The Changing Structure of Commercial Banks Lending to Agriculture

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This study examines the effect of selected factors on the changes in agricultural lending from 2000 to 2005 using a quantile regression method with commercial bank data. The study finds that the effects of the characteristics of commercial banks and the financial markets on the agricultural loan growth differ among quantiles. The results indicate that there are three significant characteristics affecting agricultural loan growth using the OLS regression, however, six different factors are significant in the different quantiles. Bank assets and deposit growth rates have a positive impact, and the population growth rate, loan to deposit ratio, equity to asset ratio, and location have a negative impact on the agricultural loan growth rate at commercial banks. The agricultural loan rate and ROA showed mixed results as banks with low and medium growth rates increase their lending to agriculture while those with higher growth rates decrease their agricultural loans.

Key words: agricultural loan, agricultural loan growth, quantile regression.

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Introduction

The banking industry is highly regulated to ensure the safety and soundness of the institutions and to protect the interest of the public and the banks' customers. The deregulation of the early 1980s and late 1990s allowed competitive market forces to shape the industry. The geographic liberalization of banking and branching laws have resulted in fewer and larger banking organizations. The number of insured commercial banks in U.S. has declined from 14,364 in 1980 to 7,739 in 2005, while the average total asset held by commercial banks have increased from $128.6 million in 1980 to $1,102.6 million[1].

Restructuring of the commercial banking industry could have significant impact on its rural customers since many of the financial institutions in rural areas are localized. Small companies generally depend on local banks for their financial services and establish a strong relationship with their lenders which are rural banks (Rose, 1986; Berger and Udell, 1996). Commercial banks are a primary supplier of credit to small and mid-size farms, and if the larger banks are less inclined to serve the credit needs of small businesses, the structural shift from independent banks to non-locally owned, large banks could adversely affect the cost and availability of credit for agricultural and rural businesses (Koenig and Dodson, 1995).

Even though small farmers have other sources in income, and have lower credit needs, the larger operations require a much broader set of financial services, and their

[1] The numbers of banks and branches in 1980, 1990, 2000 come from the Historic Statistics on Banking of FDIC. The number of them in 2005 is estimated from Call and Income Report of Federal Reserve System and Summary of Deposit of FDIC.

credit needs frequently exceed both lending limits and single funding capacity of many banks (LaDue and Duncan, 1995). Rural community banks have similar functions for the customers in financial markets, but they play a different role from urban banks in local financial markets (Lummer and McConnell, 1989; Lee, 2002). Rural banks are one of the important sources in loans and mortgages for local borrowers and providing funds for local businesses. Even though rural banks owned 19.44% of total U.S. assets, they held 63.25% of all U.S. banks agricultural loans in 2004.[2]

This study is intended to identify the characteristics affecting the behavior of banks lending to agriculture. The changes in the rural economy and financial markets have influenced the strategies of banks. Some banks have chosen to specialize and expand agricultural and rural lending while others are diversifying by reducing the amount of rural lending or expanding other parts of their portfolio. Since commercial banks are important sources for financing in rural economies, it is necessary to investigate the characteristics of banks which are adjusting their agricultural loan portfolios and changing their market presence in rural areas. The patterns of delivery of credit are one of the important aspects to study related to the rural banking industry.

The objective of this paper is to investigate the types of institutions that are expanding or contracting agricultural loans, that is, to examine the characteristics which may contribute to an increase or decrease in the agricultural loans of commercial banks. The changes in the banking industry adjust the operations of the loan portfolio in rural areas. This study investigates not only the specific banks' characteristics which are more likely to lend to agriculture, but also some of the market factors in these areas.

[2] FDIC, 2004

A quantile regression method is used to investigate the characteristics of rural commercial banks and market properties related to the agricultural loans. The dependent variable is the agricultural loan growth rates. Unlike previous studies (Bard, et al., 2000; Betubiza and Leatham, 1995), regarding to the analysis of factors affecting agricultural lending using tobit model, a quantile regression method is used since the dependent variable is the change in agricultural loans and both lower and upper or all quantiles are of interest. This analysis will derive the basic bank characteristics and market characteristics of institutions that have changed their loan portfolios. Based on five-year commercial banks' data, the likelihood of the change in agricultural loans can be estimated. Through the analysis of the marginal effects, the changes in predicted probability of rural banks' loan portfolio associated the changes in the explanatory variables can be estimated.

Review of literature

Most of studies for the banking industry analyzed the performance and effects of branches and bank consolidation using all commercial data in U.S. (Wu, Yang, and Liang, 2006; Sathye, 2003; DeYoung and Hasan, 1998; Berger, Leusner and Mingo 1997; Färe and Primont, 1993). Some studies provide an overview of the agricultural banking environment and the legislative, structural changes for encouraging rural financial market consolidation (LaDue and Duncan 1996; Neff and Ellinger, 1996; Featherstone, 1996). However, there is little recent evidence to suggest the characteristics of banks which are expanding their agriculture and rural lending. Gilbert and Belongia (1988) analyzed

whether the agricultural loan rate of subsidiaries of large bank holding company and other banks in the same counties are different.

Betubiza and Leatham (1995) analyzed the factors affecting commercial bank lending to agriculture using a tobit model in Texas. They found that the ratio of agricultural loans to bank assets declined as commercial bank deposits become more sensitive to market rates. Bard et al. (2000) examined the structural and other characteristics of banks which are affecting the lending to agriculture. They also used a tobit model and OLS using bank data in three states.

Koenker and Bassett (1978) introduced quantile regression approach, where the conditional quantiles are expressed as a function of explanatory variables. They suggested that quantile estimators may be more efficient than the least squares estimators for non-normal error distributions even though they have comparable efficiency to least squares estimators for normally distributed errors. Several studies have used quantile regression to account for the effect of covariates on the location, scale and shape of the distribution of the response variable (Buchinsky, 1998; Canarella and Pollard, 2004). Meta and Machado (1993) and Gorg et al. (2000) employed a quantile regression to analyze the determinants of firm start-up size. They showed that a quantile regression estimator can provide more precise information on the determinants of start-up size than an OLS regression. Recent empirical studies have conducted by Fattouh et al. (2005) and Somers and Whittaker (2007). Fattouh et al. (2005) investigated the evolution and determinants of Korean firms' capital structure and focus on differences between firms in different quantiles of the debt-capital distribution. They also showed a quantile regression method is better than the OLS regression.

Commercial Banking Industry in the U.S.

The banking industry in the U.S. has changed dramatically over the past 15 years due to advances in technology, merger and acquisition, and expansion of U.S. economy. The number of branches of U.S. commercial banks keeps increasing, 38,738 in 1980, 50,406 in 1990, 64,079 in 2000, 78,030 in 2005 , whereas the number of head offices is declining during the same periods. There were 14,364 insured commercial banks in U.S in 1980, but 12,347 in 1990, 8,315 in 2000, and 7,739 in 2005.[3]

The global changes in financial markets and financial market players could lead to changes in the delivery of credit to agriculture and rural America. The changing competitive landscape could result in expanded niche players, new entrants, and firms exiting the rural and agricultural lending market. Understanding the changing structure of banking institutions should provide useful policy information to assure a safe, sound, competitive and efficient rural and agricultural lending market. The ability of banks to deliver agricultural and rural loans efficiently in the future will play an important role in rural economy.

The number of the banks in U.S. in 2001 and 2005 by area and asset size is summarized in Table 1 and 2.[4] The number of total banks in 2005 was 7,739 which declined from 8,323 in 2001 (7.02%). While agricultural banks decreased by 10.02% from 2001 to 2005, non-agricultural banks decreased by 5.52%. The decrease in the number of institutions is primarily attributed to mergers and acquisitions, and the increase

[3] The numbers of banks and branches in 1980, 1990, 2000 come from the Historic Statistics on Banking of FDIC. The number of them in 2005 is estimated from Call and Income Report of Federal Reserve System and Summary of Deposit of FDIC.
[4] See the definition for a rural bank and an agricultural bank in next section.

of the branches is due to bank expansion and the expansion of U.S. economy. Interestingly, the number of smaller banks that were classified into groups 1and 2, declined by 32.00%, 19.68% respectively, while the number in larger banks increased in both rural and urban banks.

Tables 1 and 2 also show characteristics of rural and urban banks. Most of agricultural banks are rural banks (79.02% in 2005 and 78.26% in 2001), and the number of agricultural rural banks is greater than that of non-agricultural rural banks in both years. The size of agricultural rural banks is relatively smaller than that of agricultural urban banks based on the proportion of the each group. Agricultural rural banks have comparatively larger proportion of total rural banks (53.88%). Even though agricultural urban and rural banks declined, larger agricultural urban banks increased from 2001 to 2005. Thus the number of larger banks increased in all bank classifications while that of smaller banks decreased.

Information presented in this section is relevant in assessing the performance of agricultural and non-agricultural banks by asset size. Table 3 shows operational performances of all commercial banks in U.S. in 2005 by the asset size. There are 7,739 banks and 78,030 branches which include head office of each institution. In Table 3, total assets in non-agricultural banks are ten times larger than those in agricultural banks, and average assets in non agricultural banks are almost five times larger. However, the total amount of agricultural loans in agricultural banks is higher than that in non-agricultural banks in 2005 (Table 3). The average agricultural loan rate at agricultural banks is 37.53% while that in non-agricultural banks is only 2.58% in 2005. Even though the amount of average agricultural loans in smaller banks, groups 1 and 2, is smaller than

those in larger banks, groups 5 and 6, smaller banks report the agricultural loan rate that is much higher than those in larger banks.

In fact, for larger banks, average reported ROA was 2.5 times higher than the ratio for smaller banks on average. Selected agricultural and non-agricultural bank performance measures for 2001 and 2005 are provided in Table 4. The rate of return of equity capital (ROE), a profitability ratio which measures net income per dollar of equity, improved during that period. Further examination of Table 4 reveals that agricultural banks' ROE and ROA are higher than non-agricultural banks' in both years and they increased from 2001 to 2005. Within the groups of each agricultural and non-agricultural bank, larger banks have higher ROE and ROA ratios in both years.

The loan to deposit ratio, a conventional measure of liquidity, increased from 2001 to 2005 as lenders continued to expand the use of debt funds. The loan to deposit ratio of agricultural banks is lower than that of non-agricultural banks for both years. Within the groups, larger banks have higher ratio for both agricultural and non-agricultural banks.

Data

The data used to investigate the characteristics of banks lending to agriculture and financial market is taken from the Call and Income Report of Federal Reserve. Rural banks in this study are defined as those banks located outside of a metropolitan statistical area (MSA), a city with a population of more than 50,000 people or an urbanized area of at least 50,000 with a total metropolitan population of at least 100,000. In this study, agricultural loans are defined as the sum of loans secured by farm real estate loans plus

loans for agricultural production. Agricultural banks are defined as commercial banks with ratios of agricultural loans to total loans that exceed the unweighted average ratio (13.80% in 2005) for all commercial banks. Since this study is focused on agricultural lending, banks that had total agricultural loan less than $2.5 million in 2000 were eliminated.[5]

The Economic Research Service (ERS) developed a set of county-level typology codes that captures differences in economic and social characteristics; farming-dependent, mining-dependent, manufacturing-dependent, federal/state government-dependent, services-dependent, and nonspecialized. The classification of metropolitan area and nonmetropolitan area was originally completed in 2002 and results were published in Rural America. Only counties that were classified as nonmetropolitan area by the 1990 census were classified. The classification was updated for this typology by coding the metro counties in 1990 that changed to nonmetropolitan status in 2000. The county-level population growth rates are also taken from the ERS.

Empirical model

Previous studies (Bard, et al., 2000; Betubiza and Leatham, 1995), used a tobit model, suggested the selection of the explanatory variables even though they had a geographical limitation.[6] In this study, since the proportional changes in loans are used as the dependent variable, a tobit model is not an appropriate model. Under the significant structural and technological changes, and geographical deregulation, some of commercial banks can reduce or increase the amount of agricultural lending. Thus, these variables can

[5] 3,153 banks are eliminated.
[6] Betubiza and Leatham (1995) used only Texas data and Bard, et al. used bank data in three mideast states, Illinos, Iowa, and Indiana.

be negative or positive. To analyze the characteristics of banks which increase or decrease their loans to agriculture, negative or positive changes are considered as dependent variables.

The discrete choice models can lose substantial information about the variables and the OLS model set up the relationship between one or more covariates and the conditional means of a response variable given explanatory variables. However, the quantile regression is an appropriate model to explain the changes in loans. This study examines the characteristics of high growth banks in agricultural loans which are different from those of low growth banks. Therefore, the implications of the model are tested using the conditional quantile regression estimator developed by Koenker and Basset (1979). While the OLS regression describes how the mean value of the response variable varies with a set of explanatory variables, quantile regression describes the variation in the quantiles of the response. When this response distribution differs from normality, the quantiles provide a substantially richer description of the distribution than can be obtained by standard regression, obtainable without making any assumptions on the form of the distribution.

A quantile regression approach identifies different effect for alternative quantiles of the agricultural loan growth distribution and test whether or not the effects are statistically significant. Quantile regression methods can estimate upper and lower quantile reference curves as a function of variables without imposing stringent parametric assumptions on the relationships among these curves. There is often a desire to focus attention on particular segments of the conditional distribution without the imposition of global distributional assumptions.

This study investigates characteristics of banks lending to agriculture and focuses on the difference between banks in different quantiles of the change in the agricultural loans. Conditional quantile regressions show that while variables associated with standard models, like simple OLS, and significant throughout the distribution, there are considerable differences, including differences in sign, in significance of variables. Conditional regression traces the entire distribution of the changes in loans, conditional on a set of explanatory variables. An overview of the distribution of banks at different levels of the changes in loans can be a very informative descriptive device, especially when data are heterogeneous. Furthermore, since the changes in loans contain large outliers and the distribution of the disturbances is nonnormal, applying conditional mean estimators to the standard model would not be suitable. Since these estimators are not robust to departures from normality or long tail error distributions, OLS is likely to produce inefficient and biased estimates.

Let (y_i, x_i), *i=1,2,...,n* be a sample from some population where x_i is a ($K \times 1$) vector of explanatory variables. Assuming that the θth quantile of the conditional distribution of y_i is linear in x_i, the conditional quantile regression model can be written as follows:

$$y_i = x_i' \alpha_\theta + u_{\theta i}$$

$$\text{Quant}_\theta(y_i | x_i) \equiv \inf\{y : F_i(y|x)\theta\} = x_i' \alpha_\theta$$

$$\text{Quant}_\theta(u_\theta | x_i) = 0$$

where $\text{Quant}_\theta(y_i | x_i)$ denotes the θth conditional quantile of y_i on the explanatory vector x_i; α_θ is the unknown vectors of parameters to be estimated for different values of θ in

(0,1); u_θ is the error term which is assumed to have a continuously differentiable cumulative density function $F_{u\theta}\left(.|x\right)$ and a density function $f_{u\theta}\left(.|x\right)$. $F_i\left(.|x\right)$ denotes the conditional distribution function of *y*. By varying the value of θ from 0 to 1, the entire distribution of *y* conditional on *x* can be traced.

The estimator for α_θ is obtained form:

$$\text{Min} \sum_i^n \rho_\theta(y_i - x_i'\alpha_\theta)$$

where $\rho_\theta(u)$ is the "check function" defined as

$$\rho_\theta(u) = \begin{cases} \theta u & \text{if } u \geq 0 \\ (\theta - 1)u & \text{if } u < 0 \end{cases}$$

The estimator does not have an explicit form, but the resulting minimization problem can be solved by linear programming techniques (Koenker and Basset, 1978)

Empirical evidence on the standard model form other studies suggest that total assets, loan to deposit ratio, equity to asset ratio, profitability, competition, location, population growth rate, deposit growth rate, Multi-bank holding company (MBHC), are the main determinants of the loan amounts. The following model can be specified;

$$\text{Quant}_\theta(y_i|x_i) = \alpha_0 + \alpha_\theta' x_i$$

where y_i is the dependent variable at quantile θ. In this study, the dependent variable is used to measure the lending to agriculture; the percentage change in agricultural loans.

The dependent variable is defined as the percentage change in total agricultural loan volume from 2000 to 2005. Commercial banks invest their assets in many different opportunities, including lending to agriculture. Loans can increase/decrease the volume or be unchanged as more funds are moved in/out of agriculture relative to other

investment options. In this study, the characteristics of commercial banks which affect agricultural lending can be analyzed by using the percentage change in agricultural loans as the dependent variable.

Eleven independent variables are chosen to represent the factors affecting the lending to agriculture. Total assets of a bank reflect bank size. Larger banks tend to have more diverse lending opportunities, but also more opportunities to raise deposit funds for lending to agriculture. However, increased bank size could lead to more urbanization of banks. Large banks may be likely to reduce the agricultural lending because they use more centralized lending procedures without local bank personnel in the lending decision.

Equity to asset ratio is a proxy for the capital position of the bank. Equity capital can be another source of funds. Moreover, as the proportion of equity capital declines the risk position of the bank increases and may reduce the impact of the bank to expand its portfolio. Banks with high levels of bank capital are in a better position to take on risk by investing more in loans. It is expected to have a positive impact on the agricultural loan growth.

The loan to deposit ratio is a proxy for the liquidity of the bank and the potential funds available for loan growth. Banks with high loan to deposit levels are limited in the amount of funds available for additional lending. Thus, this ratio can be expected to negatively affect lending to agriculture.

Higher profit rates (ROA) could result from lower cost of funds and also reflect higher loan rates. There are many sources for the banks' profit, but loans in financial institutions are important factor for the profits. Thus, ROA may have positive relationship with the loan growth.

The agricultural loan rate may be an important variable for the change in the agricultural loan rate from 2000 to 2006. Banks that tend to lend a high proportion to agriculture may seek out additional opportunities in agriculture due to their market niche.

Deposit growth rate for each bank reflects the changes in an availability of loanable funds in a bank. Since a bank can have more funds to invest when it has high deposit growth rate, this rate would have a positive impact on the agricultural loan growth.

A financial institution is affected by the competition of other banks and organizations for investment decisions. In this study, Herfindahl and Hirschman Index (HHI) is used for a proxy for the bank competition.[7] The banking industry in rural areas is often less competitive and very concentrated (Collender, ERS). Since there are limited farmers and agribusinesses in a certain areas, banks in rural areas may have limited opportunities to grow. If there were a lot of banks in a small area (lower HHI), banks would try to obtain profits and increase their loans. Therefore there is negative relationship between the change in loans and ratio of the concentration.[8]

A multi-bank holding company (MBHC) provides banks with greater lending capacity, more competitive behavior, stronger risk bearing, more flexible funds acquisition (Barry and Pepper, 1985). Since MBHC should contribute positively to the

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[7] Herfindahl- Hirschmann Index (HHI) shows a degree of concentration of banking market *m*. $HHI = \sum_{i=1}^{n} A_i^2$, where A_i represents the percentage of deposit share of *i*-th bank in a banking market in which total of n banks are operating. Higher HHI means that there are few banks in a certain area and they are in less competitive market while lower HHI means that there are a lot of banks and the market is more competitive.

[8] Since HHI and competition have negative relationship, it is expected that there is a positive relationship between the change in loans and ratio of the competition.

availability of credit services, it is expected to positively affect the agricultural loan growth rate.

The area where banks are located is affected the change in agricultural loans. Since urban banks which are located in a standard metropolitan statistical area (MSA) have more diverse customers, they are more likely to move in and out of agricultural lending. However, rural banks which are more dependent on the agriculture are more likely to lend more money to agriculture. Thus a positive relationship can be expected in the change in agricultural lending.[9]

Population growth rate can be used as a proxy for the changes in the expected loan demand and supply for the funds in each county. Financial institutions located in areas with higher population growth can have more sources for loans and more likely to increase the amount of loanable funds. Thus, population growth rate is expected to have a positive relationship with the agricultural loan growth. The characteristics of the county might affect the lending to agriculture. When a county is specialized and depends on farming rather than other characteristics such as manufacturing, services, a bank has more chance to invest in the agriculture. Thus, this factor is hypothesized to have a positive impact on the agricultural loan growth.

Table 5 shows the descriptive statistics for the variables used in this study for all banks and separated by quantile of the change in agricultural loans. The commercial banks over the 80th quantile experience more than 50% growth in the lending to agriculture, while the banks under the 40th quantile reduced the agricultural loans.

[9] In a model, location variable which is binary is used. Metro area (urban) is denoted '1' and non-metro area (rural), '0'

The asset variables as a measure of absolute size of the banks which are expressed in logarithm have a U-shape relationship with the change in agricultural loans (Figure 1). The highest and lowest quantiles are associated with the highest value of these variables. That is, the mean for the log asset is 12.09 for the 10th quantile and 11.60 for the 90th quatile while middle quantiles such as the 50th and 60th quantiles are 11.27, 11.24 respectively. Higher asset sizes, observed for the highest and lowest quantiles, suggest that the banks with different size shows different pattern in the agricultural loans in 2000 and 2005, that is, larger and smaller banks are more likely to increase or decrease the lending to agriculture. Loan to deposit ratio and the population growth rate variables have a U-shape relation ship with the change in agricultural loans.

The MBHC, agricultural loan rate and ROA presents an inverted U-shape relationship with the agricultural loan growth rate; the higher and lower quantile of the change are associated with a lower agricultural loan rate, ROA, and MBHC (likely to be independent banks). The other variables used in this study do not clearly defined relationships with the change in agricultural loans and the agricultural loan rates. Interestingly, the higher growth in the agricultural loans is associated with higher concentration ratio (HHI) and the lower growth with lower concentration ratio. The mean value of the HHI for the 10th quantile is 3,427.35, but for the 90th quantile it is 3,945.30. The higher growth in agricultural loans is related with the higher deposit growth rate. That is, more funds are available to lend to agriculture. According to the correlation matrix of explanatory variables, which is not provided in this paper, there is no multi-collinearity between the explanatory variables.

Result

The OLS regression results for the change in agricultural loans are reported in the first column in Table 6. Estimated coefficients for the log asset and the deposit growth rate show positive and significant impacts on the change in agricultural loans while the population growth rate has a negative and significant impact on the change in agricultural loans. According to these OLS results, the size of loan to deposit ratio, equity to asset ratio, location, profitability (ROA), concentration (HHI), MBHC, the agricultural loan rate and the characteristic of the county (typology code) have no significant effect on the change in agricultural loans.

In order to emphasize the importance of a quantile regression, the presence of heteroskedasticity and the normality of the OLS errors are tested. According to the results of the Breusch-Pagan test, the hypothesis that the residuals are homoskedatic is rejected. The OLS estimators with heteroskedasticity may be less efficient even though they are still unbiased. The parameter estimates of the quantile regression will be different from each other as well as from the OLS estimates. For normality of the OLS errors, a Jarque-Bera test, a Shapiro-Wilk test, and a Shapiro-Francia test are conducted. From the results of these tests, the non-normality of the residuals was confirmed. The test results of the heteroskedasticity and normality indicate that the quantile estimators may be more efficient relative to the OLS estimators.

Quantile regressions are estimated for the nine quantiles of the change in agricultural loans in Table 6. The pseudo R^2 in the last row, which is developed by Koenker and Machado (1999), is a quantile measure of goodness of fit and has the same role as the R^2 in the OLS regression. Table 6 shows that some effects from the quantile

regression approach appear to be different based on the commercial banks in the distribution of the change in agricultural loans. Interestingly, some variables, such as HHI, ROA, agricultural loan rate, are observed to change signs across quantiles of the coefficients. Figure 2 shows the quantile regression estimates and the OLS estimates. The dashed lines represent the upper and lower bounds of the 95% confidence intervals for each of the quantiles regression estimates. If the OLS estimate is outside of the upper and lower bound for the quantile estimates, then the quantile regression coefficients are significantly different from the OLS coefficients.

The log asset as a measurement of the absolute size of a bank has a positive impact on the change in agricultural loans for the 30th through 90th quantiles and the magnitude of the coefficients is smaller than that of the OLS coefficient except the 90th quantile. Furthermore, except the 90th quantile, the estimated coefficients are significantly different from the OLS estimates. The first panel in Figure 2 illustrates this result, that is, the 95% confidence intervals for the quantile regression estimates are below the OLS estimate. The result indicates that for a bank with medium and high agricultural loan growth, an increase in assets will lead to more lending to agriculture.

Even though the loan to deposit ratio does not have a significant impact in the OLS regression, the ratio negatively affects the change in agricultural loans for the 20th and 80th quantiles and the ratio for the other quantiles is not significant. Banks with high and low growth in agricultural loans are not able to increase additional lending to agriculture. All of the quantile coefficients for the ratio except 20th and 80th quantile are not significantly different form the OLS estimates. The equity to asset ratio has a negative effect on the change in agricultural loans for the 20th through 60th quantile. The

quantile coefficients for the 40th through 60th quantile are significantly different from the OLS estimates. This result suggests that banks in a high agricultural loan growth rate with high equity to asset ratio are less likely to increase the lending to agriculture.

The profitability (ROA) is not significant in the OLS regression even though it was expected that ROA would have a positive impact on the agricultural loan growth. The estimates of the quantiles regression are significantly different from the OLS in the 10th through 60th quantile. The quantile regression has interesting results that the sign changes across quantiles of the coefficients are observed. The ROA positively and significantly affect the change in agricultural loans for the 10th through 50th while it negatively affect for the 90th quantile. According to this result, for low agricultural loan growth banks, higher profitability is associated with an increase in lending to agriculture. On the other hand, for high growth banks, higher profitability is associated with a decrease in agricultural lending. Therefore, higher profitability for banks will results in more lending to agriculture only if the banks have not experienced recent growth in lending to agriculture. This result was only possible to detect by using quantile regression analysis.

The result of the OLS shows that this variable, agricultural loan ratio has no significant impact on the agricultural loan growth. However, the quantile regression provides different results. Like the ROA variable, this variable has a significant, but positive impact for the lower and medium quantiles (10th to 40th) and negative impact for the higher quantiles (70th to 90th) on the agricultural loan growth. The result indicates that banks with lower and medium agricultural loan growth increase the lending to agriculture while banks with higher agricultural loan growth decrease the lending to agriculture. The

estimates of the quantile regression are significantly different from the OLS estimates except for the 60th and 70th quantile.

The deposit growth has a positive impact on the change in agricultural loans for the all quantiles, as the OLS does. However, the estimates of the quantile regression are significantly different from the OLS estimates. In addition, as the quantiles increase, the magnitude of the coefficients also increases. These results indicate that the effect of the deposit growth rate is larger for high growth banks in the agricultural loans than for those with lower growth.

As a measure of the concentration, the HHI has a significant but mixed impact on the agricultural loan growth. For the 20th and 30th quantile, the HHI negatively impact on the growth, but for the 80th and 90th quantile, it has positive impact on the growth. This means that banks in the higher concentration area is more likely to increase the agricultural loan while banks in the lower concentration area are even reducing the agricultural loan. The estimates for the 60th to 90th quantile are not significantly different from the OLS estimates. The MBHC is not significant for the OLS regression, but it has a significant and positive impact on the agricultural loan growth for the 10th quantile only. Since the MBHC is a binary variable, the result indicates that a lower agricultural loan growth MBHC bank increase more agricultural loan than an independent bank.

The location has a significant and negative impact on the change in agricultural loan for the 20th and 30th quantile. The estimates of the quantiles regression are significantly different from the OLS estimates for the 10th to 70th quantile. According to the result, since this variable is also a binary variable, a rural bank in the lower agricultural loan growth increases more the agricultural loan than an urban bank. The

population growth rate has a negative impact on the agricultural loan growth for the all quantiles. The estimates of the quantiles regression are significantly different from the OLS estimates for the 40th to 60th quantile. This result indicates that as the population in a county increases, the agricultural loan growth decreases. This might be because a bank can invest more resources rather than the agriculture as the population grows in its county. The characteristic of county negatively impact on the agricultural loan growth for the 10th and 20th quantile. The coefficients of the quantile regression are significantly different from the OLS coefficients for the 10th to 50th quantiles. From this result, a lower agricultural loan growth bank in the farm-characterized county decreases the agricultural loan. This means that banks in the farm-dependent county is limited to lending to agriculture because they have already invested funds in agricultural loan.

Conclusion

This study examines the effect of selected factors on the change in agricultural loans from 2000 to 2005 with commercial bank data. The study uses a conditional quantile regression method to explore the changing distribution of the agricultural loan growth. Even though the OLS estimation results may provide limited information for the differences in the effects of the characteristics on the change in agricultural loan, the quantile regression method is a useful tool to evaluate the relative importance of the characteristics at different points of the distribution of the agricultural loan growth.

The results indicate that there are three significant characteristics affecting on the agricultural loan growth from the OLS regression while about six different factors are significant in the different quantiles. These results are derived from the quantile

regression which enables to be made of greater information from the sample distribution. An asset and the deposit growth rate has a significant and positive impact, and the population growth rate, loan to deposit ratio, equity to asset ratio, county characteristic and location has a negative impact on the agricultural growth rate. For the ROA, HHI and the agricultural loan rate, their sign of the estimates changes across the quantiles. That is, the high growth bank for the agricultural loan and the low growth bank have different characteristics; for example, a high growth bank with higher profit decreases the lending to agriculture while a low growth bank with higher profit increases the lending to agriculture.

Understanding the characteristics of commercial banks which are affecting the increase in the agricultural loans and properties of rural market will be provided to bank managers to open a new branch and operate an agricultural loan portfolio. The results also provide information and motivation for policy makers to evaluate the effects of the rural banks expansion and behavior of a branch.

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Table 1 Number of banks by asset size (2005)

Asset size group	Agricultural bank			Non-Agricultural bank			Total
	Rural	Urban	Total	Rural	Urban	Total	
1	309	77	386	96	145	241	627
2	1,122	275	1,397	644	979	1,623	3,020
3	413	116	529	565	1,090	1,655	2,184
4	120	45	165	333	1,028	1,361	1,526
5	2	9	11	42	300	342	353
6	0	0	0	3	26	29	29
Total	1,966	522	2,488	1,683	3,568	5,251	7,739

Banks are classified by assets size; group1, assets < $25 mil; group2, $25 mil ≤ assets <$100mil, group3, $100 mil ≤ assets <$250mil, group4, $250 mil ≤ assets <$1 bil, group5, $1 bil ≤ assets <$10bil, group6, $10 bil≤ assets

Table 2 Number of banks by asset size (2001)

Asset size group	Agricultural bank			Non-Agricultural bank			Total
	Rural	Urban	Total	Rural	Urban	Total	
1	478	114	592	137	193	330	922
2	1,271	348	1,619	830	1,311	2,141	3,760
3	345	100	445	590	1,117	1,707	2,152
4	69	34	103	244	824	1,068	1,171
5	1	5	6	22	270	292	298
6	0	0	0	1	19	20	20
Total	2,164	601	2,765	1,824	3,734	5,558	8,323

Banks are classified by assets size; group1, assets < $25 mil; group2, $25 mil ≤ assets <$100mil, group3, $100 mil ≤ assets <$250mil, group4, $250 mil ≤ assets <$1 bil, group5, $1 bil ≤ assets <$10bil, group6, $10 bil≤ assets

Table 3 Bank lending, by size, 2005

Asset size group[1]	Total assets[2]	Avg assets[3]	Total ag. loans[2]	Avg. ag. loans[3]	Ag. loan rate (%)
a. agricultural bank lending					
1	6,787	17,583	1,730	4,481	45.02
2	76,910	55,054	17,626	12,617	39.24
3	79,277	149,862	15,729	29,734	31.52
4	66,165	400,997	11,209	67,931	25.51
5	24,782	2,252,950	3,769	342,607	25.37
6	0	0	0	0	0
Total	253,921	102,058	50,063	20,122	37.53
b. non-agricultural bank lending					
1	4,131	17,140	70	290	3.10
2	101,204	62,356	2,059	1,269	3.35
3	264,965	160,100	4,311	2,605	2.55
4	625,622	459,678	7,863	5,777	1.91
5	855,489	2,501,429	7,771	22,722	1.58
6	673,552	23,225,930	1,432	49,391	0.46
Total	2,524,962	480,854	23,506	4,476	2.58

[1] Banks are classified by assets size; group1, assets < $25 mil; group2, $25 mil ≤ assets <$100mil, group3, $100 mil ≤ assets <$250mil, group4, $250 mil ≤ assets <$1 bil, group5, $1 bil ≤ assets <$10bil, group6, $10 bil≤ assets

[2] In millions of dollars, [3] In thousands of dollars

Table 4 Agricultural bank performance measures

	2005			2001		
	ROE	ROA	L/D ratio[1]	ROE	ROA	L/D ratio[1]
a. agricultural bank lending						
1	5.95	0.67	63.46	5.66	0.65	64.88
2	7.95	0.84	69.50	7.37	0.78	69.54
3	9.00	0.89	74.56	8.32	0.83	73.82
4	9.53	0.88	80.70	8.91	0.80	78.39
5	9.87	0.96	86.50	11.23	0.93	83.76
6	-	-	-	-	-	-
total	7.98	0.83	70.39	7.22	0.76	69.59
b. non-agricultural bank lending						
1	-0.87	-1.24	65.57	0.45	-0.35	65.05
2	4.98	0.42	74.78	5.13	0.48	71.57
3	7.93	0.77	78.29	7.80	0.73	74.68
4	8.86	0.85	81.52	8.55	0.80	77.28
5	9.16	0.91	83.34	9.39	0.87	77.53
6	10.91	1.17	83.52	11.03	0.97	64.19
total	6.95	0.60	79.08	6.58	0.59	73.46

Banks are classified by assets size; group1, assets < $25 mil; group2, $25 mil ≤ assets <$100mil, group3, $100 mil ≤ assets <$250mil, group4, $250 mil ≤ assets <$1 bil, group5, $1 bil ≤ assets <$10bil, group6, $10 bil≤ assets

[1] L/D ratio means loan to deposit ratio.

Table 5. Descriptive statistics by quantiles

		Quantiles									
Variable	All	10th	20th	30th	40th	50th	60th	70th	80th	90th	100th
Agricultural loan growth	26.83	-100.00	-69.22	-20.42	-3.22	9.32	20.90	34.30	52.16	83.02	261.71
Asset (log)	11.50	12.09	11.71	11.29	11.20	11.27	11.24	11.31	11.40	11.60	11.92
Loan to Deposit ratio	0.83	0.88	0.82	0.81	0.78	0.82	0.81	0.84	0.82	0.84	0.85
Equity to Asset ratio	0.10	0.09	0.10	0.10	0.11	0.10	0.11	0.10	0.10	0.09	0.09
ROA	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Agricultural loan rate	0.23	0.20	0.13	0.23	0.27	0.28	0.29	0.27	0.25	0.23	0.15
Deposit growth rate	53.80	-	35.22	31.44	25.30	33.15	31.88	39.40	50.13	69.12	162.46
HHI	3691.10	3427.35	3619.46	3765.20	3660.61	3643.25	3970.09	3530.57	3520.20	3829.46	3945.30
MBHC	0.69	0.39	0.60	0.72	0.76	0.74	0.76	0.74	0.74	0.75	0.70
Location	0.42	0.53	0.54	0.43	0.34	0.32	0.32	0.39	0.41	0.43	0.51
Population growth rate	2.03	2.61	4.43	2.44	0.59	0.33	0.75	0.73	1.82	3.09	3.56
County typology code	0.15	0.120	0.107	0.167	0.150	0.181	0.197	0.161	0.156	0.132	0.093
Observations	5075	508	507	508	507	508	507	509	506	508	507

Table 6 OLS and Quantile Regression Results for the change in agricultural loans from 2000 to 2005

		quantile								
	OLS	10th	20th	30th	40th	50th	60th	70th	80th	90th
Asset (log)	10.652	-0.503	0.758	3.109	3.413	2.989	2.735	2.813	3.150	12.202
	(5.63)**	(-0.4)	(0.77)	(4.04)**	(4.58)**	(3.62)**	(3.06)**	(2.58)**	(2.84)**	(5.59)**
Loan to Deposit ratio	3.230	-2.028	-6.358	1.612	0.627	-1.182	-2.954	-6.765	-14.617	-15.464
	(0.46)	(-0.4)	(-1.79)*	(0.58)	(0.23)	(-0.38)	(-0.83)	(-1.43)	(-2.61)**	(-1.07)
Equity to Asset ratio	-15.279	-64.886	-57.151	-56.150	-69.560	-70.560	-60.670	-30.771	-22.770	72.066
	(-0.28)	(-1.95)*	(-2.14)**	(-2.62)**	(-3.29)**	(-2.99)**	(-2.35)**	(-0.97)	(-0.71)	(1.11)
ROA	-194.87	1119.19	1000.07	697.75	409.59	350.71	242.55	-121.78	-298.50	-1134.37
	(-0.47)	(3.93)**	(4.73)**	(4.15)**	(2.5)**	(1.96)**	(1.28)	(-0.52)	(-1.25)	(-2.24)**
Agricultural loan rate	-11.093	58.859	47.852	41.288	39.934	26.928	6.086	-13.418	-35.368	-69.207
	(-0.85)	(6.16)	(6.59)**	(7.45)**	(7.63)**	(4.71)**	(0.99)	(-1.82)*	(-4.62)**	(-4.63)**
Deposit growth rate	0.612	0.218	0.333	0.420	0.493	0.591	0.651	0.819	1.024	1.340
	(37.53)**	(18.17)**	(38.33)**	(64.76)**	(77.54)**	(86.02)**	(96.09)**	(101.34)**	(126)**	(84.6)**
HHI	0.0008	0.0000	-0.0006	-0.0007	0.0001	0.0001	0.0002	0.0002	0.0008	0.0016
	(1.11)	(-0.01)	(-1.68)*	(-2.38)**	(0.45)	(0.41)	(0.65)	(0.41)	(1.9)*	(2.03)**
MBHC	-0.1190	2.9811	2.4763	1.9981	-0.8299	-1.4166	-1.1923	0.3067	-0.7421	-5.4308
	(-0.03)	(1.67)*	(1.33)	(1.33)	(-0.57)	(-0.88)	(-0.68)	(0.15)	(-0.35)	(-1.33)
Location	2.5915	-2.9268	-3.5020	-3.8194	-2.0645	-1.2135	-1.3060	-2.3056	0.9327	-0.8043
	(0.69)	(-1.31)	(-1.86)*	(-2.54)**	(-1.41)	(-0.74)	(-0.74)	(-1.09)	(0.44)	(-0.21)
Population growth rate	-0.5869	-0.5165	-0.6195	-0.4721	-0.3002	-0.2683	-0.2988	-0.3531	-0.6417	-0.7569
	(-2.42)**	(-3.26)**	(-5.02)**	(-4.83)**	(-3.14)**	(-2.53)**	(-2.61)**	(-2.51)**	(-4.7)**	(-2.94)**
County typology code	5.0218	-8.6293	-5.1424	-2.5061	-2.3495	-0.9999	1.2123	0.1295	0.3630	3.2432
	(1.00)	(-2.78)**	(-1.99)**	(-1.23)	(-1.19)	(-0.46)	(0.51)	(0.05)	(0.13)	(0.61)
Constant	-109.18	-42.45	-35.71	-54.68	-47.46	-31.14	-14.53	-0.81	13.78	-59.83
	(-4.48)**	(-2.61)**	(-2.81)**	(-5.53)**	(-4.96)**	(-2.93)**	(-1.26)	(-0.06)	(0.94)	(-1.99)**
Observation	4368	4368	4368	4368	4368	4368	4368	4368	4368	4368
R^2/pseudo R^2	0.2701	0.063	0.0672	0.0857	0.1093	0.1389	0.1697	0.2067	0.2572	0.3347

Note: t-statistics (OLS) and bootstrap t-statistics (Quantile regression) are in parentheses, * and ** denote coefficients that are significantly different from zero at the 10%, and 5% significance level, respectively.

Figure 1 Mean Values of Selected Variables by Quantiles of the percentage change in agricultural loans

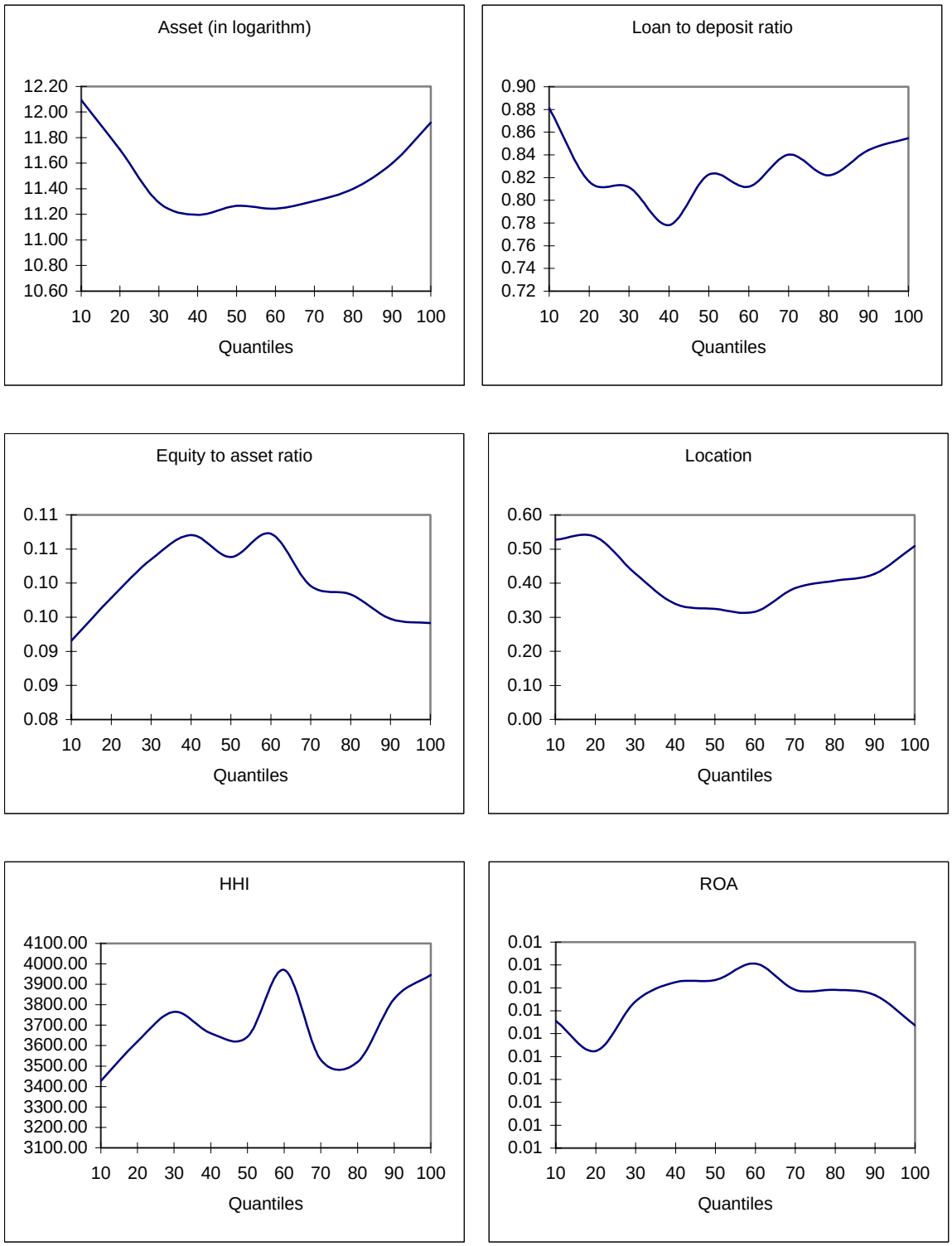
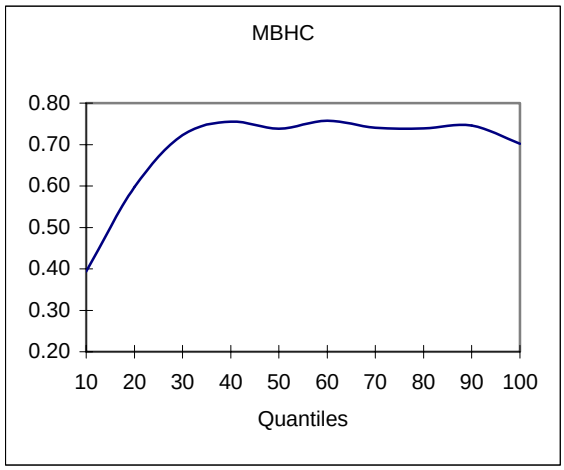
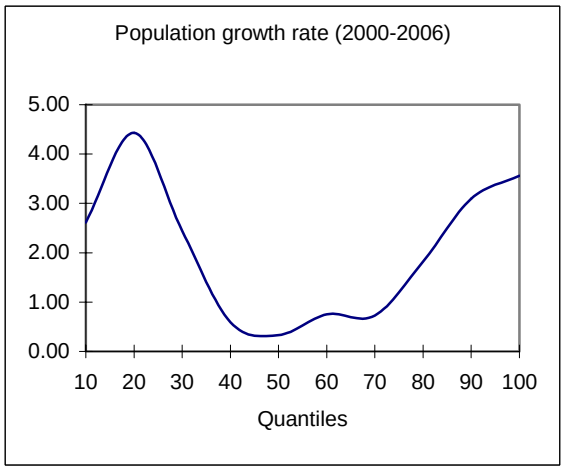
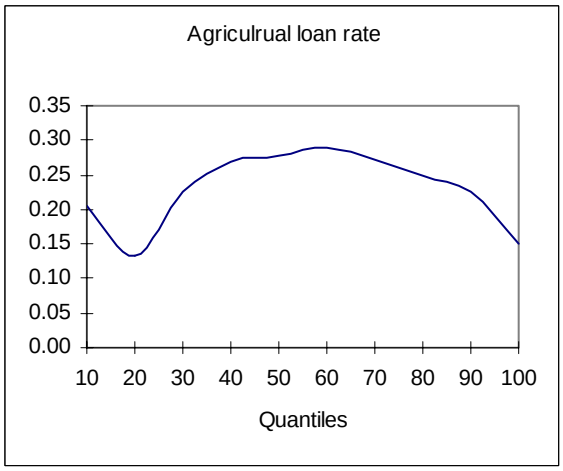
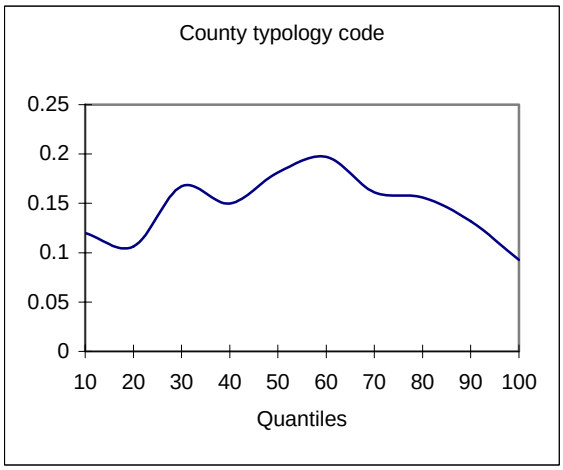


Figure 1 Mean Values of Selected Variables by Quantiles of the percentage change in agricultural loans (Cont')









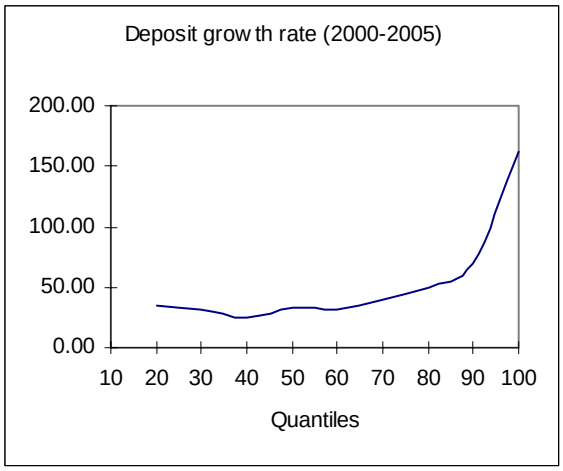


Figure 2 Quantile Regression Results

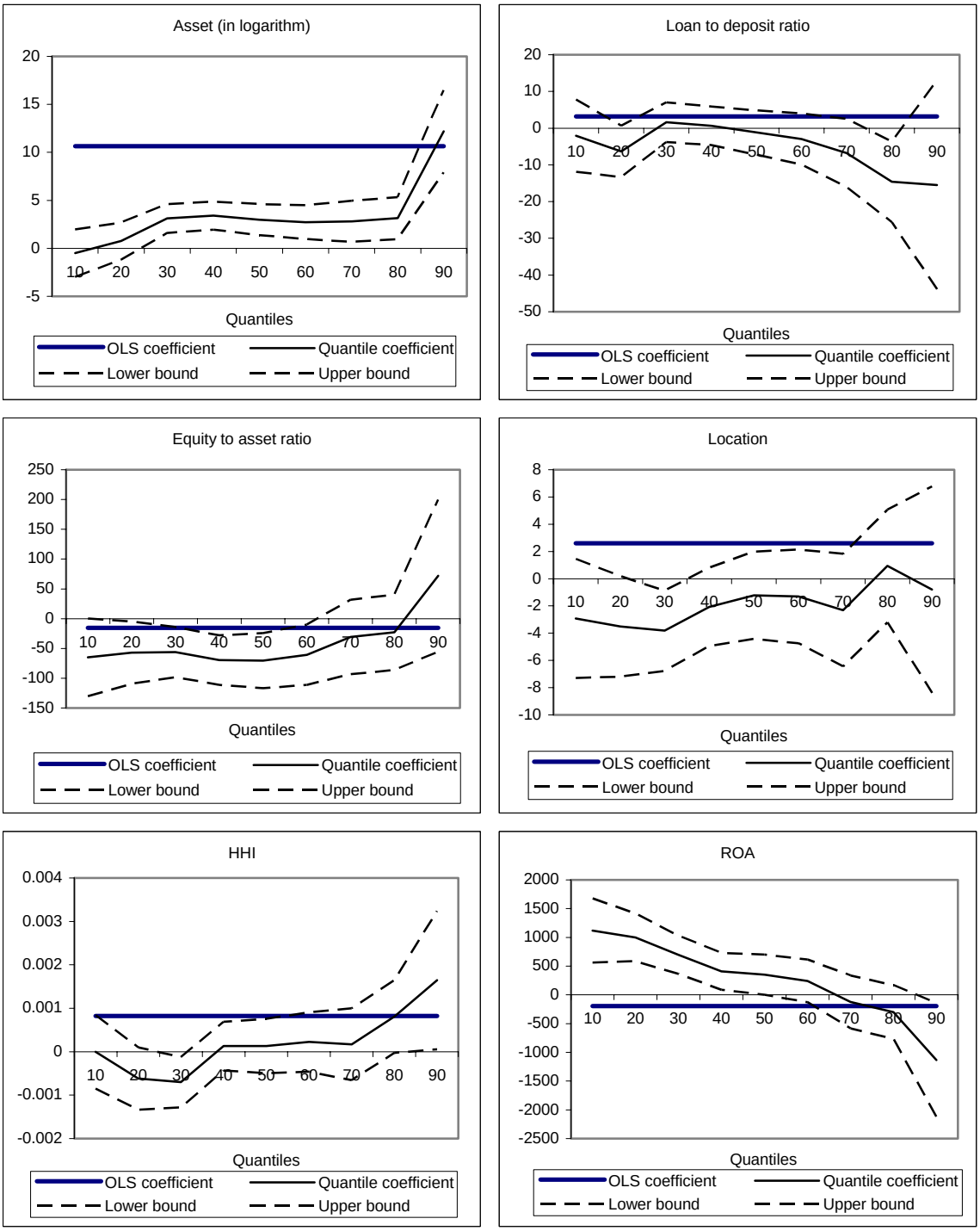


Figure 2 Quantile Regression Results (cont')