Financial Derivatives and Bank Performance

by

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Abstract

Recent financial regulation changes have brought many challenges to community banks. In particular, the Volcker Rule, section 619 of the Dodd-Frank Financial Reform Act of 2010, prohibits banks from engaging in proprietary trading in derivatives. Banning proprietary trading has the potential to deter smaller banks, especially community banks, from using permissible risk management derivatives. This dissertation provides empirical evidence on how profitability and riskiness at banks would be affected when derivative activities are restricted under the requirement of the Volcker Rule. The focus is on community banks, and specifically agricultural banks, which are small, relatively new to the derivatives market, and thus more vulnerable to inappropriate derivative activities.

Chapter 2 explores how profitability and its variability in agricultural banks are affected by the volume of derivative activities by product – swap, option and future. The effects of derivatives on agricultural banks are also compared to those on non-agricultural banks. Chapter 3 analyzes the effects of derivatives on profitability of agricultural banks before, during and after the 2008 financial crisis by constructing a counterfactual analysis through the endogenous switching model. Chapter 4 extends the analysis to community banks by the lending specialty, and the endogenous switching model is modified to use panel data. All the three chapters find evidence contrary to the ideas in the Volker Rule– community banks benefit from, rather than are hurt by, derivative activities in terms of improvement in profitability and reduction in profitability variability.

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List of Abbreviations

2SLS	Two Stage Least Square
ABS	Asset Backed Securities
CMO	Collateralized Mortgage Obligation
CRE	Commercial Real Estate
CAMELS	Capital Adequacy, Asset Quality, Management, Earning, Liquidity and Sensitivity to Market Risk
FDIC	Federal Deposit Insurance Corporation
FED	Federal Reserve
GLB	Gramm-Leach-Bliley Act of 1999
MBS	Mortgage Backed Securities
MLE	Maximum Likelihood Estimation
NIM	Net Interest Margin
OCC	Office of the Comptroller and the Currency
OLS	Ordinary Least Square
ROA	Return on Assets
ROE	Return on Equity

Chapter 1

1. Introduction

Financial derivatives have been introduced as tools for risk management. Hedging theory suggests that proper use of derivatives could remove uncertainty and balance future cash flows from investment. However, in practice, they have made astonishing headline stories, such as the recent trading losses of JPMorgan Chase and Union Bank of Switzerland, and the collapse of Orange County in California, Barings Bank and Long-Term Capital Management. Derivatives have been accused of playing an important role in the 2008 financial crisis and thus their effects on the financial stability of the U.S. banking industry have attracted the attentions of regulators. As a result, Section 619 of Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010, commonly known as Volcker Rule, prohibits banks from engaging in proprietary trading in derivatives, which is alleged to be one of the main causes of the recent financial crisis. However, permitted derivative activities, such as market making, underwriting and risk management, are similar to proprietary trading in many cases, which makes it difficult in practice to distinguish proprietary trading from permissible activities. Thus, implementation of the Volcker Rule is extremely difficult in practice and challenges banks to justify their permissible derivative activities. If it were implemented, banks, especially small banks, may have to reduce and even stop using derivatives for risk management due to the increased regulatory costs.

Previous empirical studies on derivatives at banks focused on exploring how these contracts affect the performance of large financial institutions, mainly because large financial institutions are the main players in the derivatives market and because they have a long history of using derivatives. Derivatives at community banks or small banks were less explored due to their limited exposure. Call Report data show that less than 1% of small banks used derivatives before 2000. However, Gramm-Leach-Bliley Act of 1999 (GLB Act) has made it possible for small banks or community banks to use derivatives. Derivative activities at community banks have exploded since the enactment of GLB Act in 2001, and about 1,200 (or 16%) community banks became active users by 2012 (Q3).

Moreover, previous literature focused on studying how firm value and risk levels are affected by these derivatives due to the risk management nature of these contracts. There is limited literature on how bank profitability is affected even though trading losses triggered by inappropriate derivative activities are usually large enough to cause financial difficulty and even bankruptcy. In particular, community banks are usually small in size, face limited funding sources, and thus are more vulnerable to the inappropriate derivative activities.

My dissertation tries to fill these gaps in the current literature and provides empirical evidence on how derivatives affect profitability and its variability or risk level at community banks. A focus is placed on agricultural banks, which are the largest single lending specialty group by number but with the smallest banks by size. As one of the main funding sources to support agricultural production and small businesses in rural areas, effective risk management and financial health at agricultural banks are crucial to rural economic development. Most importantly, as what is discussed in section 1.2, agricultural banks are more conservative towards derivatives and are less likely to speculate than other specialty groups, which allows to separate the effects of hedging from those of non-hedging derivative activities. Section 1.1 discusses the opportunities and challenges brought by financial derivatives to banks. The discussion in section

1.2 focuses on how community banks use derivatives. Section 1.3 discusses the structure of my dissertation.

1. 1 Risk Management and Derivatives

In their role as financial intermediary between lenders and borrowers, banks have expertise in managing financial risks and profit from the difference between the interest income they charge for long-term loans and interest expense paid to depositors. Similar to that for commodities such as crude oil and rice, fluctuation of the price for funds, or interest rate, significantly affects the demand and supply for funds. Accordingly, interest rate sensitive income and expense, such as interest income and expense and the market value of trading assets, also change significantly with the fluctuation of the interest rate, which brings many uncertainties to the bank operations.

Historically, interest rate in the US has been fairly stable especially in the decades after the World War II, and foreign exchange rates had been stabilized under the Bretton Woods monetary system. With branching restrictions and deposit interest rate controls before 1980, many banks operated in a protected environment and were relatively immune to competition and external events such as interest rate shocks. Risk management was not a big concern for banks. However, starting from the breakdown of the Bretton Woods monetary system in 1970s, the market environment began to change, and foreign exchange rates became much more volatile than ever before. In addition, high inflation induced from the oil shock of the 1970s along with the anti-inflation monetary policy actions of the Federal Reserve (FED) made the interest rate even more volatile. Moreover, the deregulation of savings and loan institutions (thrifts) in the early 1980s[1] not only removed deposit interest rate caps, which made the interest rate even more

[1] Depository Institutions Deregulation and Monetary Control Act of 1980 (DIDMCA) removed deposit interest rate ceilings, allowed thrifts provide checkable deposits, and raised deposit insurance from $40,000 to $10,000. Garn-St. Germain Depository Institutions Act of 1982 further deregulated thrifts and allowed them to provide commercial loans to strengthen their long-term financial stability.

volatile, but also whittled away the major differences between the commercial banks and thrifts, thus bringing increased competition to the banking industry. These events have brought many challenges to banks. However, recession in the agriculture sector, and regional recessions in energy-producing southeastern states, northeastern states and the California housing market brought more challenged to the banking industry. Over 1,600 banks failed between 1980 and 1994. Among these failed banks, over 60% were located at states whose economy was mainly dependent on agriculture (Federal Deposit Insurance Corporation, 1997).

The importance of risk management became apparent during the banking crisis in the 1980s and early 1990s. Since then, risk management became central element to developments in the banking industry. Traditionally, interest rate risk is managed through balancing short-term assets, such as loans and securities, and liabilities to minimize the dollar maturity gap and the duration gap. However, the cost of on-balance sheet asset-liability management could be high not only because it is time consuming to alter banks' balance sheet but also because such actions have the potential to disrupt banks' business strategy (Hirtle, 1997; Brewer et al. 2001).

Progress in financial theory and increased computerization led to the financial innovation of financial derivatives whose value depends on the value of something else, namely underlying assets – a group of loans, the S&P 500 equity index, the 3-month London Interbank Offered Rate (LIBOR), the US/Euro exchange rate, or the default of corporate debt. The structure of derivative contracts separates risk factors from the underlying assets and allows investors to benefit from the fluctuation of the underlying assets without investing in such assets. As long as investors take positions in derivatives towards the opposite direction of the price fluctuation in underlying assets, the uncertainty of future cash flow is reduced, if not removed, or hedged. For example, a bank has to pay interest to depositors on a principle of $1 billion loans based on money market rate which is floating, but receive fixed payments from loan investment. If money market rate doubles, the interest payment will also be doubled. To hedge the risk, the bank can transform the money market deposit account to a fixed rate account, but may lose deposits from lenders who are in favor of the variable rates. In contrast, the bank could enter a swap contract and agree to pay a fixed interest rate on $1 billion to the counterparty and receive a payment based on money market interest rate. Then the bank could pay depositors with the floating rate payment received from the swap contract counterparty and the only payment the bank has to make is a fixed interest payment to the swap counterparty. Similarly, in the case of foreign exchange risk, if banks receive periodical payments dominated by other currencies, they could enter a forward, future or a currency swap to lock in the payments or they could take a position in foreign exchange option to hedge against losses due to exchange rate fluctuations.

Compared to on-balance sheet asset-liability management, risk management through financial derivatives, usually referred to as off-balance sheet activities, is less costly, could substitute for expensive capital and gives banks the flexibility to reach desired risk exposures without changing their original business objectives. However, financial derivatives also expose investors to additional risks. Entering a position in derivatives does not need much initial investment, but future cash flows given fluctuation of the underlying assets could be huge due to the high leverage behind the contracts. Thus, speculating and inappropriate hedging with derivatives have the potential to cause severe financial losses and even bankruptcy. Secondly, although it is relatively easy to liquidate exchange-traded derivatives with a simple structure and standardized contract, over-the-counter derivatives, which are tailored for each customer, are much more difficult to liquidate in the market and banks have to leave such positions unhedged. In this case, when unexpected events happen, banks have to either liquidate the derivatives with large discount or suffer huge losses based on the contract. Lastly, the structure of some derivatives, such as some collateralized debt obligations (CDOs), can be so complex that even the investors themselves do not understand what and how much risk they are taking. This is an extremely dangerous situation and has a potential to cause unexpected financial difficulty and even bankruptcy when unfavorable market conditions occur. Thus, as stated by Stulz (2005), financial derivatives allow investors to "achieve payoffs that they could have never achieved without derivatives, or could only achieve at greater cost" but investors must understand what are they getting and use derivatives properly.

1. 2 Derivatives in Community Banks

Although gains from hedging is proportionally larger for small banks and small banks should be more likely to hedge due to the higher bankruptcy cost in small firms (Warner, 1977), community banks did not manage risks through derivatives until the enactment of GLB Act in 2001. Call report data show that less than 1% of community banks used derivatives in 1999. For those community banks which used derivatives before 2000, these contracts were mainly used to control interest rate risk. However, regulatory changes in the 1990s made it possible for small banks to hedge through other derivatives. The Riegle-Neal Interstate Banking and Branching Act of 1994 removed the interstate branching limit, making affiliation of small banks with large bank holding companies (BHCs) possible and allowing them to enjoy economies of scale. The GLB Act of 1999 allowed the consolidation of commercial banks, insurance companies, security firms and investment banks, making it possible for banks to benefit from economies of scope. It is observed that derivative activities at small banks have exploded since 2001. By 2012 (Q3), around 16% of the community banks were active derivative users which included 10% of agricultural specialists, 16% of commercial real estate (CRE) specialists, 16% of mortgage specialists, 20% of multi-specialists, and 15% of non-specialty banks.

Unfortunately, there is not sufficient information to distinguish speculating derivative activities from risk management derivative activities due to their similarities in many cases. However, unlike large banks which focus on transactional banking and serve as dealers in derivatives market, community banks are small in size, committed to serve local customers, and are end-users in derivatives. They are also relatively new to the derivatives market. Further, the compliance cost and the cost to take derivative positions, either for risk management or for trading, at community banks are proportionally higher than those at large banks. Thus, it is less likely for community banks to speculate in derivatives than large banks.

In the case of agricultural banks, it is possible to get the role of derivatives by comparing them to their competitors – Farm Credit System (FCS) institutions which provide over one-third of all credits to farmers. FCS institutions state clearly in their annual report that they only use derivatives for risk management, cash flow hedging and fair value hedging, and derivatives are mainly used to manage interest rate risk. Because both FCS institutions and agricultural banks are committed to support the progress of agricultural sector, operate in the similar geographic areas, and serve similar customers, it is reasonable to assume that they have similar policies towards derivatives, and thus agricultural banks mainly use derivatives for risk management as well. Thus, studying derivative activities at agricultural banks has the added advantage of separating the effects of risk management activities from the speculation or trading activities.

Although credit derivatives have been introduced to manage credit risk and FED allows banks to use credit derivatives to substitute capital, such products are mainly used in large banks.

Call report data show that community banks, especially agricultural banks, did not use such products to manage credit risks.

2. Literature Review

Previous literature on derivatives at commercial banks mainly focused on two areas: (1) the incentives of using derivatives and (2) how derivatives affect banks' risk level and investment.

2. 1 Why Banks Use Derivatives

Capital structure irrelevance theory developed by Modigliani and Miller (1958) suggests that in a perfect world, the equity value of a commercial bank is not affected by how the bank is financed as well as its hedging activities. However, market imperfections create incentives for firms to hedge: 1) increase the after-tax cash flow; 2) reduce the cost of financial distress; 3) reduce other costs such as cost of expensive external financing, agency cost and asymmetric information. As discussed by Smith and Stulz (1985) and Nance, Smith, and Smithson (1993), in a value-maximizing firm, with a convex expected corporate tax liability function, hedging can lead to a lower tax liability when the pretax income is relatively high. The benefits of hedging increase with an increase in pretax income if the tax function can make the after-tax cash flow function more concave. Meanwhile, Stulz (1984) and Smith and Stulz (1985) also argue that with the reduced variation in cash flow, the probability of financial distress is lowered as well, and thus hedging can reduce the expected cost of bankruptcy. Motivated by this argument, the model developed by Froot, Scharfstein, and Stein (1993) implies that, with increased cash flows from hedging, the demand for expensive external financing is reduced. Thus, banks' hedging behaviors are also motivated by the desire to reduce the expensive external financing for future investments.

In addition, the financial intermediary theory developed by Diamond (1984) implies that banks should not assume risks that they could not control or have no advantage of monitoring, such as interest risk. Allowing banks to hedge uncontrollable risks or systematic risks can further reduce the delegation cost to monitor loan borrowers. Thus, hedging allows banks to obtain optimal benefits from diversification by reducing the delegation cost, which serves as an incentive for lending. His model implies that if the systematic risks are hedged completely, bank value and cash flow should not be sensitive to the variation of interest rate and bank should increase lending. Motivated by Diamond's idea (1984), Froot and Stein (1998) extend the analysis and decompose risks into tradable risks, such as interest risk, and non-tradable risks, such as credit risk. With the existence of non-tradable risks, banks must hold capital and decide their optimal level of exposure to such risks given the benefits and costs of hedging non-tradable risks. Thus, risk management, capital structure and capital budgeting decisions must be determined simultaneously in order to maximize bank value. In this case, allowing banks to hedge both tradable and non-tradable risks will not only affect bank lending and profitability but also have an impact on their capital structure. Empirical studies, such as Geczy, Minton, and Schrand (1997) and Sinkey and Carter (2000), support these arguments and document that banks with riskier capital structure and with less liquid assets are more likely to use derivatives.

Warner (1977) suggests that small banks should hedge more than large banks due to the cost of bankruptcy, which is proportionally higher at small banks. However, the cost of retaining qualified personnel and establishing hedging program is also proportionally higher at small banks, which serves as disincentives for banks to hedge. In addition, manager utility maximization by Stulz (1984), Smith and Stulz (1985) and Shapiro and Titman (1985) suggests that managers are more likely to hedge if their compensation is a concave function of firm value.

This theory implies if a manager is compensated with stock option, whose value is positively correlated to the volatility of the firm value, he is more willing to take more risks and thus is less likely to hedge to maximize his own compensation.

Other factors that are not related to market imperfection also affect banks' risk management decisions. Alternative financial policies, such as conservative capital structure and low dividend payout ratio, serve as a substitute for hedging, and thus reduce the incentive to hedge (Shapiro and Titman, 1985; Nance et al., 1993; Pagano, 2001). As community banks are small and the cost of hedging is relatively high for small banks, rather than use derivatives, these banks are more inclined to maintain conservative capital structures and investment policies to reduce risk exposures.

2. 2 Derivatives Activities in Banks

Since derivative activities at community banks, especially at agricultural banks, grew mostly in the past decade, the link between derivative use and performance has not been explored. The predominant agricultural banking literature is focused on or motivated by the 1980s farm credit crisis. Belongia and Gilbert (1990) argue that lack of diversification into assets other than loans and high proportion of agricultural loans were the primary cause of the farm credit crisis in the 1980s; they also detect that affiliation with large BHCs is associated with lower probability of failure of agricultural banks. To combat the banking crisis in 1980s, regulation changes reduced limitation on intrastate, interstate, and international banking, and thus lead to a wave of consolidation in agricultural banks. Consequent empirical studies on agricultural banks focused on studying efficiencies of agricultural banks (Belongia and Gilbert. 1990; Gilbert, 1991; and Ahrendsen et al., 1995, Featherstone and Moss, 1994; Neff, Dixon, and Zhu, 1994; Dias and

Helmers, 2001; Choi and Stefanou, 2006; Choi, Stefanou, and Stokes, 2007; Settlage, Preckel and Settlage, 2009).

Relative to previous financial crisis impacts, the 2008 financial crisis had less of an impact on agricultural banks, because they were in a better position to manage risks and because agriculture as sector was doing better than the rest of the economy (Briggeman, Gunderson, and Gloy, 2009; Ellinger, 2009; Hartarska and Nadolnyak, 2012). In particular, while delinquencies in loans have been increasing, the share of problem loans of agricultural lenders remains less than 50% of that of non-agricultural banks (Briggeman, 2011; Ellinger, 2011). However, there is little literature studying the performance of risk management derivative activities at agricultural banks.

The literature on derivatives and the general banking sector has identified mixed results. Some empirical studies support the theory by Diamond (1984) which indicates derivatives serve as a complement to banks' lending activities. Brewer, Jackson, and Moser (1996) find that, with derivatives, savings and loan institutions experience higher growth rate in fixed-rate mortgage loans and charge lower rates on large, partially insured certificates of deposit. Similarly, Zhao and Moser (2009a), Brewer, Minton, and Moser (2000) and Brewer, Jackson, and Moser (2001) detect a positive relationship between commercial and industrial (C&I) loan growth and derivative activities. In addition, by studying the effects of macroeconomic shocks on interest rate risk management at commercial banks, Purnanandam (2007) finds that derivative user banks make less or no adjustments to the on-balance sheet maturity gaps and do not cut lending when FED tightens monetary supply, while the non-users reduce lending when facing the same situation.

In addition, some studies find that derivatives help reduce the banks' risk level. For example, Gorton and Rosen (1995) study derivative activities at commercial banks during 1985 and 1993. They find that the change in net incomes due to the change in interest rate is partially offset by the opposite change in net incomes from the interest rate risk hedge through swaps, and thus derivatives help mitigate most of the systematic risks at commercial banks. Zhao and Moser (2009b) find that with both on- and off-balance sheet risk management methods, BHCs effectively reduce the interest rate sensitivity of bank stocks. Similarly, Brewer et al. (1996) find that derivatives reduce the risk, which is measured by the volatility of the stock returns at savings and loan institutions. By extending the two-factor market model developed by Flannery and James (1984), Choi and Elyasiani (1996) detect a strong risk reduction effect of derivatives on the interest risk and foreign exchange risk for large banks when the risk is measured as sensitivity of stock returns to interest rate risk and to foreign exchange risk respectively.

Other work, however, finds that derivatives increase the riskiness at commercial banks. Using similar methods of Flannery and James (1984) and Choi and Elyasiani (1997), Hirtle (1997) examines the relationship between derivative activities and BHCs' interest rate sensitivity of stock returns between 1986 and 1994. He finds that interest rate derivatives increased the interest rate sensitivity of stock returns, and stock returns of large dealer BHCs were more sensitive to interest rate risk than the other BHCs. Based on the dealer model developed by Ho and Saunders (1981), Angbazo (1997) analyzes the effects of off-balance sheet activities on banks' profitability during 1989 and 1993. She finds that while off-balance sheet activities improved banks' profitability by allowing activities otherwise restricted with debt or equity financing, these activities increased banks' exposure to on-balance sheet liquidity risk and interest rate risk. Measuring risk with systematic risk (β), standard deviation of the stock returns, and implied volatility, Hassan and Khasawneh (2009a) find that while interest rate swaps are risk-reducing products across all the three risk measures, but the other derivative contracts (option, future and forward) are positively correlated to the systematic market risk (β).

The mixed results about the effects of derivatives on bank performance are likely due to the fact that speculating and hedging derivative activities are difficult to be distinguished in practice and that above studies are based on a sample with large banks which have extensive market making and speculating derivative activities. Therefore, the results from above studies are highly likely to be disrupted by the non-hedging activities, especially speculating activities. However, community banks have shorter history of using derivatives. Although there was a wave of consolidation of community banks, these banks remain small, have conservative capital structures, and are not likely to speculate in derivatives due to the costs of trading derivatives that are proportionally higher at small banks. Thus, studying the effect of derivatives at community banks, especially agricultural banks, allow to reduce, if not avoid, the disruptions of non-hedging derivative activities.

3. Determinants of Bank Profitability

Banks serve as the intermediary between the depositors and borrowers, profiting from the difference between the interest charged for loans and the interest paid to depositors. The interest rate spread between loans and deposits plays a dominant role in bank profitability. Based on the assumption that the bank serves as a risk-averse dealer and maximizes expected utility of wealth, Ho and Saunders (1981) develop a framework to explain bank pure interest rate spread. Such framework has been extended by Allen (1988), Angbazo (1997), and Saunders and Schumacher (2000) to different situations. Allen (1988) extends the single-product model to a multi-product model in which the bank grants more than one type of loans. Angbazo (1997) extends the framework and develops an empirical model to take into account credit risk. Saunders and Schumacher (2000) extend the analysis internationally to seven countries.

The basic framework by Ho and Saunder (1981) assumes a single period model. Interest rates for the loan and deposit are set at the beginning of the period and remain constant during the rest of the period. The size of the transaction in the loan and deposit is fixed (Q).

Loan rate: $R_L=r+b$

Deposit rate: $R_D=r-a$

Margin or pure spread: $R_L - R_D = a+b$

Where a is the fee charged for intermediary service; b is the required compensation for interest rate risk; and r is the risk-free rate.

As there are uncertainties on when the transactions on loan and deposit happens, the bank faces interest rate risk. For example, if the demand for a new loan comes before the deposit, the bank has to borrow from money market and is subject to refinancing risk. Similarly, if the deposit happens before the demand for a new loan, the bank has to reinvest the funds at risk-free rate, and thus the bank faces reinvestment risk. In facing asymmetric transaction and the interest risk, the bank has to determine the optimal rates paid for the deposit a and charged for the loan b, or the spread $a+b$, to maximize the expected utility of wealth at the end of the period.

(1) $\max_{a,b} EU(\widetilde{W}|a,b) = \lambda_a EU(\widetilde{W}|deposit) + \lambda_b EU(\widetilde{W}|loan)$

(2) $\lambda_a = \alpha - \beta a$

(3) $\lambda_b = \alpha - \beta b$

Where λ_a and λ_b are the probability of deposit and loan, subjecting to independent Poisson process.

The optimal pure spread $a+b$ [2]is

[2] Please refer to Ho and Saunders (1981) for detailed derivation.

(4) $$S^* = \frac{\alpha}{\beta} + \frac{1}{2} R\sigma_I^2 Q$$

The first term *α/β* measures the bank risk neutral spread which increases with monopoly power and decreases with market competition. The second term is the adjustment term that depends on management's risk aversion (R), transaction size (Q), and the variance of interest rate.

As the above framework is constructed under the assumption of perfect market, market imperfections should be taken into account when conducting empirical test. Following Ho and Saunders (1981) and Angbazo (1997), the pure spread function is nested into the empirical model, and bank profitability or net interest margin (NIM) is modeled as a function of bank specific risk factors as follows:

(5) $$NIM_{it} = F(S_{it}^*(.), X_{it}, \epsilon_{it})$$

Where function $S_{it}^*(.)$ is the pure spread between loan rate and deposit rate, mainly determined by interest rate risk. X_{it} includes bank specific variables which control liquidity risk, credit risk, capital adequacy, management quality and other factors.

Although noninterest rate income is increasingly affecting bank revenues, starting from the 1980s and although in 2010 31% of the total revenues at commercial banks came from noninterest income, only 12% of the revenues at community banks and 8% of the revenues at agricultural banks came from noninterest income. It is reasonable to assume that NIM plays a dominant role on bank profitability, especially at community banks. However, NIM only includes the unhedged operating income from banks' investments, and gains or losses from derivatives are recorded in the trading revenues which are part of noninterest income. In order to capture the full effects of derivatives on bank profitability and these changes in bank operation, rather than NIM, return on assets (ROA) is used to measure bank profitability in this research. The empirical model is adjusted accordingly as

(6) $$ROA_{it} = F(Interest\ rate\ risk, Credit\ risk,$$

$Liquidity\ risk, Capital\ adequacy, Management, Other\ control\ variables\ )$

4. Empirical Study Structure

Chapter 2 explores how the volume of derivatives – swaps, options and futures, affects the profitability and its variability at agricultural banks. The results for agricultural banks are compared to those for non-agricultural banks as well. Chapter 3 examines the effects of derivatives on the profitability at agricultural banks for the period before, during and after the 2008 financial crisis. Counterfactual analyses are constructed by estimating derivative user banks' profitability had they not used derivatives, and vice versa, through the endogenous switching model which controls the non-random selection problems. Chapter 4 extends the analysis to community banks by lending specialty, and the endogenous switching model is adjusted for panel data. Negative relationships between bank profitability and derivative activities should be identified under the assumption of the Volcker Rule. However, results from all three chapters suggest the opposite that community banks benefit from derivatives in terms of increased profitability and decreased risk level.

Chapter 2

1. Introduction

This chapter examines how the bank profitability and risk level are affected by volumes of derivatives by product – swap, option, future and forward. The effects of derivatives on agricultural banks are also compared to those on nonagricultural banks.

As the regulation change in 1999[3] allows banks to benefit from diversifying into other businesses such as investment banking and insurance, there was a wave of merger and acquisition after the act was enacted. Both the scale and scope of the banking industry have changed greatly since then, which implies a model structural change due to the deregulation. Meanwhile, the 2008 financial crisis led to the depression of 2007-2009 and also brought tremendous impacts on banking industry. To address the effects of these notable external shocks on the banking industry, this chapter also analyzes the role of derivatives played in banks after the regulation changes in 1999 and during the 2008 financial crisis.

2. Empirical Model

Motivated by the dealer model for NIM by Ho and Saunders (1981), the empirical model for profitability is constructed as a function of bank specific risk factors and other control variables. As traditional savings and loans are still the main business line for majority of banks, especially for small banks, and only around 12% of the revenues at small banks come from interest incomes, it is reasonable to assume that the risk factors which affect NIM are also the main determinates

[3] Gramm–Leach–Bliley (GLB) Act of 1999 allowed the consolidation of commercial banks, insurance companies, security firms and investment banks.

of bank ROA. Most importantly, benefits from hedging are recorded in trading revenues as part of non-interest income and NIM does not include the benefits from hedging. In order to take into account the full benefits of hedging, rather than NIM, ROA is analyzed instead. Following Ho and Saunders (1981) and Angbazo (1997), the empirical model is as follows:

$$(1) \qquad ROA_{it} = F(S_{it}^{*}(.), X_{it}, \epsilon_{it})$$

Where $S_{it}^{*}(.)$ is the pure spread function which is affected by interest rate risk, and X_{it} includes bank specific risk factors which also have an impact on bank profitability and other control variables. These variables are constructed with the same criteria used by Federal Deposit Insurance Corporation (FDIC) to evaluate commercial banks' CAMELS rating which represents capital adequacy, asset quality, management, earning, liquidity and sensitivity to market risk. The final empirical model for profitability is:

$$(2)\ ROA_{it} = F(Interest\ rate\ risk, Credit\ risk, Liquidity\ risk, Capital\ adequacy, Management, Other\ control\ variables)$$

Risk should not be left alone when studying bank profitability. Three measures of bank risk have been widely used in the previous literature: (1) volatility of common stock returns (Hassan and Khasawneh, 2009a and Brewer et al., 1996); (2) implied volatility, measuring bank risk level from the investors' perspective (Hassan and Khasawneh, 2009a and Li and Yu, 2010); and (3) sensitivity of stock return to specific risks such as interest rate risk and foreign exchange risk (Choi and Elyasiani, 1997; Hirtle, 1997). Construction of the above three risk measures requires the bank to have public traded stocks. However, only a few banks, which have publicly traded stocks, can be classified as agricultural banks, and thus the above commonly used measures for risk are not plausible for agricultural banks. Following the methods used by Cebenoyan and Strahan (2004), the time series standard deviation of the accounting profitability (ROA) is used as the proxy for the overall risk of the banks. Based on the empirical methods used by Cebenoyan and Strahan (2004) and Hassan and Khasawneh (2009a), the empirical model which analyzes the relationship between bank risk and derivative activities is as follows:

(3) *Bank Risk=F(Credit risk, Interest rate risk, Liquidity risk, Capital adequacy, Operating risk)*

The credit risk is captured by nonperforming loans (NPL) which are scaled by total assets. Nonperforming loans will be charged off eventually if the loans cannot be recovered, and the losses will be deducted from the investor's equity capital when the retained earnings cannot cover the losses. Thus, nonperforming loans are expected to be positively correlated with the bank overall risk and negatively correlated with bank profitability.

Interest risk is measured by the short-term maturity gap (Gap) constructed with a method similarly to that by Flannery and James (1984) with the absolute difference between bank short-term assets and liabilities scaled by earning assets, or interest rate sensitive assets. An increase in Gap is expected to result in a decrease in profitability at banks under unfavorable market conditions, and vice versa. In this case, the signs for Gap in profitability function are not determined. Meanwhile, the greater the portion of the bank assets to be repriced in the short term, the more the bank profits are exposed to the unexpected changes in interest rates. The variability of bank profitability is expected to positively correlate to the maturity gap.

The liquidity risk (Liquidity) is captured by the liquid assets scaled by total assets. Returns on liquid assets are usually lower than that on loans and other risky assets. An increase in investments in liquid assets will result in a lower profitability, but the chance of failing to meet the short-term cash demands is also reduced. Capital adequacy (Capital) measures the insolvency risk and is captured by the portion of bank total assets financed by equity capital. An increase in the equity capital results in less interest expense and reduces the chance of financial distress, and thus the positive sign is expected for capital ratio in the profitability function and the negative sign is expected in the risk function.

Management quality (Manage) is captured by the banks' earning assets scaled by total assets because management decisions affect the distribution of bank assets to risky investments, such as loans and securities, which earn higher returns. The positive sign is expected for management quality in the profitability function. Management quality enters risk function through the variable operating risk (Operate), which is measured by the ratio of the operating expense to the operating income. An increase in this ratio implies a higher possibility of not being able to generate enough income to cover operating expense. Thus, the operating risk is assumed to positively correlate to bank total risk or the variability of the bank profitability. The logarithm of total assets is also included in the model to control for scale economy, and agricultural loan ratio is also included to control for diversification. Annualized quarterly inflation rate is added to control for inflation. Quarter dummies are included to control the seasonality in bank profitability.

Derivative activities are approximated by the notional value of the contracts scaled by total assets. This ratio presents the portion of bank assets covered by derivatives. Future and forward contracts have similar structure and are combined to be one variable. Although option contracts are reported as option written and option purchased, there is no information on whether the option is a call or a put. Thus, these two items are also combined.

3. Data

The bank data used in this research come from the Call Report from the Federal Reserve Bank of Chicago for the period 1995–2010. In order to remove the bias and distractions from the merger and acquisition activities, banks with less than 64 observations are excluded from the sample, resulting in 330,990 observations for 5,285 banks.

Two definitions for agricultural banks are commonly used in the literature. FED defines agricultural banks as banks with an agricultural loan ratio higher than the industry average, while the definition from FDIC is more restrictive and banks with at least 25% loans to finance agriculture sector (including agricultural production loans and real estate loans secured by farmland) are classified as agricultural banks. To test the consistency of the results, both classifications are used in this research. Finally, 2,147 banks could be classified as agricultural banks by the FDIC definition and 2,522 agricultural banks by FED definition. Moreover, the cost of funding and the scope of operations are tends to be different across the banks with different size. Accordingly, banks in the sample are categorized into two groups by size as well. Banks with assets over $1 billion are classified as large banks, and the rest of the banks are classified as small banks or community banks.

Revenues and expenses in the income statement are reported on year-to-date basis i.e. net income reported in the second quarter includes revenue and expense generated in the first quarter. In this case, quarterly operating performance is calculated by taking the difference between the reported revenue and expense in current quarter and those in the previous quarter for each year. Then the resulted revenue and expense are annualized.

4. Empirical Results

4. 1 Characteristics of Agricultural Banks and Non-agricultural Banks

Table 2-1 presents the summary statistics for the key variables used in this chapter. Agricultural banks are smaller in size with total assets of $74 million on average, comparing to $344 million for non-agricultural banks. Over 40% of loans at agricultural banks are invested in agriculture sector, but only 6% at non-agricultural banks. When it comes to the performance, compared to non-agricultural banks, agricultural banks are more profitable (ROA of 1.1% for agricultural banks and of 1.03% for non-agricultural banks), more liquid (34% of liquid asset for agricultural banks but only 30% for nonagricultural banks), and less leveraged (11.4% of assets are funded by equity capital but only 10.5% for nonagricultural banks). In terms of risk factors, agricultural banks are subject to lower credit risk with lower non-performing loans, but slightly higher maturity gaps (interest risk) between short-term assets and liabilities. Profitability at agricultural banks is less volatile than that at non-agricultural banks (0.74% of standard deviation of ROA for agricultural banks but 0.85% for nonagricultural banks).

Table 2-1 Summary Statistics

Bank Characteristics	Pool	Non-AG	FDIC AG	FED AG	Derivatives	Pool	Non-AG	FDIC AG	FED AG
Variables					*By Product*				
ROA (%)	1.05	1.03	1.11	1.11	Swap (%)	0.147	0.204	0.013	0.025
	(1.25)	(1.34)	(1.01)	(1.02)		(2.38)	(2.83)	(0.30)	(0.79)
STDROA (%)	0.81	0.84	0.74	0.73	Option (%)	0.153	0.204	0.032	0.046
	(1.45)	(1.69)	(0.59)	(0.59)		(2.89)	(3.44)	(0.43)	(0.75)
Nonperforming Loans	0.78	0.80	0.76	0.75	Future (%)	0.08	0.11	0.01	0.02
(%)	(1.14)	(1.19)	(1.01)	(0.99)		(2.08)	(2.46)	(0.45)	(0.48)
Gap (%)	33.97	33.54	34.98	35.15	*By Purpose*				
	(38.01)	(24.05)	(59.01)	(53.72)	Non-Trading	0.27	0.36	0.05	0.08
Liquidity (%)	31.60	30.46	34.27	34.10	(%)	(3.61)	(4.27)	(0.74)	(1.28)
	(14.76)	(14.63)	(14.71)	(14.68)	Trading (%)	0.03	0.05	0.003	0.003
Capital (%)	10.76	10.49	11.40	11.27		(1.42)	(1.69)	(0.10)	(0.11)
	(3.97)	(4.01)	(3.80)	(3.71)	*By Type*				
Manage (%)	92.52	92.23	93.21	93.06	Commodity	0.002	0.002	0.001	0.001
	(5.18)	(5.15)	(5.18)	(5.27)	(%)	(0.19)	(0.22)	(0.07)	(0.06)
AG Loans (%)	18.10	6.10	46.34	41.28	Equity (%)	0.010	0.008	0.014	0.012
	(21.12)	(7.15)	(15.49)	(17.16)		(0.36)	(0.40)	(0.22)	(0.20)
Inflation (%)	2.41	2.41	2.41	2.41	FE (%)	0.013	0.018	0	<0.001
	(3.62)	(3.66)	(3.51)	(3.59)		(1.19)	(1.42)	-	(<0.001)
Total Assets	263.6	344.3	73.7	83.5	Interest Rate	0.28	0.38	0.04	0.07
(US$ Millions)	(1,267)	(1,502)	(153)	(166)	(%)	(3.66)	(4.34)	(0.70)	(1.26)
# of Institutions	5,285	4,230	2,522	2,147	# of User (1995)	31	30	1	1
					# of User (2010)	829	697	186	132

Most derivative user banks entered the market in the last decade after the enactment of the GLB Act of 1999. Call Report data show that only 31 banks in the sample used derivatives in 1995 with only 1 agricultural bank. However, 829 banks were active derivative users by 2010 with over 180 agricultural banks. Although derivative activities have been exploded in the past decade, only 16% of the banks are active derivative users, and thus the reported mean for the notional value of derivatives is small and the standard deviation is high. However, it is clear that most derivative activities at banks are for non-trading purposes and non-agricultural banks use more derivatives. The notional value of the non-trading derivatives at agricultural banks represents only about 0.05% of their total assets on average, compared to 0.36% for non-agricultural banks. Because most agricultural banks mainly serve rural areas and businesses in the community, they are not exposed to much foreign exchange risk. Thus, they do not use derivatives based on foreign exchange rates. Derivatives based on interest rates were the only contracts used by agricultural banks before 2001, but they started to use contracts based on other assets after the deregulation. Unlike the non-agricultural banks in which derivatives based on interest rates are the most used contracts, derivatives based on equity are the most used contracts at agricultural banks.

4. 2 Effects of Risk Factors on Bank Profitability and Risks

Banks make their risk management decisions in conjunction with their daily operations, and risk management activities are supposed to be endogenous with the factors which also affect the bank performance. Brewer et al. (2000) identified the endogeneity problem between C&I loans growth and derivative activities at Savings and Loan institutions. Similarly, Purnanandam (2007) identified endogeneity between derivative activities and on-balance sheet interest rate management. Thus, the endogeneity issues should be taken into consideration if they are identified. Instrument variables or two stage least square regressions could be used to control the endogeneity.

As discussed by Wooldridge (2008), a valid instrument variable should not directly affect the bank performance but through derivatives. Meanwhile, the correlation between the instrument variable and derivatives must be high. Banks are required by regulation to hold certain level of liquid assets[4] as reserves which serve as a cushion for financial losses and meet cash demands from customers. Thus, the liquidity ratio should not affect the bank performance directly. However, an increase in liquid assets is supposed to lower the chance of financial distress and lower the need to use derivatives for risk management. However, the correlation between the liquidity ratio and derivatives is too low (1%), and the Hausman test could not reject the null hypothesis of exogeneity of derivative activities. Thus, endogneity is not identified and panel regression is valid in this case. As banks manage their risk profiles actively and there is a delay in the payoffs of most of the derivative contracts, one period lag is applied to all independent variables.

There are two primary panel data models – fixed effects and random effects. The fixed effects model assumes certain level of correlation between the individual error term and independent variables, while the random effects model assumes no correlation between those two items. The assumption for the random effects model is too strong and not realistic in the real world. Meanwhile, the Hausman test suggests rejecting the null hypothesis of random effects. Thus, the fixed effects model is applied to analyze the effects of derivatives on bank profitability. Standard errors are clustered at bank levels to control for the potential autocorrelation and heterogeneity.

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[4] The liquidity ratio is not statistically significant in the regression for bank profitability even after the treatment of endogeneity although the negative sign is expected. This result implies that the liquidity preference is not supposed to affect the banks' profitability directly.

Results for the fixed effects regressions for bank profitability are displayed in Table 2-2. Because bank risk is measured as the standard deviation of bank profitability over the whole sample period for each bank, the between effects panel model is estimated, which explores the full panel but uses the mean for both dependent and explanatory variables for each bank to fit the model. Table 2-3 presents the regression results for bank risk.

Apart from grouping by lending specialty, banks are further grouped by size as well. Only about 10% of the banks have a total asset greater than $1 billion, including 48 agricultural banks by the FED definition and 26 by the FDIC definition at any quarter. The following discussion of the results focuses on the group comparisons i.e. agricultural vs. non-agricultural banks and large vs. small banks.

The first three columns in Table 2-2 and Table 2-3 include the results for pooled banks; the next three columns include results for non-agricultural banks; the following three columns include results for agricultural banks by the FED definition; and the last three columns includes the results for agricultural banks by the FDIC definition. For each groups, banks are further broken down by size with the first column for all banks in that group, the second column for large banks and last column for small banks.

In general, the profitability of small banks is less affected by on-balance sheet credit risk and interest risk which are measured by nonperforming loans and short-term maturity gaps respectively. Grouping banks by specialty, agricultural banks are less affected by credit risk and interest rate risk than non-agricultural banks with a decrease of ROA of 0.34% (0.003%) resulting from a 1% increase in nonperforming loans (short-term maturity gap) for non-agricultural banks but a decrease ROA of 0.18% (0.0005%) for agricultural banks. But the profitability of large agricultural banks is not sensitive to interest risk.

Table 2-2 Regression Result for Bank Profitability

Variables	Pooled			Non-Agricultural Banks			FED Agricultural Banks			FDIC Agricultural Banks		
	(1) Pooled	(2) Large	(3) Small	(4) Pooled	(5) Large	(6) Small	(7) Pooled	(8) Large	(9) Small	(10) Pooled	(11) Large	(12) Small
NPL	-0.305***	-0.454***	-0.289***	-0.341***	-0.453***	-0.324***	-0.183***	-0.343*	-0.182***	-0.170***	-0.181**	-0.170***
	(0.008)	(0.031)	(0.008)	(0.010)	(0.031)	(0.010)	(0.012)	(0.177)	(0.012)	(0.013)	(0.075)	(0.013)
Gap	-0.001**	-0.005***	-0.001**	-0.003***	-0.005***	-0.003***	-0.0005***	-0.001	-0.0005***	-0.0004***	-0.0002	-0.0004***
	(0.0005)	(0.0011)	(0.0005)	(0.0003)	(0.0012)	(0.0003)	(0.0001)	(0.0013)	(0.0001)	(0.0001)	(0.0012)	(0.0001)
Liquidity	0.0003	0.002	0.001	0.001	0.002	0.001	0.001	-0.005	0.001	0.001	-0.007	0.001
	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.005)	(0.001)	(0.001)	(0.006)	(0.001)
Capital	0.008	0.027	0.004	0.008	0.028	0.003	0.004	-0.009	0.004	0.006	-0.006	0.006
	(0.007)	(0.023)	(0.006)	(0.008)	(0.023)	(0.008)	(0.005)	(0.024)	(0.005)	(0.005)	(0.028)	(0.005)
Manage	0.025***	0.026***	0.025***	0.025***	0.027***	0.025***	0.020***	-0.025	0.021***	0.021***	-0.061	0.021***
	(0.002)	(0.008)	(0.002)	(0.002)	(0.008)	(0.002)	(0.002)	(0.038)	(0.002)	(0.002)	(0.056)	(0.002)
log(asset)	-0.180***	-0.185***	-0.150***	-0.176***	-0.188***	-0.143***	-0.060**	0.006	-0.060**	-0.057**	0.150**	-0.058**
	(0.015)	(0.031)	(0.016)	(0.016)	(0.032)	(0.018)	(0.029)	(0.074)	(0.029)	(0.025)	(0.070)	(0.025)
AG Loans	0.001	-0.005	0.002*	-0.001	-0.005	<0.001	0.004***	0.006	0.004***	0.004***	0.007	0.004***
	(0.001)	(0.005)	(0.001)	(0.002)	(0.008)	(0.002)	(0.001)	(0.005)	(0.001)	(0.001)	(0.005)	(0.001)
Inflation	0.003***	0.001	0.003***	0.001	0.001	0.001	0.003***	-0.001	0.003***	0.003***	0.002	0.003***
	(0.001)	(0.004)	(0.001)	(0.001)	(0.004)	(0.001)	(0.001)	(0.006)	(0.001)	(0.001)	(0.007)	(0.001)
D6	-0.023***	-0.069*	-0.018***	-0.029***	-0.073*	-0.022***	-0.002	0.087	-0.003	-0.001	0.112	-0.002
	(0.007)	(0.039)	(0.006)	(0.008)	(0.039)	(0.007)	(0.009)	(0.068)	(0.009)	(0.010)	(0.087)	(0.010)
D9	-0.004	-0.046	0.0001	-0.010	-0.051*	-0.004	0.021***	0.083	0.021***	0.018**	0.108	0.018**
	(0.005)	(0.030)	(0.005)	(0.006)	(0.031)	(0.006)	(0.008)	(0.071)	(0.008)	(0.009)	(0.098)	(0.009)
D12	-0.295***	-0.196***	-0.295***	-0.250***	-0.198***	-0.248***	-0.373***	-0.183*	-0.373***	-0.394***	-0.141	-0.395***
	(0.009)	(0.036)	(0.008)	(0.009)	(0.036)	(0.009)	(0.015)	(0.097)	(0.015)	(0.017)	(0.130)	(0.017)
Constant	1.016***	1.470*	0.655**	1.102***	1.424	0.722**	-0.144	3.805	-0.157	-0.279	5.144	-0.287
	(0.241)	(0.878)	(0.258)	(0.288)	(0.904)	(0.313)	(0.424)	(3.719)	(0.428)	(0.385)	(5.153)	(0.386)
Swap	-0.016	-0.019*	-0.036**	-0.017	-0.020*	-0.036**	-0.003	-0.005**	-0.006	-0.007	-0.005	-0.013
	(0.010)	(0.011)	(0.015)	(0.010)	(0.011)	(0.015)	(0.002)	(0.002)	(0.012)	(0.012)	(0.005)	(0.014)
Option	0.005**	0.009**	0.005**	0.005**	0.008*	0.005**	0.003	0.002	0.003	0.001	-0.007	0.001
	(0.002)	(0.005)	(0.002)	(0.002)	(0.005)	(0.002)	(0.006)	(0.004)	(0.006)	(0.011)	(0.024)	(0.011)
Future	0.001	0.001	-0.001	0.001	0.002	-0.001	-0.004	0.021	-0.005	-0.001	-0.044	-0.0004
	(0.002)	(0.003)	(0.004)	(0.003)	(0.004)	(0.004)	(0.009)	(0.024)	(0.009)	(0.007)	(0.252)	(0.007)
R^2	0.111	0.171	0.105	0.129	0.171	0.122	0.069	0.094	0.069	0.070	0.086	0.071
F(14)	284.5	35.93	266.0	218.1	35.46	199.4	96.87	37.38	96.60	89.51	6.623	89.58
Observations	330,990	27,212	318,309	232,549	26,567	220,006	123,422	1,091	123,096	98,441	645	98,303
Number of entity	5,285	452	5,220	4,230	448	4,164	2,522	48	2,513	2,147	26	2,143

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2-3 Regression Result for Risk

Variables	Pooled			Non-Agricultural Banks			FED Agricultural Banks			FDIC Agricultural Banks		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Pooled	Large	Small	Pooled	Large	Small	Pooled	Large	Small	Pooled	Large	Small
NPL	0.094	0.740***	0.065	0.452***	0.734***	0.410***	-0.181	0.144	-0.169	-0.252	-0.533	-0.244
	(0.169)	(0.082)	(0.171)	(0.021)	(0.081)	(0.021)	(0.299)	(0.260)	(0.300)	(0.361)	(0.476)	(0.361)
Gap	-0.009	-0.0002	-0.010*	0.0005	<-0.0001	<0.0001	-0.008	-0.054***	-0.004	-0.006	-0.059**	-0.005
	(0.006)	(0.003)	(0.006)	(0.001)	(0.003)	(0.001)	(0.011)	(0.011)	(0.011)	(0.013)	(0.023)	(0.013)
Liquidity	-0.040***	0.005	-0.038***	-0.004***	0.004	-0.003***	-0.089***	0.022	-0.090***	-0.091***	0.012	-0.091***
	(0.008)	(0.004)	(0.008)	(0.001)	(0.004)	(0.001)	(0.016)	(0.017)	(0.016)	(0.018)	(0.026)	(0.018)
Capital	0.581***	0.129***	0.555***	0.091***	0.128***	0.083***	0.808***	0.247***	0.844***	0.845***	0.253***	0.871***
	(0.025)	(0.012)	(0.024)	(0.003)	(0.012)	(0.003)	(0.043)	(0.031)	(0.044)	(0.047)	(0.047)	(0.048)
Operating	0.053***	0.029***	0.050***	0.013***	0.029***	0.011***	0.082***	-0.020	0.085***	0.078**	-0.050	0.079**
	(0.012)	(0.006)	(0.012)	(0.001)	(0.006)	(0.001)	(0.028)	(0.027)	(0.029)	(0.033)	(0.047)	(0.033)
log(asset)	0.085	-0.133**	0.035	-0.029**	-0.116**	-0.049***	-0.001	-0.520***	0.128	-0.062	-0.362	0.053
	(0.103)	(0.053)	(0.119)	(0.013)	(0.053)	(0.015)	(0.243)	(0.187)	(0.250)	(0.297)	(0.326)	(0.302)
AG Loans	-0.014***	-0.013*	-0.014***	-0.010***	-0.020*	-0.011***	-0.040***	-0.005	-0.040***	-0.054***	-0.021	-0.055***
	(0.005)	(0.006)	(0.005)	(0.002)	(0.011)	(0.002)	(0.012)	(0.015)	(0.012)	(0.015)	(0.023)	(0.015)
Inflation	1.830	1.381**	1.822	0.020	0.752	0.024	-0.062	-0.009	-0.054	-0.111	0.782	-0.163
	(2.221)	(0.666)	(1.189)	(0.018)	(0.485)	(0.018)	(0.249)	(0.210)	(0.249)	(0.418)	(0.557)	(0.419)
Constant	-13.213**	-4.643**	-12.050***	-1.033***	-3.323**	-0.509**	-9.461**	7.468*	-11.595**	-7.937	7.460	-9.444*
	(5.694)	(1.901)	(3.338)	(0.234)	(1.523)	(0.253)	(4.437)	(3.961)	(4.525)	(5.422)	(6.918)	(5.470)
Swap	-0.029	0.021**	-0.106	0.051***	0.022***	0.069***	-0.428**	-0.047	-0.988***	-1.080***	-0.171	-1.124***
	(0.055)	(0.009)	(0.070)	(0.006)	(0.008)	(0.008)	(0.207)	(0.036)	(0.319)	(0.352)	(0.115)	(0.363)
Option	0.035	0.116***	0.070	0.048***	0.110***	0.030***	0.086	-0.165**	0.059	0.239	-0.799	0.222
	(0.061)	(0.012)	(0.052)	(0.006)	(0.012)	(0.006)	(0.352)	(0.076)	(0.329)	(1.050)	(2.151)	(1.050)
Future	0.015	-0.062***	0.016	-0.030***	-0.059***	-0.004	0.397	0.864**	0.052	0.058	-3.276	0.018
	(0.088)	(0.014)	(0.160)	(0.010)	(0.014)	(0.018)	(0.963)	(0.402)	(0.999)	(1.012)	(8.955)	(1.011)
R^2	0.100	0.517	0.096	0.302	0.525	0.294	0.134	0.781	0.138	0.142	0.887	0.144
F(11)	53.53	42.76	50.43	166.0	43.72	157.5	35.30	11.64	36.25	32.07	9.976	32.56
Observations	330,988	27,212	318,307	232,547	26,567	220,004	123,422	1,091	123,096	98,441	645	98,303
Number of entity	5,285	452	5,220	4,230	448	4,164	2,522	48	2,513	2,147	26	2,143

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Liquidity and capital adequacy have no effect on bank profitability. As expected, management quality is positively correlated to bank profitability and a 1% increase in earning assets results in about 0.025% increase in bank profitability for both large and small banks. However, all banks, both large and small, are operating at a size larger than the optimal size as suggested by the negative sign of bank size in the profitability models. Only small banks, both agricultural and non-agricultural banks, benefit from lending in agricultural loans, while the profitability of large banks is neutral to agricultural loans. Meanwhile, consistent with previous findings by Hanweck and Ryu (2005), seasonality of bank profitability is detected. All banks are less profitable at the last quarter than the first quarter, but only non-agricultural banks are less profitable in the second quarter. When it comes to derivative activities, while the profitability at non-agricultural banks is hurt by swaps, these banks benefit from options. However, profitability of agricultural banks, especially small agricultural banks, is not sensitive to any of the derivative contracts.

When it comes to bank risk or profitability variability, an increase in credit risk results in an increase in variation in profitability at non-agricultural banks but places no effect on the profitability variability at agricultural banks. Profitability variability at large agricultural banks is even reduced with an increase in interest risk although the bank risk at other banks is not sensitive to interest risk at all. As expected, an increase in liquid assets holdings, or a decrease in liquidity risk, decreases the variability of profitability at small banks. But the profitability variability at large banks are not sensitive to liquidity risk. Grouping small banks by lending specialty, the profitability variability at small agricultural banks are more sensitive to liquidity risk than that at small non-agricultural banks. In particular, a 1% increase in liquid assets, or a decrease in liquidity risk, results in a 0.09% decrease in the variability of profitability at small agricultural banks but only results in a 0.003% decrease at small non-agricultural banks.

As expected, an increase in operating risk results in an increase in profitability variability at all banks, and an increase in bank size results in a lower variability of bank profitability through the benefits of economy of scale. As argued by previous studies (Briggeman et al., 2009; Ellinger, 2009; Hartarska and Nadolnyak, 2012) that agricultural sector performed better than the rest of the economy, agricultural loans serve as the risk cushion at non-agricultural banks. In particular, a 1% increase in agricultural loans results in a 0.02% decrease in the variability of profitability at large non-agricultural banks but only results in a 0.01% decrease at small non-agricultural banks. But the profitability variability at agricultural banks is not sensitive to agricultural loans with the exception for a few large agricultural banks.

When it comes to derivatives, these activities affect the profitability variability at banks differently by product and by lending specialty. The variability of profitability at non-agricultural banks, both large and small, increases with an increase in swaps and options but decreases with an increase in futures. On the other hand, the variability of profitability at agricultural banks is lowered by derivatives, but the risk at large and small agricultural banks is reduced by different products. Options reduce the variability of profitability at large agricultural banks, while swaps reduce the risk at small agricultural banks. In particular, a 1% increase in swaps results in a 1% decrease in profitability variability at small agricultural banks but results in a 0.05% increase in profitability variability at non-agricultural banks.

The net effects of derivatives on bank profitability and its variability can be estimated when these contracts are evaluated at mean. Grouping banks by size, large banks are adversely affected by derivatives in terms of increased profitability variability and decreased profitability, while small banks are neutral to derivatives. Further grouping banks by lending specialty, derivatives help reduce the variability of profitability at small agricultural banks without affecting their profitability. Thus, such results imply that the speculative activities at large banks may hurt their performance in terms of increased risk level and reduced profitability, while small banks, more conservative towards derivatives and less likely to speculate in derivatives, enjoy the benefits of derivatives from reduced profitability variability. However, the problems arise when distinguishing the trading and speculative activities from hedging activities because these two activities are similar in many cases.

Table 2-4 Model Structure Change for Agricultural Banks

	2008 Financial Crisis				Banking Deregulation of 1999			
VARIABLES	(1) AG Before 2008	(2) AG After 2008	(3) AG STD Before 2008	(4) AG STD After 2008	(5) AG Before 2000	(6) AG After 2000	(7) AG STD Before 2000	(8) AG STD After 2000
NPL	-0.121***	-0.188***	-0.191	0.321***	-0.072***	-0.210***	0.203***	-0.164
	(0.011)	(0.031)	(0.357)	(0.021)	(0.013)	(0.015)	(0.014)	(0.333)
Gap	-0.000***	-0.004***	-0.003	-0.002*	-0.000	-0.000***	0.002**	-0.004
	(0.000)	(0.001)	(0.012)	(0.001)	(0.000)	(0.000)	(0.001)	(0.011)
Liquidity	0.000	0.002	-0.101***	-0.000	-0.001	0.003***	-0.003***	-0.110***
	(0.001)	(0.004)	(0.018)	(0.001)	(0.001)	(0.001)	(0.001)	(0.019)
Leverage	0.005	-0.112***	0.942***	0.040***	-0.051***	-0.001	0.040***	1.204***
	(0.006)	(0.036)	(0.048)	(0.005)	(0.013)	(0.006)	(0.003)	(0.057)
Manage	0.011**	0.013***			0.014***	0.021***		
	(0.004)	(0.004)			(0.005)	(0.003)		
log(Asset)	0.035	-0.566**	0.082	-0.082***	-0.317***	-0.121***	-0.119***	-0.001
	(0.040)	(0.222)	(0.277)	(0.024)	(0.063)	(0.038)	(0.014)	(0.295)
AG Loans	0.002**	0.011**	-0.045***	-0.001	0.000	0.003**	-0.001	-0.062***
	(0.001)	(0.005)	(0.013)	(0.001)	(0.001)	(0.001)	(0.001)	(0.014)
Inflation	0.001	0.001	-1.772***	0.034*	-0.011**	0.004***	0.017	-0.045
	(0.001)	(0.001)	(0.385)	(0.018)	(0.005)	(0.001)	(0.034)	(0.271)
Operating			0.098***	0.019***			0.012***	0.059*
			(0.034)	(0.002)			(0.002)	(0.031)
d6	0.029***	-0.054**			0.048***	-0.015		
	(0.011)	(0.022)			(0.014)	(0.012)		
d9	0.048***	-0.023			0.080***	0.003		
	(0.009)	(0.021)			(0.012)	(0.009)		
d12	-0.350***	-0.402***			-0.362***	-0.357***		
	(0.016)	(0.026)			(0.019)	(0.016)		
Constant	-0.200	7.215**	-8.235	-0.505	3.986***	0.504	0.349	-10.918**
	(0.582)	(2.857)	(5.076)	(0.389)	(0.811)	(0.539)	(0.261)	(5.225)
Swap	-0.005**	-0.002	-0.068	-0.004	0.011***	0.005	0.089	-0.474**
	(0.002)	(0.019)	(0.300)	(0.018)	(0.003)	(0.006)	(0.087)	(0.208)
Option	-0.003	0.011	-0.085	0.004	-0.045	0.007	0.094*	0.128
	(0.010)	(0.011)	(0.410)	(0.016)	(0.043)	(0.006)	(0.049)	(0.370)
Future	-0.003	0.026	0.062	0.003	0.022***	-0.003	0.036	0.549
	(0.006)	(0.016)	(1.403)	(0.038)	(0.003)	(0.009)	(0.237)	(0.944)
Observations	100,301	23,121	100,301	23,121	38,417	85,005	38,417	85,005
R^2	0.056	0.053	0.154	0.224	0.076	0.067	0.232	0.166
Number of entity	2,464	2,110	2,464	2,110	2,273	2,390	2,273	2,390
F	81.12	28.13	40.55	55.07	723.2	70.18	62.03	42.92

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

It is also interesting to see whether the deregulation of 1999 and the 2008 financial crisis make agricultural banks use derivatives differently. The Chow test detects model structure changes for0020the deregulation of 1999 and the 2008 financial crisis. Thus, regressions are performed on subsample periods before and after deregulation in 1999 respectively, and on subsample periods before and after 2008 respectively. Table 2-4 presents the regression results for model structure changes.

Before the deregulation, profitability of agricultural banks is improved by futures and swaps but its variability is also increased by options. As more banks entered derivative market after the deregulation, benefits in profitability have disappeared with improved market efficiencies in the post deregulation period. Meanwhile, agricultural banks start to master the skill of managing risks through swaps which help reduce the variability of profitability effectively without hurting profitability after the deregulation. Meanwhile, although swaps hurt profitability at agricultural banks before 2008 financial crisis, they place no effects on profitability and its variability at agricultural banks during and after the crisis.

5. Conclusion

This chapter provides empirical evidence on how volumes of derivatives affect bank profitability and its variability by products. It is found that agricultural banks, especially small agricultural banks benefit from derivative activities in terms of reduced profitability variability without hurting their profitability during 1995-2010. However, nonagricultural banks, much larger in size, are hurt by derivatives in terms of reduced profitability and increased variability of profitability due to the possible trading and speculative activities.

Given the estimation by this chapter, although Volcker Rule has the potential to lead to a safer large bank with higher profitability and lower risks, it is extremely difficult to distinguish proprietary trading or speculating activities from permissible risk management derivative activities. Implementation of the policy will result in a huge jump in the regulatory cost for banks, especially for small banks, which will deter banks from permissible derivatives. Small banks, especially agricultural banks, will have to manage risks through other methods such as reducing lending. As agricultural banks are one of the main funding sources to finance agriculture and economic development in rural areas, these developments will harm agriculture, business and job creation in rural areas.

Chapter 3

1. Introduction

This chapter examines how derivative activities affect profitability at agricultural banks before, during and after the 2008 financial crisis. Subprime lending and structured asset-baked-securities (collateralized mortgage obligations or CMOs, mortgage backed securities or MBS, and asset backed securities or ABS), are accused as main causes of the 2008 financial crisis. As large banks were in pain, agricultural lenders, agricultural banks[5] and Farm Credit System institutions, who had suffered heavy losses in previous banking crisis in the 1980s and 1990s, however, were relatively immune to the recent crisis because they are more conservative toward loan origination and financial derivatives so that they have less exposures to subprime lending as well as the toxic structured securities. As stated clearly in the annual report, Farm Credit System institutions neither originate subprime loans nor invest in asset-backed securities which are backed by low quality assets and financial derivatives, such as forward, option and swap, are only used for risk management, cash flow hedging and fair value hedging[6]. Although there is little information on how agricultural banks participate in the derivatives market because most of them are privately held and do not disclose their investment and risk management policies, these banks operate in the similar geographic areas and serve the same customers as Farm Credit System institutions.

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[5] The Federal Reserve defines agricultural banks as commercial banks with more than the mean agricultural loan ratio of the commercial banking industry, while the FDIC has a more strict definition that banks with at least 25% loans to finance agriculture industry (including production loans and real estate loans secured by farmland) are classified as agricultural banks. The FED definition of agricultural banks is used in this chapter.

[6] Federal Farm Credit Banks Funding Corporation stated in annual report that "each bank relies on derivative financial instruments to hedge against interest rate and liquidity risks and to lower the overall cost of funds." Farmer Mac has similar statements in their annual report as well.

Thus, it is reasonable to assume that commercial banks have a similar attitude towards derivatives and subprime lending, i.e. for risk management rather than for speculation

However, the regulation change in 1999 allows commercial banks to enter other businesses such as insurance, and investment banking. Our data shows that many agricultural banks, such as Great Western Bank (headquarter in South Dakota), Eastwood Bank (headquarter in Minnesota), Citizens Business Bank (headquarter in California), not only provide traditional savings and loans but also provide services such as asset management, insurance, and investment services. With more diversified services and investment portfolio, agricultural banks are more likely to make some investments in subprime loans and lower-rated non-agency mortgage backed securities. The need to manage excess risks from providing such services also increased. It is observed that increasing number of agricultural banks entered derivative market after the enactment of GLB Act of 1999. They use such products to better control risks and to mitigate variations in cash flow and investment value. For example, Robobank, the largest derivative user in our sample, stated in their 2010 report that they used derivative financial instruments "as part of asset and liability management to manage its interest rate risks, credit risks and foreign currency risks". Their "derivative financial instruments generally comprise foreign exchange contracts, currency and interest rate futures, forward rate agreements, currency and interest rate swaps, and currency and interest rate options (written as well as acquired)." Agricultural lenders, especially agricultural banks, have little exposures to credit derivatives even though such securities, such as credit default swaps[7], have been widely used in large banks and other financial institutions to control credit risks. It is observed that only one agricultural bank, State Bank

[7] As stated in the 2009 interim report, Farmer Mac started to use credit default swaps to hedge against credit risks on the investment in corporate debt securities issued by HSBC Financial since fourth quarter 2009. The notional value of credit default swaps used by Farmer Mac in 2011 is $10 million. Even though Farm Credit Bank Funding Corporation stated that they also use credit default swaps to manage credit risks for certain investment, there is no information on their exposures.

Financial (headquarter in Wisconsin) in the sample used credit default swaps in 2010.

Simple mean comparisons show that derivatives user agricultural banks are more profitable than the non-user banks even during the recent financial crisis. However, due to the heterogeneity of user and non-user banks and the non-randomness of the banks' choice to participate in the derivatives market, direct comparison tends to lead to misleading results. Thus, endogenous switching model which is developed by Maddala and Nelso (1975) and Maddala (1986) is used to control the endogenous selection problems. Most importantly, such model also allows to construct counterfactual analyses which predict the user agricultural banks' profitability had they not used derivatives, and vice versa.

The next section discusses empirical models and data; and section 3 will discuss the empirical results. Finally, section 4 will summarize and conclude this chapter.

2. Empirical Model

Motivated by the dealer model for NIM by Ho and Saunders (1981), the empirical model for profitability is constructed as a function of bank specific risk factors and other control variables. As traditional savings and loans are still the main businesses for agricultural banks, especially for small banks, and only around 8% of the revenues at agricultural banks come from interest income, it is reasonable to assume that the risk factors which affect NIM are also the main determinates of bank ROA. Most importantly, benefits from hedging are recorded as part of non-interest income and NIM does not include the benefits from hedging. In order to take into account the full benefits of hedging, rather than NIM, ROA is analyzed instead. Following Ho and Saunders (1981) and Angbazo (1997), the empirical model is as follows:

(1) $$ROA_{it} = F(S_{it}^{*}(.), X_{it}, \epsilon_{it})$$

Where $S_{it}^{*}(.)$ is pure spread function which is affected by interest rate risk, and X_{it} includes bank specific risk factors which also have an impact on bank profitability and other control variables. These variables are constructed with the same criteria used by FDIC to evaluate commercial banks' CAMELS rating. The final empirical model for profitability is:

$$(2)\ ROA_i = F(Interest\ rate\ risk, Credit\ risk, Liquidity\ risk, Capital\ adequacy, Management, Other\ control\ variables\ )$$

To detect the effect of derivative activities, a common method is to include a dummy variable which identifies the banks which participate in the derivatives market in the above equation:

$$(3) \qquad ROA_i = X_i\beta + I\zeta + \varepsilon$$

Where X is a vector of risk factors and other control variables in equation (2), and I is the dummy variable which identifies derivative users. This model assumes that banks' decision to use derivatives is exogenous to profitability, and that derivative activities only affect the average profitability (intercept effect) but not the sensitivities of profitability (β) to various risk factors. However, such assumption is too strong and unrealistic in the real world. First, the decision to use derivatives is affected by unobserved factors such as manager's knowledge of derivatives, banks' risk management policy, and manager's risk preference, which are likely to affect profitability through asset-liability management as well. Derivatives users, in turn, are systematically different from non-users and have self-selected themselves to use derivatives. Secondly, bank profitability for user and non-user banks tends to react differently to risk factors due to derivatives. Thus, banks' decision to use derivatives and their profitability are not independent, and profitability for derivative users and non-users should be estimated separately as well.

In this case, the endogenous switching model, developed by Maddala and Nelso (1975) and Maddala (1986), is applied to control for the endogenous selections by allowing correlation between the decision to use derivatives and bank profitability. This framework also permits profitability at user and non-user banks to react differently to risk factors. Profitability functions on derivative user and non-user banks are estimated simultaneously with the decision function:

(4) $$Y_{1i} = X_{1i}\beta_1 + \varepsilon_{1i} \;\; if \; I_i = 1$$

(5) $$Y_{2i} = X_{2i}\beta_2 + \varepsilon_{2i} \;\; if \; I_i = 0$$

(6) $$Y_{3i}^{\ *} = Z_i\gamma - \nu_i$$

(7) $$I_i = 1 \; iff \; Y_{3i}^{\ *} \geq 0$$

(8) $$I_i = 0 \; iff \; Y_{3i}^{\ *} < 0$$

Where X_1 and X_2 are risk factors which affect user and non-user banks' profitability; and Z is a vector of variables which affect the decision to use derivatives. The error terms ε_1, ε_2 and ν are assumed to be trivariate normally distributed with mean zero and covariance matrix as follows:

(9) $$\Omega = \begin{bmatrix} \sigma_1^2 & . & . \\ . & \sigma_2^2 & . \\ \sigma_{1\nu} & \sigma_{2\nu} & \sigma_\nu^2 \end{bmatrix}$$

Where σ_1^2, σ_2^2 and σ_ν^2 are the variance for ε_1, ε_2 and ν in the above equations, $\sigma_{1\nu}$ is the covariance for ε_1 and ν, $\sigma_{2\nu}$ is the covariance for ε_2 and ν. Covariance for ε_1 and ε_2 is not defined because y_1 and y_2 are never observed simultaneously. The model is estimated with full information maximum likelihood method [8] and the log likelihood function for the above equations is as follows:

[8] The endogenous switching regression is estimated with the command "movestay" in Stata by Lokshin and Sajaia (2004).

(10) $lnL = \sum_i \{I_i\, [ln(F(\eta_{1i})) + ln\, (f(\varepsilon_{1i}/\sigma_1)/\sigma_1)] + (1 - I_i)\, [ln(1 - F(\eta_{2i})) +$ $ln(f(\varepsilon 2i/\sigma 2)/\sigma 2)]$

Where F is a cumulative normal distribution functions, f is a normal density function, and

(11) $$\eta_{ji} = \frac{(Z_i\gamma + \rho_j\varepsilon_{ji})/\sigma_j}{\sqrt{1-\rho_j{}^2}} \quad j = 1,2$$

Where ρ_j is the correlation coefficient between v and $\varepsilon_{i.}$ After estimating the model, the conditional expectation is estimated by adjusting the unconditional expectation with a term similar to the inverse Mills ratio in the Heckman's selection model to correct the selection problems. Conditional expectation could be calculated as follows:

(12) $$E(Y_{1i}|I_i = 1, x_{1i}) = x_{1i}\beta_1 + \sigma_1\rho_1 f(Z_i\gamma)/F(Z_i\gamma)$$

(13) $$E(Y_{2i}|I_i = 1, x_{2i}) = x_{1i}\beta_1 - \sigma_1\rho_1 f(Z_i\gamma)/(1 - F(Z_i\gamma)$$

(14) $$E(Y_{1i}|I_i = 0, x_{1i}) = x_{2i}\beta_2 + \sigma_2\rho_2 f(Z_i\gamma)/F(Z_i\gamma)$$

(15) $$E(Y_{2i}|I_i = 0, x_{2i}) = x_{2i}\beta_2 - \sigma_2\rho_2 f(Z_i\gamma)/(1 - F(Z_i\gamma)$$

The effects of derivatives are represented by the difference in outcomes when the profitability at user banks is predicted with non-user parameters and the prediction with its own parameters, and vice versa.

(16) $$Diff_{1i} = E(Y_{1i}|I_i = 1, x_{1i}) - E(Y_{1i}|I_i = 0, x_{1i})\ for\ \ I_i = 1$$

(17) $$Diff_{2i} = E(Y_{2i}|I_i = 1, x_{2i}) - E(Y_{2i}|I_i = 0, x_{2i})\ for\ \ I_i = 0$$

Previous research shows that participation in the derivatives market has high fixed costs of establishing and implementing hedging strategies, and these costs serve as a barrier to small banks to hedge (Brewer et al. 1996, 2000, 2001; Carter and Sinkey, 1998; Sinkey and Carter, 2000; Koppenhaver, 1990; Kim and Koppenhaver, 1993). Therefore, large agricultural banks or small agricultural banks which are part of BHCs may have access to the sophisticated hedging techniques. Apart from the risk factors in the profitability model, a dummy variable which identifies the bank that is affiliated to a BHC, and size of banks are also added in the decision model to improve identification.

3. Data

Bank data used to construct the models comes from the Call Report from Federal Reserve Bank of Chicago. Following the definition of agricultural banks by FED, agricultural banks are defined as banks with an agricultural loan ratio[9] higher than the mean agricultural loan ratio of the industry. The financial crisis of 2008 brought tremendous changes to the banking regulation and market structure, which have the potential to affect the derivative activities at agricultural banks as well. To capture possible differences, cross-sectional regressions are estimated separately for the period before, during, and after the recent financial crisis, or for the years 2006[10], 2009, and 2010. For each year, there are over 2,000 agricultural banks in the sample (2,447 in 2006; 2,337 in 2009; and 2,267 in 2010).

Risk factors entering the above empirical models are consistent with the criteria used by FDIC to evaluate commercial banks, namely the CAMELS rating which captures banks' capital adequacy, asset quality, management quality, earnings, liquidity and sensitivity to market risk. Default risk (or credit risk) is measured by loan charge-offs which is scaled by total loans. An increase in loan charge-offs leads to a lower profitability. Interest risk is measured by the short term maturity gap (Gap), constructed similarly to that by Flannery and James (1984), with the absolute difference of the banks' short-term assets and liabilities scaled by earning assets. An

[9] Agricultural loans include agricultural production loan and real estate loans secured by farmland.
[10] U.S. Subprime lending crisis started in 2007 and the crisis spread to the other sectors of the economy in 2008. In order to avoid the noise of the market turmoil, we choose 2006 as the year before the financial crisis.

increase in Gap is expected to decrease the profitability in unfavorable market conditions and to increase the profitability in favorable market conditions. Thus, signs for interest rate risks are non-defined. With perfect hedge, interest rate risk should place no effect on bank profitability.

Liquidity risk is measured by the proportion of the liquid assets scaled by total assets. Because liquid assets usually have a lower return, an increase in liquid assets or a decrease in liquidity risk will result in lower operating revenues and thus lower ROA, but the probability of financial distress is lowered as well. Capital adequacy is measured by the asset-to-equity ratio (Leverage). An increase in leverage signals increased interest expense, which results in an increase in insolvency risk. Thus, leverage is associated with lower ROA. In addition, the agricultural loan ratio, i.e. agricultural loans scaled by total loans, is also included in the model to control diversification.

Following the method used by Angbazo (1997), management efficiency (manage) is measured by the earning assets scaled by total assets. Because management affects the allocation of assets to risky investments which earn high interest, this variable is expected to be positively correlated to bank profitability. The logarithm of total assets and a dummy variable BHC which identifies the banks which are affiliated to BHCs are included in the selection model to improve identification.

4. Empirical Results

4. 1 Characteristics of Derivatives User and Non-user Banks

Table 3-1 presents summary statistics of key variables for user and non-user agricultural banks. The number of derivative user agricultural banks has increased from 154 in 2006 to 241 in 2010, representing around 10% of agricultural banks. Over 95% of derivative users are part of BHCs, while only 85% of non-user banks are part of BHCs. Derivative user banks are about 4 times as big as those not using derivatives. Throughout the whole sample period, user banks allocated more assets to risky investments, such as loans, than non-user banks. In particular, user banks invested around 91% of total assets in loans, securities and other earning assets, but non-user banks only invested 89% of total assets in risky assets during and after the financial turmoil. However, compared to non-user banks, user agricultural banks had more diversified loan portfolio with around 30% of their total loans in agricultural loans while non-user agricultural banks allocated 39% of their loans to agricultural loans. These improvements in management quality likely come from the reduced delegation costs from risk management activities as suggested by Diamond (1984). Compared to non-user banks, derivative user banks were more leveraged. But there was a trend of deleveraging over time with leverage ratio reduced from 11x in 2006 to 10.3x in 2010. On the other hand, non-user agricultural banks increased their leverage over time with from 9.7x in 2006 and to 10x in 2010.

Before the end of the financial crisis, the profitability of user and non-user agricultural banks was similar though slightly higher for user-banks. However, the difference in profitability has increased over time, and was statistically significant from zero in 2010 with a ROA 0.12% higher at derivative user banks than that at non-user banks. Similarly, in 2010, loan charge-offs decreased to 0.58% at non-user agricultural banks, while it remained 0.75% at user agricultural banks. However, loan charge-offs at user and non-user banks were similar before the end of the financial crisis, and loan charge-offs tripled for both user and non-user banks during the crisis. It is also observed that derivative users held less liquid assets or higher liquidity risk throughout the sample period. Meanwhile, users had about 7% lower interest rate risk during and after the financial crisis (in 2009 and 2010), while the gap between short-term assets and liabilities were similar at user and non-user banks before the financial crisis. These differences in profitability and on-balance sheet risk factors between user and non-user banks suggest that off-balance sheet risk management is complement to user banks' on-balance sheet risk management, and that revenues from derivatives not only successfully covered the losses from problematic loans at derivative users but also improved their profitability.

Table 3-1 Summary Statistics for Agricultural Banks

Variable	2006			2009			2010		
	Pool	User+	Non-User	Pool	User	Non-User	Pool	User	Non-User
ROA (%)	1.08	1.12	1.08	0.67	0.73	0.66	0.85	0.95**	0.83
	(0.79)	(0.55)	(0.81)	(1.09)	(0.89)	(1.11)	(0.86)	(0.83)	(0.86)
Manage (%)	93.23	93.79*	93.19	89.50	91.37***	89.32	88.85	90.90***	88.61
	(4.61)	(2.61)	(4.71)	(7.95)	(4.32)	(8.20)	(8.64)	(5.03)	(8.95)
Total Asset	116.43	428.6***	95.47	150.70	527.10***	113.92	157.33	465.26***	120.71
(US$ Millions)	(266.90)	(909.60)	(117.48)	(373.50)	(110.36)	(139.55)	(379.60)	(102.97)	(151.55)
AG Loans	36.50	30.09***	36.93	36.86	29.37***	37.59	37.65	30.18***	38.54
	(18.05)	(14.80)	(18.17)	(18.17)	(12.36)	(18.48)	(18.26)	(13.18)	(18.58)
Leverage	9.74	11.02***	9.66	9.87	10.62***	9.79	10.00	10.33	9.96
	(2.62)	(2.21)	(2.62)	(3.05)	(2.43)	(3.10)	(5.30)	(2.32)	(5.55)
Charge-off (%)	0.28	0.27	0.28	0.75	0.79	0.75	0.60	0.75***	0.58
	(0.67)	(0.61)	(0.68)	(1.33)	(1.04)	(1.35)	(0.82)	(0.95)	(0.80)
Gap (%)	38.42	37.65	38.47	43.12	37.66***	43.66	38.57	31.82***	39.38
	(21.65)	(19.76)	(21.78)	(23.03)	(20.29)	(23.22)	(21.65)	(17.95)	(21.91)
Liquidity (%)	29.62	24.08***	29.99	31.99	26.45***	32.53	33.65	28.50***	34.26
	(14.90)	(10.42)	(15.08)	(15.76)	(11.66)	(16.00)	(15.70)	(11.78)	(15.99)
BHC (%)	85.33	95.45	84.65	86.95	97.11	85.96	86.59	96.27	85.44
	(35.39)	(20.9)	(36.05)	(33.69)	(16.78)	(34.75)	(34.08)	(18.99)	(35.28)
Number of Banks	2,447	154	2,293	2,337	208	2,129	2,267	241	2,026

+: Difference from non-user banks is tested: *** p<0.01, ** p<0.05, * p<0.1

4. 2 Effects of Risk Factors on Derivatives User and Non-user Agricultural Banks

Before applying the endogenous switching regression, endogenous selection and structural differences between derivatives users and non-users need to be tested. As suggested by Heckman (1976), whether the selection is correlated with the error ε_i in the profitability equations, or H_0: $\rho_i=0$ in equations (12) to (15), needs to be tested. If $\rho_i=0$, the selection problem is not the case and we could run simple OLS regressions on user and non-user banks' profitability respectively.

This can be done by a simple *t* test or Wald test. Results in Table 3-2 show that the estimates for ρ_i are statistically different from zero at the confidence level of 1%. Moreover, the Wald test of independent equations rejects the null hypothesis of independence of the bank decision to use derivatives and profitability at the confidence level of 1%. Thus, sample selection is detected.

Whether the sensitivities of profitability to various risk factors are the same for derivative user and non-user banks also needs to be tested. If the test fails to identify the difference in coefficients for user and non-user banks, OLS regression on pooled data with a dummy variable which identify the banks' derivative activities can give valid results. A Chow test is performed and rejects the null hypothesis that coefficients for user and non-user banks are the same at the 1% confidence level. Thus, endogenous switching model is the appropriate model, i.e. profitability ROAs for derivative users and non-users has different sensitivities to various risk factors, and endogenous selection also needs to be controlled.

Table 3-2 presents the regression results on bank profitability by year after controlling for endogenous selection problems. The first three columns include the results for the year before the recent financial crisis (2006), the next three columns include the results for the period during the crisis (2009), and the last three columns include the results for the year after the crisis (2010). The first column for each year (columns 1, 4 and 7) presents the results of the banks' choice to use derivatives and the next two columns presents the results for profitability of user and non-user agricultural banks. To control for potential heterogeneity and autocorrelation problems, Huber-White robust standard errors are used and reported in the parentheses under the parameter estimates.

Table 3-2 Regression Results

VARIABLES	2006 (1)	(2)	(3)	2009 (4)	(5)	(6)	2010 (7)	(8)	(9)
	Selection (Duser=1)	ROA User	ROA Non-user	Selection (Duser=1)	ROA User	ROA Non-user	Selection (Duser=1)	ROA User	ROA Non-user
log(Asset)	0.6368***			0.6679***			0.6055***		
	(0.0573)			(0.0499)			(0.0457)		
BHC	0.1407			0.2627			0.3631**		
	(0.2332)			(0.2061)			(0.1771)		
Charge-off	-0.0507	-0.1598	-0.3049***	-0.0895*	-0.3472***	-0.4628***	-0.0016	-0.4846***	-0.5069***
	(0.0627)	(0.1303)	(0.0742)	(0.0463)	(0.0955)	(0.0401)	(0.0680)	(0.0485)	(0.0376)
Manage	0.0193	0.0293	0.0116**	0.0076	0.0386***	0.0243***	0.0068	0.0357***	0.0194***
	(0.0163)	(0.0182)	(0.0051)	(0.0082)	(0.0149)	(0.0038)	(0.0065)	(0.0095)	(0.0018)
AG Loans	0.0015	-0.0019	0.0014	-0.0050**	0.0036	0.0039***	-0.0076***	0.0070**	0.0023***
	(0.0028)	(0.0044)	(0.0010)	(0.0025)	(0.0038)	(0.0009)	(0.0025)	(0.0033)	(0.0009)
Leverage	0.0558***	-0.0731***	-0.0074	0.0164	-0.1088***	-0.0577***	-0.0280	-0.0528***	-0.0287***
	(0.0189)	(0.0270)	(0.0126)	(0.0143)	(0.0327)	(0.0132)	(0.0192)	(0.0141)	(0.0080)
Gap	0.0001	-0.0062***	-0.0048***	-0.0038*	-0.0081**	-0.0001	-0.0056***	0.0011	0.0023***
	(0.0021)	(0.0021)	(0.0009)	(0.0021)	(0.0035)	(0.0009)	(0.0021)	(0.0022)	(0.0009)
Liquidity	-0.0079**	0.0015	-0.0024	-0.0077**	0.0139***	0.0043***	-0.0069**	0.0065*	-0.0002
	(0.0033)	(0.0042)	(0.0016)	(0.0032)	(0.0042)	(0.0013)	(0.0030)	(0.0035)	(0.0011)
Constant	-11.2170***	-0.2342	0.3396	-9.6748***	-1.2731	-0.9054**	-8.3204***	-1.6037*	-0.5311**
	(1.8164)	(1.6492)	(0.5472)	(1.0059)	(1.3823)	(0.4004)	(0.8333)	(0.9626)	(0.2131)
$\sigma_{non\text{-}user}$			0.7720***			0.8194***			0.7108***
			(0.0499)			(0.0600)			(0.0359)
σ_{user}		0.5216***			0.6566***			0.6125***	
		(0.04259)			(0.0570)			(0.0684)	
$\rho_{non\text{-}user}$			-0.2960***			-0.2525***			-0.4122***
			(0.0487)			(0.0586)			(0.1306)
ρ_{user}		-0.3499**			-0.2884**			-0.2480	
		(0.1360)			(0.1338)			(0.1601)	
Observations	2,447			2,337			2,267		
Log Likelihood	-3,216			-3,328			-2,982		
Wald Test ($\chi^2(2)$)	39.45			20.96			10.34		

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Liquidity risk and bank size are the main factors which determine the derivatives market participation for both user and non-user banks throughout the sample period. Agricultural banks are more likely to use derivatives when they are larger and face higher liquidity risk (lower liquidity ratio or less liquid asset holdings). Even though the small size of agricultural banks has created a natural barrier for the derivative market participation, the barrier has been broken down by a wave of consolidation and merger and acquisitions after 2008. Thus, although agricultural banks were still small, banks which are part of BHCs, were more likely to hedge after 2008. Another factor which affected the banks' decision to use derivatives before the financial crisis is financial leverage. The banks with higher financial leverage, or higher portion of banks assets in debt, were more likely to use derivatives before the financial crisis. But leverage did not affect banks' decision to use derivatives during and after the financial crisis.

Meanwhile, during and after the financial crisis, banks with more diversified loan portfolios (fewer AG loans) and balanced short term assets and liabilities (less interest rate risks) were also more likely to participate in the market, but these two factors were not relevant to the banks' decision to hedge before the financial crisis. Loan charge-offs negatively affected the decision of derivatives activities during the crisis, though the decision to use derivatives was not affected by charge-offs in other years.

The results from bank profitability function show that the magnitude of the effects of risk factors on bank profitability is different for user and non-user agricultural banks. As expected, loan charge-offs are negatively correlated to bank profitability, but ROA at user banks is less affected by increased credit risks or loan charge-offs. In particular, user bank profitability was not affected by loan charge-offs at all before the financial crisis, while a 1% increase in loan charge-offs resulted in a 0.03% decrease in ROA at non-user banks at the same time. Moreover, during the crisis when the loan charge-off ratio tripled at both user and non-user banks, profitability at user banks was 24% less sensitive to loan charge-offs than that at non-user banks. These results imply that derivative activities have helped mitigate a part of the negative effects from credit risks.

As expected, management quality for user banks results in higher profitability, especially for the period during and after the financial crisis, but user bank profitability was not affected before the financial crisis. However, the decrease in profitability due to the increase in financial leverage or decreased equity capital was larger for user banks with a 100% increase in leverage associated with a 0.11% decrease in ROA at user agricultural banks but only a 0.06% decrease at non-user banks during the financial crisis.

Contrary to the expectation of negative relationship between profitability and liquid assets, the result shows that an increase in holding liquid assets resulted in a higher profitability for both user and non-user banks especially during the financial crisis. After the financial crisis, only the user banks' profitability was affected by liquidity risk. Interest rate risk was negatively correlated with the bank profitability for the period before and during the financial crisis with user banks more sensitive to interest rate risk than that at non-user banks. However, after the crisis, interest rate risk was perfectly hedged at user banks and placed no effects on profitability, while non-user banks benefited from an increase in net position in short-term assets or liabilities. Finally, consistent with previous findings that agricultural banks were in a better position to do well in the aftermath of the financial crisis, it is found that both user and non-user agricultural banks benefited from agricultural loans in terms of higher ROA.

The results suggest that though small in size, new to the derivatives market and more vulnerable to inappropriate hedging strategies, agricultural banks not only master but also benefit from the off-balance sheet risk management through derivatives. In particular, derivative activities at agricultural banks help mitigating, at least partially, the negative effects of increased credit risk and interest risk and help boosting the positive effects of improved internal management.

4. 3 Effects of Derivatives Activities on Profitability

Table 3-3 Counterfactual Effects

Year	Predicted ROA for Derivatives User			Predicted ROA for Derivatives Non-User		
	E(ROA|Duser=1)	E(ROA|Duser=0)	Difference	E(ROA|Duser=1)	E(ROA|Duser=0)	Difference
2006	1.12	0.71	0.41***	1.50	1.08	0.42***
	(0.24)	(0.26)	(0.01)	(0.31)	(0.25)	(0.005)
2009	0.73	0.27	0.46***	1.11	0.66	0.45***
	(0.62)	(0.57)	(0.02)	(0.82)	(0.75)	(0.01)
2010	0.95	0.30	0.65***	1.31	0.84	0.47***
	(0.57)	(0.54)	(0.01)	(0.66)	(0.51)	(0.01)

*** p<0.01, ** p<0.05, * p<0.1

After estimating the profitability equation for derivative user and non-user agricultural banks, the effects of derivative activities for these banks are estimated in accordance with equation (16) and (17), which measures the differences between expected profits for user banks and hypothetical expected profits had they not used derivatives, and vice versa. These effects are presented in Table 3-3. The profitability of agricultural banks if they were to use derivatives to manage risks is higher than that if they were not to use derivatives, and the difference is statistically significant. For example, in 2010, compared to ROA of 0.95% for derivative user banks, the predicted ROA for derivative user banks had they not used derivatives is only 0.30%, around 1/3 of their actual profitability. Meanwhile, while the difference in profitability for derivative non-user banks is stable throughout the years, the difference in profitability for user banks is increasing over the sample period from 0.41% to 0.65%. Because, as argued previously, derivative activities are mainly for risk management at agricultural banks due to their limited ability to fund such activities, and these derivatives helped improve bank profitability when used properly. The above results suggest that risk management via derivatives is effective at agricultural banks and helps these banks improve the profitability.

5. Conclusion

Dodd-Frank Act of 2010 has brought huge changes in the U.S. banking industry, including restricting banks' derivative activities, a.k.a. Volcker Rule. This chapter provides empirical evidence on how Volcker Rule will affect profitability of agricultural banks which are small and conservative, mainly participate in the end-user derivatives market, and thus are less likely to speculate in derivatives.

The results suggest that agricultural banks can benefit from derivatives in terms of increased profitability, and the benefits are increasing over time. Moreover, interest rate risk management at user agricultural banks is effective after the financial crisis, and derivatives help mitigating, at least partially, the negative effects of credit risk and interest risk on bank profitability.

In this case, restricting derivative activities at banks as required by Volker Rule will deter small banks from using derivatives due to the increased regulatory costs which are proportionally higher for small banks such as agricultural banks. Estimation results from this chapter suggest that the proposed restrictions on derivative activities have the potential not only to hurt the profitability at small banks such as agricultural banks but also to result in riskier banks due to the increased sensitivities of bank profitability to several risk factors. These banks, in turn, will be less willing to finance agricultural productions and small businesses in rural areas. These developments will have an adverse impact on economic development and job creation in rural areas.

Chapter 4

1. Introduction

Community banks are usually small banks and serve within a relatively small geographic area. Compared to large banks, they have more conservative capital structures, hold more liquid assets and are more cautious to risky investments. Although there has been a trend of diversifying services from traditional loans and savings to fee generating services due to the increased interest rate risk and bank deregulation since 1980s, community banks still focus on providing traditional savings and loans. By 2011, over 88% of revenues at community banks came from interest income. However, in large banks, over 30% of operating revenues came from non-interest income. Call Report data revealed that a majority of community banks, which participated in the derivatives market by 2011, entered derivatives markets after the GLB Act of 1999. However, little is known how derivatives affect these community banks. This chapter will extend the analyses to community banks, which are grouped by lending specialty. It will also analyze how derivative activities affect lending specialists' profitability during and after the financial crisis in 2008.

Following the classification of FDIC (2012), community banks can be grouped as commercial real estate (CRE) specialists, mortgage specialists, agricultural specialists, commercial and industrial (C&I) specialists, consumer specialists, multi-specialists and non-specialists. The next section discusses the empirical model; section 3 discusses data; and section 4 discusses the empirical results. Finally, section 5 summarizes and concludes this chapter.

2. Empirical Model

Motivated by the dealer model for NIM by Ho and Saunders (1981), the empirical model for profitability is constructed as a function of bank specific risk factors and other control variables. As traditional savings and loans are still the main businesses for majority of banks, especially for small banks, and only around 12% of the revenues at small banks come from interest income, it is reasonable to assume that the risk factors which affect NIM are also the main determinates of bank ROA. Most importantly, benefits from hedging are recorded in trading revenues as part of non-interest income and NIM does not include the benefits from hedging. In order to take into account the full benefits of hedging, rather than NIM, ROA is analyzed instead. Following Ho and Saunders (1981) and Angbazo (1997), the empirical model is as follows:

(1) $$ROA_{it} = F(S_{it}^{*}(.), X_{it}, \epsilon_{it})$$

Where $S_{it}^{*}(.)$ is the pure spread function which is affected by interest rate risk, and X_{it} includes bank specific risk factors which also have an impact on bank profitability and other control variables. These variables are constructed with the same criteria used by FDIC to evaluate commercial banks' CAMELS rating. The final empirical model for profitability is:

(2) $$ROA_{it} = F(Interest\ rate\ risk, Credit\ risk, Liquidity\ risk, Capital\ adequacy, Management, Other\ control\ variables\ )$$

To detect the effects of derivative activities, a common method is to include a dummy variable which identifies the banks which participate in the derivative market in the above equation:

(3) $$ROA_{it} = X_{it}\beta + I\zeta + \varepsilon$$

Where *X* is a vector of risk factors and other control variables in equation (2), and *I* is the dummy variable which identifies derivative users. This model assumes that the bank decision to use derivatives is exogenous to its profitability and that derivative activities only affect the average profitability (intercept effect) rather than the sensitivities of profitability (β) to various risk factors. However, such assumption is too strong and unrealistic in the real world. First, the decision to use derivatives is affected by unobserved factors such as manager's knowledge of derivatives, banks' risk management policy, and manager's risk preference, which are likely to affect profitability through asset-liability management as well. Derivative users, in turn, are systematically different from non-users and have self-selected themselves to use derivatives. Secondly, bank profitability for user and non-user tends to react differently to risk factors due to derivatives. Thus, the bank decision to use derivatives and its profitability are not independent, and profitability for derivative users and non-users should be estimated separately.

In this case, the endogenous switching model, developed by Maddala and Nelso (1975) and Maddala (1986), not only controls for the endogenous selection problems, but also allows the user and non-user banks to react differently to the risk factors. The model is adjusted to fit panel data by the method suggested by Wooldridge (1995, 2002):

(4) $Y_{1it} = X_{1it}\beta_1 + c_{1i}^* + \mu_{1it} \ \ if\ I_{it} = 1$

(5) $Y_{2it} = X_{2it}\beta_2 + c_{2i}^* + \mu_{2it} \ \ if\ I_{it} = 0$

(6) $I_{it}{}^* = X_{it}\beta_3 + Z_{it}\gamma + {}_{\varepsilon_i} + a_{it}$

(7) $I_{it} = 1\ iff\ I_{it}{}^* \geq 0$

(8) $I_{it} = 0\ iff\ I_{it}{}^* < 0$

Where equation (4) and (5) are the models of interest which model bank profitability as a function of risk factors; X_{1it} and X_{2it} is the vectors of variables which affect profitability for user and non-user banks; and Z_{it} is a vector of variables which affect decision to use derivatives. c_{1i}^* and c_{2i}^* contain unobserved individual effects which also determine the profitability for users and non-user banks. To control the correlation between ε_i and $I_{it,}$ with panel data, it is assumed that the correlation follows the form proposed by Mundlak (1978):

(9) $$\varepsilon_i^* = \overline{x_\iota}\theta_1 + \xi_i$$

Where $\varepsilon_i \,|x_i, z_i \sim$ Normal$(0,\sigma_\varepsilon^2)$; $\overline{x_\iota} = T^{-1}\sum_{t=1}^{T} z_{it}$

Thus, the selection function becomes:

(10) $$I_{it}^* = X_{it}\beta_3 + Z_{it}\gamma + \overline{x_\iota}\theta_3 + \xi_i + a_{it}$$

It is further assumed that:

(11) $$c_{1i}^* = \overline{x_\iota}\theta_1 + c_{1i}$$

(12) $$c_{2i}^* = \overline{x_\iota}\theta_2 + c_{2i}$$

Thus, equation (2) to (3) becomes:

(13) $$Y_{1it} = X_{1it}\beta_1 + \overline{x_\iota}\theta_1 + c_{1i} + \mu_{1it} \;\; if\; I_{it} = 1$$

(14) $$Y_{2it} = X_{1it}\beta_2 + \overline{x_\iota}\theta_2 + c_{2i} + \mu_{2it} \;\; if\; I_{it} = 0$$

Under the above settings, c_{1i} and c_{2i} are independent of explanatory variables as well as μ_{1it} and μ_{2it} with normal distribution with zero mean and variance σ^2. β_1 and β_2 are the coefficients which capture the sensitivities of bank profitability to risk factors. θ_1 and θ_2 capture the fixed effects factors in the error terms. Following the method suggested by Wooldridge (1995 and 2002), the two-step method is used to adjust for the sample selection problems. In the first step, probit regression on banks' choice of whether to use derivatives, as expressed in equation (8), is estimated for each period and then the inverse Mills ratios for users and non-users are calculated as follows:

(15) $$\lambda_{1it} = \frac{f(X_{it}\beta_3 + Z_{it}\gamma + \overline{x_\iota}\theta_3)}{F(X_{it}\beta_3 + Z_{it}\gamma + \overline{x_\iota}\theta_3)} \; if\; I_{it} = 1$$

(16) $$\lambda_{2it} = -\frac{f(X_{it}\beta_3 + Z_{it}\gamma + \overline{x_\iota}\theta_3)}{1 - F(X_{it}\beta_3 + Z_{it}\gamma + \overline{x_\iota}\theta_3)} if\; I_{it} = 0$$

In the second step, the inverse Mills ratios are plugged into the main equations (9) and (10). The coefficients vectors β_1, β_2 and β_3 include the effects of risk factors on profitability for user and non-user banks and on the decision to use derivatives. Bootstrapped standard errors are calculated for both steps to correct for the heteroskedasticity and serial correlation. After estimating the models, conditional expectation can be calculated:

(17) $$E(Y_{1it}|I_i = 1, x_{1i}) = x_{1it}\beta_1 + \bar{x}_i\theta_1 + \alpha_1\lambda_{1it}$$

(18) $$E(Y_{2it}|I_i = 1, x_{2i}) = x_{2i}\beta_1 + \bar{x}_i\theta_1 + \alpha_1\lambda_{2it}$$

(19) $$E(Y_{1it}|I_i = 0, x_{1i}) = x_{1i}\beta_2 + \bar{x}_i\theta_2 + \alpha_2\lambda_{1it}$$

(20) $$E(Y_{2it}|I_i = 0, x_{2i}) = x_{2i}\beta_2 + \bar{x}_i\theta_2 + \alpha_2\lambda_{2it}$$

The effects of derivative activities are represented by the difference in outcomes when the profitability at user banks is predicted with non-user parameters and the prediction with its own parameters, and vice versa.

(21) $$Diff_{1it} = E(Y_{1it}|I_{it} = 1, x_{1it}) - E(Y_{1it}|I_{it} = 0, x_{1it})\ for\ \ I_{it} = 1$$

(22) $$Diff_{2it} = E(Y_{2it}|I_{it} = 1, x_{2it}) - E(Y_{2it}|I_{it} = 0, x_{2it})\ for\ \ I_{it} = 0$$

Previous research shows that participation in the derivatives market has high fixed costs with establishing and implementing efficient hedging strategies, and these costs serve as a barrier for small banks to hedge (Brewer et al. 1996, 2000, 2001; Carter and Sinkey, 1998; Sinkey and Carter, 2000; Koppenhaver, 1990; Kim and Koppenhaver, 1993). Therefore, large community banks or small banks which are part of BHCs may have access to the sophisticated hedging techniques. Apart from the risk factors in the profitability model, a dummy variable which identifies the bank that is affiliated to BHCs and size of banks are also included in the decision model to improve identification.

3. Data

Quarterly bank data between 1995 and 2012 (Q3) come from Call Report from Federal Reserve Bank of Chicago. Following the definition by FDIC (2012), banks are excluded from sample for the community banks if they specialize in providing services other than savings and loans, hold more than 10% of total assets as foreign assets, or fall in certain specialty groups, such as credit card specialists, industrial loan companies, banker's banks, trust companies, and consumer nonbank banks. In the remaining banks, banks with total assets larger than $10 billion for majority of the sample's periods are also excluded because they tend to operate nationwide rather than in a relatively small geographic area. Meanwhile, banks with total assets between $1 billion and $10 billion are also excluded if they hold less than 33% of total assets in loans or with less than 50% of assets financed by core deposits in majority of the sample period[11]. Banks merged with, or acquired by, other banks during the sample period are also excluded. The final dataset includes 6,921 community banks with 1,056 agricultural specialists (1,021 agricultural single specialists), 1,322 commercial real estate (CRE) specialists (149 CRE single specialists), 1,289 mortgage specialists (326 mortgage single specialists) and 2,485 multi-specialists and 2,831 non-specialists[12].

Risk factors are constructed with the criteria consistent with CAMELS rating used by FDIC to evaluate commercial banks, which captures banks' capital adequacy, asset quality, management quality, earnings, liquidity and sensitivity to market risks. Default risk (or credit risk) is measured by loan charge-offs which is scaled by total loans. An increase in loan charge-offs decreases bank profitability. Interest risk is measured by the short-term maturity gap (Gap), constructed similarly to that by Flannery and James (1984), with the absolute difference between banks' short-term assets and liabilities scaled by earning assets. An increase in the gap is expected to decrease bank profitability in unfavorable market conditions and to increase the

[11] Following the FDIC (2012) definition, the total assets for banks are assumed to grow at a rate of 5.7% annually with $1 billion or $10 billion total assets at the end of the sample period (2012 Q3). The asset size check is performed for the year-end report only.

[12] Given the classification of FDIC (2012), only 349 banks and 93 banks can be identified as commercial and industrial specialists and consumer specialists respectively. The regression is not converged for these two groups due to lack of observations for derivative users. Thus, this chapter only studies specialty groups other than commercial and industrial specialists and consumer specialists. Appendix 3 includes detailed definitions for each specialty group.

profitability in favorable market conditions. Thus, the signs for interest rate risk are non-defined. With perfect hedge, interest rate risk should place no effect on bank profitability.

Liquidity risk is measured by the proportion of the banks' liquid assets scaled by total assets. Because liquid assets usually have a lower return, an increase in liquid assets or a decrease in liquidity risk will result in lower operating revenues and thus lower ROA, but the probability of financial distress is lowered as well. Capital adequacy is measured by the asset-to-equity ratio (Leverage). An increase in leverage signals increased interest expense, which lead to an increased insolvency risk. Thus, leverage is associated with lower ROA. In addition, volume of agricultural loans, scaled by total loan portfolio, is also included in the model to measure diversification.

Following the method used by Angbazo (1997), management efficiency is measured by the banks' earning assets scaled by total assets. Because management affects the allocation of assets which earn high interests (or liabilities which in turn pay low interests), this variable is expected to be positively correlated to bank profitability. The logarithm of bank total assets and a dummy variable BHC which identifies the banks which are affiliated to BHCs are included in the selection model to improve identification. The variable number of employees is used in the profitability functions to control for the efficiency and the scale of the bank.

4. Empirical Results

4. 1 Characteristics of Derivative User and Non-user Banks by Lending Specialty

Most user banks enter derivatives market after the deregulation of 1999. Among the three single specialty groups, only one agricultural specialist, six mortgage specialists, and two CRE specialists were derivative users in 1999. However, over 16% of community banks used derivatives by 2011. Although agricultural specialists had the largest number of derivative users among the three single specialty groups by 2012, these users represent 10% of agricultural specialists (119 users of 1,019 agricultural banks), while over 19% of mortgage specialists and CRE specialists are derivative users (58 of 322 mortgage specialists, and 28 of 148 CRE specialists). Wooldridge's method (1995 and 2002) of correcting sample selection for panel data requires running cross-sectional probit regression on the choice of using derivatives for each period. However, due to the low probability of using derivatives before the deregulation of 1999, the probit regression does not converge for the period before 2003. Thus, to allow valid estimation of inverse Mills ratios, the sample period was shortened to 2003-2012 (Q3). Meanwhile, changes in bank's on-balance sheet structures have been detected for the financial crisis in 2008. Table 4-1 contains the summary statistics of key variables for the sample by specialty groups for the period before the 2008 financial crisis, 2003 to 2007. Table 4-2 contains summary statistics of key variables for the sample by specialty groups for the period after the break out of the 2008 financial crisis, 2008 to 2012 (Q3).

Compared to non-users, derivative users were less profitable for the whole sample period because derivative users in agricultural banks, the largest bank group, underperformed non-users before the financial crisis. However, derivative users were more profitable than non-users across all groups during and after the financial crisis in 2008. Derivative users are larger in size with a size around 3 times that of non-users. They are also more leveraged (hold less capital), are subject to less interest rate risk with more balanced short-term assets and liabilities, hold less liquid assets or higher liquidity risk, and invest higher portion of their assets in loans. Derivative users have a more diversified loan portfolio with a smaller portion of total assets distributed to their specialty loans. With the exceptions for mortgage and agricultural specialists, derivative users charged off fewer loans than non-users before the crisis although all derivative users charged off more loans after 2008. As expected, higher portion of the derivative users are part of BHCs than the non-user banks across the specialty groups. On average, 89% of derivative users are part of BHCs, compared to 82% for non-users.

Table 4-1 Summary Statistics, 2003 – 2007

Variables	AG		Mortgage		CRE		Multiple		Non-Specialty	
	User	Non-user	User	Non-user	User	Non-user	User	Non-user	User	Non-user
ROA (%)	1.16	1.18	0.74	0.85	1.14	0.84	1.07	0.78	1.19	1.08
	(0.81)	(0.98)	(0.57)	(1.78)	(0.79)	(1.43)	(1.09)	(1.68)	(1.18)	(1.26)
Charge-Off (%)	0.31	0.29	0.24	0.18	0.22	0.34	0.21	0.25	0.30	1.14
	(0.77)	(0.98)	(0.83)	(0.54)	(0.40)	(0.90)	(0.51)	(0.79)	(0.73)	(165.82)
Manage (%)	97.66	98.29	97.89	97.53	97.48	96.68	97.09	97.56	96.99	97.59
	(1.48)	(1.36)	(0.98)	(1.78)	(1.58)	(2.28)	(1.94)	(1.87)	(2.36)	(2.40)
Leverage	10.45	9.72	11.40	9.98	11.54	9.95	10.93	10.00	10.90	9.72
	(2.22)	(2.46)	(1.97)	(2.64)	(2.84)	(2.80)	(2.10)	(2.84)	(2.40)	(2.72)
Gap (%)	24.82	29.34	27.76	26.68	22.85	22.77	25.31	27.89	22.22	28.94
	(15.06)	(61.90)	(16.44)	(18.53)	(15.57)	(18.09)	(19.65)	(20.66)	(16.75)	(19.20)
Liquidity (%)	23.73	27.70	24.95	28.88	24.55	23.73	18.60	19.35	29.89	36.57
	(10.49)	(12.05)	(11.79)	(13.47)	(11.04)	(10.87)	(8.88)	(10.46)	(11.95)	(15.80)
BHC (%)	96	86	75	77	85	84	80	67	94	81
	(19)	(34)	(44)	(42)	(36)	(36)	(40)	(47)	(24)	(39)
Loan Ratio (%)	70.36	65.54	69.15	63.67	69.58	67.20	74.97	72.59	62.90	55.11
	(10.63)	(12.24)	(11.83)	(13.73)	(10.85)	(12.49)	(9.46)	(11.75)	(12.52)	(15.81)
AG Loan (%)	31.47	32.62	1.86	2.94	2.57	2.68	1.54	2.17	5.48	6.91
	(10.37)	(11.05)	(3.07)	(4.22)	(2.95)	(3.91)	(3.23)	(4.79)	(5.99)	(6.48)
Mortgage Loan (%)	11.21	10.04	32.33	32.08	18.52	17.08	23.24	23.29	17.66	16.36
	(6.54)	(6.80)	(4.03)	(5.50)	(6.75)	(7.69)	(15.83)	(16.95)	(7.08)	(7.93)
Consumer Loan (%)	4.25	5.05	2.53	3.77	3.50	3.90	3.40	4.80	5.08	6.40
	(2.97)	(2.96)	(2.32)	(2.65)	(2.48)	(3.01)	(4.70)	(6.73)	(4.00)	(4.23)
C&I loan (%)	10.06	8.74	7.26	6.19	6.83	7.83	11.87	11.18	9.85	8.49
	(4.45)	(4.63)	(4.20)	(4.90)	(4.74)	(4.97)	(8.95)	(9.46)	(4.96)	(5.52)
CRE loan (%)	12.09	8.23	24.69	18.00	37.57	35.21	34.36	30.82	23.57	16.10
	(7.81)	(6.88)	(8.37)	(10.04)	(7.98)	(9.39)	(13.93)	(18.46)	(9.02)	(10.66)
# of Employees	55	24	151	89	177	86	223	68	211	57
	(55)	(28)	(127)	(707)	(167)	(207)	(395)	(243)	(245)	(101)
Total Asset	186	77	669	288	692	227	836	237	705	172
(US$ Millions)	(169)	(85)	(674)	(486)	(1,046)	(405)	(955)	(338)	(888)	(327)
Number of Banks (2007)	68	938	21	182	14	119	308	1,749	273	2,292

Table 4-2 Summary Statistics, 2008 – 2012

Variables	AG		Mortgage		CRE		Multiple Specialty		Non-Specialty	
	User	Non-user	User	Non-user	User	Non-user	User	Non-user	User	Non-user
ROA (%)	1.05	0.98	0.57	0.39	0.57	-0.09	0.22	0.05	0.75	0.63
	(1.02)	(1.20)	(0.77)	(2.04)	(1.86)	(2.28)	(2.16)	(2.18)	(1.44)	(1.88)
Charge-Off (%)	0.46	0.43	0.56	0.54	1.08	1.02	1.01	0.87	0.77	0.69
	(1.04)	(1.25)	(1.02)	(1.34)	(1.67)	(2.15)	(1.77)	(1.87)	(1.48)	(13.90)
Manage (%)	97.11	98.14	97.16	97.15	95.59	95.90	96.41	96.69	96.50	97.12
	(1.67)	(1.64)	(1.56)	(2.24)	(2.52)	(2.84)	(2.31)	(2.69)	(2.12)	(2.71)
Leverage	10.22	9.67	10.65	9.90	10.38	11.48	10.70	10.33	10.35	9.47
	(1.73)	(2.31)	(2.07)	(2.99)	(4.16)	(64.75)	(3.56)	(4.47)	(4.25)	(3.22)
Gap (%)	27.54	31.35	25.52	33.10	26.53	32.57	28.46	36.08	25.36	34.29
	(15.57)	(17.45)	(14.57)	(19.86)	(18.01)	(20.32)	(21.42)	(23.13)	(16.85)	(19.82)
Liquidity (%)	25.61	30.35	24.78	28.18	25.76	27.66	20.64	21.20	30.71	37.70
	(10.96)	(13.73)	(9.84)	(12.95)	(11.15)	(12.50)	(9.48)	(10.78)	(13.05)	(16.94)
BHC (%)	96	88	83	72	90	79	82	66	93	81
	(20)	(33)	(37)	(45)	(30)	(40)	(38)	(47)	(26)	(39)
Loan Ratio (%)	68.58	62.85	68.72	65.01	66.68	63.77	72.91	72.08	62.39	54.65
	(10.98)	(13.39)	(10.31)	(12.51)	(11.36)	(12.15)	(9.62)	(10.70)	(12.57)	(16.40)
AG Loan (%)	31.09	36.18	2.28	3.55	3.02	2.69	1.86	2.47	6.98	8.14
	(11.83)	(15.29)	(4.04)	(5.45)	(3.76)	(3.73)	(4.16)	(5.27)	(7.54)	(8.95)
Mortgage Loan (%)	11.97	9.38	31.58	32.67	19.59	17.26	22.48	23.38	17.72	16.30
	(6.01)	(6.49)	(5.84)	(6.76)	(9.13)	(8.16)	(14.75)	(16.83)	(7.35)	(8.35)
Consumer Loan (%)	3.30	3.95	1.86	2.46	2.09	2.23	2.62	3.09	3.62	4.72
	(2.63)	(2.64)	(1.76)	(2.06)	(1.73)	(2.17)	(4.50)	(5.37)	(3.78)	(3.99)
C&I loan (%)	9.49	8.29	7.11	5.54	6.68	6.67	10.96	9.75	9.06	7.64
	(4.23)	(4.67)	(3.93)	(4.62)	(3.88)	(4.58)	(8.12)	(8.47)	(4.88)	(5.22)
CRE loan (%)	9.48	5.90	15.49	13.37	22.91	23.71	22.31	22.93	15.82	12.36
	(9.51)	(7.36)	(13.50)	(12.61)	(17.56)	(17.95)	(19.42)	(21.30)	(13.97)	(12.87)
# of Employees	48	22	160	72	163	70	210	65	207	52
	(48)	(23)	(118)	(461)	(163)	(114)	(377)	(179)	(228)	(87)
Total Asset	296	100	881	343	766	267	926	288	889	205
(US$ Millions)	(278)	(117)	(1,844)	(601)	(1,327)	(409)	(1,335)	(415)	(1,506)	(383)
Number of Banks (2002 Q3)	119	900	58	264	28	120	514	1,940	464	2,329

Compared to the period before 2008 financial crisis, with a few exceptions, during and after the crisis community banks were subject to higher interest rate risk and lower liquidity risk, and invested lower portion of their assets in loans. As it takes time to record loans as nonperforming, especially for real estate loans, banks were less profitable and charged off more loans during and after the 2008 crisis.

Compared to residential real estate loans, CRE loans are less liquid due to the fact that there is no securitization system for this type of loans. Thus, when the economy is in recession and when the owners of CRE loans experience a financial difficulty which deters them from making monthly payments, it is much more difficult for banks to recover these investments and liquidate these CRE loans. Non-user CRE specialists, in turn, suffered a loss of 0.09% on ROA on average after 2008, while the derivative user CRE specialists gained 0.57% on ROA during the same period. It is also observed that there has been a trend of reducing exposure to CRE loans during and after the financial crisis although the holding of residential mortgage loans remained the same at banks.

By specialty group, agricultural banks are the largest single specialty group by number, but they are the smallest institutions by size with average $99 million total assets for 1,019 agricultural banks. Mortgage banks are the largest single specialty group by total assets with average $373 million total assets for 322 mortgage specialists. Among all the specialty groups, agricultural banks are the most profitable group on average with average 1% of ROA compared to 0.8% for mortgage specialists and 0.7% for CRE specialists. Although all single specialty banks invest heavily in their specialty loans, CRE specialists also have large exposures to residential mortgages with around 27% of assets in CRE loans and 18% of assets in mortgages. Multiple specialists also invest heavily in these real estate loans as well with around 50% of assets invested in residential mortgage and CRE loans. Even though residential mortgage were at the center of the 2008 financial crisis, mortgage specialists charged off least loans (0.3%) during the whole sample period because they were able to remove these loans from balance sheet through securitization and loan sales. However, CRE specialists suffered most from loan charge-offs with average 0.56% of loans charged off for the whole sample period but over 1% after 2008.

Overall, compared to other specialty banks, agricultural banks are the smallest in size, have more equity capital, are subject to less liquidity risk, but are more profitable than the other specialty groups. Consistent with previous findings, user banks have more on-balance sheet risks – credit risk and liquidity risk. While simple mean comparison suggests that derivative user banks are less profitable than non-user banks, it is not correct to conclude that derivative activities hurt banks' profitability because banks are heterogeneous, balance sheet structures are significantly different between user and non-user banks, and the decision to use derivatives is endogenous.

4. 2 Effects of Risk Factors on Derivatives User and Non-user Community Banks

The 2008 financial turmoil have brought huge changes to the financial institutions, it is observed that banks operated differently during and after the crisis, and thus a model structure change due to the financial crisis in 2008 is expected. The Chow test detects that bank profitability reacts to risk factors differently during and after the financial crisis. In this case, analyses on bank profitability are performed on sub-sample period of 2003-2007 and 2008-2012. Although the probit regression on banks' decision to use derivatives between 2003 and 2012 is performed for each period to calculate the appropriate inverse Mills ratios to correct the selection problems in the profitability function, the panel probit regression results are reported in Table 4-3 for the period of 1995-2007 and 2008-2012. In the table, *θs* capture fixed effects in the error term as expressed in equation (8). Discussion of results will be focused on *βs* which capture the sensitivity of bank decision of using derivatives to different risk factors.

The results are consistent with previous findings that the larger the banks, the greater the likelihood to use derivatives. However, whether a bank is part of BHCs does not affect its decision to use derivatives for agricultural and CRE specialists, while BHC members of multiple specialists and non-specialists were more likely to use derivatives during and after the 2008 financial crisis. Since mortgage specialists tend to move risk management upstream to BHCs to avoid the regulation at bank level, BHC members of mortgage specialists were less likely to use derivatives before the crisis if they were part of BHCs.

When it comes to how risk factors affect bank decision to use derivatives, liquidity risk and credit risk are not the factors affecting bank decision to use derivatives with the exception for mortgage specialists before 2008. All specialty groups, except mortgage specialists, are less likely to hedge with increased interest rate risk (Gap). Mortgage specialists, multiple specialists and non-specialists took the leverage (insolvency risk) into consideration when making the decision about derivative activities after the financial crisis. However, mortgage specialists were more likely to use derivatives if they were more leveraged or held less equity capital during and after the 2008 crisis, while multiple specialists and non-specialists were less likely to use derivatives if they were more leveraged during the same period.

Sensitivities of bank profitability to risk factors for the sub-periods 2003-2007 and 2008-2012 are presented in Table 4-4 and Table 4-5 respectively. Similarly, *θs* in these two tables capture fixed effects factors in the error term as expressed in equation (11) and (12), and *βs* are of interest. Panel bootstrapped standard errors are used and reported in the parentheses under the parameter estimates.

Table 4-3 First-step Probit Regression

VARIABLES	AG		Mortgage		CRE		Multiple Specialists		Non-Specialists	
	(1)	(6)	(2)	(7)	(3)	(8)	(4)	(9)	(5)	(10)
	1995-2007	2008-2012	1995-2007	2008-2012	1995-2007	2008-2012	1995-2007	2008-2012	1995-2007	2008-2012
β (Coefficients on x_{it})										
log(asset)	1.191***	0.571***	1.236***	1.267***	1.430***	0.461***	0.949***	0.523***	0.959***	0.480***
	(0.163)	(0.160)	(0.295)	(0.343)	(0.279)	(0.164)	(0.069)	(0.072)	(0.078)	(0.073)
Charge-Off	-0.006	-0.003	0.092**	-0.015	-0.018	0.004	0.005	<0.0001	-0.002	0.002
	(0.018)	(0.008)	(0.047)	(0.020)	(0.029)	(0.014)	(0.015)	(0.003)	(0.020)	(0.003)
Manage	-0.014	-0.013	0.048	-0.032	-0.014	0.007	-0.036*	0.002	-0.044***	-0.020*
	(0.055)	(0.027)	(0.072)	(0.027)	(0.089)	(0.032)	(0.020)	(0.008)	(0.017)	(0.012)
Leverage	-0.023	-0.016	0.012	0.050**	0.077	0.001	0.003	-0.009**	-0.001	-0.006**
	(0.033)	(0.011)	(0.063)	(0.021)	(0.051)	(0.001)	(0.003)	(0.004)	(0.014)	(0.003)
Gap	-0.007***	-0.003*	-0.003	-0.004	-0.009*	-0.005	0.001	-0.002***	-0.004***	-0.004***
	(0.003)	(0.002)	(0.003)	(0.003)	(0.005)	(0.004)	(0.001)	(0.001)	(0.001)	(0.001)
Liquidity	-0.004	0.000	-0.015*	-0.003	0.004	-0.010	0.004	0.002	-0.003	0.003
	(0.007)	(0.003)	(0.008)	(0.005)	(0.009)	(0.006)	(0.004)	(0.002)	(0.003)	(0.002)
BHC	0.199	-0.071	-0.496**	0.136	-0.618	0.039	-0.092	0.199***	0.056	0.227**
	(0.221)	(0.248)	(0.226)	(0.194)	(0.392)	(0.331)	(0.078)	(0.069)	(0.119)	(0.093)
D2000	1.232***		-0.192		-0.019		0.019		0.231***	
	(0.251)		(0.163)		(0.173)		(0.063)		(0.060)	
Constant	-6.677	-0.179	-26.526**	-10.981**	-28.069***	-5.186	-2.532	-5.790***	-7.859***	-8.237***
	(7.130)	(3.772)	(12.235)	(4.752)	(9.127)	(4.433)	(2.406)	(1.342)	(2.167)	(1.410)
θ (Coefficients on $\bar{x}_i$)										
log(asset) Mean	-0.779***	0.124	-0.729**	-0.834**	-0.621**	0.143	-0.351***	0.049	-0.384***	0.122
	(0.186)	(0.172)	(0.333)	(0.328)	(0.307)	(0.219)	(0.077)	(0.078)	(0.084)	(0.080)
Charge-Off Mean	0.251*	-0.060	0.166	0.018	0.879*	0.176	-0.322***	-0.034	-0.162	-0.022
	(0.150)	(0.107)	(0.224)	(0.197)	(0.484)	(0.153)	(0.101)	(0.036)	(0.120)	(0.037)
Manage Mean	0.001	-0.082*	0.141	0.080	0.202	-0.033	-0.031	-0.026	0.034	0.019
	(0.097)	(0.047)	(0.147)	(0.054)	(0.128)	(0.058)	(0.034)	(0.016)	(0.027)	(0.018)
Leverage Mean	0.028	0.058*	0.075	-0.016	-0.149*	-0.023	0.039**	0.023**	0.047**	0.042***
	(0.053)	(0.033)	(0.080)	(0.037)	(0.087)	(0.029)	(0.017)	(0.010)	(0.023)	(0.012)
Gap Mean	-0.001	-0.001	-0.003	-0.008	0.010	-0.003	0.001	-0.001	0.001	-0.005**
	(0.005)	(0.004)	(0.010)	(0.006)	(0.009)	(0.009)	(0.003)	(0.002)	(0.003)	(0.002)
Liquidity Mean	0.002	-0.006	0.008	-0.009	-0.029*	-0.013	-0.013**	-0.010**	-0.007	-0.015***
	(0.010)	(0.006)	(0.015)	(0.010)	(0.017)	(0.014)	(0.006)	(0.004)	(0.004)	(0.003)
Observations	51,983	19,177	9,709	4,253	5,444	2,769	87,403	43,038	127,706	50,274
χ^2	168.7	137.2	71.66	39.77	72.16	54.66	571.6	483.1	682.7	582.5
Log Likelihood	-3938	-4496	-1518	-1529	-894.9	-1007	-16557	-16990	-15018	-14908
# of Institutions	1010	1020	205	324	133	149	2197	2574	2603	2802

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4-4 Second-step Regression Results, 2003 – 2007

VARIABLES	AG		Mortgage		CRE		Multiple Specialists		Non-Specialists	
	(1) ROA User	(2) ROA Non-User	(3) ROA User	(4) ROA Non-User	(5) ROA User	(6) ROA Non-User	(7) ROA User	(8) ROA Non-User	(9) ROA User	(10) ROA Non-User
β (Coefficients on x_{it})										
Employee	-0.008*	-0.004***	-0.002	<0.001	0.002	0.0004	<0.001	<0.001	-0.001	-0.0004
	(0.004)	(0.001)	(0.004)	(0.001)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Charge-off	-0.451***	-0.357***	-0.387***	-0.098	-0.067	-0.285***	-0.406***	-0.280***	-0.096	-0.001
	(0.162)	(0.034)	(0.078)	(0.073)	(0.174)	(0.047)	(0.052)	(0.040)	(0.086)	(0.085)
Manage	0.072	0.142***	0.145	0.019	0.068	0.191***	0.171*	0.183***	0.165***	0.076
	(0.051)	(0.025)	(0.142)	(0.060)	(0.187)	(0.069)	(0.092)	(0.032)	(0.055)	(0.056)
Leverage	-0.196***	-0.112***	-0.083**	0.120	-0.021	0.012	-0.156**	0.172***	-0.165***	-0.087***
	(0.045)	(0.032)	(0.041)	(0.091)	(0.044)	(0.059)	(0.062)	(0.030)	(0.061)	(0.024)
Gap	-0.002	<0.001	-0.008**	-0.006	0.001	<0.001	-0.004	0.001	<0.001	-0.002
	(0.003)	(0.002)	(0.003)	(0.004)	(0.005)	(0.004)	(0.003)	(0.001)	(0.003)	(0.001)
Liquidity	0.010	-0.001	-0.002	-0.014	0.003	-0.004	0.015**	-0.022***	0.003	<-0.001
	(0.009)	(0.002)	(0.012)	(0.018)	(0.014)	(0.010)	(0.006)	(0.004)	(0.005)	(0.002)
IMR	-0.080	-0.755***	0.047	0.520	0.087	-0.057	-0.227**	-0.736***	0.034	-0.470***
	(0.149)	(0.156)	(0.108)	(0.522)	(0.207)	(0.231)	(0.091)	(0.149)	(0.076)	(0.172)
Constant	-5.360	-9.873***	-1.824	-8.479	16.992	-7.296	2.045	-15.576***	3.153	3.213
	(3.281)	(1.752)	(13.668)	(6.593)	(26.942)	(5.485)	(4.415)	(1.573)	(4.708)	(6.282)
θ (Coefficients on $\bar{x}_i$)										
Employee M	0.01*	0.006***	0.003	0.0001	<0.001	<0.001	<-0.001	0.0005	0.001	0.001
	(0.005)	(0.001)	(0.004)	(0.001)	(0.005)	(0.001)	(0.001)	(0.001)	(0.001)	(0.0001)
Charge-off M	-0.133	0.037	0.256	0.132	0.069	0.491	0.158	0.465***	0.151	0.004
	(0.257)	(0.066)	(0.615)	(0.192)	(1.845)	(0.442)	(0.188)	(0.071)	(0.265)	(0.043)
Manage M	0.011	-0.022	-0.109	0.074	-0.223	-0.112	-0.173	-0.032	-0.180**	-0.096
	(0.062)	(0.024)	(0.180)	(0.105)	(0.336)	(0.095)	(0.125)	(0.031)	(0.089)	(0.080)
Leverage M	0.092*	0.072**	0.047	-0.024	-0.040	0.112**	0.155**	-0.013	0.105**	0.064***
	(0.051)	(0.034)	(0.077)	(0.066)	(0.166)	(0.051)	(0.065)	(0.030)	(0.050)	(0.023)
Gap M	-0.003	-0.001	-0.004	-0.002	-0.001	-0.034***	-0.002	-0.004	-0.009*	-0.001
	(0.006)	(0.001)	(0.008)	(0.009)	(0.031)	(0.009)	(0.004)	(0.002)	(0.005)	(0.002)
Liquidity M	-0.013	-0.012***	-0.007	-0.002	-0.021	-0.001	-0.023***	0.016***	0.004	0.002
	(0.010)	(0.003)	(0.015)	(0.013)	(0.028)	(0.011)	(0.006)	(0.005)	(0.006)	(0.003)
Observations	945	19,161	312	3,583	265	2,064	4,065	32,918	3,693	46,503
R^2	0.355	0.192	0.522	0.049	0.300	0.256	0.091	0.158	0.053	0.056
$\chi^2(13)$	136.8	530.8	97.06	44.96	6.073	128.1	126.5	400.7	77.67	178.7

Bootstrapped standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4-5 Second-step Regression Results, 2008 – 2012

VARIABLES	AG		Mortgage		CRE		Multiple Specialist		Non-Specialists	
	(1) ROA User	(2) ROA Non-User	(3) ROA User	(4) ROA Non-User	(5) ROA User	(6) ROA Non-User	(7) ROA User	(8) ROA Non-User	(9) ROA User	(10) ROA Non-User
β (Coefficients on x_{it})										
Employee	0.002	-0.002	-0.003	0.005*	0.008**	0.001	0.001	0.003**	0.000	0.002
	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)	(0.002)	(0.001)	(0.001)	(0.000)	(0.002)
Charge-off	-0.412***	-0.378***	-0.300***	-0.789***	-0.565***	-0.492***	-0.564***	-0.515***	-0.347***	-0.009
	(0.066)	(0.022)	(0.050)	(0.164)	(0.073)	(0.073)	(0.030)	(0.016)	(0.040)	(0.143)
Manage	0.072	0.162***	0.038	-0.093	-0.012	0.186***	-0.028	0.064***	0.061	0.227***
	(0.046)	(0.029)	(0.067)	(0.118)	(0.087)	(0.048)	(0.036)	(0.015)	(0.038)	(0.046)
Leverage	-0.277***	-0.148***	-0.112***	0.033	-0.028	0.000	-0.053***	0.003	-0.121***	-0.017
	(0.044)	(0.024)	(0.039)	(0.146)	(0.096)	(0.012)	(0.019)	(0.013)	(0.044)	(0.012)
Gap	0.003	-0.002**	-0.007**	-0.015***	-0.002	-0.014***	-0.001	-0.008***	-0.008***	-0.009***
	(0.003)	(0.001)	(0.004)	(0.006)	(0.008)	(0.004)	(0.005)	(0.001)	(0.002)	(0.002)
Liquidity	0.005	-0.005***	0.009	-0.009	0.023	0.008	0.018***	0.007**	0.010**	-0.007***
	(0.005)	(0.001)	(0.006)	(0.010)	(0.018)	(0.008)	(0.006)	(0.003)	(0.005)	(0.003)
IMR	-0.215	-1.095***	0.098	0.299	0.808***	-0.817*	-0.420***	-1.647***	0.002	-0.679**
	(0.142)	(0.244)	(0.140)	(0.305)	(0.302)	(0.480)	(0.124)	(0.199)	(0.134)	(0.290)
Constant	-14.606***	-11.099***	-2.841	-1.925	-12.936*	-7.873***	0.215	-7.347***	-5.666***	4.736
	(2.517)	(1.476)	(4.868)	(2.857)	(7.234)	(2.926)	(1.664)	(1.103)	(1.822)	(9.268)
θ (Coefficients on $\bar{x}_i$)										
Employee M	-0.001	0.002	0.003	-0.004	-0.006*	-0.000	-0.001	-0.004***	0.000	-0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.001)	(0.001)	(0.000)	(0.002)
Charge-off M	-0.189*	-0.238***	-0.037	-0.239*	-0.094	0.179	-0.233***	-0.226***	-0.106	-0.032
	(0.104)	(0.031)	(0.115)	(0.131)	(0.246)	(0.249)	(0.059)	(0.053)	(0.128)	(0.075)
Manage M	0.103*	-0.030	0.008	0.127	0.169*	-0.101	0.048	0.022	0.015	-0.268***
	(0.053)	(0.031)	(0.088)	(0.120)	(0.100)	(0.066)	(0.043)	(0.019)	(0.037)	(0.099)
Leverage M	0.187***	0.098***	0.055	-0.033	-0.055	-0.025	0.005	-0.053***	0.057	-0.060***
	(0.048)	(0.027)	(0.051)	(0.123)	(0.081)	(0.026)	(0.022)	(0.018)	(0.035)	(0.022)
Gap M	-0.001	0.002	0.005	0.004	-0.017	0.003	-0.009	0.007***	0.004*	0.010***
	(0.005)	(0.002)	(0.005)	(0.005)	(0.016)	(0.006)	(0.010)	(0.002)	(0.002)	(0.002)
Liquidity M	-0.002	-0.003	-0.022**	0.007	-0.046	0.004	-0.013**	-0.007*	-0.007	0.019***
	(0.006)	(0.002)	(0.009)	(0.011)	(0.033)	(0.014)	(0.006)	(0.004)	(0.006)	(0.006)
Observations	1,751	18,075	633	3,620	446	2,323	7,670	33,474	6,818	43,456
R^2	0.392	0.278	0.304	0.329	0.509	0.287	0.328	0.312	0.293	0.070
$\chi^2(13)$	498.4	935.3	218.0	188.2	133.0	147.6	1335	2780	190.4	301.4

Bootstrapped standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Profitability of banks reacts differently to risk factors by specialty and by derivative use. As expected, loan charge-offs have a negative effect on bank profitability. However, compared to the period before the crisis, profitability of user agricultural and user mortgage specialists was less sensitive to credit risk during and after the crisis, while profitability of non-user banks in these two groups was more sensitive to credit risk during the same period. As it is hard to securitize CRE loans due to the uniqueness of each loan, these loans are much less liquid than residential mortgage. It is expected that banks with large CRE loans holdings, i.e. CRE and multiple specialists, are more sensitive to credit risk during and after the crisis due to their huge exposure to CRE loans. As expected, sensitivities of profitability for non-user CRE and multiple specialists almost doubled after 2008. However, the sensitivity of profitability for user multiple specialists only increased 40% during the same period. These results imply that gains from derivatives offset part of losses from the problematic loans, and thus helped mitigating the negative effects of loan charge-offs on these lenders during the crisis.

Interest rate risk had no effect on banks' profitability before 2008 although it adversely affected bank profitability after the break out of 2008 financial crisis. However, user banks were less affected, even not affected in some banks, by interest rate risk during and after the financial crisis. For example, a 1% increase in the gap between short-term assets and liabilities at mortgage banks decreased the profitability by 0.007% at derivative users but by 0.015% at non-user banks after 2008. For the three single specialists, agricultural, mortgage, and CRE specialists, their profitability was not sensitive to the liquidity risk during the whole sample period with the exception for agricultural non-user banks whose ROA decreased 0.005% with a 1% increase in liquid assets (less liquidity risk) after 2008. For multiple specialists and non-specialists, it is surprising to see that ROA at user banks was positively correlated with liquid assets with an increase of 0.02% in ROA at multiple specialists for a 1% increase in liquid assets for the whole sample period.

As expected, an increase in leverage (or a decrease in equity capital) results in a decrease in bank profitability due to the increased interest expenses the from increased debt level. With the exception for CRE specialists, user bank profitability is more sensitive to leverage than that at non-user banks. For example, before the 2008 financial crisis, a 100% decrease in equity capital resulted in a decrease of 0.2% in ROA at user agricultural banks but only a decrease of 0.1% in ROA at non-user banks.

4. 3 Effects of Derivatives Activities on Bank Profitability

After estimating the profitability equation for derivative user and non-user banks, the effects of derivative activities are estimated in accordance with equation (21) and (22), which measure the difference between expected profits for user banks and hypothetical expected profits had they not used derivatives, and vice versa. These effects for user banks and non-user banks are presented in Table 4-6 for sample period between 2003 and 2007 and in Table 4-7 for the sample period between 2008 and 2012 (Q3).

As the U.S. economy had suffered 18 month recession due to the problem in housing markets, the loan charge-offs have been increasing during and after the financial crisis especially for lenders which had large exposure to the problematic mortgage and CRE loans. Given the hypothetical expected profitability, user agricultural and user multiple specialists could have lost 0.24% and 1.33% in ROA respectively before 2008 had they not used derivatives, and they could have lost up to 0.88% and 2.65% in ROA during and after the financial crisis had they not used derivatives, although derivative users in these two groups reported gains, or positive ROA, during the whole sample period. Similarly, derivative activities have also successfully offset the losses at user CRE specialists during and after the financial crisis with an improvement of 1.71% in ROA.

Table 4-6 Counterfactual Analysis, 2003 – 2007

	Predicted ROA for Derivatives User			Predicted ROA for Derivatives Non-User		
Specialty Groups	E(ROA|Duser=1)	E(ROA|Duser=0)	Difference	E(ROA|Duser=1)	E(ROA|Duser=0)	Difference
AG Single Specialists	1.16	-0.24	1.41***	1.38	1.18	0.19***
	(0.48)	(0.51)	(0.44)	(0.62)	(0.43)	(0.32)
Mortgage Specialists	0.74	1.85	-1.12***	0.70	0.85	-0.15**
	(0.41)	(0.32)	(0.40)	(1.74)	(0.39)	(1.74)
CRE Specialists	1.14	1.08	0.06	1.10	0.84	0.26***
	(0.43)	(0.62)	(0.79)	(0.63)	(0.72)	(0.96)
Multiple Specialists	1.07	-1.33	2.40***	0.31	0.78	-0.47***
	(0.34)	(2.25)	(2.12)	(0.54)	(0.83)	(0.73)
Non-Specialty banks	1.18	0.37	0.81***	1.20	1.08	0.12**
	(0.27)	(0.31)	(0.33)	(15.16)	(0.30)	(14.9)

Standard deviation in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4-7 Counterfactual Analysis, 2008 – 2012

	Predicted ROA for Derivatives User			Predicted ROA for Derivatives Non-User		
Specialty Groups	E(ROA|Duser=1)	E(ROA|Duser=0)	Difference	E(ROA|Duser=1)	E(ROA|Duser=0)	Difference
AG Single Specialists	1.04	-0.88	1.93***	1.57	0.97	0.60***
	(0.65)	(0.71)	(0.47)	(0.76)	(0.64)	(0.34)
Mortgage Specialists	0.57	1.00	-0.43***	0.38	0.39	-0.008
	(0.42)	(0.96)	(0.63)	(0.48)	(1.17)	(0.83)
CRE Specialists	0.57	-1.14	1.71***	-0.79	-0.09	-0.70***
	(1.33)	(1.03)	(0.85)	(2.69)	(1.22)	(2.13)
Multiple Specialists	0.22	-2.65	2.88***	0.90	0.05	0.85***
	(1.23)	(1.27)	(0.49)	(1.29)	(1.22)	(0.34)
Non-Specialists	0.75	-0.44	1.19***	0.82	0.63	0.19***
	(0.78)	(0.43)	(0.80)	(5.39)	(0.50)	(5.08)

Standard deviation in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Derivative non-users can benefit from derivatives as well. For non-user agricultural banks and non-user non-specialists, the hypothetical expected profitability had they used derivatives is higher than that if they do not use derivatives, even for the period during and after the financial crisis in 2008. However, for the non-user banks with large exposure to RE loans, i.e. mortgage, CRE, and multiple specialists, the effects of derivatives express different pattern before and after the 2008 financial crisis. The hypothetical expected ROA for non-user mortgage and multiple specialists had they used derivatives is 0.15% and 0.47% less than their respective expected ROA before the crisis. However, during and after the financial crisis, the profitability of mortgage specialists becomes neutral to derivatives and derivatives could increase ROA at non-user multiple specialists by 0.85% during the same period. On the contrary, although non-user CRE specialists could benefit from derivatives with 0.26% increase in ROA if they had used derivatives before the crisis, derivatives are estimated to hurt their profitability with a decrease of 0.7% in ROA during and after the 2008 crisis.

5. Conclusion

Financial derivatives have been blamed for the 2008 financial crisis. The Volcker Rule, a section of Dodd-Frank Financial Reform Act of 2010, is designed to prohibit banks from engaging in proprietary trading in derivatives. This chapter provides empirical evidence on the potential effects of this new policy on community banks which are small, serve rural areas, and mainly participate in the end-user derivatives market.

Contrary to the premise of Volcker Rule, this chapter finds that derivative activities at community banks successfully reduce the sensitivity of their profitability to on-balance sheet interest rate risk. In addition, derivatives have improved profitability at majority of user community banks, especially at CRE lenders. Moreover, most derivative non-users could also benefit from derivative activities in terms of increased profitability.

As Volcker Rule will impose proportionally higher regulatory cost on community banks than on large banks, community banks will have to reduce derivatives use and substitute their cheap off-balance sheet risk management through derivatives for costly on-balance sheet asset-liability management. The results from this chapter suggest that the Volcker Rule will not only hurt the profitability at community banks but also increase the sensitivity of their profitability to a number of risk factors, including credit risk and interest rate risk which are the main risks built into the traditional saving and loans. Community banks, in turn, may have to reduce the lending to finance local economic development. Thus, the new rule could not only make community banks riskier but also harm economic development and job creation in rural areas.

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Appendix 1: Empirical Model Variables for Chapter 2

Variables	Calculation	Predicted Signs in Profit	Predicted Signs in Risk
Dependent Variable			
Risk	$\mathrm{STDROA} = \sqrt{\frac{\sum_t (\mathrm{ROA}_{it} - \overline{\mathrm{ROA}_i})^2}{T-1}}$	-	-
Profitability	$\mathrm{ROA} = \frac{\text{Net Income}}{\text{Total Assets}}$	-	-
Explanatory Variable			
Capital Adequacy	$\text{Capital} = \frac{\text{Equity Capital}}{\text{Total Assets}}$	Positive	Negative
Liquidity Risk	$\text{Liquidity} = \frac{\text{Current Assets}}{\text{Total Assets}}$	Negative	Negative
Default Risk	$\text{NPL} = \frac{\text{Nonperforming Loans}}{\text{Total Assets}}$	Negative	Positive
Interest Risk	$\text{Gap} = \frac{\lvert\text{Net Short} - \text{term Assets}\rvert}{\text{Earning Assets}}$	Negative or Positive	Positive
Management	$\text{Manage} = \frac{\text{Earning Assets}}{\text{Total Assets}}$	Positive	-
Operating Risk	$\text{Ooerating} = \frac{\text{Operating Expense}}{\text{Operating Revenue}}$	-	Positive
Control Variable			
Diversification Risk	$\text{AG loans} = \frac{\text{Agricultural Loans}}{\text{Total Assets}}$	-	-
Scale	ASSET=ln(Total Assets)	-	Negative
Inflation	$\text{Inflation} = \frac{\mathrm{CPI}_t - \mathrm{CPI}_{t-1}}{\mathrm{CPI}_{t-1}}$	-	-
Derivative Variable			
Swap	$\text{Swap} = \frac{\text{Swaps}}{\text{Total Assets}}$	Positive	Negative
Option	$\text{Option} = \frac{\text{Options Write} + \text{Options Purchase}}{\text{Total Assets}}$	Positive	Negative
Future and Forward	$\text{Future} = \frac{\text{Futures} + \text{Forwards}}{\text{Total Assets}}$	Positive	Negative

Note: Data used in this study are from Call Report.

Appendix 2: Empirical Model Variables for Chapter 3 and 4

Variables	Calculation	Predicted Signs in Profit Function
Dependent Variable		
Profitability	$\text{ROA} = \frac{\text{Net Income}}{\text{Total Assets}}$	-
Explanatory Variable		
Capital Adequacy	$\text{Leverage} = \frac{\text{Total Assets}}{\text{Equity Capital}}$	Negative
Liquidity Risk	$\text{Liquidity} = \frac{\text{Current Asset}}{\text{Total Asset}}$	Negative
Default Risk	$\text{Charge} - \text{off} = \frac{\text{Charge} - \text{Offs}}{\text{Total Loans}}$	Negative
Interest Risk	$\text{Gap} = \frac{\lvert\text{Net Short} - \text{term Assets}\rvert}{\text{Earning Assets}}$	Negative or Positive
Management	$\text{Manage} = \frac{\text{Earning Assets}}{\text{Total Assets}}$	Positive

Note: Data used in this study are from FDIC's Reports of Condition and Income (Call Report).

Appendix 3: Definition of Lending Specialty Groups for Chapter 4

Lending Specialty Group	**Definition**
Agricultural Specialists	Agricultural production loan plus loans secured by farmland greater than 20% of total assets
Mortgage Specialists	Residential Mortgage loans greater than 30% of total assets
Consumer Specialists	Credit card lines and other loans to individuals greater than 20% of total assets
Commercial Real Estate (CRE) Specialists	construction and development (C&D) loans greater than 10% of total assets OR total CRE loans (C&D, multifamily, and secured by other commercial properties) greater than 30% of total assets
Commercial &Industrial (C&I) Specialists	C&I loans greater than 20% total assets
Multi-Specialists	Meets more than one of the single-specialty definition above OR holds either retail loans* or commercial loans** greater than 40% of total assets
No Specialty	All other institutions

Source: FDIC, 2012

Note: All specialty groups require the bank to hold loans greater than 33% of total assets. *retail loans include 1-4 family residential real estate loans and loans to individual. **commercial loans include CRE loans and C&I loans.