

**Diversification, Stability and the Performance of Banks
Operating Under Financial Holding Companies:
Evidence from Taiwan**

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Abstract

Taiwan's banking system entered a new era following the introduction of the Financial Holding Company (FHC) Act and the establishment of 14 FHCs during 2001 and 2002. This thesis assesses whether banks (FHC banks) operating as part of an FHC do better than their counterparts (non-FHC banks) which do not belong to an FHC. The performance and diversification of FHC banks and non-FHC banks are assessed for two periods: 1999-2001 (pre-acquisition period) and 2003-2005(post-acquisition period). Findings show there is little evidence that banks operating as part of an FHC help to improve their performance and expand into non-interest activities. The decomposing variance of operating revenue and cross-sectional regression results for 42 sample banks in Taiwan indicate that banks' expansion into non-interest income activities increase their profitability and reduce their volatility on average return on assets (ROAA). Banks with a moderate loan-to-asset ratio, but lower non-interest income shares, generate lower profits and suffer higher risk.

Executive Summary

The introduction of the Financial Holding Company (FHC) Act in Taiwan permits commercial banks, securities companies and insurance firms to affiliate and operate under the same roof of an FHC. Fourteen FHCs were set up in Taiwan during 2001 and 2002. At the end of 2005, the 14 FHCs consolidated 94 financial institutions, including 16 domestic banks, 1 foreign bank, 14 securities companies, 7 insurance companies and 56 other financial institutions. More banks in Taiwan are interested in transforming themselves into FHCs to pursue potential synergies and enhance their competitive advantage provided by the structure of an FHC. Identifying the influences of Taiwan's FHCs became an important issue which needed to be assessed rigorously.

Assessing whether banks (FHC banks) operating as part of an FHC do better than their counterparts (non-FHC banks) that do not belong to an FHC is the major objective for this thesis. The performance and degree of diversification of FHC Banks and non-FHC banks was compared between two periods: 1999-2001 (pre-acquisition period) and 2003-2005(post-acquisition period). The return on average asset (ROAA) and return on average equity (ROAE) are used as proxies for performance and the non-interest income's share as a proxy for the degree of diversification. Results show that the overall performance of FHC banks was better than the non-FHC banks. This is probably due to banks which have historically higher profitability were more likely to be approved by the regulator for the conversion into FHCs. The growth rates of ROAA and ROAE of FHC banks during the post-consolidation period were not higher than their non-FHC counterparts, which provides little evidence that banks operating as parts of FHCs help to improve their performance. Though the degree of diversification of FHC banks was found to be higher than their non-FHC counterparts over the entire sample period, the growth rates of the degree of diversification during the post-acquisition period are not significantly different for FHC and non-FHC banks, indicating that operating as part of an FHC does not help banks to diversify into non-interest activities.

Finally the decompose variance of operating revenue and cross-sectional regression for 42 sample banks are performed to investigate the risk and profitability impact of banks' expansion into non-interest income activities. Empirical evidence shows that banks with a

higher share of trading and fee income enjoy higher returns. The banks' expansion into fee-income activities reduces the volatility of ROAA, but has no effect on the reduction of the volatility of ROAE, possibly indicating that the diversification benefits were more than offset by the increased leverage when they expanded into fee-income activities. The unexpected U-relationship between loan-to-assets ratio and profitability, as well as the insolvency risk caused the further investigation. Findings show that banks with a higher or lower loan-to assets ratio also have a higher share of non-interest income. This provides the evidence that banks either devote themselves to expand more interest or non-interest income activities enjoy higher profitability and lower insolvency risk. Banks with a moderate loan-to-asset ratio, but lower non-interest income shares, may lack competitive advantages since they generate lower profit and suffer higher risks.

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Chapter 1: Introduction

Over the past few decades, the rapid development of financial conglomerates¹ has formed a new landscape in financial markets. Through the structure of a financial holding company (FHC) or universal bank, financial conglomerates can take advantage of their huge capital bases to integrate traditional commercial banking, securities and insurance businesses. Universal banking was first adopted by Germany, to provide traditional commercial banking services and non-banking financial services within a single legal entity. In the United States, the passage of the Gramm-Leach-Bliley Act in 1999 marked the end of the Glass Steagall Act, which caused a separation between the commercial and investment banking (securities activities) businesses. This significant change opened a new era for the US financial markets. Now under the umbrella of an FHC, the US banking organizations are free to offer commercial banking, investment banking and insurance services.

In Taiwan, an “overbanking” problem has long been cited as the reason for the decline in the overall competitiveness of financial market. Since 1991 the Government gave approval for 16 new commercial banks to enter the financial market, as the intense price competition had gradually weakened the profitability of the banking industry and the quality of financial assets. In 2001, the non-performing loan ratio (NPL ratio)² for all domestic banks reached its highest level of 7.48%. There were 332 financial institutions operating in Taiwan’s financial market, including 53 domestic and 39 foreign banks, 57 domestic and foreign insurance companies, and 183 securities firms. The market saturation and deteriorating competitive capability of financial institutions has led to the Government’s determination to reform the financial market in Taiwan. Two major financial reform acts, Financial Institutions Merger Law and the Financial Holding Company Act, were enacted in November 2000 and June 2001 respectively, to help facilitate financial restructuring and acquisition. In 2001, Taiwan’s Ministry of Finance

¹ The Basel Committee has defined financial conglomerates as “*any group of companies under common control whose exclusive or predominant activities consists of providing significant services in at least two different financial sectors (banking, securities, insurance).*” (see BIS 1995, “The Supervision of Financial Conglomerates”)

² NPL ratio is defined as non-performing loan divided by total loan outstanding.

(MOF)³ set up a threshold of NT\$ 20 billion capital as a requirement for the establishment of an FHC. At the end of 2005, 14 FHCs operated in Taiwan. These 14 FHCs had successfully integrated 94 financial institutions under their umbrellas (see Appendix 1). In this essay, the banks operating as part of an FHC are called FHC banks; the other banks which do not belong to the FHCs are called non-FHC banks.

The Act facilitated the development of financial conglomerates to allow different kinds of financial subsidiaries such as banks, securities companies, insurance companies, bill finance companies and venture capital companies to operate under the umbrella of an FHC. Proponents argue the advantages of an FHC to integrate banking, securities and insurance activities under a financial conglomerate to create the synergies of information sharing, cross-selling, economies of scope and scale, diversification and operating efficiency. However, the empirical evidence for the existence of economies scale and scope is unclear.⁴ A large FHC does not guarantee the improvement of assets quality and profitability. For example, Berger and Mester (1997) investigate the relationship between bank size and efficiency. They found that the cost efficiency is about 2.5% higher in larger banks. However, smaller banks show higher profit efficiency.

The 14 FHCs quickly consolidated many financial institutions to expand their business realms. The number of financial institutions operating under FHCs grew fast from 68 in 2003 to 94 in 2005. Many banks in Taiwan are interested in transforming themselves into FHCs to pursue potential synergies and enhance their competitive advantage provided by the structure of FHCs⁵. Based on the rapid development of

³ Originally Taiwan's financial institution was supervised by the MOF. However, after the establishment of FHCs, a single regulator, Financial Supervisory Commission (FSC), was established on 1 July 2004 to consolidate the supervision of banking, securities and insurance companies.

⁴ Numerous studies explore the presence of economies of scale and scope in banking. However, their results are controversial. For example, Clark (1988) researched the US banks covering the period from the 1970s to 1980s. He found that the economies of scale in commercial banking were exhausted at relatively low deposit levels. More recent studies found evidence of economies of scale in larger banks. Shaffer (1994) finds significant scale economies up to \$60 billion in the largest banks in the US. This thesis will not consider the issue. Instead the object is to examine whether FHC banks in Taiwan, facilitated by being part of FHCs, make them do better than their non-FHC counterparts.

⁵ After the approval of the establishment of 14 FHCs in 2001 and 2002, the MOF stopped granting new licenses for the establishment of the FHCs in the light of the crowded financial sector. However, many financial institutions are interested in transforming themselves into FHCs, so the FSC is planning to resume licensing new FHCs and to increase the capital requirement to at least NT\$50 billion (US\$ 1.55 billion).

FHCs in Taiwan and the argument for the Government to allow more FHCs to set up in Taiwan, it is worth investigating whether banks' performances have been improving since being acquired by an FHC. Furthermore, another important question for regulators, managers, shareholders and the customers is the financial stability of banks. It is expected that the degree of diversification would be higher for FHC banks due to Taiwan's legal difference of cross-selling between FHC banks and non-FHC banks. FHC banks enjoy a wider range of cross-line business activities, which may contribute to them engaging in more non-interest income activities.⁶ It is generally believed that diversification could reduce the banks' risks. However, the empirical results in many past studies indicated that the impact of increase of non-interest income is mixed⁷. Whether the increases of the non-interest income reduces or increases banks' risks depends on the volatility of non-interest income and the correlation between the interest income and non-interest income.

This thesis sets out to accomplish three related tasks, with the objective of assessing whether FHC banks in Taiwan, helped by being part of an FHC, makes them do better than their non-FHC counterparts. Firstly, the potential benefit/cost of banks that operate as part of the FHCs will be investigated. The profitability of FHC banks before and after they were acquired by an FHC will be compared to assess whether the FHC structure helped them to improve their profitability. Second, given that FHC banks have a wider scope in marketing cross-business financial services, it is useful to investigate whether the FHC structure could help banks to generate the non-interest income revenue. The degree of diversification of FHC banks (defined as non-interest income as a share of operating revenue) will be evaluated before and after they were acquired by an FHC. Finally, the diversification benefits will be investigated to check whether banks' expansion into non-interest income activities increases or reduces their profitability and risk. The variance of operating revenue is decomposed by using the variance-covariance theory, and sensitivity analysis is employed to examine how non-interest income contributes to the volatility of banks' income. Two regression models are also used to explore whether the non-interest income share contributes to the bank's profitability and risk.

⁶ See Chapter 2 for further discussions.

⁷ See Chapter 3 for further discussions.

This thesis is organized as follows. Chapter 2 offers a synopsis of the banking industry in Taiwan. Chapter 3 provides the literature review, in which the impact for financial institutions' expansion into non-interest income activities will be discussed. Chapter 4 presents the methodologies and the results of the econometric research, which includes the assessment of the performance and the degree of diversification of FHC banks and investigation of the risk and return related to the banks' expansion into non-interest income activities. Chapter 5 concludes this thesis.

Chapter 2: A Synopsis of Taiwan's Banking Industry

Before 1991 Taiwan's banking industry was protected from outside competition and the public-owned banks were the major players in the deposit and loan market. However, under the Government's policy to pursue the financial liberalization and increase operating efficiency, the market was opened to new entrants for free competition. In 1991, 16 newly established privately-owned commercial banks were approved to join the financial market. Lately the Government has employed a series of policies to enhance the market competition, including allowing the trust and investment corporations, credit cooperatives and small and medium business banks to convert to commercial banks, as well as granting more foreign banks access to the Taiwan market. At the end of 2000, the number of banks reached its highest level to 53 domestic banks and 39 local branches of foreign banks (see Table 1). The oligopoly market has diminished; instead a fully competitive environment has cut the profit margins of the banks and challenges them to manage their asset more efficiently.

Table 1: The Number of Banks in Taiwan's Banking Industry

Year	Head office		Branches	
	Domestic	Local Branches of	Domestic	Local Branches of
1993	41	37	1 382	55
1994	42	37	1 577	57
1995	42	38	1 807	58
1996	42	41	1 936	65
1997	47	45	2 176	69
1998	48	46	2 404	72
1999	52	41	2 576	71
2000	53	39	2 693	70
2001	53	38	3 005	69
2002	52	36	3 068	68
2003	50	36	3 173	69
2004	49	35	3 189	67
2005	45	36	3 239	68

Source: Statistic for Financial Institution, Banking Bureau, Financial Supervisory Commission of Taiwan.

After the Asian financial crises in 1997, the accelerating NPL ratio and deteriorating profitability of domestic banks (see Table 2) revealed the problems of over-

competition. The Government applied a tax and deposit reserve rate reduction policy⁸ to facilitate banks to write-off its non-performing loans, as well as urging banks to sell non-performing loans to asset management companies to trim down the NPL ratio. Also, the Financial Institutions Merger Law and the Financial Holding Company Act were passed to encourage banks' mergers and integration of banking, securities and insurance companies to moderate the fierce competition in financial markets and keep pace with the international trend for bank's diversification. Fourteen FHCs were established during the years 2001 and 2002, as well as several mergers and acquisitions which were took place during these years. At the end of 2005, the number of banks had been reduced to 45.

**Table 2 : ROAA, ROAE and Non-Performing Loan Ratio
for Domestic Banks and Branches of Foreign Banks**

Year	Domestic Banks			Branches for Foreign Banks		
	ROAA	ROAE	NPL	ROAA	ROAE	NPL
1997	0.89	13.18	3.71	1.52	33.27	1.07
1998	0.75	10.27	4.37	1.01	22.00	1.65
1999	0.57	7.31	4.88	0.77	16.72	3.20
2000	0.48	6.22	5.34	1.29	33.16	3.22
2001	0.27	3.60	7.48	1.19	32.01	3.53
2002	-0.48	-6.93	6.12	1.22	31.73	2.36
2003	0.22	3.52	4.33	1.29	38.33	1.51
2004	0.63	10.30	2.78	1.19	39.36	1.03
2005	0.30	4.81	2.24	1.00	35.24	0.75

unit: %

Source: Statistic for Financial Institution, Banking Bureau, Financial Supervisory Commission of Taiwan.

As shown in Table 2, the overbanking problem has led to the decline of the ROEE of domestic banks from 0.89% in 1997 to -0.48 in 2002. However the ROAA of branches of foreign banks in Taiwan were still upheld at 1.22% in 2002. Furthermore, the NPL ratio for domestic bank climbed from 3.71% in 1997 to a record high of 7.48% in 2001 while the NPL ratio for branches of foreign banks was at 3.53%. These signs reflect the operating inefficiency and inferior risk management of domestic banks. Some of the arguments pointed out the failure of domestic banks to provide the same products and services to customers and the lack of the ability to diversify their business to enhance their competitiveness.

⁸ In 1999, the MOF lower the value-added tax rate (from 5% to 2%) as well as the deposit reserve rate to require banks to apply increase earnings exclusively to bad debt write-off.

In recent years the Government in Taiwan has dedicated itself to create an environment to help banks to expand to non-interest income business. Traditionally, Taiwan's banks earn non-interest income from services such as checking, trust, letters of credit, credit cards and cash management. Moreover, Taiwan's banks have long been permitted to engage in partial investment banking businesses⁹. So parts of their non-interest income come from the securities activities such as underwriting and proprietary trading businesses. Furthermore, to promote the pace of product innovation, the Government has endeavored to deregulate financial restrictions for banks to allow them to develop new kinds of products and services. For example, the derivatives markets grew rapidly during the past few years.

As shown in Table 3, derivative activities have been substantially increased. The notional amount of outstanding derivatives has increased by 13 times from 1999 to 2005.

Table 3: Notional Amount of Outstanding Derivatives by Risk

Unit :NT dollar millions

Year	Interest	Exchange	Equity	Commodity	Credit	Other	Total
1999	487,600	1,645,830	-	12,537	-	-	2,145,967
2000	702,791	2,353,786	-	47,596	-	-	3,104,173
2001	1,308,772	3,363,045	5,518	47,132	-	-	4,724,467
2002	3,029,844	4,140,787	35,349	79,589	-	-	7,285,569
2003	6,288,102	7,119,975	56,953	97,039	-	-	13,562,069
2004	11,675,498	9,870,345	43,057	145,976	43,043	-	21,777,919
2005	18,923,399	10,783,615	40,140	185,564	83,069	4,312	30,020,099

Source: Central Bank of Taiwan.

As securitization markets continued to grow rapidly globally, Taiwan's Government followed this global trend to develop its securitization market. Two vital acts—"Financial Asset Securitization Act" and the "Real Estate Securitization Act"

⁹ Shen (2005) point out "Taiwan's banking system can be referred to as a 'partial universal banking' systems.". He said "...commercial banks in Taiwan, which were initially prohibited from engaging in commerce, securities and other financially-related businesses. These prohibitions were soon found to severely deter corporate financing from the equity market since few securities houses were available during the early stage of economic development. To make a compromise, commercial banks are later permitted to choose two of three 'standard investment banking business', that is, underwriting, proprietary trading and brokerage,.....they are not a universal banking system since insurances and equity-related business, are still prohibited."

were introduced on July 24, 2002 and July 23, 2003 respectively to provide a legal framework for banks to develop the local securitization market. The first product was issued in February 2003, which consisted of a NT\$ 3.65 billion of collateralized loans originating from the Taiwan Industrial Banks. At the end of 2005, the issue amount of securitization was NT\$ 258.5 billion (see Table 4) which included collateralized loan obligations (CLO), mortgage back securities (MBS), as well as credit card and car loan receivables. The market is promising since more and more banks in Taiwan have recognized the benefit of securitization to increase efficiency of capital allocation. They work with experienced international arrangers to upgrade their ability to further develop the securitization markets. The rapidly growing securitization market has provided ample room for banks to earn fee income from originating and servicing loans, which is different from holding loans to earn interest income.

Table 4: Amount of Securitisation

Unit: NT dollars one hundred millions

Year	Securisation		Securitisation		Total	
	Issued	Outstanding	Issued	Outstanding	Issued	Outstanding
2003	269.8	158.8	0.0	0.0	269.8	158.8
2004	421.5	478.2	99.8	99.2	521.3	577.4
2005	1418.6	1653.3	375.4	463.7	1794.0	2117.0
	2109.9		475.2		2585.1	

Source: 2005 Annual Report of Financial Supervisory Commission.

The establishment of FHCs also opened the gate for banks to expand fee-income activities. Under the structure of FHC, banks can provide a channel of one-stop shopping to customers by offering banking, securities and insurance products through cross-selling. According to the FHC Act in Taiwan, banks, securities companies and insurance companies which belong to the same FHC (FHC firms) are allowed to set up marketing and service counters at each other's branch or offices to facilitate cross-selling of financial institutions. However, the financial institutions that do not belong to FHCs (non-FHC financial firms) were restricted in their marketing of cross-business financial services. Although this restriction was eased on June 2003, to enable non-FHC firms to provide cross-business marketing services through strategy alliance with other financial firms, the cross-line business scope of these non-FHC

firms is smaller than that of FHC firms.

Banks being permitted to cross-sell financial products also allows them to move to the area of “Wealth Management” business. By means of providing wealthy individuals a comprehensive asset management and advisor service which involves offering integrated financial products and services such as trust, insurance, brokerage, mutual funds, pension funds, as well as derivative and structure products, banks can create more fee-income revenue.

Chapter 3: Literature Review

Over the past decades, a substantial number of studies have investigated how commercial banks, expanding to nontraditional financial services, has had their risk and performance affected. These studies employed a variety of methodologies to evaluate the risk and profitability effects on combining banking and non-banking activities. In terms of risk, some studies employed stock market measures to evaluate the bank's risks, while others used standard deviation of ROA, variance of ROA, the coefficient of variation (the standard deviation of returns divided by the mean of returns) and the probability of bankruptcy to evaluate risk. In the US studies, since the Glass-Steagall Act separated commercial and investment banking for several decades, the studies for diversification of the US banking industry use two different approaches. One is by creating a synthetic universal bank, combining one bank, one securities company and one insurance company to examine the synthetic risk effect. The other approach is to examine the risk effect of the commercial banks' shift from interest income to non-interest income activities, including their establishment of non-bank components like Section 20 subsidiaries.¹⁰ However, the findings of the profit and risk impacts on banks' expanding to non-interest income activities are mixed.

Demsetz and Strahan (1997) used the stock market data of 180 US bank holding companies (BHCs) from 1980 to 1993 to check the relationship with BHCs' size and their degree of diversification. He found that there is a strong positive correlation between BHC's size and diversification. However, large banks employ this diversification benefit to operate with lower capital and pursue riskier activities, thus offsetting the diversification benefit. Their results showed that diversification offers an important incentive for banks to expand through merger to engage in more risky, potentially more profitable businesses, such as trading accounts and derivative

¹⁰ In the US, the Glass-Steagall Act (1933) and Bank Holding Company Act (1956) restricted the commercial banks to engage in investment banking activities. However, the Glass-Steagall Act was eroded by the legal interpretation of Federal Reserve that allowed banks to establish separate Section 20 subsidiaries to undertake securities activities provided the revenue generated from the subsidiaries did not exceed 5% (later enlarged to 10 percent in 1989 and to 25 percent in 1996). Finally, in 1999, the US Congress enacted the Financial Service Modernization (Gramm-Leach-Bliley) Act which removed the legal barriers among bank, insurance and securities companies.

activities.

Boyd and Graham (1988) analyze the risk and profit effects by simulating BHCs merger with securities, life-insurance and real estate industries. They used both of the accounting (book) data and market (stock price) data of 146 BHCs, as well as other securities firms, insurance firms, and real estate firms from 1974 to 1984, to evaluate risk and profitability. They also evaluated the bankruptcy risk of a firm which is called Z (or Z-score). They used Z as a proxy for the probability of bankruptcy when in the event that the losses exceed equity. In their study, Z is calculated by considering the average rate of return, the volatility of rates of return and the equity ratio.¹¹ The results derived from both data shows that BHCs, combined with securities firms or real estate developers, increase the volatility of returns and bankruptcy risk while the combination of BHCs and insurance companies seemed to reduce the volatility of returns and bankruptcy risk.

Using the data of 422 US BHCs, as well as other insurance, securities firms and real estate firms from 1979 to 1997, Laderman (2000) adopted a new simulated merger methodology to test the impact on the standard deviation of BHC ROA and the bankruptcy probability of BHC when expanding into non-bank financial activities. He used the same measure Z-score employed by Boyd and Graham as the proxy of bankruptcy risk. The results showed a significant investment in life insurance underwriting is the most favorable for reducing the standard deviation of BHC's ROA. The probability of bankruptcy also reduced considerably when combining BHC with life insurance underwriting, casualty insurance underwriting, and securities brokerage.

Using the stock market data, Jagtiani and Allen (2000) created synthetic universal banks to evaluate the risk effects of combining banking, securities and insurance activities. They replicated the monthly return data of 729 synthetic universal banks from the period of 1986 to 1994 and employed a two-factor model with time-varying betas to analyze the potential diversification benefits of non-bank activities. The

¹¹ Z is calculated by $(\bar{r} + k) / \sigma$, where \bar{r} is the mean of return, σ is the standard deviation of return, and k is the equity to assets ratio. The higher the Z, the lower will be the probabilities of failure risk.

findings showed that combined non-bank activities decreases the firms' total risk but increases their systematic market risk. Furthermore, the unit price of risk was lower when combining non-bank activities which meant that there are no diversification gains for integrating banks, securities and insurance activities.

De Young and Roland (2001) used the accounting data of 472 US commercial banks from March 1988 to June 1995 to check the impact on the revenue volatility and the leverage ratio when banks expand to fee-income activities. Findings showed that banks that shift their income sources from traditional lending activities to fee-base activities increase their risk and leverage ratio. However the shift to non-interest income activities, accompanied by an increase in the bank's profitability, means that the increase in risks were at least partially compensated by an increase in profitability.

Using the data of 4166 banks of 15 EU countries from 1994 to 1998, Smith, Staikouras and Wood (2003) examined how banks in 15 EU countries which shifted to fee-income activities changed their risk and performance. It was found that the income source which came from non-interest income activities had an increasing trend in those years. Furthermore, non-interest income is much more volatile than interest income. But a negative correlation between interest and non-interest income reduced the variability of a bank's earning stream, which meant that the banks' expansion to non-interest activities stabilized the profit in the EU banking industry.

Stiroh (2004) used the accounting data of 14,523 US banks from the late 1970s to 2001 to investigate how the ongoing trend for banks moving to non-interest activities has an effect on the mean and variance of bank profits and revenues. He used the Sharpe Ratio and the Z-score to measure the bank performance and risk. He also applied a modern portfolio theory to decompose the operating revenue growth volatility into interest income growth volatility and non-interest income growth volatility. His findings showed that the non-interest income is much more volatile than interest income and shows an increasing correlation with net interest income. Furthermore, he found no evidence of benefits of diversification for banks which moved to non-interest income activities, particularly in trading activities, since these activities increased banks' risks and lowered their risk-adjusted profits.

Recently, several studies on US banks examined the effects on the deregulation of Gramm-Leach-Bliley Act. Cornett, Ors and Tehranian (2002) used the data of 40 BHCs from 1987 to 1997 to investigate the performance of commercial banks around the establishment of a Section 20 subsidiary. They found that after 3 years of the establishment of a subsidiary, banks demonstrates an improved on industry-adjusted operating cash flow return on assets. The improved performance mainly comes from the revenues generated from non-banking activities. This result provides evidence that the regulation changed to allow banks to establish a Section 20 subsidiary have improved the performance of commercial banks.

Using the market measure to assess the risk and performance, Mamun, Hassan and Maroney (2005) used the data of 343 US banks from 1998 to 2000 to examine the impact of the deregulation on the Gramm-Leach-Bliley Act. He found that all banking industry has a welfare gain from this law. However banks with section 20 subsidiaries had gained more than other banks. The findings showed that after the passage of the Gramm-Leach-Bliley Act, the banks' systematic risk has decreased, which implies the successful introduction of this Act created the opportunities for diversification.

Lately, Stiroh and Rumble (2006) used accounting data for 1,816 FHCs from 1997 to 2002 to explore the benefit of diversification for US FHCs to expand into non-interest activities. They employed Sharpe ratio and Z-score to evaluate the risk-adjusted return and bankruptcy risk of FHCs. Their findings showed that although there was diversification benefits for FHCs to engage in non-interest activities, these gains are more than offset by the increased volatility associated with non-interest activities. In other words, the marginal increases in non-interest income are coupled with lower risk-adjusted returns.

This thesis examines the benefit of diversification by using the actual accounting returns of bank institutions, rather than the accounting or market returns, which derived from a synthetic combination of bank and non-bank financial institutions. Furthermore, most of the past studies focused on investigating the risk and profitability impact on non-interest income activities which did not separate different

income types such as fee, trading and other income. This thesis examines the benefits of diversification which come from different income types and uses the Sharpe ratio and Z-score to evaluate the risk-adjusted return and bankruptcy risk. Finally, in a previous study, Stiroh used the modern portfolio to decompose the operating revenue which caused a problem as contributions to variance do not equal total variance. This study employed the standard variance and covariance theory together with a sensitivity analysis by evaluating the risk impacts of change in different types of income to avoid this problem.¹²

¹² See Chapter 4 for further discussion.

Chapter 4: Performance and Diversification Evaluation

4.1 Data

All the data used in this section came from the Statistics for Financial Institutions (1999-2005) published by Banking Bureau, Financial Supervisory Commission of Taiwan. The data¹³ are from the annual balance sheets and income statements of 13 FHC¹⁴ and 29 non-FHC banks. All domestic banks in Taiwan have been included with the following exceptions:

- Two industrial banks, the China Development Industrial Bank and Taiwan Industrial Bank, which provide long term credit and long term investment for Taiwan's industry, and one specialized bank, the Export-Import Bank of the Republic of China, whose major goal is to facilitate the export and import trade of Taiwan through offering Export Credit Insurance are excluded from the sample. The reason is because these three banks are specialized in distinct business areas and have very different revenue sources from commercial banks.
- Seven banks which were acquired by the other banks, so are dropped from the sample, though the acquiring banks are included. (see Table 5)

Table 5: The Mergers and Acquisitions of Commercial Banks (1999 to 2005)

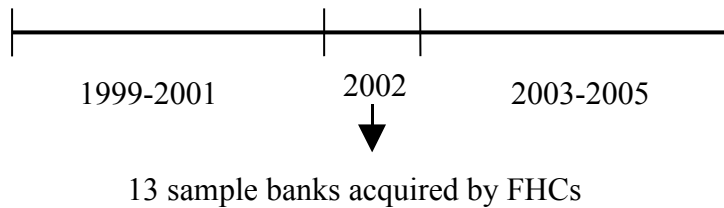
Acquiring Banks	Acquired Banks	Merger Dates
Taishin International bank	Dah-An Commercial Bank	2002.02. 28
United Bank	Cathy Commercial Banks	2003.10.27
Chinatrust Commercial Bank	Grand Commercial Banks	2003.12.01
E. Sun Commercial Bank	Kaoshiung Business Bank	2004.09.04
Taipei Commercial Bank	Fubon Commercial Bank	2005.01.01
Union Bank of Taiwan	Chung Shing Bank	2005.03.19
Sunny Bank	Kao Shin Commercial Bank	2005.11.26

Source: Statistics for Financial Institutions published by Banking Bureau, FSC of Taiwan.

¹³ The ROAA, ROAE, Non-interest Income as a share of Operating revenue are reported in Appendix 2.

¹⁴ At the end of 2005, 16 domestic banks and 1 foreign bank are operating under the roof of FHCs. Among them, 2 banks, Lucky Bank and Taipei International Commercial Bank, were acquired by FHCs on July 2005 and December 2005 respectively, therefore they are categorized as non-FHCs banks. One bank, the China Development Industrial Bank, is excluded in the sample. The foreign bank, Fubon Bank (Hong Kong) is excluded from the sample because it operates in the Hong Kong financial markets. Therefore, 13 FHC banks are included in the sample.

The time horizon covers the period of 1999 to 2005. There were 3 sample banks acquired by FHCs on 31 Dec, 2001 ,another 9 acquired by FHCs during the year 2002 and the other 1 acquired by FHCs in the early January of 2003 (see Appendix 1), 2002 is excluded to make the comparison period consistent. The comparison is done for two periods: three years before the banks were acquired by FHCs from 1999 to 2001 (Pre-acquisition) and three years after they were acquired by FHCs from 2003 to 2005 (Post-acquisition), excluding the year 2002.



This thesis assumes that all the banks are equally affected by the macro economic variables during the research periods, although, the macro economic variables such as interest and exchange rate might have a different influence on the performance of each individual bank. For example, the fluctuation of the exchange rate might have much more impact on the banks which are involved in more global banking activities.

4.2 Performance Assessment

4.2.1 Methodology

This section examines the performance of banks being acquired by FHCs. The Return on average asset (ROAA) and Return on average equity (ROAE) are used as proxies of performance. One way to examine whether banks acquired by FHCs are performing better is to compare the banks' average ROAA and ROAE of Pre- and Post-acquisition periods. The average ROAA and ROAE of pre- and post-acquisition periods are computed to test whether they are significantly different. The hypothesis for the 13 FHC banks is:

ROAA/ROAE Test:

$$H_0 : \mu_{PR(1)} - \mu_{PR(0)} = 0 \quad \mu_{PR(0)} = 3 \text{ years (1999-2001) average ROAA (ROAE)--}$$

Pre-acquisition ROAA (ROAE)

$$H_1 : \mu_{PR(1)} - \mu_{PR(0)} >, < 0 \quad \mu_{PR(1)} = 3 \text{ years (2003-2005) average ROAA (ROAE) --}$$

Post-acquisition ROAA (ROAE)

However, even though the pre- and post acquisition performance of those 13 FHC banks are significantly different, it could be due to the macro economic environment which contributed positively or negatively to the performance of the banking industry and has nothing to do with their operating as part of FHCs. Thus a further investigation for the comparison of the average growth rate of ROAA and ROAE of FHC banks and non-FHC banks during the post-acquisition period will be implemented. Because the growth rate of ROAA and ROAE for FHC banks and non-FHC banks are compared at the same period (post-acquisition period), they are equally affected by the same macro economic variables. However, if the growth rate of ROAA and ROAE for FHC banks are higher than those of non-FHC banks, this means that the FHC structure helps banks to generate higher performances than their non-FHC counterparts.

4.2.2 Results

Table 6, Figure 1 and Figure 2 show the significant negative ROAA and ROAE of all banks in 2002. This is due to the "2-5-8" target for Taiwan financial reform set up by President Chen Shui-bian in 2002. The target was to cut the banks' NPL ratio to less than 5% and to improve their capital adequacy ratio to above 8% within two years. The banks started to write-off huge amounts of non-performing loans in 2002. Consequently, the ROAA and ROAE of all banks dropped from 2001 to 2002. Another fact is that the ROAA and ROAE of all banks also dropped from 2004 to 2005. This is mainly due to the impact of the bad cash- and credit-card loans "storm" in 2005 which undermined the profit of many banks in Taiwan. To improve the asset quality for credit card business, the FSC ordered banks with a delinquency rate of higher than 8 % to suspend the issue of new cards, which caused the banks to write-off large amounts of credit card bad debts. Both the FHC and non-FHC banks engage significantly in credit card business, thus they were equally exposed to the "storm" as shown in Figure 1 and 2.

What is also worth noticing is that the ROAA and ROAE of FHC banks over the

whole sample period from 1999 to 2005, is higher than those non-FHC banks. This may be due to the fact that Taiwan's MOF set up a threshold of a NT\$ 20 billion capital requirement for the establishment of FHCs to enhance the capital adequacy of FHC. Furthermore, according to the Financial Holding Company Act the authority should consider the soundness of the financial and operational status and management ability when approving an application for establishing an FHC. Thus those banks with inferior capital ratio and financial performance have less probability of being approved by the MOF for the conversion to FHCs.

Since the performance of FHC banks was superior in both of the pre and post-acquisition periods, there is no evidence that they operate more efficiently as part of an FHC. To understand whether the performance of FHC banks has been improved, after they were acquired by an FHC, it is necessary to compare their profitability between the pre- and post-acquisition periods. Table 7 shows that the average ROAA and ROAE of FHC banks are not significantly different between the pre- and post-acquisition periods. Nor are they significantly different for the non-FHC group. The average growth rates of ROAA and ROAE for FHC banks and non-FHC banks during the post-acquisition period are also examined. The results displayed in Table 8 do not reject the null hypothesis for the equality of the average growth rate of ROAA and ROAE during the post-acquisition period and confirm that there is no significant performance improvement for FHC banks.

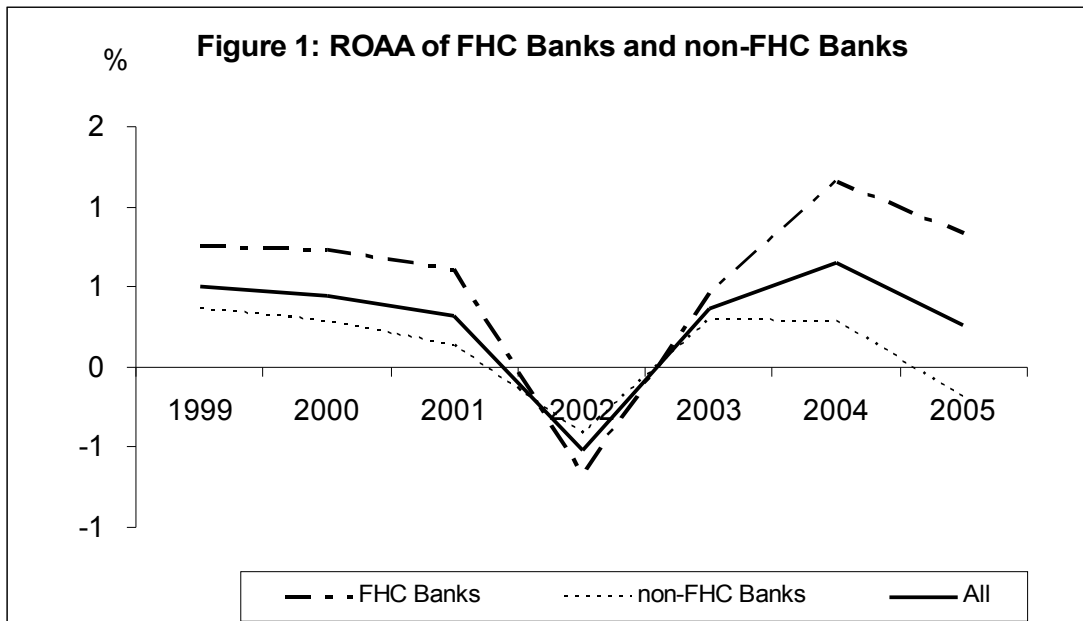
Table 6: Bank ROAA and ROAE of FHC Banks and non-FHC Banks

Unit: %

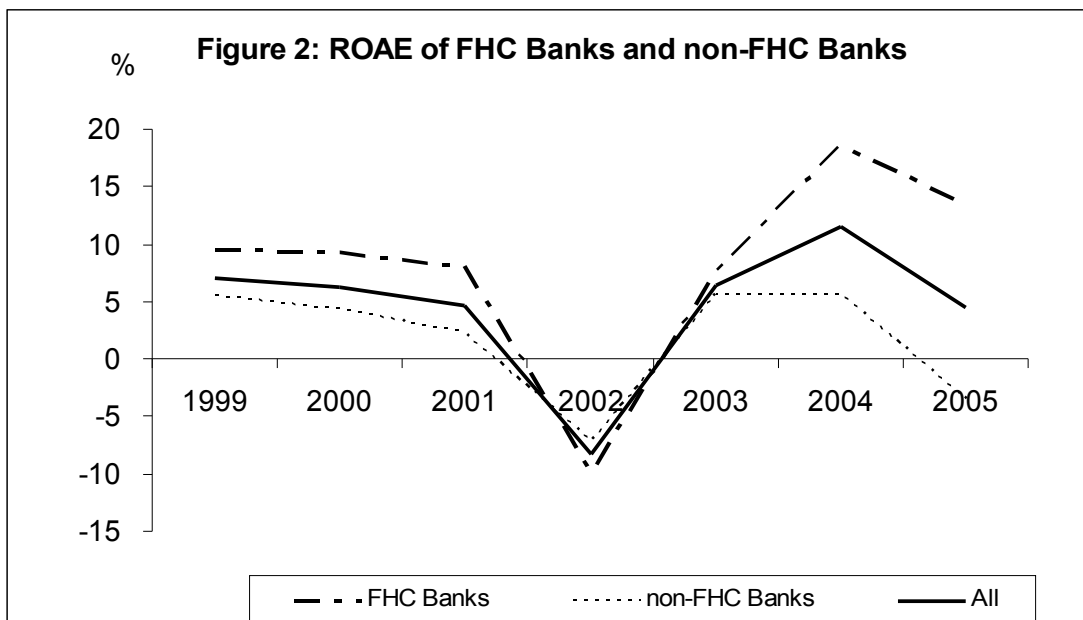
	1999	2000	2001	2002	2003	2004	2005
FHC Banks (Number of Banks:13)							
ROA	0.75	0.73	0.61	-0.67	0.46	1.16	0.84
ROA	9.48	9.29	8.02	-9.87	7.57	18.54	13.38
Non FHC Banks (Number of Banks:29)							
ROA	0.36	0.29	0.14	-0.42	0.30	0.29	-0.19
ROA	5.42	4.27	2.20	-7.21	5.59	5.54	-3.48
All Banks (Number of Banks:42)							
ROA	0.50	0.45	0.32	-0.52	0.37	0.65	0.26
ROA	7.06	6.32	4.65	-8.34	6.44	11.45	4.48

Note: ROAA and ROAE are calculated from the aggregate data for FHC banks, non-FHC banks and all banks respectively.

Source: Author's calculations.



Note: ROAA are calculated from the aggregate data for FHC banks, non-FHC banks and all banks respectively.
 Source: Author's calculations.



Note: ROAA and ROAE are calculated from the aggregate data for FHC banks, non-FHC banks and all banks respectively.
 Source: Author's calculations.

Table 7: Performance Evaluation of FHC Banks and Non-FHC Banks
Unit: %

ROAA					
Bank	Period	Mean	Std. Dev.	t-test	Probability
FHC Banks	1999-2001	0.696278	0.075953	0.609867	0.5749
	2003-2005	0.821189	0.346527		
Non-FHC Banks	1999-2001	0.263383	0.112476	0.72173	0.5104
	2003-2005	0.137433	0.280557		
ROAE					
Bank	Period	Mean	Std. Dev.	t-test	Probability
FHC Banks	1999-2001	8.92821	0.796489	1.322905	0.2564
	2003-2005	13.16455	5.489056		
Non-FHC Banks	1999-2001	3.96325	1.635048	0.44833	0.6771
	2003-2005	2.546767	5.222387		

Source: Author's Calculations; Output obtained from EViews

Table 8 : Performance Evaluation of FHC Banks and Non-FHC Banks
- Growth rate of ROAA and ROAE

Unit: %

Bank	Period	Mean	Std.	t-test	Probability
Growth Rate of ROAA	FHC Banks	0.969305	1.078756	0.82559	0.4554
	Non-FHC Banks	0.018894	1.676902		
Growth Rate of ROAE	FHC Banks	0.97935	1.100623	0.795286	0.471
	Non-FHC Banks	0.047464	1.705202		

Source: Author's Calculations; Output obtained from EViews

Finally the average ROAA and ROAE of the pre- and post-acquisition periods for each FHC bank are compared¹⁵. As shown in Tables 9 and 10, the ROAA and ROAE of majority FHC banks are not significantly different between pre- and post-acquisition periods. Of 13 banks, only the average ROAA of 3 banks and ROAE of 5 banks are significantly different. The common characteristic of these banks is that they are highly diversified into non-interest income business. Table 11 shows that they seem to have a higher average share of non-interest income than the other FHC

¹⁵ The objective of this study is to investigate whether the performance of FHC banks are significantly different before and after being acquired by FHCs, therefore the performance of pre- and post-acquisition periods of each non-FHC bank are not compared.

banks.¹⁶ Thus, there is little evidence that the structure of FHC influences the performance of FHC banks. Instead the shares of non-interest income might be a more important factor to affect the performance of FHC banks.

**Table 9 :Performance Comparisons of FHC banks Between Pre- and Post-acquisition
- ROAA
Unit: %**

Bank	Period	Mean	Std. Dev.	t-test	Probability
Chaio Tung Bank	1999-2001	1.038342	0.116811	1.373066	0.2417
	2003-2005	1.145914	0.069056		
First Commercial Bank	1999-2001	0.410725	0.143317	0.408905	0.7036
	2003-2005	0.114696	1.245713		
Hua Nan Bank	1999-2001	0.46697	0.08846	5.278036	0.0062***
	2003-2005	0.803188	0.065942		
Taipei Fubon Bank	1999-2001	0.613639	0.050092	1.583076	0.1886
	2003-2005	0.881293	0.288526		
Cathay United Bank	1999-2001	1.175442	0.219367	0.533743	0.6218
	2003-2005	0.909483	0.834719		
The International Commercial Bank of China	1999-2001	0.743148	0.109493	2.957853	0.0416**
	2003-2005	1.005786	0.108		
Taiwan Shin Kong Commercial Bank	1999-2001	0.120733	0.341249	0.42652	0.6917
	2003-2005	0.030954	0.128334		
Fuhwa Bank	1999-2001	0.068863	0.981981	0.614573	0.5721
	2003-2005	0.440513	0.364423		
Bank SinoPac	1999-2001	0.922859	0.120905	0.600619	0.5805
	2003-2005	0.812483	0.294442		
E.Sun Bank	1999-2001	0.866091	0.151896	1.748163	0.1553
	2003-2005	1.540131	0.650324		
Taishin International Bank	1999-2001	0.830884	0.280258	3.821464	0.0188**
	2003-2005	1.696849	0.274782		
Jih Sun International Bank	1999-2001	0.159875	0.061428	0.949779	0.396
	2003-2005	-0.530555	1.257593		
Chinatrust Commercial Bank	1999-2001	1.090533	0.12251	0.308334	0.7732
	2003-2005	1.154405	0.337236		

Source: Author's calculations

¹⁶ The Chinatrust Commercial Bank and Bank SinoPac also have a higher share of non-interest income. However, their performance are not significance difference between pre- and post consolidation periods. This might be due to the fact that Chinatrust and SinoPac are two of the leading banks in foreign exchange activities. The volatility of foreign exchange rates might affect the performance stability of these two banks, which results in no significant improvement on their profitability.

**Table 10 :Performance Comparisons of FHC banks Between Pre- and Post-acquisition
- ROAE**

Bank	Period	Mean	Std. Dev.	t-test	Probability
Chaio Tung Bank	1999-2001	11.84788	2.240366	0.01978	0.9852
	2003-2005	11.82188	0.403817		
First Commercial Bank	1999-2001	6.180292	1.917798	0.319052	0.7657
	2003-2005	0.184609	32.4925		
Hua Nan Bank	1999-2001	6.946274	1.020819	9.399464	0.0007***
	2003-2005	20.00913	2.179931		
Taipei Fubon Bank	1999-2001	8.606483	0.462103	2.212448	0.0914*
	2003-2005	12.41718	2.947261		
Cathay United Bank	1999-2001	11.78336	2.000032	0.066277	0.9503
	2003-2005	11.38624	10.18372		
The International Com- mercial Bank of China	1999-2001	9.942406	0.937347	4.857933	0.0083***
	2003-2005	15.66253	1.811287		
Taiwan Shin Kong Commercial Bank	1999-2001	1.733668	4.781548	0.354524	0.7408
	2003-2005	0.636436	2.423407		
Fuhwa Bak	1999-2001	0.002385	0.123047	0.944158	0.3985
	2003-2005	0.072326	0.058866		
Bank SinoPac	1999-2001	9.602142	0.834232	1.226338	0.2873
	2003-2005	12.79708	4.434673		
E.Sun Bank	1999-2001	9.541799	1.858611	2.621979	0.0587**
	2003-2005	22.01502	8.027311		
Taishin International Bank	1999-2001	8.481915	2.890369	5.639325	0.0049***
	2003-2005	21.73608	2.866642		
Jih Sun International Bank	1999-2001	2.17561	0.817686	0.892333	0.4226
	2003-2005	-11.12186	25.79792		
Chinatrust Commercial Bank	1999-2001	13.17472	1.678983	0.798784	0.4692
	2003-2005	15.86945	5.596746		

Note: ***, **, * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Source: Author's calculations

Table 11: Non-Interest Income Share of Operating Revenue of FHC Banks

Unit: %

Chinatrust Commercial Bank	28.37
Taipei Fubon Bank	25.70
The International Commercial Bank of Chian	22.35
Taishin International Bank	21.92
Hua Nan Bank	21.39
Bank SinoPac	21.02
E. Sun Bank	18.93
Fuhwa Bank	17.53
First Commercial Bank	17.24
Chaio Tung Bank	16.74
Cathay United bank	16.52
Taiwan Shin Kong Commercial Bank	14.03
Jih Sun International Bank	10.19

Note: The figures are average numbers from 1999 to 2005 for each FHC Banks

4.3 Diversification Assessment

4.3.1 Methodology

The banks' operating revenue is broken down into interest income and non-interest income. Non-interest income comprises many different financial activities, so it is categorized into three primary components—trading income, fee income and other income. Trading income refers to income from trading stocks, bonds and short term bills. Fee income includes loan commitment fees, commissions, underwriting fees, fiduciary fees, credit card fees and other service fees. Other income includes real estate investment earnings, profit from sale of non-performing loans, rental revenue, consulting fees, management fees for deposit accounts and revenue from securitization.

In this thesis, the degree of diversification is measured by the extent to which banks

engage in non-interest income activities. The non-interest income as a share of operating revenue (NII/OR) is used as the proxy for diversification. To examine whether banks after being acquired by FHCs are more diversified, the average NII/OR of FHC banks between the periods of pre- and post-acquisition are compared. The hypothesis is:

$$H_0 : \mu_{NII(1)} - \mu_{NII(0)} = 0 \quad \mu_{NII(0)} = 3 \text{ years (1999-2001) average NII/OR before banks acquired by FHCs}$$

$$H_1 : \mu_1 - \mu_0 <, > 0 \quad \mu_{NII(1)} = 3 \text{ years (2003-2005) average NII/OR after banks acquired by FHCs}$$

However, even though the degree of diversification of FHC banks increased during the post-acquisition periods, this might be due to an increased trend in the banking industry to expand into non-interest activities and have nothing to do with the structure of FHC. Hence the growth rate of NII/OR of FHC banks and non-FHC banks during the post-acquisition period are compared to examine whether FHC structure benefits FHC banks to diverse more rapidly to non-interest income activities.

4.3.2 Results

As shown in Table 12 and Figure 3, non-interest income as a share of operating revenue for all banks shows an increased trend from 2000 to 2004. This is consistent with the global trends of some banks rapidly expanding to non-interest income activities. From 2004 to 2005, the non-interest income share for all banks dropped from 26.72% to 22.98%. This is mainly due to the cash and credit card problems which happened in Taiwan in 2005. The FSC ordered banks with a delinquency rate of higher than 8 % to suspend the issue of new cards which caused the number of outstanding credit cards to drop sharply in 2005, thus reducing the fee-income revenue stemmed from the credit card business. Although the FHC banks' market share of cash- and credit- card business is higher than non-FHC banks, Figure 3 shows that the impact of the reduction of the share of fee income is almost the same for FHC and non-FHC banks. This is mainly because the FHC banks have better asset quality of cash- and credit-cards, which moderate the negative impact on their

revenues that come from cash- and credit-card businesses.¹⁷

Figures 4, 5 and 6 show the decomposing share of non-interest income. It is found that the shares of fee income and other income demonstrate a similar pattern which increases gradually from 1999 to 2005. However, the share of trading income behaves more volatile, which is consistent with the view that trading activities are more risky than other income activities.

Another trend worth noticing is that the FHC banks are more diversified than non-FHC banks in the whole sample periods. The overall non-interest income share of FHC banks is higher than the non-FHC banks from 1999 to 2005. However, the difference is insufficient to conclude that the FHC structure helps facilitate banks to expand to non-interest income activities, as the FHC banks were more diversified than non-FHC banks in the pre-acquisition period.

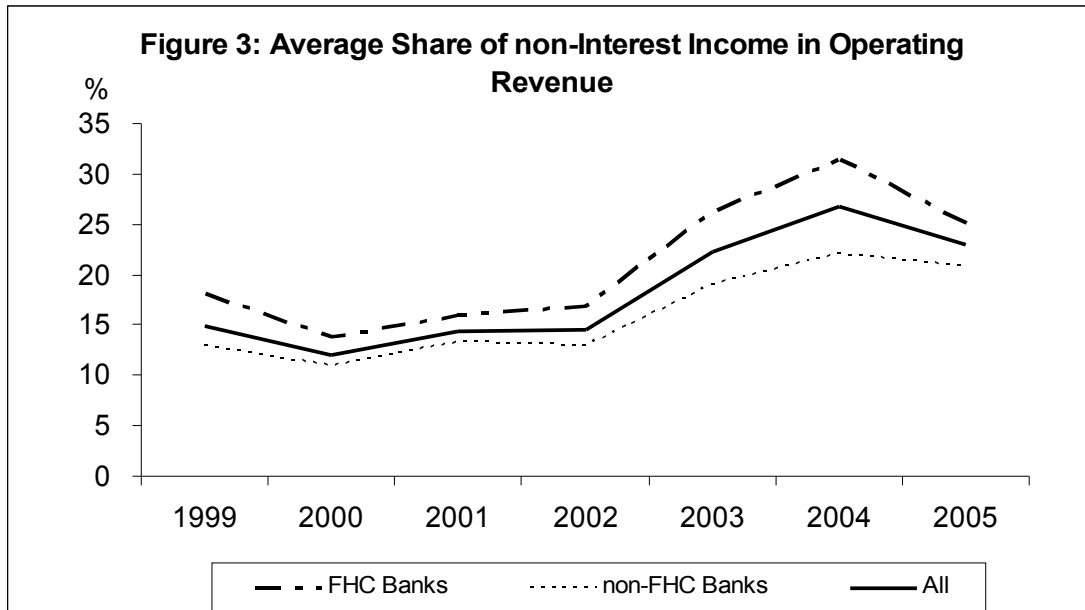
Table 12: Interest Income Share and Non-Interest Income Share of Banks

	Unit:%						
Income Type	1999	2000	2001	2002	2003	2004	2005
FHC Banks (Number of Banks:13)							
Operating Revenue	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Net interest Income	81.93	86.22	84.10	83.20	73.78	68.54	74.92
Non-interest Income	18.07	13.78	15.90	16.80	26.22	31.46	25.08
Trading Revenue	7.11	5.82	5.61	4.70	6.84	3.96	3.63
Fee Income	4.60	5.28	5.29	9.20	12.50	14.87	13.71
Others	6.36	2.69	5.00	2.89	6.89	12.64	7.74
Non FHC Banks (Number of Banks:29)							
Operating Revenue	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Net interest Income	87.02	89.09	86.76	87.14	80.90	77.85	79.17
Non-interest Income	12.98	10.91	13.24	12.86	19.10	22.15	20.83
Trading Revenue	7.33	5.59	7.44	6.01	8.81	4.09	3.80
Fee Income	2.61	3.01	3.05	4.56	7.07	9.45	8.47
Others	3.04	2.31	2.76	2.29	3.22	8.61	8.56
All Banks (Number of							
Operating Revenue	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Net interest Income	85.04	87.96	85.68	85.51	77.73	73.28	77.02

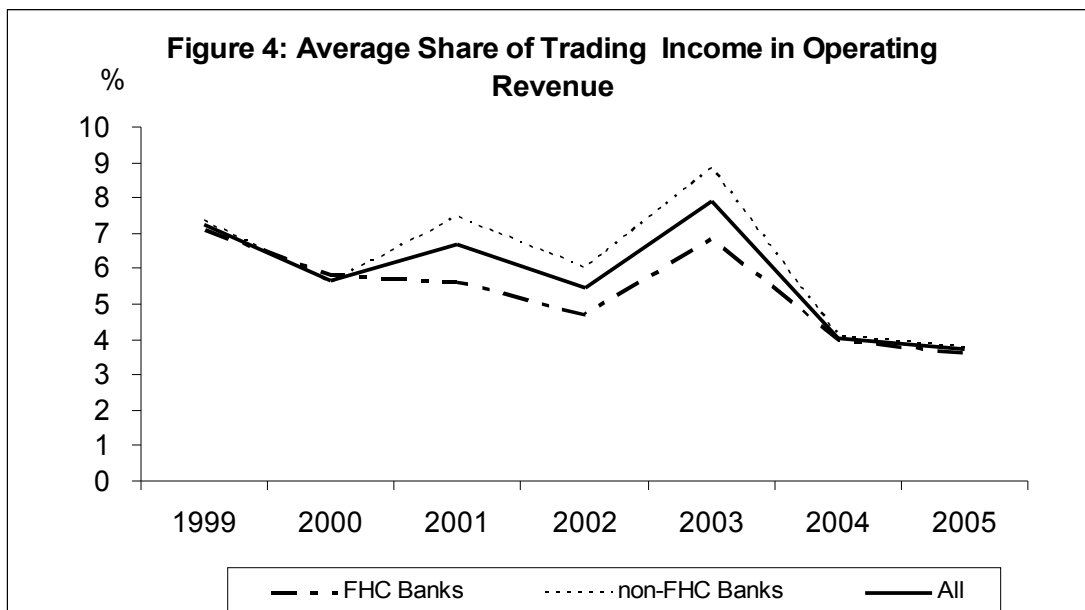
¹⁷ According to the statistics of cash- and credit-business published by FSC (June 2005), the market share for FHC banks' accounted for 46.81% and 54.18% respectively. However, the average NPL ratios of cash- and credit-card business of FHC banks are 0.77% and 2.17% respectively which are lower than 1.13% and 2.53% of non-FHC banks.

Non-interest Income	14.96	12.04	14.32	14.49	22.27	26.72	22.98
Trading Revenue	7.24	5.68	6.70	5.47	7.93	4.02	3.71
Fee Income	3.38	3.90	3.96	6.48	9.49	12.11	11.13
Others	4.33	2.46	3.67	2.54	4.85	10.59	8.14

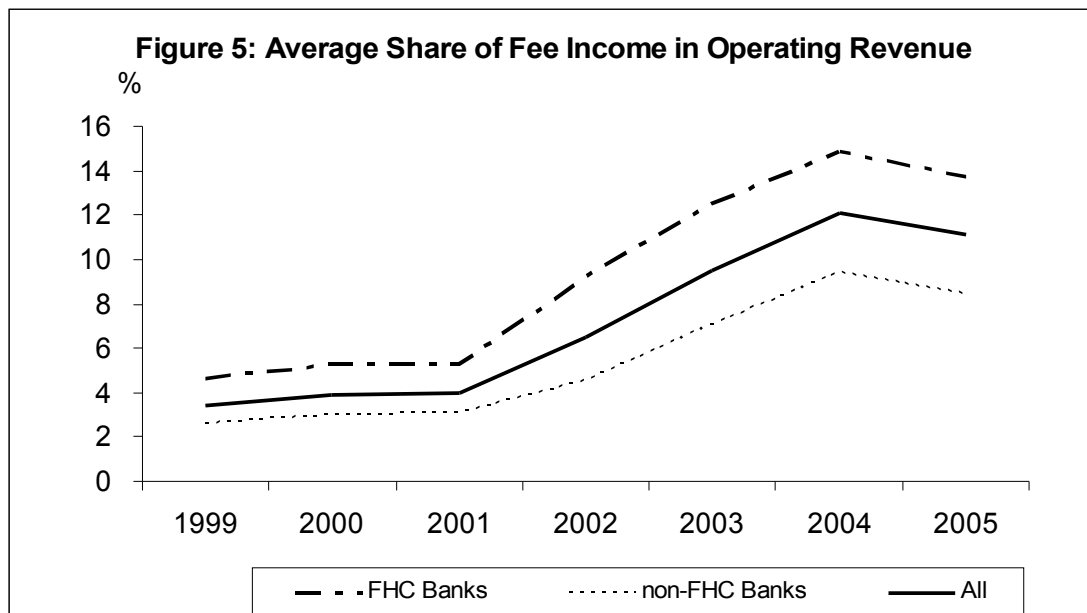
Note: Non-interest Income as a Share of Operating Revenue (Interest Income plus Non-interest Income) is calculated for FHC banks, non FHC banks and all banks respectively.
Source: Author's calculations



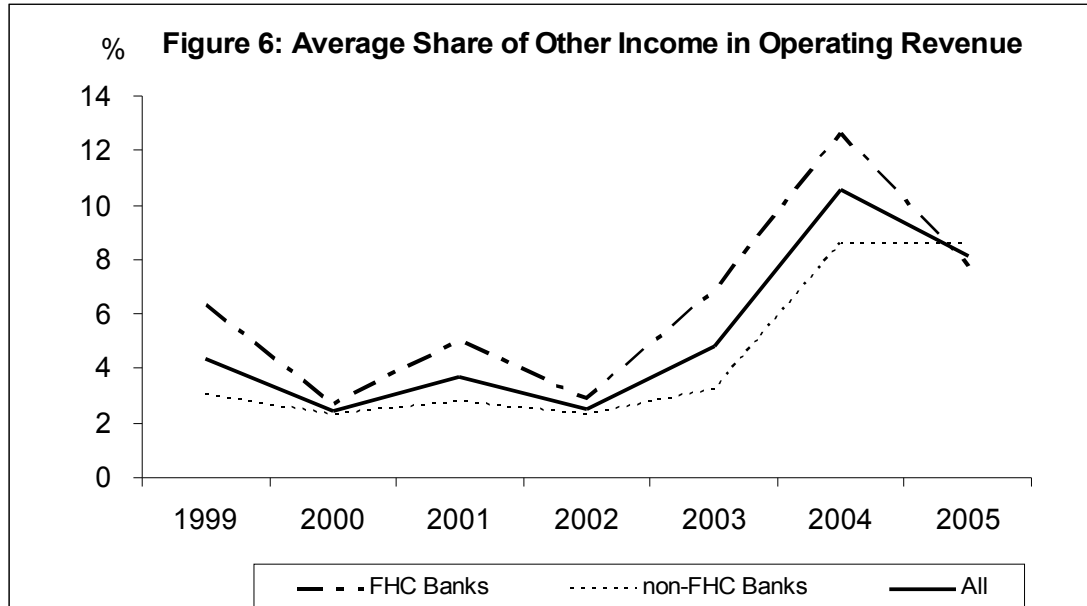
Note: Non-interest Income as a Share of Operating Revenue (Interest Income plus Non-interest Income) is calculated for FHC banks, non-FHC banks and all banks respectively.



Note: Trading Income as a Share of Operating Revenue (Interest Income plus Non-interest Income) is calculated for FHC banks, non-FHC banks and all banks respectively.



Note: Fee Income as a Share of Operating Revenue (Interest Income plus Non-interest Income) is calculated for FHC banks, non-FHC banks and all banks respectively.



Note: Fee Income as a Share of Operating Revenue (Interest Income plus Non-interest Income) is calculated for FHC banks, non-FHC banks and all banks respectively.

Comparing the degree of diversification of FHC banks between the pre- and post-acquisition periods, the average non-interest income share of FHC banks is found to

be significantly higher in the post-acquisition period (see Table 13). The fee income share also appears very significant, which means the fee income activities play a more important role in the post-acquisition period. The finding for other income shares is almost in significant at a 0.10 level. However, the trading income share is more volatile during the sample periods, thus it is not significantly different between the periods of pre- and post-acquisition. The results for non-FHC banks are similar to those of FHC banks, with the exception of “other income” which is significant at 10%.

Table 13 : Diversification Evaluation of FHC Banks and Non-FHC Banks

Unit: %

Non-interest Income As a Share of Operating Revenue					
Bank	Period	Mean	Std. Dev.	t-test	Probability
Banks Under FHCs	1999-2001	15.9179	2.145044	5.022656	0.0074***
	2003-2005	27.58824	3.405184		
Banks Not Under FHCs	1999-2001	12.3779	1.276887	7.230423	0.0019***
	2003-2005	20.69436	1.529205		
Trading Income As a Share of Operating Revenue					
Banks Under FHCs	1999-2001	6.177249	0.812796	1.221262	0.289
	2003-2005	4.808509	1.762856		
Banks Not Under FHCs	1999-2001	6.788182	1.035984	0.705129	0.5196
	2003-2005	5.566721	2.815817		
Fee income As a Share of Operating Revenue					
Banks Under FHCs	1999-2001	5.057918	0.393194	11.96906	0.0003***
	2003-2005	13.692	1.185962		
Banks Not Under FHCs	1999-2001	2.888118	0.241006	7.729488	0.0015***
	2003-2005	8.330733	1.195551		
Other income As a Share of Operating Revenue					

Banks Under FHCs	1999-2001	4.682737	1.856736	2.110548	0.1024
	2003-2005	9.087731	3.101757		
Banks Not Under FHCs	1999-2001	2.701598	0.367894	2.271192	0.0856*
	2003-2005	6.796904	3.101409		

Source: Author's Calculations; Output obtained from EViews

Note: ***, * indicate statistical significance at the 1% and 10% levels, respectively.

The above results confirm that both FHC banks and non-FHC banks were more diversified during the post-acquisition periods and two components of NII significantly contributed to their operating revenue. However, they do not shed any light on whether the structure of FHC helped banks to expand to non-interest income activities. The average growth rate of the non-interest income share for FHC banks and non-FHC banks is compared during the post-acquisition stage, to assess whether the FHC banks expanded more rapidly to non-interest income activities than the non-FHC banks. Table 14 does not reject the null hypothesis for the equality of the average growth rate of FHC banks and non-FHC banks and confirms that the FHC structure does not necessarily generate a benefit for banks to expand to non-interest income activities.

**Table 14 : Performance Evaluation of FHC Banks and Non-FHC Banks
- Growth rate of Non-interest Income share**

Unit:%

Bank	Period	Mean	Std.	t-test	Probability
Average Growth Rate of NII/OR	FHC Banks	0.925239	1.422312	0.821475	0.4575
	Non-FHC Banks	-0.070252	1.543584		
Average Growth Rate of NII/OR	FHC Banks	0.825261	1.208694	0.674829	0.5368
	Non-FHC Banks	0.151892	1.235347		

Source: Author's calculations; Output obtained from EViews

4.4 Diversification Benefit Assessment

In this section the diversification benefit is defined in terms of the volatility reduction in a bank's operating revenue, ROAA and ROAE as a bank increases its share of non-interest income as a percentage of total operating revenue.

4.4.1 Decomposing the Contribution to the Revenue Volatility

4.4.1.1 Methodology

It is useful to measure how different categories of income contribute to the volatility of banks' operating revenue. This thesis adopts the standard variance and covariance theory to decompose the volatility of operating revenue, together with a sensitivity analysis to evaluate the volatility change contributed by the percentage increase in different kinds of income. The operating revenue (OR) is defined as the sum of interest income (IIN), trading income (TI), fee income (FI) and other income (OI). According to the traditional variance-covariance theory¹⁸, the variance of OR could be expressed as follows:

$$\sigma^2_{OR} = \begin{bmatrix} IIN_w & TI_w & FI_w & OI_w \end{bmatrix} * \begin{bmatrix} Cov(IIN, IIN) & Cov(IIN, TI) & Cov(IIN, FI) & Cov(IIN, OI) \\ Cov(TI, IIN) & Cov(TI, TI) & Cov(TI, FI) & Cov(TI, OI) \\ Cov(FI, IIN) & Cov(FI, TI) & Cov(FI, FI) & Cov(FI, OI) \\ Cov(OI, IIN) & Cov(OI, TI) & Cov(OI, FI) & Cov(OI, OI) \end{bmatrix} * \begin{bmatrix} IIN_w \\ TI_w \\ FI_w \\ OI_w \end{bmatrix} \quad (4-1)$$

1)

where IIN_w , TI_w , FI_w , and OI_w are the weight on IIN, TI, FI and OI respectively.¹⁹

According to the traditional variance-covariance theory, the sum of the variance contribution of IIN, TI, FI and OI will be equal to the variance of operating revenue.²⁰ The contribution of different types of income to the variance of the operating revenue could be summarized as follows:

$IIN_w IIN_w Cov(IIN, IIN)$	$IIN_w TI_w Cov(IIN, TI)$	$IIN_w FI_w Cov(IIN, FI)$	$IIN_w OI_w Cov(IIN, OI)$
-----------------------------	---------------------------	---------------------------	---------------------------

¹⁸The basic variance and covariance rules are as follows:

Rule 1: If $Y=V+W$, $Var(Y)=Var(V)+Var(W)+2Cov(V, W)$

Rule 2: If $Y=bZ$, where b is a constant, $Var(Y)=b^2 Var(Z)$

Rule 3: If $Y=bZ$ where b is a constant and Z is a variable, $Cov(X, Y)=b Cov(X, Z)$

¹⁹ Initially the IIN_w , TI_w , FI_w , and OI_w are both equal to 1 in equation 4-1 since $OR=IIN+TI+FI+OI$.

However, when conducting a sensitivity analysis, the IIN_w , TI_w , FI_w , and OI_w will increase from 1 to 101% respectively to measure the impact on variance of OR of increasing 1% of each type of Income.

²⁰ This can be proved by the variance rule. See Dougherty, 2002, Introduction to Econometrics, page 39.

	$TI_w IIN_w Cov(TI, IIN)$	$TI_w TI_w Cov(TI, TI)$	$TI_w FI_w Cov(TI, FI)$	$TI_w OI_w Cov(TI, OI)$
	$FI_w IIN_w Cov(FI, IIN)$	$FI_w TI_w Cov(FI, TI)$	$FI_w FI_w Cov(FI, FI)$	$FI_w OI_w Cov(FI, OI)$
+	$OI_w IIN_w Cov(OI, IIN)$	$OI_w TI_w Cov(OI, TI)$	$OI_w FI_w Cov(OI, FI)$	$OI_w OI_w Cov(OI, OI)$
Contribution to the Variance of Operating Revenue	IIN	TI	FI	OI

A sensitivity analysis was conducted to calculate the effect of a 1% increase in different types of income on the variance of operating revenue. The mean of the different types of income is used to scale the sensitivity of different types of income.

4.4.1.2 Results

Table 15 shows estimates for different types of income contributing to the variation of operating revenue from 1999 to 2005. Both interest income and trading income show a negative covariance with fee income and other income and contribute positively to the variance of operating variance. However, fee and other income contribute negatively to the volatility of operating revenue. Thus banks gain by diversifying into fee and other income activities, but increase volatility if they expand into activities which generate interest and trading income.

Table 15 : Decomposition of Variance of Operating Revenue

Income	Interest	Trading	Fee	Other
Interest Income	30722.67	2403.34	-3638.58	-1858.17
Trading Income	2403.34	346	-446.43	-262.42
Fee Income	-3638.58	-446.43	693.46	487.22
Other Income	-1858.17	-262.42	487.22	556.67
Contribution to Variance of Operating Revenue	27629.26	2040.5	-2904.32	-1076.7
	(1)	(2)	(3)	(4)
Sensitivity Analysis				
Income	Interest	Trading	Fee	Other
Variance of Operating Revenue²¹	25688.74	25688.74	25688.74	25688.74
(5)=(1)+(2)+(3)+(4)				

²¹ The variance of operating revenue calculated from EVIEWS is 25688.78 which is equal to the sum of the variance contribution of IIN, TI, FI and OI. This result is consistent with the traditional variance-covariance theory.

Variance of Operating Revenue- Change in 1% of Different Types of Income :(6)	26244.40	25729.58	25630.73	25667.26
Sensitivity of Income :(7)=(6)-(5)	555.66	40.84	-58.02	-21.48
Mean of Income (8)	791.48	63.68	59.95	43.43
Scaled Sensitivity: (9)=(7)/(8)	0.70	0.64	-0.97	-0.49
Unit Variation: (10)=(5)/(8)	34.91	32.04	-48.45	-24.79

Note: Sensitivity of Income is defined as a change of variance of operating revenue by increasing 1% of different types of income. All data are aggregates for the 42 sample banks in Taiwan. The time periods cover from 1999 to 2005. The unit of income is one billion NT dollars.

Source: Author's calculations; Output obtained from EViews

The unit variance contribution of the different types of income showed that the scaled sensitivity and unit variation of trading income are 0.64 and 32.04 respectively, which is slightly less than those of interest income. Thus a unit increase in trading income contributes to a lower variance of operating revenue than interest income. This confirms that not only do banks who expand to fee and other income activities gain from diversification, but shifting lending to trading business will also achieve the diversification benefits. The sensitivity analysis also shows that the magnitude of variance reduction to operating revenue is the highest, as the bank expands to fee-income activities.

One question is why does interest income and trading income increase the volatility of operating revenue but fee and other income reduce it? A plausible explanation is that the credit risk and market risk might be closely related. Weigel and Gemmill (2006) investigated the factors affecting the creditworthiness of Argentina, Brazil, Mexico and Venezuela. They found that the credit risk was positively related to the stock-market returns in the US and the region. During periods of economic boom, firms borrow more to expand their business and contribute to the profitability of the banking industry. The trading income could also be boosted by to the prospective economic outlook raising the performance of the stock market. By contrast, the economic recession could raise the problem of non-performing loans and damage the profit of the banking industry. The trading income usually experiences deterioration during a period of economic downturn. The fee income is less affected by the economic cycle and is more stable. Therefore it correlates negatively with interest income and trading income. The components of other income are fairly complex and

not as stable as fee income, however it also has a negative correlation with interest income and trading income.

4.4.2 Relation of Non-interest Share, Bank Risk and Performance

4.4.2.1 Methodology

The final step is to examine the relation of the non-interest shares with the banks' profitability and risk. Stiroh (2004) used a regression model with mean of ROA, standard deviation of ROA, "Sharpe ratio" and "Z-score" to measure banks' performance and risk, and to examine their relationship with the non-interest income share of operating revenue. The advantage of using "Sharpe ratio" in this model is that it measures the risk/return trade-off as banks expand to non-interest income activities. Sharpe ratio was proposed by William Sharp, the Nobel Prize winning economist, which is a common criteria for evaluating the risk-adjusted return. It is defined as average excess return over the sample, divided by the standard deviation of that period. Furthermore, the bankruptcy risk measured by "Z-score" was employed to investigate the impact of the banks' expansion to non-interest income activities. In the study of Stiroh, he used the same measure as Boyd and Graham to measure the Z-score, which is defined as ROA plus average equity/asset ratio, divided by the standard deviation of ROA. It measures bankruptcy risk and assesses the number of standard deviations of ROA fall below its mean in order to cause the firm's failure.

In this essay Stiroh's model is extended by adding the mean of ROAE, standard deviation of ROAE, the Sharpe ratio (as defined below in Model ROAE) and the Z-score (as defined below in Model ROAE) as dependent variables. Moreover, two new variables LTA and $(LTA)^2$ (defined below) were added to assess whether the loan-to-asset ratio contributes to the bank's risk and return. Also, remember that instead of using one independent variable, non-interest income share, to evaluate the degree of diversification of banks, this thesis decomposed non-interest income share to three types of non-interest income shares (trading income shares, fee-income shares and other income shares) separately to evaluate the different types of non-interest income contributing to the risk and return of banks.

The following regression models are applied to estimate the relationships of non-interest share and profitability and risk of banks. All the variables are derived from the balance sheets and income statement of 42 sample banks from 1999 to 2005. A cross-sectional regression is used to estimate the parameters. Samples are not divided into FHC banks and non-FHC banks, but 42 banks are used altogether for estimation. Mainly due to the previous studies suggest that the structure of FHC does not affect the performance and the degree of diversification of banks. This point of view is confirmed by dividing the sample into two periods: pre- and post acquisition, and the dummy variable signifying FHC banks and non-FHC banks were added into the post acquisition model for estimations. However, no significant coefficient on the dummy variable was found in the model, which means that there is little evidence that the structure of the FHC affects the risk and performance of banks.

Model ROAA :

$$\begin{aligned} \overline{ROAA}_i = & \alpha + \beta_1 \ln \overline{A}_i + \beta_2 \overline{(E/A)}_i + \beta_3 \overline{GRA}_i + \beta_4 \overline{TRSR}_i + \beta_5 \overline{FESR}_i \\ & + \beta_6 \overline{OTSR}_i + \beta_7 \overline{LTA}_i + \beta_8 \overline{LTA}_i^2 + \varepsilon_i \end{aligned} \quad (4-2)$$

$$\begin{aligned} \overline{SHARPE}(ROAA_i) = & \alpha + \beta_1 \ln \overline{A}_i + \beta_2 \overline{(E/A)}_i + \beta_3 \overline{GRA}_i + \beta_4 \overline{TRSR}_i + \beta_5 \overline{FESR}_i \\ & + \beta_6 \overline{OTSR}_i + \beta_7 \overline{LTA}_i + \beta_8 \overline{LTA}_i^2 + \varepsilon_i \end{aligned} \quad (4-3)$$

$$\begin{aligned} \overline{STD}(ROAA_i) = & \alpha + \beta_1 \ln \overline{A}_i + \beta_2 \overline{(E/A)}_i + \beta_3 \overline{GRA}_i + \beta_4 \overline{TRSR}_i + \beta_5 \overline{FESR}_i \\ & + \beta_6 \overline{OTSR}_i + \beta_7 \overline{LTA}_i + \beta_8 \overline{LTA}_i^2 + \varepsilon_i \end{aligned} \quad (4-4)$$

$$\begin{aligned} \overline{ZSCORE}(ROAA_i) = & \alpha + \beta_1 \ln \overline{A}_i + \beta_2 \overline{(E/A)}_i + \beta_3 \overline{GRA}_i + \beta_4 \overline{TRSR}_i + \beta_5 \overline{FESR}_i \\ & + \beta_6 \overline{OTSR}_i + \beta_7 \overline{LTA}_i + \beta_8 \overline{LTA}_i^2 + \varepsilon_i \end{aligned} \quad (4-5)$$

Model ROAE :

$$\begin{aligned} \overline{ROAE}_i = & \alpha + \beta_1 \ln \overline{A}_i + \beta_2 \overline{(E/A)}_i + \beta_3 \overline{GRA}_i + \beta_4 \overline{TRSR}_i + \beta_5 \overline{FESR}_i \\ & + \beta_6 \overline{OTSR}_i + \beta_7 \overline{LTA}_i + \beta_8 \overline{LTA}_i^2 + \varepsilon_i \end{aligned} \quad (4-6)$$

$$\overline{SHARPE}(ROAE_i) = \alpha + \beta_1 \ln \overline{A}_i + \beta_2 \overline{(E/A)}_i + \beta_3 \overline{GRA}_i + \beta_4 \overline{TRSR}_i + \beta_5 \overline{FESR}_i$$

$$+ \beta_6 \overline{OTSR}_i + \beta_7 \overline{LTA}_i + \beta_8 \overline{LTA}_i^2 + \varepsilon_i \quad (4-7)$$

$$STD(ROAE_i) = \alpha + \beta_1 \ln \overline{A}_i + \beta_2 \overline{(E/A)}_i + \beta_3 \overline{GRA}_i + \beta_4 \overline{TRSR}_i + \beta_5 \overline{FESR}_i$$

$$+ \beta_6 \overline{OTSR}_i + \beta_7 \overline{LTA}_i + \beta_8 \overline{LTA}_i^2 + \varepsilon_i \quad (4-8)$$

$$ZSCORE(ROAE_i) = \alpha + \beta_1 \ln \overline{A}_i + \beta_2 \overline{(E/A)}_i + \beta_3 \overline{GRA}_i + \beta_4 \overline{TRSR}_i + \beta_5 \overline{FESR}_i$$

$$+ \beta_6 \overline{OTSR}_i + \beta_7 \overline{LTA}_i + \beta_8 \overline{LTA}_i^2 + \varepsilon_i \quad (4-9)$$

where in above two model, “i” is the bank name and bar above variables indicates the average value of the period of 1999 to 2005 for bank i.

4.4.2.2 Variable Defined

Dependent Variables

Model ROAA:

- ROAA —Return on average assets
- SHARPE (ROAA) — ROAA divided by the standard deviation of ROAA
- STD(ROAA) — Standard deviation of ROAA
- ZSCORE (ROAA) — ROAA plus average equity/asset ratio, divided by the standard deviation of ROAA.

Model ROAE:

- ROAE —Return on average equity
- SHARP E(ROAE) —ROAE divided by the standard deviation of ROAE
- STD(ROAE) — Standard deviation of ROAE
- ZSCORE (ROAE) —ROAE plus average equity/asset ratio, divided by the standard deviation of ROAE.

Independent Variable:

- In A — Logarithm of Total Assets

This is a proxy for bank size. It is possible for the relationship between size and bank performance to be positive or negative. It is difficult to prove the existence of scale and scope of economies in banks. The performance of banks depends on their efficiency.²² Although large banks can have the benefit of improving

²² See Heffernan (2005), page 26.

performance, there are many examples of small banks which dedicate their niche market to produce high profitability. So either the positive or negative sign of the coefficient is possible.

The relationship between size and bank risk may be negative. Large banks could have more capital to develop their risk management system and may enjoy a larger customer base to lower their operating costs, as well as diversify their loan portfolio.

- E/A — Total Equity divided by Total Assets

Instead of using risk-adjusted assets to calculate the capital to asset ratio, the equity ratio is simply calculated by using the equity divided by the unweighted assets. Bank capital acts as a safety net to sustain potential losses. However, an excessive equity ratio may imply inefficiency, because the bank is not using a sufficient amount of capital for profitable investments. Therefore, the relationship between bank performance and E/A is unclear.

The relationship between equity ratio and bank's risk is expected to be negative. As stated above, a bank's capital acts as a safety net to sustain its losses. The higher the ratio the lower will be the probability of bankruptcy.

- GRA — Average logarithm growth rate of Total Asset

The relationship between bank performance and GRA may be unclear. Banks with a higher asset growth rate may signify its high growth opportunity. However, if the balance sheet expands too quickly, the asset quality might deteriorate due to incurring bad loan. Therefore, the sign of the coefficient is unclear.

The relationship between GRA ratio and bank's risk is expected to be positive. According to the stage of the firm's life cycle, firms with high growth rates expand their business rapidly. However their earning might be unstable as they expand their business too quickly. High growth rate usually accompanies high risk.

- TRSR — Trading income's share of operating revenue.
- FESR — Fee income's share of operating revenue.
- OTSR — Other income's share of operating revenue.
- LTA and $(LTA)^2$ — Total Loans divided by Total Assets and its quadratic form

Traditionally, a bank is an intermediary between depositors and borrowers. Higher loan-to-asset ratio represents a bank transfer of higher funds into loans, which may raise interest income. However, an excess loan-to-asset ratio implies that banks tend to involve higher liquidity risk and credit risk, therefore lessening the profitability of banks. Thus both the LTA and $(LTA)^2$ are used to examine whether or not there is a non-linear relationship between bank profit and LTA ratio.

The relationship between loan-to-asset and bank risk is expected to be positive, the higher the ratio the higher the risk.

4.4.2.3 Multicollinearity Study

An analysis of the coefficients for independent variables was shown in Table 16. A high correlation of 0.9989 between variables LTA and $(LTA)^2$ was found in the matrix. This will cause a problem of multicollinearity if these two variables are estimated at the same time. However, sometimes the problem can be ignored if the existence of multicollinearity does not affect the significance on other variables and the model is otherwise appropriate, i.e. each coefficient with plausible sign and magnitude. Actually the near multicollinearity does not violate any assumptions of classical linear regression model; hence the estimators will still be consistent, unbiased and efficient. (See Brooks, 2002, page 192)

To check whether the existence of multicollinearity has influenced the significance on other variables, we estimated the model by dropping the variable of LTA and

$(LTA)^2$ respectively. In each case, no change on the significance of the other variables has been found. This confirms that the presence of multicollinearity does not affect the adequacy of the models, therefore the two variables of LTA and $(LTA)^2$ were both included in the model.

Table 16 : Correlation Matrix for the Independent Variables

	lnA	E/A	GRA	TRSR	FESR	OTSR	LTA	$(LTA)^2$
lnA	1							
E/A	-0.06313	1						
GRA	0.161663	0.374641	1					
TRSR	0.285172	-0.05594	0.104153	1				
FESR	0.135096	0.153741	0.206294	-0.0177	1			
OTSR	0.489391	-0.15519	-0.09438	-0.0564	0.224504	1		
LTA	-0.29067	-0.08642	0.125966	0.015914	-0.06784	-0.03759	1	
$(LTA)^2$	-0.29421	-0.0805	0.117323	0.016723	-0.06277	-0.02588	0.998922	1

Source: Author's calculations; Output obtained form EViews.

4.4.2.4 Regression Results

Results of ROAA Model

Table 17 shows the regression results of Model ROAA. Columns 1, 2 and 3 use the mean and standard deviation of ROAA, as well as the average Sharpe Ratio (as defined in Model ROAA) respectively, as the dependent variables to examine the determinants of bank risk and return. Column 4 uses the Z-score (as defined in Model ROAA) as a dependent variable to examine the relationship between different types of non-interest income share and insolvency risk.

With the mean of ROAA as dependent variable (Column 1), the coefficients Log Asset, Equity/Asset and Growth in Asset are all positive and statistically significant. This means larger banks with higher equity ratio and asset growth rate are more profitable. As Taiwan's banking industry is highly competitive, price competition is a common strategy for larger banks to increase their market share. The intensive competition posts a substantial threat to smaller banks since their operating costs are

higher. The positive coefficient of the asset growth rate suggests that banks expand their business more rapidly, enjoying higher profitability. Finally, the strongly positive significant coefficient of the Equity/Asset variable implies that sound capital to asset ratio is crucial to the profitability of banks. According to the Statistics for Financial Institutions published by FSC, the average capital adequacy ratio of all banks was 10.34% in 2004, with the highest at 14.24%. Overall, there seems no inefficiency problem in banks utilizing their capital.

The share of trading income and fee income are also very important factors in determining the profitability of banks. The result shows that higher trading and fee income shares contribute to higher profit of banks. This suggests that banks diversify to trading and fee-income business to increase their profitability. In Taiwan's banking industry, intense price competition has slashed the profit margin of traditional loan businesses. Banks are seeking to expand to non-interest income activities to promote their profitability. The result provides the evidence that banks' rapid increase in non-interest income shares in recent years promotes their profitability.

Surprisingly, with the dependent variable of mean of ROAA (Column 1), the linear and quadratic LTA ratio are both significant and show the U shape, which is unexpected, i.e., a negative coefficient on the linear LTA ratio term and positive coefficient on the squared term. This means that banks with a higher or lower LTA ratio have a higher return. This result is inconsistent with the hypothesis described above, that banks have to manage to balance LTA ratio to maintain sound asset quality and promote their profitability. However, after further examining the relationship between LTA ratio and Non-interest income share, by equally dividing 42 banks into three categories: high, middle and low LTA ratio, it was found that banks with a higher or lower LTA ratio also have a higher non-interest income share (see Table 18). This finding suggests that banks with a higher or lower LTA ratio devote themselves to more non-interest income activities which contributes to higher profitability. In particular, those with a lower LTA ratio, transfer more of their resources from interest income activities to non-interest income activities, resulting in higher profitability.

Table 17: Model ROAA- Determinants of Bank Risk and Return

	Dependent Variables			
	Return on Average Asset (ROAA)			
	Mean	Std. Dev.	Sharp Ratio	Z-score
Constant	0.108 (1.278)	-0.091 (-0.777)	46.008 (1.498)	380.149 (1.245)
Log Asset	0.002** (2.302)	-0.002* (-1.843)	0.538 (1.574)	5.368 (1.581)
Equity/Asset	0.111** (2.59)	-0.042 (-0.702)	36.575** (2.342)	421** (2.712)
Growth in Asset	0.039** (2.19)	0.012 (0.494)	10.779 (1.682)	4.634 (0.073)
Trading Income Share	0.043* (1.776)	-0.047 (-1.403)	5.813 (0.664)	51.56 (0.592)
Fee Income Share	0.05** (2.333)	-0.051* (-1.702)	-5.974 (-0.764)	-89.82 (-1.155)
Other Income Share	-0.002 (-0.08)	0.012 (0.407)	2.676 (0.357)	10.107 (0.135)
Loan/Asset	-0.488* (-1.777)	0.468 (1.226)	-174.946* (-1.752)	-1476.391 (-1.487)
Loan/Asset Square	0.396* (1.799)	-0.394 (-1.285)	138.566* (1.729)	1187.326 (1.49)
R-squared	0.636	0.322	0.322	0.353
Adjusted R-squared	0.548	0.158	0.158	0.196
No. of Observations	42	42	42	42

Note: ***,** Significant at the 1% and 5% levels, respectively. T-statistics are in parentheses below coefficient values.

Source: Author's calculations; Output obtained from EViews

Table 18 : Relationship between LTA Ratio and Non-interest Share

	LTA ratio		
	High	Middle	Low
Average LTA ratio	0.699	0.649	0.570
Average Non-interest Income Share	0.164	0.137	0.180

Source: Author's calculations.

Turning to determinants of bank's risk, the two variables with a significant negative relationship with standard deviation of ROAA (Column 2) are Log Asset and the share of fee income. The result means that there exist diversification benefits for bank's expanding into fee-income business. The more the banks expands into the fee-income business, the less volatile their ROAA. The negative coefficient of Log Asset is consistent with the hypothesis that large banks incur lower risk.

Moving to Sharpe Ratio (Column 3), the same U-relationship with the LTA ratio is found indicating banks with higher and lower LTA ratio generate higher return per unit of risk. The other variable that is significantly positive is Equity/Asset. It suggests that banks with higher equity ratio have a higher return per unit of risk. However the non-interest income share is not statistically significant, which means increase in non-interest share does not necessarily increase the return per unit of risk.

Finally, using the Z-score (Column 4) as the dependent variable, the positive and significant coefficient on the equity ratio indicates that banks with higher equity ratio have a relatively lower insolvency risk. But no significant relationship has been found between Z-score and three types of non-interest income share which means banks' expansion into non-interest income activity do not increase the insolvency risk.

Results of ROAE Model

Table 19 shows the regression results of Model ROAE, which uses the mean and standard deviation of ROAE, the average Sharpe Ratio (as defined in Model ROAE) as well as the Z-score (as defined in Model ROAE) as the dependent variables to examine the relationship between non-interest income share and bank risk and return.

With the ROAE (Column 1) as the dependent variable, the findings are similar to model ROAA. The bank size, capital ratio, asset growth rate and trading income share are all positively significantly correlated with mean of ROAE. The Sharp ratio (Column 3) and Z-score (Column 4) are both positively significant with equity ratio. However, unlike model ROAA, the only factor which contributes to the standard deviation of ROAE is equity ratio. The Log Asset and fee income share which is negatively significant correlated with standard deviation of ROAA, have no impact on the standard deviation of ROAE. This is likely to be due to the reason given by Spong (1994) that bank regulators do not require banks to set aside additional capital for their fee-income business. Banks might however, internally allocate some capital to these activities. But the lack of regulatory capital might increase the financial leverage of banks when they expand to fee-income business and contribute to higher

earnings volatility. Therefore, the benefit of a decrease in the volatility of ROAA when banks increase fee income share is likely to be underscored by its increase in financial leverage. Consequently, there is no decreased volatility in ROAE when banks increase their fee income share²³. Instead, the equity ratio becomes the most important factor in reducing the volatility of ROAE.

Table 19: Model ROAE - Determinants of Bank Risk and Return

	Dependent Variables			
	Return on Average Equity (ROAE)			
	Mean	Std.Dev.	Sharp Ratio	Z-score
Constant	1.689 (1.62)	-0.587 (-0.229)	43.715 (1.509)	68.571 (1.438)
Log Asset	0.011 (0.922)	-0.035 (-1.219)	0.503 (1.563)	0.826 (1.557)
Equity/Asset	1.309** (2.47)	-3.057** (-2.343)	33.775** (2.293)	74.392*** (3.069)
Growth in Asset	0.767*** (3.529)	0.133 (0.248)	9.109 (1.507)	6.584 (0.662)
Trading Income Share	0.525* (1.768)	-0.975 (-1.333)	6.396 (0.774)	10.684 (0.786)
Fee Income Share	0.3 (1.129)	-0.81 (-1.239)	-4.574 (-0.62)	-8.850 (-0.729)
Other Income Share	0.155 (0.607)	0.161 (0.256)	1.1 (0.155)	0.564 (0.048)
Loan/Asset	-6.363* (-1.878)	4.963 (0.595)	-165.837* (-1.761)	-264.773* (-1.708)
(Loan/Asset) ²	5.057* (1.859)	-4.165 (-0.622)	131.396* (1.738)	211.662* (1.701)
R-squared	0.622	0.316	0.425	0.427
Adjusted R-squared	0.531	0.151	0.286	0.289
No. of Observations	42	42	42	42

Note: ***, **, * Significant at the 1%, 5%, and 10% levels, respectively. T-statistics are in parentheses below coefficient values.

Source: Author's calculations; Output obtained from EViews

Finally, as in model one, with the mean of ROAE and Sharpe ratio (Columns 1 and 3) as a dependent variable, the coefficients of linear and quadratic LTA ratio again shows a U relationship with banks' returns and risk-adjusted returns. Moreover, the

²³ ROAE is a foundation of ROAA and financial leverage, the higher the financial leverage the more volatile the ROAE. The relationship between ROAA and ROAE can be illustrated as the following well-known Dupon Formula:
 $ROAE = ROAA * Leverage$, Where $ROAE = \text{Operating profit(after tax)} / \text{Average Shareholder's Fund}$,
 $ROAA = \text{Operating profit(after tax)} / \text{Average Total Assets}$, $Leverage = \text{Average Shareholder's Fund} / \text{Average Total Assets}$.

Z-score also demonstrates a U relationship with LTA ratio. This means that banks with a higher or lower loan-to-asset ratio generate higher ROAE, higher return per unit of risk and suffer insolvency less. This might be due to the same reason we mentioned above, that banks with a higher or lower loan-to-asset ratio also devote themselves to more non-interest income activities, which makes them more profitable and with a lower insolvency risk. However, banks with a moderate loan-to-asset ratio and who devote less to non-interest income activities might generate a lower return on equity and suffer higher insolvency risks.

Chapter 5: Conclusion

This thesis looked at the behaviour and performance between FHC banks and non-FHC banks in Taiwan. The objective was to explore two questions. First, if banks are part of an FHC are they more diversified, and perform better? Second, how do non-interest income activities affect banks' risks and return? Though the overall performance of FHC banks was better than those of non-FHC banks, this is probably because banks with a historically higher profitability were more likely to be approved by the regulator for conversion into FHCs. Comparing results from the growth rate of both ROAA and ROAE of FHC banks and non-FHC banks during the post-acquisition period provides little evidence that the structure of FHC helps banks to improve their profitability.

With regard to the question of whether FHC banks are more diversified than non-FHC banks, the degree of diversification of FHC banks was found to be higher than that of non-FHC banks over the entire sample period, indicating that FHC banks were devoting themselves to more non-interest income activities. However, there is little evidence that being part of an FHC helps banks to expand to non-interest income activities. There is a trend for all banks in Taiwan to expand into non-interest income activities to promote their profitability.

Decomposing the volatility of operating revenue from 1999 to 2005, and through the sensitivity analysis, it is found that a bank's expansion to non-interest income activities did reduce its variance of operating revenue. The results show that banks' expansion to fee-income and other activities benefit from these forms of diversification. Switching from interest income activities to trading income activities may slightly reduce the variance of operating revenue. However, the magnitude of the reduction of variance is highest as banks expand into fee-income activities.

The empirical evidence of the relationship between banks' profits and non-interest income activities shows that banks that expand more to trading and fee-income activities appear to enjoy a higher return. Other important factors that are associated positively with a bank's profitability include size, the equity ratio and growth in

assets. In terms of risk, a reduction on its standard deviation of ROAA was found when a bank is expanding into fee-income activities. This outcome was consistent with the results obtained when the volatility of operating revenue was divided into the contribution of interest, trading, fee and other income. It showed revenue variability was lowest for a bank expanding to fee income activities. However the fee-income share seems to have no effect on the reduction of volatility of the ROAE. This may be due to the benefits of decreased volatility of bank's ROAA being underscored by the increase in their financial leverage, when they expand to fee-income activities.

The most striking result is that the loan-to-asset ratio demonstrates a U shape relationship with return, risk-adjusted return and Z-score. By further discovering the relationship with loan-to-asset ratio and share of non-interest income, banks either devote to expand interest income or to non-interest income activities will benefit from higher return, risk-adjusted return and lower insolvency risk. Those banks that maintain a strategy of a moderate loan-to-asset ratio, but lower share of income derived from non-interest sources may lack competitive advantage in Taiwan's banking industry, since they generate lower profit and may incur higher insolvency risk.

Finally, although findings in this thesis provide no evidence that the FHC structure improves the profitability of banks, it is difficult to draw a definitive conclusion in this regard. The limitation of this study was that the regulator's policies in requiring and encouraging banks to reduce their non-performing loans in 2002 and 2005 may have caused them to write-off a greater amount of bad debt in order to improve income in future years. These policies impact on the volatility of ROAA and ROAE and may distort the annual performance of banks. The other limitation is that this study doesn't control the macro economic variables such as GDP growth rate, interest rate and exchange rate, which might have a different impact on each individual bank. For example, the fluctuation of exchange rates might have much more impact on banks which are involved in more global banking activities.

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Appendix 1:

Total Asset and Total Equity of FHCs

Date: 2005.12.31.

Unit: NT dollar one hundred millions

FHC	Date of Establishment	Total Asset	Total Equity	Subsidiaries
Cathay United	2001/12/31	30,525	1,834	2 banks, 1 securities company, 2 insurance companies and 3 other financial institutions.
Mega	2002/02/04	22,280	1,910	2 banks, 1 securities company, 1 insurance company and 4 other financial institutions.
Hua Nan	2001/12/19	16,740	894.83	1 bank, 1 securities company, 1 insurance companies and 5 other financial institutions.
First	2003/01/02	15,985	919.63	1 bank, 1 securities company, 5 other financial institutions.
Fubon	2001/12/19	16,844	1,596	2 banks (including 1 foreign bank), 1 securities company, 2 insurance companies and 6 other financial institutions.
Chinatrust	2002/05/17	16,240	1,456	1 bank, 1 securities company, and 5 other financial institutions.
Shin Kong	2002/02/19	13,281	684.04	1 bank, 1 securities company, 1 insurance companies and 2 other financial institutions.
Taishin	2002/02/18	23,825	1558.8	1 bank, 1 securities company, and 3 other financial institutions.
SinoPac	2002/05/09	10,992	907.97	2 banks, 1 securities company, and 8 other financial institutions.
E.Sun	2002/01/28	6,420	436.04	1 bank, 1 securities company, and 3 other financial institutions.
Fuhwa	2002/02/04	4,010	398.49	1 bank, 1 securities company, and 7 other financial institutions.
Jih Sun	2002/02/05	3,429	263.48	1 bank, 1 securities company, and 1 other financial institutions.
China	2001/12/28	2,729	1,298	1 bank, 1 securities company
Waterland	2002/03/26	2,532	246.22	1 securities company, and 2 other financial institutions.

Source: Statistic of Financial Institution, Banking Bureau, Financial Supervisory Commission.

Appendix 2:
The Average ROAA, ROAE and Non-Interest Income Share of Taiwan's Banks (1999-2005)

Unit: NT dollars one

Bank	Average Asset	Average Equity	Average ROAA	Average ROAE	Average Non-Interest Income Shares	Average Trading Income Shares	Average Fee Income	Average Other Income
FHC Banks								
Chaio Tung Bank	580,339	55,292	1.04	11.20	16.74	5.08	4.52	7.14
First Commercial Bank	1,405,317	71,656	-0.12	-4.22	17.24	5.26	6.12	5.86
Hua Nan Bank	1,385,697	68,661	0.15	3.45	21.39	7.74	5.45	8.21
Taiwan Fubon Bank	740,558	52,407	0.76	10.77	25.70	10.91	12.29	2.51
Cathay United Bank	803,716	68,138	0.64	7.02	16.52	2.77	7.60	6.15
The International commercial Bank of China	997,413	67,008	0.82	12.04	22.35	1.75	8.66	11.93
Taiwan Shin Kong commercial Bank	202,552	11,850	0.08	1.29	14.03	3.44	8.60	1.99
Fuhwa Bank	210,043	13,640	-0.07	-0.33	17.53	8.73	7.32	1.48
Bank SinoPac	352,092	25,186	0.87	11.20	21.02	8.67	7.55	4.80
E.Sun Bank	330,594	24,533	0.79	10.19	18.93	6.13	7.39	5.40
Taishin International Bank	505,824	41,506	1.26	15.22	21.92	5.34	12.43	4.16
Jih Sun International Bank	216,551	12,581	-0.32	-6.45	10.19	2.47	6.68	1.05
Chinatrust Commercial Bank	1,003,378	76,938	1.22	15.25	28.37	4.37	17.12	6.87
Non-FHC Banks								
Central Trust of China	260,999	5,523	0.15	0.24	19.38	5.59	8.60	5.20
The Farmer Bank of China	547,967	21,581	-0.15	-3.78	19.53	4.38	7.63	7.52
Bank of Taiwan	2,347,895	181,043	0.49	6.35	18.66	4.98	3.04	10.64
Land Bank	1,604,700	81,881	0.35	6.55	20.88	10.56	2.36	7.96
Taiwan Cooperative Bank	1,859,023	60,111	0.21	6.34	12.54	5.16	4.80	2.59
Chang Hwa Bank	1,241,180	69,305	-0.70	-14.02	14.42	10.50	2.89	1.03
Bank of Overseas Chinese	268,501	11,588	-0.67	-15.26	13.54	3.36	4.94	5.23
The Shanghai Commercial and Saving Bank	378,998	43,325	0.88	7.77	15.81	4.09	9.34	2.38
Bank of Kaohsiung	172,270	10,199	0.17	2.91	35.48	4.75	10.07	20.66
Hwatai Bank	75,802	6,227	0.39	4.55	14.52	9.25	4.51	0.76
Sunny Bank	147,092	8,542	0.58	9.70	10.36	6.29	3.27	0.80
Bank of Panhsin	120,928	8,101	-0.08	-1.46	9.21	3.40	4.90	0.92
COTA Commercial Bank	68,335	5,249	0.09	1.46	10.18	5.86	5.06	-0.74
Lucky Bank	84,446	4,682	-0.06	-1.92	7.44	1.06	6.02	0.35
Union Bank of Taiwan	218,811	16,966	0.08	0.06	7.55	5.54	1.75	0.26
The Chinese Bank	211,460	15,950	-0.09	-1.45	19.82	4.73	13.08	2.01
Far Eastern International Bank	217,783	17,426	0.33	4.40	10.07	1.04	7.65	1.37
Cosmos Bank, Taiwan	219,670	17,791	0.23	2.65	18.79	4.94	10.98	2.87
Bowa Bank	175,456	9,894	-0.50	-10.64	9.81	1.29	6.75	1.76
Da Chung Bank	251,357	16,921	0.10	1.93	10.65	4.42	5.19	1.04
EnTie Bank	226,587	16,478	0.19	2.36	14.71	2.71	10.40	1.59
Chinfon Bank	159,876	10,745	-0.24	-3.55	15.34	6.16	8.33	0.85
Taiwan Business Bank	971,117	41,477	-0.40	-11.27	25.60	1.22	9.46	14.92
International Bank of	358,835	31,719	0.87	9.82	8.34	3.00	4.12	1.22

Taipei									
Hi Bank	332,677	17,308	0.25	5.08	24.07	13.73	7.32	3.02	
Taichung Bank	231,823	15,075	0.20	2.68	16.44	5.48	8.42	2.54	
King's Town Bank	136,045	8,122	-0.23	-3.61	9.43	4.91	3.78	0.74	
Enterprise Bank of Hualien	42,307	1,454	-0.83	-8.76	8.01	2.33	4.94	0.73	
Taitung Business Bank	49,597	3,586	-2.27	-9.30	1.80	-1.47	1.01	2.26	