



## **The Roles of Regulation, Concentration, and Corporate Governance in the Relationship of Non-Interest Income and Bank Risk**

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### **ABSTRACT**

This study employs the ordinary least squares regression model to analyze the impact of non-interest income on bank risk after controlling for bank-specific, country-specific, and time effects. It also examines if regulation, bank concentration, and governance mechanism can change the relationship between non-interest income and bank risk. The sample consists of banks in 43 countries for the period of 2003 to 2015. We find that non-interest income would raise bank risks, however, the roles of regulation, concentration, and corporate governance changes the relationship between non-interest income and bank risk. The results suggest that the utilization of non-interest income in a country that has better shareholders' protection, applies deposit insurance policy, and has strict capital regulation is encouraged. Furthermore, banks in a highly concentrated market should employ income diversification to reduce their return volatility and insolvency risk. In addition, the engagement of non-interest income by a management-controlled bank is effective to control the bank's return volatility and bank insolvency risk.

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## 1. Introduction

Prior to the financial crisis, depository institutions have increased the share of non-traditional revenue compared to their interest income for more than two decades. In the early 1990s in the U.S., the deregulation was passed by the legislation allowing the banks to diversify their activities. After the Glass-Steagall Act was abolished by the Gramm-Leach-Bliley Acts in 1999, the banking industry has dramatically increased its focus on non-interest income<sup>1</sup>.

The last financial crisis in 2008 was a critical point where the banking industry is regarded as one of the causes of the crisis. Various banking transactions that are considered as high-risk transactions are pointed out as the source of the problem. Bank non-interest income results from fee, commission, or income from trading and market-making activities, which are different from the traditional banking activities<sup>2</sup> and are considered as high-risk transactions since it is usually more volatile than interest income (Köhler, 2014).

For the last decades, many researchers put much attention on non-interest based activities. Several studies empirically proved the relationship between non-interest income and bank risk such as Stiroh (2004); Deng, Elyasiani, and Mao (2007); Lepetit et al. (2008); Demirgüç-Kunt and Huizinga (2010); and De Jonghe (2010). These studies are focusing on the risk of particular banks. Other studies highlighted the influence of other factors that affected the bank risk. According to Laeven and Levine (2009), two factors, i.e., regulation and bank governance, influence bank risk-taking. Moreover, Boyd and Nicolo (2005) and Beck, Demirgüç-Kunt, and Levine (2006) explained that market concentration also influences bank risk. Therefore, regulation, market concentration, and bank governance also influence bank risk.

Prior studies mainly discussed the relationship between non-interest income and bank risk (Lepetit et al., 2008; Williams and Prather, 2010; Demirgüç-Kunt and Huizinga, 2010; Hidayat, Kakinaka, and Miyamoto, 2012) or the relationship between either regulation, concentration, and/or corporate governance and bank risk (Laeven and Levine, 2009; Pathan, 2009; Agoraki, Delis, and Pasiouras, 2011; Barakat and Hussainey, 2013; and Berger, Kick, and Shaeck, 2014). In order to investigate the impact of bank diversification on stability (Z-Index, NPL/TA, NPL/Equity, LLR/NPL and Equity/TA) in 22 Asian countries, Hsieh et al. (2013) introduce two bank diversifications which are the asset and income diversity measured by non-interest income. The conditional variables such as globalization, laws and regulations, corporate governance, and economic development from a country-level view are included in their analysis. Their laws and regulation variables consist of four restriction indices which are the restriction of commercial banks to engage in the security business, the restriction on insurance, the restriction on real estate, and the restrictions on non-financial related business. In addition, the corporate governance variables include investor protection, creditor protection, and legal efficiency. They found that assets diversification is insufficient to improve bank stability; however, income diversity can improve bank stability. In addition, bank stability is lessened as the impact of a higher degree of globalization through income diversity. Then, the diversity of income in a higher degree of corporate governance reduces the agency problem; therefore, it improves bank stability. Lastly, diversity will be supported in a country with a higher degree of economic development; thus, it increases profit and lowers the risk that leads to the improvement of bank stability.

Nevertheless, no studies discuss the impact of bank diversification on bank risk that includes interaction terms such as regulation, bank concentration, and corporate governance from combining a country-level and a bank-level views. The regulation variables of this study consist of shareholder rights,

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<sup>1</sup> Please see Filson and Olfati (2014) and White (2010) for the background information to Gramm-Leach-Bliley Acts in 1999,

<sup>2</sup> Traditional banking activities include deposit-taking and lending functions.

deposit insurance, law enforcement, and the capital regulatory. Moreover, this study analyses the role of corporate governance, especially in the area of ownership concentration and board characteristics.

To fill the gap in the literature, the purpose of this study is not only to investigate the relationship between non-interest income and bank risk but also to examine if regulation, bank concentration, and governance mechanism can change the relationship between non-interest income and bank risk. This study contributes in several ways. First, the existing literature mostly focused on the relationship between non-interest income and bank risk or the association between bank risk with regulation, concentration, and/or corporate governance, respectively (Laeven and Levine, 2009; Pathan, 2009; Agoraki, Delis, and Pasiouras, 2011; Barakat and Hussainey, 2013; and Berger, Kick, and Shaeck, 2014). This study is different from the existing literature since it focuses on the impact of non-interest income on bank risk with an emphasis on the roles of regulation, concentration, and corporate governance. Therefore, this study fills the gap in the literature since this study is the first paper to discuss the impact of non-interest income on bank risk with the emphasis on the interaction variables between non-interest income and regulation, non-interest income and market concentration, along with non-interest income and corporate governance. Furthermore, the second contribution is this study employs cross country analysis for 43 countries<sup>3</sup>, while the previous studies are focusing only on the US banking industry, European, Australia, Asian or Asia-Pacific countries. The sample countries are members of the G20 that include all European Union countries at the end of 2010. This sample is employed since the G20 represents approximately 80% of the world's GDP, where the largest contribution is Brazil, Russia, India, China, and South Africa. In 2014, the G20 countries represented more than 80% of the global economy. Furthermore, the G20 was accounted for 77.5% of the exported goods and services worldwide in 2015. The critical role of the G20 in the global economy makes the banking industry in these countries have an essential function to support the economy of the G20 members.

After carefully analyzing the relationship of non-interest income, regulation, concentration and corporate governance with bank risk in 43 countries, we found that non-interest income would raise bank risks, however, the roles of regulation, concentration, and corporate governance changes the relationship between non-interest income and bank risk. Banks in countries with better shareholder protection tend to minimize their return volatility and increase their credit risk when they do income diversification. In addition, deposit insurance policy mitigates banks' credit risk while banks utilize the non-interest income. The banks in stricter law implementation countries tend to have higher return volatility when they rely on non-interest income. Furthermore, a higher capital requirement aids banks in minimizing insolvency risk when banks diversify their income. Moreover, the utilization of non-interest income in a country with high market concentration lessens the bank's return volatility and insolvency risk. Lastly, a management-controlled bank is more effective to minimize return volatility and insolvency risk when it actively involves in income diversification.

This paper is structured as follows. Following the introduction, section 2 provides a review of the literature for supporting our analysis. Section 3 describes the data, sample, variables, and develops the model. Section 4 presents the empirical results and discussion. Section 5 provides the robustness test, and section 6 concludes.

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<sup>3</sup> The countries include Australia, Argentina, Austria, Belgium, Brazil, Bulgaria, Canada, China, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, India, Indonesia, Ireland, Italy, Japan, Republic of Korea, Latvia, Lithuania, Luxembourg, Malta, Mexico, Netherlands, Poland, Portugal, Romania, Russian Federation, Saudi Arabia, Slovakia, Slovenia, South Africa, Spain, Sweden, Turkey, United Kingdom, and United States.

## 2. Literature Review

### 2.1 Non-interest income and bank risk

Kohler (2014) defined the non-interest income as a combination of heterogeneous components that generate income other than the income from interest. The non-interest income consists of fee and commission income from the bank's traditional activities such as payment services fees and market-oriented activities such as underwriting and securitization. According to DeYoung and Torna (2013), there are three types of non-interest income. The first one is non-interest income from non-traditional activities of shareholders, such as proprietary trading and investment banking. The second one is non-interest income from non-traditional fee-for-service activities such as insurance sales. The third one is non-interest income from traditional fee banking activities that are permitted by the regulator (i.e., depositor services, etc.).

The relationship between non-interest income and bank risk has attracted the attention of researchers. Stiroh (2004) and Stiroh and Rumble (2006) explained that earning volatility of banks in the US is related to bank activities diversification. According to De Young and Roland (2001), since the non-interest income is unstable, the diversification effect may reduce the bank risk only to some extent. The point of view that stated non-interest income increases the bank risk is supported by some studies such as Lepetit et al., (2008); Williams and Prather (2010); Demirgüç-Kunt and Huizinga (2010) and Lee, Yang, and Chang (2014).

***Hypothesis 1a: The utilization of non-interest income increases the risk exposure of banks.***

***Hypothesis 1b: The utilization of non-interest income reduces the risk exposure of banks.***

### 2.2 Regulation and bank risk

The regulator uses regulation to stabilize the banking industry. Bank risk-taking behavior is encouraged by a moral hazard related to the incentive of the risk-taking, which is more profit. The banking industry needs regulation to limit this behavior. The goal of prudential regulation is to ensure the financial stability of the overall system (Acharya, 2009).

Restriction on bank activities is a form of bank regulation, whether the banks are allowed to commence activities that generate non-interest income. The scope of restriction on bank activities involves fee-based activities from securities, insurance, and real estate activities. In addition, Fernandez and Gonzalez (2005) explained that the stricter restriction on bank activities is effective for banking risk reduction. Therefore, the regulation is limiting the bank's risk-taking activities such as non-interest income that lead to a decrease in bank risk.

The minimum bank capital has been one of the regulatory tools to control the banks. Capital requirement or capital adequacy is the minimum amount of capital that a bank or financial institution has to hold as the regulatory requirement. Increasing the capital ratio would lower the incentive for banks to increase the risk of their assets (Keeley & Furlong, 1990). Therefore, according to Barth et al. (2013), strengthening bank capital requirement is designed to reduce bank risk.

The other regulation mechanism used by the regulator to control the stability of the financial system is deposit insurance. In order to prevent the bank run, many countries adopt a deposit insurance mechanism (Behr, Schmidt, and Xie, 2010). Barth, Caprio Jr., and Levine (2013) mentioned that the objective of a deposit insurance scheme is to prevent systemic risk. However, deposit insurance might enhance the excessive risk-taking by banks since the incentive of depositors to monitor bank executives and curtail excessive risk-taking is reduced.

***Hypothesis 2: The existence of regulation is lowering bank risk***

### 2.3 Market concentration and bank risk

Banks in lower concentration countries have a higher level of non-interest income (Moshirian, Sahgal, and Zhang, 2011). Non-interest income does increase systemic risk in highly competitive banking environments; however, it can improve bank stability in high concentration countries. Beck et al. (2004) also found that in the banking industry, the correlation between concentration and activity restriction is positively correlated.

Boyd and De Nicoló (2005) argued that market concentration and risk-seeking behavior are positively correlated. However, ElBannan (2015) mentioned there is an ambiguity of the link between concentration and bank risk-taking. The first point of view supports the “concentration-stability”. There is a negative relationship between concentration and bank risk-taking behavior (Liu, Molyneux, and Nguyen, 2012). Moreover, competition might motivate banks to employ greater risk to become more profitable. The other point of view is “competition-stability”, where the competition will support stability, as the negative relationship between competition and bank risk is found (De Nicolo, Jalal, and Boyd, 2006; Koetter and Poghosyan, 2009). Amidu and Wolfe (2013) explained that in a highly concentrated market, larger banks are inefficient and likely to fail, while in a low concentrated market, banks tend to be efficient because of the tight competition.

***Hypothesis 3a: Bank risk exposure is low in countries with a highly concentrated market. (concentration-stability hypothesis)***

***Hypothesis 3b: Bank risk exposure is low in countries with a low concentrated market. (competition-stability hypothesis)***

### 2.4 Corporate governance and bank risk

Chen and Lin (2016) explained that there are two mechanisms of corporate governance. The first mechanism is the motivating mechanism. The motivate mechanism is associated with the compensation of the company’s executives. Several studies documented the influence of executive compensation on bank risk-taking (John, Litov, and Yeung, 2008 and Laeven and Levine, 2009). Moreover, Balachandran, Harnal, and Kogut (2010) explained that there is a positive relationship between bank risk and executive compensation since to achieve higher compensation, the CEO behaves to be more risk-taking.

The second mechanism of corporate governance is the constraint mechanism. The constraint mechanism reveals to the degree that shareholders’ control the bank management. In other words, the constraint mechanism related to the role of the shareholders or the boards. According to Morck, Wolfenzon, and Yeung (2005) and Stulz (2005), to protect the shareholders’ interest, they tend to monitor and control the CEO. When the shareholders dominate the control of the banks, it is called the shareholder-controlled bank, while the management-controlled bank is when the management has control domination on the bank’s operation. Large blockholders tend to dominate firms (Gropp and Kohler, 2010). Moreover, Pathan (2009) explained that the strong boards would lead to better monitoring, therefore positively affecting bank risk-taking.

***Hypothesis 4a: The bank risk is lower when the bank is a management-controlled bank.***

***Hypothesis 4b: The bank risk is higher when the bank is a shareholder-controlled bank.***

## 2.5 The interaction terms and bank risk

Lepetit et al. (2008) explained that the expansion of non-interest income activities is considered a higher risk than the expansion of loans. However, several studies argue that the interaction of non-interest income and other factors is capable of lessening the bank risk. Firstly, the existence of regulation is effective in controlling the risk-shifting incentive (Repullo, 2004). Moreover, according to Agoraki, Delis, and Pasiouras (2011), the banks with higher market share tend to have lower credit risk and insolvency risk as a consequence of the domination to earn the income compared to its competitor. Lastly, nowadays, the shareholders are aware of being not over-exposed to the volatility that outweighs the benefit of income diversification (Williams and Prather, 2010). Moreover, shareholders increase their concern about monitoring activities.

***Hypothesis 5a: The interaction between non-interest income and regulation absorbs the bank risk.***

***Hypothesis 5b: The interaction between non-interest income and bank concentration reduces bank risk.***

***Hypothesis 5c: The shareholder-controlled bank tends to control the risk-taking behavior when utilizing the non-interest income effectively.***

## 3. Data and Methodology

### 3.1 Sample and data source

This study uses data from banks across 43 countries from 2003 to 2015. Approximately 57% of the banks are from the US, 9% of the banks are from Russia, 4% of banks are from Germany, and the rest are from other countries of G20 members. The data is obtained from several sources. The bank financial data and corporate governance data are obtained from the *Bankscope* database. Regulation data is obtained from La Porta, Lopez-de-Silanes, and Vishny (1998) and *Bank Regulation and Supervision* database of the World Bank. Other data such as country characteristics are obtained from the *International Financial Statistics (IFS)* of International Monetary Fund (IMF) and *The Organization for Economic Co-operation and Development (OECD)* database.

### 3.2 The variable definitions and the estimated models

#### 3.2.1 Dependent variables

The purpose of the study is to examine the relationship between non-interest income and bank risk and to explore further if the roles of regulation, bank concentration, and corporate governance change the relationship between non-interest income and bank risk. The list of variables, along with the definitions, is presented in Table 1. The dependent variable is bank risk, and three proxies are used to measure bank risk.

- (1) The standard deviation of adjusted return on assets (AROAs<sub>tdev</sub>): is measuring bank return volatility, which reflects bank risk-taking strategy (Soedarmono, Machrouh, and Tarazi, 2011). Adjusted return on assets is calculated as the total of pre-tax profit and loan impairment charge divided by total assets. The standard deviation of banks' adjusted return on assets is calculated from the adjusted return on assets value taken from period  $t$  to  $t-7$  (an eight-period rolling window).
- (2) Non-performing loan ratio (NPL): is the indicator to measure the bank riskiness (Shehzad, De Haan, & Scholtens, 2010). The NPL data is obtained from the *Bankscope* database. The NPL ratio is the total impaired loan compared to the gross bank loan. According to Shehzad and De Haan (2015), there are three advantages of using this ratio as the ratio for bank risk. First, international organizations such as the IMF, the BIS, and the World Bank have used this ratio. Second, it is directly

indicated the quality of credit extended by the bank. Lastly, this ratio is not restricted to the listed bank only. Therefore the more sample can be used. The higher value of the NPL ratio means that the bank's credit risk is increasing.

- (3) Ln Z-Score (Ln\_Z): is used to measure the bank risk-taking. Ln Z-Score is obtained as a natural logarithm of (adjusted return on assets + equity to total assets)/the standard deviation of adjusted return on assets. The bank stability is higher when the Z-Score is higher (Zhang, Wang, and Qu, 2012). The high degree of Z-Score means that the bank is solvent. In this study, we use the natural logarithm of Z-Score to deal with the right-skewed distribution of the Z-Score data.

**Table 1 Description of variables**

Variables	Description	Data sources
<i>Bank risk proxy</i>		
AROAstdev	The standard deviation of adjusted return on assets value taken from period t to t-7 (an eight-period rolling window).	Bankscope
NPL (%)	Impaired loan divided by gross loan	Bankscope
Ln_Z	The natural logarithm of Z-Score. Where Z-Score is adjusted return on assets (ARO) add equity ratio divided by standard deviation of adjusted return on assets (ARO).	
<i>Non-interest income</i>		
NON	Non-interest income divided by total operating income. Total operating income is non-interest income plus net interest income.	Bankscope
<i>Regulation proxy</i>		
SR	Shareholder rights. Anti-director index is used to measure how strong the legal system favors minority shareholders against managers or dominant shareholders in the corporate decision-making process, including the voting process. The index is range from 0 to 6, which is adding 1 if : (1) The country allows the proxy vote to the firm can be mailed by shareholders; (2) Prior to a general meeting, there is no obligation for shareholders to deposit their share; (3) Cumulative voting or proportional representation of minorities in the board of directors is allowed; (4) An oppressed minorities mechanism is in place; (5) The shareholders can call an Extraordinary Shareholders Meeting when the minimum percentage of share capital is less than or equal to 10%; (6) Shareholders have preemptive rights that can only be waived by a shareholders' vote. Where larger values indicate greater shareholder rights.	La Porta et al. (1998)
DepIns	Deposit insurance. A dummy variable indicating whether a country has explicit deposit insurance.	Demirguic-Kunt, and Levine (2006)
LawImp	Law implementation index. The index is the average of five enforcement variables scores. There are five enforcement variables : (1) efficiency of Judicial System, (2) Rule of Law, (3) Corruption,(4) Risk of Expropriation, (5) Risk of Contract Repudiation.	La Porta et al. (1998)
CapReg	Capital regulatory index. There are nine informations includes in Capital Regulatory Index : (1) Is the minimum capital-asset ratio requirement risk-weighted in line with the Basel guidelines? (2) Does the minimum ratio vary as a function of market risk? (3) Are market value of loan losses not realized in accounting books deducted from capital? (4) Are unrealized losses in securities portfolios deducted? (5) Are unrealized foreign exchange losses deducted? (6) What fraction of revaluation gains is allowed as part of capital? (7) Are the sources of funds to be used as capital verified by the regulatory/supervisory authorities? (8) Can the initial disbursement or subsequent injections of capital be done with assets other than cash or government securities? (9) Can initial disbursement of capital be done with borrowed funds? It ranges from 0 to 9. Higher value indicates greater strictness.	<i>Bank Regulation and Supervision of the World Bank</i>
<i>Bank concentration proxy</i>		
TopThree (%)	Top three market share. Total percentage of market share of the top three banks in each country.	Bankscope
<i>Corporate governance proxy</i>		
ShareIndp	BvD independence indicators. The values 4 to 1 are assigned to A, B, C, D, respectively. Higher score indicates that shareholders have higher degree of independence, which means the bank tends to be a management-controlled bank. While the lower degree means the bank tends to be a shareholder-	Bankscope

	controlled bank.	
BOD	The number of directors on the board. A bank with a small board is inclined to be a shareholder-controlled bank.	<i>Bankscope</i>
<i>Control variables-Country characteristics</i>		
RGDPG (%)	Real Gross Domestic Product growth	<i>International Monetary Fund</i>
CPI (%)	Consumer Price Index	<i>Bankscope</i>
IntSpr (%)	Treasury bonds rate – Treasury bill rate	<i>International Monetary Fund and The Organisation for Economic Co-operation and Development</i>
<i>Control variables-Bank characteristics</i>		
ROAA(%)	Net income divided by average assets	<i>Bankscope</i>
CIR (%)	The ratio of cost divided by income	<i>Bankscope</i>
LnTA	Natural logarithm (ln) of total assets	<i>Bankscope</i>

The description of all the observed and the analyzed variables of the paper's analyses is provided in this table.

### 3.2.2 Independent variables

We use four independent variables in this study, which are non-interest income (NON), regulation, concentration, and corporate governance. In addition, we include the interaction variables on non-interest income with regulation, concentration, and corporate governance in our empirical model.

#### 3.2.2.1 Non-interest income (NON)

We follow Demirgüç-Kunt and Huizinga (2010) and Köhler (2014) in measuring the diversification of income using the non-interest income ratio (NON). The non-interest income ratio is calculated as non-interest income divided by the total operating income. The total operating income is non-interest income plus net interest income. The non-interest income can be defined as the combination of income components other than interest income (Köhler, 2014). In this study, the non-interest income comprises fees, trading commission, and other non-interest income. The non-interest income has been widely used as a measurement of bank's revenue diversification, as seen in studies by DeYoung and Roland (2001), Stiroh and Rumble (2006), Baele et al. (2007), Laeven and Levine (2007), Chiorazzo et al. (2008), Lepetit et al. (2008), De Jonghe (2010), Fiordelisi et al. (2011), Hsieh et al. (2013), Köhler (2014), Lee, Yang, & Chang (2014), Williams (2016) and other related studies. The non-interest income is an important indicator to reflect the bank's non-interest generating activities (Demirgüç-Kunt & Huizinga, 2010). The non-interest income ratio shows the proportion of income from nontraditional activities toward the total generating income of the bank. A higher NON means banks rely more on non-interest income activities.

#### 3.2.2.2 Regulation

In the highly regulated industry, such as the banking industry, the existence of the principal-agent problem might be severe that other industries (Levine, 2004). Prowse (1997) explains that the bank regulation impedes the market to control unto the banks since it protects the management upon entry and during the merger, the changes of administrative rule, and takeovers. However, Laeven and Levine (2009) argue that some regulation might increase the tendency of bank risk or conversely, might limit the bank risk. In addition, each bank ownership structure might result in different shareholders' power. Therefore the regulation effects on bank risk-taking might be different. To examine the relationship between regulation and bank risk-taking, we use four regulation indicators in our primary empirical model.



**(1) Shareholder rights (SR)**

In measuring the shareholder rights, we use the anti-director index in this study. The index is calculated by La Porta et al. (1998), which has a 0 to 6 range of value to reflect the aggregates' shareholder rights. The higher index means greater shareholder rights or legal protection to shareholders. Stronger protection to shareholders encourages even the minority stakeholder to take benefit of risk-taking behavior (Gropp and Köhler, 2010).

**(2) Deposit insurance (DepIns)**

We use a dummy variable for the deposit insurance indicator. The value is equal to one if the deposit insurance policy is implemented in a country and zero otherwise (Laeven and Levin, 2009). According to DeLong and Saunders (2011), the existence of deposit insurance encourages banks to become riskier since deposit insurance promotes moral hazard problems in the banking sector by motivating banks to involve on excessive risk.

**(3) Law implementation (LawImp)**

The index reflects the various rule of law measurement of countries. The index consists of five variables: judicial system efficiency, the rule of law, corruption, expropriation risk, and contract repudiation risk (La Porta et al., 1998). The index is the average score of the abovementioned variables scores. The higher index means that the country has better law enforcement.

**(4) Capital regulation (CapReg)**

Capital regulation is defined as a certain level of liquid capital set by the Federal Reserve or central bank that is mandatory to be maintained by a financial institution. The capital requirement is required to anticipate the potential loss of the financial institution. We follow Chen and Lin (2016) to use the capital regulation index, an index released by the World Bank in 2001 and is updated in 2003, 2007, and 2012, respectively, in capturing the change in capital requirements. The index is ranged from 0 to 9 where the greater stringency is shown by, the higher the value.

**3.2.2.3 Bank Concentration**

The proxy for bank concentration is the top three market share (TopThree). The top three market share is the percentage of the top three bank's market share in its country. This data is obtained from the *Bankscope* database. The bank concentration is essential since it determines the stability of the banking system. Beck, Demirgüç-Kunt, and Levine (2006) mentioned that a highly concentrated market provides better monitoring since fewer banks in the market improve the effectiveness of bank supervision; therefore, it enhances the stability of the banking system. However, Boyd and De Nicoló (2005) argue that a highly competitive market (low concentration) improves the stability of the banking system. Further explained that in the higher concentrated market (less competitive market), the banks tend to charge higher interest rates that increase the chance of the borrowers to default on their obligation.

**3.2.2.4 Corporate Governance**

The corporate governance measurements in this study are divided into two categories, which are ownership concentration and board characteristics. Shareholders' independence (ShareIndp) reflects the ownership concentration, while the size of the board of directors (BOD) refers to the board characteristics. Gropp and Köhler (2010) explain that a bank with a high degree of ownership concentration is inclined to be a shareholder-controlled bank. In *Bankscope*, shareholder independence is shown by the BvD independence indicator. The BvD independence indicators are shown by indicators A, B, C, D, and U, which are converted into the value of 4,3,2, and 1 to A, B, C, D, respectively. The higher degree of shareholder independence means that the bank is more management-controlled, while the lower degree is a more shareholder-controlled bank (Laeven and Levin, 2009). Moreover, the shareholder-controlled bank tends to have high risk-taking behavior.

The number of directors on the board of directors refers to the board size (Cheng, 2008). The larger size board diminishing the bank efficiency and impede the decision-making process since it is more challenging to achieve the consensus among the directors. Thus, the CEO is gaining more control since the CEO dominates the board. Conversely, the bank with a smaller board becomes a shareholder-controlled bank as the board has substantial control over the management (Chen and Lin, 2016). The smaller board size is linked to the bank risk-taking behavior that might increase bank risks.

### 3.2.3 Control variables and the time dummy variable

There are two sets of control variables that we use in the empirical model. Real GDP growth (RGDPG), consumer price index (CPI), and interest rate spread (IntSpr) are the proxies of macroeconomics characteristics. The other set of control variables are bank characteristics. Bank profitability, overhead ratio, and bank size are used to proxy bank characteristics. Return on average assets (ROAA) is the measurement of bank profitability, cost to income ratio (CIR) is the measurement of the overhead ratio, and the natural logarithm of total assets (LnTA) is the measurement of the bank size. In addition, we control for a time by adding the year dummy variable.

### 3.3 Estimated Model

This study employs the ordinary least square (OLS) regression. To estimate the empirical model, the estimated equation is constructed as follows:

$$\begin{aligned} Bank\ risk_{ijt} = & \beta_0 + \beta_1 NON_{ijt-1} + \beta_2 Regulation_{it-1} + \beta_3 Concentration_{it-1} \\ & + \beta_4 Governance_{ijt-1} + \beta_5 Country_{it-1} + \beta_6 Bank_{ijt-1} \\ & + \beta_7 Time_t + \varepsilon_{ijt} \end{aligned} \quad (1)$$

The study is extended by involving the interaction term between non-interest income and regulation, non-interest income and concentration, along with non-interest income and corporate governance in our model. The second estimated equation is as follows:

$$\begin{aligned} Bank\ risk_{ijt} = & \beta_0 + \beta_1 NON_{ijt-1} + \beta_2 Regulation_{it-1} + \beta_3 Concentration_{it-1} \\ & + \beta_4 Governance_{ijt-1} + \beta_5 NON_{ijt-1} \times Regulation_{it-1} \\ & + \beta_6 NON_{ijt-1} \times Concentration_{it-1} + \beta_7 NON_{ijt-1} \times Governance_{ijt-1} \\ & + \beta_8 Country_{it-1} + \beta_9 Bank_{ijt-1} + \beta_{10} Time_t + \varepsilon_{ijt} \end{aligned} \quad (2)$$

In the regression model, we use lagged independent variables for non-interest income, regulation, concentration, corporate governance, country characteristics, and bank characteristics. The usage of one-year lagged values is to minimize any unintended feedback from the possible endogenous variables (Chen and Lin, 2016). In addition, one-year lagged values also reflect the previous decision.

## 4. Result and Discussion

### 4.1 Descriptive Statistics

The descriptive statistics for dependent and independent variables are presented in Table 2. Panel A shows the descriptive statistics for the whole sample. The mean for the standard deviation of adjusted return on assets (AROAstdev) is 0.02, which means that the volatility of profitability is considered low. The non-performing loan ratio (NPL) shows a low level where the mean is only 4.82%. The mean of non-interest income is 0.34 or 34%. The regulation variables show that the regulation is favorable to shareholders in the G20 countries. Most countries applied the deposit insurance policy and had strict capital regulation. The bank concentration is considered low since the mean of the top three market share is 31.65%, which means the competition is tight in the banking industry.

**Table 2 Descriptive statistics**

Panel A - Whole sample						
Variables	No obs.	Mean	Median	Max	Min	Std. Dev.
AROAstdev	23451	0.02	0.00	36.63	0.00	0.31
NPL	15280	4.82	2.43	101.22	0	8.25
Ln_Z	16102	3.20	3.25	11.23	-5.24	1.09
NON	28719	0.34	0.27	23	-392.50	2.61
SR	48503	4.03	5	5	0	1.54
DepIns	55900	0.97	1	1	0	0.18
LawImp	48503	9.18	9.52	9.87	4.38	0.91
CapReg	55900	6.26	7	9	0	1.56
TopThree	55900	31.65	31.60	100	0	23.80
ShareIndp	26947	2.57	3	4	0	1.52
BOD	14079	5.64	2	43	0	6.83
RGDP	55900	2.14	2.22	14.16	-14.81	2.68
CPI	35944	3.06	2.54	40.95	-7.43	2.73
IntSpr	55146	1.52	1.74	21.92	-3.39	1.42
ROAA	21590	1.14	0.78	136.93	-400.67	6.25
CIR	21172	68.34	65.33	981.82	0	38.78
LnTA	29947	21.13	20.68	28.97	8.99	2.31

**Table 2 (Continued)**

Panel B - Pre-financial crisis and post-financial crisis periods												
Variables	Pre-financial crisis period						Post-financial crisis period					
	No obs.	Mean	Med.	Max.	Min.	Std. Dev.	No obs.	Mean	Med.	Max.	Min.	Std. Dev.
AROAstdev	6813	0.01	0.00	0.36	0.00	0.02	16638	0.02	0.00	36.63	0.00	0.36
NPL	4110	2.86	1.237	100	0.00	5.37	11170	5.54	2.82	101.22	0.00	8.97
Ln_Z	5196	3.34	3.38	11.23	-1.05	1.13	10906	3.14	3.20	9.73	-5.24	1.06
NON	9495	0.31	0.23	23	-10.35	0.40	19224	0.35	0.30	20.44	-392.50	3.17
SR	18655	4.03	5	5	0	1.54	29848	4.03	5	5	0	1.54
DepIns	21500	0.97	1	1	0	0.18	34400	0.97	1	1	0	0.18
LawImp	18655	9.18	9.52	9.87	4.38	0.91	29848	9.18	9.52	9.87	4.38	0.91
CapReg	21500	5.92	6	9	0	1.18	34400	6.48	7	9	0	1.71
TopThree	21500	39.66	29.82	100	21.50	20.65	34400	26.65	31.69	99.87	0	24.26
ShareIndp	5415	1.95	2	4	0	1.75	21532	2.73	3	4	0	1.42
BOD	5420	3.32	0	43	0	6.14	8659	7.09	7	43	0	6.84
RGDP	21500	3.31	2.81	12.68	-10.90	2.00	34400	1.42	1.71	14.16	-14.81	2.79
CPI	13608	3.15	2.54	40.95	-1.34	2.49	22336	3.01	2.31	21.32	-7.43	2.86
IntSpr	21018	1.59	1.54	7.23	-3.03	1.20	34128	1.48	1.93	21.92	-3.39	1.55
ROAA	5971	1.50	0.97	50.84	-162.80	4.54	15619	1.00	0.70	136.93	-400.67	6.79
CIR	5866	62.53	61.96	700	0	26.89	15306	70.57	66.93	981.82	0	42.25
LnTA	9111	20.70	20.24	28.36	11.68	2.19	20836	21.32	20.89	28.97	8.99	2.33

**Table 2 (Continued)**

Panel C - Developed and developing countries												
Variables	Developed countries						Developing countries					
	No obs.	Mean	Med.	Max.	Min.	Std. Dev.	No obs.	Mean	Med.	Max.	Min.	Std. Dev.
AROAstdev	17807	0.01	0.00	15.24	0.00	0.22	5644	0.03	0.01	36.63	0.00	0.49
NPL	10677	4.77	2.48	101.22	0	8.00	4603	4.92	2.30	100	0	8.78
Ln_Z	12460	3.29	3.37	11.23	-4.52	1.08	3642	2.88	2.88	8.85	-5.24	1.04
NON	22648	0.29	0.24	23	-392.50	2.92	6071	0.50	0.48	5.81	-10.03	0.37
SR	45864	4.13	5	5	0	1.49	2639	2.23	2	4	0	1.14
DepIns	47047	0.98	1	1	0	0.12	8853	0.88	1	1	0	0.33
LawImp	45864	9.37	9.52	9.87	6.71	0.47	2639	5.99	6.12	6.70	4.38	0.63
CapReg	47047	6.22	6	9	0	1.51	8853	6.50	7	9	0	1.76
TopThree	47047	31.80	31.88	100	0	23.94	8853	30.87	28.95	100	0	23.04
ShareIndp	21046	2.75	4	4	0	1.47	5901	1.95	1	4	0	1.56
BOD	9494	6.92	6	43	0	7.17	4585	2.99	0	31	0	5.13
RGDP	47047	1.66	1.93	11.62	-14.72	1.98	8853	4.73	5.08	14.16	-14.81	4.07
CPI	30443	2.19	2.31	14.05	-6.56	1.17	5501	7.88	8	40.95	-7.43	3.69
IntSpr	46820	1.66	1.96	21.92	-3.39	1.29	8326	0.76	0.94	7.23	-3.25	1.87
ROAA	16107	0.99	0.67	136	-348.07	5.89	5483	1.58	1.12	136.93	-400.67	7.20
CIR	15758	68.02	64.76	981.82	0	39.33	5414	69.27	68.75	946.43	0	37.14
LnTA	23871	21.36	20.77	28.97	11.68	2.13	6076	20.26	19.90	28.85	8.99	2.73

The table presents the descriptive overview of the data. The descriptive statistics of the variables is shown by classifying the data into whole sample, the pre-financial crisis period, the post-financial crisis period, developed economies and developing economies.

Panel B of Table 2 shows the descriptive statistics during pre- and post-financial crisis periods. The utilization of non-interest income is increased in the post-financial crisis period. The mean of non-interest income is increased from 0.31 during the pre-financial crisis period to 0.36 in the post-financial crisis period. In terms of regulation, the minimum capital requirement is increasing in the post-financial crisis period, it is shown by the mean of CapReg that increases from 5.92 to 6.48. In addition, the bank concentration in the post-financial crisis period is lower than in the pre-financial crisis period. Furthermore, the banks in the post-financial crisis tend to be more management-controlled than in the pre-financial crisis period. The increase of mean for ShareIndp and BOD are 0.78 and 3.77, respectively.

The descriptive statistics for developed and developing economies are shown in panel C of Table 2. The developing countries were intensively utilizing the non-interest income compared to the developed countries. The protection of shareholders' rights is higher in developed countries compare to in developing countries. The mean of deposit insurance in developed countries is 0.98, while in developing countries are 0.88. Law enforcement in developed countries is better than in developing countries. In addition, the minimum capital requirement in developed countries is higher than in developing countries. Regarding the bank concentration, the banks' sector in developed countries is more concentrated compared to in developing countries, the mean of TopThree is 31.80 and 30.87, respectively, which means that the competition in developing countries is tighter than in developed countries. Panel C of Table 2 also shows that banks in developed countries tend to be more management-controlled than in developing countries.

The correlation matrix for the whole sample in Table 3 presents that the standard deviation of adjusted return on assets (AROAstdev), non-performing loan ratio (NPL), and Ln Z-Score (Ln\_Z) are interrelated. The correlation between AROAstdev and NPL is positively correlated with the correlation coefficient of 0.14. In addition, the correlation between AROAstdev and Ln\_Z is -0.56. The NPL and Ln\_Z are negatively correlated ( $r = -0.21$ ). The non-interest income ratio is positively correlated to the standard deviation of adjusted return on assets and Ln Z-Score with a correlation coefficient of 0.07 and 0.01, respectively. However, the non-interest income ratio is negatively correlated with the non-

performing loan ratio. Shareholder rights (SR), deposit insurance (DepIns), and law implementation index (LawImp) are negatively correlated to the standard deviation of adjusted return on assets, while capital regulation (CapReg) has a positive correlation. The coefficient of correlation between SR and LawImp with NPL is -0.27 and -0.12, respectively. Most of the regulation variables are positively correlated with Ln Z-Score except for CapReg ( $r = -0.04$ ). The market concentration (TopThree) has a positive correlation to the standard deviation of adjusted return on assets and non-performing loan ratio; however, it negatively correlated to Ln Z-Score. Moreover, shareholder independence (ShareIndp) and the size of the board of directors (BOD) are negatively correlated to AROAstdev and NPL. Since the coefficient of correlation among the independent variables is less than 0.70, therefore there is no collinearity problem existed for this study.

**Table 3 Correlation matrix among regression variables**

	AROAstdev	NPL	Ln_Z	NON	SR	Deplns	LawImp	CapReg	TopThree	Share Indp	BOD	RGDP	CPI	IntSpr	ROAA	CIR	LnTA
AROAstdev	1																
NPL	0.14	1															
Ln_Z	-0.56	-0.21	1														
NON	0.07	-0.02	0.01	1													
SR	-0.04	-0.27	0.07	-0.05	1												
Deplns	-0.06	0.01	0.01	-0.08	-0.05	1											
LawImp	-0.20	-0.12	0.12	-0.08	0.51	0.20	1										
CapReg	0.09	0.04	-0.04	0.09	0.07	-0.03	-0.22	1									
TopThree	0.01	0.02	-0.04	-0.01	-0.32	-0.14	-0.07	-0.02	1								
ShareIndp	-0.06	-0.08	-0.01	0.01	0.22	0.00	0.22	-0.14	-0.14	1							
BOD	-0.02	-0.02	0.02	0.05	-0.01	-0.08	-0.04	0.00	-0.04	0.27	1						
RGDP	0.00	-0.18	0.03	0.03	0.06	-0.07	-0.37	0.23	-0.03	-0.10	-0.06	1					
CPI	0.14	-0.04	-0.06	0.08	-0.06	-0.18	-0.63	0.37	0.03	-0.20	0.01	0.53	1				
IntSpr	0.17	0.25	-0.11	0.05	-0.05	0.03	-0.03	0.15	-0.12	-0.03	-0.03	-0.28	-0.03	1			
ROAA	0.07	-0.25	0.14	0.08	0.00	-0.10	-0.14	0.08	0.02	-0.07	-0.05	0.18	0.17	-0.12	1		
CIR	0.11	0.07	-0.16	-0.12	0.05	0.03	0.12	-0.06	0.00	0.01	0.01	-0.09	-0.10	0.04	-0.48	1	
LnTA	-0.13	-0.02	-0.06	0.07	-0.26	-0.03	-0.08	-0.17	0.11	0.20	0.26	-0.03	-0.07	-0.08	-0.03	-0.10	1

## 4.2 The Effects of Non-Interest Income, Regulation, Bank Concentration, and Corporate Governance on Bank Risk

### 4.2.1 The effect of non-interest income on bank risk

As shown in Table 4, the non-interest income is impacting the bank risk differently. Table 4 shows that bank earnings volatility (AROastdev) is higher when the bank increases the utilization of the non-interest income (NON). The coefficient is 0.0034, and it is significant at 10%. According to William and Prather (2010), non-interest income is considered riskier than traditional income. Therefore, it increases the bank risk since it escalates volatility to the bank's return. This result confirms the finding of Köhler (2014). The result also presents the relationship of the non-interest income and non-performing loan ratio (NPL). The relationship is negative, with a coefficient of -0.4873. The result is statistically significant at the 10% level. The result reveals that non-interest income is reducing the non-performing loan ratio. The increasing share of non-interest income is decreasing the proportion of interest income in a bank income portfolio; consequently, it reduces the impaired loans of the bank. The result supports hypotheses 1a and 1b.

**Table 4 Non-interest income, regulation, bank concentration, and corporate governance to bank risk**

Variables	AROastdev	NPL	Ln_Z
Constant	0.0305*** (4.01)	15.5266*** (8.61)	3.7903*** (13.85)
NON	0.0034* (1.75)	-0.4873* (-1.90)	-0.0864 (-0.84)
SR	0.0008*** (4.50)	-0.6252*** (-5.74)	-0.0433*** (-3.22)
DepIns	0.0029** (2.00)	-0.9015 (-1.41)	-0.1697 (-1.52)
LawImp	-0.0019*** (-7.73)	-0.5292*** (-3.47)	0.1368*** (6.73)
CapReg	-0.0001** (-2.07)	0.1371*** (3.57)	0.0143** (2.38)
TopThree	0.0001*** (4.84)	0.0031 (0.35)	-0.0027** (-2.21)
ShareIndp	-0.0001 (-1.42)	-0.0960 (-1.52)	-0.018* (-1.70)
BOD	-0.00004*** (-2.57)	-0.0423*** (-3.97)	0.0184*** (8.33)
Country-specific	Yes	Yes	Yes
Bank-specific	Yes	Yes	Yes
Time dummy	Yes	Yes	Yes
Adj. R-Squared	0.1112	0.2299	0.0910
N of observation	6179	4868	6028

This table shows the relationship between bank risk (AROastdev, NPL, and Ln\_Z) with non-interest income, regulation, bank concentration, corporate governance and the control variables. The OLS regression is employed. The data used for this regression is the data of banks in 43 countries from 2003-2015. The t-statistic is reported in parenthesis. \*\*\*, \*\*, \* denotes the significant level at 1%, 5% and 10%.

#### 4.2.2 The effect of regulation on bank risk

The regulation effect on bank risk is shown in Table 4. According to Table 4, shareholder rights (SR) has a positive relationship with the volatility of bank return (AROAstdev) and insolvency risk (Ln\_Z). The coefficient is 0.0008 and -0.0433. The result is significant at the 1% level. The result affirms that the banks in countries with better shareholder rights have higher return volatility and higher insolvency risk. Our finding supports Gropp and Köhler (2010) finding that found banks in countries with strong shareholders' protection have higher risk exposure. They explain that banks in countries with better shareholders' protection have higher risk-taking behavior since their shareholders prefer more risk. The effect of SR on NPL is negative with a coefficient of -0.6252 (at the 1% significance level). Result suggests that in countries with better shareholders' protection, the bank's credit risk is lower than in countries with less concern on shareholders' protection. Since better shareholders' protection promotes the increase of the bank's risk-taking behavior, the bank benefits from the diversification activities that lead to an increase in profit. Diversification activities play an essential role in reducing the bank's reliance on interest income; thus, credit risk can be minimized.

The empirical result presents that the deposit insurance policy is increasing the bank's return volatility. The coefficient of DepIns is 0.0029, and it is significant at 5%. Moreover, the strict law implementation reduces the bank's return volatility, credit risk, and the bank's insolvency risk. The result is significant at the 1% level. In addition, the result also exhibits that capital regulation has two implications. First, the capital regulation policy minimizes the bank's return volatility and the bank's insolvency risk. The coefficient of capital regulation is -0.0001 for AROAstdev and 0.0143 for Ln\_Z, respectively. Next, the minimum capital requirement escalates the bank's credit risk with a coefficient of 0.1371. The abovementioned results are statistically significant at the 1% and 5% levels. Deposit insurance drives banks to involve in high risk and high return nontraditional activities (Demirgüç-Kunt and Detragiache, 2002) As a result it increases the volatility of bank return. Our results related to the effect of shareholder right, law enforcement (LawImp), and capital regulation on bank risk are partly support hypothesis 2 that stated the existence of regulation is lowering bank risk.

#### 4.2.3 The effect of concentration on bank risk

The result in Table 4 shows that the coefficients of market concentration are 0.0001 for AROAstdev and -0.0027 for Ln\_Z (significant at 1% and 5%). It affirms that higher bank concentration raises the bank's return volatility and the bank's insolvency risk. Boyd and De Nicolo (2005) argued that concentrated banking increases the bank's market power, and it encourages the banks to charge a higher interest rate. Further, they explained that the policy to increase the interest rate might have less attention on credit rationing and the significant increase in the loan. Therefore, it increased the bank's return volatility and the bank's insolvency risk. The result supports our hypothesis 3b that stated the bank in the lower concentrated market has lower risk exposure.

#### 4.2.4 The effect of corporate governance on bank risk

Corporate governance factors are essential when investigating bank risk. According to Table 4, ownership concentration (ShareIndp) and board characteristics (BOD) are vital for bank risk. Shareholder independence (ShareIndp) influences Ln\_Z negatively. The coefficient is -0.0180 and it's significant at the 10% level. The result means that when banks' shareholders have a high degree of independence, it leads banks to increase their insolvency risk. The higher degree of shareholders' independence results in the high degree of ownership and control separation that makes the bank to be a management-controlled bank. Although bank managers to be likely risk-averse (John et al, 2008; Laeven and Levine, 2009), however, the existence of agency problems might encourage them to take riskier activities that might increase the bank risk insolvency.



Regarding the board of director size, the coefficient of board size for bank return volatility and bank credit risk are -0.00004 and -0.0423, respectively. The coefficient of board size for bank insolvency risk is 0.0184. The coefficients are statistically significant at the 1% level. The result implies that the larger size of the bank's board mitigates the bank return volatility, bank credit risk, and bank insolvency risk. The larger board size indicates that the bank more management-controlled, therefore, the bank is less exposed to the bank risk since the management-controlled bank tends to be more risk-averse. The impact of board of director size on bank risk is partly supporting hypothesis 4a that stated the management-controlled bank is lowering the bank risk.

### 4.3 The Effect of the Interaction Variables on Bank Risk

#### 4.3.1 The effect of the interaction term of non-interest income and regulation on bank risk

This study aims to investigate whether the interaction variables between non-interest income with regulation, non-interest income with market concentration, and between non-interest income and corporate governance have a significant influence on bank risk. The empirical results of the interaction term between non-interest income and regulation are shown in Table 5. The result indicates that the employment of non-interest income in the country with better shareholders protection reduces the bank return volatility, and it increases the bank credit risk. The coefficients are -0.0042 and 0.5935, respectively. The result is statistically significant at 1% and 10%.

**Table 5 Bank risk and non-interest income: The roles of regulation, bank concentration, and corporate governance**

Variables	AROAstdev	NPL	Ln Z
Constant	0.0302*** (3.99)	11.3953*** (5.08)	4.4616*** (11.43)
NON	0.0031 (0.33)	7.0699* (1.67)	-2.3992*** (-3.77)
SR	0.0023*** (7.20)	-0.8309*** (-4.78)	-0.0667*** (-2.99)
DepIns	-0.0025 (-0.63)	3.8272*** (2.73)	-0.3581 (-1.53)
LawImp	-0.0028*** (-6.87)	-0.5052** (-2.51)	0.1578*** (5.53)
CapReg	-0.0001 (-0.92)	0.1878*** (3.46)	-0.0171* (-1.79)
TopThree	0.0001*** (6.86)	-0.0043 (-0.35)	-0.0059*** (-3.96)
ShareIndp	-0.0004** (-2.02)	0.0030 (0.03)	-0.0638*** (-3.27)
BOD	0.0001 (1.57)	-0.0585*** (-2.65)	0.0090** (2.25)
NON × SR	-0.0042*** (-4.51)	0.5935* (1.74)	0.0471 (0.86)
NON × DepIns	0.0052 (0.74)	-8.4031*** (-3.01)	0.4968 (1.11)
NON × LawImp	0.0024** (2.49)	-0.075 (-0.18)	-0.0261 (-0.46)
NON × CapReg	-0.0004 (-1.05)	-0.1509 (-0.97)	0.1200*** (4.14)
NON × TopThree	-0.0002*** (-4.64)	0.0193 (1.07)	0.0096*** (4.45)
NON × ShareIndp	0.0010 (1.51)	-0.3463 (-1.33)	0.1431*** (2.63)
NON × BOD	-0.0004** (-2.38)	0.0515 (0.96)	0.0291*** (2.82)
Country-specific	Yes	Yes	Yes

Bank-specific	Yes	Yes	Yes
Time dummy	Yes	Yes	Yes
Adj. R-Squared	0.1534	0.2326	0.1058
N of observation	6179	4868	6028

This table shows the relationship between bank (ARO,  $\sigma_{ROA}$ , NPL, and  $\ln Z$ ) risk with non-interest income, regulation, bank concentration, corporate governance, including the interaction variables between non-interest income with regulation, bank concentration, and corporate governance. The OLS regression is employed. The data use for this regression is the data of banks in 43 countries from 2003-2015. The t-statistic is reported in parenthesis. \*\*\*, \*\*, \* denotes the significant level at 1%, 5% and 10%.

Next, The  $NON \times DepIns$  is negatively and significantly impacting the bank credit risk. The coefficient is -8.4031 (significant at 1%), which reveals that employing the non-interest income in the country who applied deposit insurance policy lessens the bank's credit risk. Moreover, the utilization of non-interest income in the country with strict law enforcement is positively affected by the bank's return volatility. The coefficient  $NON \times LawImp$  is 0.0024, and it is statistically significant at 5%. Further, the coefficient of  $NON \times CapReg$  is 0.1200 and it's significant at the 1% level in the  $\ln Z$  equation. The result reveals that the income diversification in a stricter country of capital regulation lessens the bank's insolvency risk.

The findings for the impact of the interaction terms between non-interest income and regulation variables on bank risk is interesting since the interaction effect leads to different outcomes compared to the relationship between regulation variables and the bank risks without the interaction terms. First, without the interaction with non-interest income, SR is increasing the volatility of the bank's return and is minimizing the bank's credit risk. Nonetheless, the utilization of non-interest income in the countries with better shareholders' protection brings the contrary impact on the bank's return volatility and the bank's credit risk. Next, the utilization of non-interest income in the strict law enforcement countries increases the bank's return volatility rather than minimizes the risk. Countries with higher shareholder rights and strict capital regulation encourage the shareholders to pursue higher risk in order to maximize their wealth. The bank might benefit from the diversification effect which is minimizing the return volatility. Zhang et al. (2012) found that in the country with strong law enforcement, banks are encouraged to take a greater risk. The stronger law enforcement tends to strengthen the financial system environment. This condition motivates banks to lend money to risky borrowers or involve in higher risky activities. Therefore, the utilization of non-interest income in the country with strong law enforcement magnifies the bank risks. The result partly supports our hypothesis 5a, which stated that the interaction term between non-interest income and regulation absorb the bank risk.

#### 4.3.2 The effect of the interaction term of non-interest income and bank concentration on bank risk

Table 5 shows the relationship between the interaction variable of non-interest income and bank concentration with bank risk. In countries with a highly concentrated market, the utilization of non-interest income leads to bank risk declining. The interaction variable ( $NON \times TopThree$ ) has a negative effect on the standard deviation of adjusted return on assets and a positive effect on  $\ln Z$ -Score with coefficients of -0.0002 and 0.0096, respectively. The result is statistically significant at the 1% level. The result reveals that the utilization of non-interest income in a highly concentrated market lessens the bank's return volatility and the bank's insolvency risk. The interaction effect between non-interest income and bank concentration leads to risk minimization especially for bank's income volatility and bank's insolvency risk compared to the direct relationship between bank concentration and bank risk that increases the bank's risk. The difference might have existed as the benefit of income diversification. This result is confirming our hypothesis 5b.

### 4.3.3 The effect of the interaction term of non-interest income and corporate governance on bank risk

As shown in Table 5, the interaction variable of non-interest income and corporate governance proxies assist the banks to minimize their risks. The interaction terms of non-interest income and shareholder independence lead to the lower bank's insolvency risk. The coefficient of  $\text{NON} \times \text{ShareIndp}$  is 0.1431 (significant at 1%). This result is contrasted from the previous section that finds the increase of shareholder independence (without the interaction with the non-interest income) magnifies the exposure of the bank's insolvency risk.

In addition, the coefficients of  $\text{NON} \times \text{BOD}$  for  $\text{AROastdev}$  and  $\text{Ln\_Z}$  are -0.0004 and 0.0291, respectively. The result is significant at 1% and 5%. It reveals that the banks with larger board size when utilizing the non-interest income minimize the bank's return volatility and the bank's insolvency risk. The increase in shareholders' independence and the larger size of the board of directors indicates that the bank is a management-controlled bank. Thus, our results reveal that the employment of non-interest income by a management-controlled bank results in the minimization of the bank's risk exposure. Since the management-controlled bank tends to be risk-averse, the diversification activities are carried out prudently. Therefore, the bank might benefit from diversification activities. This result does not support the hypothesis 5c.

## 5. Robustness Test

For robustness tests, we divided our data into pre- and post-financial crisis periods then breaks down the data into developed and developing economies countries. The pre-financial crisis period is starting from 2003 to 2007, and the post-financial crisis period is beginning from 2008 to 2015. There are 29 countries categorized as developed countries, whereas 14 countries are categorized as developing countries. We run the regression with the same dependent and independent variables.

### 5.1 The Effects of the Non-Interest Income, Regulation, Bank Concentration, and Corporate Governance on Bank Risk

Table 6 and Table 7 present the results for the pre- and post-financial crisis periods as well as for developed and developing countries. Non-interest income in the pre-financial crisis period is increasing the bank's return volatility and minimizing the bank's credit risk and bank's insolvency risk, while in the post-financial crisis period NON is only reducing the bank's credit risk. Even though the relationship of NON and  $\text{AROastdev}$  or NON and  $\text{Ln\_Z}$  is not significant in the post-financial crisis period, however, it shows a consistent direction. In addition, NON is positively affecting  $\text{AROastdev}$  and is negatively affecting NPL in developed countries. The result is significant at the 10% level. The robustness test for the relationship of non-interest income and bank risks in the pre-financial crisis period, post-financial crisis period, and developed economies countries verify the main results in Table 4. The difference occurs for the effect of NON on the bank's insolvency risk in the pre-financial crisis period that becomes significant and the NON coefficients are insignificant for all of the equations in developing countries.

**Table 6 Robustness test - Non-interest income, regulation, bank concentration, and corporate governance to bank risk (pre- and post-financial crisis periods)**

Variables	Panel A Pre-financial crisis period			Panel B Post-financial crisis period		
	AROAstdev	NPL	Ln_Z	AROAstdev	NPL	Ln_Z
Constant	0.0281*** (3.68)	14.3993*** (4.95)	2.3948*** (3.63)	0.0197*** (6.42)	16.1132*** (7.35)	4.0456*** (13.80)
NON	0.0075*** (3.61)	-1.1968** (-2.06)	-0.6702*** (-3.96)	0.0029 (1.56)	-0.4777* (-1.68)	-0.0243 (-0.32)
SR	0.0019*** (3.51)	-0.5433*** (-3.31)	-0.0538 (-1.19)	0.0005*** (2.85)	-0.6573*** (-5.11)	-0.0457*** (-3.34)
DepIns	0.0112*** (3.01)	-0.2440 (-0.24)	-0.5381* (-1.88)	0.0002 (0.11)	-1.2704 (-1.61)	-0.1018 (-0.79)
LawImp	-0.0039*** (-4.14)	-0.8963*** (-2.92)	0.2713*** (4.02)	-0.0014*** (-6.22)	-0.2943* (-1.68)	0.0613*** (3.02)
CapReg	-0.0003 (-1.38)	0.2412* (1.65)	-0.0057 (-0.23)	-0.0001 (-1.12)	0.0845* (1.95)	0.0225*** (3.66)
TopThree	0.0001*** (3.02)	-0.0190** (-2.28)	-0.0009 (-0.31)	0.0001*** (4.04)	0.0068 (0.54)	-0.0030** (-2.03)
ShareIndp	0.0002 (1.37)	0.1572*** (3.08)	-0.1085*** (-5.83)	-0.0003** (-2.52)	-0.3001*** (-3.17)	0.0410*** (3.26)
BOD	-0.00004 (-1.19)	-0.0462*** (-3.28)	0.0266*** (4.95)	-0.00004*** (-2.77)	-0.0405*** (-3.15)	0.0147*** (6.41)
Country-specific	Yes	Yes	Yes	Yes	Yes	Yes
Bank-specific	Yes	Yes	Yes	Yes	Yes	Yes
Time dummy	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-Squared	0.1450	0.2897	0.1095	0.1129	0.2151	0.0969
N of observation	1819	1317	1799	4360	3551	4229

This table shows the relationship between bank risk (AROAstdev, NPL, and Ln\_Z) with non-interest income, regulation, bank concentration, corporate governance and the control variables during the pre-financial crisis and post-financial crisis periods. The OLS regression is employed. The data used for this regression is the data of banks in 43 countries from 2003-2007 for pre-crisis period and from 2008-2015 for post-crisis period. The t-statistic is reported in parenthesis. \*\*\*, \*\*, \* denotes the significant level at 1%, 5% and 10%.

**Table 7 Robustness test - Non-interest income, regulation, bank concentration, and corporate governance to bank risk (developed and developing countries)**

Variables	Panel A Developed countries			Panel B Developing countries		
	AROAstdev	NPL	Ln_Z	AROAstdev	NPL	Ln_Z
Constant	0.0194** (2.06)	13.0822*** (5.21)	5.833*** (12.2)	0.0620*** (5.14)	19.4849*** (2.67)	1.0311 (1.33)
NON	0.0037* (1.7)	-0.6588* (-1.91)	-0.1001 (-0.89)	-0.0023 (-1.01)	1.3692 (0.95)	0.1678 (1.04)
SR	0.0004** (2.29)	-0.7150*** (-5.26)	-0.0268 (-1.60)	0.0039*** (6.13)	1.0456* (1.8)	-0.1426*** (-2.9)
DepIns	- -	- -	- -	0.0045* (1.88)	2.8210** (2.22)	-0.3321* (-1.73)
LawImp	-0.0004 (-1.18)	-0.4439* (-1.70)	-0.1378*** (-3.52)	-0.0046*** (-3.22)	-0.9362 (-2.58)	0.0671 (0.89)
CapReg	-0.000012 (-0.23)	0.1823*** (4.38)	0.0107* (1.68)	-0.0017*** (-5.30)	-0.5773*** (-4.01)	0.0823*** (3.97)
TopThree	0.0001*** (3.39)	-0.0071 (-0.66)	-0.0040*** (-2.92)	-0.00005 (-1.18)	-0.0058 (-0.19)	0.0097*** (2.76)
ShareIndp	-0.0002 (-1.63)	-0.0545 (-0.77)	-0.0145 (-1.24)	0.0002 (0.71)	-0.3234 (-1.49)	-0.0223 (-0.91)
BOD	-0.00002* (-1.8)	-0.0560*** (-5.31)	0.0163*** (6.95)	-0.00001 (-0.14)	0.0620 (1.20)	-0.0011 (-0.16)
Country-specific	Yes	Yes	Yes	Yes	Yes	Yes
Bank-specific	Yes	Yes	Yes	Yes	Yes	Yes
Time dummy	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-Squared	0.1029	0.2583	0.1059	0.3113	0.2118	0.1856
N of observation	5518	4287	5385	661	581	643

This table shows the relationship between bank risk (AROAstdev, NPL, and Ln\_Z) with non-interest income, regulation, bank concentration, corporate governance and the control variables. The OLS regression is employed. The data used for this regression

is the data of banks in 29 developed countries and 14 developing countries from 2003-2015. The variable of DepIns in Panel A is dropped since the deposit insurance policy is implemented for all of the observations used in each regression model. The t-statistic is reported in parenthesis. \*\*\*, \*\*, \* denotes the significant level at 1%, 5% and 10%.

The relationship between bank risks and regulation variables confirms the main findings in Table 4 except for a few differences. The result for SR shows that SR still increases the bank's insolvency risk, but it becomes insignificant in the pre-financial crisis period and in developed countries. In addition, SR unexpectedly increases the bank's credit risk in developing countries. In Table 6, the deposit insurance is increasing the bank's insolvency risk (coefficient = -0.5381) at the 10% significant level only for a pre-financial crisis period. Since the deposit insurance policy is implemented for all of the observations used in each model in developed countries, we drop this variable from the regression models. In developing countries (see Table 7), DepIns increases the bank's return volatility, the bank's credit risk, and the bank's insolvency risk. Hence, the effect of DepIns on insolvency risk becomes significant especially in pre-financial crisis period and in developing countries. Moreover, the coefficient of DepIns has a different direction (from negative in Table 4 to significantly positive in Table 7) for the relationship of DepIns with bank's credit risk in developing countries. Regarding law enforcement, all of the results in Table 6 and 7 verifies the main finding except that LawImp exacerbates the bank's insolvency risk in developed countries. Both of the capital regulation coefficient in the AROAstdev equation for pre-financial crisis period and post-financial crisis period become insignificant, and CapReg only reduces the bank's insolvency risk in the post-financial crisis period. For developed countries, CapReg worsens the bank's credit risk and lessen the bank's insolvency risk. In developing countries, CapReg decreases bank risks. Hence, the result supports the main finding excluding that CapReg is reducing the bank's credit risk in developing countries.

Bank concentration (TopThree) has a positive and significant relationship with the bank's return volatility in both periods and has a negative and significant relationship with Ln\_Z in the post-financial crisis period. In developed countries TopThree is positive and significant for AROAstdev and is negative and significant for Ln\_Z. The coefficient is statistically significant at the 1% level. However, the coefficient is different for Ln\_Z in developing countries since it has a positive relationship. The main finding is supported by the robustness test finding except for the coefficient for Ln\_Z in developing countries.

Regarding the corporate governance variables which are the shareholders' independence and the size of the board of directors, for the pre-financial crisis period, ShareIndp is increasing the bank's credit risk and bank's insolvency risk. The result is significant at the 1% level. Whereas for the post-financial crisis period, ShareIndp is minimizing the bank's return volatility and bank's credit risk significantly. The ShareIndp is lessening the bank's insolvency risk for the post-financial crisis period. The coefficient is 0.0410 and significant at the 1% level. For the pre-financial crisis period, the bank's credit risk and bank's insolvency risk are reduced when the size of the board is larger. In the post-financial crisis period and developed countries, a larger board size mitigates the bank's return volatility, the bank's credit risk, and the bank's insolvency risk significantly. Therefore, the outcomes for the robustness test generally confirm the main findings in Table 4. However, a higher degree of ShareIndp leads to the reduction of the bank's insolvency risk only for the post-financial crisis period. The divergence might arise in the post-financial crisis since the managers are more risk-averse than before. Therefore, this behavior might prevent the managers from involving in riskier nontraditional activities.

## 5.2 The Effect of the Interaction Variables on Bank Risk

The result of the robustness test for the impact of the interaction variables on bank risk is shown in Tables 8 and 9. NON × SR has a negative and significant relationship with the bank's return volatility for pre- and post-financial crisis periods as well as developed and developing countries. The main finding is confirmed; however, the difference is existing for developing countries that have a significant and positive relationship with the Ln\_Z whereas the main finding is insignificant.

**Table 8 Robustness test - Bank risk and non-interest income: The roles of regulation, bank concentration, and corporate governance (pre- and post-financial crisis periods)**

Variables	Panel A Pre-financial crisis period			Panel B Post-financial crisis period		
	AROAstdev	NPL	Ln_Z	AROAstdev	NPL	Ln_Z
Constant	0.0436*** (3.64)	22.9900** (2.52)	2.9310*** (2.87)	0.0223** (2.23)	8.6285*** (2.91)	5.0583*** (6.81)
NON	-0.0369 (-1.18)	-28.4725 (-1.19)	-2.5296 (-1.20)	0.0036 (0.20)	12.9949** (2.29)	-2.7113** (-2.15)
SR	0.0035*** (3.31)	-1.1025*** (-4.75)	-0.0767 (-0.93)	0.0020*** (6.07)	-0.8177*** (-4.17)	-0.0660*** (-2.98)
DepIns	0.0072 (1)	-2.5248* (-1.7)	-0.6676 (-1.34)	-0.0058 (-0.61)	7.4189*** (3.03)	-0.6261 (-0.96)
LawImp	-0.0066*** (-4.15)	-0.7763 (-1.36)	0.3439*** (3.65)	-0.0020*** (-5.23)	-0.2804 (-1.29)	0.0729** (2.46)
CapReg	-0.0003 (-0.64)	-0.5911 (-0.87)	-0.1032** (-2.16)	-0.0001 (-1.26)	0.1177** (1.97)	-0.0024 (-0.24)
TopThree	0.0002** (2.33)	-0.0477** (-2.28)	-0.0040 (-0.70)	0.0001*** (5.81)	-0.0030 (-0.19)	-0.0059*** (-3.33)
ShareIndp	0.0007* (1.73)	0.4260*** (6.45)	-0.1089*** (-3.77)	-0.0008*** (-3.12)	-0.3133** (-2.17)	-0.0090 (-0.38)
BOD	0.0001 (0.67)	-0.0319 (-1.12)	-0.0117 (-1.43)	0.0001 (1.04)	-0.0598** (-2.41)	0.0114*** (2.62)
NON × SR	-0.0056** (-1.99)	1.5464 (2.59)	0.1085 (0.57)	-0.0041*** (-4.02)	0.4114 (1.13)	0.0482 (0.92)
NON × DepIns	-0.0083 (-0.49)	6.4761* (1.7)	1.3658 (1.19)	0.0091 (0.54)	-15.9007*** (-3.36)	0.9561 (0.82)
NON × LawImp	0.0090*** (2.91)	0.1858 (0.11)	-0.2960 (-1.44)	0.0014 (1.38)	-0.0080 (-0.02)	0.0008 (0.01)
NON × CapReg	0.0004 (0.29)	2.3222 (1.24)	0.2602** (1.99)	-0.0002 (-0.53)	-0.1078 (-0.64)	0.0981*** (3.4)
NON × TopThree	-0.0002 (-1.02)	0.0685 (1.20)	0.0122 (0.93)	-0.0002*** (-4.08)	0.0245 (1.30)	0.0086*** (3.53)
NON × ShareIndp	-0.0016 (-1.30)	-1.1502*** (-4.80)	0.0296 (0.33)	0.0017** (1.99)	0.0432 (0.13)	0.1456** (2.34)
NON × BOD	-0.0003 (-1.04)	-0.0307 (-0.41)	0.1015*** (5.14)	-0.0003* (-1.85)	0.0625 (1.03)	0.0100 (0.87)
Country-specific	Yes	Yes	Yes	Yes	Yes	Yes
Bank-specific	Yes	Yes	Yes	Yes	Yes	Yes
Time dummy	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-Squared	0.1834	0.3239	0.1304	0.1636	0.2176	0.1096
N of observation	1899	1317	1799	4360	3551	4229

This table mainly shows the relationship between bank risk (AROAstdev, NPL, and Ln\_Z) with non-interest income, regulation, bank concentration, and corporate governance, including the interaction variables between non-interest income with regulation, bank concentration, and corporate governance for pre-financial crisis and post-financial crisis periods. The OLS regression is employed. The data used for this regression is the data of banks in 43 countries from 2003-2007 for pre-financial crisis period and 2008-2015 for post-financial crisis period. The t-statistic is reported in parenthesis. \*\*\*, \*\*, \* denotes the significant level at 1%, 5% and 10%.

**Table 9 Robustness test - Bank risk and non-interest income: The roles of regulation, bank concentration, and corporate governance (developed and developing economies)**

Variables	Panel A Developed countries			Panel B Developing countries		
	AROAstdev	NPL	Ln_Z	AROAstdev	NPL	Ln_Z
Constant	0.0055 (2.37)	23.3804*** (4.99)	7.0991*** (10.05)	0.0557*** (3.21)	18.2773* (1.85)	3.3468*** (2.81)
NON	0.7431** (2.50)	-30.9706*** (-2.71)	-4.3726*** (-2.87)	0.0274 (1.03)	5.5537 (0.21)	-5.8003*** (-2.81)
SR	0.0017*** (5.14)	-0.8787*** (-4.08)	-0.0327 (-1.30)	0.0052*** (4.86)	1.8118 (1.12)	-0.2994*** (-3.43)
DepIns	- -	- -	- -	-0.0048 (-1.00)	7.0224** (2.24)	-0.8944** (-2.42)
LawImp	0.0009 (0.86)	-1.4729*** (-2.70)	-0.1998*** (-2.89)	-0.0036* (-1.74)	-1.6088*** (-2.98)	0.0124 (0.11)
CapReg	0.00003 (0.33)	0.2570*** (4.37)	-0.0254** (-2.46)	-0.0026*** (-4.35)	-0.4549 (-1.18)	0.0634 (1.62)
TopThree	0.0001*** (4.88)	-0.0097 (-0.65)	-0.0060*** (-3.72)	-0.00001 (-0.16)	-0.0198 (-0.52)	0.0042 (0.85)
ShareIndp	-0.0003 (-1.50)	0.0311 (0.30)	-0.0657*** (-3.21)	-0.0003 (-0.69)	-0.0068 (-0.03)	-0.0530 (-1.39)
BOD	0.000005 (1.02)	-0.0668*** (-2.76)	0.0109*** (2.71)	0.0004* (1.82)	0.0687 (0.99)	-0.0337*** (-2.69)
NON × SR	-0.0032*** (-3.65)	0.3829 (0.95)	-0.0102 (-0.18)	-0.0058* (-1.94)	-2.2897 (-0.43)	0.5074* (1.85)
NON × DepIns	- -	- -	- -	0.0003 (0.04)	-7.9443 (-0.84)	1.9412** (2.41)
NON × LawImp	-0.0050** (-1.50)	3.1810** (2.39)	0.2578 (1.48)	-0.0047 (-1.41)	2.0590* (1.83)	0.2174 (1.07)
NON × CapReg	-0.0005 (-1.46)	-0.2034 (-1.44)	0.1390*** (4.33)	0.0032** (2.45)	-0.3915 (-0.37)	0.0225 (0.23)
NON × TopThree	-0.0002*** (-3.14)	0.0034 (0.16)	0.0063*** (2.68)	-0.0002 (-1.46)	0.0501 (0.94)	0.0115 (1.46)
NON × ShareIndp	0.0004*** (0.61)	-0.2626 (-0.99)	0.1650*** (2.94)	0.0021 (1.59)	-0.8973 (-1.15)	0.0371 (0.36)
NON × BOD	-0.0002* (-1.72)	0.0375 (0.63)	0.0176* (1.74)	-0.0015*** (-2.71)	-0.0106 (-0.06)	0.1210*** (3.44)
Country-specific	Yes	Yes	Yes	Yes	Yes	Yes
Bank-specific	Yes	Yes	Yes	Yes	Yes	Yes
Time dummy	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-Squared	0.1536	0.2647	0.1213	0.362	0.2279	0.2181
N of observation	5518	4287	5385	661	581	643

This table mainly shows the relationship between bank risk (AROAstdev, NPL, and Ln\_Z) with non-interest income, regulation, bank concentration, and corporate governance, including the interaction variables between non-interest income with regulation, bank concentration, and corporate governance. The OLS regression is employed. The data used for this regression is the data of banks in 29 developed countries and 14 developing countries from 2003-2015. The variable of DepIns in Panel A is dropped since the deposit insurance policy is implemented for all of the observations used in each regression model. The t-statistic are reported in parenthesis. \*\*\*, \*\*, \* denotes the significant level at 1%, 5% and 10%.

Next, the coefficient of NON × DepIns for NPL in the pre-financial crisis period is 6.4761 and it is significant at the 10% level, whereas in the post-financial crisis period it is -15.9007 and significant at the 1% level. We drop deposit insurance variable from the regression models since it is implemented for all of the observations used in each model in developed countries. In developing countries, NON × DepIns minifies the bank's insolvency risk. This effect is consistent and become significant when we compare it with the result of Table 5. Hence, the finding is different from the main findings for the pre-financial crisis period.

Then, the robustness test result for NON × LawImp for the pre-crisis period confirms the main finding that it increases the bank's volatility return. Moreover, the effects of NON × LawImp on NPL ratio in Table 9 are quite different from the result in Table 5. In developed and developing countries the coefficients of NON × LawImp for NPL are positive and significant, while for the main finding it is negative and insignificant. NON CapReg has a positive and significant relationship with Ln\_Z in the

pre-financial crisis period, post-financial crisis period, and in developed countries. This result is confirming the main finding. However, the result in developing countries is different since it has a positive and significant relationship with AROAstdev rather than with Ln\_Z.

The coefficients of the interaction term between non-interest income and market concentration in the post-financial crisis period and in developed countries confirm the main findings. The result shows that  $NON \times TopThree$  dilutes the bank's return volatility and the bank's insolvency risk. Even though the result in the pre-financial crisis and in developing countries is not significant, the coefficients have the similar direction with the ones of the main findings.

In regard to the interaction term between non-interest income and corporate governance, the results in Table 8 and Table 9 show that the findings mostly confirm the main results. That is,  $NON \times ShareIndp$  minimizes the bank's insolvency risk in the post-financial crisis period and in developed countries. However, the result is different for the pre-financial crisis period and the post-financial crisis period since the effects of  $NON \times ShareIndp$  on NPL and AROAstdev become significant. The impact of  $NON \times BOD$  on bank risks in each subsample also confirm the main findings. Even though the coefficients of  $NON \times BOD$  are insignificant for AROAstdev in the pre-financial crisis period and for Ln\_Z in the post-financial crisis period, the coefficients have the same direction as the main findings.

## 6. Conclusion

Our study investigates the relationship of non-interest income and bank risk and concentrates on the role of regulation, bank concentration, and corporate governance and their relationship with non-interest income. We investigate the bank across 43 countries from 2003 to 2015. We employ an ordinary least square method for our analysis.

The result indicates that non-interest income would raise bank risks, however, the roles of regulation, concentration, and corporate governance changes the relationship between non-interest income and bank risk. In a better country of shareholders' protection, the utilization of non-interest income reduces the bank's return volatility but it worsens the bank's credit risk. In addition, banks that employ non-interest income in the countries with deposit insurance policy minimize their credit risk. The strictness of law enforcement is one of the factors that should be avoided when banks utilize income diversification because the interaction effect of non-interest income and law enforcement might lead to the increasing of bank's return volatility. Moreover, banks employing the non-interest income in the countries with strict capital regulation could protect them from becoming insolvent. Similarly, the diversification of income is encouraged in a highly concentrated market due to minimizing the bank's income volatility and insolvency risk. It is better for management-controlled banks to employ the non-interest income to scale down banks' return volatility and insolvency risk.

Even though the income diversification is considered as a risky activity, proper regulation, highly concentrated market, and management controlled might help banks minimize their risks. Therefore, the authorities should be focused on the regulation and market concentration that can maintain the stability of the banking sector. The bank managers are encouraged to engage in bank nontraditional activities when they dominate the strategies of banks from the risk reducing perspective.



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