HEDGING AND TRADING ACTIVITIES OF BANK HOLDING COMPANIES: ANALYSIS OF FOREIGN EXCHANGE DERIVATIVES ACCOUNTS

A Thesis Submitted to
The College of Graduate Studies and Research
in Partial Fulfillment of the Requirements
for the Degree of Master of Science in Finance
in the Edwards School of Business
University of Saskatchewan
Saskatoon, Saskatchewan

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ABSTRACT

Bank holding companies (BHCs) in the United States (US) have been recently required to report foreign exchange derivatives in two accounts. One account includes the foreign exchange derivatives held for trading while the other account contains the foreign exchange derivatives held for purposes other than trading. The objective of this study is to examine the factors that determine the sizes of these two accounts.

We propose that the size of the securities portfolio held for purposes other than trading is an indicator of the magnitude of the hedging operations by a US BHC. In particular, we are interested in the portfolio of foreign exchange derivatives held for purposes other than trading and we refer to this portfolio as the foreign exchange derivatives hedging account. Our proposition is consistent with Adkins, Carter and Simpson (2007) who regard the securities that are held for purposes other than trading as primarily used for hedging purposes. Thus, we use the foreign exchange hedging account to study the foreign exchange hedging behavior of BHCs and determine the factors that influence the magnitudes of the foreign exchange hedging accounts.

Hedging activities in general are very important for practitioners, regulators, and academics as evidenced by the extensive publicity and attention that has been given to interest rate risk and the extensive research that has been done to examine the factors that determine the magnitudes of interest rate hedging activities. Yet, little research has been devoted to examine the factors that determine the magnitudes of the foreign exchange hedging activities in US BHCs. One purpose of this study is to fill this gap in the literature.

Similarly, we propose that the size of the trading account of a BHC is an indicator of the magnitude of the trading operations. These operations are attracting the attention of academics, regulators, and practitioners as they can generate significant revenues to BHCs but they are sources of significant risks. For example, much of the surprisingly high revenues reported by major US banks in the first and second quarters of 2009 are credited to trading operations while revenues from other activities were significantly low. On the other hand, trading activities are largely blamed for several catastrophic financial events such as the collapse of the Baring Bank PLC and the financial crisis of 2008 which nearly lead to the collapse of the global financial system. One objective of this study is to improve our understanding of the foreign exchange derivatives trading and the factors that influence the magnitudes of the foreign exchange trading

accounts at US BHCs. Given the importance of the trading operations it is surprising that little research has been done in this area.

The results of this study are derived from empirical data observed over the period from 1995 to 2007 inclusive. This data is obtained from the financial reports and statements of US BHCs. We use regression analysis to show that the notional amounts of the foreign exchange derivatives held in the hedging and trading accounts are related to various firm-specific and environmental factors. In particular, we argue that the net asset exposure, which measures the difference between the assets and liabilities denominated in foreign currency, and the net income exposure, which measures the difference between the interest income and interest expenses denominated in foreign currency, should be significant determinants of the notional amount of derivatives held in the hedging account. We propose that these two factors are indicators of a BHC's exposure to foreign exchange fluctuations and hedging should be designed to offset their influence on the value of assets or level of income. In addition, we propose that a BHC's size and level of capitalization affect the size of the hedging account.

Similarly, we propose that the notional amount of foreign exchange derivatives held for trading should be related to the same factors. In particular, we argue that the notional amount of derivatives in the trading account is related to the net asset exposure and the net income exposure as they indicate a BHC's involvement in international operations such as lending, deposit taking, risk management, and correspondent relationships in foreign countries. In our opinion, the larger the involvement in international operations the larger is a BHC's ability to trade foreign exchange derivatives.

This study makes several unique contributions. First, it shows that the net asset exposure and the net income exposure have positive and significant effects on both the hedging and the trading accounts. Second, we show that the capital ratio and the magnitude of the hedging and trading accounts are positively and significantly related. In addition, this study confirms that the magnitude of total assets is a positive and significant determinant of BHCs' foreign exchange derivative securities held in either the hedging or the trading accounts. This result is consistent with previous studies such as Carter and Sinkey (1998), Brewer, Jackson and Moser (2001), Adkins, Carter and Simpson (2007), and Hassan and Khasawneh (2009).

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to my co-supervisors, Dr. Abdullah Mamun and Dr. George Tannous, for their guidance, direction and encouragement throughout the completion of this thesis. They devoted a significant amount of time and effort and it has been my great pleasure to have worked with them. I would also like to thank the internal examiner of my thesis committee, Dr. Dev Mishra, and the external examiner, Dr. Nancy Ursel, for their invaluable suggestions and comments.

I would like to extend my appreciation to other faculty and staff from the Department of Finance and Management Science for all assistance provided by them during my days at the University of Saskatchewan. I also wish to acknowledge the help from the Edwards School of Business Technology Support Center.

Finally, I would like to thank my family, classmates, and friends for their continued support.

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CHAPTER 1

INTRODUCTION

Banks and bank holding companies (BHCs) in the United States (US) report their holdings of foreign exchange derivatives in one of two accounts. One account includes all the foreign exchange derivatives held for trading while the other account contains foreign exchange derivatives held for all other purposes. These reporting requirements are mandated by Financial Accounting Standards Board (FASB) Statement No. 119 which specifies that a distinction must be made between financial instruments held or issued for trading purposes and financial instruments held or issued for purposes other than trading.[1]

According to the Office of the Comptroller of the Currency's (OCC's) quarterly reports, the 25 banks with the largest derivative portfolios hold approximately 96% of their contracts for trading, essentially to serve corporate and institutional clients that are hedging risk. The remainder of the derivatives is used by banks for their own purposes. These purposes include mainly hedging a bank's own foreign exchange risk but may also involve proprietary trading in which a bank speculates by holding foreign exchange derivatives to profit from expected movements in financial markets. Yet, the tendency of academics, regulators, and practitioners is to assume that the dominant portion of the derivatives and other assets held for purposes other than trading consists of hedging tools. For example, Adkins, Carter and Simpson (2007) argue that the size of the foreign exchange derivatives held by BHCs for purposes other than trading is an indicator of hedging activities. We adopt this convention to analyze the determinants of the foreign exchange hedging activities of US BHCs. For brevity we use the term "hedging account" to refer to the securities held for purposes other than trading.

One major objective of this thesis is to determine the factors that affect the hedging activities of US BHCs. In particular, the focus is on hedging with foreign exchange derivatives. These hedging activities are designed to reduce foreign exchange risk. Saunders, Cornett and McGraw (2006) define this risk as the fluctuations in the value of a financial institution's assets and liabilities denominated in foreign currencies due to variations in the exchange rate. In

[1] FASB Statement No. 119 sets the standards of disclosures about financial derivatives such as futures, forwards, swaps, and option contracts. It also amends existing requirements provided by FASB Statement No. 105, *Disclosure of Information about Financial Instruments with Off-Balance-Sheet Risk and Financial Instruments with Concentrations of Credit Risk,* and FASB Statement No. 107, *Disclosures about Fair Value of Financial Instruments.*

addition to the academic interest, the issue of the determinants of foreign exchange hedging is gaining practical importance with the globalization of the financial services industry. As a BHC increases its involvement in international banking its exposure to foreign exchange fluctuations will increase. In response, banks have developed derivative contracts to hedge their risks without having to make extensive changes on the on-balance sheet items (Hassan and Khasawneh (2009)). They also suggest that using derivatives can avoid regulatory costs and taxes since reserve requirements and deposit insurance premiums are not levied on off-balance-sheet items.

The importance of hedging activities in general is recognized by practitioners, regulators, and academics. Extensive publicity and attention are continuously given to interest rate risk and many regulations, for example the risk-based capital requirements, have been introduced to control this risk. Similarly, previous studies have mainly concentrated on interest rate risk and the derivatives used to hedge this risk. Brewer, Minton and Moser (2000) report that commercial banks have become active end users or intermediaries in the interest rate derivatives markets since mid 1980s. In addition, extensive research efforts have been devoted to investigate the determinants of interest rate hedging activities and the association between the use of interest rate derivatives and risk reduction. These studies include Koppenhaver (1990), Shanker (1996), Ahmed, Beatty and Takeda (1997), Brewer, Jackson and Moser (2001), Zhao and Moser (2006), and Purnanandam's (2007).

At the same time, interest in managing foreign exchange risk has prompted researchers to examine many aspects of foreign exchange hedging. For example, Grammatikos, Saunders, and Swary (1986) investigate foreign exchange hedging activities of BHCs and find that banks imperfectly hedge their overall asset position in individual foreign currency and expose themselves to foreign exchange risk. Wetmore and Brick (1994) argue that foreign exchange risk is positively related to the foreign loan exposure. Other studies, for example Chamberlain, Howe and Popper (1997), Choi and Elyasiani (1997), Chaudhry, Christie-David, Koch and Reichert (2000), Reichert and Shyu (2003), and Clark, Delisle and Doran (2008), focus on whether banks use foreign exchange derivatives to decrease their foreign exchange exposure. However, previous studies seem to leave ample room for improvement in our knowledge of the determinants of foreign exchange derivatives hedging and trading. First, they all consider foreign exchange derivatives as a whole without differentiating them on the basis of trading or hedging activities. This study advances the literature by making these differentiations. Second, some

previous studies focus on individual foreign exchange derivative types. We broaden their contributions by analyzing all derivatives as a group as well as analyzing the major components of the group. Third, little research has been devoted to examine the factors that determine the magnitudes of the foreign exchange hedging activities in US BHCs.

Adkins, Carter and Simpson (2007) is the only study that has similarities with this study's approach and objectives. They consider the factors that affect the decisions of financial firms to use foreign exchange derivatives for hedging purposes. They conclude that managerial ownership increases the likelihood of hedging and the existence of option-like features in managerial compensation decreases this likelihood. Yet, contrary to expectations they find no statistically significant relation between the use of foreign exchange derivatives and foreign exchange exposure. In addition, they report a negative relation between the extent of derivative use and the level of foreign exchange exposure. The authors explain their findings by arguing that managers are hedging to stabilize cash flow, pacify institutional owners, and reduce their own risk. However, the Adkins, Carter and Simpson (2007) study may be criticized on the basis that their measure of foreign exchange exposure is not appropriate to determine foreign exchange hedging. In light of the findings of Carter and Sinkey (1998), their measure fails to account for natural hedges.

This study analyzes the determinants of hedging with foreign exchange derivatives using measures of foreign exchange exposure that take natural hedges into consideration. We propose that the net asset exposure is one of these determinants. It measures the difference between the assets and liabilities denominated in foreign currency. If a BHC has more assets denominated in foreign currency than liabilities, a depreciation of the US currency will lead to an increase in the value of the BHC's assets. On the other hand, an appreciation in the US currency will lead to a decrease in the value. Thus, the hedging activities of this BHC must be determined by the size of the net asset exposure as the other foreign exchange denominated assets and liabilities are naturally hedged. Appendix I provides a simple example that demonstrates how a BHC's foreign operations may lead to net foreign exchange asset exposure and why a BHC must limit its hedging activities to manage this exposure.

Similarly, we propose that the net income exposure is a determinant of hedging activities. It is measured as the difference between the interest income and interest expenses denominated in foreign currency. The net income exposure measures the degree by which a BHC's income is

affected by fluctuations in the value of the currency. For example, if a BHC has more income denominated in foreign currencies than expenses, a depreciation of the US currency will lead to an increase in income. On the other hand, an appreciation in the US currency will lead to a decrease in income. Thus, the hedging activities of this BHC must be determined by the size of the net income exposure as the other foreign exchange denominated income and expenses are naturally hedged. Appendix I provides a simple example that demonstrates how a BHC's foreign operations may lead to net foreign exchange income exposure and why a BHC must limit its hedging activities to manage this exposure.

Another major purpose of this study is to determine the factors that influence the foreign exchange trading activities of banks. Brewer, Minton and Moser (2000) propose two possible sources of bank revenues from participating in interest-rate derivatives. They state "One source of revenue comes from banks' use of derivatives as speculative vehicles". Gains from speculating on interest-rate changes would enhance revenues from bank-trading desks. A second source of income is generated when banks act as OTC dealers and charge fees to institutions placing derivative positions. Saunders, Cornett and McGraw (2006) conclude that taking an open position or speculating in currencies contributes greatly to profits or losses on foreign trading, while revenues from the bid-ask spread or from acting as agents for customers provide only a secondary source. Hassan and Khasawneh (2009) argue that banks are involved in off-balance-sheet activities in hope of earning additional fee income to compensate for declining margins or spreads on their traditional lending business.

Similarly, Saunders, Cornett and McGraw (2006) indicate two major trading activities generally associated with a financial institution's position in the foreign exchange trading account. First, banks may act as agents to purchase and sell foreign currencies on behalf of their customers. As agents, banks earn fee income for matching buyers and sellers but they do not assume the foreign exchange risk themselves. Second, banks may trade foreign currencies for speculative purposes. They forecast future movements in relevant foreign exchange rates and then they take position to benefit from the forecasted movements. Speculative positions can be instituted through trading the spot currency instruments or by taking a position in the foreign exchange derivatives.

Trading activities in general generate substantial revenues and contribute significantly to the net income of large US banks and BHCs. Allen and Santomero (2001) suggest that banks

have moved away from their traditional role of taking deposits and making loans to innovative fee-producing activities, such as investing or trading in derivatives. Sapsford and Zuckerman (1999) report that in 1999 Chase Manhattan Bank reported $2.9 billion trading revenue during the three quarters ending September 30. Mollenkamp, Beckett and Miller (2000) report that in the first quarter of 2000 trading-account profits at Bank of America were $724 million, an increase of 45% from a year earlier. They attribute the increase to a flurry of trading in equity derivatives and interest rate swap orders to hedge the markets. Similarly, they report that Bank of New York was helped by strong growth in its securities servicing and foreign exchange operations. In the first quarter of 2000 fee revenue from securities servicing amounted to $372 million, an increase of 28% over the previous year, while foreign-exchange and other trading increased 81% to $76 million. The OCC's Quarterly Report on Bank Trading and Derivatives Activities, Third Quarter 2008, *(www.occ.treas.gov/ftp/release/2008-152a.pdf*) suggests that these impressive revenues and profits fluctuate significantly but on average they continue to grow. It reports that in the third quarter of 2008 these revenues from cash and derivatives trading for all US commercial banks amounted to $6.0 billion compared to $1.6 billion the prior quarter and $2.2 billion the average revenue over the eight quarters leading to September 30, 2008.

Trading activities at banks include interest rate and foreign currency derivatives as well as cash securities, equities, bonds, and other assets. According to the OCC's quarterly reports, the notional amount of derivatives held by banks consist mainly of interest rate derivatives while a small portion consists of foreign exchange derivatives. Figures 1.1 and 1.2 show that for the period 1997-2007 the total notional amount of interest rate contracts per year is much larger than the total notional amount of foreign exchange contracts. Yet, the total revenue from interest rate contracts is on average less than the total revenue from foreign exchange contracts. Only in Years 1997, 2001, 2002 and 2007 the total revenue from interest rate contracts is higher than the revenue from foreign exchange contracts but the difference per year is minor compared to the difference in the notional amounts. Apparently, the profit per unit of the notional amount of foreign exchange contracts is much higher than the profit per unit of the notional amount of interest rate contracts or the inventory turnover is significantly higher.

----Insert Figure 1.1 about here----

----Insert Figure 1.2 about here----

Despite the importance of the trading activities, very little has been done to examine their determinants. One objective of this thesis is to fill the gap. We propose that the notional amount of foreign exchange derivatives held for trading is related to the net asset exposure and the net income exposure. This relation would be positive if the sizes of the net asset exposure and the net income exposure grow with the depth and the breadth of a BHC's international operations. These operations include banking relationships with domestic and foreign international companies, business relationships with foreign governments, and banking operations in foreign countries including lending, deposit taking, risk management, and correspondent relationships. We expect that the more extensive these operations are the more chances a BHC will have to conduct foreign exchange derivatives trading.

Our analysis of the factors that affect the foreign exchange hedging and trading accounts considers the impact of capitalization. If all else are equal, the level of capitalization by a BHC and the size of the hedging account should be negatively related. A negative relationship will exist if a BHC increases its hedging activities when its capital ratio is low. This is consistent with the notion that hedging decreases risk and with the Basle Accord which requires that the higher the level of risk in an asset the higher should be the associated capital ratio. However, previous studies examine this relation and find surprising conclusions. Demsetz and Strahan (1997) and Hirtle (2009) suggest that the hedging activities do not necessarily reduce a bank's risk. They attribute these observations to a neutralizing substitution of risks where the reduction of risk through hedging is offset by higher risk from expansion into other activities. We suggest that the characteristics of these other activities may lead to a positive, insignificant, or negative relation between hedging and the capital ratio. In particular, we expect to observe a positive relation if the other activities into which a bank expands following hedging are mostly off-balance sheet activities that require little or no capital. On the other hand, we expect a negative relation if the other activities that are undertaken are riskier than the assets they substitute.

Trading operations are also affected by the level of a BHC's capitalization. Hirtle (2003) indicates that banks with large trading accounts are required to hold higher capital based on internal risk assessment formulas. However, she reports that the actual capital reported to comply with these requirements is minor in proportion to total capital. These findings suggest that a positive or insignificant relation exists between the trading account and the level of capitalization of a BHC. Overall, our results are consistent with the substitution theory of risk reduction.

The remainder of this thesis is organized as follows: Chapter 2 provides a detailed review of the literature related to the topics relevant to this study. Chapter 3 proposes the three groups of hypotheses that we test in this study. Chapter 4 describes the data and the methodology. Chapter 5 analyzes the empirical results and Chapter 6 concludes the study.

CHAPTER 2
LITERATURE REVIEW

There is extensive literature that examines various topics related to interest rate risk and foreign exchange exposure of BHCs. Similarly, there is a wealth of studies that consider the use of interest rate and foreign exchange derivatives for hedging. This chapter divides this literature into three sections: Section 2.1 discusses the literature that examines the determinants of interest rate risk at financial institutions, Section 2.2 provides a review of the literature related to interest rate and foreign exchange derivative usage by banks, and Section 2.3 discusses the capital requirements set by bank regulators.

2.1 The determinants of interest rate risk at banks

The traditional borrowing and lending operations of a financial institution often lead to a mismatch between the maturities of its assets and the maturities of its liabilities. As a result, it exposes itself to interest rate risk. Maturity mismatches are the first that were considered by researchers trying to explain the changes in interest rate sensitivity of bank stock returns. Flannery and James (1984a) examine the relation between the interest rate sensitivity of common stock returns and the maturity composition of the bank's nominal contracts. They find that the cross-sectional variation in the interest rate sensitivity measure is significantly related to the maturity mismatch between the bank's assets and liabilities. They conclude that the effect of the nominal interest rate changes on common stock prices is related to the maturity composition of a firm's net nominal asset holdings. Tarhan (1987) concludes that a firm's holdings of nominal assets and nominal liabilities are not important in affecting common stock returns. Kwan (1991) develops an index model controlling for the time-varying interest rate sensitivity caused by a bank's changing maturity profile for stock returns of commercial banks. He finds evidence consistent with the hypothesis that bank stock return interest rate sensitivity is related to its balance sheet composition.

However, the maturity model ignores the timing of the cash flows from the financial institution's assets and liabilities. Hence, duration is introduced as a more accurate measure of a financial institution's interest rate risk exposure. Duration takes into account the time of arrival of all cash flows and accounts for the maturity of the assets and liabilities. Staikouras' (2003) indicates that the duration gap inherent in financial intermediaries' balance sheet structures can explain a significant portion of their yield sensitivity.

Besides the basic maturity model and the duration model, more advanced methods are discussed in previous research to account for the change of interest rate risk exposure as well. Flannery and James (1984b) focus on the effective maturities of five prominent balance sheet items, net assets subject to re-pricing within one year, demand deposits, regular savings deposits, small time deposits, and cash. They conclude that banks could help reduce the interest rate sensitivity of their stock returns by holding higher percentages of their portfolios in the form of demand deposits, savings accounts, and small time deposits. Fraser, Madura and Weigand (2002) test the relation between bank's interest rate sensitivity and bank characteristics described by a bank's financial leverage, its reliance on noninterest income, its proportion of income derived from re-priced assets, and its reliance on noninterest liabilities. Their evidence shows that interest rate risk can be explained by these characteristics.

2.2 Evidence on bank derivative use

Sinkey and Carter (2000) argue that banks participate in the derivative market as dealers or end users or both. However, only a very small number of banks are able to act as dealers to generate fee income in the derivative market. The remaining banks are primarily using derivatives as end users to hedge against the unexpected movement of related economic variables or speculate on the future changes of those variables. Sinkey and Carter (2000) further report that banks which use derivatives for hedging display several unique financial characteristics. In comparison with nonusers, they have riskier capital structures (more notes and debentures and less capital equity), larger maturity mismatches between assets and liabilities, greater net loan charge-offs, and lower net interest margins.

Hirtle (1997) suggests that derivative instruments are off-balance sheet items whose payoffs are dependent on their underlying assets. As these assets are not included on the bank's balance sheet, derivatives provide banks an easy way to separate risk management from their other business objectives. Furthermore, she proposes that the potential for banks to move toward their desired levels of interest rate risk exposure is increased by the existence of an active derivatives market. She argues that the wide acceptance of interest rate and foreign exchange derivatives as risk management tools allows bank to directly manage their interest rate and foreign exchange risk profiles.

Many previous studies focus on the use of interest rate derivatives for hedging purposes and report mixed results. Some previous studies conclude that interest rate derivatives are

effective in reducing interest rate risk, that is, banks use interest rate derivatives mainly for hedging purposes. Koppenhaver (1990) illustrates that both long and short futures and forward positions are used to hedge the balance sheet interest rate risk faced by banks. Shanker (1996) investigates the effect of the use of interest rate derivatives (futures, options, and swaps) upon the interest rate risk of commercial banks, and proves the hedging function played by derivatives. Ahmed, Beatty and Takeda (1997) provide evidence which indicates that derivative users as a group expose themselves to lower mean interest rate risk than nonusers. Moreover, for the majority of users, derivative usage reduces exposure. Schrand (1997) shows that interest rate derivative activities by savings and loan associations are positively related with lower interest rate sensitivity of stock price. Brewer, Jackson and Moser (2001) suggest that derivatives users overall tend to have less systematic risk than nonusers, and that derivatives users are less risky than nonusers. They also argue that large banks are much more likely than small banks to use derivatives. Zhao and Moser (2006) examine how derivative usage affects the interest rate sensitivity of BHCs. The major finding of their study is that the stock returns of a BHC using derivatives are less sensitive to interest changes after controlling for balance sheet composition and asset size. So interest rate derivatives allow banks to decrease their systematic exposure to interest rate changes, and thereby increase their ability to better manage their interest rate risk exposure. The findings of Purnanandam (2007) regarding the banks' use of interest rate derivatives are consistent with the hedging purposes.

On the other hand, a few papers illustrate that the use of interest rate derivatives is associated with higher interest rate sensitivity of bank stock returns. The findings of these studies are consistent with the notion that banks are trying to employ interest rate derivatives for speculation purposes. By controlling for the impact of on-balance-sheet items as well as other specific characteristics, Hirtle (1997) examines the role played by derivatives in influencing the interest rate sensitivity of BHCs' stocks. The main finding of this analysis is that there is evidence that increased usage of interest rate derivatives is accompanied by higher interest rate sensitivity of bank stock returns. This relationship varies across banks in different size categories, and is particularly strong for smaller, end-user BHCs as well as for derivative dealer BHCs. Carter and Sinkey (1998) investigate the use of interest-rate derivatives by U.S. large community banks which are end users of interest-rate derivatives rather than dealers. They find that the use of interest-rate derivatives is positively related to exposure to interest-rate risk as

measured by the absolute value of the 12-month maturity gap. Furthermore, a community bank's decision to be involved in interest rate contracts is positively related to its size. However, there is no positive relationship between size and the extent of participation in the derivatives market.

In addition to interest rate derivatives, foreign exchange derivatives have also been widely used by banks. However, unlike interest rate derivatives, existing studies all conclude that banks use foreign exchange derivatives to decrease the foreign exchange exposure of bank stock returns. Chamberlain, Howe and Popper's (1997) cross-sectional evidence is consistent with the use of foreign exchange contracts for the purpose of hedging. Choi and Elyasiani (1997) examine both interest rate risk and foreign exchange risk. They argue that foreign exchange risk may be attributed to exchange rate risk exposure generated from the portfolio of different types of foreign exchange derivative contracts and basic exposure generated from the composition of foreign assets and liabilities. They propose that basic exposure may be explained by measures such as assets in foreign offices divided by assets in domestic offices, deposits denominated in foreign currencies divided by deposits in domestic currency, foreign interest income divided by total interest income, foreign interest expenses divided by total interest expenses, and foreign noninterest expenses divided by total noninterest expenses. Their results demonstrate that either interest rate derivatives or currency derivatives can affect a bank's interest rate and exchange rate risks but the currency derivatives generally have a greater effect. Chaudhry, Christie-David, Koch, and Reichert (2000) find that foreign exchange swaps are primarily used for risk-control purposes by US commercial banks. Reichert and Shyu (2003) measure foreign exchange risk by employing both the notional values of different types of interest rate and foreign exchange derivative contracts and a number of key balance sheet control variables as independent variables. Their study indicates that use of options increases the interest rate risk exposure for all banks, while interest rate and foreign exchange swaps generally reduce risk. Adkins, Carter, and Simpson (2007) consider the factors that affect a financial institution's decisions related to the use of foreign exchange derivatives for hedging. They find that there is no statistically significant relationship between foreign exchange derivatives use and foreign exchange exposure defined as the ratio of foreign interest income to total interest income. Clark, Delisle and Doran (2008) link derivative use to the sensitivity of BHCs' implied volatilities to several macroeconomic factors to identify whether banks are using derivatives (interest rate derivatives, foreign exchange derivatives, credit derivatives, and commodity derivatives) to speculate or hedge. Their results

suggest that the relationship between risk sensitivity and use of derivatives is strongest for interest rate and foreign exchange products. They also find that whether a BHC uses derivatives or not is not very important to its future stock performance, but how it uses derivatives matters. In their sample, hedgers outperform speculators for most risk sensitivities, and significantly for credit risk exposure.

A few papers discuss the use of derivatives by other types of financial institutions or nonfinancial firms. Allayannis and Ofek (1997) examine some S&P nonfinancial firms to see whether those firms use foreign exchange derivatives for hedging purposes or for speculation. They find that the use of currency derivatives reduces the foreign exchange exposure of those firms. Guay (1999) investigates the roles of derivatives for firms which are new users of derivatives. The results indicate that firm risk declines following the initiation of a derivatives portfolio. Makar and Huffman (2001) demonstrate that, for companies that do not effectively use foreign exchange derivatives to fully hedge their currency risk, there is association between the changes in firm value and the changes in exchange rates. Raturi (2005) points out that although smaller insurers are slow to employ derivatives, these securities are innovative tools that may be useful for insurance companies to manage actuarial, market, credit, and liquidity risks.

2.3 Capital Requirements

Exposure to interest rate risk and foreign exchange risk affects a bank's risk-adjusted assets. Thus, a change in exposure will lead to a change in the risk-based capital required by regulations. In particular, an increase in the risk of assets will increase the capital required to comply with the requirements. As the capital that may be used to satisfy capital requirements is more expensive than other capital such as deposits, taking additional risk by a financial institution implies additional cost of capital to that institution. Therefore, there is a cost saving incentive for banks and BHCs to hedge their risk exposure.

The existing literature finds mixed observations regarding the relationship between capitalization and the use of derivatives. Peek and Rosengren (1997) suggest that undercapitalized banks are more likely to participate in the derivatives markets suggesting a negative relationship. Koppenhaver (1989) finds that capital constraint factors are unimportant in the decisions of banks to engage in derivative activities. Similarly, Sinkey and Carter (2000) do not support the argument that stronger capital positions are required for banks to engage in derivatives activities. Hassan and Khasawneh (2009) consider the capital adequacy ratio as a

proxy for capital requirements regulations and conclude that it is not a significant factor in determining the usage of derivatives. These three studies suggest an insignificant relation between capitalization and the use of derivatives. Yet, other studies suggest a positive relation. Gunther and Siems (1995) suggest that the regulatory environment may ask for a higher capital level as a prerequisite for banks to enter derivative markets since banks with the highest capital cushion and potentially the lowest risk-taking incentives are more active participants. Adkins, Carter and Simpson (2007) also indicate that banks use derivatives only when their capital is sufficient to meet regulatory requirements.

CHAPTER 3
HYPOTHESES

The past two decades witnessed the proliferation of both interest rate and foreign exchange derivatives use by banks. The focus of this thesis is on foreign exchange derivatives. Although the number of banks that use foreign exchange derivatives is not as large as the number of banks that use interest rate derivatives; foreign exchange derivatives are important instruments to hedge a bank's foreign exchange risk and trading them generates significant revenues for banks.

3.1 Determinants of foreign exchange derivatives held for hedging purposes

Banks employ derivatives either as dealers or end users. As indicated by Sinkey and Carter (2000), the majority of banks are involved in the derivatives market primarily as end users while only a small number of banks serve as dealers for derivative products. As end users, banks use derivatives for hedging purposes or for speculation. If banks employ derivatives to reduce the risks which are inherent from the normal operations, then the use of derivatives should be associated with lower interest rate and foreign exchange risk exposure. Alternatively, banks could be speculating with derivatives and that may increase risk.

Previous research, for example Chamberlain, Howe, and Popper (1997) and Choi and Elyasiani (1997), show that foreign exchange derivatives as a whole are useful to help banks reduce their foreign exchange exposure. In addition, there is evidence suggesting that banks may be using the various types of derivatives for various purposes. For example, Chaudhry, Christie-David, Koch and Reichert (2000), Reichert and Shyu (2003), and Clark, Delisle and Doran (2008) propose that swaps are used by banks mainly for hedging purposes while Reichert and Shyu (2003) and Clark, Delisle and Doran (2008) suggest that futures and options are used mainly for speculation purposes.

Adkins, Carter and Simpson (2007) investigate the factors that affect the size of the portfolio of derivatives used for purposes other than trading. They propose that the foreign exchange derivatives held by BHCs in the non-trading account are primarily used for hedging purpose. We adopt their proposition and for brevity we call the portfolio of securities held for purposes other than trading as the hedging account. The focus of this thesis is on the elements that may have effects on the size of the hedging account and the sizes of the various types of derivative contracts that make up the hedging account.

BHCs are exposed to foreign exchange risk due to normal operations that involve foreign currencies. These operations include trading foreign currencies, making loans denominated in foreign currencies, investing in foreign currency securities, and issuing foreign currency debt. These activities by a BHC can generate a mismatch between assets and liabilities denominated in foreign currencies. We propose that such mismatch exposes the common share capital, hence common share value, of a BHC to foreign exchange risk. We measure the significance of the exposure by the magnitude of the difference between assets denominated in foreign currencies and liabilities denominated in foreign currencies. We call this measure net foreign exchange asset exposure. A BHC is in a long position if its foreign assets exceed its foreign liabilities. This BHC will suffer capital losses if the domestic currency appreciates against the foreign currencies that make up the mismatch. In contrast, a BHC is in a short position if its liabilities in foreign currencies exceed its assets. For this BHC, an appreciation of the domestic currency will lead to common share capital appreciation. Therefore, if a BHC is primarily concerned about the fluctuations in the value of its common shares, it is likely to hedge the foreign exchange mismatch between its assets and liabilities using foreign exchange derivative securities. This BHC will use the net foreign exchange asset exposure as a guide for its hedging operations that employ foreign exchange derivatives.

Simultaneously, a BHC may be concerned about the fluctuations in the income it reports to shareholders. These fluctuations could be the result of foreign exchange rate fluctuations. As financial intermediaries with operations in international markets, US BHCs are likely to pay interest denominated in foreign currencies and receive interest denominated in foreign currencies. A BHC that has more foreign income than expenses will face reduction in income if the domestic currency appreciates against the foreign currencies in which income is derived. In contrast, if the domestic currency appreciates a BHC will realize income appreciation if its expenses which are denominated in foreign currencies exceed its income. We propose that the difference between interest income and interest expenses denominated in foreign currency exposes a BHC to foreign exchange income risk. In addition, we speculate that the larger the difference the larger is the potential loss or gain. Therefore, we measure the significance of the exposure by the magnitude of the difference. We call this difference the net foreign exchange income exposure. Our proposition implies that if a BHC is primarily concerned about the fluctuations in the income it

reports to its common shareholders, it is likely to hedge the net foreign exchange income exposure by using foreign exchange derivative securities.

Our analysis of the factors that affect the foreign exchange hedging and trading accounts considers the impact of capitalization. We propose, if all else are equal, the level of capitalization by a BHC and the size of the hedging account should be negatively related. A negative relationship will exist if a BHC increases its hedging activities when its capital ratio is low. Hedging decreases risk and the need for high capital ratio. This is consistent with the Basle Accord which requires that the higher the level of risk in an asset the higher should be the associated capital ratio. However, previous studies examine this relation and find surprising conclusions. Demsetz and Strahan (1997) and Hirtle (2009) suggest that the hedging activities do not necessarily reduce a bank's risk. They attribute these observations to a neutralizing substitution of risks where the reduction of risk through hedging is offset by higher risk from expansion into other activities. We suggest that the characteristics of these other activities may lead to a positive, insignificant, or negative relation between hedging and the capital ratio. In particular, we expect to observe a positive relation if the other activities into which a bank expands following hedging are mostly off-balance sheet activities that require little or no capital. On the other hand, we expect a negative relation if the other activities that are undertaken are riskier than the assets they substitute.

A number of existing papers have related bank size to the extent of derivative use. Koppenhaver (1989) provides evidence suggesting that bank size affects a bank's decisions to participate in derivatives activities. Carter and Sinkey (1998) find a positive relation between a community bank's decision to participate in interest-rate derivatives contracts and its asset size, although bank size was not found to be a determinant of the extent of participation in the derivatives market. Brewer, Jackson and Moser (2001) conclude that large banks are much more likely than small banks to use derivatives. Adkins, Carter and Simpson (2007) illustrate that the larger a bank is, the more likely that bank would use foreign exchange derivatives. Hassan and Khasawneh (2009) propose that the positive relationship between a bank's size and derivative use can be explained by the higher qualifications (capital, technology, and talents, etc.) required for derivative activities, which are more likely available in large banks. Consistent with previous studies, we use total assets to control for the size of the BHC.

In summary, our propositions suggest four hypotheses:

Hypothesis 1.a: The size of a BHC's hedging operation in foreign exchange derivatives is positively related to the BHC's net foreign exchange asset exposure.

Hypothesis 1.b: The size of a BHC's hedging operation in foreign exchange derivatives is positively related to the BHC's net foreign exchange income exposure.

Hypothesis 1.c: The size of a BHC's hedging operation in foreign exchange derivatives is positively related to the BHC's assets size.

Hypothesis 1.d: The size of a BHC's foreign exchange hedging operations is related to the level of a BHC's capitalization either positively or negatively depending on how a BHC uses the capital that is freed by hedging.

3.2 Determinants of foreign exchange derivatives held for trading purposes

Trading activities are increasingly attracting the attention of practitioners, policy makers, and academics. Allen and Santomero (2001) suggest that banks are gradually moving towards innovative fee-producing activities, such as investing or trading in derivatives. Sapsford and Zuckerman (1999) and Mollenkamp, Beckett and Miller (2000) report that trading activities generate substantial revenues and contribute significantly to the net income of large banks. The OCC's Quarterly Report on Bank Trading and Derivatives Activities, Third Quarter 2008, indicates that these revenues continue to grow. In the third quarter of 2008, revenues from cash and derivatives trading for all US commercial banks amounted to $6.0 billion compared to $1.6 billion the prior quarter and $2.2 billion the average revenue over the eight quarters leading to September 30, 2008. Furthermore, the OCC's report suggests that while banks trade significantly more interest rate derivatives the revenues from foreign exchange derivatives trading is higher on average. This means, the revenues that banks earn per unit of foreign exchange derivatives held are higher than the revenues they earn per unit of interest rate derivatives held.

Despite the importance of the foreign exchange derivatives trading activities, very little has been done to examine their determinants. One objective of this thesis is to fill the gap. We propose that the notional amount of foreign exchange derivatives held for trading is related to the net asset exposure and the net income exposure. This relation would be positive if the sizes of the net asset exposure and the net income exposure grow with the depth and the breadth of a BHC's international operations. These operations include banking relationships with domestic and foreign international companies, business relationships with foreign governments, and banking operations in foreign countries including lending, deposit taking, risk management, and

correspondent relationships. We expect that the more extensive these operations are the more chances a BHC will have to conduct foreign exchange derivatives trading.

Trading operations are also affected by the level of a BHC's capitalization. Hirtle (2003) indicates that banks with large trading accounts are required to hold higher capital based on internal risk assessment formulas. However, she reports that the actual capital reported to comply with these requirements is minor in proportion to total capital. Demsetz and Strahan (1997) argue that better diversification at BHCs does not change into reductions in risk. Hedging operations will decrease the risk of the BHC and thereby allow it to pursue additional risky activities, such as derivatives trading, without raising additional capital. Hirtle (2009) provides evidence supporting these arguments. In this situation, the hedging account and the trading account are connected with each other. These findings suggest that a positive or insignificant relation exists between the trading account and the level of capitalization of a BHC.

The size of a bank affects its decision to be involved in foreign exchange derivatives trading and the extent of its involvement. Janabi (2008) argues that large BHCs are more qualified than small size BHCs to be involved in foreign exchange derivatives hedging and trading. In particular, the author argues that large BHCs are relatively more sophisticated and efficient in managing the risks associated with holding foreign exchange derivatives. These risks include price risk, market risk, event risk, issuer risk, credit and counterparty risk, country risk, liquidity risk, and system and operational risk.

In summary, our propositions suggest the following hypotheses:

Hypothesis 2.a: The size of a BHC's portfolio of foreign exchange derivatives held in the trading account is positively related to the net foreign exchange asset exposure.

Hypothesis 2.b: The size of a BHC's portfolio of foreign exchange derivatives held in the trading account is positively related to the net foreign exchange income exposure.

Hypothesis 2.c: The size of a BHC's portfolio of foreign exchange derivatives held in the trading account is positively related to the BHC's asset size.

Hypothesis 2.d: The size of a BHC's portfolio of foreign exchange derivatives held in the trading account is positively related to the level of a BHC's capitalization

3.3 Analysis of various foreign exchange derivative contracts

There are seven types of foreign exchange derivative contracts reported by BHCs: futures, forwards, exchange-traded purchased options, exchange-traded written options, over-the-counter purchased options, over-the-counter written options, and swaps.[2] In principle, each type of these derivatives may be used by banks to reduce risk exposure. However, each type may work differently from the others and has its own rewards and risks. A few previous studies have examined the effect of each type of derivatives (both interest rate and foreign exchange) on banks' unbalanced positions and find inconsistent results. Chaudhry, Christie-David, Koch and Reichert (2000) find that foreign exchange swaps are mainly used by US commercial banks for risk-control purposes. Similarly, Reichert and Shyu (2003) report that interest rate and currency swaps decrease risk and argue that the use of options increases the interest rate risk of banks. These findings suggest that options are used to generate trading profits while swaps are used for hedging purposes. In contrast, Clark, Delisle and Doran (2008) suggest that exposed BHCs seem to be speculating with foreign exchange purchased options, futures, and forward contracts, and hedging with written options and swaps.

Table 3.1 divides the holdings of foreign exchange derivatives among the various types. The table shows that on average foreign exchange forward contracts account for the biggest portion of the gross notional amount of foreign exchange derivatives held by US BHCs, followed by foreign exchange swaps.[3] Figure 3.1 plots the number of BHCs using each type of foreign exchange derivatives from 1995 to 2007. Forward contracts are shown to be the most popular derivatives among BHC. In addition, the figure shows that swaps and OTC options are among the frequently traded derivatives. Apparently, the non-standardized characteristics of forward contracts, swaps, and OTC options are reasons for their popularity. Banks can tailor-make them to fit the needs of their customers, a service that allows them to generate significant fees.

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[2] The Federal Reserve Bank requires BHCs to report the gross amount (stated in US dollars) of all forward contracts committing the reporting BHC to purchase foreign (non-US) currencies and US dollar exchange and whose predominant risk characteristic is foreign exchange risk. A forward foreign exchange contract is an agreement for delayed delivery of a foreign (non-US) currency or US dollar exchange in which the buyer agrees to purchase and the seller agrees to deliver, at a specified future date, a specified amount at a specified exchange rate.

[3] Only one side of a foreign currency transaction is reported. In those transactions where foreign (non-US) currencies are bought or sold against US dollars, only the side of the transaction that involves the foreign (non-US) currency is reported. For example, if the reporting BHC enters into a futures contract that obligates it to purchase US dollar currency in return for Japanese yen, then the BHC would report in US dollars the equivalent amount of Japanese yen sold. In cross-currency transactions, which involve the purchase and sale of two non-US currencies, only the purchase side is reported.

----Insert Table 3.1 about here----

----Insert Figure 3.1 about here----

We conduct analysis to examine whether banks rely on one type of foreign exchange derivatives more than others. In particular, our interest is in finding whether hedging or trading is done through forward contracts, futures, swaps, or other derivatives. We propose that if such preference exists, the relations we are proposing between the hedging or trading account and our risk measures should be significant for those derivative securities that are preferred for hedging or trading and insignificant for the other derivatives. Thus, the hypotheses that are listed in Section 3.1 are also examined for each major type of derivatives in which banks have activities.

CHAPTER 4

VARIABLE DESCRIPTION, DATA, AND METHODOLOGY

This chapter describes the relevant variables, the data, the sample, and the methodology used in this study. Section 4.1 describes the sample and the data collection procedures. In addition, it explains how we divide the sample into three sub-samples based on asset size. Section 4.2 gives a detailed description of all the variables associated with our hypotheses. Section 4.3 discusses the methodology.

4.1 Bank holding company data

We collect financial statements data of BHCs from the database of the Federal Reserve Bank of Chicago (FRBC). The data are originally reported in the Consolidated Financial Statements for Bank Holding Companies (FR Y-9C)[4]. Since the relevant information dates back only to 1995 and it is available up to 2007, we choose the period of 1995 to 2007 inclusive as our sample period. A BHC is included as an observation for a given sample year if it used at least one type of foreign exchange derivatives in that year. This rule limited our initial sample to1209 BHCs.

During the data collection, we faced several situations where a pair of banks has very similar names but different accounting information and other situations where a pair of banks has different names but exactly the same accounting information. In the first case, we only include the BHC with the larger asset size. In the later case, we include only one of the two and if asset sizes are different we choose the BHC with the larger asset size. However, if two BHCs have slightly different names and different numbers, we keep both. Furthermore, it happens that in one year, we choose BHC A because it has more total assets than BHC B but in successive years, BHC A becomes the one with a smaller asset size. To maintain the consistency of our data, we take the year when the two BHCs in question appeared for the first time as our base year. If there is any conflict in later years, we just follow the selection made for the base year. These adjustments generate a final sample of 1126 BHCs.

We use the capital ratio data to examine whether the capitalization of a BHC affects its hedging and trading operations in the presence of other explanatory variables. However, the

[4] The Board of Governors of the Federal Reserve System requires BHCs to file the FR Y-9C report on a quarterly basis. However, the information provided in the financial statements of the first three quarters in each sample year is incomplete; so we only use the fourth quarter data for all our regression variables.

FRBC database does not provide the capital ratio data for the whole sample period 1995-2007. We use the total assets data and the Cusip numbers to match the BHCs in our sample with the BHCs reported in the Compustat.[5] Only 1011 observations can be matched. For those 1011 observations, we search the Compustat database for the capital ratio data. This search enabled us to obtain capital ratios for only 817 observations.[6] We found seven of these observations to be abnormal as their capital ratios are either negative or more than 100%. We remove these observations from the sample. Thus, the final sub-sample of observations for which we have capital ratios consists of 810 observations.

We divide the full sample (1126 observations) into three sub-samples based on asset size. In each year, we rank the sample BHCs from the smallest to the largest based on their asset size. Then, we divide the observations into 3 groups. The large-size group contains the observations that have the top 25 percent asset sizes, the small-size group is composed of the observations that have the bottom 25 percent asset sizes, and the remaining 50 percent of the observations are included in the medium-size group. This sorting results in 281 observations in the small-size group sample, 558 observations in the medium-size group, and 287 observations in the large-size group. We form the three sub-samples to examine how the hedging and trading behaviors differ among the different size groups.

4.2 Description of Variables

We calculate two foreign exchange exposure variables, net foreign exchange asset exposure and net foreign exchange income exposure. Chamberlain, Howe, and Popper (1997) define net exposure as the difference between foreign assets and foreign liabilities. Foreign assets include the dollar value of foreign debt and foreign equity securities held in the investment portfolio and foreign commercial loans, while foreign liabilities include the dollar value of interest and non-interest bearing deposits held in foreign offices. Reichert and Shyu (2003) calculate net interest margin as the difference between total interest income and total interest expenses expressed as a percentage of total assets. Saunders, Cornett, and McGraw (2006) define the foreign exchange exposure in any given currency as Net exposure = (Foreign exchange assets

[5] The set of bank holding companies for which the Compustat has records is different from the set for which the FRBC has records. We only keep the observations that can be matched with the observations from the Compustat.

[6] For these observations, the total assets data from the FRBC database match exactly the total assets data from the Compustat.

– Foreign exchange liabilities) + (Foreign exchange bought – Foreign exchange sold) = Net foreign asset + Net foreign exchange bought. The net foreign asset exposure measures the imbalance in a bank's foreign asset-liability portfolio. Based on those previous works, we form our own formulas to calculate the two types of foreign exchange exposure.

Net asset exposure = Absolute value of {(Commercial and industrial loans to non-U.S. addressees (domicile) + Loans to foreign banks + Trading assets in foreign offices) – (Deposits in foreign offices, Edge and Agreement subsidiaries, and IBF[7]s (Noninterest-bearing) + Deposits in foreign offices, Edge and Agreement subsidiaries, and IBFs (Interest-bearing))}

Net income exposure = Absolute value of {Interest income in foreign offices, Edge and Agreement subsidiaries, and IBFs – Interest on deposits in foreign offices, Edge and Agreement subsidiaries, and IBFs}

Note that the net foreign exchange asset exposure and the net foreign exchange income exposure are rough estimates of the foreign exchange exposure generated from all relevant balance sheet items available to us. We use absolute values of the two items because the exact position (long or short) of each type of foreign exchange contracts is not known. It would be preferable to use the signed exposures but in this case we will need the exact derivatives positions (buying or selling) that the banks have taken. Unfortunately, this information is not available. The total gross notional amount of foreign exchange derivatives held for hedging or trading is the only information available. Under these circumstances, we feel that using the signed exposures will lead to inaccurate results. The absolute values are better indicators of the sizes of the hedging and trading operations and that is our main interest.

There are other limitations to the two foreign exchange exposure variables. First, both net asset exposure and net income exposure are not adjusted for their maturities and the timing of cash flows from them. Second, they fail to account for the indirect foreign exchange risk. For example, the increased risk of default on the part of the borrower due to exchange rate

[7] IBF=International banking facility, a banking entity that any US bank, or a US branch/subsidiary of a foreign bank, or an Edge Act Corporation establishes in the United States to offer services to only non-US residents and institutions.

fluctuations after a BHC lends to an exporter is not reflected in the net asset exposure or net income exposure. Third, net fee income for BHCs acting as agents or dealers to trade foreign exchange derivatives for their customers may be one component of net income exposure. We do not include net foreign exchange fee income because the FR Y-9C reports do not provide enough information to measure this fee income accurately.

Our measures of foreign exchange exposure are comparable but not necessarily equivalent to the measures used by previous studies. First, in comparison to Chamberlain, Howe and Popper (1997), our measure of net asset exposure has the same components of foreign liabilities but different components of foreign assets. Second, our net income exposure measures the net interest income from foreign sources while Reichert and Shyu (2003) measure the net interest margin based on total interest income and total interest expenses. Third, Saunders, Cornett, and McGraw (2006) include the net foreign exchange bought as a component of net asset exposure. We do not include this component explicitly in our measure of net asset exposure for two reasons. First, our measure includes the portion of the net foreign exchange bought which is used to increase or decrease the assets and liabilities used in determining our measure of net asset exposure. The portion that is not included is perhaps the amount of foreign exchange that is held as cash in domestic offices or booked as domestic deposits or assets. We speculate that this portion is stable in size, hence ignoring is not likely to change the qualitative results significantly. Second, the required data is not available from the submitted financial statements.

4.3 Methodology

We use regression analysis to determine the relations between the hedging and trading accounts and the foreign exchange risk exposure measures that we propose to explain the variations in the holdings of foreign exchange derivatives. In addition, we control for asset size, the capitalization of the BHCs, and for the passage of time.

4.3.1 The relation between the hedging account and the explanatory variables

We estimate following linear regressions to test the hypotheses described in section 3.1. The regressions are used on the full sample which includes all 1126 BHCs.

$$HEDGE_{it} = \alpha + \beta_1 TA_{it} + \beta_2 NAE_{it} + \gamma_t \sum_{t=1996}^{2007} Dummy_t + \varepsilon_{it} \quad (4.1)$$

$$i = 1,2,\ldots,1126\,,\ t = 1995,1996,\ldots,2007$$

$$HEDGE_{it} = \alpha + \beta_1 TA_{it} + \beta_2 NIE_{it} + \gamma_t \sum_{t=1996}^{2007} Dummy_t + \varepsilon_{it} \quad (4.2)$$

$$i = 1,2,\ldots,1126,\ t = 1995,1996,\ldots,2007$$

$HEDGE_{it}$ is our hedging accounts variable, defined as total gross notional amount of foreign exchange derivative contracts held for purposes other than trading by a BHC i at year t. TA_{it} is total assets, which proxies for the size of each BHC. NAE_{it} and NIE_{it} are our net asset exposure and net income exposure variables respectively, which have been discussed in Section 4.2. $Dummy_t$ represents the dummy variable used to control time effects. If a sample BHC holds any type of foreign exchange derivatives in year 1996, then $Dummy$ is designated as 1 for that year, otherwise 0. For other years, the same rule applies. ε_{it} is the classical error term. We estimate the above models for large, medium, and small sub-samples.

We expect that the coefficient associated with total assets, net asset exposure and net income exposure to be positive as described by Hypothesis 1.a, 1.b, and 1.c.

Note that Equations 4.1 and 4.2 do not include a variable to control for the capitalization of BHCs. This variable will be introduced at a later stage due to data issues.

4.3.2 The relation between the trading account and the explanatory variables

The second group of hypotheses which aims at investigating the factors that can affect the foreign exchange derivatives held in the trading accounts of BHCs is tested with two similar linear regression models using the full sample.

$$TRADE_{it} = \alpha + \beta_1 TA_{it} + \beta_2 NAE_{it} + \gamma_t \sum_{t=1996}^{2007} Dummy_t + \varepsilon_{it} \quad (4.3)$$

$$i = 1,2,\ldots,1126,\ t = 1995,1996,\ldots,2007$$

$$TRADE_{it} = \alpha + \beta_1 TA_{it} + \beta_2 NIE_{it} + \gamma_t \sum_{t=1996}^{2007} Dummy_t + \varepsilon_{it} \quad (4.4)$$

$$i = 1,2,\ldots,1126,\ t = 1995,1996,\ldots,2007$$

$TRADE_{it}$ is the total gross notional amount of foreign exchange derivative contracts held for trading, measuring the size of trading operation. All other variables are defined as they are in models 4.1 and 4.2. We estimate these models for the three sub-samples.

The signs of the coefficient estimates are positive by Hypothesis 2.a, 2.b, and 2.c.

4.3.3 The relation between the various components of the hedging and trading accounts and the explanatory variables

The existing literature argues that foreign exchange forward contracts are used primarily for speculation which can be treated as trading activities. In contrast, swaps are proposed to be

preferable instruments for hedging. We use variations of Equations 4.1– 4.2 to examine the relation between forward contracts held by banks for hedging or trading and the explanatory variables. For this analysis, we use the gross notional amount of foreign exchange forward contracts as the dependent variable in Equations 4.1 – 4.2. Similarly, we use Equations 4.1 – 4.2 to conduct analysis on swaps and other components of the hedging and trading accounts.

CHAPTER 5
RESULTS

This chapter presents the empirical results and the corresponding analysis for the hedging and trading accounts as well as for the individual types of foreign exchange derivatives. Section 5.1 reports the descriptive statistics of both dependent and independent variables and provides a whole picture on foreign exchange derivative use by BHCs. Section 5.2 discusses the empirical results for hedging and trading accounts. Section 5.3 presents the robustness test results. Section 5.4 provides the empirical results after we include the capital ratio as an explanatory variable. Section 5.5 reports the results for foreign exchange forward contracts and the other six types of foreign exchange derivatives.

5.1 Descriptive statistics

Table 5.1 presents descriptive statistics of the hedging accounts, trading accounts, forward contracts, total assets, net asset exposure, and net income exposure. We calculate the mean, standard deviation, maximum, and minimum of these six variables for each sub-sample of BHCs as well as for the full sample. For the hedging accounts, the large group has a mean value of $6.6 billion dollars, over 200 times larger than that of the small-size group, and over 23 times larger than that of the medium-size group. We observe the same pattern for the trading accounts. Within each sub-sample, the mean value of the total gross notional amount of foreign exchange derivatives held for trading is much larger than the mean value of the total gross notional amount of foreign exchange derivatives held for hedging. The ratio of foreign exchange derivatives held in the hedging accounts to the foreign exchange derivatives held in the trading accounts for the full sample, small sub-sample, medium sub-sample, and large sub-sample are 1.73%, 22.97%, 5.33%, and 1.63%, respectively. These statistics imply that the hedging account is much smaller than the trading, an observation which is in line with OCC's report. In addition, we observe that the portion of derivatives used for hedging as opposed to trading increases inversely with the size of assets. Table 5.1 also shows that BHCs use a significant amount of foreign exchange forward contracts. For net asset exposure and net income exposure, the mean value of the large group is more than ten times larger than that of the medium group, which is again more than ten times larger than the mean value of the small group. A similar observation may be made for the net income exposure. Thus, the large BHCs are exposed to more foreign exchange risk than the medium and small BHCs. However, the ratio of net income exposure to net asset exposure is

firmly stable across the size sub-samples. This ratio for the full sample, small sub-sample, medium sub-sample, and large sub-sample is 4.12%, 3.35%, 4.01%, and 4.15%, respectively.

----Insert Table 5.1 about here----

Table 5.2 presents the correlations between total assets, net asset exposure, and net income exposure for the full sample as well as for the three sub-samples. We can see that the correlations between net asset exposure and net income exposure are very high for thefull sample as well as for each of the sub-samples. This is mainly due to the nature and construction of the two variables. The items reported by BHCs in their financial statements and used for calculating net asset exposure and net income exposure are related with each other. Income is generated from assets while liabilities would lead to expenses. So if we include both these variables simultaneously in any of our models, there may be a multicollinearity problem. To avoid such a potential problem, we use one of these variables at a time in our estimation. We also observe that for the large sub-sample and for the full sample, total assets are highly correlated with both measures of foreign exchange exposure. We analyze the extent of this problem in the section entitled robustness tests.

----Insert Table 5.2 about here----

We run paired t-tests to examine if the means of the hedging accounts, trading accounts, forward contracts, total assets, net asset exposure, and net income exposure for any two sub-samples are statistically different from each other. The overall mean value of each variable is calculated over the 13 average values generated over the 13 years included in the study. These results are presented in Table 5.3. It shows that for any variable of interest to this study, the means of any two BHC sub-samples are significantly different from each other at the 1% significance level with one exception. The mean net income exposure of the small BHCs and medium BHCs are statistically different at the 5% significance level. These observations indicate that the full sample and each of the sub-samples are significantly different in every dimension that we examine, which justifies dividing our full sample into these sub-samples.

----Insert Table 5.3 about here----

Table 5.4 summarizes the trend of foreign exchange derivative use in the thirteen-year sample period for both trading and hedging accounts. The size of the hedging account is smaller than 2 percent of the size of the trading account in each sample year. The same pattern has been found for the large sub-sample.

----Insert Table 5.4 about here----

Figures 5.4.1 and 5.4.2 present interesting observations regarding the trends in derivative use. Figure 5.4.1 shows that for the 1995-2000 period the number of BHCs reporting foreign exchange derivatives in the trading accounts is higher than the number of BHCs reporting foreign exchange derivatives in the hedging accounts. Beyond 2000, the number of BHCs reporting foreign exchange derivatives for trading is almost equal to the number reporting foreign exchange derivatives in the hedging account. In contrast, Figure 5.4.2 demonstrates that in any given year of our sample the amount of foreign exchange derivatives reported in the trading accounts by all BHCs is higher than that reported in the hedging accounts. Interestingly, we observe that the amount of foreign exchange derivatives reported in either account follows the same pattern of changes from year to year. Overall, the trend in foreign exchange derivatives use by BHCs either for trading or hedging is increasing. However, a major drop occurred over the period from 1998 to 2001. This drop is very likely associated with the 1997 Asian financial crisis. As a result of this and other crises that occurred during that period, a large number of big US banks reported substantial losses.

----Insert Figure 5.4.1 about here----

----Insert Figure 5.4.2 about here----

5.2 Empirical results

5.2.1 The determinants of the hedging account

In this study, we propose that the hedging account is partially determined by the net asset exposure and net income exposure. In addition, previous studies such as Carter and Sinkey (1998), Brewer, Jackson and Moser (2001), Adkins, Carter, and Simpson (2007), and Hassan and Khasawneh (2009) suggest that there is a positive relationship between a bank's size and its use of derivatives. Equations 4.1 and 4.2 are designed to investigate these propositions using regression analysis. Table 5.5.1 presents the results.

----Insert Table 5.5.1 about here----

For the full sample and the large sub-sample, we find that the total asset variable is statistically significant at the 1% level with the expected positive signs in both models. However, as we move from the large-size group to the lower size groups the significance of the total assets variable drops. For the medium size sub-sample, the total assets variable is positive and has significant explanatory power when used jointly with the net asset exposure but when the net

income exposure is used, the explanatory power of the total assets variable becomes insignificant. For the small sub-sample the total assets variable is insignificant.

Panel A of Table 5.5.1 shows that net asset exposure is significant and positive for our full sample and large sub-sample. In contrast, the net asset exposure for the medium and small size sub-samples is insignificant. Therefore, the net asset exposure plays a major role in deciding the hedge accounts of the large BHCs, particularly the top 25 percent BHCs by asset size. This result is expected as large BHCs are more involved in international banking. Thus, they take a more active role in hedging their exposed positions. In addition, larger BHCs have the resources and expertise to effectively use their derivative instruments to hedge their risk.

Panel B shows that net income exposure, which measures the unbalanced position between the interest income and interest expenses in foreign currencies, is positive and significant at the 1% significance level for the full sample, the large sub-sample, and the medium sub-sample. Thus, the net income exposure is much more powerful than the net asset exposure in explaining the variations in the hedging accounts of medium-size BHCs. Apparently, medium-size BHCs are more interested in stabilizing their income than protecting their assets against foreign exchange risk.

Table 5.5.1 also shows that the time dummy variables for the years 1996 to 2000 and 2004 to 2007 are not significant. However, the dummies for the years 2001-2003 are all significant at the 2% level. We speculate that a host of factors including regulatory changes and the financial crisis that occurred between 1996 and 2004 are responsible for these observations. Consideration of these issues is beyond the scope of this thesis but should be a fertile area for future research.

The adjusted R-Squares suggest that our model is a good fit for the large sub-sample and the full sample. The reported F-statistics show that the coefficients are jointly different from zero for the full sample, the large sub-sample, and the medium sub-sample.

5.2.2 The determinants of trading accounts

We propose that the trading account is partially determined by the net asset exposure and net income exposure. In addition, we suggest that there is a positive relationship between a BHC's size and its derivatives trading activities. Equations 4.3 and 4.4 are designed to investigate these propositions using regression analysis. Table 5.5.2 presents the results.

----Insert Table 5.5.2 about here----

The total assets variable is a significant and positive determinant of the trading account for the full sample and the large sub-sample, consistent with the existing literature. For the medium size sub-sample the relation depends on whether the risk measure used is net asset exposure or net income exposure. When asset exposure is used (Panel A), the total assets variable is negative and significant. When net income exposure is used (Panel B) to explain the trading account the total assets variable is positive but not significant. For small size BHCs, the total assets variable is insignificant in explaining the variations in the trading account. Our results indicate that the larger BHCs are the dominant traders in the foreign exchange derivatives markets. This is consistent with the OCC's report that the top 25 banks hold 96% of all contracts for trading.

Table 5.5.2 shows that the net asset exposure is significant and positive for the full sample, large sub-sample, and medium sub-sample. Panel B also shows that the net income exposure is positive and significant at the 1% level of significance for the full sample and at the 5% level for the large and medium size sub-samples. Neither net asset exposure nor net income exposure can explain the variations in the foreign exchange derivatives held by small BHCs.

Table 5.5.2 shows that the time dummy variable is not significant for all years and the direction of its impact and the significance of this impact are not consistent across the three sub-samples. For the large sub-sample, the dummies related to years 2000-2007 are negative and significant whether we use net income exposure or net asset exposure as measures of risk. Apparently, large BHCs have decreased their foreign exchange trading activities during those years in comparison to 1995.

The adjusted R-Squares for the full sample and the large sub-sample are all higher than 70%, indicating the models we use are effective in explaining the variations in the trading accounts. For the medium sub-sample, the adjusted R-Square depends on whether we use the net asset exposure or the net income exposure as measures of risk. When we use the net asset exposure, the adjusted R-square is approximately 72% but when we use the net income exposure, the adjusted R-square is approximately 21%. The reported F-statistics show that the coefficients are jointly different from zero for the full sample and the three sub-samples.

Overall, the results reported in this section show that the size of total assets, the net asset exposure, and the net income exposure can explain a significant portion of the variations in the hedging and trading accounts of large US BHCs. The explanatory power of these variables drops

when we use them to explain the variations in the hedging and trading accounts of medium size US BHCs. It is important to note that the same variables that can explain the foreign exchange hedging activities can also explain the trading activities suggesting that both the hedging and trading activities of BHCs are determined jointly and affected by the same set of factors. This finding is consistent with the results of previous researchers, for example Demsetz and Strahan (1997) and Hirtle (2003), who report that the risk reduction activities of large and sophisticated BHCs allow them to pursue more risky activities, such as trading.

5.3 Robustness tests using two-stage method

Table 5.2 reports the correlations between the total assets variable and the net asset exposure and the net income exposure for the full sample and the three sub-samples. For the large sub-sample, the three variables are highly correlated with coefficients exceeding 69%. For the medium and small size sub-samples, the correlations drop respectively but they remain high for the medium size sub-sample. In this section we conduct two-stage regression analysis to assess the potential bias, if any, in the qualitative results due to the high correlations among the independent variables.

5.3.1 The Two-Stage Analysis: Hedging Accounts

As the name implies, the two-stage regression analysis involves two regressions. In the first stage, we regress net asset exposure on total assets without an intercept to get the residuals. In the second stage, we use the residuals from the first regression and the total assets variable as the independent variables for the second-stage regression. The resulting regression equations are:

$$NAE_{it} = \beta_0 TA_{it} + \varepsilon_{it} \tag{5.1.1}$$

$$i = 1,2,\ldots,1126,\ t = 1995,1996,\ldots,2007$$

$$HEDGE_{it} = \alpha + \beta_1 TA_{it} + \beta_2 \,\mathrm{Re}s\_NAE_{it} + \gamma_t \sum_{t=1996}^{2007} Dummy_t + \varepsilon_{it} \tag{5.1.2}$$

$$i = 1,2,\ldots,1126,\ t = 1995,1996,\ldots,2007$$

$\mathrm{Re}s\_NAE$ in the second-stage model are the residuals for net asset exposure derived from the first-stage regression, which measure the variation of net asset exposure that cannot be explained by total assets. This new variable is uncorrelated with total assets but could still have effects on BHCs' hedging accounts. All other variables are defined as before.

We also design a two-stage regression for the net income exposure model, using the same method described for the two-stage regression for net asset exposure.

$$NIE_{it} = \beta_0 TA_{it} + \varepsilon_{it} \quad (5.1.3)$$

$$i = 1,2,\ldots,1126,\ t = 1995,1996,\ldots,2007$$

$$HEDGE_{it} = \alpha + \beta_1 TA_{it} + \beta_2 \,\mathrm{Res}\_NIE_{it} + \gamma_t \sum_{t=1996}^{2007} Dummy_t + \varepsilon_{it} \quad (5.1.4)$$

$$i = 1,2,\ldots,1126,\ t = 1995,1996,\ldots,2007$$

Res_NIE are the residuals for net income exposure derived from the first-stage regression. All other variables are defined as they are in models 4.1 and 4.2.

5.3.2 The Two-Stage Analysis: Trading accounts

Similar to the hedging account analysis, we employ two-stage models to analyze the impact of high correlations on the qualitative results related to the trading account. The regression models for this analysis are:

$$NAE_{it} = \beta_0 TA_{it} + \varepsilon_{it} \quad (5.2.1)$$

$$i = 1,2,\ldots,1126,\ t = 1995,1996,\ldots,2007$$

$$TRADE_{it} = \alpha + \beta_1 TA_{it} + \beta_2 \,\mathrm{Res}\_NAE_{it} + \gamma_t \sum_{t=1996}^{2007} Dummy_t + \varepsilon_{it} \quad (5.2.2)$$

$$i = 1,2,\ldots,1126,\ t = 1995,1996,\ldots,2007$$

$$NIE_{it} = \beta_0 TA_{it} + \varepsilon_{it} \quad (5.2.3)$$

$$i = 1,2,\ldots,1126,\ t = 1995,1996,\ldots,2007$$

$$TRADE_{it} = \alpha + \beta_1 TA_{it} + \beta_2 \,\mathrm{Res}\_NIE_{it} + \gamma_t \sum_{t=1996}^{2007} Dummy_t + \varepsilon_{it} \quad (5.2.4)$$

$$i = 1,2,\ldots,1126,\ t = 1995,1996,\ldots,2007$$

The residual variables are similar to the ones employed in the hedging models. All other variables are as defined earlier.

5.3.3 Results of the two-stage regression analysis

The results of the two-stage analysis of BHCs' hedging accounts for the full sample and the large sub-sample are provided in Table 5.6.1. We find that the total assets variable is positive and significant at 1%. The residual variable for net asset exposure is also positive and significant as expected. We observe similar results when we use residuals of net income exposure. Adjusted R-Squares for all these models are better than 70%.

----Insert Table 5.6.1 about here----

Results for trading account models are provided in Table 5.6.2. Similar to the results related to the hedging accounts, the total asset variable is positive and significant, consistent with the one-stage analysis. For the full sample as well as the large sub-sample, residuals of both net asset exposure and net income exposure are positive and significant at 1% level. The adjusted R-Squares for all models are higher than 70%.

----Insert Table 5.6.2 about here----

Overall, we observe that the results of the one-stage regression analysis are not significantly affected by the high correlations among the independent variables.

5.4 Capital ratio

In Section 5.2.1and 5.2.2, we demonstrate that total assets, net asset exposure, and net income exposure influence BHCs' holdings of foreign exchange derivatives reported in the hedging and trading account. As discussed in pervious chapters, the capital ratio may be another potential determinant of BHCs' derivative activities. To test whether this factor would make a difference, we use a sub-sample of 810 BHCs for which the risk-based capital ratio data are available (described in Section 4.1).

Table 5.7.1 presents descriptive statistics for the two dependent and four independent variables. The average value of the capital ratio is 12.68 percent, more than the 8% required by regulations. The capital ratio varies significantly among the sample BHCs. The maximum capital ratio is 84.15% while the minimum ratio is 0%. Table 5.7.2 shows that the capital ratio is negatively but not highly correlated with the other three independent variables.

----Insert Table 5.7.1 about here----

----Insert Table 5.7.2 about here----

We include capital ratio as an independent variable to the original specification that examines the determinants of hedging and trading accounts (equations 4.1, 4.2, 4.3, and 4.4), so the modified models are as follows.

$$HEDGE_{it} = \alpha + \beta_1 TA_{it} + \beta_2 NAE_{it} + \beta_{cr} CR_{it} + \gamma_t \sum_{t=1996}^{2007} Dummy_t + \varepsilon_{it} \quad (5.3.1)$$

$$i = 1,2,\ldots,810\,,\ t = 1995,1996,\ldots,2007$$

$$HEDGE_{it} = \alpha + \beta_1 TA_{it} + \beta_2 NIE_{it} + \beta_{cr} CR_{it} + \gamma_t \sum_{t=1996}^{2007} Dummy_t + \varepsilon_{it} \quad (5.3.2)$$

$$i = 1,2,\ldots,810\,,\ t = 1995,1996,\ldots,2007$$

$$TRADE_{it} = \alpha + \beta_1 TA_{it} + \beta_2 NAE_{it} + \beta_{cr} CR_{it} + \gamma_t \sum_{t=1996}^{2007} Dummy_t + \varepsilon_{it} \quad (5.3.3)$$

$$i = 1,2,\ldots,810\,,\ t = 1995,1996,\ldots,2007$$

$$TRADE_{it} = \alpha + \beta_1 TA_{it} + \beta_2 NIE_{it} + \beta_{cr} CR_{it} + \gamma_t \sum_{t=1996}^{2007} Dummy_t + \varepsilon_{it} \quad (5.3.4)$$

$$i = 1,2,\ldots,810\,,\ t = 1995,1996,\ldots,2007$$

Where *CR* is the risk-based capital ratio, defined as total risk-based capital divided by total risk-weighted assets, and all other variables are as defined earlier in Chapter 4.

The regression results are provided in Table 5.7.3. The table shows that the capital ratio is a positive and significant determinant of BHCs' hedging and trading accounts. Including the capital ratio into our models does not influence the original results significantly. This means that the hedging and trading activities increase with the increase in the capital ratio. Furthermore, adding the capital ratio as an explanatory variable does not change the explanatory power of the total assets and net income exposure variables. These variables continue to be significant and have the expected positive signs. However, adding the capital ratio reduces the explanatory power of the net asset exposure which becomes insignificant for the trading accounts.

----Insert Table 5.7.3 about here----

For robustness purposes, we analyze the impact of the capital ratio using a two-stage regression analysis. This analysis is done to assess the impact, if any, of multicollinearity which may be an issue given the high correlations among the independent variables. These results are presented in Appendix III. The two-stage regressions generate results similar to the results we obtain from the one-stage regressions. They indicate that multicollinearity is not biasing the results.

Our results regarding the capital ratio are consistent with the previous studies that report a positive relation between the capital ratio and hedging. These studies include Gunther and Siems (1995), Hirtle (2003), and Adkins, Carter, and Simpson (2007).

5.5 Individual types of foreign exchange derivatives

So far, the analysis of the hedging and trading accounts has been conducted on the entire portfolio of foreign exchange derivatives held in each account. However, these accounts have several types of foreign exchange derivatives that may be utilized differently by BHCs. We conduct analysis on the holdings of specific types of foreign exchange derivatives to gain insights regarding potential differences.

5.5.1 Forward contracts

Table 5.8.1 presents the regression results for the holdings of foreign exchange forward contracts by BHCs. The notional amount of foreign exchange forward contracts is positively and significantly related to both net asset exposure and net income exposure. This result is consistent for the full sample and the large and medium sub-samples. However, for the small size group the two variables have no significant impact on the notional amount of foreign exchange forward contracts held by BHCs. The total assets variable is significant and positive at 1% level for the full sample and the large sub-sample. For the medium size group, it is negative and significant, and it is insignificant for the small sub-sample. The R-Squares for the small sub-sample are much lower than the ones for the full sample and the other two sub-samples.

----Insert Table 5.8.1 about here----

5.5.2 Two-stage results for forward contracts

For robustness purposes, we repeat the analysis of the forward contracts using a two-stage regression analysis. This analysis is done to assess the impact, if any, of multicollinearity which may be an issue given the high correlations among the independent variables. These results are presented in Table 5.8.2. The two-stage regressions generate results similar to the results we obtain from the one-stage regressions. They indicate that multicollinearity is not biasing the results related to the forward contracts.

----Insert Table 5.8.2 about here----

5.5.3 Other types of foreign exchange derivative contracts

BHCs are required to report separately in their financial statements (FR Y-9C reports) their holdings of foreign exchange futures, exchange-traded options (written and purchased), over-the-counter options (written and purchased), and swaps. We use the total notional amount of each type of these foreign exchange derivatives as the new dependent variable in our original one-step models and apply these models to the full sample to test the hypotheses proposed in Section 3.3.[8]

Table 5.9.1 presents descriptive statistics for the six dependent variables for the full sample. Both foreign exchange swaps and over-the-counter options are frequently used by BHCs.

----Insert Table 5.9.1 about here----

[8] For hedging accounts, trading accounts, and forward contracts, we employ both one-step models and two-stage models to detect potential multicollinearity problems. The regression results show that this problem does not affect our results. Thus, we only apply the one-step model to other types of foreign exchange derivatives.

All regression results are presented in Table 5.9.2. The dependent variable is the notional amount of each of the six types of derivative instruments. The total assets variable is positive and significant in determining the size of any type of derivatives held by banks. In contrast, net asset exposure and net income exposure are positively and significantly related to only the holding of foreign exchange futures. They have no significant effects on the holdings of options or swaps.

----Insert Table 5.9.2 about here----

CHAPTER 6

CONCLUSIONS, LIMITATIONS, AND SUGGESTIONS FOR FUTURE RESEARCH

This chapter summarizes the results, points out the limitations, and makes suggestions for future research.

6.1 Conclusions

Derivative use of BHCs has increased over time. BHCs use three major types of derivatives, interest rate derivative, foreign exchange derivative and credit derivative. Most of the academic studies concentrate mainly on the use of interest rate derivative as they are more frequently used by banks. However, with the globalization of businesses and financial institutions, an increasing number of banks are taking positions in foreign assets and liabilities – hence there is need for hedging their foreign currency positions. The goal of this thesis is to determine the factors that affect the foreign exchange derivative activities of BHCs.

Following the implementation of Financial Standards Accounting Board (FSAB) Statement No. 119, BHCs are required to report their foreign exchange derivatives in either the trading or the hedging account. This Statement was effective for all financial institutions with an asset value of more than $150 million for the fiscal year ending after December 15, 1994 and for banks smaller than that this statement was effective for financial statements issued for fiscal years ending after December 15, 1995. So the sample period used in this study can only start in 1995 and finish in 2007. All BHCs that has reported any type of foreign exchange derivatives in either the hedging or the trading accounts are included in the sample.

The importance of the hedging activity of banks had been recognized by academics and practitioners. In contrast, the trading activity has not gained similar attention. According to the OCC, trading in foreign exchange contracts is more profitable than trading in interest rate contracts. In our sample period banks earned more profit from trading of foreign exchange contracts compared to interest rate contracts; however, in every year the volume of interest rate contracts held by banks was much higher than the volume of foreign exchange contracts held by banks. Our sample allows us to examine the determinants of foreign exchange hedging and trading separately.

It is intuitive that the foreign exchange derivatives used by BHCs for hedging will be influenced by their exposure in other currencies. We construct two variables to capture a BHC's

exposure. Our measures are intuitively similar to Chamberlain, Howe, and Popper (1997), who construct measures to capture foreign exchange exposure. The two measures that we construct are net asset exposure and net income exposure. Net asset exposure is defined as the absolute value of foreign exchange assets minus foreign exchange liabilities and Net income exposure is defined as the absolute value of foreign exchange interest income received minus foreign interest income paid. These two measures take into account the natural hedges that a bank achieves by holding assets and liabilities in foreign currency or having income and expenditure in foreign currency. By construction these two measures should be highly correlated and we observe that in our data. In addition to these measures we use bank size and risk-based capital ratio as determinants of trading and hedging activity. We also observe a high correlation between these two exposure variables and bank size.

We find that both net asset exposure and net income exposure have positive and significant effects on foreign exchange derivative holdings of BHCs in both hedging and trading accounts. Total assets play an important role in determining the sizes of hedging and trading accounts as well. The larger the BHC is, the more extensively BHC is involved in foreign exchange derivative activities, for both hedging and trading purposes. We divide our sample to three size-sorted sub-samples to examine how size plays a role in our results. For any given year we put the top 25% of BHCs in the large group and the bottom 25% in the small size group and the rest of the BHCs are assigned to the medium size group. We find that asset size and the exposure variables can explain large BHCs hedging behaviour but not necessarily the behaviour of the other size groups.

We investigate how the capitalization requirement influences a BHC's holdings of foreign exchange derivatives. We construct a sub-sample to test its influence by using the capital ratio as an indicator of the level of capitalization of BHCs. A negative relationship will exist if a BHC increases its hedging activities when its capital ratio is low. We find a positive and significant relationship between the capital ratio and the foreign exchange derivatives holdings in the hedging or trading account. Our result is consistent with the findings of Hirtle (2009) and Demsetz and Strahan (1997) who show that hedging activities at banks do not necessarily lead to lower risk. Instead, they show that banks take additional activities that offset the risk reduction gained from hedging operations. Overall, our results are consistent with the substitution theory of risk reduction.

For completeness of the analysis we also investigate how our exposure measures influence BHCs' holding of different types of foreign exchange derivatives. For forward contracts, the largest category of foreign exchange derivative contracts, we analyze the influence of the exposure variables on the full sample and size-sorted sub-samples while controlling for asset size. We find that the exposure variables are significant determinants of foreign exchange forward contracts in the full sample and in the large and medium sample. For other types of derivatives we only analyze the influence of exposure in the full sample. We find that only for futures contracts exposure variables are statistically significant.

FASB Statement No.119 suggests that regulators and policy makers consider the financial instruments held or issued for purposes other than trading to have a risk profile different from the risk profile of the financial instruments held or issued for trading. However, the results of our thesis show that, as far as foreign exchange derivatives are concerned, both hedging and trading accounts are explained by the same factors, net asset exposure and net income exposure. This implies that the current reporting regulations are not achieving their objectives of distinguishing between the two activities. Therefore, other efficient monitoring means should be considered. In addition, since the size of the trading account is much larger than the size of the hedging account and trading activities involve many risks, regulators should execute more supervision over the trading activities of BHCs.

Our results that the hedging and trading accounts are determined by the same factors suggest that it is very likely that the two accounts are connected with each other. This is important information for security analysts and regulators who are involved in evaluating the US banking industry. This information suggests that bank analysts and regulators cannot simply rely on the sizes of the two accounts to determine whether BHCs have appropriate risk controls. It is possible that when BHCs hold foreign exchange derivatives to hedge their foreign exchange risk exposure, they are also engaged in the foreign exchange derivative trading activities extensively, which would expose them to additional associated risks. Hence, the information gained from analysing the hedging and trading accounts may be of little value to practitioners.

6.2 Limitations

This study proposes that net asset exposure and net income exposure are measures of foreign exchange exposure and examines whether they are determinants of the foreign exchange derivatives hedging and trading accounts. However, there may be other factors that have effects

on the hedging and trading accounts of BHCs. For example, Adkins, Carter and Simpson (2007) consider the managerial compensation and incentives as factors that could affect the decisions of BHCs to use foreign exchange derivatives for hedging. Due to the limited financial statements data available to us from the FR Y-9C reports, we do not account for these other determinants in our analysis. Yet, these factors may influence the hedging or trading accounts or both and may convey distinct information to regulators and practitioners.

The net asset exposure and net income exposure that we use to measure foreign exchange risk are calculated from the year-end financial statements' information. Therefore, neither one of the two measures can account for the dynamic nature of a BHC's foreign exchange exposure. For example, the holdings of foreign exchange derivatives for hedging may vary significantly from day to day or from month to month. Our data does not capture seasonal swings or the possibility that the hedging or trading positions at year-end may be low or high in comparison with the average holdings over the year. Unfortunately, the quarterly reports are not reliable and no information is available for more frequent observations. The two dependent variables have the same limitation and may provide relatively rough estimation results.

6.3 Suggestions for future research

According to the limitation mentioned earlier in Section 6.2, other potential determinates of the hedging and trading accounts may be included in future research. First, it may be useful to include controls for managerial incentives and corporate governance structures as suggested by Adkins et al (2007). Second, it may be useful to examine the impact of the differential tax treatment of income from off-balance sheet activities on the BHCs use of foreign exchange derivatives for hedging or trading. Third, market imperfections, such as agency problems and asymmetric information, in the foreign countries where BHCs have business operations may also provide incentives for BHCs to hedge.

In the literature review chapter of this study, we discuss a few research papers that analyse the use of interest rate derivatives by banks. Similar to foreign exchange derivatives, the holdings of interest rate derivatives by BHCs are divided between those held for purposes other than trading and those held for trading. The two holdings are reported separately in the FR Y-9C reports. The number of BHCs involved in the interest rate derivative activities is larger than the number involved in foreign exchange derivatives. In addition, within each company, the total notional amount of interest rate derivatives is usually larger than the total notional amount of

foreign exchange derivatives in both the hedging and trading accounts. However, there is no existing literature differentiating the interest rate derivatives on the basis of hedging or trading or examining the determinants of the two accounts regarding interest rate derivatives. Therefore, a study that focuses on the determinants of the interest rate derivatives held for purposes other than trading and for trading will extend the literature and provide insights that are complementary to our results.

REFERENCES

Adkins, Lee C., David A. Carter, and W. Gary Simpson, 2007, Managerial incentives and the use of foreign-exchange derivatives by banks, *The Journal of Financial Research*, Vol. 30, No.3, pp. 3990-413.

Ahmed, Anwer S., Anne Beatty, and Carolyn Takeda, 1997, Evidence on interest rate risk Management and derivatives usage by commercial banks, *working paper, University of Florida*.

Allayannis, George and Eli Ofek, 1997, Exchange rate exposure, hedging, and the use of foreign currency derivatives, *Department of Finance working paper series 1998*.

Allen, Franklin, and Anthony M. Santomero, 2001, What do financial intermediaries do?, *Journal of Banking & Finance*, 25(2001) pp. 271-294.

Brewer, Elijah, Bernadette A. Minton, and James T. Moser, 2000, Interest-rate derivatives and bank lending, *Journal of Banking & Finance*, 24(2000), pp. 353-379.

Brewer, Elijah, William E. Jackson, and James T. Moser, 2001, The value of using interest rate derivatives to manage risk at U.S. banking organizations, *Economic Perspectives*, 3Q/2001, pp. 49-66.

Carter, David A., and Joseph F. Sinkey, Jr. 1998, The use of interest rate derivatives by end-users: The case of large community banks, *Journal of Financial Service Research* 14, pp. 17-34.

Chamberlain, S., J.S. Howe, and H. Popper, 1997, The exchange rate exposure of US and Japanese banking institutions, *Journal of Banking and Finance*, Vol. 21, pp. 871-92.

Chaudhry, Mukesh K., Rohan Christie-David, Timothy W. Koch, and Alan K. Reichert, 2000, The risk of foreign currency contingent claims at US commercial banks, *Journal of Banking & Finance*, 24(2000), pp. 1399-1417.

Choi, J. and Elyasiani, E. 1997, Derivative exposure and the interest rate and exchange risks of US banks, *Journal of Financial Services Research*, Vol. 12, pp. 267-86.

Clark, A. Jeffrey, Jared Delisle, and James S. Doran, 2008, Bank Risk, Implied Volatility and Bank Derivative Use: Implications for Future Performance, *working paper series*, Florida State University.

Demsetz, Rebecca S., and Philip E. Strahan, 1997, Diversification, size, and risk at bank holding companies, *Journal of Money, Credit and Banking* 29, pp. 300-313.

Flannery, M.J., and James, C.M. Sept. 1984a, The effect of interest changes on the common stock returns of financial institutions. *Journal of Finance* 39: pp. 1141-1153.

Flannery, M.J., and James, C.M. Nov.1984b, Market evidence on the effective maturity of bank assets and liabilities, *Journal of Money, Credit, and Banking* 16 (part 1): pp. 435-445.

Fraser, Donald R., Jeff Madura, and Robert A Weigand, 2002, Sources of Bank Interest Rate Risk, *The Financial Review* 37 (3), pp. 351–367.

Grammatikos, Theoharry, Anthony Saunders, and Itzhak Swary, 1986, Returns and risks of U.S. bank foreign currency activities, *The Journal of Finance*, VOL. XLI, No. 3, pp.671-682.

Guay, R. Wayne, 1999, The impact of derivatives on firm risk: An empirical examination of new derivative users, *Journal of Accounting and Economics*, 26 (1999), pp. 319-351.

Gunther, Jeffery W., and Thomas F. Siems, 1995, Who's capitalizing on derivatives? *Financial Industrial Studies*, *Federal Reserve Bank of Dallas*, July 1995, pp. 1-8.

Hassan, M. Kabir, and Ahmad Khasawneh, 2009, The determinants of derivatives activities in the U.S. commercial banks, *working paper*, *University of New Orleans*.

Hirtle, Beverly J., 2009, Credit derivatives and bank credit supply, *Journal of Financial Intermediation (San Diego)*, Volume 18, Issue 2 (April), pp. 241.

Hirtle, Beverly J., 2003, What market risk capital reporting tells us about bank risk, *Economic Policy Review - Federal Reserve Bank of New York (New York)* Volume 9, Issue 3 (September), pp. 37.

Hirtle, Beverly J., 1997, Derivatives, portfolio composition, and bank holding company interest rate risk exposure, *Journal of Financial Services Research* 12, pp. 243-266.

Janabi, Mazin A.M. AI, 2008, Internal regulations and procedures for financial trading units, *Journal of Banking Regulation*, (2008) 9, pp. 116-130.

Koppenhaver, G.D., 1989, The effects of regulation of bank participation in the guarantee market, *Research in Financial Services*, 1989, pp. 165-180.

Koppenhaver, G.D., 1990, An empirical analysis of bank hedging in future markets, *The Journal of Futures Markets(1986-1998)*, Feb 1990; 10, 1; pp.1-12.

Kwan, S. 1991, Re-examination of interest rate sensitivity of commercial bank stock returns using a random coefficient model, *Journal of Financial Services Research*, Vol. 5, pp. 61-76.

Makar, Stephen D., and Stephen P. Huffman, 2001, Foreign exchange derivatives, exchange rate changes, and the value of the firm: U.S. multinationals' use of short-term financial instruments to manage currency risk, *Journal of Business and Economics*, 53(2001) pp. 421-437.

Mollenkamp, Carrick, Paul Beckett, and James P. Miller, 2000, *Wall Street Journal (Eastern edition)*, New York, N.Y.: April 18 pp. 1.

Peek, J., and Rosengren, E., 1997, How well capitalized are well-capitalized banks? *New England Economic Review*, September/October1997 pp. 41-50.

Purnanandam, Amiyatosh, 2007, Interest rate derivatives at commercial banks: An empirical investigation, *Journal of Monetary Economics*, 54 (2007) pp. 1769-1808.

Raturi, Mayank, 2005, The use of derivatives by US insurers: Empirical evidence and regulatory issues, *The Journal of Risk Finance*, 2005; 6, 2; pp. 87-97.

Reichert, Alan, and Yih-Wen Shyu, 2003, Derivative activities and the risk of international banks: A market index and VaR approach, *International Review of Financial Analysis*, 12 (2003) pp. 489-511.

Sapsford, Jathon and Gregory Zuckerman, 1999, Chase Says Transactions Misstatement Improperly Inflated Trading Accounts, *Wall Street Journal (Eastern edition)*, New York, N.Y. Nov 2 pp. A.4.

Saunders, Anthony, Marcia Cornett, and Patricia McGraw, 2006, *Financial Institutions Management (3rd edition)*, pp. 146-201, 339-357, 485-516.

Saunders, Anthony, and Marcia Millon Cornett, 2007, *Financial Markets and Institutions: An Introduction to the Risk Management Approach*, pp. 382-411, 533-553, 603-654.

Schrand, Catherine M., 1997, The association between stock-price interest rate sensitivity and disclosures about derivative instruments, *The Accounting Review*, Vol. 72, No.1. pp. 87-109.

Shanker, Latha, 1996, Derivatives usage and interest rate risk of large banking firms, *The Journal of Futures Markets (1986-1998)*, Vol. 16, No. 4, pp. 459-474.

Sinkey, Joseph F. Jr., & David A. Carter, 2000, Evidence on the financial characteristics of banks that do and do not use derivatives, *The Quarterly Review of Economics and Finance*, Vol. 40, pp. 431-449.

Staikouras, Sotiris K., 2003, The Interest Rate Risk Exposure of Financial Intermediaries: A Review of the Theory and Empirical Evidence, *Financial Markets, Institutions & Instruments*, Vol. 12 (4), pp. 257–289.

Tarhan, V., 1987, Unanticipated interest rates, bank stock returns and the nominal contracting hypothesis, *Journal of Banking & Finance*, Vol. 11, Issue 1, pp. 99-115.

Wetmore, J.L. and J.R. Brick, 1994, Commercial bank risk: market, interest rate, and foreign exchange, *Journal of Financial Research*, Vol. 17, pp. 585-96.

Zhao, Fang, and Jim Moser, 2006, Use of Derivatives and Bank Holding Company Interest Rate Risk, *working paper, Siena College*.

Table 3.1: BHCs' Holdings of Foreign Exchange Derivatives in Each Type (dollar amounts in thousands)

Year	Futures	Forward	Exchange-traded written options	Exchange-traded purchased options	Over-the-counter written options	Over-the-counter purchased options	Swaps
1995	$11	$4,225	$8	$10	$399	$400	$345
1996	$11	$4,729	$9	$13	$521	$490	$463
1997	$22	$5,330	$12	$14	$744	$686	$605
1998	$20	$6,843	$7	$11	$948	$904	$819
1999	$14	$5,951	$4	$5	$624	$579	$969
2000	$16	$5,874	$5	$5	$527	$497	$1,142
2001	$15	$3,837	$6	$7	$380	$356	$1,152
2002	$26	$5,263	$6	$5	$623	$612	$1,650
2003	$28	$4,169	$5	$4	$671	$660	$1,891
2004	$29	$7,455	$11	$17	$1,370	$1,359	$3,179
2005	$52	$6,775	$12	$30	$1,516	$1,503	$2,923
2006	$46	$6,119	$6	$7	$1,671	$1,615	$2,569
2007	$46	$9,445	$35	$33	$2,011	$2,000	$3,303
Total	$336	$76,015	$125	$162	$12,005	$11,662	$21,011

Table 3.1 presents total gross notional amount of foreign exchange derivatives in each type held by BHCs from 1995 to 2007. Forward contracts dominate, followed by swaps.

Table 5.1: Descriptive Statistics of Regression Variables (dollar amounts in thousands)

		Full	Small	Medium	Large
		1126	281	558	287
Panel A: Dependent Variables Statistics					
Hedging accounts	Mean	1824404	30386	281370	6580962
	Standard deviation	8967496	132437	1159617	16827775
	Minimum	0	0	0	0
	Maximum	123331000	1387876	12888671	123331000
Trading accounts	Mean	105562137	132276	5278053	403765307
	Standard deviation	479944716	979698	27977563	885878600
	Minimum	0	0	0	0
	Maximum	6557252000	15726907	415483092	6557252000
Forward contracts	Mean	67509303	139871	4704358	255578884
	Standard deviation	284628855	962856	25391724	519390777
	Minimum	0	0	0	0
	Maximum	3399489000	15726907	375259667	3399489000

Panel A of Table 5.1 presents the descriptive statistics of the three dependent variables. The statistics are given for the full sample as well as for the three sub-samples. The hedging accounts variable is measured by the total gross notional amount of foreign exchange derivative contracts held for purposes other than trading, the trading accounts variable is measured by the total gross notional amount of foreign exchange derivative contracts held for trading, and the forward contracts variable is measured by the total gross notional amount of foreign exchange forward contracts.

Table 5.1 (Continued): Descriptive Statistics of Regression Variables (dollar amounts in thousands)

		Full	Small	Medium	Large
		1126	281	558	287
Panel B: Independent Variables Statistics					
Total assets	Mean	83884493	3683053	29435327	268272084
	Standard deviation	201939778	2448347	21045097	336629392
	Minimum	160204	160204	5071367	31864815
	Maximum	2187631000	16734602	132617601	2187631000
Net asset exposure	Mean	5877459	164908	1679389	19632684
	Standard deviation	22331405	428710	4250218	40865145
	Minimum	0	0	0	0
	Maximum	257051000	4187575	47233435	257051000
Net income exposure	Mean	242409	5519	67423	814563
	Standard deviation	1106784	17662	150352	2081054
	Minimum	0	0	0	0
	Maximum	12436000	174994	1212349	12436000

Panel B of Table 5.1 presents the descriptive statistics of the explanatory variables, total assets, net asset exposure, and net income exposure. The statistics are given for the full sample as well as for the three sub-samples.

Net asset exposure = Absolute value of {(Commercial and industrial loans to non-U.S. addressees (domicile) + Loans to foreign banks + Trading assets in foreign offices) – (Deposits in foreign offices, Edge and Agreement subsidiaries, and IBFs (Noninterest-bearing) + Deposits in foreign offices, Edge and Agreement subsidiaries, and IBFs (Interest-bearing))}

Net income exposure = Absolute value of {Interest income in foreign offices, Edge and Agreement subsidiaries, and IBFs – Interest on deposits in foreign offices, Edge and Agreement subsidiaries, and IBFs}

Table 5.2: Correlations

Panel A: Correlations between dependent variables for full sample

Variable	Total assets	Net asset exposure	Net income exposure
Total assets	1	0.73662***	0.71615***
Net asset exposure		1	0.94120***
Net income exposure			1

Panel B: Correlations between dependent variables for small sub-sample

Variable	Total assets	Net asset exposure	Net income exposure
Total assets	1	0.27035***	0.20043***
Net asset exposure		1	0.89334***
Net income exposure			1

Panel C: Correlations between dependent variables for medium sub-sample

Variable	Total assets	Net asset exposure	Net income exposure
Total assets	1	0.46847***	0.40977***
Net asset exposure		1	0.59250***
Net income exposure			1

Panel D: Correlations between dependent variables for large sub-sample

Variable	Total assets	Net asset exposure	Net income exposure
Total assets	1	0.69376***	0.69083***
Net asset exposure		1	0.94189***
Net income exposure			1

Table 5.2 presents the correlations between any two of the three independent variables for the full sample as well as for the three sub-samples. The number of observations for the full sample is 1126, and it is 281, 558, and 287 for the small group, medium group, and large group respectively.

Table 5.3: Paired Two-sample T-tests

Panel A: Comparisons of hedging accounts						
	Small & Medium		Medium & Large		Large & Small	
Mean (dollar amounts in thousands)	34118.51	301539.5	301539.5	6630228	6630228	34118.51
Variance	1.35E+09	6.19E+10	6.19E+10	1.51E+13	1.51E+13	1.35E+09
Observations	13	13	13	13	13	13
Hypothesized mean Difference	0		0		0	
Degree of freedom	12		12		12	
t Stat	-3.83483***		-5.859***		6.118796***	
Panel B: Comparisons of trading accounts						
	Small & Medium		Medium & Large		Large & Small	
Mean (dollar amounts in thousands)	122215.9	5510612	5510612	4.19E+08	4.19E+08	122215.9
Variance	2.34E+10	1.91E+13	1.91E+13	4.24E+16	4.24E+16	2.34E+10
Observations	13	13	13	13	13	13
Hypothesized mean Difference	0		0		0	
Degree of freedom	12		12		12	
t Stat	-4.43952***		-7.24007***		7.336015***	
Panel C: Comparisons of forward contracts						
	Small & Medium		Medium & Large		Large & Small	
Mean (dollar amounts in thousands)	129615.7	4913525	4913525	2.62E+08	2.62E+08	129615.7
Variance	2.14E+10	1.56E+13	1.56E+13	1.06E+16	1.06E+16	2.14E+10
Observations	13	13	13	13	13	13
Hypothesized mean Difference	0		0		0	
Degree of freedom	12		12		12	
t Stat	-4.35889***		-9.01776***		9.192175***	

Table 5.3 (Continued): Paired Two-sample T-tests

Panel D: Comparisons of total assets						
	Small & Medium		Medium & Large		Large & Small	
Mean (dollar amounts in thousands)	3828136	30617131	30617131	2.82E+08	2.82E+08	3828136
Variance	1.45E+12	9.24E+13	9.24E+13	2.2E+16	2.2E+16	1.45E+12
Observations	13	13	13	13	13	13
Hypothesized mean Difference	0		0		0	
Degree of freedom	12		12		12	
t Stat	-9.97215***		-6.08819***		6.751819***	
Panel E: Comparisons of net asset exposure						
	Small & Medium		Medium & Large		Large & Small	
Mean (dollar amounts in thousands)	-117891	-1575634	-1575634	-1.8E+07	-1.8E+07	-117891
Variance	5.05E+09	5.9E+11	5.9E+11	5.81E+13	5.81E+13	5.05E+09
Observations	13	13	13	13	13	13
Hypothesized mean Difference	0		0		0	
Degree of freedom	12		12		12	
t Stat	6.815846***		7.738401***		-8.46673***	
Panel F: Comparisons of net income exposure						
	Small & Medium		Medium & Large		Large & Small	
Mean (dollar amounts in thousands)	-2630.32	-24885.7	-24885.7	278137.2	278137.2	-2630.32
Variance	19801619	1.26E+09	1.26E+09	1.03E+11	1.03E+11	19801619
Observations	13	13	13	13	13	13
Hypothesized mean Difference	0		0		0	
Degree of freedom	12		12		12	
t Stat	2.246555**		-3.39043***		3.160287***	

Table 5.3 summarizes the paired t-test results. For each of six main regression variables, the statistical significance between any two of the three sub-groups' means is given. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

Table 5.4: Summary of Hedging and Trading Activities by BHCs (dollar amounts in thousands)

Year	The number of banks holding foreign exchange derivatives for		The number of banks holding foreign exchange derivatives for either account	Total gross notional amount of foreign exchange derivatives held for		Hedging /Trading
	Hedging	Trading		hedging	trading	
1995	32	82	118	$ 79,295,864.00	$ 5,297,106,275.00	1.50%
1996	31	70	111	$105,833,547.00	$ 6,061,981,609.00	1.75%
1997	24	61	95	$129,556,030.00	$ 7,184,131,140.00	1.80%
1998	25	55	79	$177,716,434.00	$ 9,281,791,250.00	1.91%
1999	31	48	81	$130,621,145.00	$ 7,971,822,843.00	1.64%
2000	33	51	92	$139,513,426.00	$ 7,852,897,022.00	1.78%
2001	44	39	66	$ 54,985,309.00	$ 5,698,510,404.00	0.96%
2002	54	49	85	$118,535,780.00	$ 8,066,931,992.00	1.47%
2003	54	54	89	$ 91,426,409.00	$ 7,336,406,600.00	1.25%
2004	52	58	88	$259,028,408.00	$ 13,160,130,483.00	1.97%
2005	53	51	84	$245,713,349.00	$ 12,567,504,843.00	1.96%
2006	43	49	73	$233,566,308.00	$ 11,798,783,583.00	1.98%
2007	37	46	65	$288,486,950.00	$ 16,584,968,117.00	1.74%

Table 5.4 describes the number of BHCs that hold foreign exchange derivatives as well as the total gross notional amount of foreign exchange derivatives for either hedging or trading purposes in each sample period.

Table 5.5.1: Hedging Accounts

Variable	Full	Small	Medium	Large
Panel A: Net asset exposure				
Intercept	-215938	-5872.492	-115317*	-446624
	[-0.66]	[-0.68]	[-1.72]	[-0.35]
Total assets	0.01138***	0.00183	0.00948*	0.01449***
	[3.35]	[0.51]	[1.96]	[3.46]
Net asset exposure	0.25709***	0.01112	-0.00723	0.26131***
	[6.21]	[0.73]	[-0.49]	[6.08]
Dummy2	201339	2138.227	-5468.442	724526
	[0.37]	[1.07]	[-0.23]	[0.34]
Dummy3	343946	342.4056	-12812	1403949
	[0.48]	[0.28]	[-0.36]	[0.50]
Dummy4	390824	10029	-54130	1913585
	[0.48]	[0.85]	[-0.79]	[0.60]
Dummy5	-779303	5232.501	8927.445	-2807088
	[-1.34]	[0.82]	[0.09]	[-1.26]
Dummy6	-578979	2855.46	41381.30	-2406142
	[-1.19]	[1.10]	[0.37]	[-1.31]
Dummy7	-1235949**	16754.11	30452.34	-4950377***
	[-2.48]	[1.63]	[0.26]	[-2.63]
Dummy8	-1123485**	80499.2**	194844	-5016058***
	[-2.32]	[2.40]	[1.07]	[-2.82]
Dummy9	-1024168**	52952.29	193854	-4559237***
	[-2.22]	[1.40]	[1.09]	[-2.64]
Dummy10	-812028	39981	377013	-3814120
	[-1.25]	[1.31]	[1.33]	[-1.46]
Dummy11	-856444	21458	475168**	-4341427
	[-1.23]	[1.58]	[1.73]	[-1.61]
Dummy12	-450538	70913.31	231793	-2500044
	[-0.70]	[1.04]	[0.71]	[-1.02]
Dummy13	-53512	100554**	330299	-1593217
	[-0.06]	[1.18]	[0.87]	[-0.50]
R-Square	0.7131	0.0687	0.0637	0.7174
Adjusted R-Sq	0.7095	0.0197	0.0396	0.7029
Observations	1126	281	558	287
F value	197.27***	1.40	2.64***	49.32***

Table 5.5.1 (Continued): Hedging Accounts

Variable	Full	Small	Medium	Large
Panel B: Net income exposure				
Intercept	-202969	-6442.274	-69489	-250061
	[-0.66]	[-0.77]	[-1.13]	[-0.20]
Total assets	0.01159***	0.00208	0.000840	0.01294***
	[4.96]	[0.63]	[0.19]	[4.23]
Net income exposure	5.23401***	0.16910	2.57634***	5.26330***
	[6.89]	[0.64]	[2.97]	[6.86]
Dummy2	284275	2387.557	25430	1041532
	[0.55]	[1.15]	[0.82]	[0.51]
Dummy3	485454	509.116	21307	1938642
	[0.71]	[0.36]	[0.52]	[0.71]
Dummy4	597387	10113	-82441	2919503
	[0.72]	[0.86]	[-1.04]	[0.90]
Dummy5	-205811	5645.367	9543.886	-466975
	[-0.37]	[0.89]	[0.10]	[-0.22]
Dummy6	-911220*	3659.13*	-50713	-3080128
	[-1.70]	[1.73]	[-0.41]	[-1.50]
Dummy7	-1645631**	17075.2*	-14747	-5955394**
	[-2.49]	[1.66]	[-0.12]	[-2.44]
Dummy8	-1003054	81607.44**	305895	-4498378**
	[-1.88]	[2.45]	[1.81]	[-2.22]
Dummy9	-717985	54273.87	218116	-3074368
	[-1.46]	[1.44]	[1.35]	[-1.61]
Dummy10	-243223	40460.65	471993.5*	-1643697
	[-0.44]	[1.32]	[1.73]	[-0.72]
Dummy11	-287035	22697	472129.5**	-1465699
	[-0.54]	[1.64]	[1.97]	[-0.70]
Dummy12	193257	71203.48	320527	333390
	[0.31]	[1.04]	[0.99]	[0.14]
Dummy13	380566	101720.5	429046	703536
	[0.51]	[1.18]	[1.11]	[0.24]
R-Square	0.7272	0.0680	0.1537	0.7214
Adjusted R-Sq	0.7237	0.0189	0.1318	0.7070
Observations	1126	281	558	287
F value	211.49***	1.39	7.04***	50.30***

Table 5.5.1 presents the regression results for hedging accounts from models 4.1 and 4.2. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

Table 5.5.2: Trading Accounts

Variable	Full	Small	Medium	Large
Panel A: Net asset exposure				
Intercept	-15071423	464184	-266729	-30650032
	[-1.50]	[1.05]	[-0.43]	[-0.84]
Total assets	1.64096***	0.01452	-0.15297***	2.01277***
	[5.94]	[0.87]	[-2.84]	[6.52]
Net asset exposure	5.07866***	0.48356	5.89294***	4.49700***
	[3.09]	[1.38]	[5.66]	[2.61]
Dummy2	2072793	-433953	604562	7809070
	[0.14]	[-0.87]	[0.96]	[0.14]
Dummy3	6268751	-523287	819554	28507567
	[0.31]	[-1.04]	[0.91]	[0.37]
Dummy4	-6860202	-578199.5	1008220	-21083113
	[-0.25]	[-1.06]	[0.47]	[-0.19]
Dummy5	-47842154**	-567713	-1690990	-1.76E+08**
	[-2.28]	[-1.07]	[-0.72]	[-2.13]
Dummy6	-45927517**	-601456	-2870221	-1.78E+08**
	[-2.10]	[-1.10]	[-1.62]	[-2.19]
Dummy7	-63087040**	-565963.5	-1787859	-2.47E+08**
	[-2.32]	[-1.04]	[-0.83]	[-2.43]
Dummy8	-71720730***	-539183	-28998	-2.90E+08***
	[-3.12]	[-0.99]	[-0.02]	[-3.56]
Dummy9	-68316191***	-583861	-1346342	-2.82E+08***
	[-2.63]	[-0.98]	[-0.69]	[-2.90]
Dummy10	-92996498***	-472954	2022106	-3.91E+08***
	[-3.24]	[-0.86]	[0.60]	[-3.60]
Dummy11	-94419159***	-472846	5376167	-3.90E+08***
	[-3.00]	[-0.79]	[1.39]	[-3.21]
Dummy12	-1.06E+08***	-502767	1114724	-4.49E+08***
	[-2.76]	[-0.83]	[0.33]	[-3.18]
Dummy13	-73587462	-414393	-1957281	-3.51E+08*
	[-1.42]	[-0.66]	[-0.74]	[-1.82]
R-Square	0.7548	0.0750	0.7293	0.7561
Adjusted R-Sq	0.7517	0.0263	0.7223	0.7435
Observations	1126	281	558	287
F value	244.28***	1.54*	104.49***	60.22***

Table 5.5.2 (Continued): Trading Accounts

Variable	Full	Small	Medium	Large
Panel B: Net income exposure				
Intercept	-15045309	427219	-3863372**	-28811409
	[-1.47]	[1.05]	[-2.08]	[-0.76]
Total assets	1.69365***	0.01187	0.20815**	2.08417***
	[7.19]	[0.98]	[2.29]	[7.38]
Net income exposure	91.25800***	15.12717	73.40459**	69.77979**
	[3.08]	[1.22]	[2.51]	[2.14]
Dummy2	3381577	-405760	113531	11364948
	[0.22]	[-0.88]	[0.10]	[0.20]
Dummy3	8605712	-493684	273777	34782309
	[0.41]	[-1.06]	[0.16]	[0.44]
Dummy4	-3489735	-554637	-800534.5	-10292745
	[-0.12]	[-1.09]	[-0.21]	[-0.09]
Dummy5	-37443575	-522542	-2901746	-1.43E+08
	[-1.59]	[-1.08]	[-0.90]	[-1.54]
Dummy6	-51522873**	-592429	-8209858**	-1.86E+08**
	[-2.38]	[-1.11]	[-2.47]	[-2.27]
Dummy7	-71087614**	-537234*	-7282963*	-2.66E+08**
	[-2.56]	[-1.06]	[-1.95]	[-2.57]
Dummy8	-69880931***	-453207*	-1409943	-2.85E+08***
	[-2.91]	[-0.97]	[-0.55]	[-3.32]
Dummy9	-63964949**	-534924.5	-3937886	-2.69E+08***
	[-2.38]	[-0.96]	[-1.35]	[-2.64]
Dummy10	-83210362***	-393159	3355394	-3.66E+08***
	[-2.87]	[-0.83]	[0.53]	[-3.30]
Dummy11	-84613907**	-362931	-265205	-3.54E+08***
	[-2.58]	[-0.72]	[-0.04]	[-2.71]
Dummy12	-96291121***	-462336	-1368475	-4.25E+08***
	[-2.59]	[-0.83]	[-0.34]	[-3.03]
Dummy13	-68258747	-360725	-5877339	-3.38E+08*
	[-1.35]	[-0.62]	[-1.61]	[-1.75]
R-Square	0.7507	0.1038	0.2341	0.7475
Adjusted R-Sq	0.7475	0.0566	0.2143	0.7345
Observations	1126	281	558	287
F value	238.93***	2.20***	11.85***	57.51***

Table 5.5.2 presents the regression results for trading accounts from models 4.3 and 4.4. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

Table 5.6.1: Hedging Accounts (two-stage)

Variable	Full		Large	
Intercept	-215948	-202969	-446617.5	-250061
	[-0.66]	[-0.66]	[-0.35]	[-0.20]
Total assets	0.03189***	0.03133***	0.035374***	0.03289***
	[11.59]	[12.34]	[11.04]	[11.45]
Res_Net asset exposure	0.25714***		0.261261***	
	[6.21]		[6.07]	
Res_Net income exposure		5.23401***		5.26330***
		[6.89]		[6.86]
Dummy2	201347	284275	724505	1041532
	[0.37]	[0.55]	[0.34]	[0.51]
Dummy3	343946	485454	1403932	1938642
	[0.48]	[0.71]	[0.50]	[0.71]
Dummy4	390808	597387	1913535	2919504
	[0.48]	[0.72]	[0.60]	[0.90]
Dummy5	-779378	-205811	-2806954	-466975
	[-1.34]	[-0.37]	[-1.26]	[-0.22]
Dummy6	-579032	-911220	-2406046	-3080128
	[-1.19]	[-1.70]	[-1.31]	[-1.50]
Dummy7	-1235927**	-1645631**	-4950556***	-5955394**
	[-2.48]	[-2.49]	[-2.63]	[-2.44]
Dummy8	-1122830**	-1003054*	-5014586***	-4498378**
	[-2.32]	[-1.88]	[-2.82]	[-2.22]
Dummy9	-1024136**	-717985	-4559465***	-3074367
	[-2.22]	[-1.46]	[-2.64]	[-1.61]
Dummy10	-812188	-243223	-3816066	-1643696
	[-1.25]	[-0.44]	[-1.46]	[-0.72]
Dummy11	-856353	-287035	-4341935	-1465699
	[-1.23]	[-0.54]	[-1.61]	[-0.70]
Dummy12	-450492	193257	-2500457	333390
	[-0.70]	[0.31]	[-1.02]	[0.14]
Dummy13	-53459	380566	-1593719	703535
	[-0.06]	[0.51]	[-0.50]	[0.24]
R-Square	0.7132	0.7272	0.7174	0.7214
Adjusted R-Sq	0.7095	0.7237	0.7028	0.7070
Observations	1126	1126	287	287
F value	197.30***	211.49***	49.31***	50.30***

Table 5.6.1 presents the regression results for hedging accounts from two-stage models 5.1.1, 5.1.2, 5.1.3, and 5.1.4. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

Table 5.6.2: Trading Accounts (two-stage)

Variable	Full		Large	
Intercept	-15071778	-15045309	-30649703	-28811409
	[-1.50]	[-1.47]	[-0.84]	[-0.76]
Total assets	2.04615***	2.03792***	2.37218***	2.34866***
	[12.11]	[12.39]	[11.60]	[11.66]
Res_Net asset exposure	5.07918***		4.49653***	
	[3.09]		[2.61]	
Res_Net income exposure		91.258***		69.77979**
		[3.08]		[2.14]
Dummy2	2072837	3381577	7808897	11364947
	[0.14]	[0.22]	[0.14]	[0.20]
Dummy3	6268645	8605712	28507513	34782310
	[0.31]	[0.41]	[0.37]	[0.44]
Dummy4	-6860699	-3489734	-21083249	-10292742
	[-0.25]	[-0.12]	[-0.19]	[-0.09]
Dummy5	-47843343**	-37443575	-1.76E+08**	-1.43E+08
	[-2.28]	[-1.59]	[-2.13]	[-1.54]
Dummy6	-45928416**	-51522873**	-1.78E+08**	-1.86E+08**
	[-2.10]	[-2.38]	[-2.19]	[-2.27]
Dummy7	-63087251**	-71087614**	-2.47E+08**	-2.66E+08**
	[-2.32]	[-2.56]	[-2.43]	[-2.57]
Dummy8	-71707995***	-69880931***	-2.90E+08***	-2.85E+08***
	[-3.12]	[-2.91]	[-3.56]	[-3.32]
Dummy9	-68316309***	-63964948**	-2.82E+08***	-2.69E+08***
	[-2.63]	[-2.38]	[-2.90]	[-2.64]
Dummy10	-92999748**8	-83210360***	-3.91E+08***	-3.66E+08***
	[-3.24]	[-2.87]	[-3.60]	[-3.30]
Dummy11	-94417458***	-84613907**	-3.90E+08***	-3.54E+08***
	[-3.00]	[-2.58]	[-3.21]	[-2.71]
Dummy12	-1.06E+08***	-96291121***	-4.49E+08***	-4.25E+08***
	[-2.76]	[-2.59]	[-3.18]	[-3.03]
Dummy13	-73588106	-68258745	-3.51E+08*	-3.38E+08*
	[-1.42]	[-1.35]	[-1.82]	[-1.75]
R-Square	0.7548	0.7507	0.7561	0.7475
Adjusted R-Sq	0.7517	0.7475	0.7435	0.7345
Observations	1126	1126	287	287
F value	244.28***	238.93***	60.22***	57.51***

Table 5.6.2 presents the regression results for trading accounts from two-stage models 5.2.1, 5.2.2, 5.2.3, and 5.2.4. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

Table 5.7.1: Descriptive Statistics of Regression Variables for the Sub-sample (dollar amounts in thousands)

Variable	Mean	Standard deviation	Minimum	Maximum
Panel A: Dependent Variable Statistics				
Hedging accounts	1839896	8838046	0	123331000
Trading accounts	107940603	514064993	0	6557252000
Panel B: Independent Variable Statistics				
Total assets	90780981	222118729	220802	2187631000
Net asset exposure	5945099	23837731	0	257051000
Net income exposure	245830	1208336	0	12436000
Capital ratio (percent)	12.68	5.51	0.00	84.15

Table 5.7.1 presents the descriptive statistics of the two dependent and four independent variables for robustness test. The statistics are given for the sub-sample with 810 observations from year 1995 to year 2007. The capital ratio is defined as total risk-based capital divided by total risk-weighted assets, and all other variables are defined as they are in Table 5.1.

Table 5.7.2: Correlations (capital ratio)

Variable	Total assets	Net asset exposure	Net income exposure	Capital Ratio
Total assets	1	0.74313***	0.71664***	-0.10737***
Net asset exposure		1	0.94418***	-0.11737***
Net income exposure			1	-0.09525***
Capital Ratio				1

Table 5.7.2 presents the correlations between any two of the four independent variables. The sub-sample contains 810 observations from year 1995 to year 2007.

Table 5.7.3: Capital Ratio

Variable	Hedging		Trading	
Intercept	-1277211**	-1144461***	-51537571**	-49396684**
	[-2.38]	[-2.65]	[-2.32]	[-2.20]
Total assets	0.01604***	0.01520***	1.79013***	1.78698***
	[4.66]	[6.01]	[5.81]	[6.81]
Net asset exposure	0.19287***		3.10289	
	[5.47		[1.62]	
Net income exposure		4.11083***		63.47669**
		[6.17]		[2.02]
Capital ratio	74430***	61657.28***	2700650***	2483006***
	[3.01]	[3.06]	[3.10]	[2.61]
Dummy2	336105	437768	4815621	6382740
	[0.43]	[0.62]	[0.22]	[0.29]
Dummy3	534608	651092	6052940	7868167
	[0.53]	[0.71]	[0.23]	[0.31]
Dummy4	355322	384672	-19509900	-19151753
	[0.37]	[0.44]	[-0.67]	[-0.67]
Dummy5	-379827	-279361	-43840458*	-42333346*
	[-0.72]	[-0.65]	[-1.77]	[-1.76]
Dummy6	-746863	-867285**	-64336715***	-66175257***
	[-1.56]	[-2.03]	[-2.87]	[-2.93]
Dummy7	-1224751**	-1461102**	-64856752**	-68517674**
	[-2.27]	[-2.48]	[-2.26]	[-2.38]
Dummy8	-976293*	-814841*	-66481784***	-63861759**
	[-1.90]	[-1.78]	[-2.70]	[-2.54]
Dummy9	-968921*	-646844	-65143352**	-60185794**
	[-1.96]	[-1.47]	[-2.40]	[-2.18]
Dummy10	-528658	-37569	-82653476***	-74920650**
	[-0.81]	[-0.07]	[-2.83]	[-2.52]
Dummy11	-586156	-66206	-83386582**	-75184353***
	[-0.85]	[-0.12]	[-2.54]	[-2.21]
Dummy12	-331941	279470	-98019019**	-88731773**
	[-0.47]	[0.42]	[-2.50]	[-2.30]
Dummy13	130611	584171	-58030489	-51227949
	[0.15]	[0.76]	[-1.10]	[-1.00]
R-Square	0.7368	0.7688	0.7675	0.7571
Adjusted R-Sq	0.7318	0.7644	0.7631	0.7446
Observations	810	810	810	810
F value	148.19***	176.00***	174.69***	176.20***

Table 5.7.3 presents the regression results for hedging and trading accounts from models 5.3.1, 5.3.2, 5.3.3, and 5.3.4. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

Table 5.8.1: Forward Contracts

Variable	Full	Small	Medium	Large
Panel A: Net asset exposure				
Intercept	1786464	466062	251560	22012329
	[0.21]	[1.05]	[0.44]	[0.70]
Total assets	0.78455***	0.01913	-0.16744***	0.97288***
	[5.83]	[1.15]	[-3.60]	[6.47]
Net asset exposure	4.94366***	0.43111	5.41836***	4.61915***
	[5.28]	[1.27]	[5.86]	[4.93]
Dummy2	2829764	-427870	560898	11139168
	[0.21]	[-0.86]	[0.96]	[0.22]
Dummy3	6579045	-526910	1053966	27589072
	[0.38]	[-1.05]	[1.20]	[0.42]
Dummy4	5617480	-572877	838159	26338628
	[0.25]	[-1.05]	[0.39]	[0.31]
Dummy5	-22342789	-541331	-1637942	-79011664
	[-1.52]	[-1.02]	[-0.82]	[-1.40]
Dummy6	-22609086	-540275.5	-2393146	-83307663
	[-1.40]	[-0.99]	[-1.49]	[-1.38]
Dummy7	-35272885**	-563473	-1556414	-1.35E+08**
	[-2.16]	[-1.04]	[-0.84]	[-2.23]
Dummy8	-43453739***	-506163	-780892	-1.72E+08***
	[-3.11]	[-0.93]	[-0.50]	[-3.41]
Dummy9	-46900043***	-610505	-1156212	-1.88E+08***
	[-3.20]	[-1.03]	[-0.68]	[-3.43]
Dummy10	-65019161***	-515997	2016045	-2.68E+08***
	[-3.98]	[-0.94]	[0.67]	[-4.41]
Dummy11	-69962163***	-564426	5351277	-2.87E+08***
	[-4.21]	[-0.95]	[1.58]	[-4.63]
Dummy12	-74619891***	-497567	1734440	-3.09E+08***
	[-3.74]	[-0.82]	[0.55]	[-4.09]
Dummy13	-47215287*	-428878	-655613	-2.14E+08**
	[-1.70]	[-0.68]	[-0.29]	[-2.04]
R-Square	0.7599	0.0681	0.7363	0.7571
Adjusted R-Sq	0.7569	0.0190	0.7295	0.7446
Observations	1126	281	558	287
F value	251.18***	1.39	108.29***	60.56***

Table 5.8.1 (Continued): Forward Contracts

Variable	Full	Small	Medium	Large
Panel B: Net income exposure				
Intercept	1752898	431434	-3030257*	24148711
	[0.20]	[1.06]	[-1.80]	[0.72]
Total assets	0.84829***	0.01493	0.15961*	1.03047***
	[7.85]	[1.25]	[1.96]	[7.87]
Net income exposure	85.72092***	14.55320	69.11417***	75.01399***
	[5.17]	[1.19]	[2.60]	[4.26]
Dummy2	4019271	-400355	127830	15096508
	[0.27]	[-0.87]	[0.12]	[0.27]
Dummy3	8736360	-497450	572478	34504023
	[0.48]	[-1.07]	[0.35]	[0.50]
Dummy4	8716324	-549135	-843492	38468650
	[0.36]	[-1.07]	[-0.24]	[0.41]
Dummy5	-12459128	-497325	-2751722	-44342215
	[-0.68]	[-1.03]	[-0.89]	[-0.63]
Dummy6	-27807588	-535784	-7362738	-92269796
	[-1.77]	[-1.01]	[-2.43]	[-1.53]
Dummy7	-43037107**	-535834	-6640560**	-1.55E+08**
	[-2.55]	[-1.06]	[-1.98]	[-2.45]
Dummy8	-41801086***	-424328	-1984141	-1.66E+08***
	[-2.80]	[-0.91]	[-1.01]	[-3.02]
Dummy9	-43099566***	-568046	-3526234	-1.73E+08***
	[-2.73]	[-1.02]	[-1.35]	[-2.87]
Dummy10	-55864942***	-436769	3300698	-2.40E+08***
	[-3.36]	[-0.93]	[0.57]	[-3.90]
Dummy11	-60787492***	-458741	158165	-2.48E+08***
	[-3.48]	[-0.92]	[0.03]	[-3.64]
Dummy12	-66298268***	-457704	-496686	-2.80E+08***
	[-3.46]	[-0.82]	[-0.13]	[-3.76]
Dummy13	-42860436	-380628	-4202867	-1.96E+08*
	[-1.60]	[-0.66]	[-1.24]	[-1.86]
R-Square	0.7449	0.1011	0.2343	0.7346
Adjusted R-Sq	0.7417	0.0538	0.2145	0.7209
Observations	1126	281	558	287
F value	231.69***	2.14**	11.87***	53.78***

Table 5.8.1 presents the one-step regression results for foreign exchange forward contracts. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

Table 5.8.2: Forward Contracts (two-stage)

Variable	Full		Large	
Intercept	1786143	1752898	22012526	24148710
	[0.21]	[0.20]	[0.70]	[0.72]
Total assets	1.17898***	1.17168***	1.34205***	1.31479***
	[13.76]	[14.51]	[12.89]	[13.38]
Res_Net asset exposure	4.94424***		4.61849***	
	[5.28]		[4.93]	
Res_Net income exposure		85.72093***		75.01339***
		[5.17]		[4.26]
Dummy2	2829824	4019271	11138870	15096508
	[0.21]	[0.27]	[0.22]	[0.27]
Dummy3	6578958	8736360	27588866	34504023
	[0.38]	[0.48]	[0.42]	[0.50]
Dummy4	5617024	8716325	26338020	38468652
	[0.25]	[0.36]	[0.31]	[0.41]
Dummy5	-22343995	-12459128	-79009468	-44342212
	[-1.52]	[-0.68]	[-1.40]	[-0.63]
Dummy6	-22609986	-27807588*	-83306048	-92269795
	[-1.40]	[-1.77]	[-1.38]	[-1.53]
Dummy7	-35272985**	-43037107**	-1.35E+08**	-1.55E+08**
	[-2.16]	[-2.55]	[-2.23]	[-2.45]
Dummy8	-43441310***	-41801086***	-1.72E+08***	-1.66E+08***
	[-3.10]	[-2.80]	[-3.41]	[-3.02]
Dummy9	-46900037***	-43099564***	-1.88E+08***	-1.73E+08***
	[-3.20]	[-2.73]	[-3.43]	[-2.87]
Dummy10	-65022309***	-55864940***	-2.68E+08***	-2.40E+08***
	[-3.98]	[-3.36]	[-4.41]	[-3.90]
Dummy11	-69960492***	-60787492***	-2.87E+08***	-2.48E+08***
	[-4.21]	[-3.48]	[-4.63]	[-3.64]
Dummy12	-74620119***	-66298269***	-3.09E+08***	-2.80E+08***
	[-3.74]	[-3.46]	[-4.09]	[-3.76]
Dummy13	-47215638*	-42860434	-2.14E+08**	-1.96E+08*
	[-1.70]	[-1.60]	[-2.04]	[-1.86]
R-Square	0.7599	0.7449	0.7571	0.7346
Adjusted R-Sq	0.7569	0.7417	0.7446	0.7209
Observations	1126	1126	287	287
F value	251.18***	231.69***	60.56***	53.78***

Table 5.8.2 presents the two-stage regression results for foreign exchange forward contracts. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

Table 5.9.1: Descriptive Statistics of Dependent Variables (dollar amounts in thousands)

Variable	Mean	Standard deviation	Minimum	Maximum
Futures	298735	1626809	0	24852000
Exchange-traded written options	111339	963551	0	28920000
Exchange-traded purchased options	143445	1189499	0	29494000
OTC written options	10671169	57604522	0	908976000
OTC purchased options	10356657	56259336	0	905768000
Swaps	18660060	105467299	0	1360349000

Table 5.9.1 presents the descriptive statistics of the six dependent variables. The statistics are given for the entire sample including 1126 observations. The futures variable is measured by the total gross notional amount of foreign exchange futures, the exchange-traded written options variable is measured by the total gross notional amount of exchange-traded foreign exchange written options, the exchange-traded written options variable is measured by the total gross notional amount of exchange-traded foreign exchange purchased options, the over-the-counter written options variable is measured by the total gross notional amount of over-the-counter foreign exchange written options, the over-the-counter written options variable is measured by the total gross notional amount of over-the-counter foreign exchange purchased options, and the swaps variable is measured by the total gross notional amount of foreign exchange swaps.

Table 5.9.2: Other Types of Foreign Exchange Derivative Contracts

Variable	Futures	Exchange-traded written options	Exchange-traded purchased options
Panel A: Net asset exposure			
Intercept	-68513.37*	6139.5	19025.94
	[-1.71]	[0.12]	[0.38]
Total assets	0.00371***	0.00162*	0.00182*
	[3.00]	[1.77]	[1.95]
Net asset exposure	0.02277***	0.00503	0.006162
	[2.89]	[1.08]	[1.20]
Dummy2	-11028.83	6759.61	19804.98
	[-0.21]	[0.14]	[0.38]
Dummy3	79147.93	39304.33	31552.51
	[0.50]	[0.61]	[0.47]
Dummy4	-51841.78	-53093.84	-33343.96
	[-0.69]	[-0.76]	[-0.50]
Dummy5	-194654.9***	-116227.5	-144404.9*
	[-2.78]	[-1.54]	[-1.87]
Dummy6	-150018.7**	-99739.28	-130369.6*
	[-2.51]	[-1.44]	[-1.78]
Dummy7	-131570.3	-76889.41	-93115.88
	[-1.30]	[-0.85]	[-0.95]
Dummy8	-115557.7	-115458.5	-168625.1*
	[-1.11]	[-1.31]	[-1.94]
Dummy9	-45121.43	-119205.1	-157687.2*
	[-0.35]	[-1.48]	[-1.94]
Dummy10	-296136.8***	-141123.3	-119740.7
	[-2.70]	[-1.02]	[-0.72]
Dummy11	-7614.32	-114151.5	48901.54
	[-0.05]	[-0.88]	[0.19]
Dummy12	-40223.45	-202349.7	-239560.9*
	[-0.17]	[-1.49]	[-1.73]
Dummy13	-118016.9	190393	108592.8
	[-0.51]	[0.80]	[0.46]
R-Square	0.5169	0.1936	0.1657
Adjusted R-Sq	0.5108	0.1834	0.1552
Observations	1126	1126	1126
F value	84.91***	19.05***	15.76***

Table 5.9.2 (Continued): Other Types of Foreign Exchange Derivative Contracts

Variable	OTC written options	OTC purchased options	Swaps
Panel A (Continued): Net asset exposure			
Intercept	-3601643***	-3433839***	-9892676***
	[-3.43]	[-3.25]	[-4.82]
Total assets	0.22349***	0.21902***	0.41936***
	[5.21]	[5.17]	[5.78]
Net asset exposure	0.13496	0.12293	0.12107
	[0.55]	[0.51]	[0.28]
Dummy2	338745.2	72580.13	-561692
	[0.28]	[0.06]	[-0.22]
Dummy3	1569372	1011471	-1861261
	[0.67]	[0.48]	[-0.55]
Dummy4	-606905.3	-966266.8	-9490902*
	[-0.18]	[-0.30]	[-1.80]
Dummy5	-6933999**	-7220090**	-11472964**
	[-2.30]	[-2.51]	[2.06]
Dummy6	-7354679***	-7456386***	-8219945
	[-3.30]	[-3.36]	[-1.61]
Dummy7	-10167575***	-10269581***	-8625727
	[-3.09]	[-3.15]	[-1.09]
Dummy8	-10111210***	-9926848***	-9305398
	[-3.66]	[-3.66]	[-1.40]
Dummy9	-8636265***	-8486719***	-5308617
	[-2.88]	[-2.88]	[-0.65]
Dummy10	-10430805***	-10037999***	-8228057
	[-2.89]	[-2.80]	[-0.97]
Dummy11	-8113912	-7746475	-9847018
	[-1.57]	[-1.56]	[-1.17]
Dummy12	-7181101	-7365945	-16972489*
	[-1.17]	[-1.22]	[-1.77]
Dummy13	-6584520	-5865672	-14821318
	[-0.87]	[-0.79]	[-1.27]
R-Square	0.6654	0.6656	0.6642
Adjusted R-Sq	0.6612	0.6614	0.6599
Observations	1126	1126	1126
F value	157.66***	157.94***	156.93***

Table 5.9.2 (Continued): Other Types of Foreign Exchange Derivative Contracts

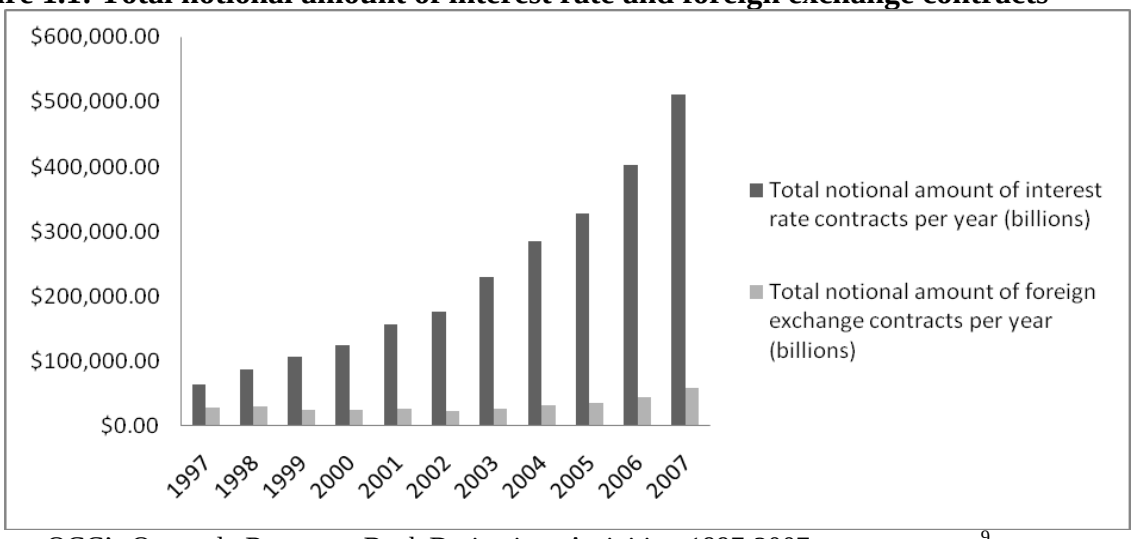
Variable	Futures	Exchange-traded written options	Exchange-traded purchased options
Panel B: Net income exposure			
Intercept	-67001.45*	7328.354	20040.39
	[-1.68]	[0.15]	[0.41]
Total assets	0.00365***	0.00143**	0.00168***
	[3.43]	[2.34]	[2.62]
Net income exposure	0.48264***	0.15181	0.16257
	[3.56]	[0.93]	[0.97]
Dummy2	-3164.22	9722.81	22800.67
	[-0.06]	[0.20]	[0.43]
Dummy3	92402.66	43938.14	36346.19
	[0.57]	[0.69]	[0.55]
Dummy4	-32428.94	-46163.71	-26221.56
	[-0.44]	[-0.70]	[-0.41]
Dummy5	-142402.6**	-101216.8	-127813.9*
	[-2.07]	[-1.56]	[-1.93]
Dummy6	-180967.6***	-110178	-141292.8*
	[-2.75]	[-1.40]	[-1.72]
Dummy7	-167993.4*	-85287.49	-103218.1
	[-1.69]	[-0.88]	[-0.99]
Dummy8	-104041.6	-110909.1	-164089.6*
	[-0.98]	[-1.27]	[-1.91]
Dummy9	-15327.73	-106313.1	-145158.3*
	[-0.13]	[-1.44]	[-1.94]
Dummy10	-243478.2**	-124091.9	-101672.3
	[-2.24]	[-0.97]	[-0.64]
Dummy11	45086.41	-97137.6	66962.47
	[0.31]	[-0.85]	[0.26]
Dummy12	22997.55	-176334.6	-214039.1*
	[0.09]	[-1.63]	[-1.91]
Dummy13	-74450.82	-212083.6	128924.1
	[-0.33]	[0.82]	[0.50]
R-Square	0.5243	0.2020	0.1706
Adjusted R-Sq	0.5183	0.1920	0.1602
Observations	1126	1126	1126
F value	87.46***	20.09***	16.32***

Table 5.9.2 (Continued): Other Types of Foreign Exchange Derivative Contracts

Variable	OTC written options	OTC purchased options	Swaps
Panel B (Continued): Net income exposure			
Intercept	-3596206***	-3427439***	-9840122***
	[-3.48]	[-3.29]	[-4.81]
Total assets	0.2239***	0.21908***	0.40966***
	[5.87]	[5.85]	[6.09]
Net asset exposure	2.67394	2.51313	4.91482
	[0.62]	[0.60]	[0.62]
Dummy2	380285.7	112520.4	-456107
	[0.32]	[0.10]	[-0.18]
Dummy3	1640885	1079529	-1702077
	[0.69]	[0.51]	[-0.50]
Dummy4	-502746.4	-866885.8	-9250289
	[-0.15]	[-0.27]	[-1.75]
Dummy5	-6638549**	-6945069**	-11015074*
	[-2.14]	[-2.34]	[-1.93]
Dummy6	-7523181***	-7616083***	-8571787*
	[-3.40]	[-3.46]	[-1.71]
Dummy7	-10382032***	-10465553***	-8837317
	[-3.23]	[-3.29]	[-1.13]
Dummy8	-10051212***	-9868798***	-9139828
	[-3.57]	[-3.58]	[-1.36]
Dummy9	-8485789***	-8338854***	-4821818
	[-2.77]	[-2.77]	[-0.59]
Dummy10	-10140931***	-9764772***	-7667430
	[-2.69]	[-2.61]	[-0.91]
Dummy11	-7823677	-7472965	-9287558
	[-1.51]	[-1.49]	[-1.10]
Dummy12	-6863074	-7055269	-16003181*
	[-1.15]	[-1.20]	[-1.66]
Dummy13	-6372834	-5655319	-13961592
	[-0.83]	[-0.76]	[-1.18]
R-Square	0.6654	0.6657	0.6651
Adjusted R-Sq	0.6612	0.6615	0.6609
Observations	1126	1126	1126
F value	157.67***	158.00***	157.62***

Table 5.9.2 presents the regression results for six types of foreign exchange derivative contracts. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

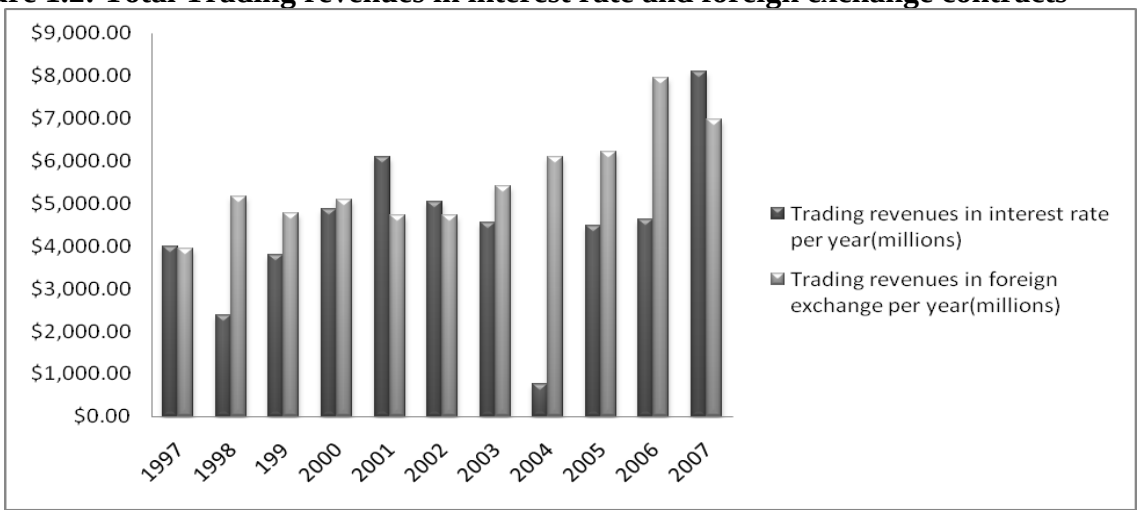
Figure 1.1: Total notional amount of interest rate and foreign exchange contracts



Sources: OCC's Quarterly Report on Bank Derivatives Activities, 1997-2007, www.occ.gov[9]

Figure 1.1 presents the total notional amount of interest rate contracts and foreign exchange contracts held by US banks from year 1997 to 2007.

Figure 1.2: Total Trading revenues in interest rate and foreign exchange contracts



Sources: OCC's Quarterly Report on Bank Derivatives Activities, 1997-2007, www.occ.gov

Figure 1.2 presents the trading revenues in interest rate contracts and foreign exchange contracts held by US banks from year 1995 to 2007.

[9] Total revenues in interest rate and foreign exchange are calculated on both cash and derivative instruments.

Figure 3.1: The Number of BHCs Holding Foreign Exchange Derivatives in Each Type

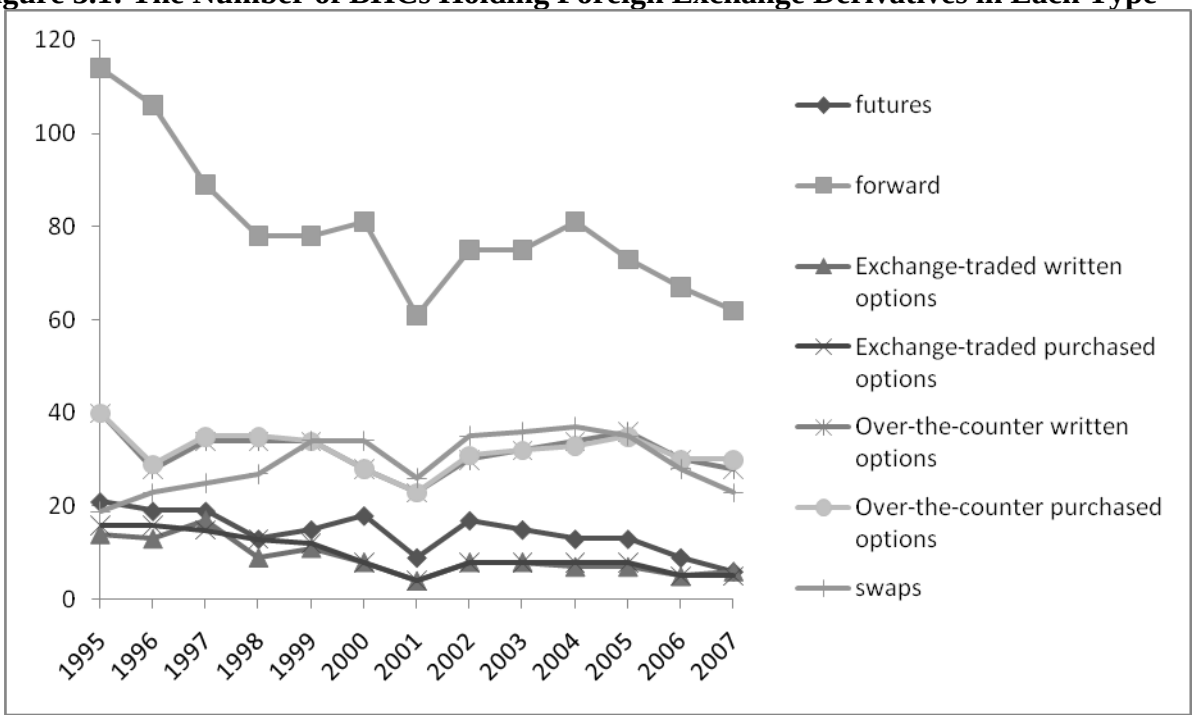
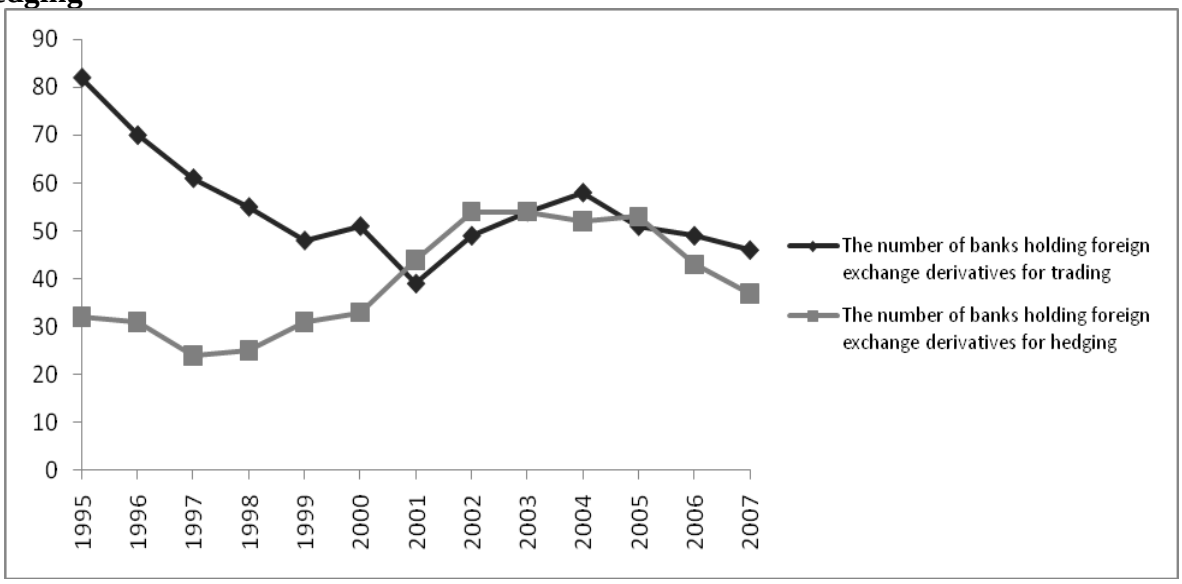


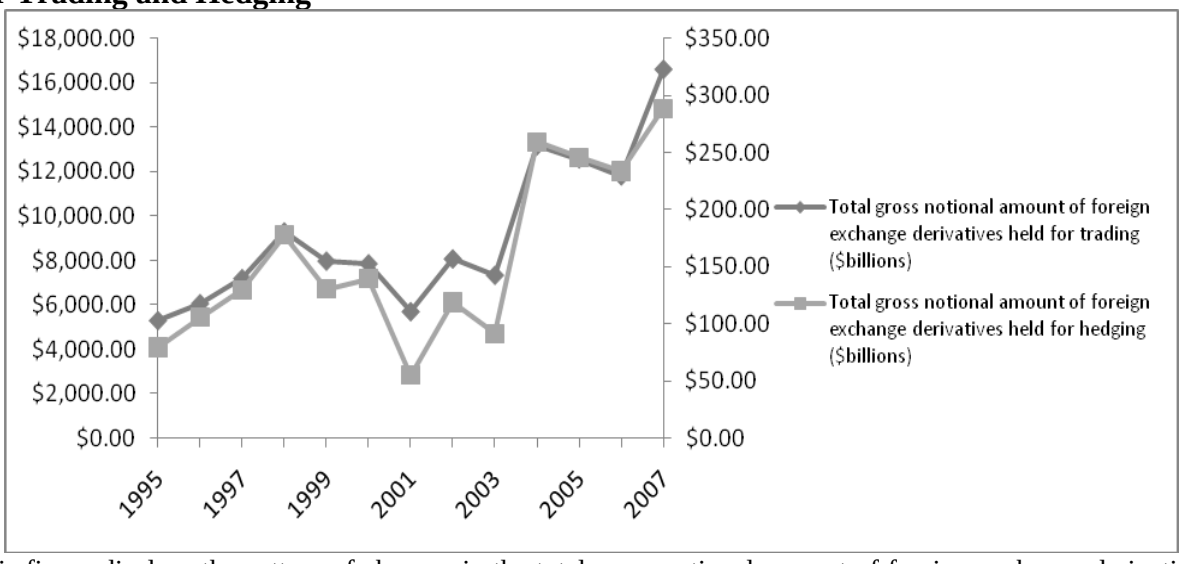
Figure 3.1 displays the yearly changing patterns of the number of BCHs using foreign exchange derivatives in each type. Forward contracts are the most popular instruments.

Figure 5.4.1: The Number of BHCs Holding Foreign Exchange Derivatives for Trading and Hedging



This figure displays the pattern of changes in the number of BCHs using foreign exchange derivatives for trading and the number of BHCs using foreign exchange derivatives for hedging.

Figure 5.4.2: Total Gross Notional Amount of Foreign Exchange Derivatives Held by BHCs for Trading and Hedging



This figure displays the pattern of changes in the total gross notional amount of foreign exchange derivatives held for trading as well as total gross notional amount of foreign exchange derivatives held for hedging.

APPENDIX I: An example of BHCs' net foreign exchange asset exposure and net foreign exchange income exposure

Consider a United States (US) BHC that ends its last fiscal year with operations entirely located in the United States. On the first day of the new fiscal year it starts operations in the United Kingdom (UK). For this purpose, it raises £100 million liabilities in UK pounds (one-year CDs) and invests 60% in assets denominated in UK pounds. It exchanges the remaining £40 to US$ and invests the proceeds in assets denominated in US$. For simplicity, assume that all assets are loans with one-year maturities and they are risk free. In addition, assume that the loans are yielding 6% while the one-year CDs are paying 4% interest.

The foreign exchange position of this BHC is mismatched. As shown by Panel A of Table I, the net asset exposure is £40 million comprised of liabilities that will come due at the end of the year. At that time, the BHC will have to buy £UK using US$ to pay this liability. This means, the £40 million are subject to the movements of the exchange rate between UK pounds and USD. The remaining part, £60 million, is naturally hedged as they are not affected by foreign exchange movements. Therefore, if this BHC wishes to hedge its asset and liability risk, it will focus on the £40 million net asset exposure as the remaining assets and liabilities are naturally hedged. For example, the BHC can enter into a forward contract to buy £40 million at predetermined exchange rate to settle its net UK liabilities without suffering losses.

Table I: Net foreign exchange asset exposure and Net foreign exchange income exposure

Panel A: Net foreign exchange asset exposure	
Assets (millions)	**Liabilities** (millions)
£60 one-year loans denominated in UK pounds	£100 one-year CDs denominated in UK pounds
£40 exchanged to US$ and invested in one-year loans denominated in US$	
Net asset exposure	| £60– £100million | = £40 million
Panel B: Net foreign exchange income exposure	
Foreign interest income	**Foreign interest expenses**
Income on loans denominated in UK pounds	Interest on one-year CDs denominated in UK pounds
£3.6 (£60 x 6%)	£4 (£100 x 4%)
Net income exposure	| £ 3.6 – £4 million | = £0.4 million

In contrast, Panel B of Table I shows that the net foreign exchange income exposure of this BHC is £0.4 million (£60 million x 0.06 - £100 million x 0.04) interest expenses that will

come due at the end of the year. At that time, the BHC will have to buy £UK using US$ to pay this liability. Therefore, the net expenses of £0.40 million are subject to the fluctuations of the exchange rate between UK pounds and US$. Therefore, if this BHC wishes to hedge its income risk, it will focus on the £0.40 million net income exposure as the remaining income is naturally hedged. For example, the BHC can enter into a forward contract to buy £0.40 million at predetermined exchange rate to hedge its exposure.

It must be emphasized that the scenarios in this example are made simple to demonstrate the concepts. In practice, the assets, liabilities, income, and expenses of any US BHC are likely to be denominated in many currencies which are all sensitive to volatilities in US$ exchange rates. Our analysis assumes that all foreign currency related activities are integrated together to cause unbalanced asset and income exposures that the BHC tries to hedge with foreign exchange derivatives.

APPENDIX II: Relationship between Trading and Hedging Accounts

Variable	Full	Large
Intercept	-11506426	-25496152
	[-0.53]	[-0.31]
Total assets	1.49165***	1.91264***
	[22.10]	[12.16]
Hedging accounts	17.43559***	13.2578***
	[9.91]	[3.83]
Dummy2	-1574932	-2443475
	[-0.05]	[-0.02]
Dummy3	141539.5	9080181
	[0.00]	[0.07]
Dummy4	-13905523	-48998944
	[-0.40]	[-0.38]
Dummy5	-33855141	-1.37E+08
	[-0.99]	[-1.06]
Dummy6	-35635220	-1.46E+08
	[-1.08]	[-1.16]
Dummy7	-42395082	-1.87E+08
	[-1.16]	[-1.35]
Dummy8	-52392097	-2.25E+08*
	[-1.55]	[-1.75]
Dummy9	-51446460	-2.28E+08*
	[-1.54]	[-1.79]
Dummy10	-78969630**	-3.44E+08***
	[-2.35]	[-2.64]
Dummy11	-79609291**	-3.34E+08**
	[-2.34]	[-2.53]
Dummy12	-99660663***	-4.30E+08***
	[-2.80]	[-3.12]
Dummy13	-74894133**	-3.48E+08**
	[-2.02]	[-2.40]
R-Square	0.7593	0.7554
Adjusted R-Sq	0.7563	0.7428
Observations	1126	287

Previous studies suggest a positive relationship between banks' hedging and trading activities (Demsetz and Strahan (1997), and Hirtle (2009)). Hedging operations decrease the risk of the bank and thereby allow it to pursue additional risky activities, such as derivatives trading. Our results for hedging and trading accounts for BHCs show that both accounts could be

determined by the same factors, total assets, net asset exposure, and net income exposure. So we examine the relationship between trading and hedging accounts using a two-stage least squares method. Trading account is our dependent variables. Total asset and hedging accounts are our independent variables. Time dummy variables are also included in our model. We use net income exposure as our instrumental variable.

Appendix II presents the estimation results. For the full sample and the large sub-sample, both total assets and hedging accounts are positive and significant determinants of trading accounts. Our results confirm previous studies' argument that BHCs' trading activities are positively related with their hedging activities.

APPENDIXE III: Two-stage (capital ratio)

Variable	Hedging		Trading	
Intercept	-1277981**	-1144461***	-51552448**	-49396685**
	[-2.38]	[-2.65]	[-2.32]	[-2.20]
Total assets	0.03103***	0.03052***	2.03123***	2.02362***
	[9.32]	[10.13]	[11.09]	[11.14]
Res_Net asset exposure	0.19269***		3.10334	
	[5.46]		[1.62]	
Res_Net income exposure		4.11083***		63.47669**
		[6.17]		[2.02]
Capital ratio	74472***	61657.28***	2701887***	2483006***
	[3.01]	[3.06]	[3.10]	[2.61]
Dummy2	336072	437768	4815153	6382740
	[0.43]	[0.62]	[0.22]	[0.29]
Dummy3	534615	651092	6052589	7868167
	[0.53]	[0.71]	[0.23]	[0.31]
Dummy4	355253	384672	-19508425	-19151753
	[0.37]	[0.44]	[-0.67]	[-0.67]
Dummy5	-379832	-279361	-43839336	-42333346*
	[-0.72]	[-0.65]	[-1.77]	[-1.76]
Dummy6	-746763	-867285**	-64335671***	-66175257***
	[-1.56]	[-2.03]	[-2.87]	[-2.93]
Dummy7	-1224710**	-1461102**	-64855773**	-68517674**
	[-2.27]	[-2.48]	[-2.26]	[-2.38]
Dummy8	-976621*	-814841*	-66490511***	-63861760**
	[-1.90]	[-1.78]	[-2.70]	[-2.54]
Dummy9	-968876*	-646844	-65142196**	-60185792**
	[-1.96]	[-1.47]	[-2.40]	[-2.18]
Dummy10	-528360	-37569	-82652735***	-74920649**
	[-0.81]	[-0.07]	[-2.83]	[-2.52]
Dummy11	-586816	-66206	-83401932**	-75184353***
	[-0.85]	[-0.12]	[-2.54]	[-2.21]
Dummy12	-331668	279470	-98010463**	-88731773**
	[-0.47]	[0.42]	[-2.50]	[-2.30]
Dummy13	130588	584171	-58025405	-51227948
	[0.15]	[0.76]	[-1.10]	[-1.00]
R-Square	0.7367	0.7688	0.7675	0.7690
Adjusted R-Sq	0.7317	0.7644	0.7631	0.7646
Observations	810	810	810	810
F value	148.12***	176.00***	174.71***	176.20***

Appendix III presents the regression results for hedging and trading accounts from two-stage models when we include capital ratio as one independent variable. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

APPENDIX IV: BHC Data Items Used in This Study

Item No.	Description
BHCK2170	Total Assets
BHCK8694	Foreign exchange futures contracts
BHCK8698	Foreign exchange forward contracts
BHCK8702	Exchange-traded foreign exchange option contracts (written options)
BHCK8706	Exchange-traded foreign exchange option contracts (purchased options)
BHCK8710	Over-the-counter foreign exchange option contracts (written options)
BHCK8714	Over-the-counter foreign exchange option contracts (purchased options)
BHCK3826	Foreign exchange swaps
BHCKA127	Total gross notional amount of foreign exchange derivative contracts held for trading
BHCK8726	Total gross notional amount of foreign exchange derivative contracts held for purposes other than trading
BHFN6631	Deposits in foreign offices, Edge and Agreement subsidiaries, and IBFs (Noninterest-bearing)
BHFN6636	Deposits in foreign offices, Edge and Agreement subsidiaries, and IBFs (Interest-bearing)
BHCK1764	Commercial and industrial loans to non-U.S. addressees (domicile)
BHCK1296	Loans to foreign banks
BHCK2183	Leasing financing receivables (net of unearned income) to non-U.S. addressees (domicile)
BHCK3542	Trading assets in foreign offices
BHCK4059	Interest income in foreign offices, Edge and Agreement subsidiaries, and IBFs
BHCK4172	Interest on deposits in foreign offices, Edge and Agreement subsidiaries, and IBFs
BHCK7205	Total risk-based capital ratio

Appendix IV presents the data items used for our analysis. Data are extracted from the Federal Reserve Bank of Chicago database and originally reported in the Consolidated Financial Statements for Bank Holding Companies (FR Y-9C).

APPENDIX V: BHCs in our sample

ABN AMRO NORTH AMERICA HOLDING COMPANY	FIRSTAR CORPORATION
AMCORE FINANCIAL INC.	FLEETBOSTON FINANCIAL CORPORATION B*B
AMSOUTH BANCORPORATION	FORT WAYNE NATIONAL CORPORATION
ASSOCIATED BANC-CORP	FOURTH FINANCIAL CORPORATION
BANCWEST CORPORATION	FULTON FINANCIAL CORPORATION
BANK OF AMERICA CORPORATION	GREATER BAY BANCORP
BANK OF BOSTON CORPORATION	HAMILTON BANCORP INC.
BANK OF HAWAII CORPORATION	HANMI FINANCIAL CORPORATION
BANK OF NEW YORK COMPANY INC. THE	HIBERNIA CORPORATION
BANK ONE CORPORATION	HUDSON UNITED BANCORP
BANKERS TRUST NEW YORK CORPORATION	HUNTINGTON BANCSHARES INCORPORATED
BARNETT BANKS INC.	IMPERIAL BANCORP
BAYBANKS INC.	INVESTORS FINANCIAL SERVICES CORP.
BB&T CORPORATION	IRWIN FINANCIAL CORPORATION
BOATMEN'S BANCSHARES INC.	J.P. MORGAN & CO. INCORPORATED
BOK FINANCIAL CORPORATION	JPMORGAN CHASE & CO.
BRENTON BANKS INC.	KEYCORP
CAPITAL ONE FINANCIAL CORPORATION	LIBERTY BANCORP INC.
CATHAY GENERAL BANCORP	M&T BANK CORPORATION
CENTRAL FIDELITY BANKS INC.	MARK TWAIN BANCSHARES INC.
CENTRAL PACIFIC FINANCIAL CORP.	MARSHALL & ILSLEY CORPORATION
CHASE MANHATTAN CORPORATION	MBNA CORPORATION
CITICORP	MELLON FINANCIAL CORPORATION
CITIGROUP INC.	MERCANTILE BANCORPORATION INC.
CITY NATIONAL CORPORATION	MERCHANTS NEW YORK BANCORP INC.
COMERICA INCORPORATED	MERIDIAN BANCORP INC.
COMMERCE BANCORP INC.	METLIFE INC.
COMMERCE BANCSHARES INC.	NATIONAL CITY BANCORPORATION
COMPASS BANCSHARES INC.	NATIONAL CITY CORPORATION
CORESTATES FINANCIAL CORP	NATIONAL COMMERCE FINANCIAL CORPORATION
COUNTRYWIDE FINANCIAL CORPORATION	NORTH FORK BANCORPORATION INC.
CRESTAR FINANCIAL CORPORATION	NORTHERN TRUST CORPORATION
CULLEN/FROST BANKERS INC.	OLD KENT FINANCIAL CORPORATION
CVB FINANCIAL CORP.	PNC FINANCIAL SERVICES GROUP INC. THE
DAUPHIN DEPOSIT CORPORATION	POPULAR INC.
FIFTH THIRD BANCORP	PROVIDENT FINANCIAL GROUP INC.
FIRST AMERICAN CORPORATION	REGIONS FINANCIAL CORPORATION
FIRST CHICAGO NBD CORPORATION	REPUBLIC NEW YORK CORPORATION
FIRST COMMERCE BANCSHARES INC.	RIGGS NATIONAL CORPORATION
FIRST COMMERCE CORPORATION	SANTANDER BANCORP
FIRST HORIZON NATIONAL CORPORATION	SIGNET BANKING CORPORATION
FIRST INTERSTATE BANCORP	SOUTH FINANCIAL GROUP THE
FIRST MIDWEST BANCORP INC.	SOUTHTRUST CORPORATION
FIRST NATIONAL LINCOLN CORPORATION	STATE STREET CORPORATION
FIRST OF AMERICA BANK CORPORATION	STERLING BANCORP
FIRST SECURITY CORPORATION	SUFFOLK BANCORP

APPENDIX V (Continued): BHCs in our sample

SUMMIT BANCORP.
SUMMIT BANCORPORATION THE
SUNTRUST BANKS INC.
TAUNUS CORPORATION
TD BANKNORTH INC.
U.S. BANCORP
UCBH HOLDINGS INC.
UMB FINANCIAL CORPORATION
UNION PLANTERS CORPORATION
UNIONBANCAL CORPORATION
UST CORP.
VALLEY NATIONAL BANCORP
WACHOVIA CORPORATION
WACHOVIA CORPORATION
WEBSTER FINANCIAL CORPORATION
WELLS FARGO & COMPANY
WELLS FARGO & COMPANY
WHITNEY HOLDING CORPORATION
ZIONS BANCORPORATION

Appendix V provides a complete list of bank holding companies that constitute our entire sample.