

# **The Effect of the Diversification in Korean Banks: The impact on Profit and Risk**

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*This study attempts to examine whether the diversification effort in Korean banks for past years positively affects to banks income structure. We find that although Korean banks have intentionally increased the share of noninterest revenue as a vehicle of banking diversification, it has also accompanied with the soaring of net noninterest income expense. Thus, we find that the key success of banking diversification does substantially depends on operating noninterest income expense.*

## **INTRODUCTION**

There are inconclusive arguments about the effect of noninterest income activities. Boyd et al. (1980, 1993), Kwast (1989), Santomero and Chung (1992) suggest that an increase in noninterest income business as a vehicle of a bank diversification improves the soundness of income resource and enhances the value of equity. However, DeYoung and Roland (2001), Stiroh (2004), and Stiroh and Rumble (2006), Lepetit et al. (2009) point out that noninterest income business is risky relative to interest income business because noninterest income activities tend to raise the volatility of overall operating income. In other words, the expansion to noninterest income business promoting banking diversification may lead to the increase of overall risk in banks. On the hand, considering this ambivalent character of noninterest income revenue, Kwast (1989), Saunders and Walter(1994), Stiroh (2006) apply Markowit's mean-variance formula (Markowitz, 1954) to find an optimal weight or fraction of noninterest income revenue so as to obtain overall minimum risk.

Over 10 years there have been a big structural change in Korean banking industry. Through the revamp of legal system, various merge and acquisitions, and takeovers, banks could increase their size and diversify their business. In this respect, analyzing Korean banks is a good sample to the effect of banking diversification. The researches of the diversification effect in Korean banks have been well documented (Lee, 2002; Kwun and Lee, 2002; Choi and Lee, 2003; Gu and Kim, 2009, Park and Byun, 2010). However, it seems that this relationship between noninterest income revenue and net operating income may mislead or may marginally analyze the effect of bank diversification to a firm's earning: because net operating income is a function of operating revenue and expense, not an only function

consisting of revenue; because the relation only evaluates banks managers sales activity not their effort of expense management. Accordingly, we look into the relation between banks earnings and net noninterest income to avoid the limited research scope to the nominal effect of noninterest income revenue to a banks' earning.

This article attempts to answer two research questions. Firstly, we examine whether the increase of noninterest income revenue drives the rise of net operating income. The Korean banking industry has intentionally increased the share of noninterest income revenue based on a belief that the increase in noninterest income revenue is positively correlated to the increase of net noninterest income. The examination whether its diversification efforts in banking industry really result in the diversification of income profit may answer the validity of Korean banking diversification. Second, we analyze whether the volatility of noninterest income is directly associated with the volatility of net operating income. Banks' diversification benefits are offset by the higher exposure to noninterest income because of the higher volatility in noninterest income revenues in banks relative to that of interest income revenues (Stiroh and Rumble, 2006). By examining operating income and expenses, we identify the performance of banking diversification and its effect to Korean banking industry.

For our empirical analysis, we employ Financial Statistics Information System (FSIS) quarterly data from 2007 to 2013. Based on this data, we look into the performance and behavior of operating noninterest & interest income with respect to three major banking types<sup>1</sup> in South Korea such as commercial banks, local banks, and special purpose banks (hereafter, special banks). Given the respective volatility for net interest & noninterest income, we generate empirical distributions and evaluate each worst case scenario for both net operating noninterest income and net operating interest income applying Delta-Normal method, Cornish Fischer method, and Monte Carlo Simulation.

This article finds three core points. The first point is that still the fraction of net operating interest income against net operating income is much greater than that of net operating noninterest income, although the fraction of noninterest income revenue against total revenue is greater than that of interest income revenue. This suggests the effort of banking diversification lead the increase of noninterest income revenue but on the flip side this also substantially produces noninterest income expense. Thus, this finding seems to say that the diversification benefit can be countervailed by the increase of noninterest income expense. In other words, regardless of their effort in Koran banking industry, banks still depend on interest income resource and their diversification benefit are canceled out by noninterest income expense. The second point is that net operating noninterest income is less volatile than operating income profit is. More specifically, the volatility of noninterest income revenue is greater than that of interest income. However, when looking into net operating interest and noninterest income structure, their standard deviations are not much different. More specifically, the risk of net noninterest income after excluding operating expense from revenue is substantially reduced, which means the increase of noninterest income revenue could not be the key factor to increase net operating income. So we can say that because the volatility of net noninterest income is less volatile than that of net interest income, based on current operation income management in Korea banks we easily find that the increase of the share of noninterest revenue may not significantly add values to the expansion of net operating income in banks. In this respect, our finding implies that the key success of banking diversification is not the reckless growth in noninterest income revenue but the stable and persistence expense control in operating noninterest income. The last point is that as Elsa et al. (2010) and Swada (2013) suggest we see that the increase of the share of nontraditional income activity diversifies banks performance. However, we also see that all of Korean banks are highly dependent on the change of the share of expense. Thus, it seems that banks tend to avoid the expansion of nontraditional bank activities.

## **DIVERSIFICATION AND BANKING INDUSTRY IN KOREA**

The restructuring of Korean banking industry has started since June 29, 1998 when financial supervisory service governor declared the bankruptcy of five commercial banks (Dongam, Dongwha, Kyuggi, and Chungchung). In 1997, Currency devaluation in Asia triggered crisis contagion to Korean

financial industry because many Korean securities corporations and banks are substantially exposed to foreign debt and credit without considering risk. Chang et al. (1998) document most of Korean banks and securities corporations depended on net interest rate spread between Japan and Southeast Asia. They borrowed short-term money with low interest rate from Japan, traded bills, and lend long-term funds with 2-3% higher rate to south Asian countries such as Indonesia, Thailand, and Malaysia. This strategy seemed to be successful prior to 1997 Asian crisis but this also pushed Korean industry into liquidity and maturity risk at the same time. In the wake of the financial meltdown, Japan stopped issuing new short-term loans and extending maturities, many countries including Japan attempted a huge withdrawal credit from Korea. Hanbo Iron & Steel Co. and Kia Motors in South Korea went into bankruptcy. Because there was a loss of 12 billion dollars from these bankruptcy events, many banks and securities corporations were critically affected. (Lee, 2011) In addition, sudden currency devaluation in Southeast Asia led to an abrupt raise of interest rate, which drove the default of companies in Southeast Asia as well. Accordingly, these sequential events raised duration mismatching and resulted in the lack of liquidity in Korea financial industry. As a result, many of unqualified insurance, securities trading companies, and banks shut down their business or were merged or taken over. In banking industry, banks had actively been on mergers and acquisitions trail until 2006.<sup>2</sup>

**TABLE 1**  
**MERGE AND ACQUISITIONS OF KOREAN BANKS<sup>a</sup>**

Banks	Date	Events
<i>KEB</i>	01/01/1999	Hano securities company merged
<i>Hana</i>	01/01/1999	Boram banks merged
<i>Kangwon</i>	02/09/1999	Hyundai securities company merged
<i>CHB</i>	05/03/1999	Chungbuk banks merged
<i>HCB</i>	09/06/1999	Jueun-Yongdong credit union merged
<i>CHB</i>	09/11/1999	Kangwon bank merged
<i>Hanvit</i>	08/01/1999.	Hanil-Chungbu credit union merged
<i>Kookmin</i>	08/22/1999.	Chun-nam, Pusan, Taeku credit unions merged
<i>Kwangju</i>	10/01/1999.	Kwangeun credit union merged
<i>HCB</i>	12/20/2000	Juen credit union merged
<i>NH</i>	07/01/2001.	National Livestock Cooperatives Federation merged
<i>KB</i>	11/01/2001	Kookmin and Jutak merger (consolidation of corporation, Change of the company name => KB)
<i>Hanvit</i>	12/31/2001	Pyunghwa bank merged
<i>Woori</i>	05/20/2001	Change of the company name : Hanvit=> Woori
<i>Hana</i>	12/02/2002	Seoul bank merged
<i>Woori</i>	07/31/2003	Woori securities company merged
<i>KB</i>	09/30/2003	Kookmin credit card company merged
<i>KEB</i>	03/02/2004	KEB credit service company merged
<i>Woori</i>	03/31/2004	Woori Credit card Co. merged
<i>Citibank Korea</i>	11/01/2004	Citigroup acquired Koram. Citibank Seoul Branch and Koram merger, Koram take-over Citibank Seoul Branch, Change of the company name: Koram -> Citibank korea
<i>Cheil</i>	11/28/2005	Standard Chartered acquired First Bank, Firstbank take over SC seoul branch, Change of the company name: SC First Bank <sup>b</sup>
<i>SHB</i>	04/01/2006.	CHB merged

a. source: Korean Financial Statistics, 2012-1

b. Change of the name, Standard Chartered Bank Korea Limited on June 3, 2009

Note. This table reports a list of merge and acquisitions from the year of 1999 to the year of 2006 in South Korea. As of 2012, there are seven commercial banks, six local banks, and five special banks.

As of the year of 2012, there are 18 banks: 7 commercial banks (Shinhan (SHB), Woori, Hana, Kookmin, Korea Exchange Banks (KEX), Citi-Korea, SC-Cheil); 6 local banks (Daegu, Pusan, Kwangju, Cheju, Cheonbuk, Kyungnam), 5 special-purpose banks (Korea Development Bank (KDB), Industrial Bank (IBK), Korean Export-Import Bank (KEIB), National Agricultural Cooperative Federation Bank (NH Bank), National Federation of Fisheries Cooperatives (NFFC Bank). Table 1 summarizes historical events of the mergers and acquisitions in Korean banking industry in chronological order since 1997 Asian crisis.

From the effort of banking diversification, banks have been able to widen their financial services and products, i.e. diversification of income structure, resulting the growth of non-interest income revenue. That is, beyond the traditional banking business focusing on interest income business, which is “spread between deposits and loans (credit and debit)”, According to Financial Statistics Information System (FSIS), the portion of noninterest income business in Korean banks sharply increased to 72% in 2008, to 65% in 2011 from 35 % in 2002. This clearly provides evidence that banks have diversified their income source through the restructuring of banking industry in Korea.

## EMPIRICAL FRAMEWORK

On the basis of FSIS quarterly time series data (18 banks) as of December 2013, this study examines the diversification of Korean banking industry and how their performance is associated with net operating noninterest income. In addition, this article estimates net operating interest & noninterest income at time  $t$  applying Monte Carlo simulation. Provided by this empirical distribution, we consider two worst case scenarios (95 percentile case, and 99 percentile case) computing Value at Risk (VaR) and Conditional Value at Risk (CVaR) measurement.

### Research Variables

#### *Diversification Measures*

This article analyzes the Herfindal-type approach to measure the diversification of Korean banks and their performance (Stiroh, 2004; Thomas, 2004; Stiroh and Rumble, 2006). To explain the relation between the diversification of revenue and the variation of net operating non-interest and interest income, we define the measurement of bank diversification, which measures the degree of diversification in Korean banks operating revenue, as in equation (1). We employ the same diversification measurement as that suggested by Stiroh and Rubmle (2006). A DIV of 1.00 indicates all income source coming from only one source either non-interest revenue or interest revenue, whereas a DIV of 0.5 means the exactly half of operating income revenue of a bank is coming from either non-interest income or interest income source.

$$DIV = 1 - (SH_{NET}^2 + SH_{NON}^2) \quad (1)$$

where  $SH_{NET}$  represents the share of net interest income, defined as in equation (2), and  $SH_{NON}$  represents the share of non-interest rate income, defined as in equation (3).

$$SH_{NET} = \frac{NET}{(NET+NON)} \quad (2)$$

$$SH_{NON} = \frac{NON}{(NET+NON)} \quad (3)$$

where  $NON$  represents non-interest income revenue and  $NET$  represent interest income revenue.

In addition, we also examine operating expense which can be breakdown into non-interest income expense and interest income expense. Because the performance of banking does not only depend on operating return, we consider operating expense as well. Similarly, the share of interest income expense,

denoted as *NETEX*, is written as in equation (4) while the share of non-interest income expense, *NONEX*, is written as in equation (5).

$$SH_{NETEX} = \frac{NETEX}{(NETEX+NONEX)} \quad (4)$$

$$SH_{NONEX} = \frac{NONEX}{(NETEX+NONEX)} \quad (5)$$

### *Interest and Non-interest Income Revenues and Expenses*

Operating revenues and expenses in the income statement of banks are decomposed into interest and noninterest income revenues and expenses. Table 2 shows the detailed items of the respective interest and noninterest income revenues and expenses. Panel A describes the items of interest income revenues and expenses while panel B shows the items of noninterest income revenues and expenses.

**TABLE 2**  
**INTEREST AND NONINTEREST INCOME REVENUES AND EXPENSES IN BANKS<sup>a</sup>**

Title of Accounts (Operating Revenues and Expenses)
<b>Panel A: Interest Income Profits &amp; Losses (Revenues and Expenses)</b>
1. Interest Income Revenue
1) Interest on Due from Banks
- Sum of Interest on Due from Banks in Won & Foreign Currency (FX), and on Off-Shore Due from Financial Institutions in FX
2) Interest on Trading Securities, Available for Sales Securities, and Held to Maturity Securities
- Government, Municipal, Corporation, Financial Bonds, CP, Beneficiary Certificate, other Securities
- Sum of Interest FX, Off-Shore Securities
3) Interest on Loans
- Interest on Loans in Won and FX, on Off-Shore Loans in FX, and on Foreign Debts
- Interest on FX rents between banks
- Others (Interest on Factoring Loans, Bills Discount Fees, etc)
4) Other Interest Income
- Sundry Interest Income, Interest on Inter Office, etc
2. Interest Income Expense
1) Interest on Deposits
- Interest on Deposits in Won, FX, and on Off-Shore Deposits in FX, CD
2) Interest on Borrowings
- Interest on Borrowings in Won, FX, and on Off-Shore Borrowings in FX
3) Others
- Interest on Call Money, Discount Fees on Cover Notes Sold, Interest on Securities Sold under Repurchase Agreements, Interest on Credit Card Receivable-backed Securities, Interest of Inter Office, etc
<b>Panel B. Noninterest Income Profits &amp; Losses (Revenues and Expenses)</b>
1. Commission Profit: Commission Received – Commission Expenses
1) Commission Received
- Commission Received on Domestic Exchange and Foreign Exchange
- Del credere commission
- Other Commission Received (Credit Cards, Commission Received from Pre-payment, others)
2) Commission Expenses
- Commission Paid on domestic exchange and Foreign Exchange
- Commission Paid on Remittance
- Others

2. Trust Profit : Trust Fees – Trust Conservation Funds – Trust Management Expense
3. Valuation and Profit (Gain/Loss) on Disposition of Securities
  - Gain/Loss on Sales/Valuation of Trading Securities,
  - Gain/Loss on Deposition of Available for Sales Securities
  - Gain/Loss on Deposition of Held to Maturity Securities
  - Recovery minus Impairment of Available for Sale Securities Loss
  - Recovery minus Impairment of Held to Maturity Securities
6. Other Operating Profits (Dividend Income, Gain/Loss on FX, Equities, Option, Derivatives, and other transactions, and Sundry Operating Profits)

a. source: Korean Financial Statistics, 2012-1

*Note.* This table summarizes operating revenues and expenses in income statement (profit and loss statement) in banks. Panel A describes the items of interest income revenue and expense while panel B shows the items of noninterest income revenue and expense.

### *Performance and Risk*

Generally, *ROA* (Return on Asset) or *ROE* (Return on Equity) measures the profitability of a firm's business. *ROA* is calculated as net income over total assets and *ROE* is defined as net income divided by shareholder's equity. The respective formula for *ROA* and *ROE* seems to be different but those two equations are close to each other. As in equation (6) and (7), we know as net income in numerator increases, both *ROA* and *ROE* increase as well. Thus, the choice of these measurements does not matter.

$$ROE = \frac{Net\ Income}{Shareholder's\ Equity} = ROA \times \frac{Total\ Assets}{Shareholder's\ Equity} \quad (6)$$

$$ROA = \frac{Net\ Income}{Total\ Assets} = ROE \times \frac{Shareholder's\ Equity}{Total\ Assets} \quad (7)$$

While most of research employ a fraction of noninterest income revenue against operating income revenue as a measurement of the level of diversification in banks, we use a fraction of noninterest income profit against net operating income as the effort of diversification because of two reasons. First, the real diversification effort is not limited to noninterest income sales activities. It should also consider the level of cost management in order to evaluate the effect of noninterest income activities. Second, net income is a key factor to measure banks overall earnings. Because either *ROA* or *ROE* is a function of net income, which defined as total revenue minus total expense, we can approximately divide net income into four components: noninterest income revenue; interest income revenue; noninterest income expense; interest income expense. In this sense, if we only look into the relation between *ROE* or *ROA* and noninterest income revenue, it is likely to misinterpret the relationship. In addition, those four components can be reclassified two groups: interest income profit (net interest income) and noninterest income profit (net noninterest income). If we use this classification, *ROE* can be decomposed into Interest Income Return on Equity, denoted by *IROE*, and Noninterest Income Return on Equity, denoted by *NIROE*, as shown in equation (8). Therefore, this measurement transparently captures the relation between overall bank profitability and diversification effort in banks.

$$ROE = \frac{Net\ Interest\ Income}{Shareholder's\ Equity} + \frac{Net\ Noninterest\ Income}{Shareholder's\ Equity} = IROE + NIROE \quad (8)$$

In addition to profit ratios such as *ROA* and *ROE*, we examine risk-adjusted return on equity,  $RAR_{ROE}$ , and risk adjusted return on assets,  $RAR_{ROA}$ , which are defined as in equation (9) and equation (10), respectively. These performance measurements say that how much risk is associated with net operating income. To compute these measurements we employ average *ROA*,  $\overline{ROA}$ , and average *ROE*,  $\overline{ROE}$ , on a yearly based on the quarterly data in an individual bank. In the similar way, we also compute the standard deviation of *ROA*,  $\sigma_{ROA}$ , and the standard deviation of *ROE*,  $\sigma_{ROE}$ .

$$RAR_{ROE} = \frac{\overline{ROE}}{\sigma_{ROE}} \quad (9)$$

$$RAR_{ROA} = \frac{\overline{ROA}}{\sigma_{ROA}} \quad (10)$$

We use Z-score, which is a function of the summation of average *ROA* and the average equity to assets over the standard deviation of *ROA* as written in equation (11). In equation (11),  $\overline{E/A}$  refers to the average equity to total asset. This measures the degree of insolvency of a bank.

$$Z = \frac{\overline{ROA} + \overline{E/A}}{\sigma_{ROA}} \quad (11)$$

Finally, we use leverage in considering a bank's risk and performance. Although financial firms are highly regulated and high leverage is normal (Calmoris, 2000, Fama and French, 1993), too much high debt may force to insolvency and liquidation (Scott, 1977, Buser et al., 1981, Bolton and Freixas, 2000). It is associated with a firm's risk. Excessive leverage by a bank is contributed to local and global crisis (D'Hulster, 2009, FSA, 2009, FSB, 2010). On the hand, Berger and and Emilia Bonaccorsi di Patti (2006) find that leverage affect agency cost and thus influence banks performance. The formula of leverage is written as

$$leverage = \frac{D}{E} \quad (12)$$

where *D* represents total debt and *E* is total equity of a bank.

### Application of Monte Carlo Simulation

Prior to set up our simulation model, we set up three assumptions. The first one is that net noninterest over shareholder's equity & interest operating income over shareholder's equity, defined as NIROE and IROE respectively, are normally distributed and each of decomposed ROEs follows a stochastic process; NIROE & IROE are correlated each other; by Ito's lemma these two returns follows a stochastic process as in equation (13).

$$p_0^{(i)} e^{(\mu_i - 0.5 \sigma_i^2) \Delta t + \sigma \sqrt{\Delta t} y_i}, \quad i = 1, 2 \quad (13)$$

where  $p_0^{(1)}$  represents IROE at present time,  $p_0^{(2)}$  represents NIROE at present time,  $p_t^{(1)}$  represents IROE at time *t*,  $p_t^{(2)}$  represents NIROE at time *t*,  $\mu_1$  is an average of IROE,  $\mu_2$  is an average NIROE,  $\sigma_1$  is an volatility of IROE, and  $\sigma_2$  is an volatility of NIROE. When generating random number  $y_1$  and  $y_2$ <sup>3</sup>, we assume NIROE and IROE are not independent. Then we assume that two ROEs satisfy the following system as written in equation (14).

$$\frac{dp_t^{(1)}}{p_t^{(1)}} = \mu_1 dt + \sigma_1 dz_1, \quad z_1 \sim N(0,1) \quad (14)$$

$$\frac{dp_t^{(2)}}{p_t^{(2)}} = \mu_2 dt + \sigma_2 (\rho z_1 + \sqrt{1 - \rho^2} dz_2), \quad z_2 \sim N(0,1)$$

### Worst Case Scenarios and Measurements

To evaluate systemic risk of two decomposed bank returns, NIROE and IROE, we employ three value at risk (VaR) approaches, which have been widely employed in measuring downside risk. Based on time horizon, distribution, and statistical significance level, this measurement says an estimation of the

maximum least magnitude of worst performance. As a result, financial institutions can measure their potential risk associated with market risk and monitor such risk in advance.

Generally, there are two major approaches to compute VaR according to Jorion (2006). The first one is computing VaR under the assumption of normality. We call it Delta-Normal method. Using the first moment and second moment, this method estimates a maximum amount of loss and is as in equation (15).

$$VaR_q = -(\mu + \sigma\Phi_q^{-1}) \quad (15)$$

where  $\mu$  refers to the average of return on equity, and  $\Phi^{-1}$  represents an inverse cumulative standard normal distribution.

This parametric VaR using normal distribution assumes that returns are approximately close to normal distribution and hence standard normal density function is an important factor to measure downside risk. Although the delta-normal method is simple to compute VaR, it encounters underestimation problem when normality assumption is violated such as asymmetric and fat-tail problem. To avoid asymmetric and platykurtic problems, Favre and Galeano (2002) suggest another parametric VaR using Cornish-Fisher asymptotic expansion (see, Cornish and Fisher, 1937), which is also known as Cornish-Fisher VaR. Adding the third moment and fourth moment in equation (16), they improve those two problems.

$$CF VaR_q = -(\mu + \sigma CF_q^{-1}) \quad (16)$$

where  $CF_q^{-1} = \Phi_q^{-1} + \frac{\xi_1}{6}((\Phi_q^{-1})^2 - 1) + \frac{\xi_2}{24}((\Phi_q^{-1})^3 - 3\Phi_q^{-1}) - \frac{\xi_1^2}{36}(2(\Phi_q^{-1})^3 - 5\Phi_q^{-1})$ ,  $\mu$  is the average of return on equity,  $\sigma$  is the standard deviation of return on equity,  $\xi_1$  refers to skewness and  $\xi_2$  represents kurtosis.

Unlike parametric methods that employ moments of distributions, we can employ empirical distribution based on lot of simulations. Since this simulation based approach needs complicated computation and enough computational time, it does not require any assumptions of a certain distribution. On top of that, it considers fat-tail problem and extreme values through a wide range of simulations.

Conditional VaR (CVaR), also known as Expected Shortfall (ES), is defined as the expected or average loss beyond VaR and is expressed as

$$CVaR_q = E[X|X < VaR_q] \quad (17)$$

In theory, Arzner et al. (1997, 1999) propose VaR is a coherent risk measurement while Arcerbi and Tache (2002) suggest that CVaR is an alternative in that VaR does not satisfy mathematical axioms for risk measurement. At an empirical perspective, CVaR reflects extreme values and fat-tail information that are neglected in VaR measurement. For example, if a distribution is symmetric but has fat tails, Both the values of VaR under normal distribution and VaR under this distribution would be similar. However, when computing each CVaR for these distributions, we can expect that CVaR captures this platykurtic problem well. In other words, it is likely to underestimate risk when using VaR measurement because the value beyond VaR under normal distribution is less than the value under non-normal distribution. Therefore, Basel Committee on Banking Supervision (2012) recommend banks to employ CVaR when to compute systemic risk.

## EMPIRICAL RESULTS

### Share of Operating Income Structure

To analyze the effect of banking diversification more thoroughly, we classify banks into seven major commercial banks, six local banks, and five special banks. Citibank Korea and SC-Cheil Bank could be classified as foreign banks because they are acquired by Citigroup Inc. and Standard Chartered PLC. But



we place them into the category of commercial banks following the Financial Supervisory Service (FSS) classification in that their line of business is the same as commercial banking.

Table 3 summarizes the shares of both operating interest revenue & expense and operating non-interest revenue & expense over three types of Korean banking industry (commercial banks, local banks, and special purpose bank). Panel A shows the proportion of non-interest income for commercial banks increased from 57% in 2007 to 87% in 2008, then decreased to 34% in 2011. This applies to special purpose banks as well; the proportion increased sharply from 38% in 2007 to 60% in 2008, then decreased to 16% in 2013. On the other hand, local banks show different results as other bank categories do. More than 78% of operational revenue comes from interest income revenue from 2007 to 2013 except for 2008 when the share of non-interest income revenue increased from 20% in 2007 to 44%. Non-interest income showed noticeable increment in 2008 as a result of the concentration of non-interest operation due to the enactment of “Capital Market and Financial Investment Services Provider Act” in 2007. However, in panel A, one interesting thing is that although Korean administration have made an effort to diversify income source, it seems that its efforts seems not to work because banks reduce the share of non-interest income source. Panel B might suggest a possible reason of the decreasing of the share in non-interest income. When it comes to the share of operating expense in overall Korean banking industry, the share of non-interest income expense is high as compared to that of interest income expense from 2007 to 2013. This higher share of expense in non-income appears in commercial banks, local bank, and special banks. For commercial banks, most of expense in non-interest income is more than 70% except for 2011 and 2013 (64% and 63%, respectively). For local banks, it ranges from 50% to 60% over the data sample period. For special bank, like other bank types the share of operating non-interest expense is much higher than that of interest income expense. Panel C summarizes the ration of the share of operating revenue to operating expense. Overall, the ratio for interest income is less than 1, which indicates that the share of expense does not excess that of revenue, whereas the ratio for noninterest income indicates that most of year the share of expense exceeds the share of operating revenue. This observation consistently appears in commercial banks, local bank, and special banks. From Table 3, we know that the shrinkage of the share of non-interest income source would be due to the higher expense structure in non-interest income.

**TABLE 3**  
**SHARES OF INTEREST AND NONINTEREST INCOME REVENUES AGAINST TOTAL OPERATING REVENUES**

Year	Commercial Banks		Local Banks		Special Banks		Total	
	Int. <sup>a</sup>	Non-Int. <sup>b</sup>	Int.	Non-Int.	Int.	Non-Int.	Int.	Non-Int.
<b>Panel A: Share of operating revenue (SOR)</b>								
2007	0.43	0.57	0.80	0.20	0.62	0.38	0.62	0.38
2008	0.13	0.87	0.56	0.44	0.40	0.60	0.37	0.63
2009	0.38	0.62	0.78	0.22	0.56	0.44	0.57	0.43
2010	0.52	0.48	0.79	0.21	0.60	0.40	0.63	0.37
2011	0.64	0.36	0.81	0.19	0.65	0.35	0.70	0.30
2012	0.39	0.61	0.82	0.18	0.50	0.50	0.57	0.43
2013	0.66	0.34	0.83	0.17	0.84	0.16	0.78	0.22
<b>Panel B: Share of operating expense (SOE)</b>								
2007	0.27	0.73	0.50	0.50	0.48	0.52	0.41	0.59
2008	0.08	0.92	0.37	0.63	0.25	0.75	0.23	0.77
2009	0.21	0.79	0.40	0.60	0.34	0.66	0.32	0.68
2010	0.29	0.71	0.40	0.60	0.35	0.65	0.35	0.65
2011	0.36	0.64	0.45	0.55	0.44	0.56	0.42	0.58
2012	0.21	0.79	0.45	0.55	0.31	0.69	0.32	0.68
2013	0.37	0.63	0.45	0.55	0.51	0.49	0.44	0.56

<b>Panel C: Ratios of SOE/SOR</b>								
2007	0.63	1.28	0.63	2.50	0.77	1.37	0.66	1.55
2008	0.62	1.06	0.66	1.43	0.63	1.25	0.62	1.22
2009	0.55	1.27	0.51	2.73	0.61	1.50	0.56	1.58
2010	0.56	1.48	0.51	2.86	0.58	1.63	0.56	1.76
2011	0.56	1.78	0.56	2.89	0.68	1.60	0.60	1.93
2012	0.54	1.30	0.55	3.06	0.62	1.38	0.56	1.58
2013	0.56	1.85	0.54	3.24	0.61	3.06	0.56	2.55

a. Int. represent interest income.

b. Non-Int. represent non-interest income.

*Note.* This table reports the proportion of interest income and noninterest income revenue over total operating income revenues with respect to three types of banks, Commercial Banks, Local Banks, and Special Banks, on yearly basis.

Table 4 that summarizes the ROE for each banking category seems to support our basic finding in Table 3. This table says that in spite of various efforts in Korean banking industry to revenue diversification, most of the banks' net profits depend on interest income on the basis of the values of IROE and NIROE. One common finding is all IROEs do always have positive numbers with respect to three banking categories while all the values of NIROEs have negative numbers. Korean banks have expanded to non-interest income revenue. But this expansion is also accompanied with the rise of substantial costs associated with non-interest income businesses. In other words, most profit in Korean banks earned is originated from interest income business regardless of the effort of revenue diversification. This suggests that banks are still focusing on interest income which does not generate lots of expense.

**TABLE 4**  
**NET OPERATING INCOME TO TOTAL EQUITY**

Year	Commercial Banks		Local Banks		Special Banks		Total	
	Int.	Non-Int.	Int.	Non-Int.	Int.	Non-Int.	Int.	Non-Int.
2007	0.09	-0.06	0.13	-0.10	0.08	-0.05	0.10	-0.07
2008	0.10	-0.10	0.13	-0.09	0.09	-0.10	0.11	-0.10
2009	0.08	-0.05	0.12	-0.09	0.09	-0.08	0.10	-0.07
2010	0.08	-0.06	0.11	-0.08	0.08	-0.06	0.09	-0.07
2011	0.07	-0.06	0.10	-0.07	0.07	-0.05	0.08	-0.06
2012	0.06	-0.06	0.09	-0.07	0.07	-0.05	0.07	-0.06
2013	0.06	-0.04	0.08	-0.05	0.07	-0.05	0.07	-0.05

a. Int. represent interest income.

b. Non-Int. represent non-interest income.

*Note.* This table reports the proportion of interest income and noninterest income profits over net operating income with respect to three types of banks, Commercial Banks, Local Banks, and Special Banks, on yearly basis.

Furthermore, Table 5 suggests the simple statistics for operating revenue and expense for interest income and non-interest income for three banking categories. In panel A, except for local banks the average of non-interest income revenue is around two times greater than that of interest income revenue. The standard deviations of interest income revenue range between 148 million in dollars and 0.1 billion in dollars while the standard deviations of non-interest income have larger values, which range from 240 million in dollars to 5.8 billion in dollars. Panel A shows the mean and standard deviation of operating interest & non-interest income revenue provide evidence that banks revenue source, on average, relies on

non-interest income revenue and thereby they work for banking diversification. However, panel B provides counter evidence that Korean banks do not manage expense in an efficient way. More specifically, for net operating interest income, all the amount of expense in dollars for three banking areas is less than those of revenue. For net non-interest income, the amount of expense for each bank group exceeds the revenue, which implies Korean banks do not successfully manage the operation expense. Consequently, it seems that their mismanagement in non-interest income expense could impede Korean banking diversification.

**TABLE 5**  
**SIMPLE STATISTICS FOR OPERATING INCOME REVENUE AND EXPENSE**  
**(\$ 100 MILLION (MM))**

Banks	Mean (\$ 100 MM)		Standard Deviation (\$ 100 MM)	
	Int.	Non-Int.	Int.	Non-Int.
<b>Panel A: Operating Revenue</b>				
<i>Commercial</i>	18.54	39.44	10.52	58.11
<i>Local</i>	2.65	1.46	1.48	2.40
<i>Special</i>	12.71	20.21	7.99	33.61
<i>Total</i>	11.50	21.58	10.56	44.19
<b>Panel B: Operating Expense</b>				
<i>Commercial</i>	10.07	46.27	6.03	60.03
<i>Local</i>	1.29	2.43	0.71	2.75
<i>Special</i>	7.62	23.66	4.55	33.49
<i>Total</i>	6.33	25.58	5.96	46.33

a. Int. represent interest income.

b. Non-Int. represent non-interest income.

*Note.* This table summarizes descriptive statistics for operating income revenue and expense by three bank types on the basis of the data from the year of 2007 to the year of 2013.

Table 6 summarizes the share of operating interest and noninterest income expenses and proves overall operating expense heavily depends on noninterest income. In particular, the 20 percent of operating income expense is coming from interest income expense while the 80 percent is from noninterest income expense. Among noninterest income expense, 70 percent of noninterest income expense includes expense on disposition of marketable securities, loss on foreign exchange trading, bad debt expense, trust management, and others.

**TABLE 6**  
**SHARE OF OPERATING INTEREST AND NONINTEREST INCOME EXPENSES**

Banks	Operating Income Expense	Operating Noninterest Income Expense		
		Commissions Expenses	Selling & Administrative Expenses	Other Expenses <sup>a</sup>
<i>Commercial</i>	0.18	0.09	0.01	0.72
<i>Local</i>	0.35	0.20	0.02	0.43
<i>Special</i>	0.24	0.07	0.01	0.68
<i>Total</i>	0.20	0.09	0.01	0.70

a. Other expenses include 1) expense on disposition of marketable securities; 2) loss on foreign exchange; 3) bad debt expense; 4) trust management and other expenses.

As in Table 7, ROEs from net interest income for commercial, local and special banks are 8%, 11%, and 8% whereas from non-interest income -6%, -8% and -6%. For Korean banks, Choi (2003), Lee (2005), Lee et al. (2009), and Park and Byun (2010) suggest that the increase in non-interest income revenue increase the volatility of Korean bank's earnings. Park and Byun (2010) report the standard deviation of the ratio of non-interest revenue over total asset is greater than that of interest revenue over total asset.

However, when it comes to net operating incomes which breakdown into non-interest income and net interest income, we see a converse finding. Table 7 summarizes that the simple statistics of net interest income and net non-interest income for the past 7 years. All the values of mean IROEs for commercial bank, local, and special bank are greater than the values of NIROEs, which have all negative values. A test for the mean equivalence using *t*-statistic rejects the null hypothesis that there is no difference at 5% significant level for the three bank groups. For the standard deviation, at a glance there is not much difference between net non-interest-based operating income and net interest-based operating income for three bank types. Using *F*-statistic, except for commercial bank we fail to reject the null hypothesis of equal volatility under 95% confidence interval, which points out that the volatility of net non-interest income may not add the increase of the aggregate volatility of a firms' net operating income even if the increase of non-interest revenue is the main cause of the increase of the risk of operating revenue.

**TABLE 7**  
**RETURN ON EQUITY (ROE) FOR INTEREST INCOME VERSUS NONINTEREST INCOME BY BANKING TYPES**

Banks	Mean			Standard Deviation		
	IROE <sup>a</sup>	NIROE <sup>b</sup>	<i>t</i> -stat	IROE	NIROE	<i>F</i> -stat.
<i>Commercial</i>	0.08	-0.06	24.04***	0.02	0.03	0.45
<i>Local</i>	0.11	-0.08	30.37***	0.02	0.02	0.88***
<i>Special</i>	0.08	-0.06	7.23***	0.04	0.05	0.62***
<i>Total</i>	0.09	-0.07	28.8***	0.03	0.03	0.78***

a. IROE stands for return on equity for net interest income.

b. NIROE stands for return on equity for net non-interest income.

\*\*\*, \*\*, \* indicate statistical significance at 1%, 5%, and 10% significant level, respectively

Note. This table summarizes descriptive statistics for IROE and NIROE by three bank types on the basis of the data from the year of 2007 to the year of 2013.

## Risk Adjusted Performance Regressions

We analyze five special banks and thirteen general banks (seven commercial and six local banks) using quarterly income statements from Financial Statistics Information System (FSIS) that provided by Korean Financial Supervisory Service (FSS). For our empirical test, we only use active banks as of December 2012 that listed in FSIS system. The data sample period starts from 2007 and continues to 2013 when all the active thirteen commercial banks and five special banks appear. We employ their income statements which regularly reported to FSS and test the risk aspects and the effect of banking business diversification. To analyze the effect of banking diversification, we classify banks into seven major commercial banks, six local banks, and five special banks. Citibank Korea and SC Cheil Bank could be classified as foreign banks because they are acquired by Citigroup Inc. and Standard Chartered PLC. But we place them into the category of commercial banks following the Financial Supervisory Service (FSS) classification in that their line of business is the same as commercial banking.

**TABLE 8**  
**SIMPLE STATISTICS FOR KOREAN BANKS**

Variables	Commercial Banks			Local Banks			Special Banks			Total		
	Mean	Median	Std.Dev	Mean	Median	Std.Dev	Mean	Median	Std.Dev	Mean	Median	Std.Dev
DIV	0.34	0.37	0.13	0.38	0.42	0.14	0.30	0.30	0.12	0.35	0.38	0.12
SH <sub>NON</sub>	0.39	0.40	0.19	0.55	0.56	0.18	0.23	0.22	0.25	0.40	0.42	0.25
SH <sub>NONEX</sub>	0.75	0.74	0.12	0.57	0.57	0.16	0.75	0.74	0.12	0.64	0.66	0.13
ROE	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.01
ROA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RAR <sub>ROE</sub>	2.38	2.03	1.56	2.06	1.81	1.19	3.30	2.73	0.99	1.79	1.57	0.99
RAR <sub>ROA</sub>	2.27	2.03	1.37	2.01	1.81	1.10	3.08	2.72	0.94	1.73	1.55	0.94
Leverage	13.89	13.98	3.66	12.63	12.84	2.03	14.35	14.25	7.63	14.69	14.84	7.63
SH <sub>NONEX</sub>	0.64	0.66	0.13	0.75	0.74	0.12	0.57	0.57	0.16	0.62	0.66	0.16
Zscore	391.55	264.92	376.76	531.92	383.32	480.05	288.37	158.77	335.00	354.38	252.68	335.00

*Note.* This table reports the simple statistics (mean, median, and standard deviation) of ten key variables for total aggregated sample and decomposed samples by banking types (commercial banks, local banks, and special banks).

Table 8 presents summary statistics (mean, median, and standard deviation) for Korean banks from the year of 2007 to the year of 2013 employing FSIS quarterly data. From three summary statistics of DIV and SH<sub>NON</sub>, we see that operating income source does not only depend on a single income source but mostly their income sources are weighted to interest income. While ROA and ROE do not clearly provide the performance of banks, most of RAR<sub>ROA</sub> and RAR<sub>ROE</sub> are greater than the average and median of 1.5 when looking at the risk adjusted returns and thereby special banks outperform relative to commercial and local banks. For leverage, the debt amount in Korean banks, on average, is 13 times as much as equity. For SH<sub>NONEX</sub>, it appears that more than 60% of operating expense are from non-interest income expense: the average share of non-interest income expense in commercial banks is 0.64; the average share of non-interest income expense in local banks is 0.57; the average share of non-interest income expense in special banks is 0.62.

Table 9 summarizes the result of the performance regressions of risk adjusted returns (RAR<sub>ROE</sub> and RAR<sub>ROA</sub>) on key attributes variables from literature (Stiroh and Rumble, 2006). From these regressions, we observe a couple of common relation among three banking groups. First, DIV positively after to the increase banking performance all three bank groups. But it seems that the simple increase in the share of non-interest revenue does not positive impact on those banks performance. Because the increase in non-

interest revenue also accompany with the increase of expense in Korean banks, it shows that a percent of change in the share of non-interest income reduces the risk adjusted returns on equity and asset.

**TABLE 9**  
**ESTIMATES OF RISK ADJUSTED RETURNS**

	Dependent variable: RAR <sub>ROE</sub>				Dependent variable: RAR <sub>ROA</sub>			
	Commercial Bank	Local Bank	Special Banks	Total	Commercial Bank	Local Bank	Special Banks	Total
Intercept	4.80*** (2.03)	16.34** (1.96)	0.93 (0.66)	2.41 (1.00)	5.11** (2.11)	19.60* (1.77)	-0.86 (-0.57)	2.95 (0.96)
DIV	0.17 (0.16)	4.67 (0.55)	3.47* (1.63)	1.47 (0.71)	0.02 (0.02)	6.91 (0.62)	3.64 (1.63)	1.69 (0.64)
SH <sub>NON</sub>	1.38 (0.49)	0.50 (0.55)	2.70 (1.03)	5.02** (1.73)	1.80 (0.62)	1.08 (0.08)	3.15 (1.14)	5.11 (1.37)
SH <sub>NONEX</sub>	-3.89 (-0.86)	-9.96 (-0.80)	-4.01 (1.28)	-3.97 (-0.86)	-4.45 (-0.97)	-13.58 (-0.82)	-4.25 (-1.28)	-3.59 (-0.61)
z-score	0.00*** (5.29)	0.00 (1.41)	0.00*** (2.85)	0.00*** (3.18)	0.00*** (6.18)	0.00 (1.26)	0.00*** (3.25)	0.00*** (2.95)
leverage	-0.11 (-1.45)	-0.79*** (-2.40)	-0.03 (-0.59)	-0.14*** (-2.03)	-0.12 (-1.48)	-0.93* (-2.13)	-0.04 (-0.81)	-0.17** (-1.83)
Asset growth	4.00 (1.62)	24.23 (0.79)	0.73 (0.39)	4.86 (1.27)	4.25* (1.68)	26.74 (0.66)	0.64 (0.32)	5.09 (1.04)
Asset growth <sup>2</sup>	-5.88 (-0.56)	-47.05 (-0.34)	-6.15 (-0.37)	-1.57 (-0.09)	-10.25 (-0.96)	-58.87 (-0.32)	-4.34 (-0.25)	-4.14 (-0.18)
Adj R <sup>2</sup>	0.36	0.04	0.46	0.09	0.43	0.00	0.49	0.06

\*\*\*, \*\*, \* indicate statistical significance at 1%, 5%, and 10% significant level, respectively

*Note.* This table reports the regression of risk adjusted return on equity and asset on DIV, SH<sub>NON</sub>, SH<sub>NONEX</sub>, Z-score, leverage, asset growth, and asset growth<sup>2</sup> for three categories: commercial bank, local bank, and special bank.

Therefore, this research employed VaR, a standard risk measurement for banks, to identify risk associated with two income sources. We included Cornish-Fisher method besides Delta-Normal method considering asymmetric and platykurtic profit/loss distribution as found in Table 5 and Table 7. Since VaR based on domestic banks' past 6 years of financial data does not have sufficient time series, there is limitation of comparison between interest income and non-interest income. This research estimated the distribution of operating interest and noninterest income by employing Monte Carlo simulation in equation (13) to suggest an alternative way.

#### **Bank's Loss Distribution Estimation and Risk Evaluation**

We run 100,000 Monte Carlo simulations to estimate interest/non-interest P&L for one year after. We used interest profit and non-interest profit from Table 9 for each group of banks and from Table 10 for individual banks.

**TABLE 10**  
**TOTAL EQUITY, INTEREST AND NONINTEREST INCOME PROFITS (\$ US)**  
**BY BANKING TYPES<sup>a</sup>**

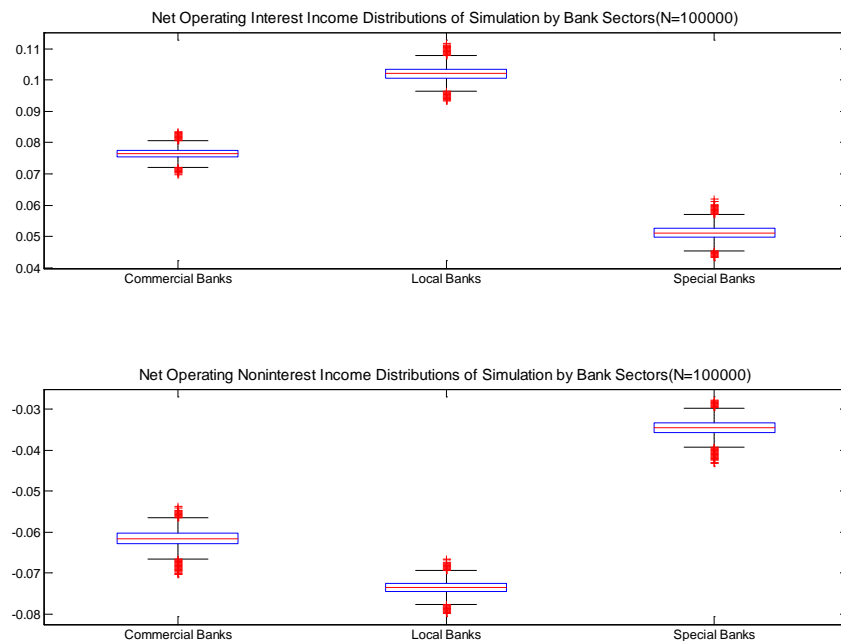
Banks	Total Equity		Net Interest Income		Net Non-interest Income	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
<i>Commercial</i>	91.5	6.7	7.1	0.5	(5.7)	1.6
<i>Local</i>	11.0	1.9	1.1	0.1	(0.8)	0.1
<i>Special</i>	80.2	6.7	4.2	0.4	(-2.8)	1.0
<i>Total</i>	60.9	26.2	4.1	1.6	(-3.1)	2.0

a. unit: 100 thousand US dollars and converted FX rate is 1200 KRW per \$1 US

*Note.* This table reports the average and standard deviation of total equity, noninterest income and interest income profits by three types of banks (seven commercial banks, six local banks, five special banks) on the basis of the data from the year of 2007 to the year of 2012.

Figure 1 shows the estimated empirical distributions of *IROE* and *NIROE* applying 100,000 times Monte Carlo simulation for commercial, local, and special banks. The above box plots in Figure 1 describe three *IROE* distributions for three type of banks and the lower box plots show three *NIROE* distributions for three respective banks. While the distributions of *NIROE* depict all of three banks have negative rate of return on equity for noninterest income business, those of *IROE* show all positive rate of returns on equity for interest income business.

**FIGURE 1**  
**DISTRIBUTIONS OF SIMULATED NET OPERATING INCOMES**  
**FOR THREE BANKING TYPES**



### Analysis of Bank's Downside Risk

We employed VaR to evaluate the risk associated with bank's P&L besides Monte Carlo simulation to evaluate bank's interest and non-interest return. To evaluate VaR, we applied Delta-Normal VaR using normal distribution and Cornish-Fisher VaR using the third momentum and fourth momentum for parametric estimation, and Monte Carlo VaR for non-parametric. Because per year interest income ratio and non-interest income ratio were based on financial data, we set time interval to one year when estimating VaR.

As seen from Table 11 for 1% and 5% VaR for each banking category, special banks show all estimation would have lowest operation performance at 95% and 99% confidence interval for interest P&L. Commercial banks show the highest non-interest P&L, while local banks the lowest. The difference between Delta-Normal method and CF for bank's categorical interest and non-interest P&L ratio at 99% confidence interval seems slight, but very similar at 95% confidence interval. Commercial and local banks show no difference in risk estimation for interest P&L ratio when comparing with the Monte Carlo using priori distribution, but different result for special banks. In particular, on the basis of all possible forecasted rate of return on equity in noninterest income business, we find it is highly likely that the performance of noninterest income business fall behind the performance of interest income business.

**TABLE 11**  
**WORST CASE SCENARIOS ON IROE AND NIROE FOR EACH BANKING CATEGORY**  
**(1% AND 5% CASES)**

Banks	VaR	IROE <sup>a</sup>			NIROE <sup>b</sup>		
		DN	CF	MC	DN	CF	MC
<i>Commercial</i>	1% VaR	0.033	0.023	0.073	(0.130)	(0.135)	(0.066)
	5% VaR	0.033	0.023	0.074	(0.130)	(0.135)	(0.065)
	10% VaR	0.054	0.052	0.074	(0.098)	(0.094)	(0.064)
<i>Local</i>	1% VaR	0.063	0.047	0.097	(0.127)	(0.130)	(0.077)
	5% VaR	0.063	0.047	0.099	(0.127)	(0.130)	(0.076)
	10% VaR	0.084	0.082	0.099	(0.106)	(0.104)	(0.075)
<i>Special</i>	1% VaR	(0.013)	(0.030)	0.046	(0.176)	(0.183)	(0.039)
	5% VaR	(0.013)	(0.030)	0.048	(0.176)	(0.183)	(0.038)
	10% VaR	0.029	0.039	0.048	(0.124)	(0.136)	(0.037)

a. IROE stands for return on equity for interest income.

b. NIROE stands for return on equity for noninterest income.

*Note.* This table shows downside risk for each banking category. The respective each first row in each banking category indicates bottom 1% of the worst case of IROE and NIROE, and the respective second row in each banking category indicates bottom 5% of the worst case scenario of IROE and NIROE. DN stands for Delta Normal method. CF stands for Cornish-Fisher method, and MC for Monte Carlo method. For Monte Carlo simulation, 10,000 scenarios are generated.

Table 12 shows the values of expected shortfall for *IROE* and *NIROE*. It appears that the distribution of the respective banking categories for *NIROE* does not have long left tail relative to the distribution for *IROE*. More specifically, the difference in *IROE* between 1% and 10% expected shortfall for commercial, local and special banks are 0.002, 0.001 and 0.002, respectively. Similarly the differences in *NIROE* are 0.002, 0.002 and 0.002, respectively.



**TABLE 12**  
**EXPECTED SHORTFALL ON P&L SIMULATION FOR EACH BANKING CATEGORY**

Banks	IROE			NIROE		
	1% ES	5% ES	10% ES	1% ES	5% ES	10% ES
<i>Commercial</i>	0.072	0.073	0.074	(0.067)	(0.066)	(0.065)
<i>Local</i>	0.097	0.098	0.098	(0.078)	(0.077)	(0.076)
<i>Special</i>	0.046	0.047	0.048	(0.040)	(0.038)	(0.038)

*Note.* This table reports that the values indicate expected shortfall at 1%, 5% and 10% significance level based on the distribution from Monte Carlo simulation for each banking category. For Monte Carlo simulation, 100,000 scenarios are generated.

### CONCLUDING REMARKS

Korean banks since the 1997 Asian crisis have been doing various efforts in order to maximize profitability by the support of government for the enhancement of bank's financial stability and advancement. As part of these efforts to expand operating income, banks diversified operation by the increase the share of noninterest income activities, such as fees, trust, securities, foreign exchanges and derivatives rather than interest income activities such as spread between deposit and loan. As a result of this, the contribution of non-interest income to total revenue showed dramatic increase to 78% in 2008 from 32% in 2002. However, many reports from academics and financial institutions raised concern about the high volatility of noninterest income activities and thus it forced the banks to reduce noninterest activities to 57% from 78% in 2008. This may suggest that all the Korean banks were aware of the risk associated with the activities and thus adjusted the share of operating noninterest income. While existing studies which evaluate operating noninterest income revenue, this study focuses net operating noninterest income. We perform empirical test using financial data for seven commercial, six local, and five special banks from 2006 to 2011 in order to see the relation between net operating income and banks diversification.

The empirical test suggests several important findings. First, Korean banks' income structure depends on net operating interest income even though banks increases sales in noninterest income activities through sales of securities and insurances with the support of Korean government. The average of net interest income to equity ratio shows 8% for commercial banks, 11% for local banks, and 8% for special banks, and the average of net noninterest income to equity ratio shows 2%, 2%, and 4%, respectively. This shows that all banks have income source depending on interest income activities.

Second, existing studies on Korean banks argue that higher volatility of noninterest income activities increased bank's overall risk. However, this study shows that net operating noninterest income does not bring much risk than net operating interest income; the volatility of net noninterest income ranges 2% to 5%, while that of net operating interest income ranges 2% to 5%.

Third, we employ Monte Carlo simulation as an ex ante method to generate all possible return on equity for net operating interest and noninterest income because of limited number of empirical data. On the basis of the given distribution, each of 99, 95, 90 percent worst case scenarios using Value at Risk and Expected Shortfall NIROE shows always negative compared to IROE, which shows all positive values.

All thing considered, we are able to summarize the followings. As shown in the OLS result, the diversification effort positively effect to the performance of the banks, but the success of the bank diversification is heavily dependent on the management of operating income cost. From the example of Korea banks, we see that although Korean banking industry intentionally boosted up the diversification increase operating noninterest revenue, operating noninterest revenue has accompanied with the increase

of operation noninterest expense thereby banks cannot expect any benefit from the banking diversification in Korea. Thus, Korean banks now reduce the share of noninterest income business and focuses on the interest income business, which means Korean banks operating income is highly exposed to the risk of interest rate.

We apply Monte Carlo simulation to generate all possible empirical return distributions but due to the limited financial data we are unable to evaluate ex post estimation. With enough time series data the future study can run backtesting to test consistency of empirical results.

## ENDNOTES

1. Sometimes, it can be divided into two groups: general banks and special purpose banks.
2. As of 1997 the number of Korean bank was 26 while as of 2012 there are 18 banks remained.
3. In equation (13),  $y_1$  is equal to  $z_1$  while  $y_2$  is equal to  $\rho z_1 + (1 - \rho)z_2$ .

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