# Risk of Internationalization on Taiwan Banking Industry

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## Abstract

Global banking system has changed dramatically in the last several decades which make banks encounter difficulties and discover opportunities while developing their business. In this increasingly saturated environment, existing banks start to find a way to expand their territories overseas to set up higher entry barriers. Especially in Taiwan, because of excessive banks, small economic scale and overlap financial services, the financial industry is more competitive than in other markets resulting the interest rate spread becomes more and more narrow. Most of research find a positive relationship between internationalization and bank risk. However, this paper employs the data of commercial banks in Taiwan, the result suggests that internationalization of a bank is associated with lower risk for overall banks. Additionally, we find that the bank size has different effects on the relationship between internationalization and risk. Large banks tend to have the lower average risk but to increase the bank risk when go abroad. On the other hand, small banks have a diversification effect on internationalization but the overall risk is larger and the operation is not as efficient as large banks.

Keywords: Internationalization Risk, Taiwan Banking Industry, Asset Size, Large Bank and small bank

## 1. Introduction

Global banking system has changed dramatically in the last several decades which make banks encounter difficulties and discover opportunities while developing their business. In this increasingly saturated environment, existing banks start to find a way to expand their territories overseas to set up higher entry barriers.

In Taiwan, because of excessive banks, small economic scale and overlap financial services, the financial industry is more competitive than in other markets resulting the interest rate spread becomes more and more narrow. Consequently, internationalization is the only of main solution for bank to gain more profits in Taiwan. As shown in Table 1, after the financial crisis the weighting of Taiwanese GDP in financial industry has dramatically declined from 7.01% in 2008 to 6.19% in 2010. However, the weighting is increasing gradually in recent years due to Taiwanese government has aggressively advocated the development of financial industry. In 2009, Taiwan signed the Memorandum of Understanding on Cross Strait Banking (MOU) with China, allowing its banks to tap China's massive market and paving the way for banks on both sides to invest in each other. As a result, Taiwanese banks started to set up representative offices in the first-tier cities of China. In the following year, Taiwan signed the Economic Cooperation Framework Agreement (ECFA) with China in Chongqing city to lower tariffs and to relax access for 539 products and services for Taiwan. Obviously, these two policies have a significant impact on financial industry in Taiwan. Table 1 Financial Industry Contribution of GDP in Taiwan

| Table 1 Financial Industry Contribution of GDP in Taiwan | | | | | | | |
|---|---|---|---|---|---|---|---|
| NTD (1 billion) | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
| GDP - Total | 13,151 | 12,962 | 14,119 | 14,312 | 14,687 | 15,221 | 16,084 |
| GDP - Financial Industry | 913 | 798 | 872 | 915 | 933 | 970 | 1,042 |
| Financial Industry/GDP | 7.01% | 6.23% | 6.19% | 6.39% | 6.42% | 6.45% | 6.61% |

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However, while banks seek more profit overseas, do banks diversify their asset allocation to lower the risk or to take on more risk from market specific factor? Some evidences show that international banks can diversify their risk through assessing to global financial market (Doukas and Kan, 2006; Laeven and Levine, 2007) which supports the diversification hypothesis. Alternatively, market risk hypothesis suggests that internationalization increases banks' risk (Amihud, Y., DeLong, G. and Saunders, A., 2002). Further, Berger, A., Sadok El Ghoul, Omrane Guedhami and Raluca A. Roman (2013) use the data among the U.S. banks from 1989:Q1 to 2010:Q4 and test with varieties of robustness models which strongly suggest that the more internationalized the bank, the higher the risk.

Our paper follows Berger, A., Sadok El Ghoul, Omrane Guedhami and Raluca A. Roman (2013) to construct the research structure to investigate the relationship between internationalization and risk of banks in Taiwan using a sample of 1,991 bank-quarter observations from 2004:Q4 to 2014Q2. We find that internationalization of a bank is associated with lower risk for overall Taiwanese banks. But when we segment our sample into large banks and small banks, we find that in each subsample the relations between internationalization and banks' risk are different. In large banks, which have a lower risk profile tend to take on more risk with higher degree of internationalization; in small banks, which have a higher risk profile are benefited from asset diversification abroad.

The paper proceeds as follows. Section 2 reviews some research on internationalization and risk. Section 3 describes the data, variables and empirical methodology. Section 4 presents summary statistics, regression result, robustness test and some additional analysis. Section 5 is conclusion.

## 2. Literature Review

Internationalization does not mean to give up domestic market, but to provide multinational corporations with banking services so that banks can hold their national position and can have more capable of ensuring banking expansion. However, how bank internationalization activity affects the risk has been wildly concerned.

### 2.1 Internationalization of bank

According to Annavarjula and Beldona (2000), there are three dimensions defining internationalization: Operation, Ownership and Orientation. The operation dimension is reflecting the foreign market penetration of a firm and its independence on foreign market, such as a number of foreign subsides of total subsides. The ownership dimension is reflecting the foreign production of a firm. The orientation dimension represents the business strategy, structure and management style are international-oriented. For banks, there are two purposes to go internationalization, one is international participation and another one is international expansion. Aliber (1976) indicates when a bank has more comparative advantage on financial services, it is more likely developing into an international bank base on 'International Trade Theory'; Moreover, domestic market density may also increase a bank's operation efficiency to take advantage of entering global market.

Based on banking activities, three different types of multinational banks (Grubel, 1977) can be identified as a.) Multinational Retail Banking: this type of banks provides individual banking services, such as personal loans, credit cards and mortgage services, in oversea markets. The management expertise and marketing know-how will be the main advantage to gain customers. b.) Multinational Service Banking: giving multinational corporations financial services for supporting their business is substantial. Long-term customer relationship is much more important in this type of banks which let local banks hard to compete with. c.) Multinational Wholesale Banking: banks help customers to deal with huge cash transactions between borders by Eurocurrency market to minimize cost. This kind of banks have economic of scale on investment information on financial consulting.

### 2.2 Internationalization and Bank risk

Some argue that international banks can diversify their risk through assessing to global financial market (Doukas and Kan, 2006; Laeven and Levine, 2007), and Buch, Claudia M., John C. Driscoll and Charlotte Ostergaard (2010) show that from a mean-variance point of bank estimated gains considerably from allocating bank asset in to cross-border.

However, others have another view on the impact of internationalization on risk. International banks can take advantage of portfolio diversification reducing their risk, but this effect can be offset by incentives going in the opposite direction leading them to take on excessive risks (Gulamhussena, M.A., Pinheirob, C., and Pozzolo A.F., 2014). Berger, A., Sadok El Ghoul, Omrane Guedhami, and Raluca A. Roman (2013) also find that a positive relation between internationalization and bank risk, and the result is robustness examined by different measures and econometric models.

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To analyze the internationalization of bank risk, we use Z-score (e.g., Boyd and Runkle, 1993; Laeven and Levine, 2009; Berger, 2013) to measure which is defined as the sum of a bank's mean return on assets and mean on capitalization ratio divided by the standard deviation of return on assets. The Z-score is a commonly method to measure risk and has been used in numerous of the empirical banking literatures to reflect insolvency risk which captures the distance of default. Z-score also assesses both individual bank risk and overall financial stability which can be easily computed using accounting data. Therefore, we also follow this measure to evaluate risk.

## 3. Methodology and Framework

### 3.1 Data

We focus on commercial banks in Taiwan, and assemble quarterly data from Central Bank of Republic China (Taiwan) which contains income statements, balance sheets (also refer to statements of financial position), and major financial ratios of all Taiwanese commercial banks. Data covers the period from 2004:Q4 to 2014Q2 with 1,991 bank-quarter observations for 79 banks over the entire sample period. According to the report from Central Bank of Republic China (Taiwan), there are 71 commercial banks, 16 financial holdings, 62 OBU, 3,614 branches, 50 representative offices and 20 subsidiaries in 2014. Table 2 is the break down summary of banks in Taiwan.

Table 2 The Banks in Taiwan

| Financial Company | Region | Head Office | OBU | Branch | Representative Office | Subsidiary |
|---|---|---|---|---|---|---|
| Domestic Bank | Taiwan | 41 | 38 | 3,451 | 3 | 0 |
| Domestic Bank | Oversea | - | 0 | 124 | 47 | 20 |
| Foreign Bank | Taiwan | 27 | 24 | 36 | 0 | 0 |
| China Bank | Taiwan | 3 | 0 | 3 | 0 | 0 |
| Holdings | Taiwan | 16 | 0 | 0 | 0 | 0 |

### 3.2 Measures of risk

Follow by Berger, Allen N., Sadok El Ghoul, Omrane Guedhami, and Raluca A. Roman (2013), our primary measure of bank risk-taking is Z-score assessed as the average return on assets plus the average capitalization asset ratio (Equity/Total asset), divided by the standard deviation of return on asset. Standard deviation of return on assets is calculated over the previous 12 periods. Z-score has been widely used in the recent literature (Boyd and Runkle, 1993; Boyd, De Nicolo, and Jalal, 2006; Beltratti and Stulz, 2010). However, some researches declare that Z-score is highly skewed, we take the natural logarithm of the Z-score (Laeven and Levine, 2009; Houston et al, 2010; Bhagat S., Bolton, B. and Lu J., 2012) to cope with this concern. We also construct Z-score over previous 8 quarters and 20 quarters to use in robustness test.

In addition, several standard measures of risk based on accounting data are used in our study. 1) Standard deviation of return on equity (Stdv. ROE): This is evaluated over 12 quarters, where return on equity (ROE) is net income divided by total equity. 2) Risk-adjusted rate of return on equity (RAROE): RAROE is defined as the ratio of the average ROE to its standard deviation by using rolling basis of 12 quarters (Chiorrazo et al. 2008; Demirgüç-Kunt and Huizinga 2010). Also, two variable are used to measure stability and sustainable growth of banks (Ana Rosa Fonseca and Francisco González 2010; Berger, Allen N., Sadok El Ghoul, Omrane Guedhami, and Raluca A. Roman 2013). 1) Non-performing loans ratio (NPLR): A loan is non-performing when payments of interest and principal are past due for over 90 days; NPL ratio is computed as the ratio of non-performing loans to total loans. Flamini (2009) finds that the success of individual banks in credit risk management is largely reflected in the proportion of NPL's loans to gross lending. 2) Allowance for loan loss ratio (LLAR): The ratio of allowance for loan losses to total loans.

### 3.3 Measures of internationalization

Following Cetorelli and Goldberg (2012) and Berger, Allen N., Sadok El Ghoul, Omrane Guedhami, and Raluca A. Roman (2013), we use several methods to evaluate the degree of bank internationalization. 1) Foreign Assets Ratios (FAR): The main measure of bank internationalization computed as a bank's foreign asset divided by total asset. 2) Bank Internationalization Dummy: If a bank has assets oversea then we take the value 1, 0 otherwise. 3) Foreign Loans Ratio (FLR): The ratio of a bank's foreign loans to the total loans of the bank. 4) Foreign Deposits Ratio (FDR): A bank's foreign deposits to the total deposits of the bank. This study uses foreign assets ratio as the primary measurement for internationalization, and the others are used in robustness tests.

### 3.4 Control variable

Many of prior researches identify that bank characteristics may affect the bank risk exposure and might potentially bias our results. Therefore, in order to account for these factors, we include several time varying bank-specific controls in our investigation.

1) Income Diversification (DIV): Internationalization bank can benefit from portfolio diversification, but this effect can lead them to take on more excessive risk. Thi Canh Nguyen, Dinh Vinh Vo, and Van Chien Nguyen (2015) find that a bank with high non-interest income presents lower risk than those with mainly interest income. Demirgüç-Kunt and Huizinga (2010) and Baele, De Jonghe, and Vander Vennet (2007) find that a higher reliance on non-interest income is linked to more risk adjust returns. To evaluate the diversification level, we follow the approach of K. J. Stiroh and A. Rumble (2006).

Commercial banks' activities are classified between traditional (taking deposits and making loans) and non-traditional (e.g., security and foreign exchange trading and provision of fee-based services). We consider income diversification into two categories, net interest income (NII) and non-interest income (NOI). Net interest income is interest income minus interest expense and non-interest income including investment income, foreign exchange income, gain (or loss) on sale of securities, trading account income and commissions and fees.

Afterward, Herfindant-Hirschman Index (HHI) is used to measure the diversification level which is highly practical and is used widely to measure the competitiveness in a specific industry or market. We construct income diversification as $1 - \left[\left(\frac{NII}{NII+NOI}\right)^2 + \left(\frac{NII}{NII+NOI}\right)^2\right]$

The smaller the value is, the lower diversification level is and vice versa.

2) Size: The log of total assets as measure of the bank size. Evidences show that bigger banks tend to better survive in competition to have higher asset-quality and to be more leveraged drives banks into a race for expansion (Tianxi Wang, 2014). Futhermore, the large banks are much more diversified and stable taking advantages on economics of scale (Demsetz, R. S. and P. E. Strahan, 1997; Berger, Bouwman, Kick, and Schaeck, 2012). However, large banks are riskier, and create more systemic risk ethier when they have lower capital and less-stable funding or when they engage more in market-based activities or are more organizationally complex (Laeven L., Ratnovski L., and Tong H., 2014). Mamiza Haq and Richard Heaney (2012) also show that large banks may reflect higher total risk and lower credit risk.

3) Listed: This study measures listed as a dummy variable which equal to one if the bank is listed in Taiwan Stock Exchange, 0 otherwise. Listed banks are considered by rating agencies to have a higher default risk (Giuliano Iannottaa, Giacomo Nocerab, and Andrea Sironi 2013).

4) Financial Holding Company (FHC): We set up a variable to control the outcome of bank risk in our study, taking value of 1 if the bank is part of a financial holding company, and 0 otherwise. In November 2001, the 'Financial Holding Company Act' was implemented in Taiwan and that provides financial companies to function as a management umbrella by operating cross-industry, such as banking, securities and insurance. As of 2014, the government approved the application of 16 financial institutions to set up financial holding companies.

Laeven and Levine (2007) show that the diversification discount exists in a financial conglomerate instead of diversification premium. Stiroh and Rumble (2006) demonstrate that non-interest income has a negative impact on banks' diversification in the U.S. financial holding companies. In Taiwan, an independent bank could have lower systemic risk because an FHC bank with diversified activities will reinforce the agency problem between insiders and outsiders (Shen, C. H. and Chang Y., 2012).

5) Overhead Cost (OHC): In order to capture the bank's operating cost structure, our study evaluates it as the ratio of total bank operating expenses to total asset named overhead cost. Demirgüç-Kunt, A. and Huizinga, H. (2010) show that banks with high overheads are further estimated to be less stable and fee-generating activities are relatively costly. Table 3 lists the definitions of all variables that are used in our research.

Table 3 Variable Definitions

| Variable | Definition |
|---|---|
| **Risk Variables** | |
| Z-score | A bank measure of financial risk calculated as logarithm of [Avg.(ROA)+Avg.(Equity/Total Asset)]/Stdv.ROA; a larger value indicates lower overall bank risk. Means of ROA and Equity/GTA as well as the standard deviation of ROA are computed over the previous 12 quarters (t-11 to t). |
| Stdv. ROE | The standard deviation of ROE calculated over the previous 12 quarters (t-11 to t.) ROE is determined as the ratio of operating income to total equity. |
| RAROE | The risk-adjusted return on equity defined as ROE/Stdv.ROE. ROE is determined as the ratio of net operating income to total equity by using rolling basis of 12 quarters (t-11 to t.). |
| NPL Ratio (NPLR) | The ratio of non-performing loans (past due at least 90 days or in nonaccrual status) to total loans. |
| LLA Ratio (LLAR) | The ratio of allowance for loan losses to total loans. |
| **Internationalization Variables** | |
| Foreign Asser Ratio (FAR) | A measure of bank internationalization determined as the ratio of foreign total assets to total assets of the bank. |
| Bank Internationalization Dummy | A dummy variable that takes a value of 1 if a bank exists foreign assets, and 0 otherwise. |
| Foreign Loans Ratio (FLR) | A measure of bank internationalization determined as the ratio of foreign total loans to total loans of the bank. |
| Foreign Deposits Ratio (FDR) | A measure of bank internationalization determined as the ratio of foreign total deposits to total deposits of the bank. |
| **Main Bank Characteristics** | |
| Income Diversification (DIV) | A measure of diversification across different sources of income, calculated as $1 - \left[\left(\frac{NII}{NII+NOI}\right)^2 + \left(\frac{NII}{NII+NOI}\right)^2\right]$; where NII is net interest income and NOI is non-interest income. |
| Size | A measure of bank size determined as the log of total assets. |
| Listed | A dummy variable that takes a value of 1 if the bank is listed on a stock exchange or is part of a bank holding company that is listed on a stock exchange and 0 otherwise. |
| Financial Holding Company (FHC) | A dummy variable that takes a value of 1 if the bank is owned by a bank holding company, and 0 otherwise. |
| Overhead Cost (OHC) | A proxy for the bank's cost structure calculated as the ratio of overhead expenses to GTA. |

## 3.5 Empirical model

To investigate the data feature, we employee univariate analysis. We compute mean, medium, standard deviation, and two samples t-test to derive the descriptive statistics In order to prevent from collinearity in further analysis, correlation analysis is used.

Next, we conduct Ordinal Least Square (OLS) multivariate regression model to estimate the relationship between internationalization of bank and risk. Meanwhile, in order to control the individual bank's characteristics and the seasonal effect, we include important control variables and seasonal dummy variables. We use following model to estimate our study:
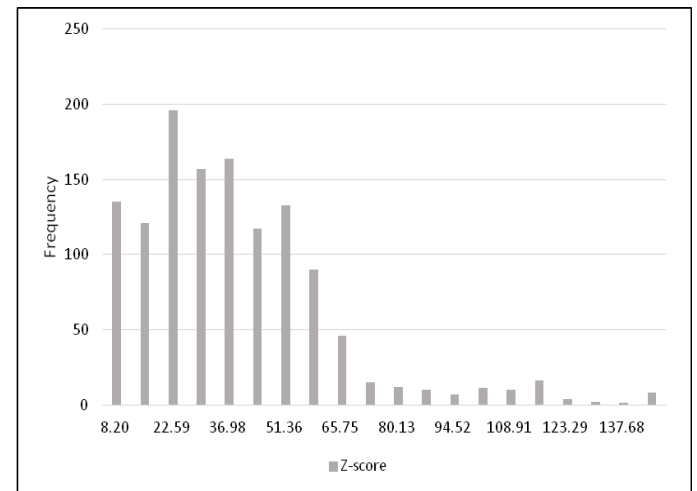
$$Risk = \alpha + \beta 1 \times Internationalization_{tlk} + \beta 2 \times Bank\ Controls_{tlk} + Time\ Fixed_t + \varepsilon_{tlk+1t}$$

where we measure the variable over the quarter from to , and the independent variables are measured in the quarter to ensure that they are predetermined associated with the dependent variable.

## 4. Empirical Analysis

In this session, we empirically analyze the impact of internationalization on bank risk. First, we simply descript the summary statistics of our variables and some characteristics of the banks. Second, univariate tests are used to compare the difference of international bank and domestic bank. Last, we conduct the regression analysis to demonstrate the relationship of internationalization and bank risk under some bank's control variables.

## 4.1 Summary statistics

Figure 1 shows that the distribution of Z-score without taking the natural logarithm and Figure 2 shows that the distribution of logarithm of Z-score. As noted, the distribution of Z-score has a serious skewed problem (Laeven and Levine, 2009; Houston et al, 2010; Bhagat S., Bolton, B. and Lu J., 2012), and in our sample which is skewed to right; therefore, after taking the natural logarithm of Z-score as shown in Figure 2, the distribution is much more similar with normal distribution. As a result, we will use the logarithm of Z-score for our further analysis.
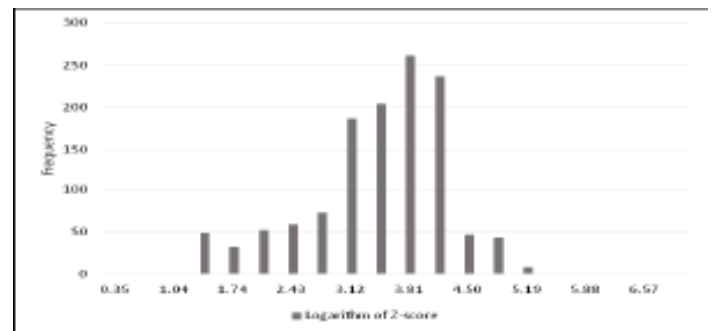


Figure 1 Distribution of Z-score



Figure 2 Distribution of Logarithm of Z-score

Table 4 demonstrates the summary statistics among all the variables in our study. In our main measure of bank risk, Z-score, the mean Z-score (12 quarters) is 3.265. It indicates that most of commercial banks in Taiwan with an average RAROE of 1.642, an average Stdv. ROE of 0.106, an average NPL Ratio of 3.1% and an average LLA Ratio of 1.6% have a small chance to default. The NPL Ratio has a very high standard deviation showing that there is a highly difference of lending situations among banks in Taiwan. The international measure indicates that almost 90% of all the commercial banks in Taiwan, with a mean foreign assets ratio of 9.4%, a mean foreign loans ratio of 8% and a mean foreign deposits ratio of 4.7%, have begun running the business overseas after 2002. In bank characteristics, 46% of the banks are listed in Taiwan Stock Exchange and 27% of the banks are owned by a financial holding company. Also, the average commercial bank has a size of 12.9, an income diversification of -1.165 which is relatively low and overhead costs of 0.008.

Table 4 Summary Statistics

| Variable | Mean | Median | Stdv. | 25p | 75p |
|---|---|---|---|---|---|
| **Risk Variables** | | | | | |
| Z-score (12 quarters) | 3.265 | 3.418 | 0.845 | 2.872 | 3.834 |
| Z-score (8 quarters) | 3.365 | 3.473 | 0.857 | 2.975 | 3.880 |
| Z-score (20 quarters) | 3.159 | 3.290 | 0.812 | 2.665 | 3.772 |
| RAROE | 1.642 | 1.423 | 1.177 | 0.621 | 2.630 |
| Stdv. ROE | 0.106 | 0.034 | 0.300 | 0.022 | 0.062 |
| NPLR | 0.031 | 0.016 | 0.057 | 0.006 | 0.029 |
| LLAR | 0.016 | 0.011 | 0.021 | 0.009 | 0.015 |
| **Internationalization Variables** | | | | | |
| FAR (Full sample) | 0.094 | 0.073 | 0.101 | 0.024 | 0.130 |
| FAR (International banks only) | 0.104 | 0.079 | 0.101 | 0.040 | 0.136 |
| Bank Internationalization Dummy | 0.906 | 1.000 | 0.292 | 1.000 | 1.000 |
| FLR | 0.080 | 0.055 | 0.096 | 0.016 | 0.101 |
| FDR | 0.047 | 0.020 | 0.072 | 0.004 | 0.060 |
| **Main Bank Characteristics** | | | | | |
| DIV | -1.165 | 0.358 | 37.399 | 0.264 | 0.450 |
| Size | 12.907 | 12.798 | 1.116 | 12.108 | 13.905 |
| Listed | 0.458 | 0.000 | 0.498 | 0.000 | 1.000 |
| FHC | 0.274 | 0.000 | 0.446 | 0.000 | 1.000 |
| OHC | 0.008 | 0.006 | 0.007 | 0.004 | 0.010 |

Table 5 demonstrates the Pearson correlation for the dependent variable and independent variables which will be used in further empirical analysis. Banks with higher foreign asset ratio tend to have higher Z-score indicating lower risk; large banks tend to have lower risk (higher Z-score) and higher foreign asset ratio. However, a negative relationship has been shown between listed bank and risk where listed banks are more likely to be large size.

Table 5 Correlation Analysis

This table reports correlations for the key bank variables used in the regression analysis. ***, **, and * indicate significance at the 1%, 5%, and 10% levels respectively

| Pearson Correlation Coefficient | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Z-score (12quarters) | FAR | DIV | Size | Listed | FHC | OHC |
| Z-score (12 quarters) | 1 | | | | | | |
| FAR | 0.24697*** | 1 | | | | | |
| DIV | -0.0187 | 0.0194 | 1 | | | | |
| Size | 0.1409*** | 0.2651*** | 0.0233 | 1 | | | |
| Listed | -0.1346*** | 0.1439*** | -0.0210 | 0.4134*** | 1 | | |
| FHC | 0.0167 | 0.1718*** | -0.0402* | 0.4354*** | 0.6090*** | 1 | |
| OHC | -0.3847*** | -0.1562*** | 0.0205 | -0.2649*** | -0.0622*** | -0.0714*** | 1 |

4.2 Univariate analysis

In order to clearly investigate the relationship between internationalization and risk, we use the bank internationalization dummy to separate our sample into two groups, international banks and domestic banks. We compare the means of risk variables and bank characteristics variables by using two sample t-test. Table 6 indicates that international banks have a higher mean Z-score (12 quarters) of 3.288 compared to 2.963 in domestic banks, and the difference is statistically significant at the 5% level.

The results of using other measures of bank risk consistently suggests that a bank with more overseas operations will take on more risk. For example, the average of Z-score computed over 8 quarters and 20 quarters for international banks are both higher than for domestic banks, and the differences in mean are 0.192 and 0.704, respectively. Furthermore, the RAROE examining the performance by adjusting for the risks is higher for international banks compared to domestic banks with the difference in mean of 0.483. Also, the average of Stdv. ROE is 1.677 for international bank compared to 1.194 for domestic banks. Both the average of non-performance loans ratio and allowance for loan losses ratio of international banks are lower than domestic banks with the difference in the mean of -3.8% and -0.9%. All of these differences are statistically significant. In sum, our findings support that commercial banks in Taiwan have an advantage on portfolios diversification contributing to lower risk.

Table 6 Internationalization and Bank Risk: Univariate Analysis

This table reports univariate comparison tests for international banks versus domestic banks. ***, **, and * indicate significance at the 1%, 5%, and 10% levels respectively.

| | International Banks | | Domestic Banks | | International - Domestic | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Variable | N | Mean | N | Mean | Diff. | t-stat |
| Z-score (12 quarters) | 1,173 | 3.288 | 90 | 2.963 | 0.325** | 2.39 |
| Z-score (8 quarters) | 1,373 | 3.381 | 129 | 3.189 | 0.192** | 2.44 |
| Z-score (20 quarters) | 840 | 3.175 | 19 | 2.471 | 0.704*** | 3.76 |
| RAROE | 1,173 | 1.677 | 90 | 1.194 | 0.483*** | 3.77 |
| Stdv. ROE | 1,173 | 0.092 | 90 | 0.288 | -0.196*** | -3.42 |
| NPLR | 1,756 | 0.026 | 219 | 0.065 | -0.038*** | -6.51 |
| LLAR | 1,761 | 0.015 | 225 | 0.024 | -0.009*** | -3.84 |
| DIV | 1,761 | -1.268 | 229 | -0.375 | -0.893 | -0.85 |
| Size | 1,761 | 13.083 | 230 | 11.561 | 1.521*** | 21.59 |
| Listed | 1,761 | 0.509 | 230 | 0.070 | 0.439*** | 21.31 |
| FHC | 1,761 | 0.304 | 230 | 0.048 | 0.256*** | 14.33 |
| OHC | 1,761 | 0.008 | 230 | 0.010 | -0.002*** | -2.88 |

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## 4.3 Regression analysis

Our goal is to evaluate how internationalization affects the risk taken by banks. We construct several regression models to elaborate our ideas. Table 7 presents the results from regressing Z-score (12 quarters) on internationalization variables with banks' control variables.

Model 1 includes all the data into regression and reports the results from regressing Z-score (12 quarters) on our main international variable, Foreign Asset Ratio. After controlling the bank characteristic variables and time fixed effects, we find that banks with higher Foreign Asset Ratio tend to have higher Z-score which means that banks can lower the risk through internationalization. An increase in one standard deviation of Foreign Asset Ratio (0.101) is associated with a decrease in Z-score of 0.154. Model 2 and Model3 present additional results. In Model 2, we replace Foreign Asset Ratio with Bank Internationalization Dummy. In Model 3, we exclude domestic banks in our sample to investigate the purely marginal effect of the Foreign Asset Ratio. The results show that the coefficient estimated on both internationalization variables are positive and statistically significant at 1% level.

In bank control variables, we can see that coefficients of Listed and OHC are both negative and statistically significant at 1% significance level. However, the coefficient of Size is not statistically significant. This result shows that the size of banks in Taiwan may not have significant explanatory power toward risk management and should be take more research.

To sum up, our primary study suggests that bank in Taiwan with higher internationalization are more capable of lowering the risk. Berger, Allen N., Sadok El Ghoul, Omrane Guedhami, and Raluca A. Roman (2013) using the data of commercial bank in the U.S. find that the market risk hypothesis dominates the diversification hypothesis and banks are more likely to take on more risk when going abroad which is contrary to our studies. That may be due to geographic difference and operations and activities difference, because banks in Taiwan usually follow their clients' pace and set up businesses in other countries to cope with their needs.

Table 7 Internationalization and Bank Risk: Regression Analysis

This table reports regression analysis of the relationship between the internationalization of Taiwanese commercial banks and risk. The main measure of internationalization is Foreign Asset Ratio and the dependent variable is our main measure of risk, Z-score (12 quarters). Robust t-statistics are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels respectively.

| | Dependent Variable: Z-score (12 quarters) | | |
| Independent Variable | (1) Full Sample | (2) Full Sample | (3) International Banks Only |
| --- | --- | --- | --- |
| FAR | 1.526*** | | 1.273*** |
| | (7.74) | | (6.80) |
| International Banks Dummy | | 0.534*** | |
| | | (5.42) | |
| Intercept | 3.100*** | 2.928*** | 3.539*** |
| | (10.62) | (9.81) | (12.44) |
| DIV | -0.00028 | -0.00018 | -0.00006 |
| | (-0.60) | (-0.37) | (-0.14) |
| Size | 0.032 | 0.020 | 0.006 |
| | (1.42) | (0.86) | (0.28) |
| Listed | -0.433*** | -0.464*** | -0.464*** |
| | (-8.65) | (-9.05) | (-9.89) |
| FHC | 0.137** | 0.176*** | 0.152*** |
| | (2.47) | (3.16) | (2.95) |
| OHC | -76.690*** | -81.931*** | -91.330*** |
| | (-16.54) | (-17.62) | (-17.90) |
| Time Fix Effect | Yes | Yes | Yes |
| Observations | 1,263 | 1,263 | 1,173 |
| R-Square | 0.284 | 0.266 | 0.313 |
| Adj. R-Square | 0.278 | 0.261 | 0.307 |

## 4.4 Robustness tests

### 4.4.1 Alternative measures of risk

Considering the robustness of our findings, we replace the Z-score with alternative measures of bank risk. First, aside from computing Z-score over previous 12 quarters, we apply 8 quarters and 20 quarters as a dependent variable in Model 2 and Model 3 respectively. Second, in Model 4, we use RAROE to examine bank risk, and in Model 5, Stdv. ROE is used. Both dependent variables are constructed by rolling previous 12 quarters in order to persist with Z-score (12 quarters) which is also computed over previous 12 quarters in baseline model (Model 1). Next, in Model 6 we employ NPL Ratio to examine bank risk. In Model 7, LLA Ratio is taken place to test bank risk. Table 8 reports all results.

We find that all of the models are consistent with our previous finding suggests that banks can lower risk with higher degree of internationalization; furthermore, instead of Model 5 and Model 7, each of the specifications are statistically significant at 1% level.

Table 8 Alternative Measures of Risk

This table reports regression analysis of the relationship between the internationalization of Taiwanese commercial banks and risk using alternative measures of risk to compare with baseline model. Robust t-statistics are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels respectively.

| Dependent Variable: Alternative Measures of Risk | | | |
|---|---|---|---|
| Independent Variable | (1) Z-score (12 quarters) | (2) Z-score (8 quarters) | (3) Z-score (20 quarters) |
| FAR | 1.526*** | 1.047*** | 2.085*** |
| | (7.74) | (5.45) | (9.61) |
| Intercept | 3.100*** | 3.676*** | 2.826*** |
| | (10.62) | (13.13) | (8.75) |
| DIV | -0.00028 | -0.00001 | -0.00040 |
| | (-0.60) | (-0.02) | (-0.95) |
| Size | 0.032 | -0.003 | 0.051** |
| | (1.42) | (-0.15) | (2.06) |
| Listed | -0.433*** | -0.331*** | -0.676*** |
| | (-8.65) | (-6.77) | (-12.94) |
| FHC | 0.137** | 0.099 | 0.160* |
| | (2.47) | (1.81) | (2.81) |
| OHC | -76.690*** | -75.500*** | -80.627* |
| | (-16.54) | (-17.47) | (-14.66) |
| Time Fix Effect | Yes | Yes | Yes |
| Observations | 1,263 | 1,502 | 859 |
| R-Square | 0.284 | 0.233 | 0.400 |
| Adj. R-Square | 0.278 | 0.228 | 0.393 |

| Dependent Variable: Alternative Measures of Risk (Conti.) | | | |
|---|---|---|---|
| Independent Variable | (4) RAROE | (5) Stdv. ROE | (6) NPLR | (7) LLAR |
| FAR | 1.226*** | -0.135* | -0.077*** | -0.006 |
| | (4.57) | (-1.86) | (-6.53) | (-1.27) |
| Intercept | -1.392*** | 0.659 | 0.163*** | 0.070*** |
| | (-3.50) | (6.14) | (10.45) | (11.26) |
| DIV | 0.00103 | 0.00002 | -0.00015*** | -0.00005*** |
| | (1.61) | (0.13) | (-4.84) | (-4.29) |
| Size | 0.158*** | -0.046*** | -0.010*** | -0.004*** |
| | (5.14) | (-5.49) | (-7.88) | (-8.59) |
| Listed | -0.009 | -0.025 | -0.014*** | -0.004*** |
| | (-0.14) | (-1.35) | (-4.70) | (-3.45) |
| FHC | -0.046*** | 0.021 | 0.0002 | 0.003** |
| | (-0.61) | (1.02) | (0.06) | (2.51) |
| OHC | -10.841*** | 24.276*** | 2.520*** | 0.732*** |
| | (-1.72) | (14.23) | (12.58) | (9.21) |
| Time Fix Effect | Yes | Yes | Yes | Yes |
| Observations | 1,263 | 1,263 | 1,991 | 1,991 |
| R-Square | 0.316 | 0.229 | 0.235 | 0.142 |
| Adj. R-Square | 0.311 | 0.223 | 0.232 | 0.138 |

### 4.4.2 Alternative measures of internationalization

As noted, our main internationalization variable is Foreign Assets Ratio, but we replace it with Foreign Loans Ratio (Model 2) and Foreign Deposits Ratio (Model 3) to strengthen our research. As shown in Table 9, although the coefficient on Foreign Deposits Ratio does not reach statistically significant level, all coefficients on internationalization Ratios have the same positive impact on Z-score. This fact convinces that internationalization and risk have a negative relationship among banks in Taiwan.

Table 9 Alternative Measures of Internationalization

This table reports regression analysis of the relationship between the internationalization of Taiwanese commercial banks and risk using alternative measures of internationalization to compare with baseline model. Robust t-statistics are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels respectively.

| Dependent Variable: Z-score (12 quarters) | | | |
|---|---|---|---|
| Independent Variable | (1) FAR | (2) FLR | (3) FDR |
| Internationalization Ratio | 1.526*** | 1.814*** | 0.230 |
| | (7.74) | (8.89) | (0.79) |
| Intercept | 3.100*** | 2.848*** | 3.175*** |
| | (10.62) | (9.76) | (10.63) |
| DIV | -0.00028 | -0.00023 | -0.00011 |
| | (-0.60) | (-0.50) | (-0.23) |
| Size | 0.032 | 0.050** | 0.038 |
| | (1.42) | (2.23) | (1.63) |
| Listed | -0.433*** | -0.401*** | -0.423*** |
| | (-8.65) | (-8.05) | (-8.26) |
| FHC | 0.137** | 0.086 | 0.160*** |
| | (2.47) | (1.54) | (2.77) |
| OHC | -76.690*** | -73.582*** | -81.233*** |
| | (-16.54) | (-15.83) | (-17.25) |
| Time Fix Effect | Yes | Yes | Yes |
| Observations | 1,263 | 1,263 | 1,263 |
| R-Square | 0.284 | 0.294 | 0.250 |
| Adj. R-Square | 0.278 | 0.289 | 0.244 |

### 4.5 Additional Analysis

### 4.5.1 Internationalization and risk during financial crisis

Some argue that international banks are benefited from a more efficient asset diversification on global markets but, at the same time, exposing to more risk as well. To evaluate how does financial crisis impact on commercial banks in Taiwan, we create the subsample of subprime lending crisis from 2007:Q3 to 2009:Q4 and the results are presented in Table 10.

The results suggest that the banks in Taiwan during the financial crisis have a higher impact on Z-score compared to baseline model. According to the quarterly report of Bank of Taiwan, Taiwanese banks did not hold much assets associated to subprime mortgage in 2007. Only 5 commercial banks sold related financial products to public investors with total amount NTD 4.1 billion. Therefore, during financial crisis, banks still can reduce their risk through portfolio diversification globally.

Table 10 Internationalization and Bank Risk during Financial Crisis

This table reports regression analysis of the relationship between the internationalization of Taiwanese commercial banks and risk during subprime financial crisis. Robust t-statistics are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels respectively.

| Dependent Variable: Z-score (12 quarters) | | |
|---|---|---|
| | (1) | (2) |
| Independent Variable | Full Sample | Financial Crises |
| FAR | 1.526*** | 1.854*** |
| | (7.74) | (3.70) |
| Intercept | 3.100*** | 2.463*** |
| | (10.62) | (3.37) |
| DIV | -0.00028 | -0.00054 |
| | (-0.60) | (-0.97) |
| Size | 0.032 | 0.081 |
| | (1.42) | (1.44) |
| Listed | -0.433*** | -0.831*** |
| | (-8.65) | (-6.99) |
| FHC | 0.137** | 0.153 |
| | (2.47) | (1.18) |
| OHC | -76.690*** | -93.391*** |
| | (-16.54) | (-8.67) |
| Time Fix Effect | Yes | Yes |
| Observations | 1,263 | 281 |
| R-Square | 0.284 | 0.386 |
| Adj. R-Square | 0.278 | 0.366 |
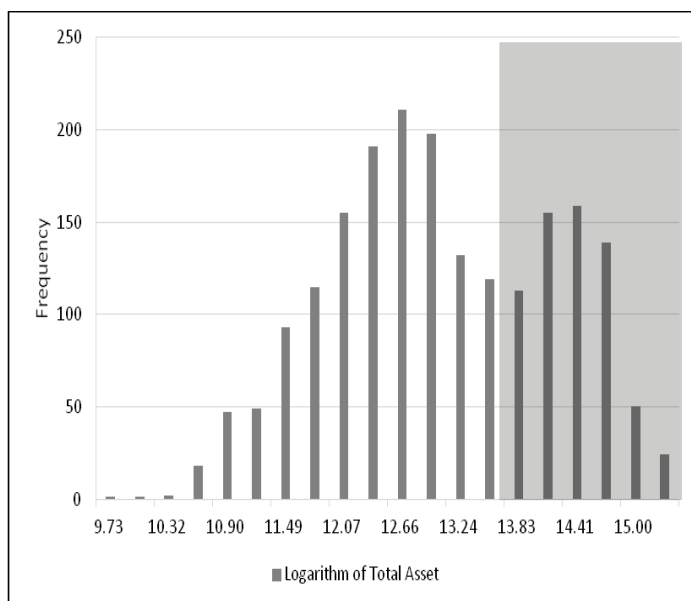


Figure 3 Distribution of Logarothm of Total Asset

Table 11 Regression Analysis by Different Bank Size

This table reports regression analysis of the relationship between the internationalization of Taiwanese commercial banks and risk using difference bank size subsamples. Robust t-statistics are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels respectively.

| Dependent Variable: Z-score (12 quarters) | | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Independent Variable | Full Sample | Large Size | Small Size |
| FAR | 1.526*** | -1.085*** | 1.871*** |
| | (7.74) | (-3.16) | (7.56) |
| Intercept | 3.100*** | -1.423 | 4.884*** |
| | (10.62) | (-1.24) | (8.94) |
| DIV | -0.00028 | 0.95138*** | -0.00035 |
| | (-0.60) | (3.61) | (-0.66) |
| Size | 0.032 | 0.344*** | -0.122*** |
| | (1.42) | (4.40) | (-2.76) |
| Listed | -0.433*** | -0.305*** | -0.264*** |
| | (-8.65) | (-4.09) | (-3.59) |
| FHC | 0.137** | 0.150*** | -0.020 |
| | (2.47) | (2.72) | (-0.21) |
| OHC | -76.690*** | -68.365*** | -78.722*** |
| | (-16.54) | (-6.24) | (-14.21) |
| Time Fix Effect | Yes | Yes | Yes |
| Observations | 1,263 | 443 | 820 |
| R-Square | 0.284 | 0.370 | 0.291 |
| Adj. R-Square | 0.278 | 0.356 | 0.283 |

### 4.5.2 Bank Size Break down

In our previous studies, all evidences demonstrate that a negative correlation exists between internationalization and risk; however, in our previous empirical analysis, the control variable, Size, has an ambiguous impact on risk without statistically significant. Accordingly, we plot out the distribution of Size in Figure 3. As you can see from the figure, the distribution of Size is bimodal which may have caused biases in regression models. To solve this problem, we select 70 percentile of Size (13.64) as the cut point to separate our sample into Small Size and Large Size which is the gray area in Figure 3. Next, we do the regression analysis to examine the relationship between internationalization and risk in two subsamples.

In Table 11, we find that the banks in the sample of large size have a positive impact of internationalization on risk with statistically significant at 1% level. This result is consistent with Berger, Allen N., Sadok El Ghoul, Omrane Guedhami, and Raluca A. Roman (2013), who claim that the market risk hypothesis may dominate over the diversification hypothesis (i.e. banks will take on more risk when going abroad and cannot get the advantage on portfolio diversification). After separating the full sample into larger size and small size, we were convinced that some of the banks characteristic variables are missing in our regression model.

In order to investigate bank characteristics in different bank size, we decompose Z-score into three main components which are mean ROA, mean capitalization asset ratio (Equity/ Total asset), and standard deviation of return on asset (Stdv. ROA). In Table 12, we find that large banks have higher average Z-score, lower capitalization asset ratio, and lower Stdv. ROA than small banks which mean although large banks tend to take on more risk from internationalization activates, large banks are more stable than small banks. Furthermore, large banks are associated with lower profitability than small banks as measured by mean ROA. The results suggest that government controls should take into consideration, for banks might meet certain criteria and be approved by government to internationalize their business. However, while accessing the global market, banks will expose themselves into a more risky environment.

Table 12 Z-score Decomposition by Different Bank Size

This table reports Z-score decomposition for large size versus small size. ***, **, and * indicate significance at the 1%, 5%, and 10% levels respectively.

| | Z-score Decomposition | | | |
| | Large Size N=443 | Small Size N=820 | Large - Small (Mean) | |
| | (1) | (2) | (3) | (4) |
| Variable | Mean | Mean | Diff. | t-stat |
| Z-score (12 quarters) | 3.4269 | 3.1769 | 0.2500 | 5.89*** |
| ROA | 0.0039 | 0.0070 | -0.0031 | -9.12*** |
| Equity/Asset | 0.0575 | 0.0977 | -0.0402 | -10.79*** |
| Stdv. ROA | 0.0024 | 0.0064 | -0.0040 | -8.70*** |

5. Conclusions

Many research papers show that the more internationalized a bank is, the higher the risk it bears. However, based on commercial banks data in Taiwan, we find that internationalization has negative relationship with risk following Berger, A., Sadok El Ghoul, Omrane Guedhami, and Raluca A. Roman (2013) structures, who analyze the relationship between internationalization and bank risk with numerous of empirical models. Also, we deliver the robustness test on different measures of risk and internationalization suggesting a consistent result to support our finding. In the end, we consider banks in distinct size because we find a bimodal distribution in Size variable. After we subsample the data into large size and small size with 70p cut point, a strong evidence shows that large banks tend to take on more risk but small banks can be benefited by diversify their portfolios and gain access to global capital market.

We show large banks could gain more risk from increasing internationalization activities. However, when we compare characteristics of bank between the two subsamples we find that large bank have a higher average Z-score and higher income diversification indicating that large banks can gain more profit and be more stable. On the other hand, small banks have a diversification effect on internationalization but the overall risk is larger and the operation is not as efficient as large banks. The reason is that regulations in Taiwan are more restricted for banks inside of the country which make only several financial holdings can do financial services differently in Asia Pacific; therefore for those who seeking more profits outside Taiwan might take on more risk. Conversely, the small banks can also provide financial services which are relatively simple and no risky; as a consequence, they could benefit from asset diversification. We suggest that different bank sizes may have different impacts of internationalization on risk and other evaluation methods should be employed in different banks.

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