglou et al., 2008). Beck et al. (2005) indicates that “young banks are less profitable than new banks due to their less experience and stability”. We, therefore, expect a positive coefficient on BAAG.

Board structure: We include board independence (BOIN) and board size (BOSI) in the model as previous studies (Yasser et al., 2017; Paniagua et al., 2018) suggests that board structure could affect firm performance but the results are mixed. Because the relationship between board structure and bank performance is ambiguous, the coefficients on BOIN and BOSI are unsigned. There are still arguments related to board structure and bank performance. Many studies agree that independent directors should be appointed to monitor and discipline managers, which may make the board larger. De Andres and Vallelado (2008) find that boards that are larger and not so independent may increase monitoring and advising effectiveness, and thus increase bank value. Pathan and Faff (2013) find that a large board with more independence can increase bank

performance. The consensus in the literature is that complex and large firms, which need a higher level of monitoring and advising, need larger boards. This is because, due to the idiosyncratic nature of the banking business, small boards in this case may have difficulty in monitoring managers. However, there is a problem that larger boards would increase the free-rider problem, which may reduce bank performance. Jiang et al. (2013) find that board size negatively and significantly affects bank performance.

Ownership structure: Based on the literature, this study controls State ownership (SOWN) and Foreign ownership (FOWN). The relationship between state ownership and firm performance in literature is mixed. Some studies find the negative relation (Qi et al., 2000; Yu, 2013), positive relation (Jiang et al., 2008), or U-shaped relation (Sun et al., 2002; Wei and Varela, 2003). However, most literature finds that State ownership enhances firm performance (Ferris and Park, 2005; Ferreira and Matos, 2008). We expect the coefficient sign of FOWN to be positive.

Macro variables: Prior studies (Alharbi, 2017; Bikker and Vervliet, 2018) also provide evidence about the positive relationship between GDP growth and bank profitability. Therefore we expect the coefficient on GDP is positive. Uddin and Suzuki (2014) find a negative relationship between bank competition and bank performance. However, Moudud-Ul-Huq (2020) find a nonlinear relationship between bank competition and performance in BRICS countries. We use GDP and CR3 as control variables in our model. All definitions of variables are presented in Table 3.

5.3. Empirical model and estimation method

5.3.1. Empirical model

In order to examine the relationship between risk governance structure and bank risk management effectiveness as well as test our six hypotheses, we estimate the following regression model using the following general form:

Table 3. Variable definitions and measures.

Variables	Definition and measure
Bank performance	
ROA	Return on assets is calculated by dividing a bank's net income by total assets
ROE	Return on equity is calculated by dividing a bank's net income by total equity
Bank risk	
Zscore	Insolvency risk is computed as the sum of the current period return on assets. (ROA) and the equity ratio (equity over total assets) divided by the standard deviation of ROA
NPLS	Credit risk is measured by the ratio of non-performing loan on total loan
DROA	Operational risk is measured by the standard deviation of ROA
Bank risk governance structure variables	
ASIZE	Audit committee size is measured by total number of audit committee members
ACIN	Audit committee independence is measured by the proportion of the number of independent director on total member of audit committee
FAEA	Financial and accounting expert on audit committee is measured by the proportion of the number of financial and accounting experts on total member of audit committee
ACMF	Audit committee meeting frequency is measured by the number of meetings of audit committee a year, including offline and online meeting
SARC	“Stand-alone risk committee” existence is dummy variable which is 1, if the bank has a “stand-alone risk committee” and 0 otherwise
EXAQ	External audit quality is dummy variable which is 1, if bank use “Big 4” audit service and 0 if otherwise
RGEI	Risk governance effectiveness index
Other control variables	
BOSI	Board size is measured by total number of members on Board
BOIN	Board independence is measured by proportion of the number of independent director on total member of Board
BAAG	Bank age is measured by the years the bank was established
BASI	Bank size is measured by logarithm of the bank's total assets
SOWN	Stated ownership is measured by the ratio of stated-own share to total share
FOWN	Foreign ownership is measured by the ratio of foreign-own share to total share
GDPC	GDP per capita is logarithm of GDP per capita
CONC	Bank competition is measured as CR3 ratio which is suggested by Chong et al. (2013)

$$PERF_{it} = \gamma_0 + \gamma_1 PERF_{it-1} + \gamma_j \sum_{j=2}^4 RISK_{it} + \gamma_k \sum_{k=5}^7 RGV_{it} * RISK_{it} + \gamma_l \sum_{l=8}^n CONT_{it} + \varepsilon_{it} \tag{2}$$

where: PERF is bank performance which was measured by ROA ratio. We also use the ROE ratio as a robustness test. RISK is a vector of risk variables including insolvency risk, credit risk, and operational risk. RGV is a vector of risk governance variables including 6 risk governance variables and RGV*RISK is an interaction variable that is used to examine the impact of risk governance structure and risk governance effectiveness on risk-performance relations (i.e. risk management effectiveness). CONT is a vector of control variables. All variables were defined in Section 3.2 and Table 2. We also include lags of bank performance measures (dependent variable) to capture the dynamic effect of past performance on the current performance of bank risk as suggested by Jackling and Johl (2009), and Khan et al. (2021).

5.3.2. Estimation methods

To test our hypotheses, we estimate Eq. (2) by the System GMM method. The System GMM estimator takes into consideration the dynamic natures of bank performance and risk governance to introduce valid and strong instruments that address unobserved heterogeneity and simultaneity. In addition, the System GMM method is found to be appropriate for research in corporate governance (Ullah et al., 2018; Wintoki et al., 2012). After estimation, we also use the Arellano and Bover (1995) AR (2) tests for second order-serial autocorrelation and use Hansen's J statistic to test the instrument validity of overidentifying restrictions.

6. Empirical analysis

6.1. Summary statistics and correlation

The descriptive statistics for the main risk, risk governance structure and other control variables are presented in Table 4. The means of ROA and ROE are 0.9% and 9.8% respectively and are quite lower than other samples. For example, Pathan and Faff (2013) report the ROA and ROE to be 4.65% and 9.92% respectively for the US sample. Zhou et al. (2019) report the ROA to be 1.21% for the Chinese bank samples. The mean of Z score is quite high and the mean of NPLS and DROA is low. This indicates that banks in ASEAN countries may have a low level of risk. The mean of RGEI is 4.22 while min and max values are 0 and 9 respectively. This indicates that bank's risk governance effectiveness in ASEAN countries may not be high and strongly differs from bank to bank.

Table 5 reports the correlation matrix for all variables which were used in the empirical analysis. The bank performance measure (ROA and ROE) is positively correlated with Z-score and negatively with the DROA, which implies that there is a high risk-high return in ASEAN banks. In other words, the negative relationship between risk and performance indicates that risk management of banks may be effective. Credit risk (NPLS) is positively correlated with ROA and negatively correlated with ROE but is not statistically significant. The pair-wise correlation measures may not be reliable indicators of the relationships among our variables of interest because other variables may also affect bank performance at the same time. Therefore, we continue to test the hypotheses by applying multiple regression methods.

6.2. The impact of risk governance structure on bank risk management effectiveness

6.2.1. Main result

Table 6 reports the hypotheses testing results for the effects of a risk committee structure on the bank's risk-performance relation. We control for bank governance, bank, and country characteristics across all the

Table 4. Descriptive statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
ROA	1,207	0.01	0.02	-0.72	0.06
ROE	1,207	0.10	0.19	-0.95	5.04
Zscore	1,207	31.01	27.48	-15.22	207.68
NPLS	1,207	0.04	0.05	0.00	0.53
DROA	1,207	0.01	0.02	0.00	0.20
ASIZE	1,207	3.67	1.43	0.00	11.00
ACIN	1,166	0.40	0.38	0.00	1.00
FAEA	1,166	0.49	0.25	0.00	1.00
ACMF	1,148	9.69	7.25	0.00	77.00
SARC	1,207	0.80	0.40	0.00	1.00
EXAQ	1,207	0.64	0.48	0.00	1.00
RGEI	1,207	4.22	1.90	0.00	9.00
BASI	1,207	9.78	0.79	6.37	11.63
BOSI	1,207	8.99	2.99	3.00	20.00
BOIN	1,207	0.24	0.22	0.00	1.00
BAAG	1,207	36.38	26.87	1.00	167.00
SOWN	1,207	0.21	0.34	0.00	1.00
FOWN	1,207	0.18	0.28	0.00	1.00
GDPC	1,207	3.47	0.41	2.53	4.81
CONC	1,207	0.63	0.32	0.41	0.99

Note: The table presents descriptive statistics for all variables, the variable definitions are reported in Table 2.

models. The model is modified by Eq. (2) and estimated by the System GMM method. These results can indicate whether risk governance structure can improve the effectiveness of banks' risk management. The results in Table 6 can be explained in some respects. First, the insolvency risk variable (Z-score) captures the effect of insolvency risk on bank's financial performance. This relationship indicates the bank's insolvency risk management effectiveness. Specifically, the trade-off between bank risk and bank return states that a higher return can be achieved by taking higher risks. Therefore, a significant negative coefficient of Z-score signifies the effective risk management of banks. Other than that, insignificant or significantly positive coefficients of Z-score imply that insolvency risk management is ineffective. The positive coefficient of Z-score indicates the high (low) risk – low (high) return strategy of banks. Unlike the insolvency risk measured by the Z-score, the negative coefficients of credit risk (NPLS) and operational risk (DROA) indicate that banks did not follow the high risk-high return strategy, and therefore banks' risk management is not effective. The insignificant or significantly negative coefficients of NPLS and DROA imply that credit risk and operational risk management are ineffective respectively.

Regarding the effectiveness of insolvency risk management in ASEAN countries, the results in Table 6 report that the Z score coefficients are positive and significant with ROA in regressions 5 and 6, while the Z score coefficients in other regressions are insignificant. These results indicate that the insolvency risk management of banks in ASEAN countries is not effective. We only find the positive relationship between credit risk and bank performance in regression 1 and regression 2, while other coefficients are negative or insignificant. This implies that the level of effectiveness of credit risk management of banks in ASEAN countries is low. Moreover, the coefficients on DROA are negative or insignificant with ROA indicating that the operational risk management of banks in ASEAN countries is also not effective. Overall, we find no evidence of a high risk-high return of banks in ASEAN countries, which suggests that the risk management activities of banks in ASEAN countries are ineffective.

Regarding the impact of the risk governance structure on bank risk management effectiveness, in regression 1 of Table 6, the coefficient on NPLS*ASIZE is found to be negative, with ROA and significant at 5% level. It indicates that audit committee size negatively relates to the

Table 5. Correlation matrix.

	ROA	ROE	Zscore	NPLS	DROA	ASIZE	ACIN	FAEA	ACMF	SARC	EXAQ	RGEI	BASI	BOSI	BOIN	BAAG	SOWN	FOWN	GDPC	CONC	
ROA	1.00																				
ROE	0.16	1.00																			
	(0.00)																				
Zscore	0.08	0.01	1.00																		
	(0.00)	0.65																			
NPLS	0.00	-0.01	-0.01	1.00																	
	(0.90)	(0.81)	(0.84)																		
DROA	-0.34	-0.19	-0.25	-0.01	1.00																
	(0.00)	(0.00)	(0.00)	(0.63)																	
ASIZE	0.01	0.02	0.13	-0.03	-0.02	1.00															
	(0.83)	(0.57)	(0.00)	(0.24)	(0.41)																
ACIN	-0.03	-0.02	0.29	0.03	0.11	0.08	1.00														
	(0.32)	(0.42)	(0.00)	(0.33)	(0.00)	(0.01)															
FAEA	0.03	0.03	-0.09	-0.05	-0.01	-0.05	0.11	1.00													
	(0.30)	(0.30)	(0.00)	(0.08)	(0.66)	(0.10)	(0.00)														
ACMF	0.03	0.03	0.04	-0.10	-0.11	0.16	0.04	0.14	1.00												
	(0.26)	(0.24)	(0.23)	(0.00)	(0.00)	(0.00)	(0.24)	(0.00)													
SARC	0.00	-0.07	0.17	-0.03	0.02	0.11	0.25	0.02	0.06	1.00											
	(0.89)	(0.02)	(0.00)	(0.35)	(0.41)	(0.00)	(0.00)	(0.56)	(0.06)												
EXAQ	0.06	0.05	0.14	-0.05	-0.18	0.10	0.05	0.06	-0.01	0.10	1.00										
	(0.03)	(0.08)	(0.00)	(0.07)	(0.00)	(0.00)	(0.07)	(0.04)	(0.83)	(0.00)											
RGEI	0.01	-0.03	-0.16	0.05	0.00	-0.33	-0.46	-0.14	-0.33	0.11	0.24	1.00									
	(0.61)	(0.25)	(0.00)	(0.07)	(0.95)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)										
BASI	0.01	0.10	0.23	-0.07	-0.19	0.12	0.35	-0.11	0.13	0.20	0.11	-0.12	1.00								
	(0.81)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)									
BOSI	0.08	0.07	0.21	-0.01	-0.16	0.27	0.37	-0.10	0.18	0.23	-0.06	-0.41	0.50	1.00							
	(0.01)	(0.01)	(0.00)	(0.73)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.03)	(0.00)	(0.00)								
BOIN	0.01	-0.05	0.30	-0.01	0.03	0.11	0.58	0.04	-0.04	0.36	0.21	-0.20	0.22	0.23	1.00						
	(0.85)	(0.06)	(0.00)	(0.63)	(0.38)	(0.00)	(0.00)	(0.13)	(0.22)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)							
BAAG	0.01	0.04	0.22	0.00	-0.14	0.13	0.29	-0.10	0.04	0.17	-0.05	-0.21	0.54	0.50	0.26	1.00					
	(0.79)	(0.20)	(0.00)	(0.90)	(0.00)	(0.00)	(0.00)	(0.16)	(0.00)	(0.09)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)						
SOWN	-0.04	-0.07	-0.04	0.06	-0.03	-0.11	-0.15	-0.18	-0.15	-0.11	-0.14	0.05	0.03	-0.05	-0.17	-0.03	1.00				
	(0.22)	(0.01)	(0.17)	(0.05)	(0.23)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.10)	(0.31)	(0.11)	(0.00)	(0.35)						
FOWN	0.00	0.11	0.07	0.17	-0.03	0.07	0.18	0.02	-0.08	0.08	0.15	-0.03	0.10	0.09	0.12	0.18	-0.27	1.00			
	(0.91)	(0.00)	(0.02)	(0.00)	(0.28)	(0.01)	(0.00)	(0.57)	(0.01)	(0.00)	(0.00)	(0.27)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)				
GDPC	-0.04	-0.03	0.38	-0.06	-0.05	0.17	0.61	-0.02	0.02	0.40	0.10	-0.16	0.63	0.41	0.66	0.45	-0.12	0.06	1.00		
	(0.13)	(0.32)	(0.00)	(0.03)	(0.09)	(0.00)	(0.00)	(0.47)	(0.50)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.03)			
CONC	0.00	0.04	-0.07	-0.03	0.10	-0.04	0.03	0.03	-0.14	-0.18	0.04	0.01	-0.21	-0.17	0.04	-0.14	-0.02	0.06	-0.15	1.00	
	(0.97)	(0.18)	(0.01)	(0.35)	(0.00)	(0.14)	(0.34)	(0.29)	(0.00)	(0.00)	(0.15)	(0.84)	(0.00)	(0.00)	(0.12)	(0.00)	(0.60)	(0.04)	(0.00)		

Note: This table reports the correlation matrix for primary variables. We report p-values in parentheses below each correlation estimate.

Table 6. Results for risk governance structure and bank risk management.

RGV	ASIZE		ACIN		FAEA		ACMF		SARC		EXAQ	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent variable: ROA	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
Lag (ROA)	-0.62***	-4.96	0.39**	2.50	-1.84***	-3.93	-2.36***	-13.82	-2.31***	-15.55	-1.72***	-7.07
Zscore	-0.00	-0.48	0.00	1.10	-0.00	-1.61	0.00	0.07	0.00**	2.58	0.00*	1.78
NPLS	0.58**	2.19	0.08**	2.58	-0.68*	-1.84	0.07	0.35	0.05	0.24	0.21	0.63
DROA	-13.65***	-4.27	-0.99***	-2.64	-0.41	-0.32	-1.27***	-2.90	-4.17*	-1.74	-4.05***	-5.47
Zscore*RGV	-0.00	-0.87	-0.00	-1.71	0.00	1.57	0.00	0.13	-0.00***	-2.62	-0.00*	-1.78
NPLS*RGV	-0.16**	-2.43	0.02	0.27	0.96*	1.68	-0.01	-0.40	-0.05	-0.21	-0.02	-0.06
DROA*RGV	2.54***	2.79	0.77**	2.18	-1.62	-0.61	-0.01	-0.10	2.90	1.24	1.97	0.74
BASI	-0.01	-0.96	0.00	0.65	0.01	0.51	0.00	0.04	0.01	1.04	0.02	1.61
BOSI	0.00	0.83	0.00	1.22	0.00	0.34	0.00	1.58	0.01**	1.99	0.00	-0.88
BOIN	0.04	1.26	0.01**	2.35	0.10	1.08	0.04	1.15	0.06	1.33	0.11**	2.00
BAAG	-0.00	-0.26	-0.00	-0.10	0.00	0.39	-0.00	-0.51	-0.00	-1.61	-0.00	-1.57
SOWN	-0.02	-0.61	-0.00*	-1.65	-0.08	-1.24	-0.03	-1.21	-0.03	-1.08	0.01	0.31
FOWN	-0.02	-0.38	-0.01	-2.18	0.07	1.17	-0.01	-0.95	-0.01	-0.58	0.00	0.18
GDPC	-0.02	-0.74	-0.01*	-1.91	-0.08	-1.55	-0.03	-1.49	-0.05**	-2.26	-0.04	-1.55
CONC	0.01	0.35	0.00	0.87	0.00	0.11	-0.00	-1.42	-0.00	-0.51	-0.01	-0.65
Cons	0.23***	2.95	0.03	1.57	0.21	1.38	0.12**	2.56	0.08	1.10	0.03	0.24
AR2 (p-value)	0.299		0.335		0.289		0.262		0.251		0.284	
Hansen test (p-value)	0.101		0.235		0.216		0.101		0.140		0.377	
No of instrument	64		81		79		67		60		63	
Obs	1101		1069		1069		1049		1101		1101	

Note: this table presents the results of the estimates of Eq. (2) by applying the system GMM approach for the dependent variable ROA. Regressions 1 to 7 present estimations for each risk governance structure variable with risk governance effectiveness used as an interaction variable. These include audit committee size (1), audit committee independence (2), number of financial and accounting experts on the audit committee (3), audit committee meeting frequency (4), risk committee existence (5), external audit quality (6), and risk governance effectiveness (7), respectively. RGV represents for each risk governance structure and the risk governance effectiveness for each regression. See Table 3 for variable definitions. ***p < 0.1, **p < 0.05 and *p < 0.001.

bank's credit risk management effectiveness. While the coefficient on DROA*ASIZE is positive and significant at 1% level, this indicates that audit committee size reduces the risk management effectiveness. Overall, the increase in audit committee size has different effects on bank risk management effectiveness, i.e. it enhances operational risk management but reduces credit risk management. Therefore, banks should determine the appropriate audit committee size depending on the trade-off between credit risk and operational risk management effectiveness. These results are well supported by hypothesis H1.

In regression 2, the coefficient on DROA*ACIN is positive and statistically significant with ROA, while Z-score*ACIN and NPLS*ACIN are insignificant. Although audit committee independence does not insolvency and credit risk management effectiveness, it enhances operational risk management effectiveness. These results support hypothesis H2, and are consistent with Dionne and Triki (2005) who argue that audit committee independence has an important role in a firm's risk assessment and hedging strategies.

Unlike the results reported by the independence of the audit committee, the results reported on regression 3 do not provide evidence of the relationship between financial and accounting experts in the audit committee and insolvency risk management or operational risk management. The coefficients of Z-score*FAEA and DROA*FAEA are insignificant while regression 3 reports the significantly positive relationship between the proportion of financial and accounting experts on audit committee and credit risk management effectiveness because the coefficient on NPLS*FAEA is positive and significant with ROA. This result fairly supports hypothesis H3 and is consistent with some literature (Dionne and Triki, 2005; Xie et al., 2003; Zalata et al., 2018), which find that the financial and accounting experts on the audit committee enhance firm management. All coefficients on Z-score*ACMF, NPLS*ACMF and DROA*ACMF in regression 4 are not significant. We, therefore, conclude that the frequency of audit committee meetings does not associate with

bank risk management effectiveness and that the results do not support hypothesis H4.

Regarding regression 5 and regression 6, the coefficients on both Z-score*SARC and Z-score*EXAQ are negative with respect to ROA, and they are significant at a 1% and 10% levels, respectively. The coefficients of other interaction variables (NPLS*SARC, DROA*SARC, NPLS*EXAQ, and DROA*EXAQ) are not significant. These results moderately support hypotheses H5 and H6 and provide evidence of a positive relationship among "stand-alone risk committee" existence, external audit quality, and insolvency risk management effectiveness. This study support Aljughaiman and Salama (2019) that risk committee enhances risk management effectiveness. These results suggest that a bank's management team is able to manage insolvency risk more effectively when the bank has a stand-alone risk committee and uses a higher quality external audit service.

In summary, we first found that stand-alone risk committee existence and external audit quality can enhance insolvency risk management effectiveness. Second, the number of financial and accounting experts on an audit committee can enhance credit risk management effectiveness, but audit committee size reduces credit risk management effectiveness. Finally, both audit committee size and audit committee independence can enhance operational risk management effectiveness. Overall, although not all risk governance structure variables were found to be significantly associated with bank risk management effectiveness, these results still support our hypotheses well.

6.2.2. Robustness test

Table 7 reports the robustness test results of how risk governance structure and risk governance effectiveness influence the relationship between risk and performance by using ROE as the dependent variable for estimation of Eq. (2). With regards to insolvency risk, stand-alone risk committee existence and risk governance effectiveness were

Table 7. Robustness test results for risk governance structure and bank risk management.

RGV	ASIZE		ACIN		FAEA		ACMF		SARC		EXAQ	
	(1)		(2)		(3)		(4)		(5)		(6)	
Dependent variable: ROE	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
Lag (ROE)	0.70***	4.47	0.47***	3.50	-3.12***	-13.01	-2.93***	-9.15	-2.76***	-12.64	-2.78***	-10.05
Zscore	0.00	0.91	0.00	0.07	-0.00	-0.94	0.00	0.37	0.01**	2.03	0.00	0.28
NPLS	0.95**	1.99	0.59*	1.68	-3.23**	-2.12	-0.54	-0.26	2.16*	1.91	-2.85*	-1.79
DROA	-19.60*	-1.75	-4.91*	-1.92	-2.08	-0.37	-3.25	-0.36	-53.99**	-2.47	-4.91***	-2.78
Zscore*RGV	-0.00	-1.00	-0.00	-0.99	0.00	0.61	-0.00	-0.84	-0.01**	-2.57	-0.00	-0.59
NPLS*RGV	-0.19*	-1.83	-0.81	-1.01	6.64**	2.20	0.08	0.28	-1.70	-1.04	3.99**	1.98
DROA*RGV	5.18*	1.73	5.35**	2.08	-10.44	-0.81	-0.61	-0.33	37.16*	1.71	-12.56	-0.81
BASI	0.05	1.52	0.03***	3.19	0.24**	2.06	0.08*	1.68	0.05	0.96	0.08	0.93
BOSI	-0.00	-0.22	-0.00	-0.41	0.03	1.04	0.06*	1.76	0.01	0.60	0.01	0.98
BOIN	-0.09	-0.90	0.01	0.10	0.22	0.57	0.07	0.15	-0.08	-0.49	-0.59	-1.13
BAAG	-0.00	-0.84	-0.00	-0.80	-0.01*	-1.87	-0.00	-1.34	-0.00	-1.07	-0.00	-0.15
SOWN	-0.11*	-1.77	-0.02	-1.43	-0.38	-1.34	-0.23	-1.16	-0.11	-1.53	-0.21	-0.80
FOWN	-0.04	-1.47	0.03	0.49	0.34	0.72	0.10	0.52	0.28	1.17	0.15	0.78
GDPC	-0.05	-0.69	-0.03	-0.68	-0.38*	-1.65	-0.28	-0.99	-0.02	-0.15	0.07	0.28
CONC	0.02*	1.77	0.02**	2.53	0.05	0.49	0.07	0.50	0.06	0.70	0.09	0.62
Cons	-0.21	-1.16	-0.13	-0.78	-0.69	-0.83	0.12	0.17	0.11	0.19	-0.52	-0.52
AR2 (p-value)	0.666		0.585		0.236		0.260		0.237		0.242	
Hansen test (p-value)	0.353		0.284		0.176		0.116		0.126		0.163	
No of instrument	78		79		77		66		82		84	
Obs	1101		1069		1069		1049		1101		1101	

Note: This table presents the results of the estimates of Eq. (2) by applying SGMM method for dependent variable ROE. Regression (1) to (7) present the estimation for each of risk governance structure variables and risk governance effectiveness used as interaction variables: It includes audit committee size (1), audit committee independence (2), financial and accounting experts on audit committee (3), audit committee meeting frequency (4), risk committee existence (5) and external audit quality (6) respectively. RGV represents for each of risk governance structure and risk governance effectiveness for each regression. See Table 3 for variable definitions. ***p < 0.1, **p < 0.05 and *p < 0.001.

found to be positively associated with bank risk management effectiveness because the coefficients on Z-score*SCRC are negative and significant with ROE, and are consistent with the results for return on assets (ROA) in Table 6. Regarding credit risk, the coefficients on NPLS*ASIZE and NPLS*FAEA remain the same as the results in Table 6 and continue to show evidence about the significant effect of audit committee size, financial and accounting experts on audit committee on bank credit risk management effectiveness. Moreover, we find that external audit quality has a positive relation to credit risk management effectiveness reported in regression 6. Similarly, regarding operational risk, the coefficients on DROA*ASIZE and DROA*ACIN remain the same as the results in Table 6. Moreover, regression 5 reports the positive relationship between stand-alone risk committee existence and operational risk management effectiveness.

Overall, using ROE for estimating Eq. (2) as a robustness test, the results are consistent with the previous results. All the findings continue to support our hypotheses. All regressions in Tables 6 and 7 were applied AR2 and Hansen J test. All p-values at the end of these tables higher than 10% indicate that all the regressions are valid.

6.2.3. The extension

As an extension, we examine the impact of risk governance effectiveness on bank risk management overall. Table 8 reports the regression results of Eq. (2) for return on assets (ROA) and return on equity (ROE) as dependent variables, respectively. Both regression 1 and regression 2 show the negative coefficient of interaction. The Z-score*RGEI indicates that risk governance effectiveness positively affects the high risk-high return strategy: i.e., it increases the bank risk management effectiveness. The coefficients of NPLS*RGEI and DROA*RGEI are expected to be positive. The results show that the coefficients of DROA*RGEI are positive and significant with both ROA and ROE, but the coefficients of NPLS*RGEI are not significant. These findings indicate that risk governance effectiveness can enhance the bank's insolvency and operational

Table 8. Results for risk governance effectiveness and bank risk management.

	ROA		ROE	
	(1)		(2)	
	Coeff	t-stat	Coeff	t-stat
Lag (ROA)/Lag ROE	-1.48***	-5.83	0.27	1.09
Zscore	0.00	0.76	0.00	0.34
NPLS	0.04	0.44	1.44*	1.98
DROA	-6.11***	-6.05	-3.30	-0.62
Zscore*RGEI	-0.00*	-1.68	-0.00**	-2.47
NPLS*RGEI	-0.01	-0.55	-0.20	-1.06
DROA*RGEI	0.64***	2.73	0.75*	1.95
BASI	0.00	0.25	0.06**	2.01
BOSI	0.00	0.62	-0.01	-1.00
BOIN	0.11*	1.65	-0.02	-0.45
BAAG	-0.00	-0.93	-0.00	-1.37
SOWN	-0.01	-0.58	-0.02	-0.87
FOWN	0.01	0.36	0.03	0.66
GDPC	-0.04	-1.34	-0.01	-0.33
CONC	0.01	0.28	0.01**	2.20
Cons	0.14	1.52	-0.41*	-1.78
AR2 (p-value)	0.292		0.914	
Hansen test (p-value)	0.370		0.349	
No of instrument	66		62	
Obs	1101		1101	

Note: See Table 3 for variable definitions. ***p < 0.1, **p < 0.05 and *p < 0.001.

risk management effectiveness. Although risk governance effectiveness is not associated with all kinds of risk management effectiveness, these results well support hypothesis H7.

7. Conclusion

The role of risk governance becomes more important in the banking sectors after the 2008 financial crisis. It not only plays a role in overseeing a bank's risk-taking activities but also oversees risk management. Despite the importance, few, if any, studies have assessed the relationship between risk governance structure and bank risk management effectiveness. By using the data of banks in ASEAN countries for the period from 2002 to 2019, we focus on six characteristics of risk governance and provide evidence that risk governance structure significantly affects bank risk management effectiveness. Specifically, we find that the audit committee's size, independence, financial and accounting expertise, along with the existence of a stand-alone risk committee and external audit quality can enhance bank risk management effectiveness. As an extension, by developing a risk governance effectiveness index, we find that the effectiveness of risk governance can enhance risk management effectiveness overall.

Our results provide some important implications for banks' shareholders and regulators. First, shareholders should consider restructuring risk governance to enhance risk management effectiveness instead of focusing on controlling bank risk. Second, because of the low-risk management effectiveness of banks, regulators in ASEAN countries should develop appropriate codes or guidelines related to bank risk governance to enhance their risk management effectiveness. Due to the difficulty of collecting the risk governance data of banks in ASEAN region, this study has limitations that investigate fewer characteristics of risk governance that may affect risk management effectiveness as well as using fewer characteristics of risk governance to develop a risk governance effectiveness index. Furthermore, the robustness test is only performed by using alternative performance measures but not using alternative risk

measures. Further research may extend this study by investigating more risk governance characteristics or more kinds of bank risk, and this will help banks' risk governance structures more appropriately.

Declarations

Author contribution statement

Quang Khai Nguyen: Conceived and designed the experiments; Performed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Van Cuong Dang: Analyzed and interpreted the data.

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Data availability statement

The authors do not have permission to share data.

Declaration of interest's statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

Appendix 1. List of banks

Githublink: <https://github.com/khai1989/Quang-Khai-Nguyen/blob/094ce113086a4fea262fdd3858dc01e89b26317a/List%20of%20banks.xlsx>.

Appendix 2. List of abbreviations

Abbreviations	Meaning
ASEAN	The Association of Southeast Asian Nations
BCBS	Basel Committee on Banking Supervision
FSB	Financial Stability Board
CEO	Chief Executive Officer
CFO	Chief Financial Officer
BOD	Board of Director

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