Derivatives at Agricultural Banks

Xuan (Shelly) Shen
Ph.D. Student
Auburn University
Email: xzs0005@tigermail.auburn.edu

Valentina Hartarska
Associate Professor
Auburn University
Email: hartavm@auburn.edu

Selected Paper prepared for presentation at the Southern Agricultural Economics Association Annual Meeting, Birmingham, AL, February 4-7, 2012

Derivatives at Agricultural Banks

Abstract

Using data between 1995 and 2010, we find that agricultural banks are benefiting from the derivatives activities by reducing total risk without hurting their profit. In nonagricultural banks, both profitability and total risk are adversely affected, possibly due to speculative derivatives positions.

Introduction

Historically, the high cost of implementing hedging strategies creates the main barrier for small banks, especially agricultural banks, to participate in the derivatives market. Only agricultural banks part of bank holding companies may have the chance to hedge with derivatives contracts. However, changes in banking regulation in the 1990s made it possible for small agricultural banks to hedge. The Riegle-Neal Interstate Banking and Branching Act of 1994 removed the interstate branching limit, making possible affiliation of small agricultural banks with large banks and bank holding companies. The Gramm–Leach–Bliley Act of 1999 allowed the consolidation of commercial banks, insurance companies, security firms and investment banks, making it possible for the commercial banks to benefit from the economies of scope.

Data shows that few agricultural banks (less than 10) participated in the derivatives markets before the deregulation in 2000, and that these banks used derivative contracts to hedge against interest rate only. Since 2000 agricultural banks begin to actively participate in the derivatives markets and by 2010 about 10% of agricultural banks participated in the derivatives market.

While end-user derivatives activities of commercial banks have been studied extensively,

there is no research on the derivatives activities of agricultural banks. Agricultural banks are one of the main funding sources to the agricultural industry but are small, have less diversified loan portfolio, relatively new to the derivatives market, and thus more vulnerable to loss from the inappropriate hedging activities. However, Warner's (1977) finding that the bankruptcy cost is proportionally greater for smaller firms suggesting that there are potential gains from hedging for small agricultural banks in terms of reduction in the probability of financial distress. Insight into effectiveness of hedging is therefore important for agricultural banks because of their unique traits.

In this paper, we study the impact of derivatives on agricultural banks' performance and compare it to that on nonagricultural banks' performance. We also study whether use of derivatives affected negatively bank performance during the latest financial crisis and whether these effects were different before and after the change in regulation that incurred in 2000.

The next section discusses the current literatures on derivatives contracts' effects and agricultural banks. Section 3 discusses empirical models and data; and section 4 will discuss the empirical results. Finally, section 5 will summarize and conclude the paper.

Literature Review

The literature on the effects of derivatives use on bank profitability and risk is somewhat ambiguous. For example, while Wilson and Holmann (1996) argue that derivatives have the potential to enhance profitability, apart from a few exceptions, empirical studies provide contradictory results. For example, Angbazo (1997) and Li and Yu (2010) find that derivatives use increase the profitability of commercial banks at the expense of the higher risks, while Brewer et al., (2001), Cebenoyan and Strahan (2004), Sarkisyan et al., (2009) show that

derivative activities have no effect on banks' profitability.

Since derivatives are used in risk management, most of the research focuses on testing whether the commercial banks' derivatives activities help reduce their risk exposures. The empirical results on risk management in commercial banks are dependent on the measure of risks used. For example, when implied volatility is used as the risk measures, Li and Yu (2010) find that derivatives increase the investor's risk perceptions toward the user bank, while Hassan and Khasawneh (2009a) indicate that investors perceive interest rate swap as risk reducing product. When risk is measured as the stock return sensitivity, Choi and Elyasiani (1997) find a strong risk reduction effect of derivatives on interest risk and foreign exchange risk for large banks. However, using a similar approach Hirtle (1997) finds that interest rate derivatives increase commercial banks' interest rate risk exposure. When risks is measured by the volatility of stock return, Brewer et al. (1996) find the interest rate swap contract help reduce the volatility of the stock return for savings and loan associations (S&Ls) but the interest rate futures have no statistical significant effect. Recently, Hassan and Khasawneh (2009a) compare the risk effects of different derivatives contracts based on three main risks measures: systematic risk (β), standard deviation of the stock returns, and implied volatility. They found that while interest rate swap contracts are risk reduction products across all three risks measures, the other derivatives contracts (option, future and forward) are positively correlated to systematic market risk (β).

Using accounting ratios as measures of risk, Angbazo (1997) finds that derivatives activities are not associated with larger risk exposures in banks even though off-balance-sheet activities (which also includes standby letter of credit, loan sale etc.,) did increase the banks' interest risk and liquidity risk during the sample period 1989-1993.

Most studies of agricultural banks are motivated by the farm credit crisis in 1980s.

Belongia and Gilbert (1990), argue that lack of diversification to assets other than loans and high portion of agricultural loans were the primary cause of the farm credit crisis, while affiliation with large bank holding companies was associated with lower probability of failure for agricultural banks. The large number of agricultural bank failures in response to the farm credit crisis and regulation changes brought a wave of consolidation in the agricultural industry since the 1980's. Consequently, studies have explored banks efficiencies and economies of scale and scope as well as banks response to regulation changes removing restrictions of intrastate, interstate, and international banking (Belongia and Gilbert. 1990; Gilbert, 1991; and Ahrendsen et al., 1995, Featherstone and Moss, 1994; Neff et al., 1994; Dias and Helmers, 2001; Choi and Stefanou, 2006; Choi et al. 2007; and Settlage et al., 2009.

As most derivatives user agricultural banks entered the market after the regulations changes in 1999 and 2000, and their small size makes them more vulnerable to the inappropriate hedging activities. Therefore, we believe it is worth to study the effects of derivative use by agricultural banks. In particular, we analyze the effects of derivatives use on profitability and risk in agricultural banks. The next section will discuss the data and theoretical models.

Model

Traditionally, commercial banks serve as intermediaries between depositors and borrowers, profiting from the difference of the interest they charge for loan borrowers and the interest they paid to the depositors, measured by net interest margin (NIM). However, since 1980s interest rate risks and market competition increased and commercial banks are reducing their loan business while noninterest income is having more impact on the banks' operating revenue. In 2010, around 31% of banks' operating revenue came from noninterest income. To address these

operation changes, we analyze the return on assets (ROA) which reflect banks' total operating performance. Motivated by the dealership model developed by Ho and Saunders (1981) and Allen (1988) and following empirical model proposed by Angbazo (1997), the banks' profitability (ROA) is modeled as a function of series of bank specific factors and risk factors.

(1) $$ROA = F(\text{Default risk};\ \text{Interest risk};\ \text{Liquidity risk};\ \text{Capital adequacy};\ \text{Management};\ \text{Diversification risk};\ \text{Asset};\ \text{Derivatives})$$

The effects of derivatives activities on banks' profitability could not be separated from its effect on the banks total risks. The two commonly used risk measures, volatility of common stock return (such as Hassan et al., 2009a and Brewer et al., 1996) and implied volatility which measures the investors' perspectives on the commercial banks risk level (such as Hassan et al., 2009a and Li and Yu, 2010) requires we use banks with publicly traded stocks and none of the publicly traded banks could be classified as agricultural banks given both definition from Federal Reserve (FED) or FDIC. Motivated by the hedging theory developed by Smith and Stulz (1985), which suggest that the hedging activities could help reduce the variation of the cash flow and thus reduce the probability of bankruptcy, the variation of the banks' earnings (STDROA) could be used to measure the commercial banks' total risk. The model to test the relationship between the banks' total risk and derivatives activities is as follows:

(2) $$STDROA = F(\text{Default risk};\ \text{Interest risk};\ \text{Liquidity risk};\ \text{Capital adequacy};\ \text{Operating risks};\ \text{Diversification risk};\ \text{Asset};\ \text{Derivatives})$$

Data and Variable Construction

Bank data used to construct the models comes from Reports of Condition and Income (Call Report) from Federal Reserve Bank of Chicago. The FAS no. 119 required all the commercial banks to disclose the purpose of derivatives activities since 1995. Therefore our sample includes

64 quarterly observations from 1995 to 2010 for each bank included in the sample. In order to remove the bias and distractions from the banks' merger and acquisition activities, the banks with less than 64 observations were excluded from the sample. The final dataset contains 5,285 banks with 330,990 observations.

With regard to the agricultural banks, current literature contains two definitions. The FED defines agricultural banks as commercial banks with more than the mean agricultural loan ratio of the commercial banking industry (2,522 agricultural banks), 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 (2,147 agricultural banks). In this research, both classifications are used to test the consistency of the regression result. Moreover, the cost of funding and the scope of operations tend to be different across banks with different sizes. The commercial banks in the sample are also categorized into two groups by their total assets with total assets over $1 billion as large banks and otherwise as small banks or community banks.

The risk factors entering the above models are consistent with the criteria used by FDIC to evaluate the commercial banks' CAMELS[1] rating. The variable construction and expected signs are presented in Appendix.

The default risk (or credit risk) is captured by the portion of the total assets which are classified as non-performing (NPL); interest risk is captured by the short term maturity gap (GAP) constructed with the method by Flannery and James (1984) with the difference of the banks' short-term asset and liability scaled by earning asset; liquidity risk is measured by the proportion of the banks' liquid assets to total assets (LIQUID); and capital adequacy is measured

[1] The CAMELS rating system stands for capital adequacy, asset quality, management, earning, liquidity and sensitivity to market risk.

by the proportion of the banks' total assets financed by equity capital (LEV). Following the method used by Angbazo (1997), management quality (MANAGE) is measured by the banks' earning assets scaled by total assets in the profitability function and by the ratio of operating expense (include interest expense) to total income (OPERATE) in the risk function. Bank specific variables, banks' total asset (ASSET) to control the scale economies and agricultural loan ratio (AGLN) to measure the diversification, are also included in the model. Other control variables include annualized quarterly inflation rate and seasonal dummies (D6, D9 and D12).

Derivatives activities are approximated by the notional value of the derivatives contracts scaled by the banks' total assets. Even though banks are required to report the derivatives activities by purpose with trading derivatives related to the market making activities (or dealership) and non-trading derivatives related to other purposes since 1995, there is no information on how to distinguish the hedging activities from the speculating activities. As cost of participating in the derivatives market is usually very high, small banks which usually face limited funding sources are unlikely to engage in speculation derivatives activities while large banks are assumed to engage in both speculation and hedging activities. Thus, the size of the bank is used to identify the hedging banks from the speculating banks. The next section discusses the empirical results.

Empirical Results

Table 2 presents the summary statistics of the key variables for the full sample. In general, the agricultural banks tend to be small in size with total assets of $48.2 million on average, compared to $144.2 million for the non-agricultural bank. Consistent with findings of previous studies, the agricultural banks are more profitable (1.2% ROA for agricultural banks and 1.03% for non-agricultural banks), more liquid (34% liquid asset for agricultural banks, but only 30%

for nonagricultural banks), have fewer nonperforming loans (0.75% for agricultural banks but 0.80% for nonagricultural banks) and are less leveraged (11.5% assets are funded by equity capital but only 10.5% for nonagricultural banks) than the nonagricultural banks. However, agricultural banks have bigger interest risks measured by the maturity gap (37% for agricultural banks but 34% for nonagricultural banks). Accordingly, their income is more volatile than the nonagricultural banks (standard deviation of the ROA is 1.1% for agricultural banks but only 0.85% for non-agricultural banks).

*********Table 1********

Compared to nonagricultural banks, agricultural banks are much less active in the derivatives market. Notional value of the non-trading derivatives for agricultural banks is only about 8% of their total assets, compared to 35% for non-agricultural banks. Because most of the agricultural banks only serve rural or local community business, they are not exposed to many foreign exchange risks and do not participate extensively in the foreign exchange derivatives activities. Unlike the nonagricultural banks which mainly use interest rate contracts, agricultural banks use the derivatives based primarily on equity.

Derivatives Activities, Profitability and Total Risk

Commercial banks usually make risk management and daily operationsdecisions jointly, and risk management activities are supposed to be endogenous with the factors which also affect the bank' performance. To control for endogeneity, following the procedures used by Hanweck and Ryu (2005) and Brock and Franken (2003), all the explanatory variables are lagged in the ROA equation. Similarly, because banks actively manage their risk exposure, one period lag is also applied to all the explanatory variables in the risk equation.

Panel regression models are used to analyze the effect of derivatives activities on the

banks' profitability. Hausman-Wu test rejects random difference across banks over time and suggests that the fixed effect for the profitability model. The fixed effect regression results are reported for the profitability function in Table 3. The standard errors are clustered at the bank level to control for the possible heteroskedasticity and autocorrelation. Because the total risk is measured as the time-series standard deviation of the profitability for each bank, the single cross-sectional model is estimated and results are presented in Table 4.

*******Table 2********

*******Table 3********

Meanwhile, only around 10% of the commercial banks could be classified as large banks (assets greater than $1 billion) with only 48 agricultural banks given the Fed definition and 26 by the FDIC definition. Thus, regression with all banks mainly captured the behavior of the small banks and the following discussion focuses on the group comparisons i.e. agricultural vs. nonagricultural banks and large vs. small banks.

As expected, the profitability of commercial banks are negatively correlated to the default risk (NPL) with the magnitude for nonagricultural banks almost twice of that for agricultural banks (0.34% for nonagricultural banks but 0.18% for agricultural banks). However, the statistically significant effect of NPL on risks is only detected for nonagricultural banks. This result could be explained by the fact that the agricultural banks usually focus on serving the local business community and already know the risks of communities, thus could manage their loan quality more efficiently.

The interest rate risk management is efficient for the commercial banking industry in that the total risk of the banking industry is unaffected by the interest rate risk exposure (GAP) and the total risk of the large agricultural banks even decreases as their interest rate risk exposure

increases. The profitability of the commercial banks is not significantly correlated to the liquidity risks (LIQUID) and capital base (LEV). As expected, the increase in the liquid asset holdings reduces the overall risk for the commercial banking industry, especially for small banks. But against our expectation, the increase in the capital base increases the overall risk of the banks. One explanation for this result is that the higher required return on equity capital provides the incentives for the management make the investment in the high risk and high return assets. As expected, the management quality is positively correlated to the profitability and total risk.

The results suggest that small agricultural banks could boost their profitability by spinning off assets without affecting total risk level, while large agricultural banks could benefit from an increase in size with high profitability or reduced total risk. However, the effects on nonagricultural banks are mixed. The benefits in profitability by spinning off assets are at the expense of higher total risk. Thus, the management's preference for risk or profit matters in this case. The agricultural loans (AGLN) are desirable investments for small banks because such loans will help increase the profitability and reduce the variation of income. However, the performance of large agricultural banks is neutral to such loans in term of both profitability and total risk. Consistent with the findings by Hanweck and Ryu (2005), evidence of seasonality (D6, D9 and D12) is also detected across bank groups. The nonagricultural banks tend to underperform the first quarter in the second quarter, while agricultural banks, especially small agricultural banks, tend to outperform in the third quarter. In the last quarter, all banks tend to underperform the first quarter. For the effects of derivatives activities, agricultural banks, especially small agricultural banks, are benefiting from the swaps contract (SWAP) in terms of risk reductions without hurting the profitability. However, the performance of the nonagricultural banks is hurt by the swaps contract in terms of increased total risk and reduced profitability.

Except for a few large agricultural banks whose variation of income is smoothed by option contracts (OPTION), the performance of the agricultural banks is neutral to option contracts in terms of both profitability and total risk. Even though nonagricultural banks are benefiting from option contracts in terms of higher profitability, such benefits are at the expense of higher risk. For the effects of future and forward contracts (FUTURE), only risk levels of large banks are affected with risk reduction effect for large nonagricultural banks but opposite effect for large agricultural banks.

These results suggest that agricultural banks, especially small agricultural banks, are benefiting from the derivatives activities in terms of risk reduction. However, while nonagricultural banks are benefiting from the derivatives use in terms of profitability, such benefits are at the expense of increased variation of income. Based on the assumption that the larger the bank's size the more likely it is for the banks to speculate on the derivatives contracts and the fact that the agricultural banks are usually small in size, agricultural banks use derivatives mainly to hedge risks but nonagricultural banks may engage in some speculation activities. We could speculate then that hedging helped commercial banks reduce the variation of income, while the speculating derivative activities increased total risk and reduced profitability. These results are consistent with the fact that large banks, which have large portion of speculating derivatives, were in more trouble during the financial crisis in 2008. In contrast, agricultural banks, especially the small agricultural banks, efficiently managed their risk exposures effectively via derivatives contracts.

********Table 4*********

The banking regulation change in 2000 and the financial crisis 2008 affected banks operational performance and derivatives activities dramatically. Structure changes with these two

events are detected by a Chow test. Table 5 presents the regression results for the model of structural change for agricultural banks. Before banking deregulation, the profitability of agricultural banks was boosted by the future and forward derivatives without hurting total risk. After the deregulation, agricultural banks master the hedging techniques gradually and enjoy the risk reduction effects by using swaps contracts; but the arbitrage benefits disappear as the derivatives market is used more than ever before. Meanwhile, the swaps contracts effectively reduce the volatility of the agricultural banks' profitability without hurting their profit during the recession period. These results reinforce the assumption that the small banks, especially small agricultural banks, only use derivatives to hedge and their hedging strategies help reduce the volatility of the profitability effectively.

Conclusion

This research studies the effects of derivatives activities on agricultural banks and compares the results with that for nonagricultural banks. Given the assumption that the larger the banks the more likely they are to speculate in the derivatives market, the agricultural banks, usually small in size, are benefiting from the hedging derivatives activities in term of risk reduction. The model exhibits a structural change due to the change in banking regulation in 2000 and the financial crisis in 2008. The results imply that small agricultural banks already obtained hedging skill with derivatives even though they were relatively new to the market and that the derivatives activities actually helped agricultural banks through the financial crisis in 2008 in terms of risk reduction. In contrast, by engaging in speculating derivatives activities, nonagricultural banks, especially large banks, were hurt by increased risk level and reduced profitability. These findings support the current regulation, so called "Volker Rule' which restricts commercial banks from taking speculative positions in derivatives trading unless on behalf of their clients. We therefore

conclude that the purpose of the derivatives matters.

Reference

Allen, L.. 1988. “The determinants of bank interest margins: a note.” *Journal of Financial and Quantitative Analyses* 23: 231-235.

Ahrendsen, B. L., Barkema, A.D. and Gustafson, C.R.. 1995. “Weighing regulatory costs in rural lending.” *American Journal of Agricultural Economics* 77: 751-756

Angbazo, L. 1997. “Commercial Bank Net Interest Margins, Default Risk, Interest-rate Risk, and Off-Balance Sheet Banking”. *Journal of Banking and Finance* 21: 55-87.

Belongia, M.T. and Gilbert, R.A.. 1990. “Effects of management decisions on agricultural bank failures.” *American Journal of Agricultural Economics* 72: 901-910.

Berger, A.N. 1995. “The relationship between capital and earnings in banking” *Journal of Money, Credit and Banking* 27:432-456

Brewer, E. III, B.A. Minton, and J.T. Moser. 2000, "Interest-Rate Derivatives and Bank Lending," *Journal of Banking and Finance* 24: 353-379.

Brewer, E. III, Jacson III, W.E. and Moser, J.T. 2001. “The value of using interest rate derivatives to manage risks at U.S. banking organizations.” *Federal Reserve Bank of Chicago Economic Perspectives*: 49-64.

Brewer, E. III, Jacson III, W.E. and Moser, J.T. 1996. “Alligators in the swamp: the impact of derivatives on the financial performance of depository institutions.” *Journal of Money, Credit, and Banking* 28(3):482-497.

Brock, P. and Franken, H. (2003). “Measuring the Determinants of Average and Marginal Bank Interest Rate Spreads in Chile, 1994-2001.” *Economía Chilena* 6(3): 45-65.

Cebenoyan, A.S. and Strahan, P.E. 2004. “Risk Management, Capital Structure and Lending at Banks.” *Journal of Banking and Finance* 28: 19–43.

Choi, J. J., and E. Elyasiani. 1997. “Derivative Exposure and the Interest Rate and Exchange Rate Risks of U.S. Banks.” *Journal of Financial Services Research* 12(2/3): 267-286.

Choi, O. and Stefanou, S.E.. 2006. “The dynamics of efficiency improving input allocation.” *Journal of Production Analysis* 25: 159-171.

Choi, O., Stefanou, S.E. and Stokes, J.R. 2007. “Efficiency differences of U.S. agricultural banks.” *Agricultural Finance Review* 67(1):55-73.

Dias, W. and Helmers, G. A.. 2001. “Agricultural and nonagricultural bank productivity: a DEA approach.” *Agricultural Finance Review* 61(1): 1-18.

Featherstone, A. M. and Moss, C. B.. 1994. “Measuring economies of scale and scope in agricultural banking.” *American Journal of Agricultural Economics* 76: 655-661.

Flannery, M.J. and James, C. M.. 1984. “The effect of interest rate changes on the common stock returns of financial institutions.” *Journal of Finance* 39(4): 1141-1153.

Gilbert, A.R. 1991. “Do bank holding companies act as’source of strength’for their bank subsidiaries?” *This Review* (January/February): 3-18.

Hanweck, G. and Ryu, L. 2005. “The sensitivity of bank net interest margins and profitability to credit, interest-rate, and term structure shocks across bank product specializations.” FDIC working paper.

Hassan, M. K. and Khasawneh, A. 2009a. “The Risks of Off-Balance Sheet Derivatives in U.S. Commercial Banks.” Networks Financial Institute Working Paper: 2009-WP-11.

Hassan, M. K., and A. Khasawneh. 2009b. “The Determinants of Derivatives Activities in U.S.

Commercial Banks." Networks Financial Institute. Indiana State University. Working Paper.
Hirtle, B. J. 1997. "Derivatives, Portfolio Composition, and Bank Holding Company Interest rate Risk Exposure." *Journal of Financial Services Research* 12(2/3):243-266.
Ho, T.S.Y. and Saunders, A.. 1981. "The determinants of bank interest margins: theory and empirical evidence." *Journal of Financial and Quantitative Analyses* 16: 581-600.
Li, L., and Z. Yu. 2010. "The Impact of Derivatives Activity on Commercial Banks: Evidence from U.S. Bank Holding Companies." *Asia-Pacific Financial Markets* 80. (Online first)
Neff, D. L. and Ellinger, P.N..1996."Participants in rural bank consolidation." *American Journal of Agricultural Economics* 78: 69-78.
Neff, D. L., Dixon, B. L. and Zhu, S.. 1994. "Measuring the efficiency of agricultural banks." *American Journal of Agricultural Economics* 76:662-668.
Sarkisyan, A., B. Casu, A. Clare, and S. Thomas. 2009. "Securitization and Bank Performance". Centre for Banking Research. City University London. Working Paper Series WP 04/09.
Settlage, D.M., P.V. Preckel and L.A. Settlage. 2009. "Risk-adjusted Efficiency and Risk Aversion In the Agricultural Banking Industry." *Agricultural Finance Review* 69(3):314-329.
Smith, C.W., Jr., and R.M. Stulz. 1985. "The Determinants of Firms' Hedging Policies." *Journal of Financial and quantitative Analysis* 20: 391-405.
Warner, J.R..1977. "Bankruptcy costs: some evidence." *Journal of Finance* 32:337-347.
Wilson, A.C. and K.W. Hollman. 1996. "Proposed Accounting for Derivatives: Implications For the Insurance Industry" *Journal of Insurance Regulation* 14(2):251-268.
Wooldridge, J.M. 2008. Introductory Econometrics: A Model Approach.

Table 1 Summary Statistics

Variable (%)	**POOL**	**NONAG**	**FEDAG**	**AG**
ROA	1.08	1.03	1.18	1.20
STDROA	0.92	0.85	1.01	1.09
Risk Factor				
NPL	0.78	0.80	0.75	0.75
LIQUID	31.62	30.43	34.22	34.41
MANAGE	92.59	92.40	92.93	93.04
OPERAT	77.93	78.05	77.60	77.65
GAP	34.63	33.66	36.73	36.95
LEV	10.84	10.49	11.47	11.65
Control Variable				
ASSET*	$104.40	$144.19	$56.20	$48.20
AGLN	17.83	5.98	41.28	46.34
INF	2.41	2.41	2.41	2.41
Derivatives				
By Purpose				
TRADING	0.036	0.047	0.010	0.011
NONTRADING	0.267	0.358	0.084	0.055
By Contract				
COMMODITY	0.002	0.002	0.001	0.002
EQUITY	0.010	0.008	0.013	0.014
FE	0.012	0.018	<0.001	0
INTEREST	0.279	0.377	0.080	0.050
By Product				
FUTURE	0.081	0.106	0.025	0.021
OPTION	0.153	0.204	0.045	0.032
SWAP	0.147	0.204	0.027	0.015

*: US Dollar value in millions

Table 2 Panel Regression for ROA

	Pool				Large				Small			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	Pooled	NONAG	AG	FDIC	Pooled	NONAG	AG	FDIC	Pooled	NONAG	AG	FDIC
CONSTANT	1.016***	1.102***	-0.144	-0.279	1.470*	1.424	3.805	5.144	0.655**	0.722**	-0.157	-0.287
	(0.241)	(0.288)	(0.424)	(0.385)	(0.878)	(0.904)	(3.719)	(5.153)	(0.258)	(0.313)	(0.428)	(0.386)
NPL	-0.305***	-0.341***	-0.183***	-0.170***	-0.454***	-0.453***	-0.343*	-0.181**	-0.289***	-0.324***	-0.182***	-0.170***
	(0.008)	(0.010)	(0.012)	(0.013)	(0.031)	(0.031)	(0.177)	(0.075)	(0.008)	(0.010)	(0.012)	(0.013)
GAP	-0.001**	-0.003***	-0.0005***	-0.0004***	-0.005***	-0.005***	-0.001	-0.0002	-0.001**	-0.003***	-0.0005***	-0.0004***
	(0.0005)	(0.0003)	(0.0001)	(0.0001)	(0.0011)	(0.0012)	(0.0013)	(0.0012)	(0.0005)	(0.0003)	(0.0001)	(0.0001)
LIQUID	0.0003	0.001	0.001	0.001	0.002	0.002	-0.005	-0.007	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.005)	(0.006)	(0.001)	(0.001)	(0.001)	(0.001)
LEV	0.008	0.008	0.004	0.006	0.027	0.028	-0.009	-0.006	0.004	0.003	0.004	0.006
	(0.007)	(0.008)	(0.005)	(0.005)	(0.023)	(0.023)	(0.024)	(0.028)	(0.006)	(0.008)	(0.005)	(0.005)
MANAGE	0.025***	0.025***	0.020***	0.021***	0.026***	0.027***	-0.025	-0.061	0.025***	0.025***	0.021***	0.021***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.008)	(0.008)	(0.038)	(0.056)	(0.002)	(0.002)	(0.002)	(0.002)
ASSET	-0.180***	-0.176***	-0.060**	-0.057**	-0.185***	-0.188***	0.006	0.150**	-0.150***	-0.143***	-0.060**	-0.058**
	(0.015)	(0.016)	(0.029)	(0.025)	(0.031)	(0.032)	(0.074)	(0.070)	(0.016)	(0.018)	(0.029)	(0.025)
AGLN	0.001	-0.001	0.004***	0.004***	-0.005	-0.005	0.006	0.007	0.002*	0.000	0.004***	0.004***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.005)	(0.008)	(0.005)	(0.005)	(0.001)	(0.002)	(0.001)	(0.001)
INF	0.003***	0.001	0.003***	0.003***	0.001	0.001	-0.001	0.002	0.003***	0.001	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.004)	(0.004)	(0.006)	(0.007)	(0.001)	(0.001)	(0.001)	(0.001)
D6	-0.023***	-0.029***	-0.002	-0.001	-0.069*	-0.073*	0.087	0.112	-0.018***	-0.022***	-0.003	-0.002
	(0.007)	(0.008)	(0.009)	(0.010)	(0.039)	(0.039)	(0.068)	(0.087)	(0.006)	(0.007)	(0.009)	(0.010)
D9	-0.004	-0.010	0.021***	0.018**	-0.046	-0.051*	0.083	0.108	0.0001	-0.004	0.021***	0.018**
	(0.005)	(0.006)	(0.008)	(0.009)	(0.030)	(0.031)	(0.071)	(0.098)	(0.005)	(0.006)	(0.008)	(0.009)
D12	-0.295***	-0.250***	-0.373***	-0.394***	-0.196***	-0.198***	-0.183*	-0.141	-0.295***	-0.248***	-0.373***	-0.395***
	(0.009)	(0.009)	(0.015)	(0.017)	(0.036)	(0.036)	(0.097)	(0.130)	(0.008)	(0.009)	(0.015)	(0.017)
SWAP	-0.016	-0.017	-0.003	-0.007	-0.019*	-0.020*	-0.005**	-0.005	-0.036**	-0.036**	-0.006	-0.013
	(0.010)	(0.010)	(0.002)	(0.012)	(0.011)	(0.011)	(0.002)	(0.005)	(0.015)	(0.015)	(0.012)	(0.014)
OPTION	0.005**	0.005**	0.003	0.001	0.009**	0.008*	0.002	-0.007	0.005**	0.005**	0.003	0.001
	(0.002)	(0.002)	(0.006)	(0.011)	(0.005)	(0.005)	(0.004)	(0.024)	(0.002)	(0.002)	(0.006)	(0.011)
FUTURE	0.001	0.001	-0.004	-0.001	0.001	0.002	0.021	-0.044	-0.001	-0.001	-0.005	-0.0004
	(0.002)	(0.003)	(0.009)	(0.007)	(0.003)	(0.004)	(0.024)	(0.252)	(0.004)	(0.004)	(0.009)	(0.007)
R-squared	0.111	0.129	0.069	0.070	0.171	0.171	0.094	0.086	0.105	0.122	0.069	0.071
Observations	330,990	232,549	123,422	98,441	27,212	26,567	1,091	645	318,309	220,006	123,096	98,303
Number of entity	5,285	4,230	2,522	2,147	452	448	48	26	5,220	4,164	2,513	2,143

Robust standard errors in parentheses

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

Table 3 Regression for Risk

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

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

Table 4 Model Structure Change

	Recession				Regulation Change			
VARIABLES	(1) AG ROA REC	(2) AG ROA NOT	(3) AG RIKS REC	(4) AG RISK NOT	(5) AG ROA BEFORE	(6) AG ROA AFTER	(7) AG RISK BEFORE	(8) AG RISK AFTER
Constant	2.295**	-0.506	-18.401***	-5.570	2.982***	1.013*	1.896***	-8.207*
	(0.914)	(0.438)	(4.634)	(4.415)	(0.681)	(0.548)	(0.377)	(4.377)
NPL	-0.255***	-0.164***	-0.319	-0.234	-0.078***	-0.218***	0.161***	-0.070
	(0.031)	(0.011)	(0.285)	(0.289)	(0.013)	(0.016)	(0.022)	(0.273)
GAP	-0.003***	-0.0004***	0.008	-0.005	-0.0001	-0.0004***	0.002*	-0.003
	(0.001)	(0.0001)	(0.011)	(0.011)	(0.0002)	(0.0001)	(0.001)	(0.009)
LIQUID	0.004*	-0.0002	-0.115***	-0.093***	-0.001	0.004***	-0.006***	-0.091***
	(0.002)	(0.001)	(0.017)	(0.016)	(0.001)	(0.001)	(0.001)	(0.016)
LEV	-0.037***	0.008	1.287***	0.855***	-0.035***	-0.004	0.067***	1.024***
	(0.013)	(0.005)	(0.059)	(0.042)	(0.009)	(0.007)	(0.004)	(0.048)
MANAGE	0.021***	0.021***			0.014***	0.021***		
	(0.004)	(0.002)			(0.004)	(0.003)		
ASSET	-0.244***	-0.026	0.369	-0.039	-0.249***	-0.160***	-0.191***	-0.053
	(0.060)	(0.030)	(0.262)	(0.241)	(0.052)	(0.038)	(0.020)	(0.251)
AGLN	0.007**	0.003***	-0.058***	-0.039***	0.001	0.002	-0.005***	-0.050***
	(0.003)	(0.001)	(0.013)	(0.012)	(0.001)	(0.002)	(0.001)	(0.012)
INF	0.006***	0.003**	0.301*	-1.640***	0.006**	0.003***	-0.007	-0.083
	(0.002)	(0.001)	(0.170)	(0.363)	(0.003)	(0.001)	(0.045)	(0.231)
OPERATE			0.073***	0.082***			0.005**	0.042*
			(0.027)	(0.028)			(0.003)	(0.025)
D6	-0.141***	0.022**			0.004	-0.016		
	(0.032)	(0.010)			(0.013)	(0.013)		
D9	-0.151***	0.033***			0.040***	0.012		
	(0.038)	(0.008)			(0.010)	(0.010)		
D12	-0.469***	-0.370***			-0.406***	-0.340***		
	(0.035)	(0.015)			(0.017)	(0.017)		
SWAP	0.004	-0.005*	-0.813***	-0.074	-0.018	0.009	0.061	-0.362**
	(0.008)	(0.003)	(0.214)	(0.261)	(0.012)	(0.008)	(0.062)	(0.168)
OPTION	0.026	-0.001	0.089	0.043	-0.031	0.009	0.087	0.124
	(0.021)	(0.008)	(0.239)	(0.436)	(0.028)	(0.006)	(0.067)	(0.304)
FUTURE	-0.020	-0.004	-0.084	0.143	0.029***	-0.003	-0.246	0.347
	(0.037)	(0.010)	(0.602)	(1.043)	(0.009)	(0.009)	(0.339)	(0.683)
R-squared	0.057	0.073	0.186	0.156	0.077	0.066	0.206	0.168
Observations	17,422	106,000	17,422	106,000	46,320	77,102	46,320	77,102
Number of entity	2,235	2,513	2,235	2,513	2,302	2,356	2,302	2,356

Robust standard errors in parentheses

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

Appendix: Empirical Model Variables

Variables	Calculation	Predicted Signs in Profit	Predicted Signs in Risk
Dependent Variable			
Risk	$\text{STDROA} = \sqrt{\frac{\sum_t (\text{ROA}_{it} - \overline{\text{ROA}_i})^2}{T-1}}$	-	-
Profitability	$\text{ROA} = \frac{\text{Net Income}}{\text{Total Asset}}$	-	-
Explanatory Variable			
Capital Adequacy	$\text{LEV} = \frac{\text{Equity Capital}}{\text{Total Asset}}$	Positive	Negative
Liquidity Risk	$\text{LIQUID} = \frac{\text{Current Asset}}{\text{Total Asset}}$	Negative	Negative
Default Risk	$\text{NPL} = \frac{\text{Nonperforming Loan}}{\text{Total Asset}}$	Negative	Positive
Interest Risk	$\text{GAP} = \frac{\text{Net Short} - \text{term Asset}}{\text{Earning Asset}}$	Negative	Positive
Management	$\text{MANAGE} = \frac{\text{Earning Asset}}{\text{Total Asset}}$	Positive	-
Operating Risk	$\text{OPERATE} = \frac{\text{Operating Expense}}{\text{Operating Revenue}}$	-	Positive
Control Variable			
Diversification Risk	$\text{AGLN} = \frac{\text{Agricultural Loan}}{\text{Total Asset}}$	-	-
Scale	ASSET=ln(Asset)	-	Negative
Inflation	$\text{INF} = \frac{\text{CPI}_t - \text{CPI}_{t-1}}{\text{CPI}_{t-1}}$	-	-
Derivative Variable			
Swap	$\text{SWAP} = \frac{\text{Swap}}{\text{Total Asset}}$	Positive	Negative
Option	$\text{OPTION} = \frac{\text{Option Write} + \text{Option Purchase}}{\text{Total Asset}}$	Positive	Negative
Future and Forward	$\text{SWAP} = \frac{\text{Future} + \text{Forward}}{\text{Total Asset}}$	Positive	Negative

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