Essays on Banking and Agricultural Finance

by

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B.S., Tribhuvan University, 2010

M.S., Louisiana State University, 2014

M.A., Kansas State University, 2017

AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the
requirements for the degree

DOCTOR OF PHILOSOPHY

Department of Agricultural Economics
College of Agriculture

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2019

Abstract

Financing agriculture has been both an opportunity and a challenge for agricultural banks. Portfolio returns on agricultural banks depend on the profitability of agricultural lending. Changes in the agricultural economy and public policies shape that profitability. A downturn in the agricultural sector adversely affects that success. The regulatory environment also influences the structure and performances of agricultural credit market. Competition with the tax-favored Farm Credit System is another for U.S. agricultural banks. The three essays of this dissertation look at these different dimensions of banking competition and financial policies and their potential effects on the commercial agricultural banks.

The first essay examines the impact of bank competition on performance and financial stability of agricultural banks using the Reports of Conditional and Income data. A Lerner index is constructed as a measure of market power. A Z-score is used as a measure of bank riskiness.The return on assets, return on equity, agricultural loan volume and proportion of agricultural loans to the total loans are used as performance measures. Results indicate that bank competition has a U-shaped effect on the probability of default, and an inverted U-shaped effect on volume and proportion of agricultural lending. There also exists an evidence of positive but non-linear effects of bank market power on the profitability of agricultural banks.

The second essay examines the effects of the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010 (Dodd-Frank Act) on cost efficiency, returns to scale and productivity growth measures between big banks and small agricultural banks. The Dodd-Frank Act was intended to reduce the too-big-to-fail practices for very large banks (with asset size above $10 billion and above $50 billion). However, it may have affected the performance of relatively small asset sized banks with different lending portfolios. Using the Reports of Conditional and Income data from 2006 to 2016, results indicate that the Dodd-Frank

Act increased cost efficiency, decreased merger incentives and encouraged product specialization for banks above the $50 billion asset size. However, these results do not hold for the banks near the $10 billion asset size. The Act reduced agricultural banks' cost efficiency and increased incentives for mergers. In addition, the Dodd-Frank Act has dampened the incentives of agricultural banks to specialize in agricultural lending. Likewise, evidence exists that this act has slowed productivity growth, efficiency and technological change in agricultural banks. Taken together, the Dodd-Frank Act reduced consolidations in very big banks that are subject to the greater oversight but adversely affected U.S. agricultural lending.

The third essay identifies the impact of corporate income tax treatment to the Farm Credit System (FCS) on farm debt share and its consequences on borrowing costs for the farm loans. Also, the spillover effects of market share on interest rates on agricultural loans are estimated. This research finds that a 10 percent increase in state (federal) level corporate income tax is associated with 1.76 percent (3.76 percent) increase in FCS total farm debt market share. For a 10 percent rise in the farm credit system's total farm debt market share results in a 0.06 percent increase in the estimated interest rate of total farm debt. Moreover, state level farm financial measures are also crucial in determining the change in market share of farm credit system and interest rate on the agricultural loan.

This dissertation makes three contributions in the banking and agricultural finance literature. First, a competition enhancing (reducing) regulation may improve the financial health of agricultural banks as well as their agricultural lending in the more (less) concentrated agricultural banking market. Second, the Dodd-Frank Act has an indirect and adverse impact on agricultural banking though it may have reduced an incentive to merge in big banks. Third, favorable tax treatment for the FCS has adversely affected the market competitiveness of agricultural banks that may have imposed an indirect burden to the farm households through higher interest rates.

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Approved by:

Major Professor
Allen M. Featherstone

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Acknowledgments

First of all, I would like to express my deepest gratitude to my major professor Dr. Allen M. Featherstone. I am extremely grateful for his guidance, support, and encouragement. Thank you so much, Dr. Featherstone!

I am also grateful to my dissertation committee members, Dr. Jesse B. Tack, Dr. Mykel R. Taylor and Dr. Eric Higgins for making this dissertation possible. I truly appreciate the opportunity to learn invaluable research skills from Dr. Tack.

I am also grateful to all of my professors from the Department of Agricultural Economics and Department of Economics. Special thanks to Dr. Christine Wilson, Dr. Nathan Hendricks, Dr. Jason Bergtold, Dr. Brian Briggeman, Dr. Terry Griffin and Dr. Vincent Amanor-Boadu for their guidance and support throughout my Ph.D. I am also thankful to Dr. Ansley Chua from K-State Finance Department and Dr. Cortney Cowley from the Federal Reserve Bank of Kansas City for their help to access data for my dissertation research.

I am very thankful to all of my friends from the Department of Agricultural Economics, Department of Economics and the Nepalese Student Association at K-State. I am also grateful to the Department of Agricultural Economics staffs, Judy, Deana, and Mary for making my Ph.D. life a wonderful family experience.

I could not have made it through my doctorate without my family. I am most thankful for my parents who sacrificed so much so that I could have a better education. I am also thankful to my sisters. To my beautiful wife and love of my life, Elina, I am extremely grateful for your unwavering love, care, support, and encouragement. To my dear son, Elon, thank you so much for bringing joy and happiness to your Ph.D. parents.

Dedication

This dissertation is dedicated to my late father Puspa Raj Regmi, my mother Rina Kumari Regmi, my wife Elina Adhikari, and my son Elon Regmi.

Chapter 1

Introduction

Commercial banks are crucial for the success of the U.S. agricultural economy. They supply more than forty percent of U.S. farm debt (Figure 1.1), with a share of non-real estate farm debt of almost fifty percent (Figure C.2). Farms and agribusiness are depositors (sources of loanable funds) and key borrowers (customers of farm loans) for small agricultural banks located in the farming region. Thus, financially sound and efficient agricultural banking signals a better agricultural economy and vice versa.

The number of U.S. agricultural banks has been declining. It declined by almost fifty percent between 1994 and 2013 (Figure 1.2). It indicates a potential decline in competition and a potential increase in market power in the farm credit market. Bank consolidation may affect relationship lending in the agricultural sector. More concentrated banking may be disadvantageous for agricultural lending, it might reduce access to credit (Cetorelli and Strahan, 2006) and increase restrictions on loan contracts due to information asymmetry (Hollander and Verriest, 2016). Kandilov and Kandilov (2017) suggest that lower bank competition may have an adverse impact on the agricultural producers. About 90 percent of agricultural banks are small banks. To identify the effect of bank consolidation on agricultural lending, it is critical to determine its role on the financial stability and performances of agricultural banks.

There are two opposite views on the effect of bank competition on stability. There are the "competition-fragility" (Keeley, 1990) and "competition-stability" (Boyd and De Nicolo, 2005) views. Martinez-Miera and Repullo (2010) combine these two views and argue that the risk-shifting effect dominates in the monopolistic markets and margin effects dominate in the competitive markets. It implies a U-shaped relationship between bank competition and the risk of bank failure. Studies estimating the effect of bank competition on profitability generally find a greater profitability under higher bank concentration. However, empirical research that focuses only on agricultural banks is lacking. The general findings may or may not hold for agricultural banks. Changes in the agricultural economy affect agricultural bank performance. An economic downturn in agriculture may not significantly impact the non-agricultural banks. Thus, following the structure-conduct-performance paradigm from industrial organization, the first essay of this dissertation examines the effect of bank competition on financial health and performance of agricultural banks.

An external constraint that affects the performance of the agricultural banks is bank regulation. In response to the financial crisis of 2008 and to stabilize the U.S. financial system, the Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act) was enacted in 2010. Dodd-Frank Act intended to directly target big banks. Small banks are also subjected to a higher regulatory burden. Evidence exists that the Dodd-Frank Act improved the market discipline of large banks (Balasubramnian and Cyree, 2014) and decreased the risk-taking of the largest financial institutions (Akhigbe et al., 2016). However, it indirectly adversely affected small banks through higher regulatory compliance burden (Peirce et al., 2014; Wille et al., 2017).

Banks may respond to the higher regulatory burden of the Dodd-Frank Act by changing the types and ranges of financial services offered. Agricultural banks may respond by changing the portfolio of agricultural lending. These potential changes in the portfolio of agricultural banks may impact the overall performance of U.S. agriculture. It is critical to determine whether the Dodd-Frank Act has a different effect on the efficiency and productivity growth across bank types. The second essay of this dissertation quantifies and compares the effects of the Dodd-Frank Act on cost efficiency, returns to scale and productivity growth measures between big banks and small agricultural banks.

Tax policy is another important factor that may affect the market competitiveness of commercial banks in agricultural lending. Commercial agricultural banks and the Farm Credit System (FCS) are the two dominant farm debt suppliers. They together supply more than 80 percent of U.S. total farm debt in recent years. The FCS is a Government Sponsored Enterprise that receives more favorable tax treatment. FCS profits on real estate loans are exempt from local, state and federal corporate income taxes; whereas, profits from the non-real estate loans are exempt from local and state corporate income tax (Ely, 2006). The FCS tax advantage is estimated to be $850 million for 2005 and first half of 2006 (Ely, 2006). However, commercial banks lending to agriculture do not receive these tax benefits.

Past studies have examined whether a tax exemption and market share or social welfare are linked. The majority of these studies focus on for-profit versus the non-profits and credit unions versus banks. Hansmann (1987) finds that a higher market share for non-profit firms is associated with a higher corporate income tax exemption. Harris and Strouse (1997) argue that the property tax exemption for a non-profit hospital is not justifiable because of its insufficient charity care. However, there is a limited empirical research on the impact the FCS tax law has on market share. Market share is a source of increased profit (Rhoades, 1985), thus, it is crucial to determine the effect of FCS tax law on the U.S. agricultural credit market. The third essay of this dissertation examines whether the market competitiveness of farm loan suppliers is affected by the FCS tax advantage. Further, the third essay also evaluates its potential spillover on the cost of borrowing on agricultural loans.

This dissertation addresses three issues (competition, regulation, and taxation) in banking for agricultural sector. The first and second essays use the bank-quarterly Reports of Conditional and Income data to address the issues related to competition and the regulation. The third essay uses a merged state-year level average effective tax rate and farm statistics. The key findings from the first essay indicate that bank market power has a U-shaped effect on agricultural bank failure and an inverted U-shaped effect on the size and proportion of agricultural lending. Higher market power is associated with greater profitability in agricultural banking. The second essay indicates that the Dodd-Frank Act reduced economic incentives for mergers in very large banks (above $50 billion in assets). However, the Dodd-

Frank Act reduced the incentives to specialize in agricultural lending and slowed productivity growth for the agricultural banks. The third essay finds that favorable tax treatment increased the FCS farm debt share by a small amount in the U.S. agricultural credit market. A higher market competitiveness of FCS is associated with the slightly higher cost of borrowing on agricultural loans.

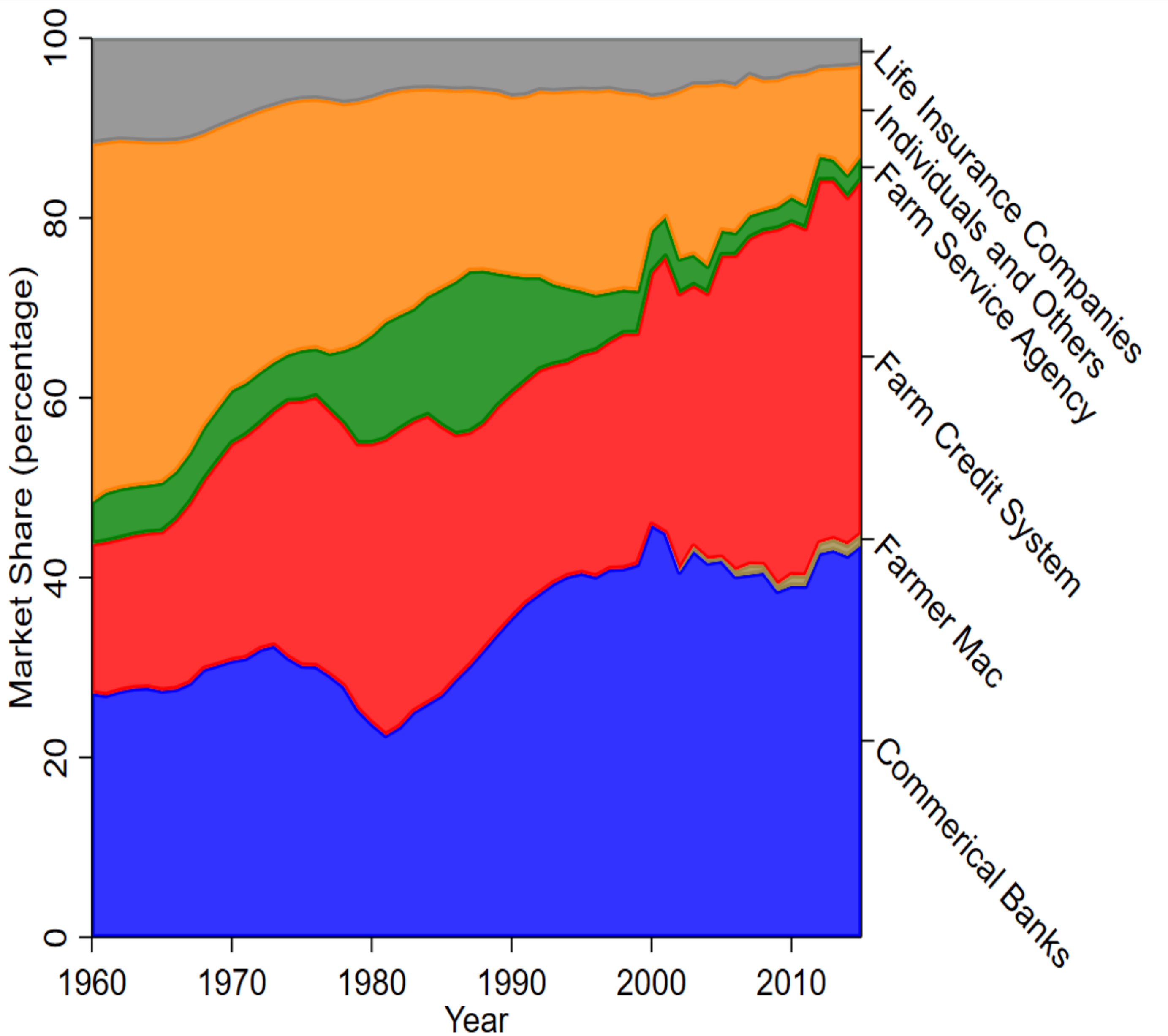

Figure 1.1: *Market Shares of Total Farm Debt.*

Note: This figure is developed by author using the USDA ERS data.

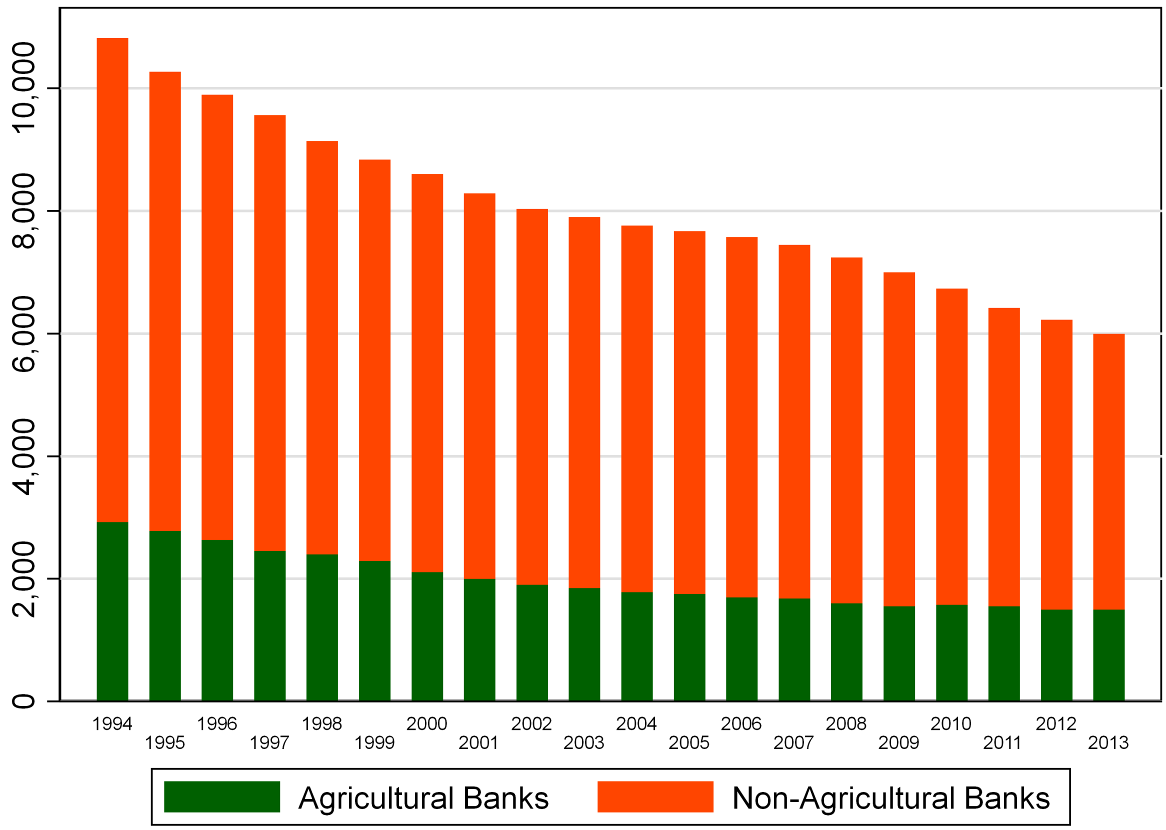

Figure 1.2: *Number of Agricultural and Non-agricultural Banks in the U.S.*

Note: This figure is developed by author using the Call Report data. Agricultural banks represent the banks with more than 25% of agricultural loans in their total loan portfolio.

Chapter 2

Competition, Performance and Financial Stability in the U.S. Agricultural Banking

2.1 Introduction

There is a decreasing trend in the number of U.S. commercial banks as the number of banks fell from 10,821 to 5,997 from 1994 to 2013 (see Figure 1.2) resulting in increased consolidation. The decrease in the number of banks may reduce bank competition. Does this potential increase in market power make the banking sector more vulnerable? Specifically, can small banks (less than 250 million dollars in total assets size) compete in this changing scenario? Many small banks lend to the agricultural sector. Almost 90 percent of agricultural banks (the share of agricultural loans to total loans greater than 25 percent) are small banks. The number of U.S. agricultural banks has declined from 2,927 in 1994 to 1,500 in 2013 (see Figure 1.2). Thus, the major focus of this study is to understand whether the risk of failure and the performance of agricultural banks has been affected by the consolidation.

The effect of bank competition on stability has been studied widely. There is a theoretical debate in the general finance literature on the relationship between competition and financial stability. Two of the most popular views are competition-fragility and competition-stability. The former is called the franchise value paradigm for bank risk taking. The argument is that higher bank competition decreases market power and lowers the profit margin (reduces franchise value), which encourages banks to adopt risk-taking strategies to increase returns (Keeley, 1990). The competition-stability view suggests that higher competition increases financial stability (Boyd and De Nicolo, 2005). The argument is that lower competition (higher market power) leads to higher interest rates for borrowers that could increase bankruptcy risk for banks. Borrowers facing higher interest rates may take more investment risk under a moral hazard environment that might increase the borrowers default risk (risk shifting) that in turn leads to an increase in non-performing loans (i.e. a higher default risk) for banks (Stiglitz and Weiss, 1981). Martinez-Miera and Repullo (2010) combine these two conflicting arguments, arguing that there is a U-shaped (non-linear) relationship between bank competition and the risk of bank failure. Martinez-Miera and Repullo (2010) identified two opposite effects: a risk-shifting effect and margin effect. As suggested by Boyd and De Nicolo (2005), the risk-shifting effect indicates that higher competition leads to a lower interest rate that might lower a borrowers bankruptcy and thereby results in lower risk of bank default. Whereas, the margin effect indicates that higher competition reduces interest rates and hence lowers revenue from performing loans that may lead to a higher risk of bank failures. Martinez-Miera and Repullo (2010) find a U-shaped relationship because the risk-shifting effect dominates in monopolistic markets and margin effect dominates in the competitive markets.

Previous studies have also explored the effect of competition on bank profitability and performance measures. Evidence exists that higher bank concentration leads to an increase in bank profitability (Sufian et al., 2011; Tregenna, 2009). Mirzaei et al. (2013) find that lower competition results in higher bank profitability for advanced economies. Others suggest a positive relationship between diversification and bank profitability (Dietrich and Wanzenried, 2011; Goddard et al., 2004, 2013).

Despite this previous research, there is a lack of literature on the impact of competition on stability and performance of U.S. agricultural banks. Agricultural banks hold more than forty percent of the U.S. farm debt, the share of non-real estate farm debt is almost fifty percent. The decrease in the number of banks or the level of competition in agricultural banking may cause an adverse effect on relationship lending. This may occur because more concentrated banking makes it more difficult to access the credit (Cetorelli and Strahan, 2006). Further, loan contracts are likely to be more restrictive due to an increase in information asymmetry (Hollander and Verriest, 2016). The decrease in bank competition may have an adverse effect on agricultural producers (Kandilov and Kandilov, 2017). Thus, this study identifies the effect of bank competition on the financial health and performance of agricultural banks.

This study uses Call Report data to estimate the impact of bank competition on performance and financial stability of agricultural banks. A Lerner index is constructed at the bank year level to measure competition. A Z-Score is constructed to measure bank stability. Similarly, the return on assets (net income to total assets ratio), return on equity (net income to the total equity ratio), agricultural loan ratio and agricultural loan volume are used as the performance measures for agricultural banks. The key finding of the research is that an increase in the market power in the U.S. agricultural banking market leads to U-shaped effect on the probability of default and an inverted U-shaped effect on agricultural loan volume and agricultural loan ratio. In addition, higher market power is associated with higher profitability for agricultural banking.

Data and Method

2.1.1 Bank Competition Measures

The Lerner index is one of the commonly used measures of competition (market power) in the banking literature. It is defined as a ratio of markup (price minus marginal cost) to the price of the bank. Its value ranges from 0 (perfect competition) to 1 (monopoly). The Lerner index for a bank i at time t can be expressed as:

$$LernerIndex_{it} = \frac{P_{it} - MC_{it}}{P_{it}} \tag{2.1}$$

where P_{it} is the price of total assets and MC_{it} is the marginal cost for bank i at time t. Koetter et al. (2012) is followed to obtain the estimate of a bank's asset price and marginal cost. The bank asset price is proxied by the ratio of total revenue (interest and non-interest income) to total assets. To obtain marginal cost, a translog cost function is estimated for a sample of 497,630 observations at the bank quarter level. Following Koetter et al. (2012), total operating cost (TC_{it}) is a function of three input prices (price of borrowed funds ($W_{j=1,it}$), price of capital ($W_{j=2,it}$) and price of labor ($W_{j=3,it}$)). There are two outputs: total loans ($Y_{p=1,it}$) and total securities ($Y_{p=2,it}$), and time trend[1] (T). The translog cost function for bank i at time t is,

$$\begin{aligned} lnTC_{it} = \alpha + \sum_{j=1}^{3}\gamma_{j,w}ln(W_{j,it}) + \left(\frac{1}{2}\right)\sum_{j=1}^{3}\sum_{k=1}^{3}\gamma_{jk,ww}ln(W_{j,it})ln(W_{k,it}) \\ + \sum_{j=1}^{3}\sum_{p=1}^{2}\gamma_{jp,wy}ln(W_{j,it})ln(Y_{p,it}) + \sum_{p=1}^{2}\gamma_{p,y}ln(Y_{p,it}) + \left(\frac{1}{2}\right)\sum_{p=1}^{2}\sum_{q=1}^{2}\gamma_{pq,yy}ln(Y_{p,it})ln(Y_{q,it}) \\ + \gamma_{e}ln(E_{it}) + \sum_{j=1}^{3}\gamma_{jT,w}Tln(W_{j,it}) + \sum_{p=1}^{2}\gamma_{pT,y}Tln(Y_{p,it}) + \gamma_{T}T + \gamma_{T2}T^{2} + \mu_{it} \end{aligned} \quad (2.2)$$

To estimate the translog cost function, symmetry ($\gamma_{jk,ww} = \gamma_{kj,ww}$) and linear homogeneity in input prices ($\sum_{j=1}^{3}\gamma_{j,w} = 1, \sum_{j=1}^{3}\sum_{k=1}^{3}\gamma_{jk,ww} = 0, \sum_{p=1}^{2}\gamma_{jp,wy}$ and $\sum_{j=1}^{3}\gamma_{jT,w}$) are imposed. These conditions are imposed by dividing all factor prices and total operating cost by the price of borrowed funds ($W_{j=1,it}$) before the logarithmic transformation. The normalized variables are denoted with the tilde symbol. Spierdijka and Zaourasa (2018) is followed

[1] Time trend accounts for the technological progress.

closely for the notations of normalized equations. The normalized translog cost function is:

$$
\begin{aligned}
ln\widetilde{TC}_{it} &= \alpha + \sum_{j=2}^{3}\gamma_{j,w}ln(\widetilde{W_{j,it}}) + \left(\frac{1}{2}\right)\sum_{j=2}^{3}\sum_{k=2}^{3}\gamma_{jk,ww}ln(\widetilde{W_{j,it}})ln(\widetilde{W_{k,it}}) \\
&+ \sum_{j=2}^{3}\sum_{p=1}^{2}\gamma_{jp,wy}ln(\widetilde{W_{j,it}})ln(Y_{p,it}) + \sum_{p=1}^{2}\gamma_{p,y}ln(Y_{p,it}) + \left(\frac{1}{2}\right)\sum_{p=1}^{2}\sum_{q=1}^{2}\gamma_{pq,yy}ln(Y_{p,it})ln(Y_{q,it}) \\
&+ \gamma_{e}ln(E_{it}) + \sum_{j=2}^{3}\gamma_{jT,w}Tln(W_{j,it}) + \sum_{p=1}^{2}\gamma_{pT,y}Tln(Y_{p,it}) + \gamma_{T}T + \gamma_{T2}T^{2} + \mu_{it} \qquad (2.3)
\end{aligned}
$$

The sum of derivatives of the cost function with respect to total loans ($Y_{p=1,it}$) and total securities ($Y_{p=2,it}$) yields the marginal cost (MC_{it}) for bank i at time t :

$$
\begin{aligned}
MC_{it} &= \frac{TC_{it}}{Y_{it}}\frac{\partial lnTC_{it}}{\partial Y_{it}} = \frac{TC_{it}}{Y_{it}}\Bigg(\sum_{p=1}^{2}\gamma_{y,p} + \sum_{j=2}^{3}\sum_{p=1}^{2}\gamma_{jp,wy}ln(\widetilde{W_{j,it}}) \\
&+ \sum_{p=1}^{2}\gamma_{pp,yy}ln(Y_{p,it}) + \left(\frac{1}{2}\right)\gamma_{12,yy}ln(Y_{1,it})ln(Y_{2,it}) + \sum_{p=1}^{2}\gamma_{pT,y}T\Bigg) \qquad (2.4)
\end{aligned}
$$

2.1.2 Bank Stability (Solvency Risk) and Performance Measures

Following (Almarzoqi et al., 2015; Imbierowicz and Rauch, 2014), the Z-score (Roy, 1952) is constructed as a measure of a bank stability. It measures the distance bank is from insolvency (distance to default). The Z-score (Z_{it}) for bank i at time t can be obtained as:

$$Z_{it} = \frac{ROA_{it} + EA_{it}}{\sigma(ROA)_{it}} \qquad (2.5)$$

where ROA_{it} is the return of assets, EA_{it} is the ratio of total equity to total assets and $\sigma(ROA)_{it}$ is the standard deviation of the ROA. A higher Z-score implies a lower probability of bank failure. Eight quarter (two year) rolling windows are used to calculate the standard deviation of ROA (Imbierowicz and Rauch, 2014). Further, the Z-score with a natural logarithmic transformation is used for the estimations because of its higher skewness (Imbierowicz and Rauch, 2014; Laeven and Levine, 2009). In this study, return on assets (net income to total assets ratio) and return on equity (net income to the total equity ratio) are used as the profitability measures. The volume of agricultural loans and ratio of agricultural loans to total loans are used to measure the impacts of agricultural lending.

2.1.3 Data

Call Report data from 1994 to 2013 at the bank-quarter level (630,763 observations) are used for all institutions chartered as commercial banks. All of the monetary variables are deflated using 2013 as the base year. The methods of Koetter et al. (2012) are followed to clean the data. Columbia and South Dakota are dropped from the estimation sample due to their exceptional credit card business (Koetter et al., 2012). Observations with negative or missing values of three input prices (price of fixed asset, price of labor and price of borrowed funds), two outputs (total securities and total loans), total costs, profits before tax, total equity and total assets are not included. Koetter et al. (2012) didn't mention the cut off threshold they used to trim the outliers. Variables are winsorized at the 1^{st} and 99^{th} percentiles. This leads to a sample of 497,630 observations at the bank quarter level.

Table 2.1 shows the summary statistics of the variables used in this study [2]. The reported statistics are in 2013 U.S. dollars. Table 2.1 reports the values of these variables at 5^{th} (P5) and 95^{th} (P95) percentiles. The total operating cost is sum of interest expenses on deposits, interest expenses on federal funds, provision for loan and lease losses, expenditures on premises and fixed assets, and salaries and employee benefits. The average operating cost of banks in the final estimation is \$5,066,000. The price of fixed assets is obtained by dividing the expenditure on fixed assets by the premises and fixed assets. The average expenditures on fixed assets is 21.1% of premises and fixed assets. The price of labor is a ratio of salary and employee benefits to the number of full time equivalent employees. The average salary is \$35,640. The price of borrowed funds is constructed by dividing the interest expense on

[2] Notice that the number of observations associated with Z-score is lower than other variables. It is because the Z-score contains missing values due to missing values in the denominator term of the z-score (the standard deviation of return on assets). As mentioned in the previous section, two years (eight quarters) rolling window is used to obtain the standard deviation of return on assets. Since the standard deviation of a single number is not possible, the statistical program skipped the first observation. Thus, most of the missing observations are from the first quarter of 1994.

deposits and federal funds by the sum of total deposits and federal funds purchased. On average 1.6% of total deposits and federal funds is the interest expense on these two items. The average loans and leases is \$121.77 million, average securities (sum of held to maturity and available for sale securities) is \$46.091 million, average equity capital is \$18.585 million, average assets is \$190.138 million, average net income is \$1.254 million and average deposits is \$158.856 million. Average agricultural loans are \$5.522 million and the loan loss provision is \$0.293 million.

Figure 2.1 illustrates the Lerner index and the Z-score for agricultural banks over the study time period. There is an increase in market power of agricultural banks from 0.183 in 1994 to 0.395 in 2013. Market power increased from 2001 to 2005 but decreased just before and during the financial crisis. Market power has an upward trend after financial crisis. Figure 2.1 illustrates the Z-score over the study period. The average Z-score decreased from 45.07 in 1994 to 42.14 in 2013. There is a sharp decline in the Z-score in 1995, then it fluctuates afterward. There is an improvement in the Z-score after 2000 until the financial crisis. After 2009, the Z-score increases and maintains a relatively high level. Agricultural banks have recovered from a period of fragility after 2008 financial crisis.

Figure 2.2 plots the profitability of agricultural banks as measured by the return on assets (ROA) and the return on equity (ROE). There is little change in the ROA from 0.788% in 1994 to 0.744% in 2013. Similarly, there is a slight change in ROE from 7.82% in 1994 to 7.20% in 2013. The trend indicates that profitability is slightly high before 2005 than after. Also, there is an improvement in the profitability of agricultural banks after the financial crisis coinciding with high profitability in the agricultural sector.

Figure 2.3 illustrates agricultural loan volume and the agricultural loan ratio over time. Average agricultural loan volume increases from \$11.4 million in 1994 to \$41.10 million in 2013. While the share of agricultural loans to total loans increases from 30% in 1994 to 46% in 2013. There is an increasing trend of both measures of agricultural lending.

Overall, market power, financial stability, the volume of agricultural loans and proportion of agricultural loans to the total loans increases over the twenty year study period. Average profitability remains about the same. Table A.1 shows the average of competition, financial stability and performance measures for agricultural banks over the study period.

2.2 Identification and Empirical Framework

To identity the impact of competition on financial stability and performance measures, a two-way fixed effect regression model[3] is estimated:

$$Y_{it} = B_i + T_t + \alpha Y_{it-1} + \gamma_1 LI_{it} + \gamma_2 {LI_{it}}^2 + \beta X_{it} + \delta C_{dum} + \epsilon_{it} \tag{2.6}$$

where Y_{it} denotes the response variables that include a measure of financial stability (logarithm of z-score), return on assets, return on equity, volume of agricultural loan and agricultural loan ratio; LI_{it} represents the Lerner index; X_{it} represents the bank level controls for bank i at time t. These control variables are the quadratic Lerner index, logarithm of total assets, loan loss provision to asset ratio, deposit to loan ratio and non-interest income to interest income ratio. Similarly, C_{dum} denotes the crisis dummy (C_{dum} takes the value of 1 for 2008 onwards). The year fixed effects (T_t) captures temporal variation. The bank fixed effects (B_i) accounts the bank level unobserved heterogeneity. To account for the possible correlation between the quarterly observations for each bank, robust standard errors (also known as Huber-White or Sandwich estimators) are clustered at the bank level. Regression estimations are performed across two sub-samples. One consists of all banks whereas the other consists only of agricultural banks. The results from the later sample is the main focus of this study.

The key parameter of interest is the Lerner index, a measure of bank competition. The quadratic Lerner index terms test the theoretical argument of Martinez-Miera and Repullo (2010), a U-shaped relationship between competition and bank stability. Following Kasman and Kasman (2015) and Noman et al. (2017) a lagged outcome variable and a crisis dummy are added as explanatory variables. The lagged outcome variable controls the effect from

[3] The equation 2.1 requires that the price of total assets needs to be higher or at least as equal as the marginal cost (Coccorese, 2014), this reduces the final regression estimation sample to 363,942 observations.

the previous years' financial situation. The crisis dummy captures changes to the banking industry after the 2008 financial crisis. Similarly, the non-interest income to interest income is used as an explanatory variable following Saunders et al. (2018). This ratio captures the impact of traditional vs non-traditional income on bank stability and performance. Schaeck and Cihák (2014) is followed by adding the logarithm of total assets, asset growth and loan loss provision to assets as additional explanatory variables. The logarithm of assets controls for bank sizes. Asset growth captures bank risk preference. The loan loss provision to assets accounts for the quality of the assets. The deposit to loan ratio captures a banks' liquidity position.

Results

Table 2.2 shows the effect of competition on probability of default and performance measures of agricultural banks[4]. The response variable in Columns (1)-(2) is the logarithm of Z-score, Columns (3)-(4) is the return on assets, Columns (5)-(6) is the return on equity, Columns (7)-(8) is the agricultural loan volume and Columns (9)-(10) is the agricultural loan ratio. The odd columns only include the quadratic competition measure and bank fixed effects as explanatory variables. The even columns extends the estimations by adding bank level controls, the crisis dummy and year fixed effects.

2.2.1 Impacts on Financial Stability

Column (2) shows that the linear term of Lerner index has a statistically significant and positive coefficient estimate while the squared term has a statistically significant negative estimate. Figure 2.4 plots the predicted effect of bank competition (Lerner index) on the probability of default (logarithm of Z-score) of agricultural banks. Figure 2.4 shows that a decrease in competition[5] (increase in Lerner index) is associated with a decrease in probability

[4]Table 2.3 presents the results for non-agricultural banks. Most of the results are consistent for the "ag-banks" and "non-ag banks" samples.

[5]Higher market power is assumed to be associated with lower level of competition.

of default (increase in Z-score) for a Lerner index measure less than 0.27. For the Lerner index above 0.27, a decrease in bank competition is associated with an increase in the probability of default for agricultural banks. Thus, an increase in market power (decrease in competition) reduces the likelihood of bank failure in the more competitive agricultural banking market. However, an increase in market power in a more concentrated agricultural banking market increases the likelihood of bank failure. This finding is consistent with the theoretical argument of Martinez-Miera and Repullo (2010); the margin effect dominates in the competitive markets and risk-shifting effect dominates in the monopolistic markets. Overall, there is a U-shaped relationship between competition and the probability of default in agricultural banking.

The point estimates of the lagged logarithm of Z-score, asset growth and loan loss provision to asset are positive and statistically significant (Table 2.2). These estimates suggest higher bank fragility in the previous year, higher asset growth, and higher loan loss provision (a reserve to cover potential loan defaults) to total assets ratio are associated with the lower likelihood of agricultural bank default. The coefficient estimate of the deposit to loan ratio is negative and statistically significant indicating that the higher deposit to loan ratio at the bank is associated with the higher default risk of agricultural banks. Finally, the crisis dummy has a positive and significant coefficient indicating that agricultural banks are less likely to default after the financial crisis of 2008.

2.2.2 Impacts on Profitability

Column (4) and Column (6) show the effect of competition and other bank characteristics on the profitability measures (return on assets and return on equity) of agricultural banks. The point estimates of both Lerner index and its squared term are positive and statistically significant. There is a positive but non-linear effect of lower bank concentration on return on assets (Figure 2.5) as well as on the return on equity (Figure 2.6). An increase in profitability is higher in a competitive environment than in the monopolistic agricultural banking market. Overall, lower competition is associated with higher agricultural banks profitability.

The coefficient estimates of bank size, loan loss provision to total assets, non-interest income to interest income and lagged of returns on assets are positive and statistically significant. These estimates indicate that larger bank size, higher share of reserve for potential loan default (higher loan loss provision) to total assets, higher share of non-traditional income (non-interest income) to interest income and higher profitability in previous years are associated with the higher profitability of agricultural banks.

Similarly, the point estimates of asset growth and deposit to loan ratio are negative and statistically significant. They suggest that higher asset growth and larger deposit to loan ratio are associated with lower profitability in agricultural banking. The negative and statistically significant estimate of financial crisis dummy indicates that agricultural banks are less profitable after the financial crisis. All the effects are consistent across both profitability measures.

2.2.3 Impacts on Agricultural Lending

Column (8) and Column (10) show the impact on agricultural loan volume and share of agricultural loan to the total loan in agricultural banks. The coefficient estimate of the linear term of Lerner index is positive and the squared term is negative for both agricultural loan and the proportion of agricultural loans. The vertex is at the Lerner index of 0.35 for agricultural loan volume (Figure 2.7) and at the Lerner index of 0.50 for agricultural loan ratio (Figure 2.8). Figure 2.7 shows that a decrease in competition is associated with increase in agricultural lending from agricultural banks for the Lerner index below 0.35. An decrease in competition above the Lerner index of 0.35 is associated with a decrease in the volume of agricultural lending from agricultural banks. Similarly, Figure 2.8 shows that a decrease in competition is associated with an increase agricultural loan ratio in agricultural banks for the Lerner index less than 0.50. However, an a decrease in competition above the Lerner index of 0.50 is associated with a reduction in proportion of agricultural loans in agricultural banks. Overall, results indicate that *a lower competition* leads to a more agricultural lending (both higher agricultural loan volume and a higher proportion of agricultural loans to the total loan) in the *competitive agricultural banking market*. However, *higher competition* results a more agricultural lending in the *monopolistic agricultural banking market*. Thus, there is an inverted U-shaped relationship between the bank competition measure and agricultural lending measures.

Column (8) shows that the coefficient estimates associated with the logarithm of total assets, assets growth and lagged of agricultural loan volume are positive and statistically significant. They imply that larger bank size, higher asset growth and larger agricultural loan volume in previous years are associated with higher agricultural loan volume in agricultural banks. The point estimates of deposit to loan ratio and financial crisis dummy are negative and statistically significant. It indicate that a higher deposit to loan ratio and the period after the financial crisis are associated with lower agricultural loan volume.

Column (10) shows that the logarithm of total assets, loan loss provision, deposit to loan ratio and non-interest income to interest income ratio has a negative and significant coefficient estimates. They indicate that larger bank size, larger reserve for potential loan default, higher deposit to loan ratio, higher share of non-traditional income to the interest income reduce the proportion of agricultural lending from agricultural banks. The point estimates of the lagged agricultural loan ratio are positive and statistically significant. These estimates suggest that higher share of agricultural loans to total loans in previous year is associated with the higher proportion of agricultural loans. Finally, the positive and statistically significant estimate of the crisis dummy indicates that the share of agricultural loans to total loans increases after the financial crisis.

Conclusions

Competition in agricultural banking market is an important concern in agricultural lending. This study has estimated the impact of bank competition on financial stability and performances of the U.S. agricultural banks. Call Report data from 1994 to 2013 are used to construct a Lerner index and the Z-score to measure bank competition and bank stability respectively. Similarly, the return on assets (net income to total assets ratio), return on equity (net income to the total equity ratio), agricultural loan ratio and volume of agricultural loan are used as the performance measures.

The key results suggest that an increase in market power in the U.S. banking sector has led to a U-shaped effects on the probability of default, and an inverted U-shaped effect on volume and proportion of agricultural loans in agricultural banks. It implies that increased competition in a competitive agricultural banking environment has increased the probability of a bank failure, reduced the supply of farm loans and reduced the proportion of agricultural loans in the total loans. In contrast, an increase in competition in more concentrated agricultural banking market has reduced the probability of bank failure, increased agricultural lending and increased the share of farm loans to total loans. Results also suggest that lower concentration in agricultural banking environment has increased bank profitability.

This study has major policy implications based on the findings associated with the bank competition measure. The reduction in the failure of agricultural banks and increase in the volume of agricultural loans and proportion of agricultural loans might be achieved through competition-enhancing policies (such as reducing entry barriers, encouraging competition through branching or interstate banking) in the more concentrated agricultural banking markets. However, the competition-reducing regulations might achieve similar goals in less concentrated agricultural banking environments. Thus, banking regulation policy should consider the degree of location-specific bank competition for agricultural banks.

Table 2.1: *Summary statistics*

Variable	Obs	Mean	Std. Dev.	P5	P95
Total Operating Cost ($000)	497,630	5,066	6,187	586	17,267
Price of Fixed Assets (%)	497,630	21.10	22.07	3.99	61.96
Price of Labor ($000)	497,630	35.64	18.11	11.65	68.31
Price of Borrowed Fund (%)	497,630	1.60	1.04	0.29	3.61
Total Loans ($000)	497,630	121,770	135,632	15,940	418,435
Total Securities ($000)	497,630	46,091	57,123	4,207	153,971
Total Equity Capital ($000)	497,630	18,585	18,987	3,134	58,777
Total Assets ($000)	497,630	190,138	195,732	31,389	625,956
Net Income	497,630	1,254	1,880	36	4,747
Total Agricultural Loan ($000)	497,630	5,522	10,977	0.00	23,238
Provision Loan ($000)	497,630	293	813	0.00	1,237
Non-Interest Income ($000)	497,630	1013	1,970	52	3,933
Total Deposits ($000)	497,630	158,856	160,367	26,785	509,966
Logarithm of Z-Score	485,072	3.49	0.51	2.78	4.34

Note: All monetary variables are deflated in 2013 U.S. dollars.

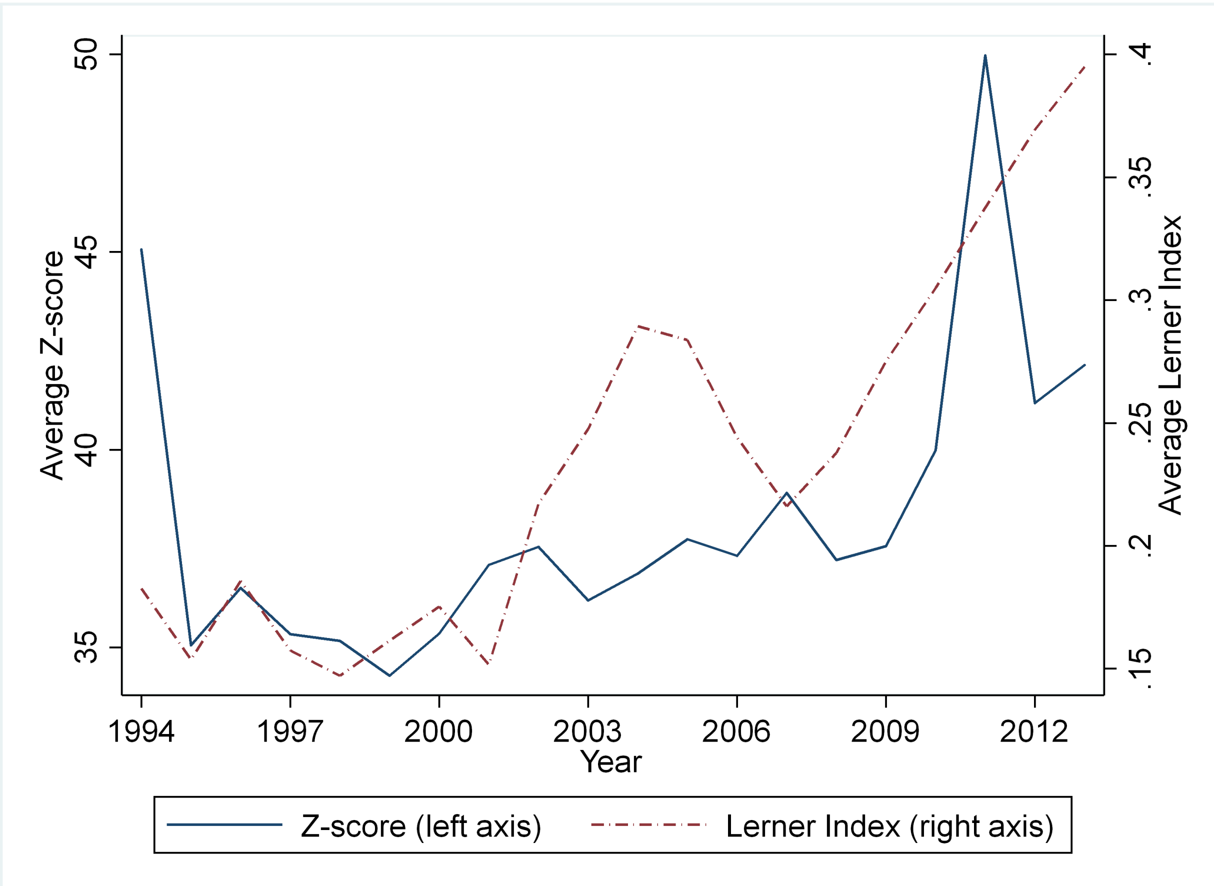

Figure 2.1: *Average Z-score and Lerner Index Among U.S. Agricultural Banks.*

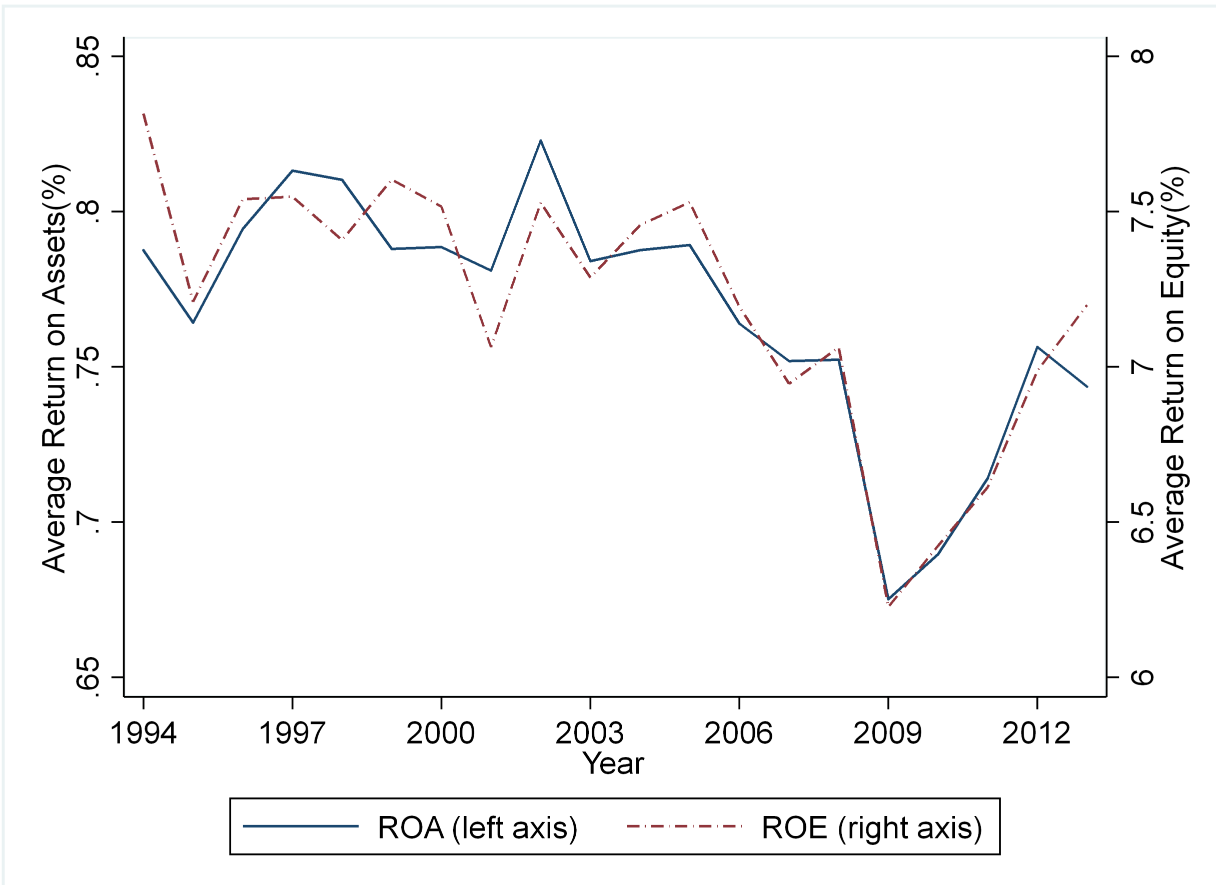

Figure 2.2: *Average Return on Assets and Return on Equity Among U.S. Agricultural Banks.*

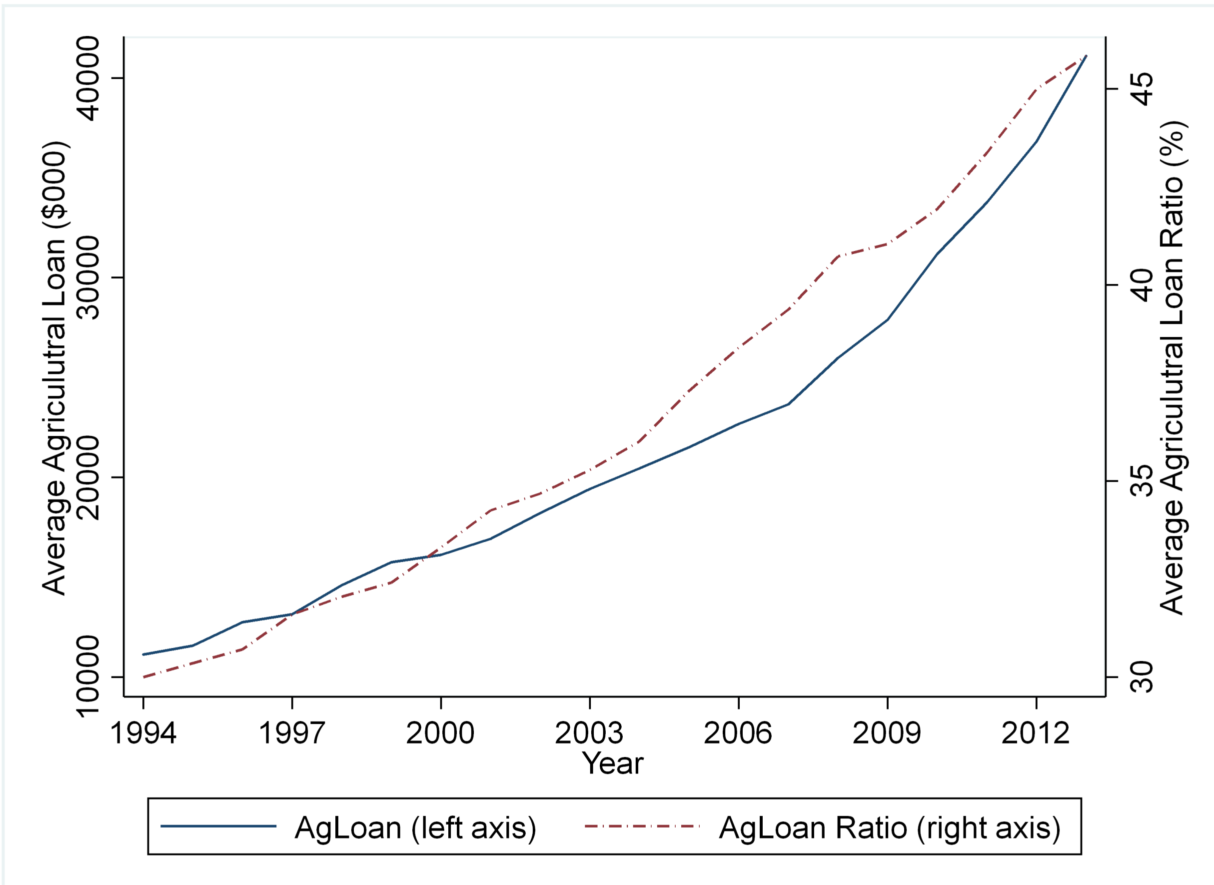

Figure 2.3: *Average Agricultural Loan and Share of Agricultural to Total Loan Among U.S. Agricultural Banks.*

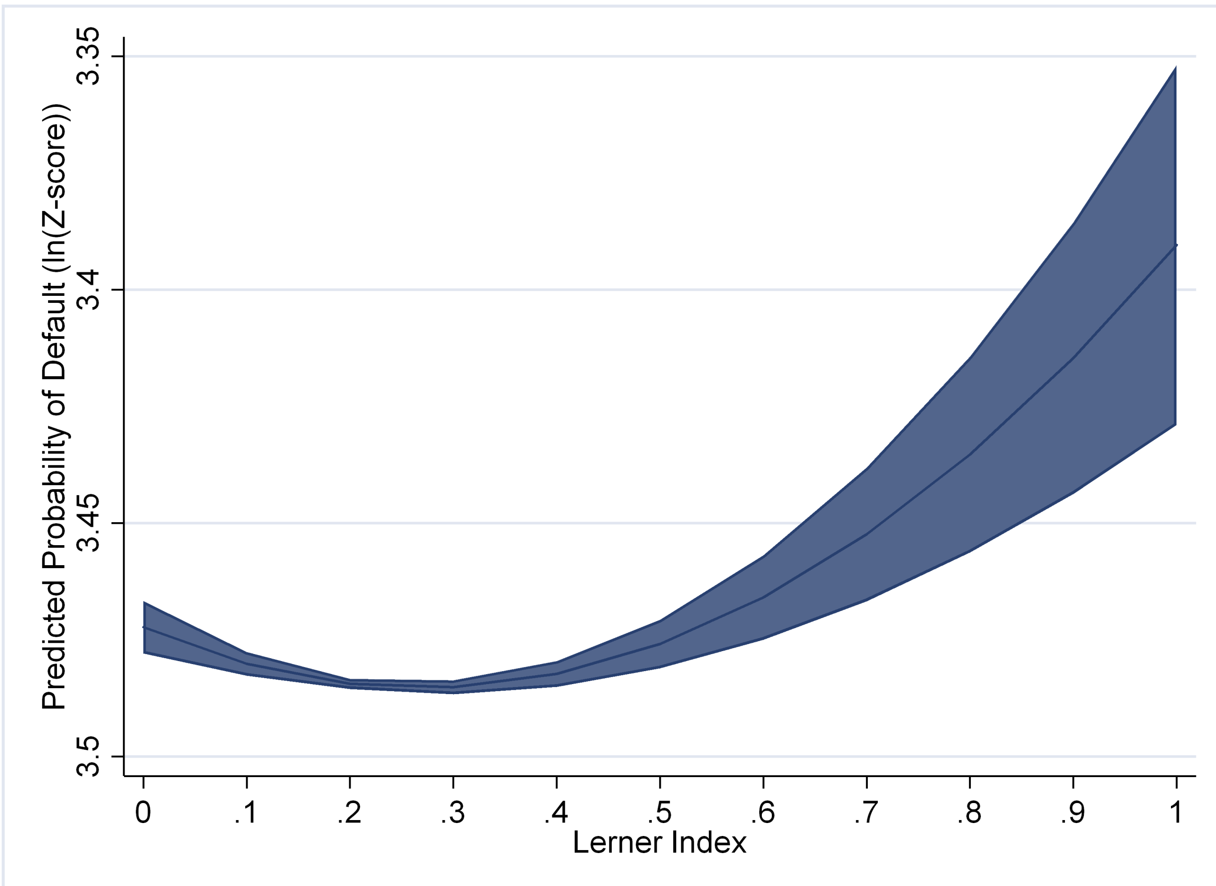

Figure 2.4: *Predicted Effect of Bank Competition (Lerner Index) on Probability of Default (Logarithm of Z-score) of Agricultural Banks with 95% Confidence Intervals.*

Note: Scale of y-axis is reversed because lower Z-score implies a higher probability of default.

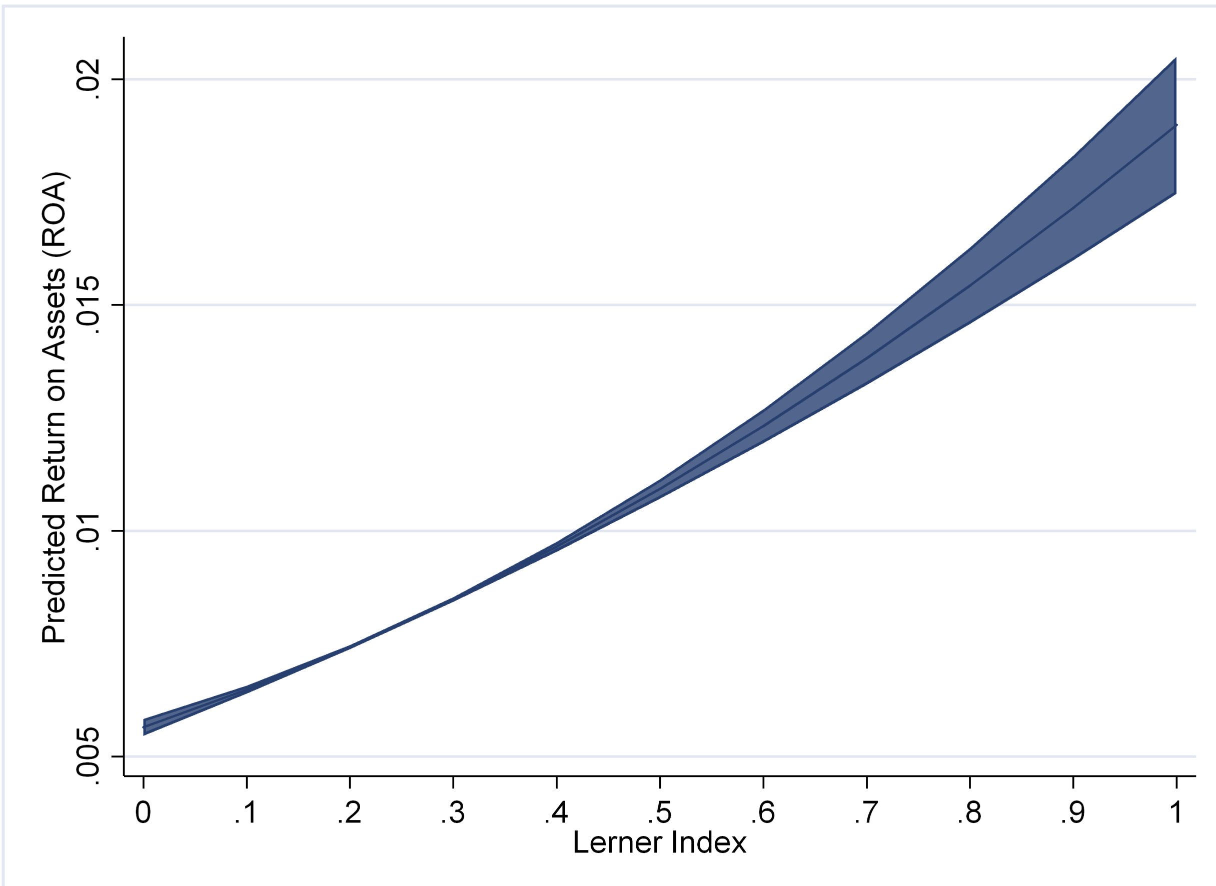

Figure 2.5: *Predicted Effect of Bank Competition (Lerner Index) on Return on Assets (ROA) of Agricultural Banks with 95% Confidence Intervals.*

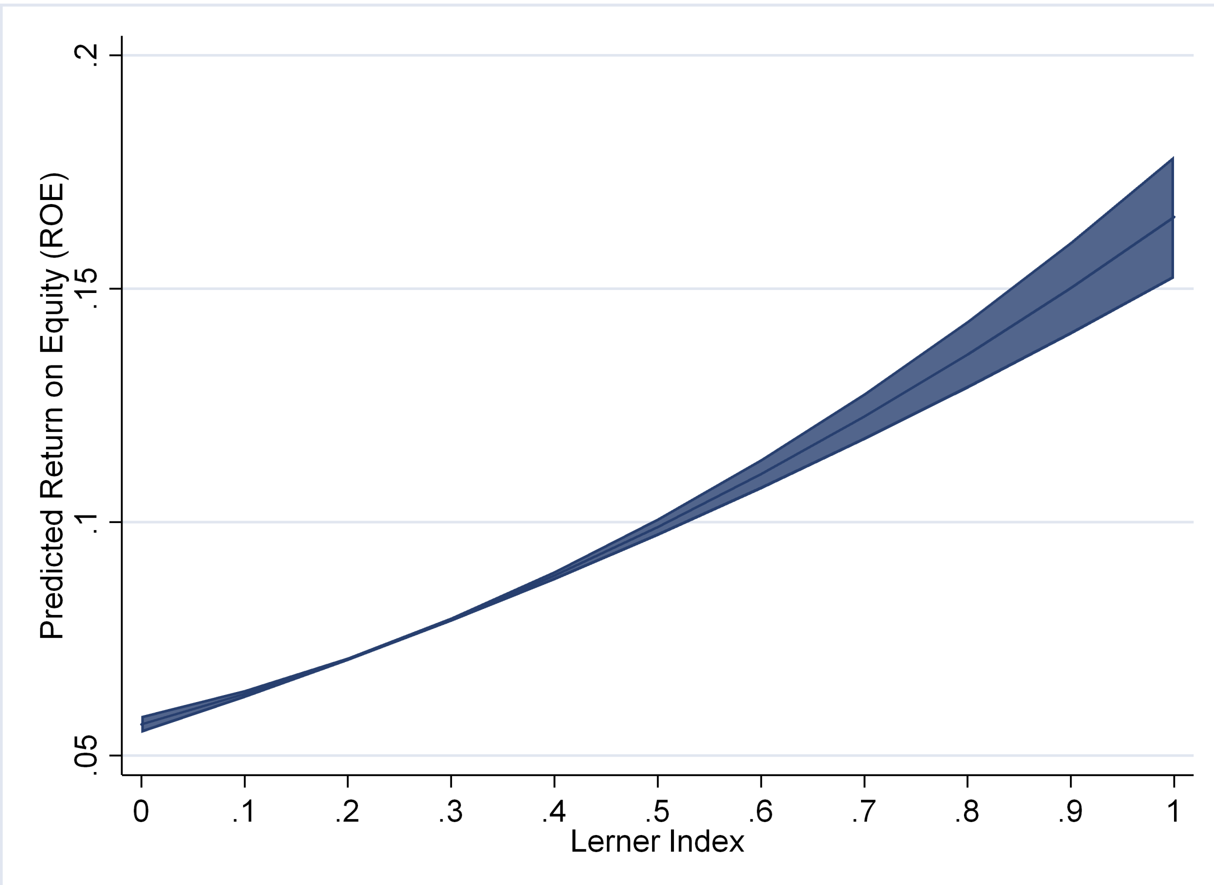

Figure 2.6: *Predicted Effect of Bank Competition (Lerner Index) on Return on Equity (ROE) of Agricultural Banks with 95% Confidence Intervals.*

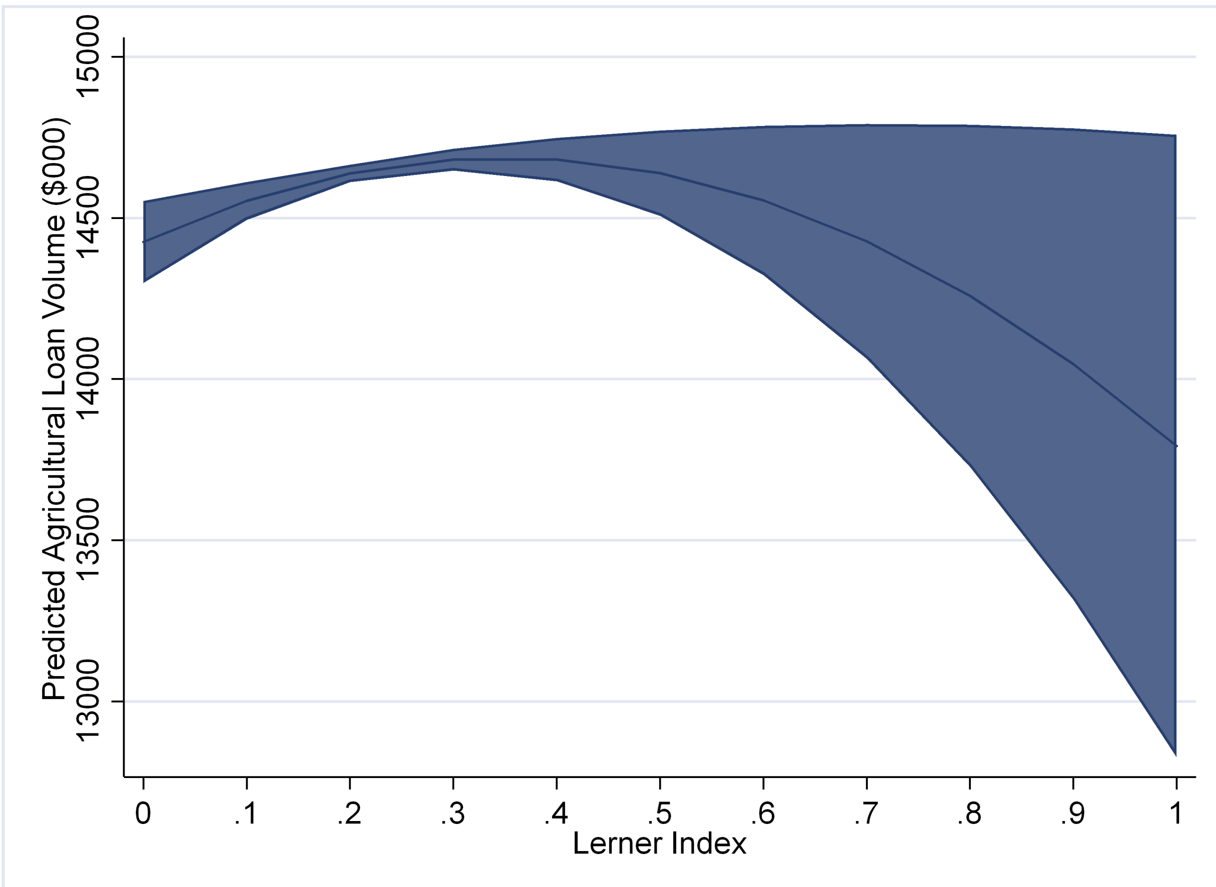

Figure 2.7: *Predicted Effect of Bank Competition (Lerner Index) on Agricultural Loan Volume of Agricultural Banks with 95% Confidence Intervals.*

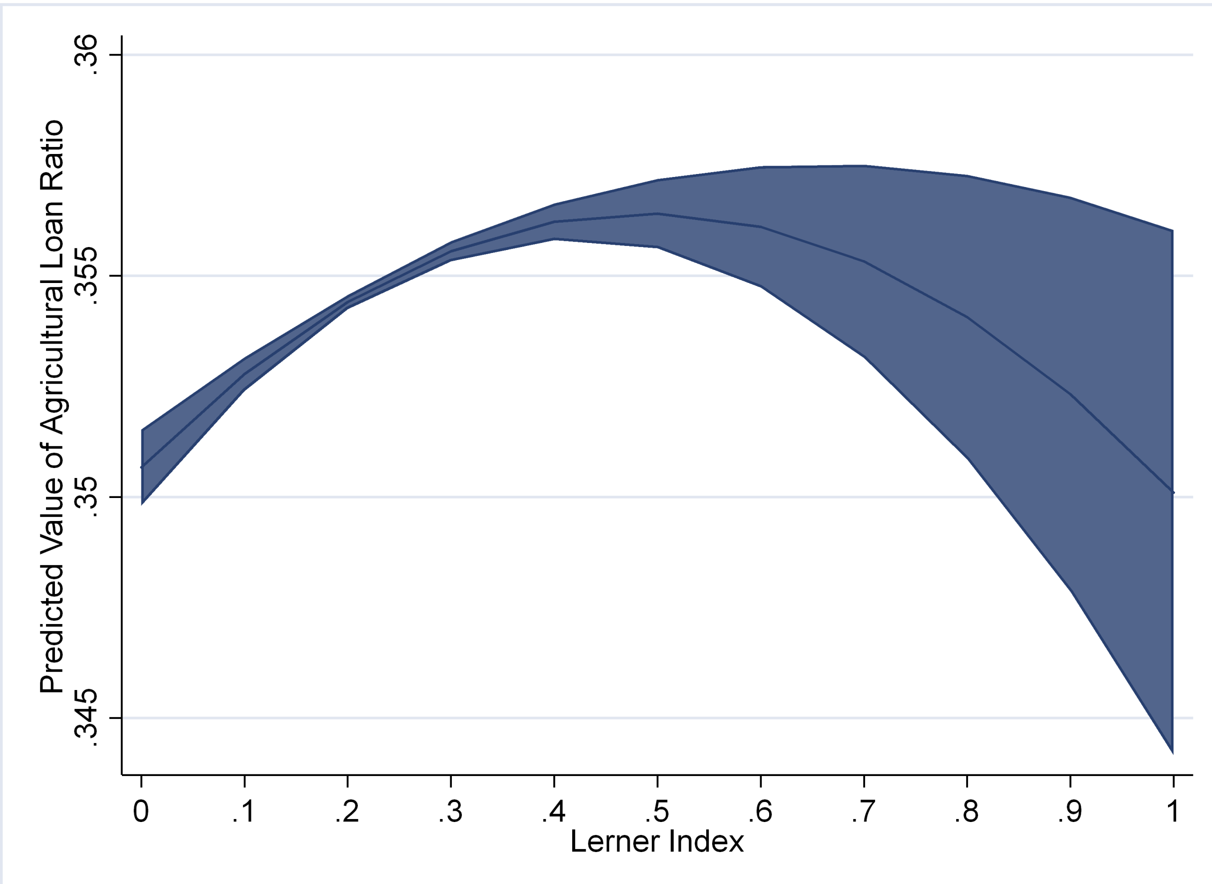

Figure 2.8: *Predicted Effect of Bank Competition (Lerner Index) on Agricultural Loan Ratio of Agricultural Banks with 95% Confidence Intervals.*

Table 2.2: *Impact of Bank Competition on Probability of Default and Performance Measures of Agricultural Banks*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	lnZ	lnZ	ROA	ROA	ROE	ROE	AgLoan	AgLoan	AgLoanR	AgLoanR
LernerIndx	0.176***	0.096***	0.003***	0.008***	0.023***	0.060***	347.270	1487.665***	0.127***	0.024***
	(0.060)	(0.021)	(0.001)	(0.001)	(0.006)	(0.007)	(1796.940)	(481.404)	(0.015)	(0.003)
LernerIndxSq	-0.368***	-0.178***	0.004***	0.006***	0.028**	0.048***	13334.467***	-2121.216**	0.194***	-0.024***
	(0.107)	(0.036)	(0.001)	(0.001)	(0.011)	(0.012)	(3342.614)	(858.213)	(0.029)	(0.006)
Lagged lnzscore		0.814***								
		(0.007)								
lnTAsset		-0.024***		0.002***		0.022***		3882.852***		-0.005***
		(0.005)		(0.000)		(0.002)		(271.925)		(0.001)
AssetGrowth		0.078***		-0.002***		-0.026***		756.204***		0.007***
		(0.015)		(0.001)		(0.007)		(228.611)		(0.001)
ProvisonAsset		8.738***		0.371***		3.500***		-13395.392		-0.353***
		(0.893)		(0.032)		(0.304)		(13064.263)		(0.084)
DepositLoan		-0.020***		-0.002***		-0.014***		-2897.700***		-0.011***
		(0.004)		(0.000)		(0.002)		(175.945)		(0.001)
NonIncIntRatio		-0.080***		0.007***		0.055***		-105.341		-0.006*
		(0.022)		(0.001)		(0.007)		(427.594)		(0.004)
CrisisDum		0.231***		-0.007***		-0.071***		-1367.258***		0.019***
		(0.006)		(0.000)		(0.002)		(147.073)		(0.001)
Lagged ROA				0.101***						
				(0.006)						
Lagged ROE						0.106***				
						(0.008)				
Lagged AgLoan								0.827***		
								(0.013)		
Lagged AgLoanRatio										0.899***
										(0.004)
Year Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R-squared	0.001	0.726	0.020	0.106	0.012	0.097	0.016	0.831	0.168	0.897
N	99220	78595	101458	80550	101458	80550	101458	80550	101458	80550

Note: Dependent variables in columns (1) and (2) is logarithm of the Z-score, columns (3) and (4) is return on assets, columns (5) and (6) is return on equity, columns (7) and (8) is volume of agricultural loan, and columns (9) and (10) is ratio of the agricultural loan to the total loan. The variables *LernerIndx* and *LernerIndxSq* are the linear and square term of Lerner index, *lnTAsset* is the logarithm of total asset, *AssetGrowth* is the assets growth, *ProvisonAsset* is the loan loss provision, *DepositLoan* is the deposit to loan ratio, *NonIncIntRatio* is the non-interest income to interest income ratio and *CrisisDum* denotes crisis dummy(=1 if year is 2009 onward). The lagged of dependent variable is represented using *L.* in respective regression. The robust standard errors in parentheses are clustered at the bank level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 2.3: *Impact of Bank Competition on Probability of Default and Performance Measures of All Banks*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	lnZ	lnZ	ROA	ROA	ROE	ROE	AgLoan	AgLoan	AgLoanR	AgLoanR
LernerIndx	0.158***	0.128***	0.005***	0.011***	0.045***	0.100***	-157.846	674.763***	0.044***	0.008***
	(0.033)	(0.011)	(0.000)	(0.000)	(0.004)	(0.004)	(553.453)	(134.702)	(0.006)	(0.001)
LernerIndxSq	-0.294***	-0.228***	0.000	-0.000	-0.009	-0.006	4704.590***	-538.179**	0.068***	-0.006***
	(0.058)	(0.019)	(0.001)	(0.001)	(0.007)	(0.007)	(1050.931)	(235.319)	(0.011)	(0.002)
Lagged lnzscore		0.828***								
		(0.004)								
lnTAsset		-0.013***		0.002***		0.021***		906.767***		-0.002***
		(0.002)		(0.000)		(0.001)		(58.722)		(0.000)
AssetGrowth		0.031***		-0.001***		-0.015***		342.632***		0.002***
		(0.008)		(0.000)		(0.005)		(82.174)		(0.001)
ProvisonAsset		11.303***		0.503***		4.914***		-13636.154***		-0.248***
		(0.448)		(0.018)		(0.201)		(4194.689)		(0.029)
DepositLoan		-0.010***		-0.001***		-0.006***		-840.790***		-0.003***
		(0.002)		(0.000)		(0.001)		(47.884)		(0.000)
NonIncIntRatio		-0.085***		0.005***		0.049***		67.887		-0.002***
		(0.010)		(0.000)		(0.004)		(71.699)		(0.001)
CrisisDum		0.257***		-0.008***		-0.081***		-472.076***		0.006***
		(0.004)		(0.000)		(0.001)		(42.463)		(0.000)
Lagged ROA				0.104***						
				(0.005)						
Lagged ROE						0.076***				
						(0.024)				
Lagged AgLoan								0.892***		
								(0.007)		
Lagged AgLoanRatio										0.944***
										(0.002)
Year Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R-squared	0.000	0.754	0.017	0.126	0.005	0.063	0.004	0.814	0.046	0.896
N	355942	280945	363942	287826	363942	287826	363942	287826	363942	287826

Note: Dependent variables in columns (1) and (2) is logarithm of the Z-score, columns (3) and (4) is return on assets, columns (5) and (6) is return on equity, columns (7) and (8) is volume of agricultural loan, and columns (9) and (10) is ratio of the agricultural loan to the total loan. The variables *LernerIndx* and *LernerIndxSq* are the linear and square term of Lerner index, *lnTAsset* is the logarithm of total asset, *AssetGrowth* is the assets growth, *ProvisonAsset* is the loan loss provision, *DepositLoan* is the deposit to loan ratio, *NonIncIntRatio* is the non-interest income to interest income ratio and *CrisisDum* denotes crisis dummy(=1 if year is 2009 onward). The lagged of dependent variable is represented using *L.* in respective regression. The robust standard errors in parentheses are clustered at the bank level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Chapter 3

Big Banks versus Agricultural Banks: Has Too-Big-To-Fail Regulation Affected Efficiency and Scale Economies Measures?

3.1 Introduction

The Dodd-Frank Wall Street Reform and Consumer Protection Act was passed by U.S. Congress and signed by President Barack Obama in 2010[1]. To reduce the too-big-to fail (TBTF) practices and increase financial stability, the law provided greater oversight to larger banks. Nevertheless, small banks are also subject to more regulatory burden. The two major thresholds in Dodd-Frank include banks and bank holding companies with assets of $10 billion and $50 billion; where the later is subject to more regulation (Huntington, 2010). This may disincentive those banks just below the asset threshold levels to increase their size of operation (Bindal et al., 2017).

There are arguments as to whether Dodd-Frank has impacted the market discipline of

[1] H.R.4173 - Dodd-Frank Wall Street Reform and Consumer Protection Act

the U.S. financial system in general, and banks in particular. Balasubramnian and Cyree (2014) find that Dodd-Frank has improved the market discipline of large banks. Similarly, Davies and Tracey (2014) find no scale economies for large banks after controlling for TBTF factors. Further, Akhigbe et al. (2016) argue that the decline in risk-taking is greater for the largest financial institutions. Others argue small banks, though not targeted directly, are also adversely affected because of the higher compliance cost (Peirce et al., 2014; Wille et al., 2017). Despite the policy interest, little is known about its impact on economic performance across different bank types.

Further, Dodd-Frank may impact the lending competitiveness and comparative advantage differently across bank size and lending portfolios. For example, U.S. agricultural banks are likely to respond to the Dodd-Frank differently than other banks due to less portfolio diversification. Nonetheless, they operate in a multiproduct framework by offering multiple products and services. They may respond to the banking regulations such as Dodd-Frank by changing agricultural lending practices. These changes in types and ranges of agricultural loans and agricultural lending services impact the success of farm households and the U.S. agricultural sector as a whole.

This paper examines the economic performance measures of commercial banks under the Dodd-Frank law. First, non-parametric estimation is applied to estimate the annual cost frontier of the U.S. commercial banks for four years before and six years after Dodd-Frank. Multiproduct and product-specific economies of scale and scope are estimated. The Malmquist productivity index is estimated to examine changes in technical and scale efficiency over time. The response of these economic and productivity measures to the Dodd-Frank is estimated for big banks in a quasi-experimental setting. Also, the effects of Dodd-Frank on agricultural banks are identified using a separate sub-sample of small banks. This is the first paper to estimate economic measures of the U.S. commercial banks separately for each year from 2006 to 2016. The results provide clear evidence that Dodd-Frank has increased cost efficiency, reduced economies of scale and lessened economies of scope of banks near the $50 billion assets threshold. It has also created more uncertainty in the agricultural lending market.

3.2 Rationale for Non-Parametric Estimation

There is a growing body of literature that examines the economic and efficiency measures of financial institutions. The translog functional form was often used to estimate the cost curves of banks and other financial institutions in early research. Lawrence (1989) argues that the Cobb-Douglas specification failed to estimate the cost of multiproduct financial institutions because it doesn't satisfy the sufficient conditions. He argues that the translog specification provides a more flexible fit to banking cost data. Similarly, using the translog cost model for commercial bank data from the early eighties, Kolari and Zardkoohi (1991) find that higher scale economies exist for the larger banks.

The main reason for using translog form was that this form doesn't impose any restrictions regarding monotonically increasing or decreasing cost curves, which is one major limitation of the Cobb-Douglas and CES (Gropper, 1991). It is a second order flexible functional form. Berger and Mester (1997) conclude that the functional form is not the only source of differences in efficiency of financial institutions. Using six years of banking data from the early nineties, Berger and Mester (1997) find that differences in efficiency concepts (cost, profit and alternative profit efficiencies), differences in measurement methodology (different measurement techniques and functional form) and the other remaining potential correlates (such as market, competition, regulatory characteristics) are three possible sources of differences in measured efficiency. In terms of productivity growth, Wheelock and Wilson (1999) use the non-parametric Malmquist index to estimate over time efficiency and technical changes in the U.S. commercial banks.

A recent study by Wheelock and Wilson (2017) finds that the use of the translog to estimate bank cost functions can lead to the "erroneous estimates of returns to scale". They suggest non-parametric estimation as an alternative because it doesn't impose a parametric assumption on the production technology. Using the data of both bank holding companies and other commercial banks, they find that mega banks (the 10 largest banks) face increasing return to scale that provides an avenue to expand size even after Dodd-Frank. There are major two differences in the research approach of this study with Wheelock and Wilson (2017).

First, Bank Holding Companies (BHCs) are not included in the sample. Second, Wheelock and Wilson (2017) study a full sample of banks for 1986 to 2015 after deflating variables in 2015 dollars. This study estimates annual cost frontiers for each year separately from 2006 to 2016 and specifically examines agricultural lending. In addition, a panel subsample from 2006 to 2016 is used to estimate technical and efficiency change over time.

The rest of the paper is structured as follows. Section 3 provides a conceptual framework that outlines the non-parametric estimation of economic and productivity measures. Section 4 gives an overview of the data. Section 5 outlines the empirical strategy to identify the impact of Dodd-Frank on efficiency and economic measures of commercial and small agricultural banks. Finally, Section 6 discusses the results and Section 7 concludes the findings.

3.3 Conceptual Framework

3.3.1 Economic Measures

To determine how Dodd-Frank affects the economic measures of banks, a variable returns to scale (VRS) input-oriented cost minimization Data Envelopment Analysis (DEA) model is estimated to examine cost efficiency. Panzar and Willig (1977) and Baumol et al. (1982) results are used to estimate the multi-product and product specific economies of scale and scope measures. The notations are based on Coelli et al. (2005). In particular,

$$\begin{aligned} Min_{\lambda,x_i^*} c_i(w,y) =\ & w_i^{'} x_i^* \\ subject\ to: -y_i + Y\lambda &\geq 0 \\ X_i^* - X\lambda &\geq 0 \\ I1'\lambda &= 1 \\ \lambda &\geq 0 \end{aligned} \tag{3.1}$$

is a VRS input oriented cost minimizing DEA, where $c_i(w, y)$, $w_i^{'}$ and x_i^* respectively represent the value of minimum cost, $N \times 1$ vector of bank input prices and the cost minimizing vector of input quantities (obtain by linear programming) for given input prices w_i, output levels y_i, for a bank i that operates under price-taking behavior. Also, X is a $N \times I$ input matrix and Y is the $M \times I$ output matrix for all I banks. Further, variable returns to scale (VRS) is allowed by adding the convexity constraint ($I1'\lambda = 1$) to make sure that an inefficient bank is compared against the banks of similar size only.

The cost efficiency for i^{th} bank is:

$$CE_i = \frac{w_i^{'} x_i^*}{w_i^{'} x_i} \tag{3.2}$$

the ratio of minimum cost (estimated frontier cost) to the actual observed total cost. It measures the relative distance of a bank from the cost frontier. When CE_i has a value of one, it is at full cost efficiency.

The economies of scale measure for bank i operating in the multiproduct setting is given as:

$$SL_i = \frac{c_i(y, w)}{\sum_m^M y_{im}\ mc_{im}} = \frac{1}{\sum_m^M \gamma_{iy_m}} \tag{3.3}$$

where mc_{im} is the marginal cost for m^{th} output which is obtained from the shadow prices on the output constraints in equation 3.1. SL_i represents the change in production cost for a proportional variation in all outputs. Bank i will operate in increasing, constant or decreasing returns to scale when SL_i is greater than, equal to or less than one respectively.

Product specific economies of scale (PSEs) for m^{th} product is defined as:

$$SL_{im} = \frac{Ic_{im}(y, w)}{y_{im}\ mc_{im}(y, w)} = \frac{Ic_{im}/c_i}{\gamma_{iy_m}} \tag{3.4}$$

where

$$Ic_{im} = c_i(y, w) - c(y_{M-m}, w) \tag{3.5}$$

is the incremental cost of the m^{th} product for bank i and $c(y_{M-m}, w) = c(y1, ..., y_{m-1}, 0, y_{m+1}, ..., y_m, W)$.

To obtain the total cost of all outputs as well as the cost of producing five outputs as a group, the incremental cost is adjusted by dropping output constraints from equation 3.1. Following (Parman et al., 2017) [2], the adjusted incremental cost ($I{c_{im}}'$) becomes:

$$I c_{im}^{'} = \frac{I c_{im}}{(1 - y_{im}^{r}/y_{im}^{a})} \tag{3.6}$$

where y_{im}^r and y_{im}^a are respectively the residual and actual output of the dropped constraint for the dropped m^{th} output. The product specific returns to scale for product m for bank i is increasing, constant or decreasing if the corresponding SL_{im} is greater than, equal to or less than one respectively.

The measure of economies of scope for the multi-product case,

$$SC_i = \left[\sum_{m=1}^{M} c_i(w, y_m)/c_i(w, y) \right] - 1 \tag{3.7}$$

represents the change in production cost when outputs are produced separately for bank i, where $c_i(w, y_m)$ is the cost of producing the m^{th} output only. When SC_i is greater (less) than zero, cost is reduced by producing multiple outputs jointly (individually) within the single bank i. Economies (diseconomies) of scope exists for bank i when SC_i is greater (smaller) than zero. Likewise, a measure of product specific economies of scope for an individual output:

$$SC_{im} = \frac{c_i(w, y_{im}) + c_i(w, y_{M-m}) - c_i(w, y)}{c_i(w, y)} \tag{3.8}$$

indicates the proportionate change in cost when all outputs are produced together except the m^{th} output, where $c_i(w, y_{M-m})$ is the total cost of producing all outputs jointly except m^{th} output. Therefore, for bank i, it may be best to produce all outputs as a group when SC_{im} is greater than zero. But, it is best to produce output m separately when SC_{im} is less than zero.

[2] A recent work by Parman et al. (2017) compares the results of scale and scope economies measures estimated using DEA from dropping one of the output constraints with constraining it to the zero.

3.3.2 Productivity Measures

A Malmquist productivity index is calculated to quantify the impact of Dodd-Frank Act on productivity change over time. Following Fare et al. (1994) and Wheelock and Wilson (1999) [3], an output distance function with respect to two time periods t and $t+1$:

$$D_o^t(x^{t+1}, y^{t+1}) = max\{\lambda : (x^{t+1}, y^{t+1}/\lambda)\epsilon S^{t+1}\} \tag{3.9}$$

$$D_o^{t+1}(x^t, y^t) = max\{\lambda : (x^t, y^t/\lambda)\epsilon S^t\} \tag{3.10}$$

where the distance function $D_o^t(x^{t+1}, y^{t+1})$ measures maximal proportional change in output required (for S^{t+1}, production technology of period $t+1$) to make observations at period $t+1$ (x^{t+1}, y^{t+1}) feasible relative to technology at time period t. Similarly, the output distance function $D_o^{t+1}(x^t, y^t)$ measures maximal proportional change in output required (for S^t, production technology of period t) to make observations at period t (x^t, y^t) feasible relative to technology at time period $t+1$. The Malmquist index $M_o(x^{t+1}, y^{t+1}, x^t, y^t)$, which is the productivity change between period t and $t+1$ is:

$$M_o(X^{t+1}, y^{t+1}, x^t, y^t) = \frac{D_o^{t+1}(x^{t+1}, y^{t+1})}{D_o^t(x^t, y^t)}\left[\frac{D_o^t(x^{t+1}, y^{t+1})D_o^t(x^t, y^t)}{D_o^{t+1}(x^{t+1}, y^{t+1})D_o^{t+1}(x^t, y^t)}\right]^{\frac{1}{2}} \tag{3.11}$$

where the Malmquist index $M_o(X^{t+1}, y^{t+1}, x^t, y^t)$ is a product of following two components (efficiency change and technical change),

$$\text{Efficiency Change} = \frac{D_o^{t+1}(x^{t+1}, y^{t+1})}{D_o^t(x^t, y^t)} \tag{3.12}$$

[3] Wheelock and Wilson (1999) is followed to choose output oriented Malmquist index approach, but the same paper suggests that “the choice of orientation is largely arbitrary”. However, it is also worth noting that both of these measures give the same result under constant returns to scale technology, but technical efficiency would be different with variable returns to scale (Coelli et al., 2005). To be consistent with similar work by Wheelock and Wilson (1999), the output oriented Malmquist Index is estimated under VRS technology.

and

$$\text{Technical Change} = \left[\frac{D_o^t(x^{t+1}, y^{t+1})D_o^t(x^t, y^t)}{D_o^{t+1}(x^{t+1}, y^{t+1})D_o^{t+1}(x^t, y^t)}\right]^{\frac{1}{2}} \tag{3.13}$$

The efficiency change in equation 3.12 measures the change in relative distance of observed production from the maximum potential output. The technical change (geometric mean of two ratios) in equation 3.13 represents the change in technology (shift in the frontier) between two periods t and $t+1$. The technical change can also be decomposed into the pure technical efficiency change and scale efficiency change. For each index (Malmquist productivity change, efficiency change, and technical change), the values less than 1, equal to 1 and greater than 1 respectively signals regress (deterioration), no change and progress between time period t and $t+1$.

3.4 Data

The data are from the Report of Income and Condition (Call Reports) from 2006 to 2016[4]. Call Reports consist quarterly data of all insured U.S. commercial banks. Following Featherstone and Moss (1994), six outputs and four inputs are defined. The six outputs are agricultural loans, non-agricultural real estate loans, other nonagricultural loans, transactions deposits, non-transaction deposits, and other bank output. The four inputs are total assets, total deposits, number of employees and fixed assets. Table 3.1 presents summary statistics of all outputs and inputs for the estimation sample. The final sample consists of more than forty-nine hundred banks in each year (more than fifty-three thousand commercial bank observations over the eleven-year time-period). On average, transaction deposits are the largest output (\$799 million). Agricultural loans are the smallest average output (\$22 million). Total assets are the largest average input (\$1.8 billion) and fixed assets are the smallest input (\$6.9 million). The total assets for the largest bank is \$1.65 trillion. The four

[4]It is worth noting that estimation sample only consists financial institutions chartered as commercial banks (rssd9048=200) in the Call Reports. The final sample consists of virtually all commercial banks because only a few are removed during the data cleaning process. However, the bank holding companies (BHCs) are not included.

input prices are constructed following Featherstone and Moss (1994) and include the price of labor (total employee expenses divided by number of employees), price of fixed assets (total occupancy expenses divided by fixed assets value), price of deposits (total interest expenses divided by total loans) and price of total assets (other expenses divided by total assets). Three of the input prices are indexes except for the price of labor (average salary) which is in thousands of dollars.

3.5 Methods

The main goal of this research is to identify the causal effect of Dodd-Frank to commercial banks' economies and productivity measures and to isolate the effect on agricultural banks. For this purpose, annual data containing bank characteristics, input-output variables and estimated economic and productivity measures are constructed. To estimate the impact of Dodd-Frank on different performance measures, the following difference in difference regression is estimated:

$$\begin{aligned} Measure_{it} =& AfterDFA + BankSize_{it} + AfterDFA * BankSize_{it} \\ &+ BankFixed_i + YearFixed_i + \epsilon_{it} \end{aligned} \tag{3.14}$$

where $Measure_{it}$ represents the economic and productivity measures including cost efficiency[5], economies of scale, economies of scope, product specific economies of scale, product specific economies scope, technical change, and efficiency change. $AfterDFA$ is a year binary variable that represents whether the bank operates after Dodd-Frank, it takes the value of zero for the years before 2010 and one for 2010 and afterward. The identification strategy used in the DiD model is based on Bindal et al. (2017) although bank level controls are not included in the regressions to avoid spurious results. Spurious results may occur because all the bank level inputs and outputs are used to calculate both the economic and productivity measures.

[5] Banks with cost efficiency score of 1 and producing only one output are excluded from obtaining returns to scale measures, as these banks have non-unique marginal costs.

The bank size threshold binary variable for bank i in year t are represented by $BankSize_{it}$.[6] Interactions of these assets threshold binary variables with Dodd-Frank provides the impacts of too-big-to-fail regulation on the performance of very big banks (both near and above the asset thresholds of $10 billion and $50 billion). Two types of regression models are estimated to identify these impacts[7]. The first regression model includes banks near to the $10 billion asset threshold only and it categorizes the banks with asset size between $10 billion to $13 billion as treated, $7 billion to $10 as indirectly treated and $4 billion to $7 billion as untreated. The second regression type consists of banks near to the $50 billion asset threshold only, where banks with assets between $50 billion to $65 billion are defined as treated, $35 to $50 billion are defined as indirectly treated and $20 billion to $35 billion are defined as untreated.

The estimates associated with the interaction term $AfterDFA * BankSize_{it}$ can be interpreted as the effect of Dodd-Frank on the economic measure, assuming that $AfterDF * BankSize_{it}$ is uncorrelated with the error term (ϵ_{it}). The key identifying assumption is that in the absence of Dodd-Frank, changes over time in economic and productivity measures would be the same for directly or indirectly treated banks and the untreated banks, conditional on the control variables [8]. All the outputs and inputs from the banks are used while calculating performance measures (dependent variables). Therefore, the regression estimates using inputs or outputs or the ratios based on them result in spurious outcomes. Hence, the only other controls are the bank ($BankFixed_i$) and year ($YearFixed_i$) fixed effects. To obtain the Dodd-Frank impacts on the efficiency and economic measures for agricultural banks, $BankSize_{it}$ in equation 3.14 is replaced with $AgBank_{it}$. $AgBank_{it}$ is a binary variable rep-

[6]The details on the choice of these bank assets size threshold dummies are in Bindal et al. (2017) and Bouwman et al. (2017).

[7]The Malmquist productivity index was estimated for a different sub-sample of banks that had 11 years of data (a balanced panel) from 2006 to 2016. The estimation of impact on productivity change using the second model (near to $50 billion asset threshold) is not completed due to a limited number of observations. Thus, the results of Dodd-Frank on technical and efficiency change over time is estimated only for the model with banks *near to $10 billion, and for agricultural banks.*

[8]As mentioned in Bouwman et al. (2017), the "treated" banks do not subject to additional restrictions for an increase in asset size. While the concerns of the "untreated" banks surpassing the Dodd-Frank threshold is minimal as they are sufficiency below it. Similarly, the "indirectly treated" banks are so close to the threshold that their efficiency and productivity growth might have been affected by the Dodd-Frank.

resenting agricultural bank, takes the value of one for a bank i with 25% of agricultural loans in its loan portfolio at time t, otherwise takes zero value. Agricultural loans consist of real estate loans secured by farm land and loans to finance agricultural production. Figure 3.1 illustrates agricultural lending from the U.S. commercial banks. In general, there is an increasing trend in agricultural lending. Figure 3.1 shows that agricultural lending increased from $74.55 billion ($36.62 billion real estate farmland loans and $37.94 billion agricultural production loans) in the first quarter of 2006 to $168.73 billion ($93.29 billion real estate farm land loans and $75.45 billion agricultural production loans) in the fourth quarter of 2016. Figure 3.2 shows the similar trend of agricultural lending from agricultural banks. Figure 3.2 shows that the total agricultural lending increased from $30.38 billion ($14.31 billion real estate farmland loans and $16.07 billion agricultural production loans) in the first quarter of 2006 to $79.05 billion ($40.71 billion real estate farm land loans and $37.82 billion agricultural production loans) in the fourth quarter of 2016. In this case, only small banks (with assets size < $ 250 million) are included in the final estimation sample as about 89% of agricultural bank observations fall within this category throughout the study period. Moreover, the asset size boundary to obtain new sample size significantly reduces the dimensionality of estimations (since all the regressions are estimated using bank fixed effects). At the same time, it also provides more reliable results as agricultural banks (more than one-third of the sample) are compared with similar size non-agricultural banks. Two types of sensitivity analysis are performed. First, banks with agricultural loans greater than 15% to the total loans are considered as agricultural bank. Second, different sets of regressions are estimated interacting $AfterDFA$ with three different agricultural lending thresholds (agricultural loans less than $1 million, between $1 million and $10 million and above $10 million).

3.6 Results and Discussion

In this study, cost efficiency, economies of scale and scope are estimated for the sample of virtually all commercial banks using the non-parametric annual cost frontiers[9]. The cumulative distribution of cost efficiency in Figure B.1 indicates for about half of the commercial banks in the U.S. have a cost efficiency score less than 0.5 throughout the study period (except in 2006 where it is about one third). Therefore, during and after the financial crisis, half of commercial banks in U.S. could have reduced at least 50% of the total cost just by reducing input use. Figure B.2 is the cumulative distribution of economies of scale. About eighty percent of commercial banks operate close to constant returns to scale. The cumulative distribution of economies of scope is in Figure B.3. Economies of scope exits in all years for almost all of the commercial banks in the U.S.

Figures B.4-B.14 plot the cumulative distributions for the product specific economies of scale from 2006 to 2016. Most commercial banks produce agricultural loans in a region of decreasing returns to scale (DRS) and close to constant returns to scale (CRS) before and after Dodd-Frank. Similarly, non-agricultural real estate loans are produced close to CRS during the financial crisis periods (2007-2008) but are under DRS at other study periods. The DRS for this output becomes more prominent after Dodd-Frank. There is a consistent production of other non-agricultural loans under the DRS during the last decade, and it moves more towards DRS in recent years. After the financial crisis, transaction deposits are produced in the region of constant returns to scale. Non-transaction deposits are produced under decreasing returns to scale at a rate higher in recent years, than before and immediately after Dodd-Frank. Finally, other bank outputs are consistently produced at the region of DRS before Dodd-Frank but slightly towards increasing returns to scale (IRS) after Dodd-Frank. Figures B.15-B.25 plot the cumulative distribution functions for product specific economies of scope from 2006 to 2016. These figures suggest that economies of scope exist in most cases for all six output combinations before and after the Dodd-Frank. Among all the combinations, the least economies of scope or cost savings is associated with the production

[9]But, as mentioned in the previous section, the efficiency and technical changes are estimated using a different sample.

of the *other bank output* separately and five remaining outputs jointly. Tables B.1-B.11 summarize these economic measures by year.

3.6.1 Economies and Efficiency Estimates for Agricultural Banks

Table 3.2 summarizes the efficiency measures for the U.S. agricultural banks. The average cost efficiency (CE) score ranges from 0.54 in 2016 to 0.62 in 2006. Thus, during and after the financial crisis, agricultural banks in the U.S. could have reduced about forty percent of the total cost by reducing input use. Agricultural banks operate close to constant returns to scale as the average economies of scale ($Scale$) estimates ranges from 0.986 in 2009 to 1.01 in 2013. Economies of scope exists in agricultural banks as the average economies of scope ($Scope$) ranges from 0.448 in 2010 to 0.574 in 2006. Annual average agricultural loan specific scale economies ($AgScale$) estimates suggest that agricultural loans are produced in the decreasing returns to scale region before Dodd-Frank but more towards constant returns to scale afterward. These estimates range from 0.857 in 2008 to 0.960 in 2014. Similarly, the agricultural loan specific economies of scope ranges from 0.054 in 2016 to 0.148 in 2008 indicating that economies of scope or cost savings exist for agricultural banks with the production of agricultural loan separately and five remaining outputs jointly. The annual average of Malmquist productivity growth ($Malmq$), efficiency change ($Effch$) and technical change ($Tech$) of agricultural banks over time increasing productivity growth and technical change throughout the study period but a slight regress in efficiency change immediately after financial crisis.

3.6.2 Impacts of Too-Big-To-Fail Regulation on Big Banks

Table 3.3 presents the effects of Dodd-Frank on big banks cost efficiency, scale economies, scope economies and productivity growth. Only the difference in difference (DiD) regression coefficients on the of key variables of interest (interaction of Dodd-Frank with bank size; $Post\ DFA * Indirectly\ Treated$ and $Post\ DFA * DirectlyTreated$) are discussed below.

Columns (1) and (2) in Table 3.3 reports estimates of the cost efficiency separately for banks *near to $10 billion* and *near to $50 billion asset threshold* [10], respectively. The coefficients on key interaction variables ($Post\ DFA * Indirectly\ Treated$ and $Post\ DFA * Directly\ Treated$) from column (1) shows that there is no statistically significant impact on the cost efficiency of banks in the $10 billion asset category. However, Column (2) of Table 3.3 reveals that Dodd-Frank has reduced the cost efficiency of directly treated banks in the $50 billion asset category by 18.4 percent.

Columns (3) and (4) of Table 3.3 display the DiD estimates of economies of scale associated with the banks near to $10 billion and $50 billion asset thresholds. The results suggest that Dodd-Frank has caused a decrease in scale economies by 0.127 and 0.234 units respectively for indirectly and directly treated banks in the $50 billion asset category. However, there is no statistically significant impact on the economies of scale of banks near to the $10 billion assets threshold. This confirms that Dodd-Frank led to a more than proportional increase in cost if banks near to $50 billion in assets threshold (which are subject to more stringent regulations) increase their outputs.

Columns (5) and (6) of Table 3.3 display the DiD estimates for the effect of Dodd-Frank on the economies of scope separately for the samples of banks near to the $10 billion asset thresholds and $50 billion asset threshold. The estimate suggests that Dodd-Frank has no statistically significant effect on the economies of scope of banks near to the $10 billion asset thresholds. Nonetheless, this act caused a decrease in economies of scope by 0.439 units for the directly treated banks in the $50 billion asset category. It reveals that Dodd-Frank contributed towards output specialization for very large banks.

The DiD estimates on agricultural loan specific economies of scale for banks near the $10 billion asset category and banks near to the $50 billion asset category are respectively presented in Columns (7) and (8) of Table 3.3. Column (7) indicates that Dodd-Frank has no statistically significant impact on the agricultural loan specific scale economies for banks near $10 billion in asset size. Column (8) shows that agricultural loan specific scale economies is reduced by 0.246 units due to Dodd-Frank for indirectly treated banks in $50 billion asset

[10] As mentioned above, *near to $10 billion* consists of banks with assets from $4 billion to $13 billion and *near to $50 billion* consists of banks with assets from $20 billion to $65 billion.

category. Thus, an increase in agricultural loans (holding all other outputs constant) results in a more than a proportional increase in cost of indirectly treated banks due to Dodd-Frank.

Finally, Columns (9) and (10) of Table 3.3 present the estimates for the effect of Dodd-Frank on the agricultural loan specific economies of scope respectively for banks near the $10 billion asset category and banks near the $50 billion asset category. The estimates of Column (9) show that the Dodd-Frank has led a decrease in agricultural loan specific scope economies by 0.009 unit for the indirectly treated banks in the $10 billion asset category. Similarly, Column (10) displays that Dodd-Frank has led to respective reduction in agricultural loan specific economies of scope for directly treated banks in $50 billion asset category by 0.197 units. This confirms that Dodd-Frank contributed to agricultural lending specialization not only for directly treated banks in the $50 billion assets category, but also for indirectly treated banks in $10 billion assets category.

Table 3.4 presents the effects of Dodd-Frank on the productivity growth of banks near the $10 billion in assets size[11]. As in the case of economic measures, Dodd-Frank has no impact on the productivity growth of the directly treated banks near to $10 Billion assets size threshold. However, Dodd-Frank has caused an improvement in productivity and efficiency of indirectly treated banks near to this threshold.

3.6.3 Impacts of Too-Big-Too-Fail Regulation on Agricultural Banks

Tables 3.5 and 3.6 present the effects of Dodd-Frank on agricultural banks[12]. The odd numbered columns of these tables contain the results for banks with more than 25% of agricultural loans in their total loan portfolio (agricultural banks). However, for sensitivity analysis, the even columns of both tables present the results for banks with more than 15% of total loans as agricultural loans. Assuming all the banks experienced larger compliance costs

[11] As the Malmquist index was estimated for sub-sample of banks that had 11 years of data (a balanced panel) from 2006 to 2016, the estimation of impact on productivity change using the third model (near to $50 billion asset threshold) become impossible due to lack of observations. Thus, the results on Dodd-Frank impact on technical and efficiency change over time is estimated only for second model (banks *near to $10 billion*).

[12] As described in the method section, all these regressions in this subsection used small banks sample (less than $250 million in total assets).

after Dodd-Frank, and with the bank and year level fixed effects, the interaction variables ($Post\ DFA\ *\ AgBank$) can be interpreted as the impact of Dodd-Frank on agricultural banks though these small banks were not directly targeted[13]. Only the coefficient estimate associated with the key parameters of interest is interpreted in this section.

The odd columns of Table 3.5 shows the impacts of Dodd-Frank on cost efficiency,and economies of scale and scope in agricultural banks. Column (1) suggests that Dodd-Frank reduced the cost efficiency estimate of agricultural banks by 3.8% meaning that this act worsened the cost efficiency of agricultural banks. Column (3) shows that Dodd-Frank increased the economies of scale estimate of agricultural banks by 0.025 units indicating that Dodd-Frank increased the consolidations among agricultural banks. Column (5) indicates that Dodd-Frank reduced the economies of scope estimate of agricultural banks by 0.046 units; thus, Dodd-Frank reduced the cost saving opportunity through diversification for agricultural banks. Similarly, Columns (7) and (9) show the impact on agricultural banks' product specific economies of scale and scope due to Dodd-Frank. The estimates suggest that Dodd-Frank increased (reduced) the agricultural loan specific economies of scale (scope) estimate by 0.046 (0.042) units. It implies that Dodd-Frank encouraged agricultural banks to scale up production of agricultural loans and encouraged them to specialize in agricultural lending. Using a different threshold for an agricultural bank (banks with more than 15% of total loans as agricultural loans) (even columns of Table 3.5), the same conclusions can reached though the estimates are slightly smaller.

Similarly, the odd columns of Table 3.6 presents the effects of Dodd-Frank on the productivity measures of the agricultural banks. Results from the key parameter of interest ($Post\ DFA\ *\ AgBank$) suggest that Dodd-Frank led to a decrease in the Malmquist productivity index by 0.003 unit and a decrease in the technical change by 0.002 unit. Thus, Dodd-Frank negatively impacted productivity growth and technical change of agricultural banks. As shown in the even columns (2) and (6), both of these results are consistent using the alternative proportion (15%) of agricultural loans. Overall, evidence exists that

[13]However, its worth noting that these are not the causal difference-in-difference estimates as in the previous sub section.

Dodd-Frank has reduced the productivity growth of agricultural banks.

Alternative Specifications: Impacts on Agricultural Banks

Tables 3.7 and 3.8 present the results from alternative specifications where agricultural banks are defined based on the volume but not as the proportion of agricultural loans. Specifically, small banks with more than \$10 million in total agricultural loans are considered as agricultural banks. Therefore, the key parameter of interest is the interaction of $Post\ DFA{*}AgLoan\ Size(>\$10M)$ represents the impact of Dodd-Frank Act on agricultural banks. Nevertheless, the interaction of Dodd-Frank with small banks between \$1 million and \$10 million in total agricultural loans $Post\ DFA * AgLoan\ Size(\$1M - \$10M)$ are also used to check the sensitivity of results to the different volumes of agricultural loans. Again, the bank and year fixed effects along with the higher compliance costs after Dodd-Frank is the basis to interpret this interaction term $Post\ DFA * AgLoan\ Size(>\$10M)$ as the effect of Dodd-Frank on agricultural banks.

Results associated with key parameter of interest in the Table 3.7 indicates that agricultural banks' cost efficiency reduced by 3.6%, economies of scale increased by 0.027 units, economies of scope decreased by 0.014 units, agricultural loan specific economies of scale increased by 0.066 units and agricultural loan specific economies of scope reduced by 0.044 units due to Dodd-Frank. Except for economies of scope, the results are consistent (but slightly smaller) across all other estimations for the banks with agricultural loans between \$1 million and \$10 million. Similarly, the coefficient estimate of $Post\ DFA * AgLoan\ Size(>\$10M)$ in Table 3.8 indicates that an agricultural bank's Malmquist index is reduced by 0.005 units and efficiency change is reduced by 0.006 units. However, there is no statistically significant effect on small banks with more than \$1 million and less than \$10 million in agricultural loans. Using the alternative measure (size of agricultural loan) to determine agricultural banks leads to the same conclusions as using the proportion of agricultural loans. Overall, Dodd-Frank decreased cost efficiency, increased the reduction of cost from consolidation, decreased cost savings through product diversification, encouraged scaling up agricultural lending, encouraged specialization in agricultural loans and decreased productivity growth in the U.S. agricultural banking sector.

3.7 Conclusion

Regulatory compliance requirements for U.S. commercial banks have increased after the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010. Cost savings of these banks depend on their input-output mix as they operate in a multiproduct framework. Assuming banks are changing the types and ranges of services in response to the higher regulatory burden after 2010, this study investigates the impact of Dodd-Frank separately on the economic and efficiency measures of big banks and small agricultural banks. The Quarterly Reports of Condition of Commercial Banks (Call Report) data are used to obtain the input and output information for each commercial bank. The individual bank level economic measures are obtained separately for each years, from 2006 to 2016. This is the first study to estimate the economic measures of virtually all U.S. commercial banks from 2006 to 2016 separately for each year using the nonparametric annual cost frontier. The change in efficiency measures over time are calculated for a subset of data (balanced panel).

To identify the impact of Dodd-Frank on big banks, these big banks are categorized into three groups (control, indirectly treated and treated) based on their asset size relative to two asset thresholds ($10 billion and $50 billion). The findings from the difference in difference estimations suggest that Dodd-Frank has caused an increase in cost efficiency, decrease in economies of scale and increase in economies of scope of banks above the $50 billion asset. However, there is no statistically significant impact of Dodd-Frank for the same economic measures for banks near $10 billion asset threshold. Nevertheless, this act improved productivity and efficiency of banks near $10 billion asset threshold but discouraged them to scale up or to specialize in agricultural lending.

Separate regression estimations are performed on a sub-sample of small banks with an aim to identify the effect of Dodd-Frank on agricultural banks. Results suggest that Dodd-Frank increased economies of scale for U.S. agricultural banks. Since the higher bank level competition may benefit agricultural producers (Kandilov and Kandilov, 2017), the increased potential for consolidations in agricultural banks might have adversely impacted the U.S. agricultural sector. Results also indicate that Dodd-Frank decreased cost efficiency, decreased cost savings through product diversification, encouraged scaling up agricultural lending, encouraged specialization in agricultural lending and decreased the productivity growth in the U.S. agricultural banking sector. These results are robust to alternative empirical specifications where agricultural banks are defined based on size rather than the proportion of agricultural loan. Overall, this study shows that Dodd-Frank reduced the economic incentives for mergers of banks above the $50 billion that are subjected to greater oversight but indirectly adversely affected U.S. agricultural banks.

Table 3.1: *Descriptive Statitics of Outputs, Inputs and Input Prices*

Variables	Observations	Mean	Std. Dev.	Min.	Max.
Outputs					
Agricultural loans ($000,000,000)	54354	0.022	0.132	0	8.774
Nonagricultural real estate loans ($000,000,000)	54354	0.522	8.885	0	447.902
Other nonagricultural loans ($000,000,000)	54354	0.474	8.145	0	482.745
Transactions deposits ($000,000,000)	54354	0.201	3.752	0	308.237
Nontransactions deposits ($000,000,000)	54354	0.799	16.362	0	976.213
Other bank output ($000,000,000)	54354	0.047	1.563	0	127.378
Inputs					
Total assets ($000,000,000)	54354	1.807	32.655	0.003	1653.853
Total deposits ($000,000,000)	54354	1.256	22.343	0	1226.078
Employees (Number)	54354	322	5338	0	233839
Fixed assets ($000,000)	53582	6.944	23.158	0	1040.976
Input prices					
Other expenses/total assets	54354	0.007	0.014	0	0.895
Interest paid/total loans	54179	0.023	1.679	0	380.3
Average salary ($000,000)	54273	0.04	0.017	0	1.589
Occupancy expense/fixed asset	53389	0.301	2.374	0	432.396

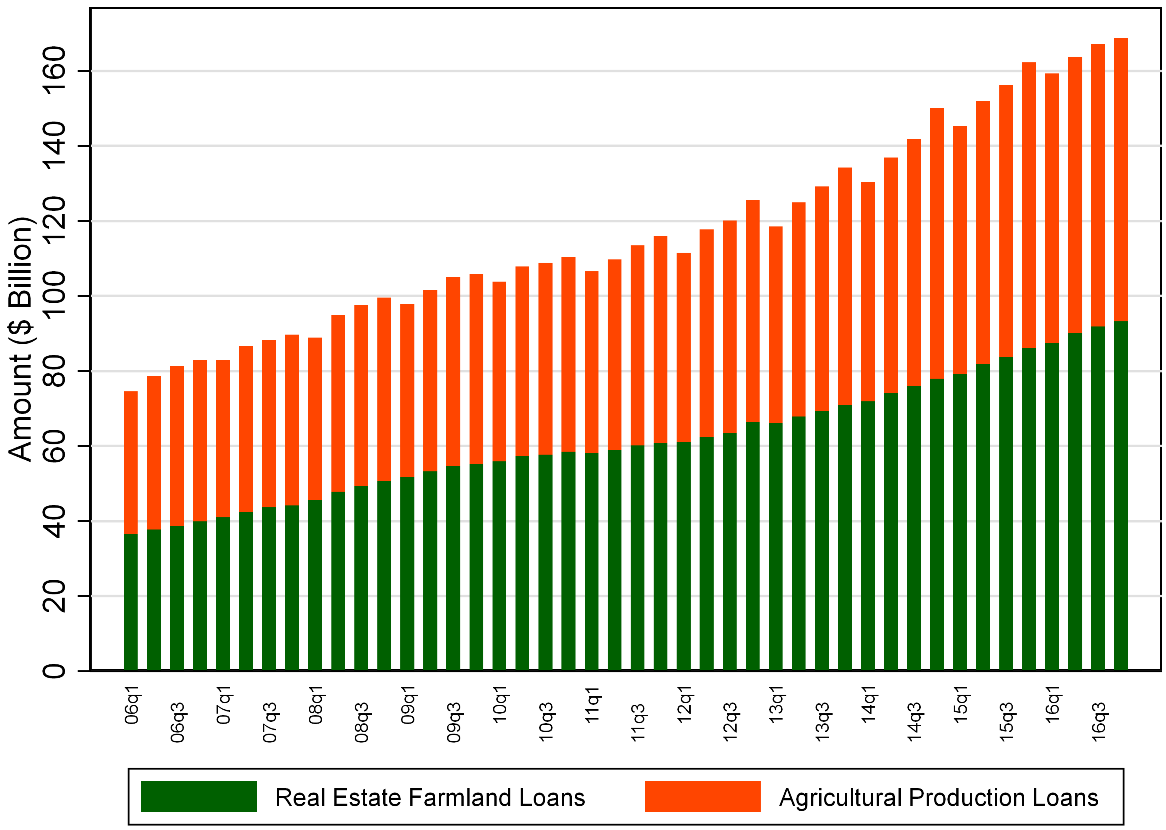

Figure 3.1: *Agriculural Lending Trend in the U.S. Commercial Banks.*

Note: This figure is developed by author using the Call Report data.

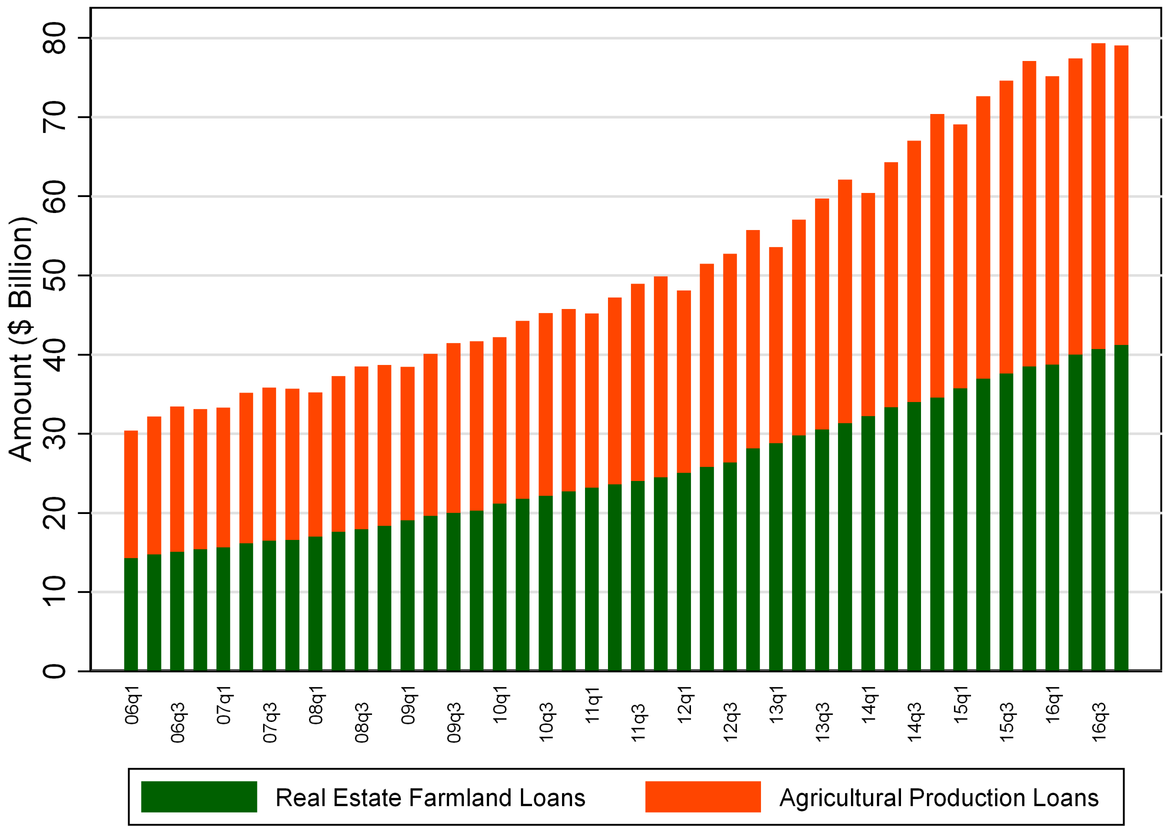

Figure 3.2: *Agriculural Lending Trend in the U.S. Agricultural Banks.*

Note: This figure is developed by author using the Call Report data. Agricultural banks represent the banks with more than 25% of agricultural loans in their total loan portfolio.

Table 3.2: *Average of Economic and Productivity Measures for Agricultural Banks*

Year	CE	Scale	Scope	AgScale	AgScope	Malmq	Effch	Tech
2006	0.623	1.000	0.574	0.889	0.102			
2007	0.612	0.984	0.475	0.877	0.123	1.003	1.001	1.002
2008	0.593	0.978	0.452	0.857	0.148	1.008	1.007	1.001
2009	0.595	0.986	0.492	0.865	0.099	1.004	0.990	1.015
2010	0.577	1.000	0.448	0.924	0.106	1.012	0.998	1.014
2011	0.584	1.004	0.494	0.909	0.057	1.013	0.989	1.024
2012	0.580	1.009	0.573	0.947	0.075	1.027	1.014	1.013
2013	0.548	1.010	0.555	0.950	0.067	1.031	1.009	1.021
2014	0.548	1.005	0.473	0.960	0.064	1.031	1.005	1.026
2015	0.540	0.998	0.457	0.953	0.061	1.028	1.019	1.009
2016	0.541	1.002	0.472	0.956	0.054	1.021	1.016	1.005

Note: Variables *CE*, *Scale*, *Scope*, *AgScale*, *AgScope*, *Malmq*, *Effch* and *Tech* respectively represents cost efficiency, economies of scale, economies of scope, agricultural loan specific economies of scale, agricultural loan specific economies of scope, Malmquist productivity index, efficiency change and technical change. Cost efficiency and scale economies measures are obtained using the annual cost frontier estimations from 2006 to 2016. however, the productivity growth components are obtained using a separate sub-sample of balanced panel from 2006 to 2016. There are no estimates of productivity growth components at the first period (2006) as it measures the changes from one period to next.

Table 3.3: *Difference in Difference Estimates for Cost Efficiency, Economies of Scale and Scope for Very Large Banks*

	(1) CE (\$10B)	(2) CE (\$50B)	(3) Scale (\$10B)	(4) Scale (\$50B)	(5) Scope (\$10B)	(6) Scope (\$50B)	(7) AgScale (\$10B)	(8) AgScale (\$50B)	(9) AgScope (\$10B)	(10) AgScope (\$50B)
Post DFA	-0.145***	-0.277***	0.111***	0.050	0.051*	-0.152	-0.045	0.265*	-0.003	-0.041
	(0.020)	(0.039)	(0.011)	(0.050)	(0.022)	(0.084)	(0.042)	(0.119)	(0.003)	(0.052)
Indirectly Treated	-0.015	-0.015	-0.009	0.024	0.006	-0.007	0.027	0.235*	0.005	-0.031
	(0.017)	(0.032)	(0.010)	(0.043)	(0.019)	(0.070)	(0.034)	(0.114)	(0.003)	(0.048)
Directly Treated	-0.023	0.002	-0.028	0.099	0.010	0.386***	0.001	0.114	0.001	0.117*
	(0.026)	(0.047)	(0.016)	(0.062)	(0.029)	(0.102)	(0.055)	(0.100)	(0.004)	(0.057)
Post DFA × Indirectly Treated	0.030	0.069	-0.006	-0.127*	0.002	-0.021	-0.031	-0.246*	-0.009**	0.032
	(0.019)	(0.042)	(0.010)	(0.055)	(0.021)	(0.092)	(0.035)	(0.119)	(0.003)	(0.060)
Post DFA × Directly Treated	0.030	0.184***	0.013	-0.234***	0.007	-0.439***	0.002	-0.113	-0.005	-0.197***
	(0.029)	(0.048)	(0.017)	(0.062)	(0.032)	(0.105)	(0.062)	(0.097)	(0.005)	(0.054)
Observations	735	196	726	187	735	196	492	132	614	155
R^2	0.810	0.897	0.540	0.535	0.855	0.709	0.551	0.693	0.510	0.638

Note: Dependent variables *CE*, *Scale*, *Scope*, *AgScale* and *AgScope* respectively represents cost efficiency, economies of scale, economies of scope, agricultural loan specific economies of scale and agricultural loan specific economies of scope. The variable *post dfa*=1 if year is 2010 onward. for banks near to \$10b assets threshold, *directly treated* = 1 if banks total assets is \$10b-\$13b, *indirectly treated* = 1 if banks total assets is \$7b-\$10b and *untreated* = 1 if total assets is \$4b-\$7b. For banks near to \$50b assets threshold, *directly treated* = 1 if banks total assets is \$50-\$65b, *indirectly treated* = 1 if banks total assets is \$35-\$50b and *untreated* = 1 if total assets is \$20-\$35b. All regressions include year and bank fixed effects. Standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 3.4: *Difference in Difference Estimates for Productivity Measures for 10 Billion Dollar Assets Size Banks*

	(1) Malmquist Index	(2) Efficiency Change	(3) Technological Change
Post DFA	0.008	0.001	0.006
	(0.010)	(0.011)	(0.005)
Indirectly Treated Banks	-0.023*	-0.022*	-0.001
	(0.009)	(0.010)	(0.005)
Directly Treated Banks	-0.006	-0.010	0.004
	(0.014)	(0.015)	(0.007)
Post DFA × Indirectly Treated Banks	0.027**	0.028**	-0.001
	(0.010)	(0.010)	(0.005)
Post DFA × Directly Treated Banks	0.022	0.025	-0.003
	(0.016)	(0.017)	(0.008)
Observations	443	443	443
R^2	0.349	0.291	0.431

Note: Dependent variables in columns (1)-(3) are Malmquist productivity index, efficiency change and technological change. The variable *post dfa*=1 if year is 2011 onward, *directly treated* = 1 if banks total assets is 10b−13b, *indirectly treated* = 1 if banks total assets is 7b−10b, *untreated* = 1 if total assets is 4b−7b. All regressions include year and bank fixed effects. Standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 3.5: *Regression Estimates for Cost Efficiency, Economies of Scale and Scope for Agricultural Banks*

	(1) CE (> 25%)	(2) CE (> 15%)	(3) Scale (> 25%)	(4) Scale (> 15%)	(5) Scope (> 25%)	(6) Scope (> 15%)	(7) AgScale (> 25%)	(8) AgScale (> 15%)	(9) AgScope (> 25%)	(10) AgScope (> 15%)
Post DFA	-0.042***	-0.039***	-0.015***	-0.017***	-0.095***	-0.095***	0.038***	0.038***	-0.012***	-0.010***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)	(0.001)	(0.001)
AgBank	0.037***	0.038***	-0.013***	-0.011***	0.063***	0.061***	-0.036***	-0.030***	0.041***	0.038***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.005)	(0.004)	(0.003)	(0.003)	(0.001)	(0.001)
Post DFA × AgBank	-0.038***	-0.035***	0.025***	0.022***	-0.046***	-0.036***	0.046***	0.035***	-0.042***	-0.036***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.003)	(0.002)	(0.002)	(0.001)	(0.001)
Observations	36828	36828	36712	36712	36828	36828	31456	31456	33078	33078
R^2	0.760	0.760	0.555	0.555	0.820	0.819	0.349	0.344	0.729	0.722

Note: Dependent variables *CE*, *Scale*, *Scope*, *AgScale* and *AgScope* respectively represents cost efficiency, economies of scale, economies of scope, agricultural loan specific economies of scale and agricultural loan specific economies of scope. The variable *post dfa*=1 if year is 2010 onward. in odd columns, *agbanks* = 1 if banks total agricultural loan is more than 25% of total loan. As a sensitivity analysis, regressions results in even columns define *agbanks* = 1 if banks total agricultural loan is more than 15% of total loan. All regressions include year and bank fixed effects. Standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 3.6: *Regression Estimates for Productivity Measures for Agricultural Banks*

	(1)	(2)	(3)	(4)	(5)	(6)
	Malmq(> 25%)	Malmq(> 15%)	Effch(> 25%)	Effch(> 15%)	Tech(> 25%)	Tech(> 15%)
Post DFA	0.025***	0.025***	0.009***	0.009***	0.016***	0.016***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
AgBank	0.002	0.001	-0.000	-0.000	0.003**	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Post DFA × AgBank	-0.003**	-0.002*	-0.001	0.000	-0.002***	-0.002***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Observations	46184	46184	46184	46184	46184	46184
R^2	0.145	0.144	0.102	0.102	0.177	0.177

Note: Dependent variables in columns (1) and (2) is Malmquist productivity index, columns (3) and (4) is efficiency change and columns (5) and (6) is technical change. The variable *post dfa*=1 if year is 2010 onward. in odd columns, *agbanks* = 1 if banks total agricultural loan is more than 25% of total loan. As a sensitivity analysis, regressions results in even columns define *agbanks* = 1 if banks total agricultural loan is more than 15% of total loan. All regressions include year and bank fixed effects. Standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 3.7: *Regression Estimates for Cost Efficiency, Economies of Scale and Scope Across Size of Agricultural Banks*

	(1) CE	(2) Scale	(3) Scope	(4) AgScale	(5) AgScope
Post DFA	-0.040***	-0.017***	-0.107***	0.023***	-0.007***
	(0.002)	(0.002)	(0.004)	(0.004)	(0.001)
AgLoan Size (\$1M-\$10M)	0.017***	-0.024***	-0.059***	-0.015***	0.004***
	(0.002)	(0.002)	(0.004)	(0.003)	(0.001)
AgLoan Size ($> \$10M$)	0.046***	-0.043***	-0.062***	-0.054***	0.028***
	(0.003)	(0.003)	(0.006)	(0.004)	(0.001)
Post DFA × AgLoan Size (\$1M-\$10M)	-0.015***	0.012***	0.018***	0.020***	-0.011***
	(0.002)	(0.002)	(0.004)	(0.003)	(0.001)
Post DFA × AgLoan Size ($> \$10M$)	-0.036***	0.027***	-0.014***	0.066***	-0.044***
	(0.002)	(0.002)	(0.004)	(0.003)	(0.001)
Observations	36828	36712	36828	31456	33078
R^2	0.758	0.556	0.819	0.353	0.717

Note: Dependent variables *CE*, *Scale*, *Scope*, *AgScale* and *AgScope* respectively represents cost efficiency, economies of scale, economies of scope, agricultural loan specific economies of scale and agricultural loan specific economies of scope. The variable *post dfa*=1 if year is 2010 onward. *agloan size (\$1m-\$10m)*=1 if banks' total agricultural loan is between \$1 million and \$10 million. *agloan size* ($> \$10m$)=1 if banks' total agricultural loan is above \$10 million. The baseline here consists the banks with agricultural loan below \$1 million. All regressions include year and bank fixed effects. Standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 3.8: *Regression Estimates for Productivity Measures for Agricultural Banks*

	(1) Malmquist Index	(2) Efficiency Change	(3) Technological Change
Post DFA	0.027***	0.012***	0.015***
	(0.002)	(0.002)	(0.001)
AgLoan ($\$1M - \$10M$)	0.002	0.001	0.001
	(0.002)	(0.002)	(0.001)
AgLoan ($> \$10M$)	0.006*	0.006*	0.001
	(0.003)	(0.003)	(0.001)
Post DFA × AgLoan ($\$1M - \$10M$)	0.001	0.001	0.000
	(0.002)	(0.002)	(0.001)
Post DFA × AgLoan ($> \$10M$)	-0.005*	-0.006**	0.001
	(0.002)	(0.002)	(0.001)
Observations	31488	31488	31488
R^2	0.161	0.122	0.224

Note: Dependent variables in columns (1)-(3) are Malmquist productivity index, efficiency change and technological change. The variable *post dfa*=1 if year is 2010 onward. *agloan size ($1m-$10m)*=1 if banks' total agricultural loan is between $1 million and $10 million. *agloan size* ($> \$10m$)=1 if banks' total agricultural loan is above $10 million. The baseline here consists the banks with agricultural loan below $1 million. All regressions include year and bank fixed effects. Standard errors in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Chapter 4

Differential Taxation in Agricultural Credit Market

4.1 Introduction

Several lenders compete in the U.S. agricultural credit markets. The U.S. federal government has been directly involved in providing credit to farmers by issuing direct loans and guarantees as well as by establishing other rural lending institutions (Monke, 2016; Robbins, 2009). The Farm Service Agency (FSA) of the United States Department of Agriculture (USDA) makes direct loans to farmers and also issues guarantees on loans from commercial banks and the farm credit systems to those farmers who are not credit-worthy otherwise. There is also a government involvement in the existence of cooperatively owned Farm Credit System (FCS) and Farmer Mac, both of which are agricultural lending institutions that operate as government-sponsored enterprises (GSEs).

The FCS was established by Federal Farm Loan Act 1916, which became fully borrower-owned cooperative lending institution in 1968. The government provided capital to the FCS in 1985 due to the farm crisis of 1980s. The Agricultural Act of 1987 established the Farm Credit System Insurance Corporation and Farmer Mac to support agricultural lending. As GSEs, these institutions have a competitive advantage due to implied backstop of the U.S.

treasury. In addition, FCS profits on real estate loans are exempted from local, state and federal income taxes; whereas, profits from the non-real estate loans are exempt from local and state but not from the federal corporate income tax (CIT) (Ely, 2006). The total FCS tax advantage is estimated $850 million ($725 million in real estate lending and $125 in non-real estate lending) for 2005 and first half of 2006 (Ely, 2006). Among the remaining agricultural lenders, commercial banks and insurance companies do not receive similar tax treatment though they compete in the same market[1]. It is also worth noting that both FCS and commercial banks don't view the FSA as a competitor because it operates in a different market (i.e.provides loans to disadvantaged farmers or those that are unable to obtain commercial credits) (Monke, 2016).

Commercial banks argue the FCS tax advantage is unfair for them for market competition. In 2015, the President of American Bankers Association requested the Chairman of the Senate Committee on Agriculture to conduct annual oversight hearings on "growth and questionable practices" of FCS. In the letter [2], they mention, the "FCS tax subsidy has outlived its usefulness, skewing markets in ways that waste government resources, raise safety and soundness concerns, and greatly harm the ability of local banks to help their communities grow and prosper." A recent study by Turvey (2017) provides the historical background on the establishment of FCS as well as the joint-stock land banks and also highlights the institution conflicts due to tax exemption for some organization. Turvey (2017) notes, "although the 1916 Act made every effort to foster competition and to allow flexibility to decide upon cooperative and joint-stock companies, the tax-free status became contentious". Despite the policy interest, there are few empirical research works on the impact of favorable tax treatment to FCS in the agricultural credit market in the empirical setting.

This study provides empirical evidence on two areas of policy interest. First, it is deter-

[1]According USDA, "The lender category of individuals and others as reported on the farm sector balance sheet would include: the Small Business Administration (SBA); State and county government lending agencies; implement dealers and financing corporations; input suppliers; co-operatives and other merchants; individuals from whom any land was bought under a mortgage or deed of trust; individuals from whom any land was bought under a land purchase contract; credit unions; any other individuals; any other lenders; credit cards; other debts and unpaid bills." Therefore, almost all of the lenders in the *individuals and other* category either do not have corporate income in their portfolio or are exempt from it.

[2]Please click here to access the letter.

mined whether the market share of agricultural lenders is affected by the change in corporate income tax. Given that the FCS receives favorable tax treatment, it is hypothesized that the tax rate may cause an increase in the agricultural market share of FCS. Second, the potential impact of an agricultural lender's market share on the farmers agricultural loan rate is examined. It is expected that an increase in the market share of FCS may reduce the farmer's cost of borrowing on agricultural loan.

4.2 Review of Literature

The standard public economics literature has explored how tax exemption affects the behavior of non-profits firms compared to for-profit firms as well as credit unions compared to banks. A portion of this literature explains the role of tax exemption particularly to the change in market share and social welfare. Market share is a source of high profits irrespective of the firm's concentration level (Rhoades, 1985); therefore, whether there should be tax-exempt financing (that affects the capital flows) is an important question that needs to be addressed carefully (O'Hara, 1983). Using statewide samples of several for-profit and non-profit firms such as residential nursing homes, hospitals, post-secondary vocational schools as well as the primary and secondary schools, Hansmann (1987) concludes that corporate income tax exemption caused a significant increase in the market share of non-profit firms.

While tax exemption seems to favor some types of firms, there is a debate about the impact of tax exemption on overall social welfare. Harris and Strouse (1997) study four non-profit hospitals and find that property tax exemptions are not justified because none of those hospitals provided sufficient charity care. They estimated the excess tax break over the free care provided by these hospitals as $4 million. At the same time, they underscore that it is crucial to collect data on tax exemptions benefits and their charity expenses to provide the justification for tax exemption. Gentry and Penrod (2000) suggest that the benefits of tax arbitrage to the non-profit hospital happens when they maintain their endowments through tax-exempt borrowing to expand facilities. In particular, they show that there are substantial arbitrage benefits as almost half of the outstanding tax-exempt debt is likely to be offset by endowments. Using a computational general equilibrium model, Johnson (2003) finds that differential corporate income tax rates for for-profit and commercial non-profit firms cause a significant impact on welfare cost. In fact, Johnson (2003) argues that some level of average excess burden to the for-profit is necessary as complete elimination also leads to a overall reduction in the social welfare. Likewise, Grabowski and Hirth (2003) provide evidence that non-profits are a quality signal for some uniformed nursing home consumers. Thus, they argue that an increase in the market share of non-profit institutions in health care improves the quality of overall nursing home including the quality of for-profits. Byrne (2014) studies the impact of state and local tax exemption on wage differentials in the non-profit hospital industry. Byrne (2014) finds that the non-profit wage differential is not more noticeable due to its tax exemption status because the wage premium of workers declines for an increase in the state tax burden.

From the literature, it can be concluded that evidence exits on the impact of a corporate income tax exemption not only to the market share but also to overall social welfare. Rushton (2007) encourages researchers to explore the reasons behind the corporate income tax exemptions before examining the special features of non-profits. Specifically, Rushton (2007) argues that it is vital to identify the distortions of corporate income tax on the economy before changing the favorable tax treatment to the nonprofits. Sjoquist and Stoycheva (2010) emphasize that it is not only essential to explore the role of the corporate income tax exemption but also the impact of property tax exemptions to the quantity and quality of services produced by for-profits and nonprofit organizations. In particular, they indicate that policymakers need to be more aware of the distribution of the property tax exemption burden, the foregone revenues as well as their advantages and disadvantages. They argue that researchers need to offer both theoretical and empirical evidence on the impact of property tax exemptions on the behavior of non-profit organizations. Overall, irrespective of the type of tax-exemptions, most of the previous research concludes that it is crucial to identify both the market and welfare distortions of the tax-exemptions on for-profits firms.

There has been some limited academic research on the welfare implications of tax exemption in the banking sector. Frame et al. (2003) investigate the pass-through of credit union federal corporate tax exemption among its members. They find that residential credit unions, in particular, misuse some portion of the income tax subsidy as they engage in expense preference behavior that is not beneficial to its members. Tatom (2005) examines the history of credit union federal tax exemptions and the impact on its competitors as well as to the members. According to Tatom (2005), the main justification behind the subsidy was that credit unions would use the tax advantage to serve low-income borrowers and depositors. However, considering that there is no regulatory reason for credit unions to provide service to low and moderate income customers, they argue that the customers of credit unions are no different for banks. Thus, they conclude that the tax subsidy fails to provide the required financial services to low-income people. Because of the similar reasons, commercial banks usually oppose policies to strengthen credit unions as these institutions face less regulation and more favorable taxation (Wheelock and Wilson, 2011). McKillop and Wilson (2011) emphasize that it is reasonable to compare the tax exemptions to credit unions with other financial institutions only if they are in direct competition. Most importantly, they argue that this debate cannot be resolved only by the theoretical arguments.

It is worth mentioning that there is no past literature that empirically identifies the impact of the corporate income tax exemption to Farm Credit System. As for non-profit firms and credit unions, this favorable tax treatment to FCS could have significant impacts on agricultural lending industry structure, the market share as well as the overall welfare. Therefore, a distinctive feature of this paper is that it provides empirical evidence on the impact of corporate income tax on the market share of agricultural lending as well as outlines some of the welfare impacts in terms of change in cost of borrowing.

It is also worth noting that some of the major empirical studies related to FCS focus on credit risk. Featherstone et al. (2006) find that repayment capacity, owner equity, and working capital originations loans are important factors affecting the probability of default for loans in seventh FCS district portfolio. Jensen and Perry (2007) find that yield spreads are more responsive to default risk than liquidity risk. Nevertheless, these studies not focused on tax-exemption in the agricultural credit markets. Jensen (2000) indicates that the FCS was established as government-sponsored enterprise (GSE) to provide loans at lower rates in response to perceived agricultural credit market failures. However, Jensen (2000) also claims that the current competitive market structure is sufficient to meet the demand of the agricultural credit market; therefore, a valid justification is required for continuing the FCS as a GSE. Importantly, the author argues that government guaranteed interest rate subsidies due to GSE status causes a missallocation of resources resulting in a rate of return less than the opportunity cost of alternative investments. Further, they argue that this distortion in relative interest rate due to subsidy causes allocative inefficiency and dead weight loss because excessive resources are allocated to one sector. A recent study by Brewer et al. (2019) identify the correlation between borrower characteristics and choice of farm credit suppliers.

4.3 Data and Method

This study examines the impact of favorable corporate income tax (CIT) treatment for the FCS in the U.S. and its spillover effect on interest rates across different types of the agricultural loans. For this purpose, a state-year level CIT dataset (since 1980 to 2010) is obtained from Serrato and Zidar (2016). This state-year level CIT is the average effective tax rate paid by C-corporations[3]. Next, several datasets from the United States Department of Agriculture, Economic Research Service (USDA-ERS) [4] are used to obtain information on state-level farm financial variables. In particular, statistics on the number of farms, amount of different types of agricultural loans and market share of agricultural lenders (from 1960 to 2003) are obtained from the state-level balance sheet. Also, farm financial ratios at the state level (from 1960 to 2003) are obtained. Furthermore, the interest expenses across different types of agricultural loans (since 1910 to 2017) are acquired at a state-level from income-wealth statistics. Lastly, these datasets are merged at the state-year level and ranges from 1980 to 2003 (1200 data points).

Table 4.1 presents descriptive statistics of the variables used in the study. Commercial

[3]Serrato and Zidar (2016) presents the details on how these average effective tax rates is actually due to statutory changes to top and bottom marginal rates for each state.

[4]Data Files: U.S. and State-Level Farm Income and Wealth Statistics

banks and FCS together share more than 80% of total farm debt shares in recent years. Figure 1.1 illustrates that total farm debt market shares has been growing for the FCS since 2000, relatively stable for commercial banks and life insurance companies, and decreasing for FSA, individuals and others (will be referred as "INOs"). The same conclusion holds for real estate loans, where the FCS has a higher market share than commercial banks after 2000 (Figure C.1). The market share of non-real estate agricultural loans has been dominated by the commercial banks in last two decades; but, the share held by FCS has been growing in last decades (Figure C.2). In 2015, the market share of real (non-real) estate farm debt for commercial banks, FCS, FSA, life insurance companies, Farmer Mac and INOs are respectively, 37.92% (49.45%), 46.30% (32.63%), 2.69% (2.53%), 6.00% , 2.32% and 4.77% (15.38%). Figure 4.1 shows that the real estate interest expenses by farm households in the U.S. is higher than the non-real estate interest expenses in recent decades. Recently, total real (non-real) estate interest expense in farm debt is 9.921 (6.490), 9.621 (6.929) and 11.434 (7.604) million dollars from 2015 to 2017. The state level CIT has varied from 0 to about 12 percent across different states (see Figure 4.2).

4.3.1 Corporate Income Tax and Agricultural Credit Market share

The impact of state corporate income tax rates on the market share of the tax-exempt sector is estimated using an ordinary least square (OLS) regression. Recall that commercial banks and the life insurance companies that lend to the agricultural sector do not receive the favorable tax treatment. The following equation is estimated:

$$MS_{ist} = \alpha_i + \beta_i SCTR_{st} + \gamma_i X_{st} + T_t + \epsilon_{ist} \tag{4.1}$$

where the outcome variable MS_{ist} represents market share of tax-exempt agricultural lenders on the agricultural loan type i for state s in year t. The regressions are estimated separately for three types of agricultural loan samples; total agricultural loans, real estate agricultural loans and non-real estate agricultural loans. The regression specification consists of the market share of Farm Credit System (FCS) as the dependent variable. Nevertheless, two other regressions are presented as robustness check, in which one has the combined market share of FCS and FSA, while the other has the total market share of FCS, FSA and INOs as the dependent variable. $SCTR_{st}$ is the average effective corporate income tax rate in the state s in year t. Given the time fixed effect (T_t), β_i becomes the parameter of interest for agricultural loan type i for a continuous change in corporate income tax policy.

The variables X_{st} represent state level variables such as number of farms and farm financial ratios for state s at time t. Specifically, the debt service ratio (DSR) represents the share of production to loan payments and times interest earned (TIE) documents the farm's ability to meet its interest obligations. Both are liquidity measures, a higher DSR indicates the farm is less liquid but a higher TIE implies the operations can generate adequate cash to meet interest obligations. Two-farm efficiency measures are used: asset turnover ratio (ATR) and the net cash farm income to debt ratio (NFID). Higher ATR and higher NFID indicate a more efficient use of assets and efficient generation of net farm income in the production process. The debt to asset ratio (DAR), a solvency ratio, is used in regression estimations. A higher percentage of this ratio generally indicates more risk. Finally, the rate of return on farm assets (ROA) is used as a control of the farms' profitability. ROA measures the returns to farm sectors assets from current farm operations. An increase in this ratio indicates an increase in profitability.

4.3.2 Agricultural Credit Market Share and Interest Rate

Next, the impact of the agricultural lenders' market share on the cost of borrowing on agricultural loans is estimated. The interest rate paid by farm households for loan type i is regressed on agricultural lenders' market share (for example, the FCS market share for loan type i in the main specification) and the previous years' farm sector financial ratios (specified in previous section) as well as the number of farms from last year. Specifically, the following regression is estimated to obtain the change in the interest rate due to the exogenous variation of the market share of different agricultural lenders:

$$IR_{ist} = \alpha_i + \varphi_i MS_{ist} + \gamma_i X_{st-1} + T_t + \epsilon_{ist} \quad (4.2)$$

where X_{st-1} and T_t represents the same information as in the equation (1). However, since the interest rate faced by the farmers and the farm sectors financial ratios are jointly determined, the above OLS regression uses lagged farm financial ratios. MS_{ist} is the market share of agricultural lenders (particularly, market share of FCS in the main specification) associated with agricultural loan type i for state s in year t.

The interest rate for loan type i for state s in year t (IR_{ist}) is obtained by dividing the total interest expense by the total loan amount for the corresponding loan type. This interest expense to farm debt ratio is a proxy for the actual interest rate on the agricultural loans. An increase in this ratio indicates that the farms are paying a higher interest rate for the given amount of farm debt. Thus, the interest rate used in this study is the cost of borrowing on agricultural loans faced by farm households. This estimate provides implications on the interest rate of agricultural loans when an agricultural lenders' market share changes. The key parameter of interest φ_i represents the response of interest rate to exogenous changes in FCS market share. Like the previous section, robustness checks are performed by estimating two alternative regressions using different market shares; where that uses the total market share of FCS and FSA, and another one uses the total market shares of FCS, FSA and INOs.

4.4 Results

The impact of CIT on total, real estate and non-real estate farm debt market share are respectively presented in the Table 4.2, 4.3, and 4.4. In all three tables, the dependent variables in the regressions in columns (1) to (3) are the market share of FCS (*MS1*), columns (4) to (6) are the market share of both FCS and FSA (*MS2*), and columns (7) to (9) are the market share of FCS, FSA and INOs (*MS3*). Furthermore, the regressions in the columns (1), (4) and (7) includes SCTR and state-year level controls (such as Debt to Asset, Return on Assets and number of farms) but no year fixed effects, columns (2), (5) and (8) include year fixed effects and columns (3), (6) and (9) further extend these regression by adding FCTR as an additional control.

4.4.1 Market Share Implications

The coefficient on the key variable SCTR is positive and statistically significant in Column (2) indicating that the state level CIT has a positive and significant impact on the total agricultural credit market share of FCS (Table 4.2). The estimate implies that a 10 percent increase in the corporate income tax rate at the state level causes the total farm debt share of FCS to rise by 1.76 percent. Across agricultural loan types, increasing the state level corporate income tax rate is associated with a significant reduction in the market share for the real estate loans (Table 4.3), but has positive effect on non-real estate loans (Table 4.4). A 10 percent rise in state level CIT reduces the FCS market share for real estate loans by 1.95 percent, and increases the FCS market share for non-real estate loan by 3.65 percent. These findings suggest that a rise in the state level CIT encourages FCS to move lending from real estate to non-real estate loans, that leads to an increase in its total agricultural credit market share. Similarly, Column (3) of Tables 4.2, 4.3, and 4.4 shows that a 10 percent increase in corporate income tax rate at the federal level is associated with 3.76 percent increase in total farm debt and 5.77 percent increase in non-real estate farm debt of FCS.

Column (2) of Tables 4.2, 4.3, and 4.4 present the effect of farm financial measures on the total, real estate, and non-real estate market shares of FCS. The coefficient estimates suggest that an additional ten thousand farms leads resulting in a statistically significant decrease in the FCS market share to the total, real estate and non-real estate loans by 0.06 percent, 0.03 percent and 0.009 percent. The same estimations show that an increase in debt service ratio by 0.1-point leads to a decrease in FCS total, real estate and non-real estate farm debt shares by 5.5%, 4.65% and 6.79% percent respectively. An increase by a point in the TIE ratio results in an increase of market share of FCS by 1.8%, 1.6% and 2.0%. Combining these findings, suggest that FCS flourishes in states that have lower number of farms but with higher liquidity and greater ability to make debt payments.

The estimates in the same column (2) in the Tables 4.2, 4.3, and 4.4 indicate that for a one percent increase in asset turnover ratio leads to a rise in total, real estate and non-real estate farm debt respectively by 0.4%, 0.2% and 0.6%. However, an additional percentage decrease in the net cash farm income to debt ratio leads to decrease in real estate farm debt respectively by 0.1%. Similarly, results suggest that additional percent increase in debt to assets ratio respectively caused an increase of FCS total, real estate and non-real estate market share by 3%, 4% and 5%. Therefore, the two efficiency ratios and the solvency ratio impact FCS total agricultural credit market share in different directions. It supports the view that an increase in efficiency in the production process (due to the increase in either of these two efficiency ratios) or the rise in credit risks (from the increase the solvency ratio) doesnt necessarily increase the FCS total farm debt market share, but rather, it depends on the magnitude of the change in these ratios. Similarly, an additional percentage increase in return on assets leads to 0.3%, 0.2% and 0.4% decrease in the market share of total, real estate and non-real estate farm debt, respectively.

4.4.2 Interest Rate Implications

Table 4.5 shows the interest rate implications of agricultural lenders market share. Recall that the farm households interest expenses to debt ratio is used as an estimate for the interest rate for agricultural loans. Columns (1), (4) and (7) present the results respectively for total (*IR*), real estate (*RealIR*) and non-real estate (*NRealIR*) estimated interest rates incurred by farm households. The key variables of interest *MS1* for column (1) is positive and statistically significant, *RealMS1* for column (4) is positive and statistically significant and *NRealMS1* for column (4) is non-negative and statistically insignificant, indicating that for a 10 percent rise in the total (real estate) market share of FCS in previous year leads to an increase (decrease) in the interest rate of total (real estate) farm debt by 0.06% (0.11%) in the current year. The findings suggest that increased competitiveness of FCS in total farm debt lending can results in an increase in cost of borrowing of overall agricultural loans for farm households, though the amount is small.

The regression estimates in columns (1), (4) and (8) of Table 4.5 also illustrate the effect of farm financial performance to the interest rate on agricultural loans. Specifically, a rise in the number of farms in previous year leads to an increase in contemporaneous interest rate associated with both real estate and and non-real estate farm loans. Similarly, a rise in the debt-service ratio and fall in time interest earned (TIE) ratio leads to an increase in the non-real estate interest rate in the following year. An increase in TIE ratio leads to a decrease in the real estate interest rate. Thus, lower liquidity (i.e. rise in DSR) and lesser ability to generate adequate cash to meet interest obligations (i.e. fall in TIE ratio) leads to an increase in the interest rate on farm debt in the following year.

For the efficiency measures, an increase in the asset turn over ratio and net cash farm income to debt ratio in previous year causes an increase interest rates for both real estate and non-real estate farm loans. An efficient use of assets (i.e. higher ATR) and efficient generation of net farm income (i.e. higher NFID) in the production process results in an increase in interest rate in the farm debt in the following year.

Furthermore, a reduction in debt to asset ratio leads to an increase in the next years non-real estate interest rates. Therefore, the interest rate goes up with an increase in the farm households credit risk. Unlike other farm financial ratios, the previous years profitability ratios do not have a statistically significant impact on this years interest rate on FCS total farm debt.

4.5 Conclusion

Using the variation in the state level corporate income tax rate, this study finds that the rise in state and federal level corporate income tax improves the market competitiveness of the FCS in the U.S. agricultural credit market. A 10 percent rise in state (federal) level corporate income tax rate increases the total farm debt market share of FCS by 1.76 percent (3.76 percent). Moreover, there is a positive effect of an increase in state and federal corporate income tax rate on the FCS market share on non-real estate agricultural loan.

The models that identify the effect of FCS market share are analyzed to the estimated interest rate effects on agricultural loan. Results suggest that the cost of borrowing on total farm debt rises by 0.06 percent for a 10 percent rise in the FCS total farm debt market share. Though the results are loan specific, meaning that a higher market share of FCS leads to an increase in interest rate of real estate farm loans but not to the non-real estate farm loans, the overall impact on total farm debt is particularly interesting.

This research finds that the change in both FCS market share and the interest rate incurred by farms can also be explained by state level farm financial conditions such as change in number of farms, the size of liquidity, ability to pay debt obligations, change in efficiency on use of assets as well as on the net farm income generation.

A clear implication of this paper is that the favorable tax treatment to FCS might have affected the market competitiveness of other agricultural lenders, mainly commercial banks in the U.S. agricultural credit market. It further implies corporate tax rate cut of 2017 might improve the relative market competitiveness of commercial banks in the agricultural credit market. At the same time, given the increase in the interest rate on total farm debt in response to increase in market share of FCS, this tax exemption might impose an indirect burden on farm households through higher interest rates. Thus, the tax-exmption to the FCS is an important issue in the U.S. agricultural credit market that needs to continue to be addressed.

Table 4.1: *Summary Statistics*

Variable	N	Mean	Std. Dev.	Min.	Max.
Market share of total farm loans for farm credit system (percent)	1200	0.32	0.113	0.031	0.715
Market share of real estate loans for farm credit system (percent)	1200	0.381	0.111	0.059	0.764
Market share of non-real estate loans for farm credit system (percent)	1200	0.252	0.147	0	0.771
Market share of farm loans for farm service agency (percent)	1200	0.119	0.082	0.009	0.519
Market share of real estate loans for farm service agency (percent)	1200	0.104	0.075	0.008	0.568
Market share of non-real estate loans for farm service agency (percent)	1200	0.141	0.111	0.004	0.63
Market share of farm loans for individuals and others (percent)	1200	0.228	0.058	0.092	0.656
Market share farm loans for individuals and others (percent)	1200	0.221	0.092	0.04	0.792
Market share of non-real estate loans for individuals and others (percent)	1200	0.237	0.075	0.091	0.751
State corporate tax rate (percent)	1200	0.068	0.029	0	0.12
Federal corporate tax rate (percent)	1200	0.382	0.051	0.34	0.46
Real interest expenses including operator dwellings (Thousand dollars)	1200	152,043	155,977	568	885,997
Real estate loan (Thousand dollars)	1200	1,669,763	1,739,686	5,535	12,287,253
Non-real estate loan (Thousand dollars)	1200	1,520,607	1,545,343	2,562	7,970,990
Interest rate for farm loan	1200	0.092	0.017	0.055	0.186
Interest rate for real estate loan	1200	0.092	0.017	0.041	0.213
Interest rate for non-real estate loan	1200	0.093	0.024	0.026	0.352
Number of farms (10,000)	1200	4.453	3.935	0.045	22.9
Debt servicing	1200	0.178	0.073	0.06	0.48
Times interest earned	1200	26.32	4.95	2.876	0.34
Asset turnover ratio	1200	20.122	7.297	6.7	52.95
Net cash farm income to debt	1200	47.258	22.005	7.68	208.14
Debt to assets	1200	15.341	5.018	1.98	31.64
Total rates of return on assets	1200	1.701	7.417	-47.9	82.13

Table 4.2: *Impact of Corporate Income Tax Rate on Total Farm Debt Market Share*

	(1) MS1	(2) MS1	(3) MS1	(4) MS2	(5) MS2	(6) MS2	(7) MS3	(8) MS3	(9) MS3
SCTR	0.206**	0.176*	0.176*	0.085	0.117	0.117	0.104	0.125	0.125
	(0.102)	(0.096)	(0.096)	(0.124)	(0.118)	(0.118)	(0.129)	(0.117)	(0.117)
Farms	-0.007***	-0.006***	-0.006***	-0.013***	-0.011***	-0.011***	-0.014***	-0.011***	-0.011***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
LQRatio_DS	-0.244***	-0.550***	-0.550***	-0.191**	-0.599***	-0.599***	-0.075	-0.763***	-0.763***
	(0.086)	(0.091)	(0.091)	(0.090)	(0.095)	(0.095)	(0.091)	(0.091)	(0.091)
LQRatio_TIE	0.012***	0.018***	0.018***	-0.003	0.017***	0.017***	-0.006*	0.019***	0.019***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.003)	(0.004)	(0.004)
EFPercent_ATR	-0.004***	-0.004***	-0.004***	-0.007***	-0.007***	-0.007***	-0.005***	-0.004***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
EFPercent_NFID	0.000	-0.001	-0.001	0.003***	0.000	0.000	0.003***	-0.001**	-0.001**
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
SLRatio_DA	0.004***	0.003*	0.003*	0.012***	0.010***	0.010***	0.006***	0.003**	0.003**
	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
ROA_Total	-0.003***	-0.003***	-0.003***	-0.005***	-0.004***	-0.004***	-0.006***	-0.004***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
FCTR			0.376*			0.949***			1.820***
			(0.224)			(0.238)			(0.217)
Year Fixed Effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Observations	1200	1200	1200	1200	1200	1200	1200	1200	1200
R^2	0.200	0.274	0.274	0.283	0.351	0.351	0.309	0.456	0.456

Standard errors in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 4.3: *Impact of Corporate Income Tax Rate on Real Estate Farm Debt Market Share*

	(1) RealMS1	(2) RealMS1	(3) RealMS1	(4) RealMS2	(5) RealMS2	(6) RealMS2	(7) RealMS3	(8) RealMS3	(9) RealMS3
SCTR	-0.184*	-0.195**	-0.195**	-0.196*	-0.154	-0.154	-0.231*	-0.165	-0.165
	(0.100)	(0.095)	(0.095)	(0.117)	(0.115)	(0.115)	(0.118)	(0.116)	(0.116)
Farms	-0.005***	-0.003***	-0.003***	-0.011***	-0.009***	-0.009***	-0.012***	-0.009***	-0.009***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
LQRatio_DS	-0.124	-0.465***	-0.465***	-0.147	-0.648***	-0.648***	0.363***	-0.368***	-0.368***
	(0.091)	(0.094)	(0.094)	(0.095)	(0.096)	(0.096)	(0.082)	(0.078)	(0.078)
LQRatio_TIE	0.007**	0.016***	0.016***	-0.003	0.019***	0.019***	-0.007**	0.024***	0.024***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)
EFPercent_ATR	-0.003***	-0.002**	-0.002**	-0.005***	-0.005***	-0.005***	-0.005***	-0.004***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
EFPercent_NFID	0.000	-0.001**	-0.001**	0.003***	-0.001	-0.001	0.003***	-0.002***	-0.002***
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
SLRatio_DA	0.006***	0.004**	0.004**	0.012***	0.009***	0.009***	0.007***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
ROA_Total	-0.003***	-0.002***	-0.002***	-0.004***	-0.003***	-0.003***	-0.004***	-0.002***	-0.002***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
FCTR			0.191			1.038***			2.127***
			(0.233)			(0.241)			(0.240)
Year Fixed Effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Observations	1200	1200	1200	1200	1200	1200	1200	1200	1200
R^2	0.075	0.155	0.155	0.217	0.318	0.318	0.256	0.417	0.417

Standard errors in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 4.4: *Impact of Corporate Income Tax Rate on Non-Real Estate Farm Debt Market Share*

	(1) NRealMS1	(2) NRealMS1	(3) NRealMS1	(4) NRealMS2	(5) NRealMS2	(6) NRealMS2	(7) NRealMS3	(8) NRealMS3	(9) NRealMS3
SCTR	0.421***	0.365***	0.365***	0.203	0.218	0.218	0.268	0.233	0.233
	(0.130)	(0.126)	(0.126)	(0.159)	(0.155)	(0.155)	(0.186)	(0.174)	(0.174)
Farms	-0.009***	-0.009***	-0.009***	-0.015***	-0.013***	-0.013***	-0.017***	-0.015***	-0.015***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
LQRatio_DS	-0.447***	-0.679***	-0.679***	-0.295**	-0.597***	-0.597***	-0.714***	-1.360***	-1.360***
	(0.116)	(0.117)	(0.117)	(0.121)	(0.125)	(0.125)	(0.144)	(0.142)	(0.142)
LQRatio_TIE	0.019***	0.020***	0.020***	-0.000	0.015***	0.015***	-0.007	0.010*	0.010*
	(0.004)	(0.005)	(0.005)	(0.004)	(0.006)	(0.006)	(0.004)	(0.005)	(0.005)
EFPercent_ATR	-0.006***	-0.006***	-0.006***	-0.011***	-0.010***	-0.010***	-0.007***	-0.006***	-0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
EFPercent_NFID	0.000	0.000	0.000	0.004***	0.002**	0.002**	0.004***	0.001	0.001
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
SLRatio_DA	0.005**	0.005***	0.005***	0.015***	0.014***	0.014***	0.008***	0.006***	0.006***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
ROA_Total	-0.004***	-0.004***	-0.004***	-0.005***	-0.005***	-0.005***	-0.007***	-0.007***	-0.007***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
FCTR			0.577**			1.007***			1.622***
			(0.281)			(0.295)			(0.298)
Year Fixed Effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Observations	1200	1200	1200	1200	1200	1200	1200	1200	1200
R^2	0.271	0.329	0.329	0.271	0.308	0.308	0.296	0.391	0.391

Standard errors in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 4.5: *Impact of Farm Debt Market Share on Cost of Capital*

	(1) IR	(2) IR	(3) IR	(4) RealIR	(5) RealIR	(6) RealIR	(7) NRealIR	(8) NRealIR	(9) NRealIR
farms1	0.000***	0.000***	0.000***	0.000***	0.000***	0.000	0.000***	0.000**	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
lqratio_ds1	0.083***	0.080***	0.079***	0.015	0.012	0.007	0.183***	0.180***	0.170***
	(0.015)	(0.015)	(0.015)	(0.012)	(0.012)	(0.012)	(0.038)	(0.038)	(0.036)
lqratio_tie1	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***	-0.001***	-0.001**	-0.001**	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
efpercent_atr1	0.000***	0.000***	0.000***	0.000***	0.000***	0.000**	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
efpercent_nfid1	0.000***	0.000***	0.000***	0.000**	0.000**	0.000*	0.000*	0.000*	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
slratio_da1	-0.001***	-0.001***	-0.001***	-0.000*	-0.000*	-0.000	-0.001**	-0.001**	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
roa_total1	0.000	0.000	-0.000	-0.000	-0.000	-0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MS_FCS1	0.006*								
	(0.003)								
MS_FCS_FSA1		0.000							
		(0.003)							
MS_FCS_FSA_INO1			-0.002						
			(0.003)						
RealMS_FCS1				0.011***					
				(0.002)					
RealMS_FCS_FSA1					0.003				
					(0.003)				
RealMS_FCS_FSA_INO1						-0.009***			
						(0.002)			
NonRealMS_FCS1							-0.003		
							(0.005)		
NonRealMS_FCS_FSA1								-0.009**	
								(0.005)	
NonRealMS_FCS_FSA_INO1									-0.011***
									(0.004)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1199	1199	1199	1199	1199	1199	1199	1199	1199
R^2	0.831	0.830	0.830	0.779	0.775	0.778	0.640	0.643	0.644

Standard errors in parentheses

* $p < .10$, ** $p < .05$, *** $p < .01$

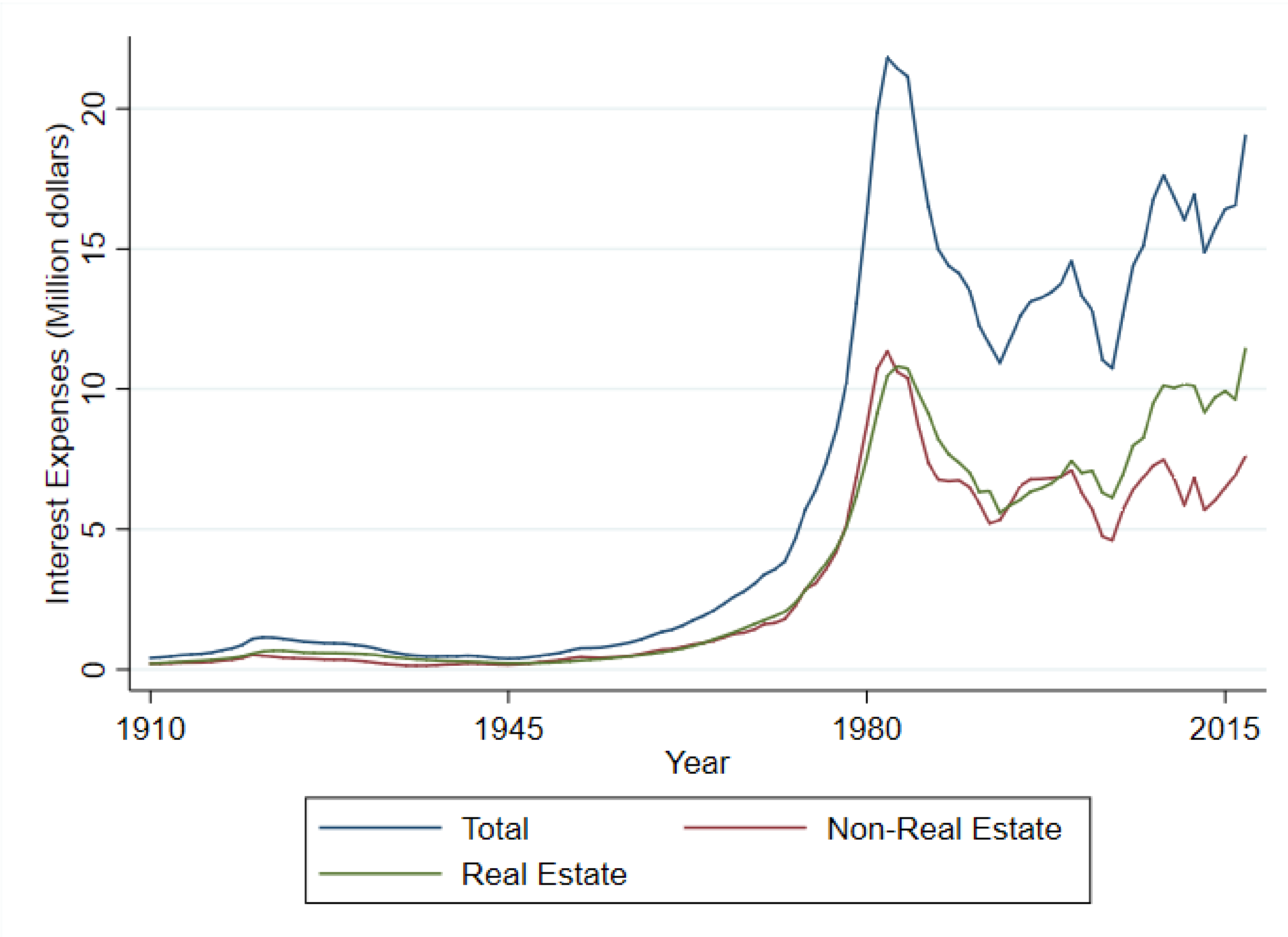

Figure 4.1: *Interest Expenses.*

Note: This figure is developed by author using the USDA ERS data.

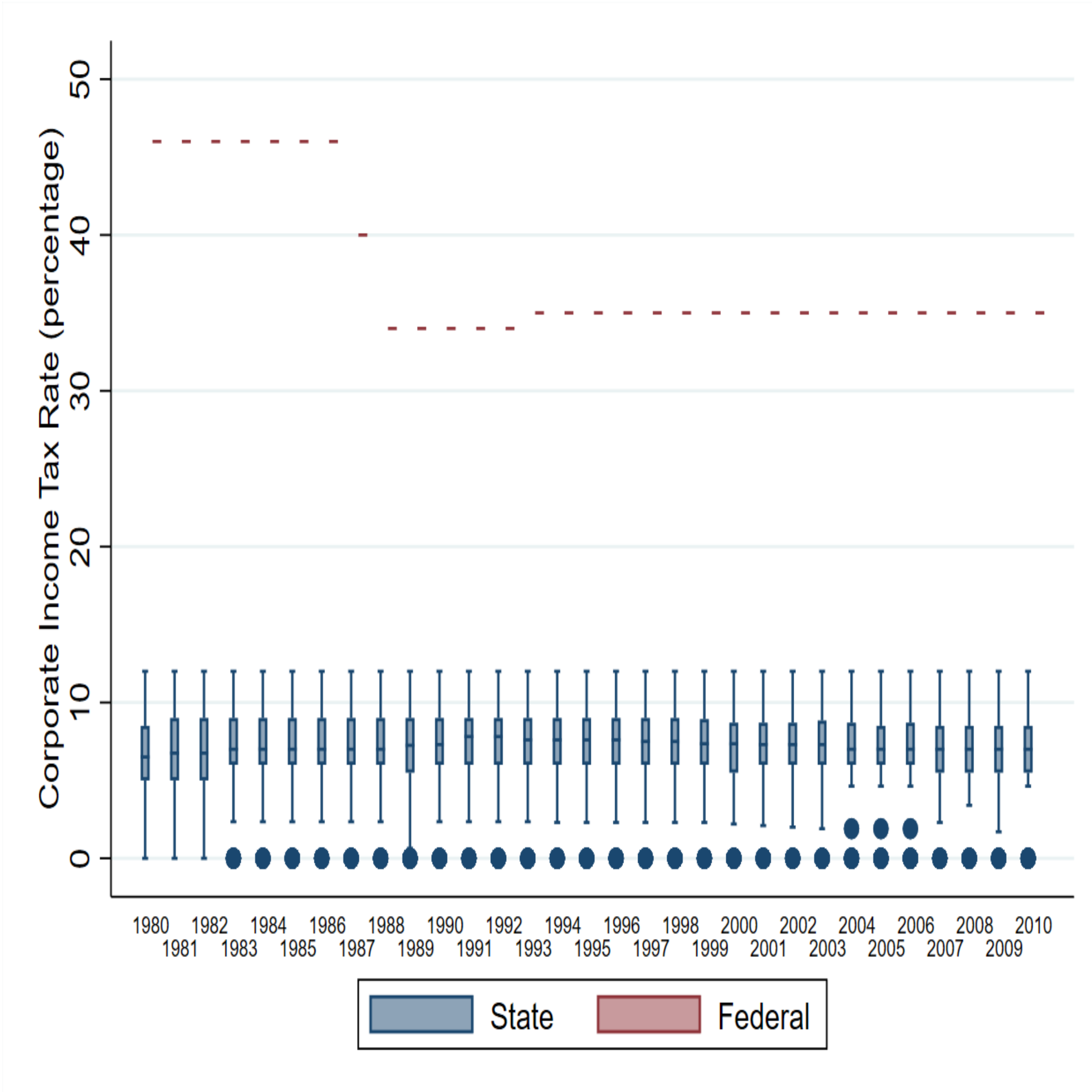

Figure 4.2: *Corporate Income Tax Rate.*

Note: This figure is developed by author using the Serrato and Zidar (2016) data.

Chapter 5

Conclusion

Three essays of this dissertation address three key issues: competition, regulation, and taxation in the banking and agricultural finance sector. The first essay examined the impact of bank competition on financial stability and performance of U.S. agricultural banks. It used the quarterly Report of Condition and Income data from 1994 to 2013. The impact of competition on performance and financial stability are estimated using bank-specific characteristics using a two-way fixed effects regression model. This study found a U-shaped relationship between market power (a measure of competition) and the risk of bank failure. Bank market power had an inverted U-shaped effect on the size and proportion of agricultural lending. A positive relationship existed between increase bank concentration and profitability. Thus, bank regulatory strategies should focus on enhancing (reducing) competition in more (less) concentrated banking markets to improve financial health and performances of agricultural banks.

The second essay quantified and compared the impacts of Dodd-Frank Act between big banks and small agricultural banks. The assumption is that banks respond to the higher regulatory burden of the Dodd-Frank Act by changing the types and ranges of financial services. This essay identified the effect of the Dodd-Frank Act on cost efficiency, returns to scale and productivity growth measures using the Report of Condition and Income data from 2006 to 2016. This is the first study to estimate the economic measures using the annual cost frontiers for all U.S. commercial banks separately from 2006 to 2016. Difference in difference regressions were estimated at two assets thresholds: near to the \$10 billion assets and near to the \$50 billion asset size. Separate regressions were estimated for a subset of data (with assets size < \$ 250 million) to estimate the impacts on the agricultural banks. Small banks were included in the final estimation sample because nearly ninety percent of agricultural banks are small in size. Robustness was checked by defining agricultural banks based on a size measured by the proportion of agricultural lending. Results suggest that the Dodd-Frank Act has increased cost efficiency, decreased economies of scale and increased economies of scope for very large banks (banks near \$50 billion assets) with no effect for large banks (banks near \$10 billion assets). Results also indicate that the Dodd-Frank Act has decreased cost efficiency, decreased cost savings through product diversification, encouraged scaling up agricultural loans, encouraged specialization in agricultural lending and decreased productivity growth for agricultural banks. Overall, the Dodd-Frank Act reduced the economic incentives for mergers of banks above the \$50 billion that are subject to greater oversight but indirectly and adversely affected U.S. agricultural banks. A clear implication from this study is that the banking regulation should consider the potential effects separately across bank types.

The third essay examined whether market competitiveness of farm loan suppliers are affected by Farm Credit System (FCS) tax policy and its potential spillover on the farmers cost of borrowing. The data are obtained from two sources: a federal and state-year level average effective tax rate paid by C-corporations and state-year level farm statistics. The final estimation sample ranged from 1980 to 2013. Ordinary least squares model was used to estimate the impact of state corporate income tax rate on the market share of the tax-exempted FCS. To estimate the spillover effect on the cost of borrowing for agricultural loans, the ratio of total interest expenses to the corresponding loan amount was estimated as a proxy for the actual interest rate. The estimated interest rate was regressed on the market share of the FCS and other explanatory variables. The key finding suggested that a 10 percent rise in state (federal) tax rate increases total farm debt market share of FCS by 1.76 percent (3.76 percent). A 10 percent rise in the FCS total farm debt market share increases the cost of borrowing on agricultural loans by 0.06 percent. There are two major implications of this study. First, the favorable tax treatment to FCS is associated with an increased competitiveness in the agricultural lending market. Second, an increase in interest rate on farm debt is associated with the increasing market share of FCS in the agricultural credit market. Thus, whether there should be tax-exemption to the FCS needs to be addressed carefully.

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Appendix A

Average of Competition, Financial Stability and Performance Measures

Appendix A is for the first essay. Table A.1 shows the average of competition, financial stability and performance measures for agricultural banks by year.

Table A.1: *Average of Competition, Financial Stability and Performance Measures for Agricultural Banks*

Year	Lerner Index	Z-Score	AgLoan Volume	AgLoan Ratio	ROA	ROE
1994	0.183	45.1	11574	0.321	0.0079	0.0782
1995	0.154	35.1	11496	0.312	0.0076	0.0721
1996	0.186	36.5	12265	0.303	0.0080	0.0754
1997	0.157	35.3	12308	0.304	0.0081	0.0755
1998	0.147	35.2	13462	0.301	0.0081	0.0741
1999	0.161	34.3	13620	0.286	0.0079	0.076
2000	0.175	35.3	13320	0.28	0.0079	0.0752
2001	0.152	37.1	13356	0.276	0.0078	0.0706
2002	0.217	37.5	13697	0.267	0.0082	0.0753
2003	0.248	36.2	13727	0.257	0.0078	0.0729
2004	0.289	36.9	13780	0.25	0.0079	0.0746
2005	0.284	37.7	13946	0.251	0.0079	0.0753
2006	0.244	37.3	14362	0.253	0.0076	0.0719
2007	0.216	38.9	14530	0.25	0.0075	0.0695
2008	0.238	37.2	15148	0.245	0.0075	0.0706
2009	0.275	37.6	15868	0.244	0.0068	0.0623
2010	0.305	40	17309	0.241	0.0069	0.0642
2011	0.338	50	17871	0.236	0.0071	0.0661
2012	0.369	41.2	18788	0.237	0.0076	0.0699
2013	0.395	42.1	19818	0.232	0.0074	0.072

Appendix B

Summary and Cumulative Distributions of Economic Measures

Appendix B is for the second essay. Figures B.4-B.14 plot the cumulative distributions for the product specific economies of scale from 2006 to 2016. Figures B.15-B.25 plot the cumulative distribution functions for the product specific economies of scope over the same study period. Tables B.1-B.11 summarize these economic measures by year.

Table B.1: *Summary of Economic Measures, 2006*

Variable	Mean	Std. Dev.	Min.	Max.	N
Cost Efficiency	0.555	0.112	0.001	1.001	4733
Economies of Scale	1	0.093	0.399	3.881	4712
Economies of Scope	0.565	0.298	-0.016	5	4733
AgLoans Specific Scope Economies	0.054	0.052	-0.07	0.627	4136
NonAg Real Estate Loans Specific Scope Economies	0.185	0.119	-0.178	1	4679
Other NonAg Loans Specific Scope Economies	0.083	0.062	-0.152	1	4703
Transactions Deposits Specific Scope Economies	0.127	0.079	-0.201	1	4703
Nontransactions Deposits Specific Scope Economies	0.201	0.116	-0.195	1	4685
Other Bank Output Specific Scope Economies	-0.005	0.158	-6.576	1	4306
AgLoans Specific Scale Economies	0.902	0.124	0.145	1.123	3198
NonAg Real Estate Loans Specific Scale Economies	0.682	0.237	0.055	1.351	4384
Other NonAg Loans Specific Scale Economies	0.841	0.199	0.024	1.793	3827
Transactions Deposits Specific Scale Economies	0.813	0.135	0.108	1.063	4646
Nontransactions Deposits Specific Scale Economies	0.779	0.229	0.02	1.398	3804
Other Bank Output Specific Scale Economies	0.897	0.167	0.061	1.241	804

Table B.2: *Summary of Economic Measures, 2007*

Variable	Mean	Std. Dev.	Min.	Max.	N
Cost Efficiency	0.522	0.127	0.001	1.001	4841
Economies of Scale	0.998	0.089	0.517	5.091	4823
Economies of Scope	0.348	0.291	-0.113	5	4841
AgLoans Specific Scope Economies	0.062	0.065	-0.088	0.784	4212
NonAg Real Estate Loans Specific Scope Economies	0.038	0.04	-0.185	1	4791
Other NonAg Loans Specific Scope Economies	0.072	0.054	-0.122	1	4814
Transactions Deposits Specific Scope Economies	0.054	0.062	-0.269	1	4818
Nontransactions Deposits Specific Scope Economies	0.101	0.064	-0.027	1	4798
Other Bank Output Specific Scope Economies	-0.016	0.086	-1.317	1	4509
AgLoans Specific Scale Economies	0.894	0.138	0.014	1.464	3618
NonAg Real Estate Loans Specific Scale Economies	0.945	0.084	0.129	1.335	4560
Other NonAg Loans Specific Scale Economies	0.825	0.199	0.103	1.279	4627
Transactions Deposits Specific Scale Economies	0.904	0.103	0.037	1.03	4762
Nontransactions Deposits Specific Scale Economies	0.864	0.137	0.053	1.43	4701
Other Bank Output Specific Scale Economies	0.873	0.182	0.086	1.479	756

Table B.3: *Summary of Economic Measures, 2008*

Variable	Mean	Std. Dev.	Min.	Max.	N
Cost Efficiency	0.494	0.126	0.007	1.003	4905
Economies of Scale	0.992	0.155	0.405	10.621	4889
Economies of Scope	0.347	0.255	-0.008	5	4905
AgLoans Specific Scope Economies	0.068	0.073	-0.078	0.967	4282
NonAg Real Estate Loans Specific Scope Economies	0.043	0.044	-0.304	1	4858
Other NonAg Loans Specific Scope Economies	0.057	0.061	-0.156	1	4881
Transactions Deposits Specific Scope Economies	0.056	0.065	-0.252	1	4879
Nontransactions Deposits Specific Scope Economies	0.091	0.075	-0.275	1	4863
Other Bank Output Specific Scope Economies	-0.014	0.072	-1.274	1	4525
AgLoans Specific Scale Economies	0.934	0.119	0.24	1.007	4098
NonAg Real Estate Loans Specific Scale Economies	0.953	0.076	0.187	1.147	4639
Other NonAg Loans Specific Scale Economies	0.793	0.211	0.026	1.472	4117
Transactions Deposits Specific Scale Economies	0.884	0.136	0.145	1.012	4851
Nontransactions Deposits Specific Scale Economies	0.868	0.135	0.146	1.42	4676
Other Bank Output Specific Scale Economies	0.962	0.101	0.192	1.243	1558

Table B.4: *Summary of Economic Measures, 2009*

Variable	Mean	Std. Dev.	Min.	Max.	N
Cost Efficiency	0.503	0.115	0.008	1.002	4926
Economies of Scale	0.998	0.068	0.564	3.105	4905
Economies of Scope	0.496	0.239	-0.04	5	4926
AgLoans Specific Scope Economies	0.049	0.053	-0.066	0.992	4339
NonAg Real Estate Loans Specific Scope Economies	0.102	0.086	-0.137	1	4874
Other NonAg Loans Specific Scope Economies	0.056	0.064	-0.229	1	4896
Transactions Deposits Specific Scope Economies	0.062	0.053	-0.165	1	4899
Nontransactions Deposits Specific Scope Economies	0.175	0.094	-0.064	1	4880
Other Bank Output Specific Scope Economies	0.008	0.063	-2.081	1	4113
AgLoans Specific Scale Economies	0.925	0.116	0.077	1.206	4174
NonAg Real Estate Loans Specific Scale Economies	0.805	0.182	0.112	1.116	4547
Other NonAg Loans Specific Scale Economies	0.809	0.221	0.051	1.46	4654
Transactions Deposits Specific Scale Economies	0.924	0.086	0.144	1.029	4879
Nontransactions Deposits Specific Scale Economies	0.85	0.165	0.103	1.405	3407
Other Bank Output Specific Scale Economies	0.957	0.115	0.108	1.094	1014

Table B.5: *Summary of Economic Measures, 2010*

Variable	Mean	Std. Dev.	Min.	Max.	N
Cost Efficiency	0.496	0.114	0.014	1.002	4937
Economies of Scale	1.003	0.061	0.587	2.523	4918
Economies of Scope	0.376	0.24	0.003	5	4937
AgLoans Specific Scope Economies	0.052	0.052	-0.15	0.636	4368
NonAg Real Estate Loans Specific Scope Economies	0.062	0.056	-0.136	1	4892
Other NonAg Loans Specific Scope Economies	0.059	0.054	-0.171	1	4910
Transactions Deposits Specific Scope Economies	0.049	0.052	-0.173	1	4914
Nontransactions Deposits Specific Scope Economies	0.092	0.076	-0.122	1	4894
Other Bank Output Specific Scope Economies	0.004	0.046	-0.481	0.976	3609
AgLoans Specific Scale Economies	0.962	0.09	0.205	1.005	4076
NonAg Real Estate Loans Specific Scale Economies	0.883	0.124	0.079	1.315	4624
Other NonAg Loans Specific Scale Economies	0.759	0.196	0.042	1.402	4629
Transactions Deposits Specific Scale Economies	0.944	0.094	0.115	1.709	4865
Nontransactions Deposits Specific Scale Economies	0.868	0.141	0.061	1.129	4784
Other Bank Output Specific Scale Economies	0.942	0.141	0.116	1.179	1191

Table B.6: *Summary of Economic Measures, 2011*

Variable	Mean	Std. Dev.	Min.	Max.	N
Cost Efficiency	0.507	0.112	0.013	1.001	4962
Economies of Scale	1.003	0.053	0.458	2.531	4941
Economies of Scope	0.495	0.226	0.006	5	4962
AgLoans Specific Scope Economies	0.033	0.036	-0.092	0.628	4414
NonAg Real Estate Loans Specific Scope Economies	0.111	0.083	-0.202	1	4918
Other NonAg Loans Specific Scope Economies	0.039	0.047	-0.222	1	4937
Transactions Deposits Specific Scope Economies	0.045	0.043	-0.268	1	4940
Nontransactions Deposits Specific Scope Economies	0.116	0.081	-0.328	1	4919
Other Bank Output Specific Scope Economies	0.009	0.043	-0.454	0.878	3340
AgLoans Specific Scale Economies	0.938	0.099	0.151	1.099	4164
NonAg Real Estate Loans Specific Scale Economies	0.762	0.179	0.057	1.234	4734
Other NonAg Loans Specific Scale Economies	0.835	0.152	0.061	1.138	4608
Transactions Deposits Specific Scale Economies	0.974	0.052	0.14	1.017	4901
Nontransactions Deposits Specific Scale Economies	0.841	0.161	0.068	1.301	3611
Other Bank Output Specific Scale Economies	0.945	0.139	0.084	1.401	1045

Table B.7: *Summary of Economic Measures, 2012*

Variable	Mean	Std. Dev.	Min.	Max.	N
Cost Efficiency	0.522	0.113	0.014	1.001	5013
Economies of Scale	1.008	0.054	0.236	2.554	4995
Economies of Scope	0.588	0.234	0.004	5	5013
AgLoans Specific Scope Economies	0.04	0.041	-0.101	0.625	4441
NonAg Real Estate Loans Specific Scope Economies	0.198	0.13	-0.287	1	4973
Other NonAg Loans Specific Scope Economies	0.055	0.05	-0.34	1	4988
Transactions Deposits Specific Scope Economies	0.108	0.059	-0.747	1	4991
Nontransactions Deposits Specific Scope Economies	0.243	0.142	-0.551	1	4972
Other Bank Output Specific Scope Economies	0.024	0.039	-0.323	0.872	3032
AgLoans Specific Scale Economies	0.966	0.081	0.211	1.026	4143
NonAg Real Estate Loans Specific Scale Economies	0.635	0.231	0.011	1.43	4593
Other NonAg Loans Specific Scale Economies	0.808	0.2	0.068	1.38	4162
Transactions Deposits Specific Scale Economies	0.881	0.095	0.048	1.023	4912
Nontransactions Deposits Specific Scale Economies	0.775	0.239	0.045	1.472	3906
Other Bank Output Specific Scale Economies	0.871	0.184	0.043	1.238	323

Table B.8: *Summary of Economic Measures, 2013*

Variable	Mean	Std. Dev.	Min.	Max.	N
Cost Efficiency	0.499	0.11	0.01	1	5014
Economies of Scale	1.009	0.056	0.226	2.378	4998
Economies of Scope	0.566	0.239	-0.11	5	5014
AgLoans Specific Scope Economies	0.037	0.039	-0.329	0.607	4449
NonAg Real Estate Loans Specific Scope Economies	0.162	0.11	-0.279	1	4973
Other NonAg Loans Specific Scope Economies	0.07	0.055	-0.336	1	4993
Transactions Deposits Specific Scope Economies	0.133	0.075	-0.18	1	4991
Nontransactions Deposits Specific Scope Economies	0.206	0.106	-0.548	1	4973
Other Bank Output Specific Scope Economies	0.027	0.046	-0.848	1	2945
AgLoans Specific Scale Economies	0.969	0.081	0.131	1.237	4371
NonAg Real Estate Loans Specific Scale Economies	0.681	0.207	0.05	1.393	4694
Other NonAg Loans Specific Scale Economies	0.786	0.212	0.036	1.411	3873
Transactions Deposits Specific Scale Economies	0.873	0.108	0.313	1.034	4908
Nontransactions Deposits Specific Scale Economies	0.782	0.217	0.018	1.441	3687
Other Bank Output Specific Scale Economies	0.905	0.191	0.172	1.438	352

Table B.9: *Summary of Economic Measures, 2014*

Variable	Mean	Std. Dev.	Min.	Max.	N
Cost Efficiency	0.502	0.109	0.014	1.002	5008
Economies of Scale	1.002	0.05	0.446	1.839	4988
Economies of Scope	0.487	0.246	0.004	5	5008
AgLoans Specific Scope Economies	0.036	0.036	-0.119	0.341	4475
NonAg Real Estate Loans Specific Scope Economies	0.147	0.11	-0.423	1	4971
Other NonAg Loans Specific Scope Economies	0.062	0.054	-0.33	1	4981
Transactions Deposits Specific Scope Economies	0.079	0.064	-0.154	1	4984
Nontransactions Deposits Specific Scope Economies	0.207	0.111	-0.407	1	4968
Other Bank Output Specific Scope Economies	0.025	0.068	-2.917	1	2773
AgLoans Specific Scale Economies	0.971	0.078	0.147	1.036	4368
NonAg Real Estate Loans Specific Scale Economies	0.721	0.207	0.076	1.474	4769
Other NonAg Loans Specific Scale Economies	0.748	0.186	0.019	1.352	4695
Transactions Deposits Specific Scale Economies	0.906	0.095	0.284	1.093	4905
Nontransactions Deposits Specific Scale Economies	0.735	0.238	0.045	1.476	3024
Other Bank Output Specific Scale Economies	0.901	0.182	0.068	1.459	444

Table B.10: *Summary of Economic Measures, 2015*

Variable	Mean	Std. Dev.	Min.	Max.	N
Cost Efficiency	0.489	0.111	0.001	1.001	5009
Economies of Scale	0.996	0.053	0.369	1.694	4989
Economies of Scope	0.475	0.256	0.009	5	5009
AgLoans Specific Scope Economies	0.034	0.036	-0.12	0.690	4500
NonAg Real Estate Loans Specific Scope Economies	0.146	0.117	-0.388	1	4971
Other NonAg Loans Specific Scope Economies	0.05	0.056	-0.338	1	4985
Transactions Deposits Specific Scope Economies	0.059	0.06	-0.201	1	4983
Nontransactions Deposits Specific Scope Economies	0.215	0.121	-0.346	1	4971
Other Bank Output Specific Scope Economies	0.027	0.086	-3.824	1	2698
AgLoans Specific Scale Economies	0.974	0.07	0.464	1.108	4423
NonAg Real Estate Loans Specific Scale Economies	0.700	0.228	0.071	1.449	4818
Other NonAg Loans Specific Scale Economies	0.796	0.171	0.055	1.462	4763
Transactions Deposits Specific Scale Economies	0.92	0.089	0.19	1.069	4923
Nontransactions Deposits Specific Scale Economies	0.755	0.244	0.04	1.489	2703
Other Bank Output Specific Scale Economies	0.911	0.203	0.179	1.446	207

Table B.11: *Summary of Economic Measures, 2016*

Variable	Mean	Std. Dev.	Min.	Max.	N
Cost Efficiency	0.493	0.109	0.001	1.002	5005
Economies of Scale	1	0.059	0.359	2.909	4987
Economies of Scope	0.503	0.242	0.004	5	5005
AgLoans Specific Scope Economies	0.031	0.033	-0.123	0.332	4497
NonAg Real Estate Loans Specific Scope Economies	0.161	0.128	-0.488	1	4972
Other NonAg Loans Specific Scope Economies	0.068	0.059	-0.293	1	4982
Transactions Deposits Specific Scope Economies	0.086	0.06	-0.248	1	4986
Nontransactions Deposits Specific Scope Economies	0.222	0.128	-0.34	1	4968
Other Bank Output Specific Scope Economies	0.027	0.04	-0.195	1	2761
AgLoans Specific Scale Economies	0.97	0.08	0.118	1.105	4240
NonAg Real Estate Loans Specific Scale Economies	0.693	0.239	0.055	1.483	4744
Other NonAg Loans Specific Scale Economies	0.687	0.236	0.028	1.472	4709
Transactions Deposits Specific Scale Economies	0.906	0.107	0.057	1.05	4932
Nontransactions Deposits Specific Scale Economies	0.775	0.261	0.053	1.463	2729
Other Bank Output Specific Scale Economies	0.885	0.216	0.07	1.446	159

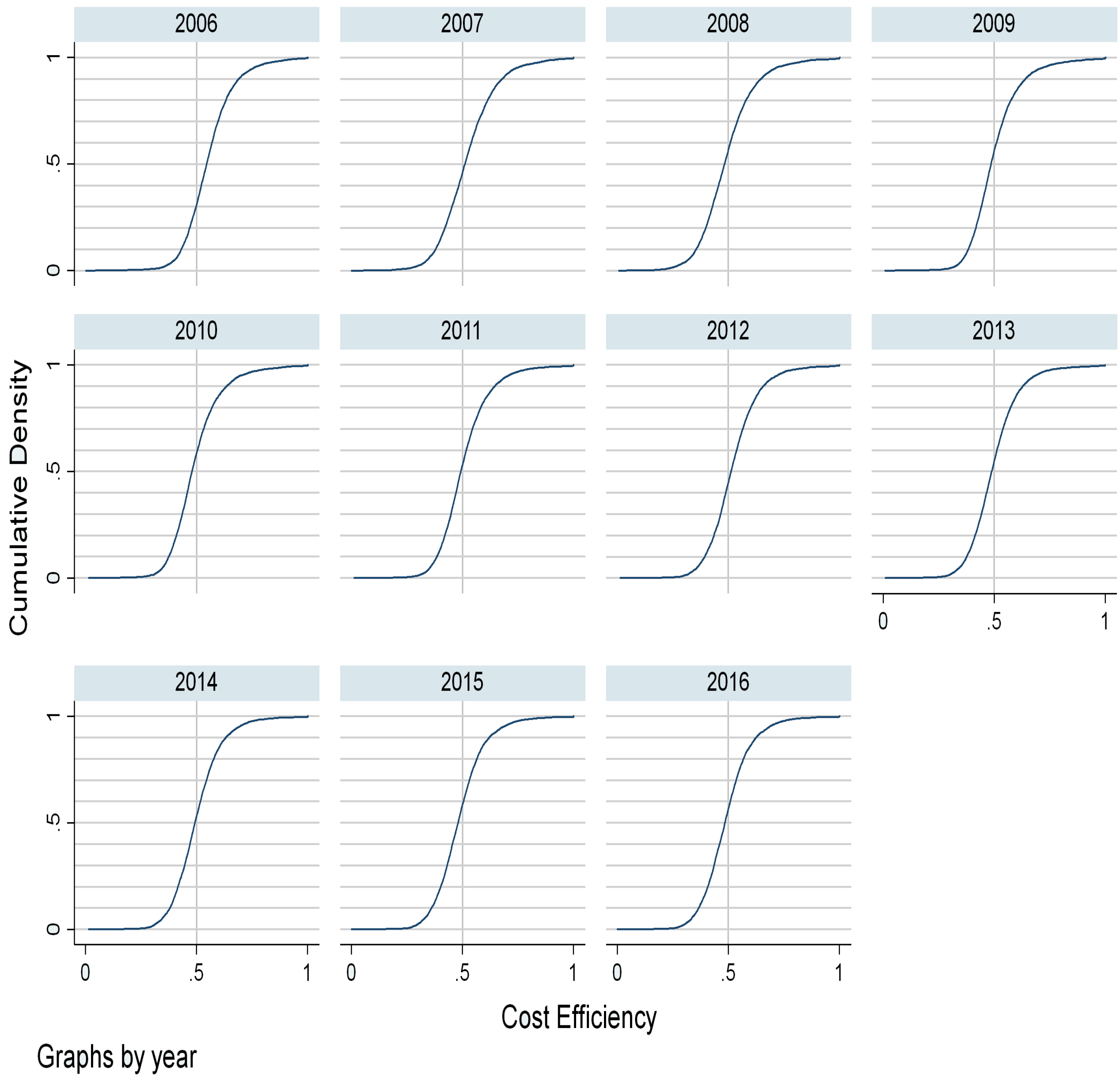

Figure B.1: *Cumulative Density of Cost Efficiency by Year.*

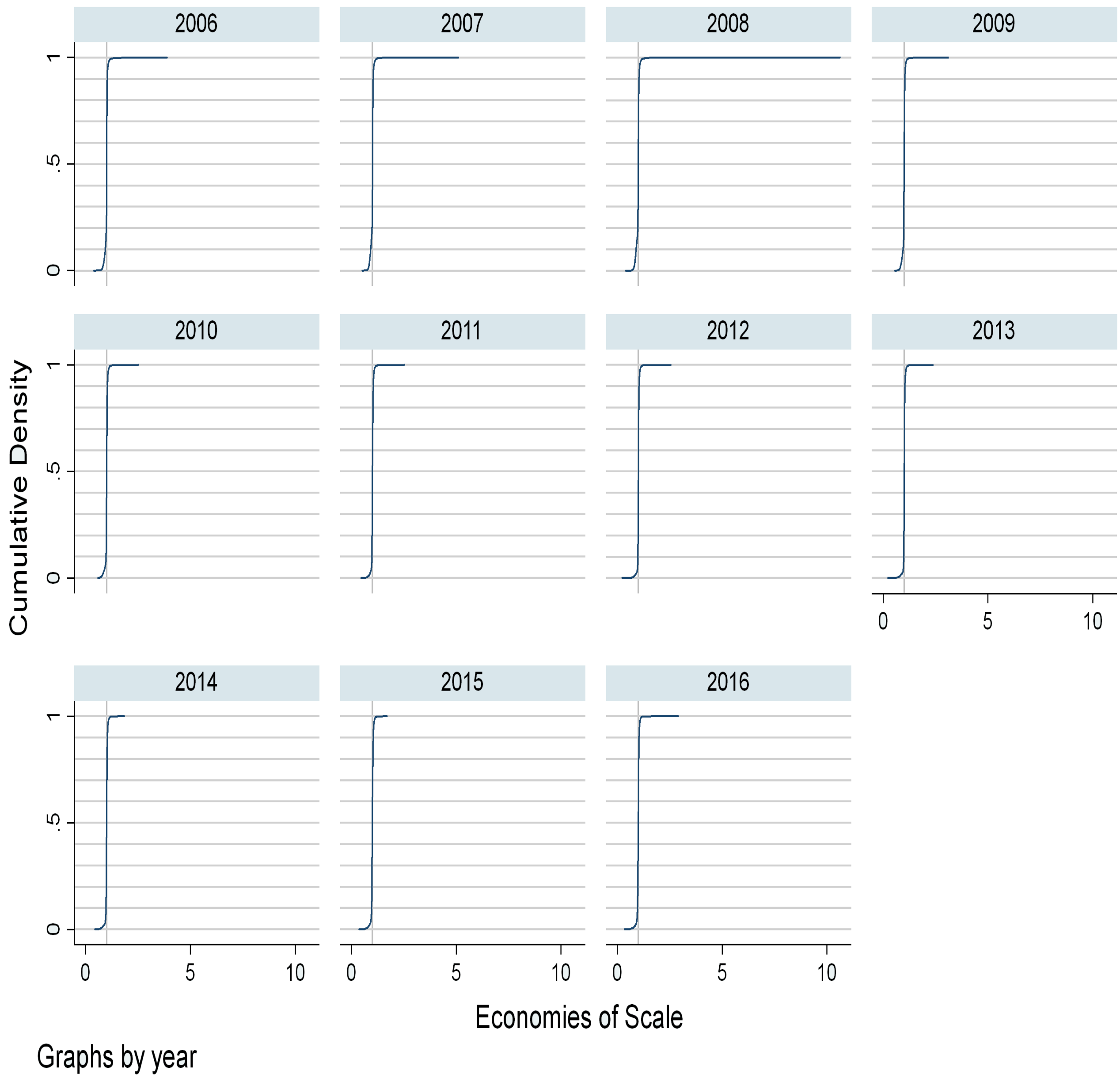

Figure B.2: *Cumulative Density of Economies of Scale by Year.*

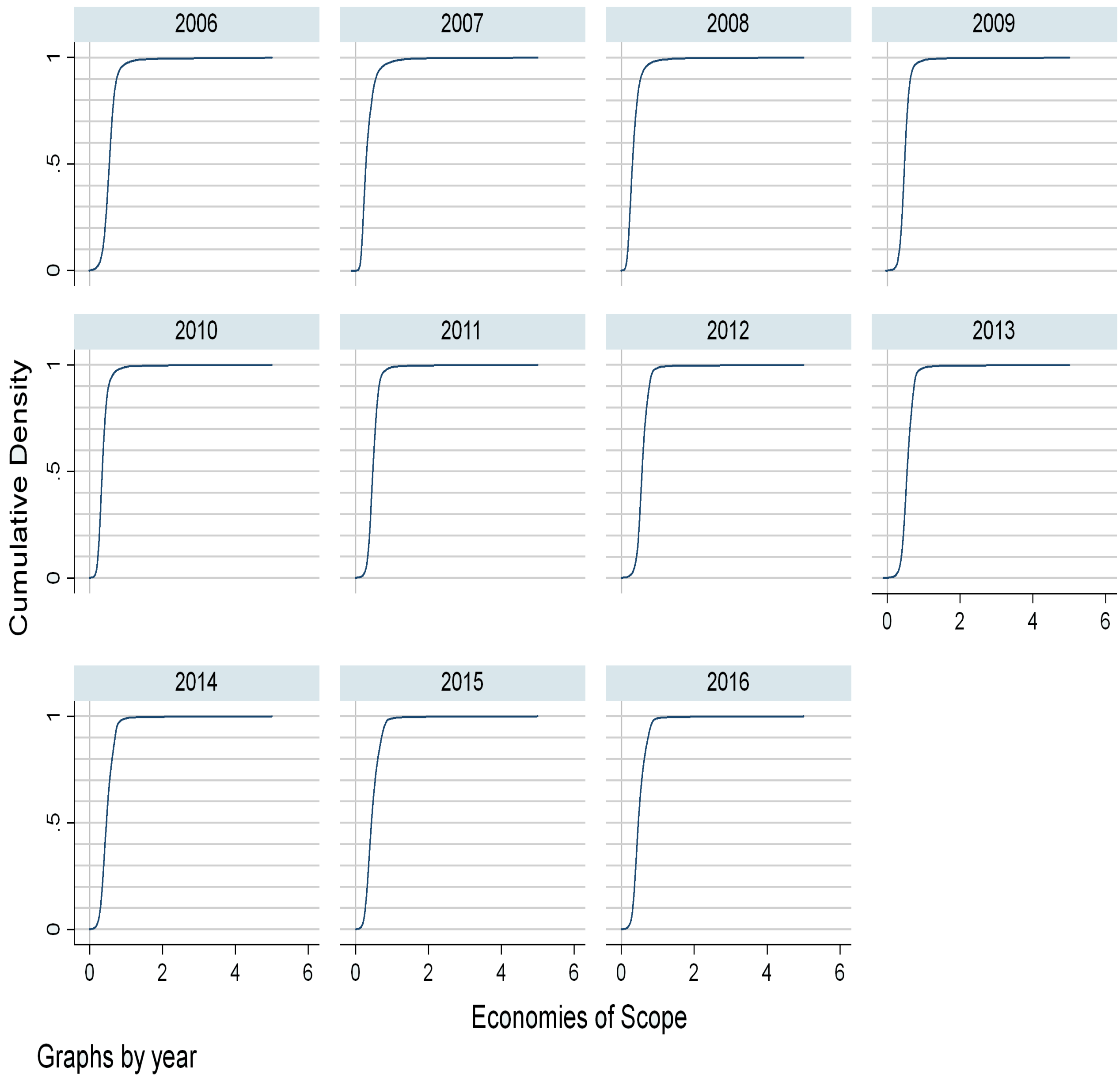

Figure B.3: *Cumulative Density of Economies of Scope by Year.*

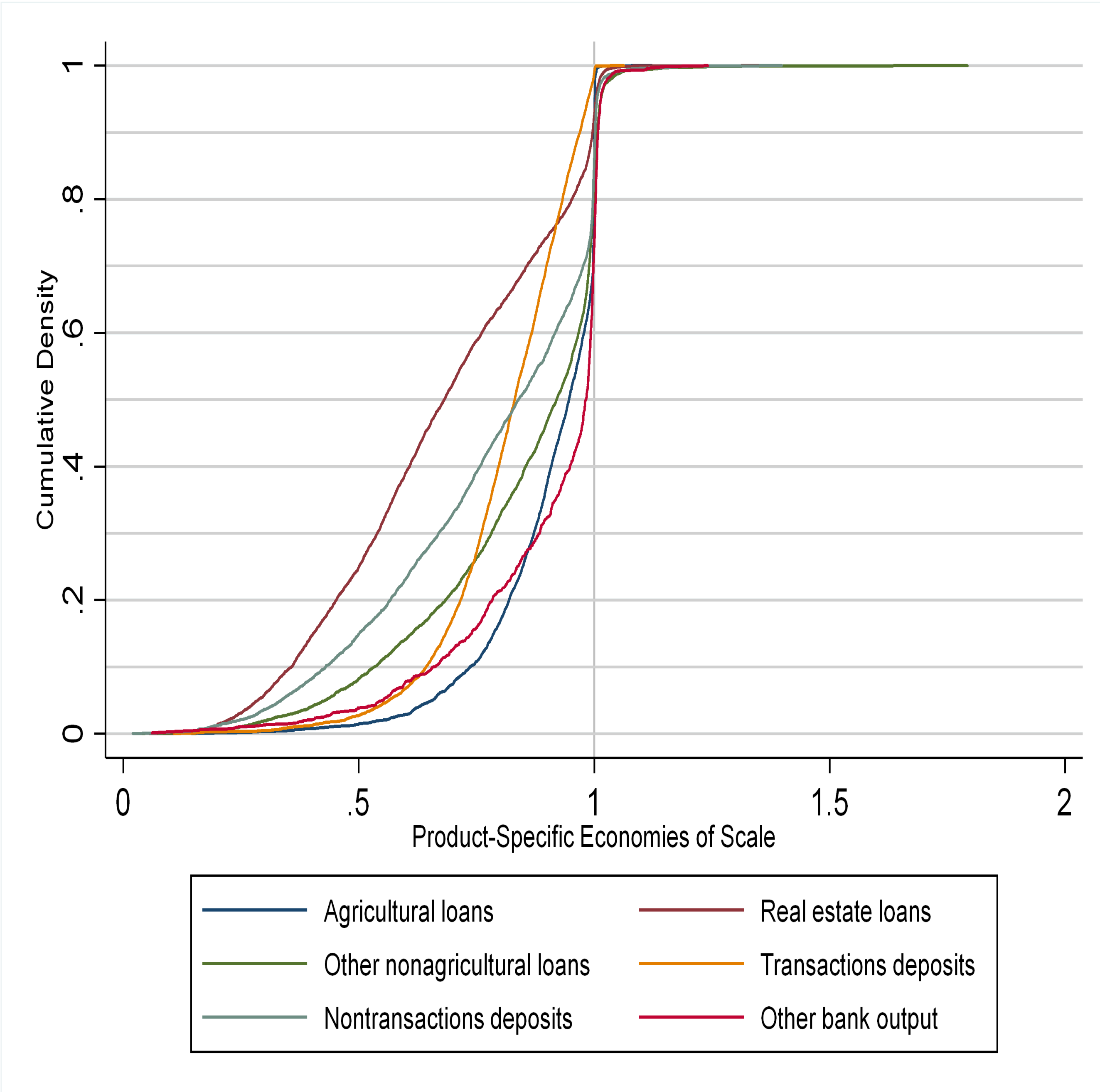

Figure B.4: *Cumulative Density of Product-Specific Economies of Scale, 2006.*

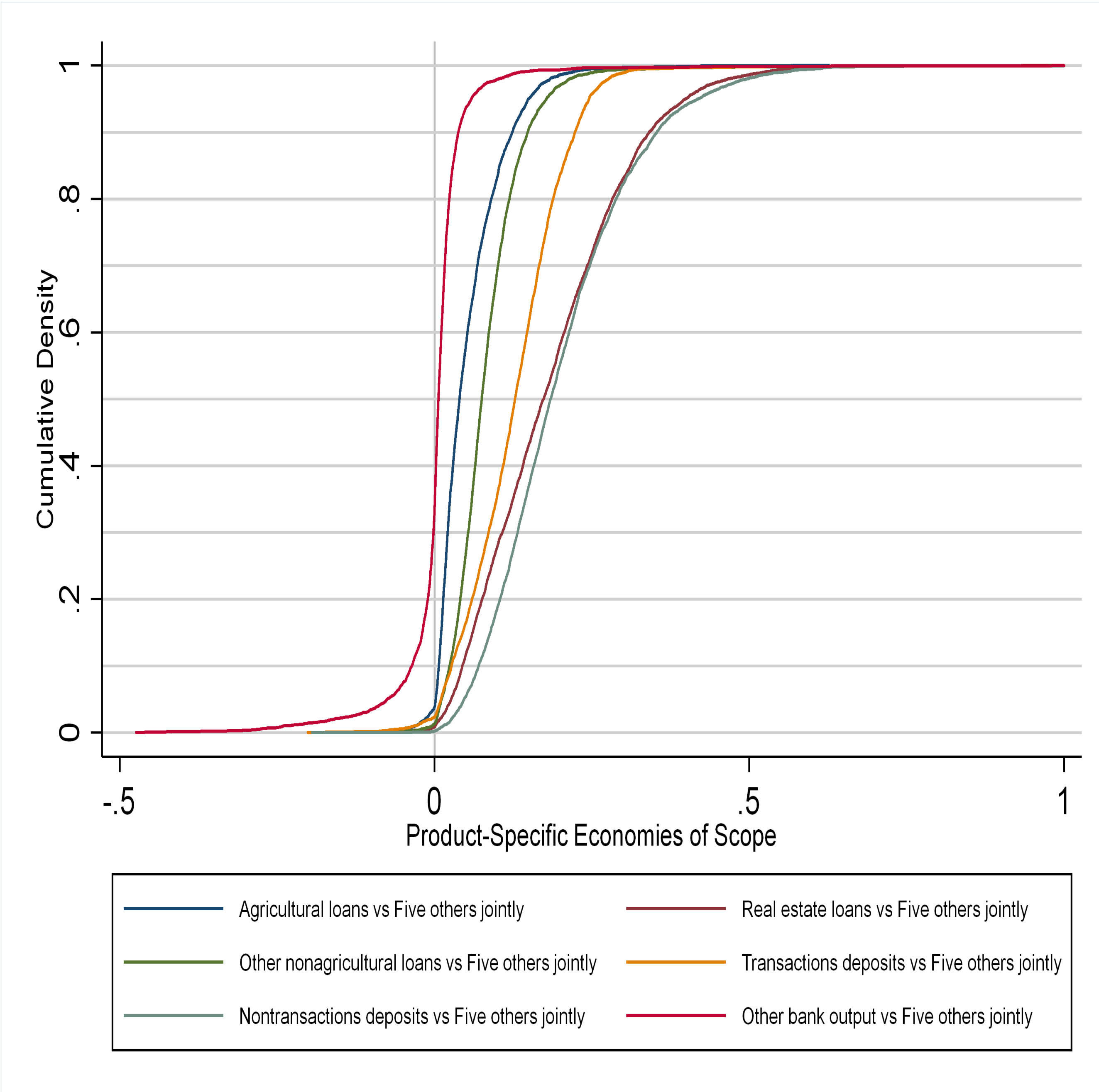

Figure B.5: *Cumulative Density of Product-Specific Economies of Scope, 2006.*

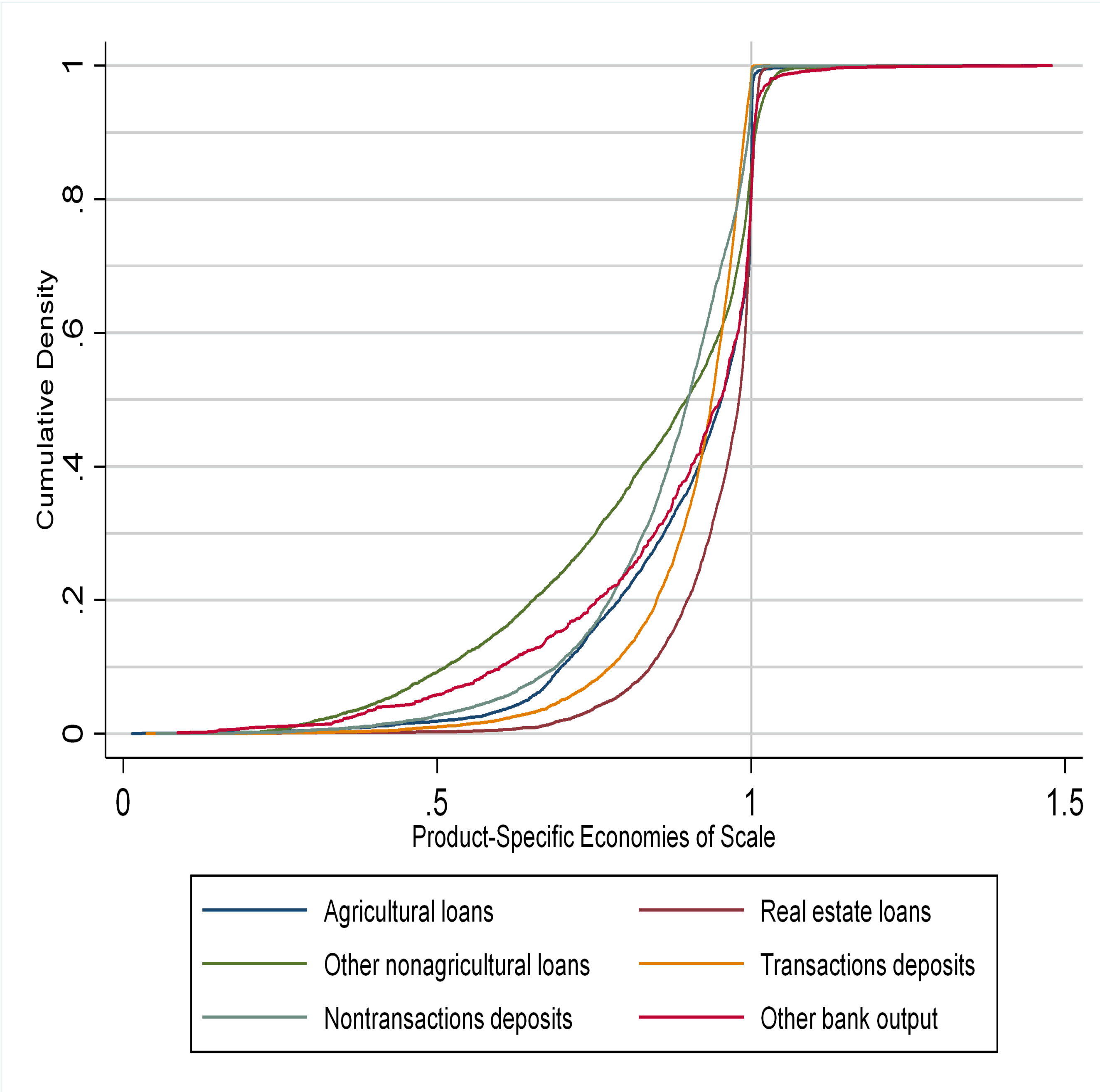

Figure B.6: *Cumulative Density of Product-Specific Economies of Scale, 2007.*

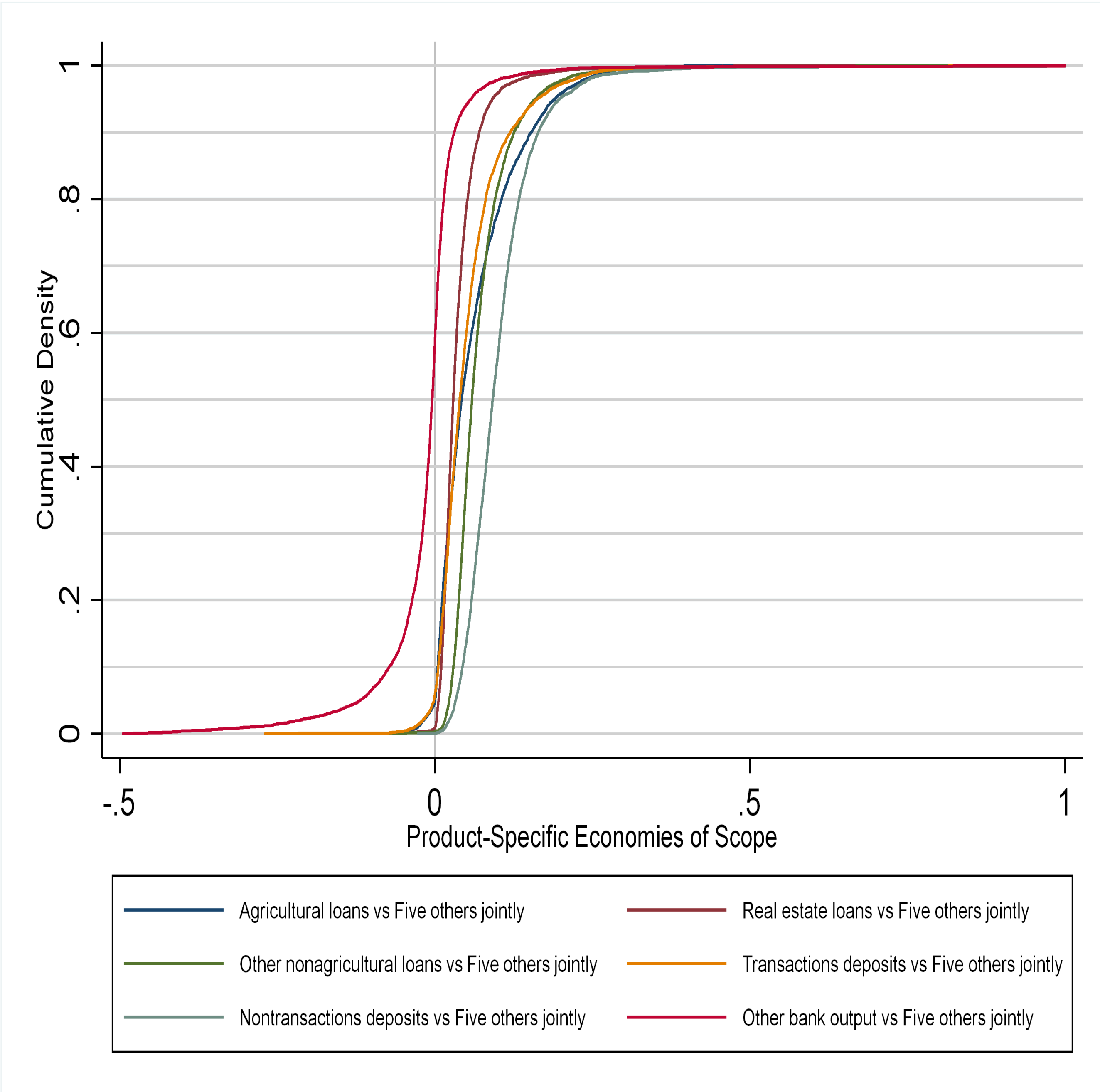

Figure B.7: *Cumulative Density of Product-Specific Economies of Scope, 2007.*

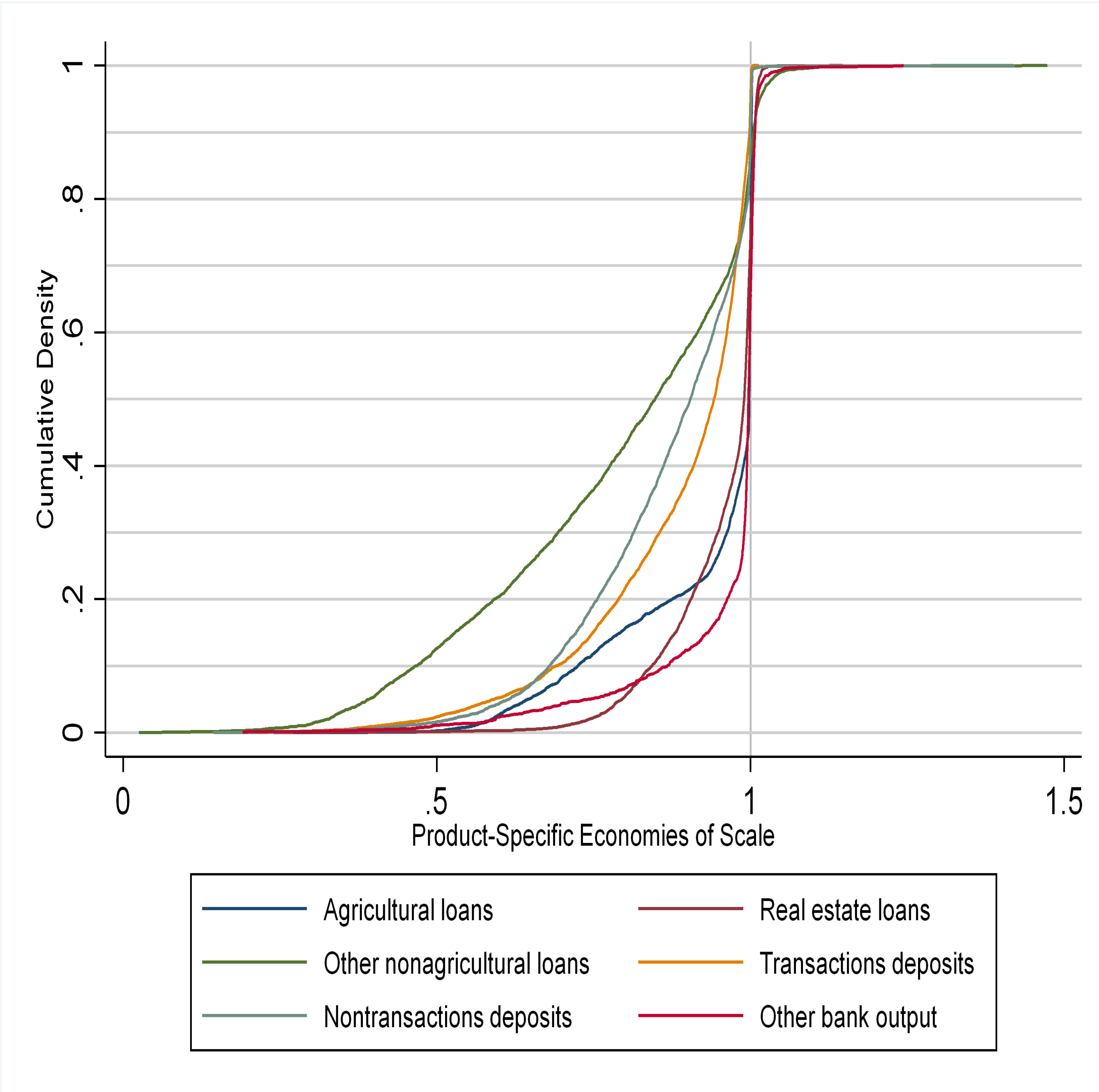

Figure B.8: *Cumulative Density of Product-Specific Economies of Scale, 2008.*

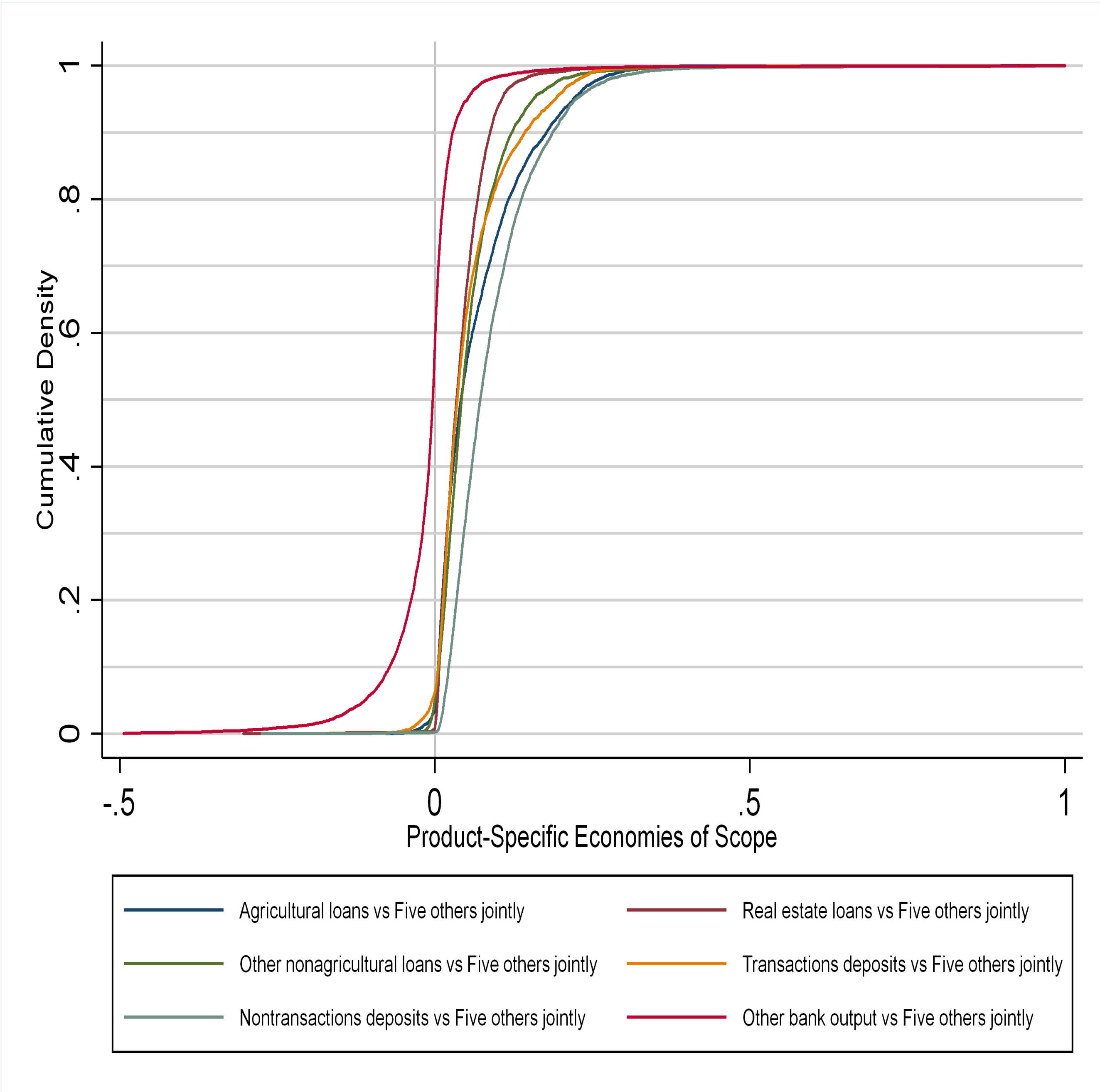

Figure B.9: *Cumulative Density of Product-Specific Economies of Scope, 2008.*

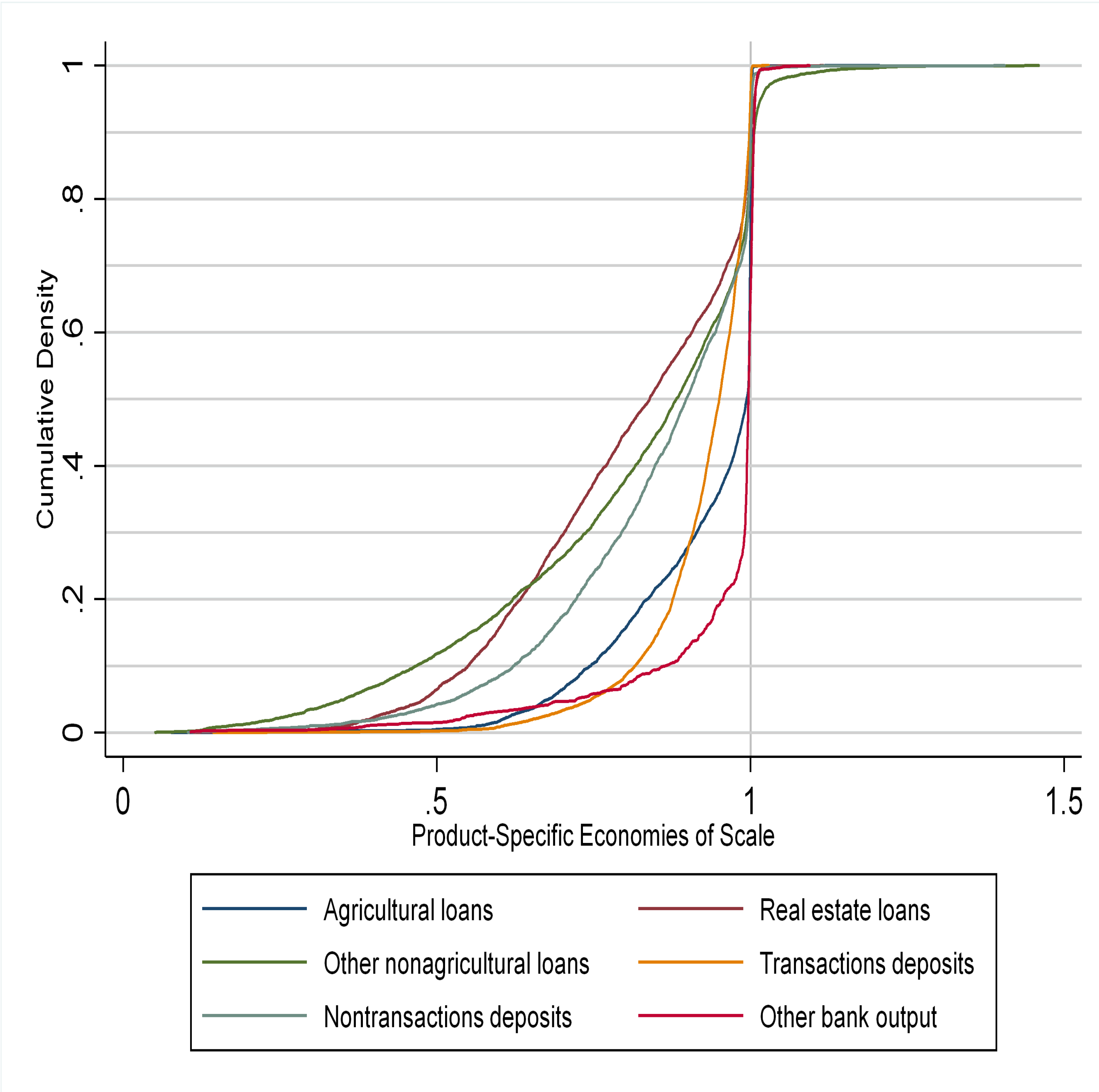

Figure B.10: *Cumulative Density of Product-Specific Economies of Scale, 2009.*

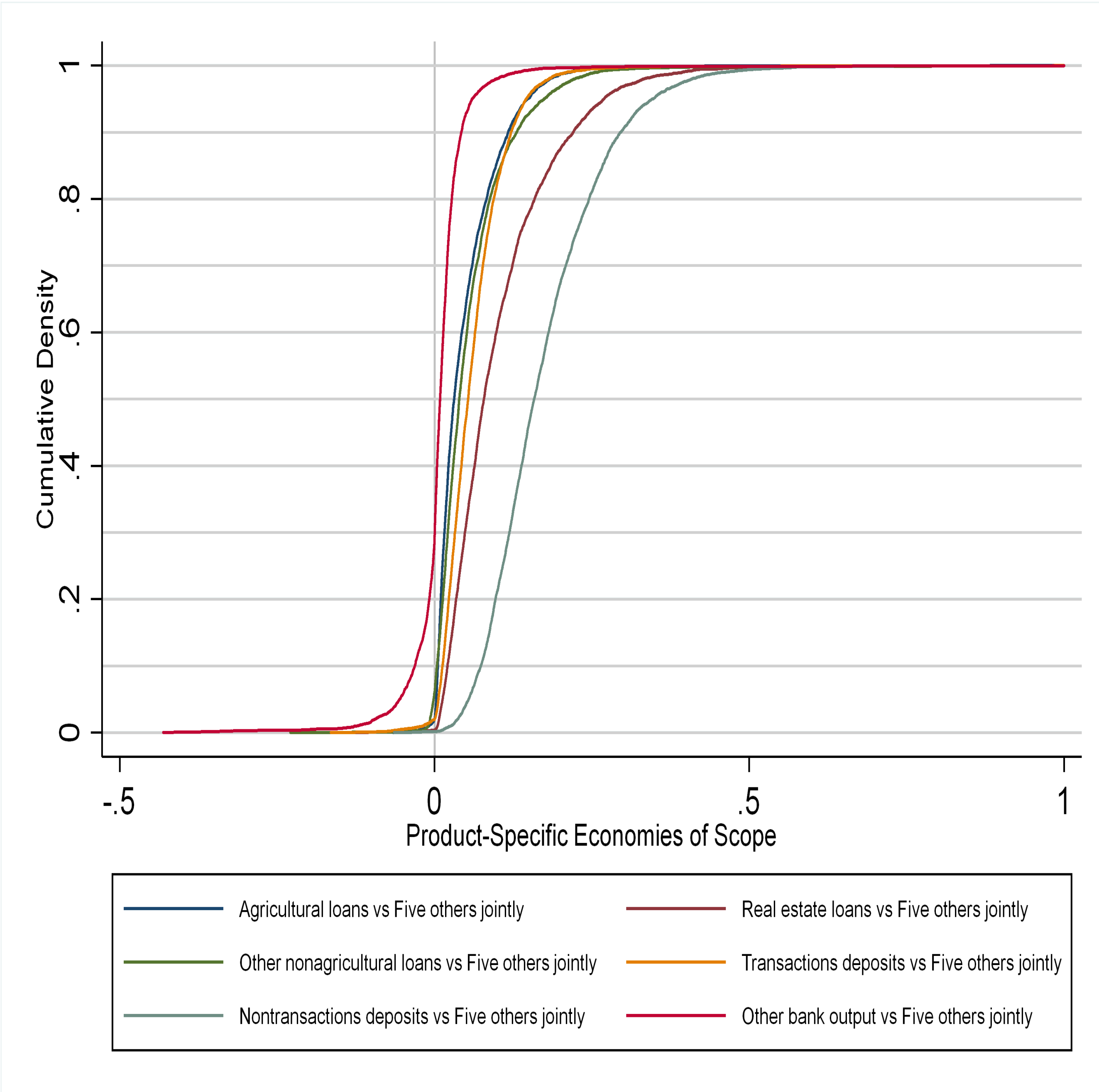

Figure B.11: *Cumulative Density of Product-Specific Economies of Scope, 2009.*

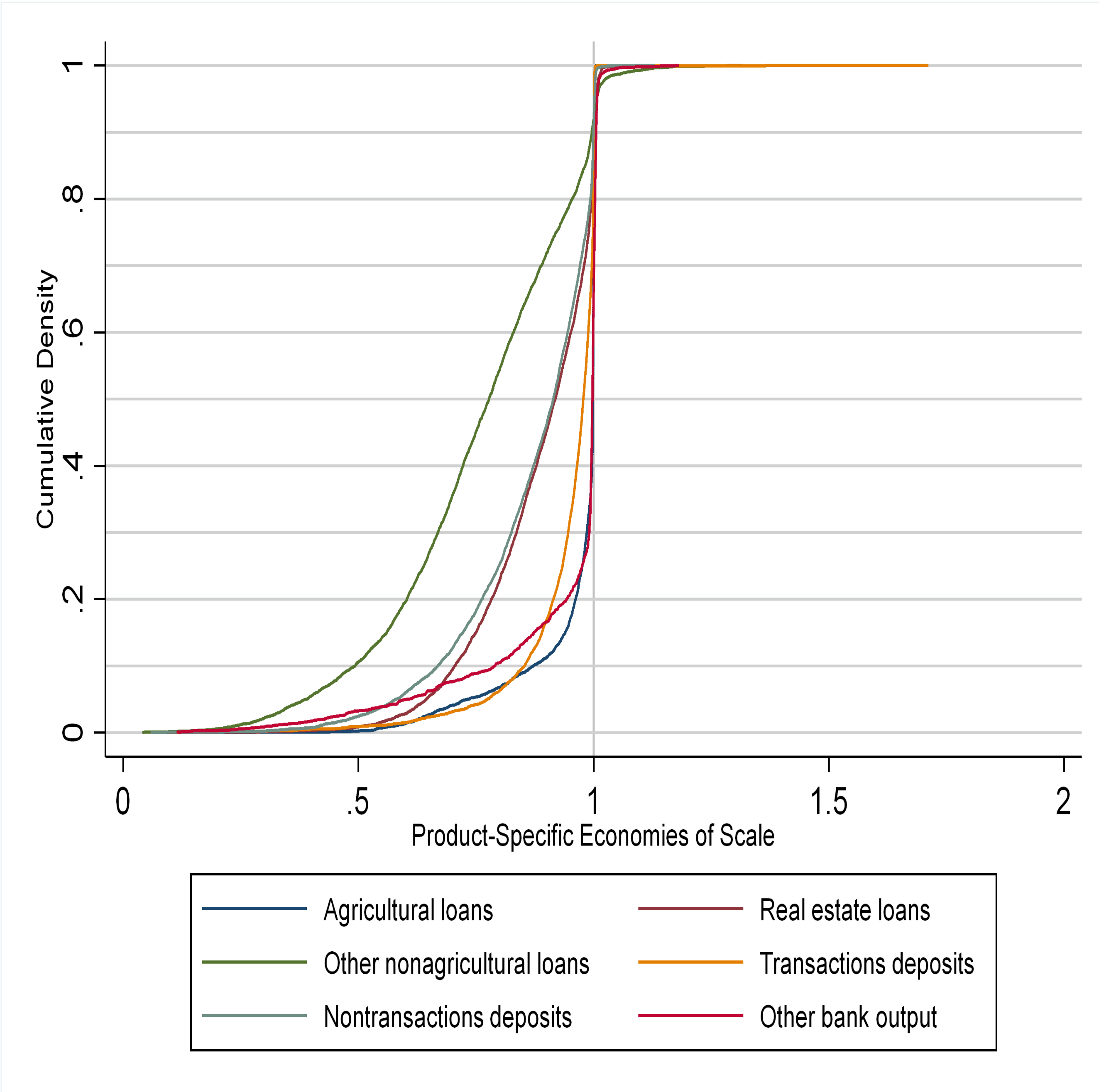

Figure B.12: *Cumulative Density of Product-Specific Economies of Scale, 2010.*

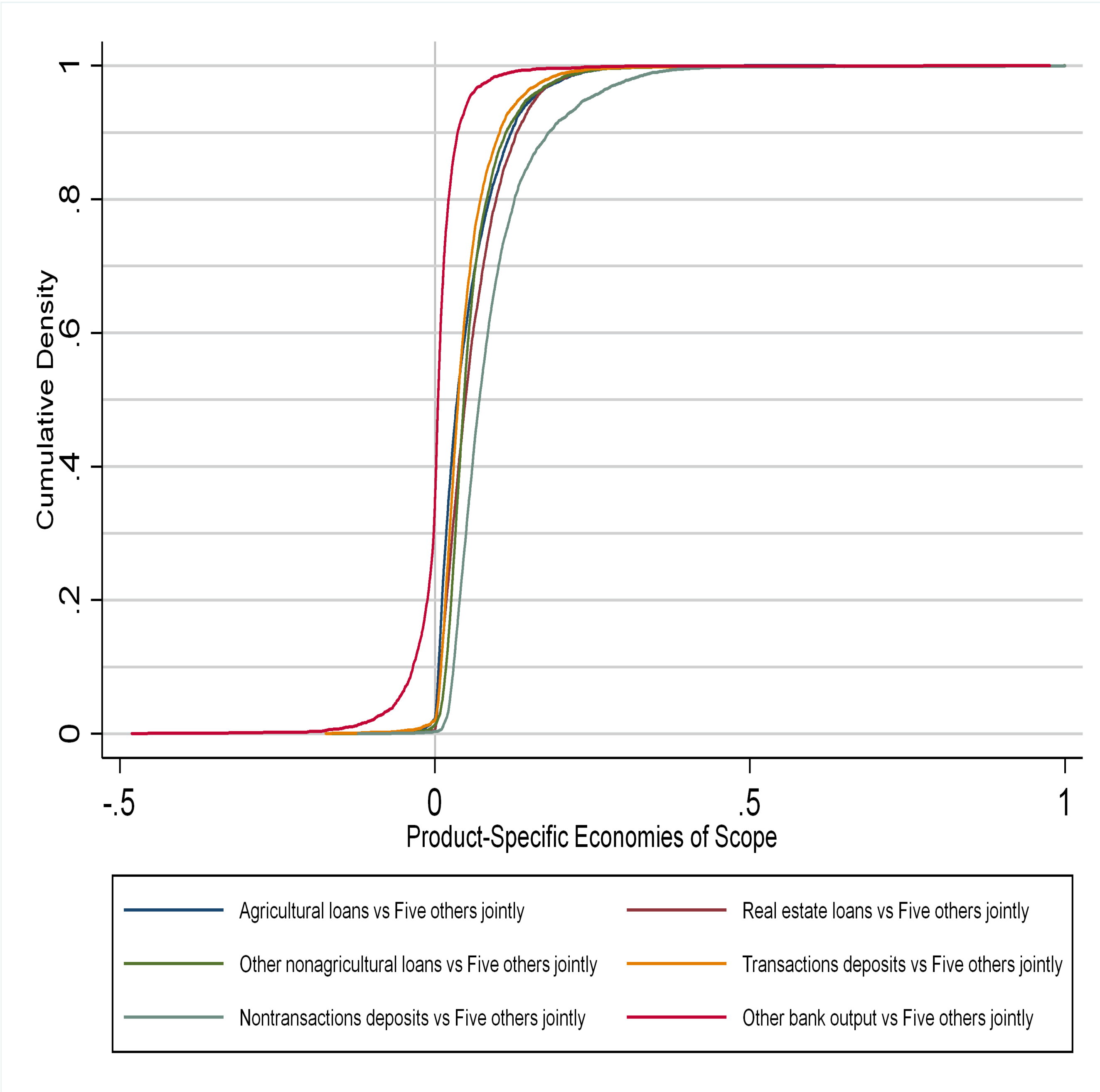

Figure B.13: *Cumulative Density of Product-Specific Economies of Scope, 2010.*

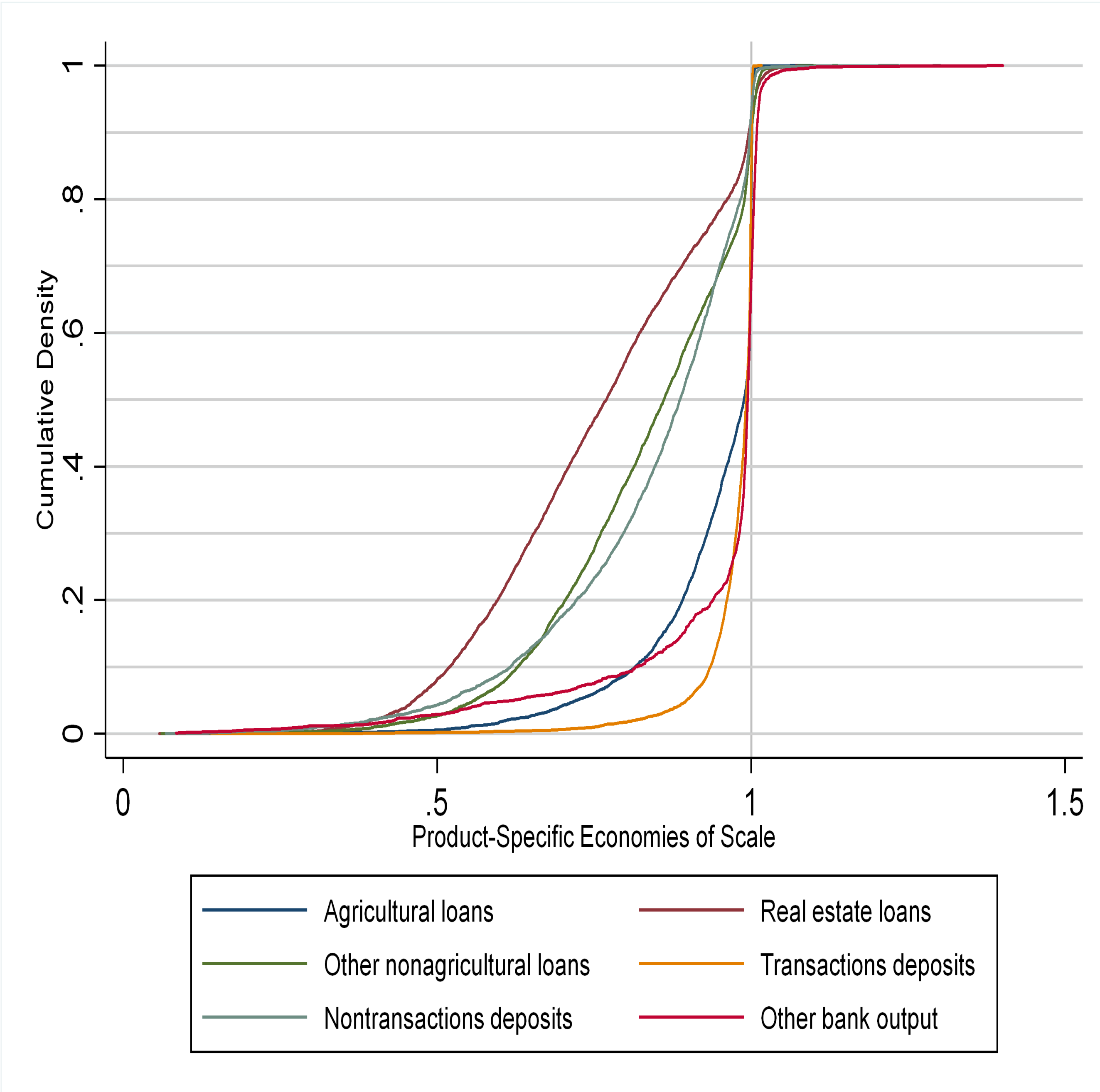

Figure B.14: *Cumulative Density of Product-Specific Economies of Scale, 2011.*

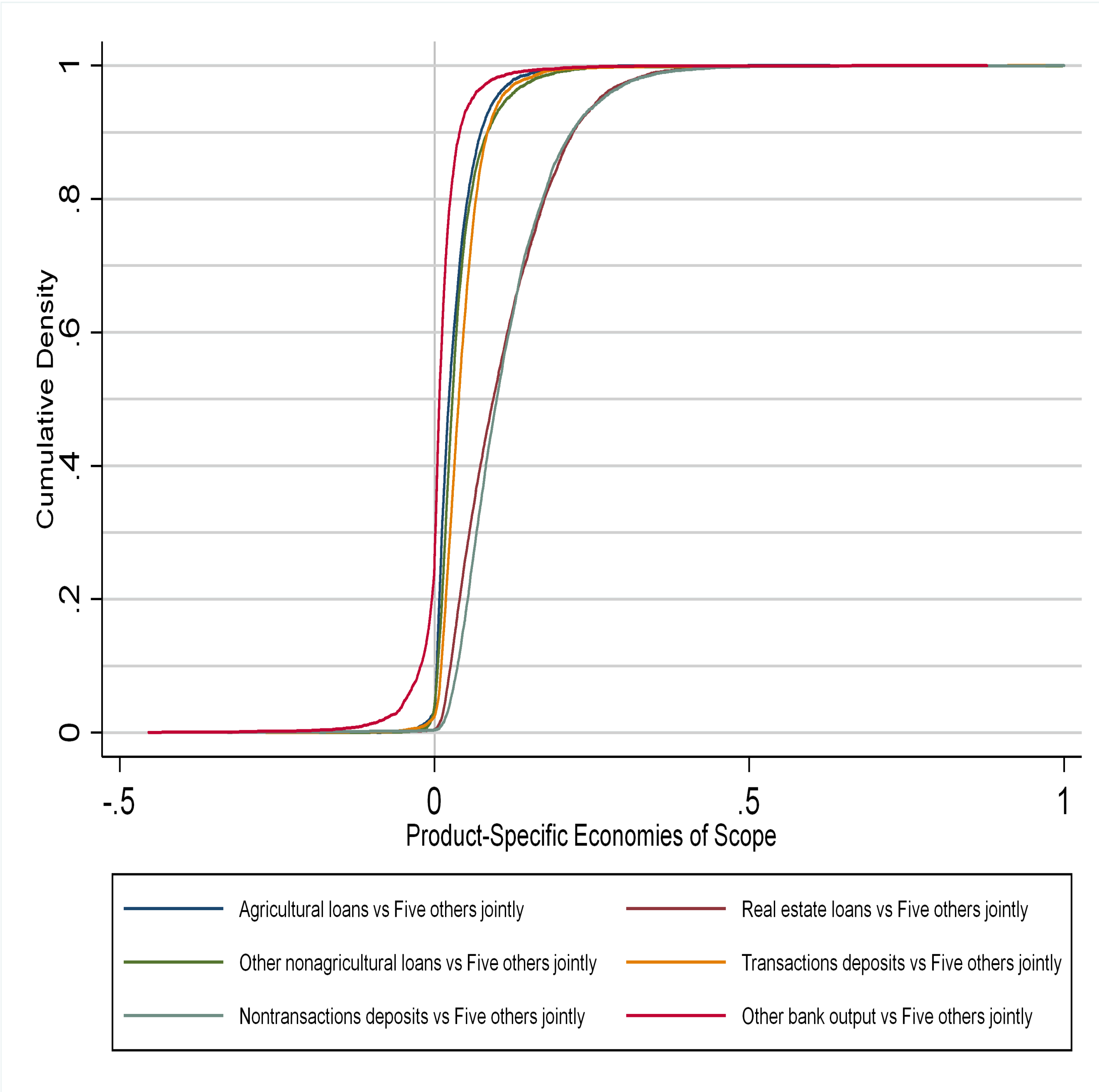

Figure B.15: *Cumulative Density of Product-Specific Economies of Scope, 2011.*

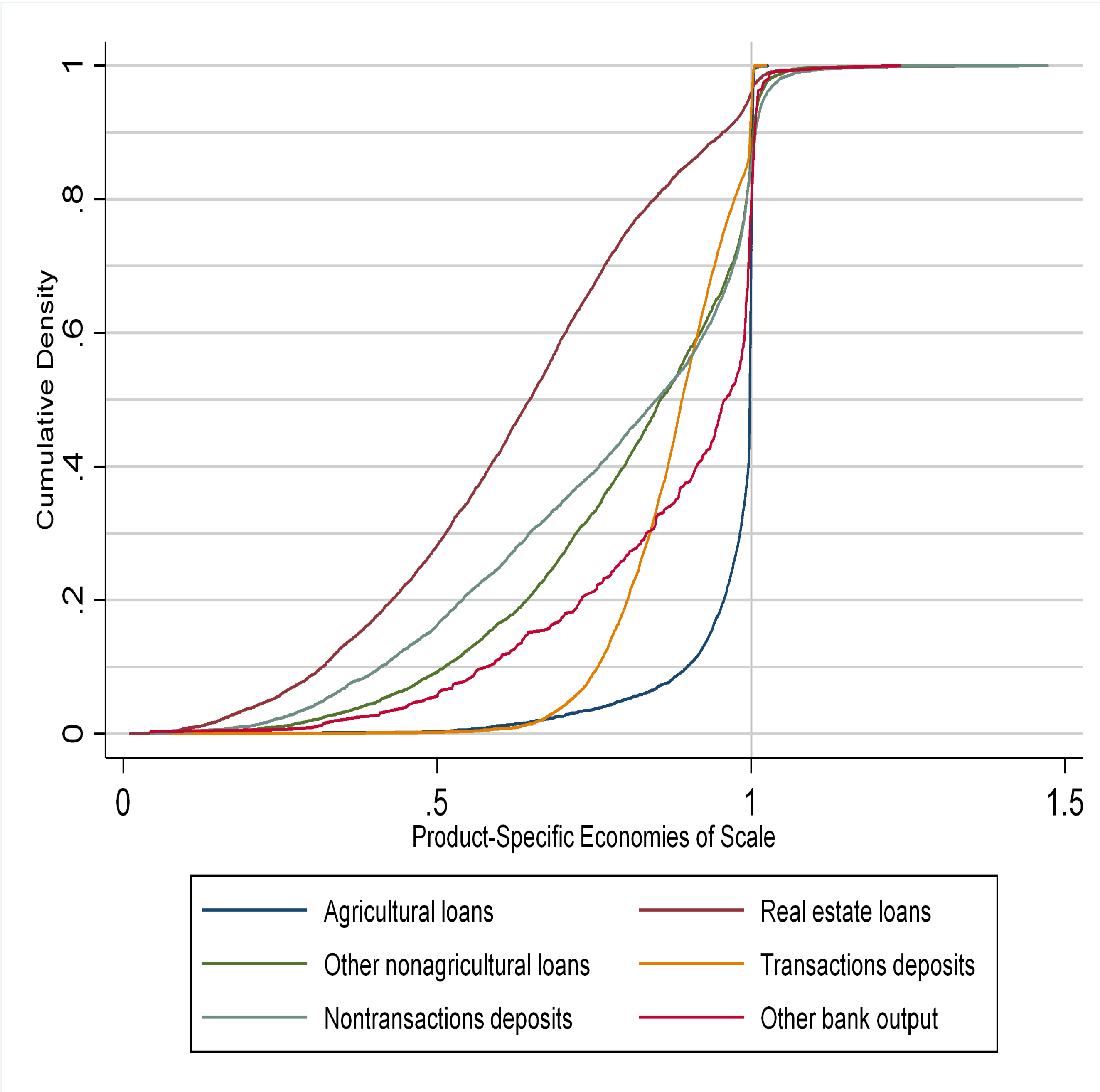

Figure B.16: *Cumulative Density of Product-Specific Economies of Scale, 2012.*

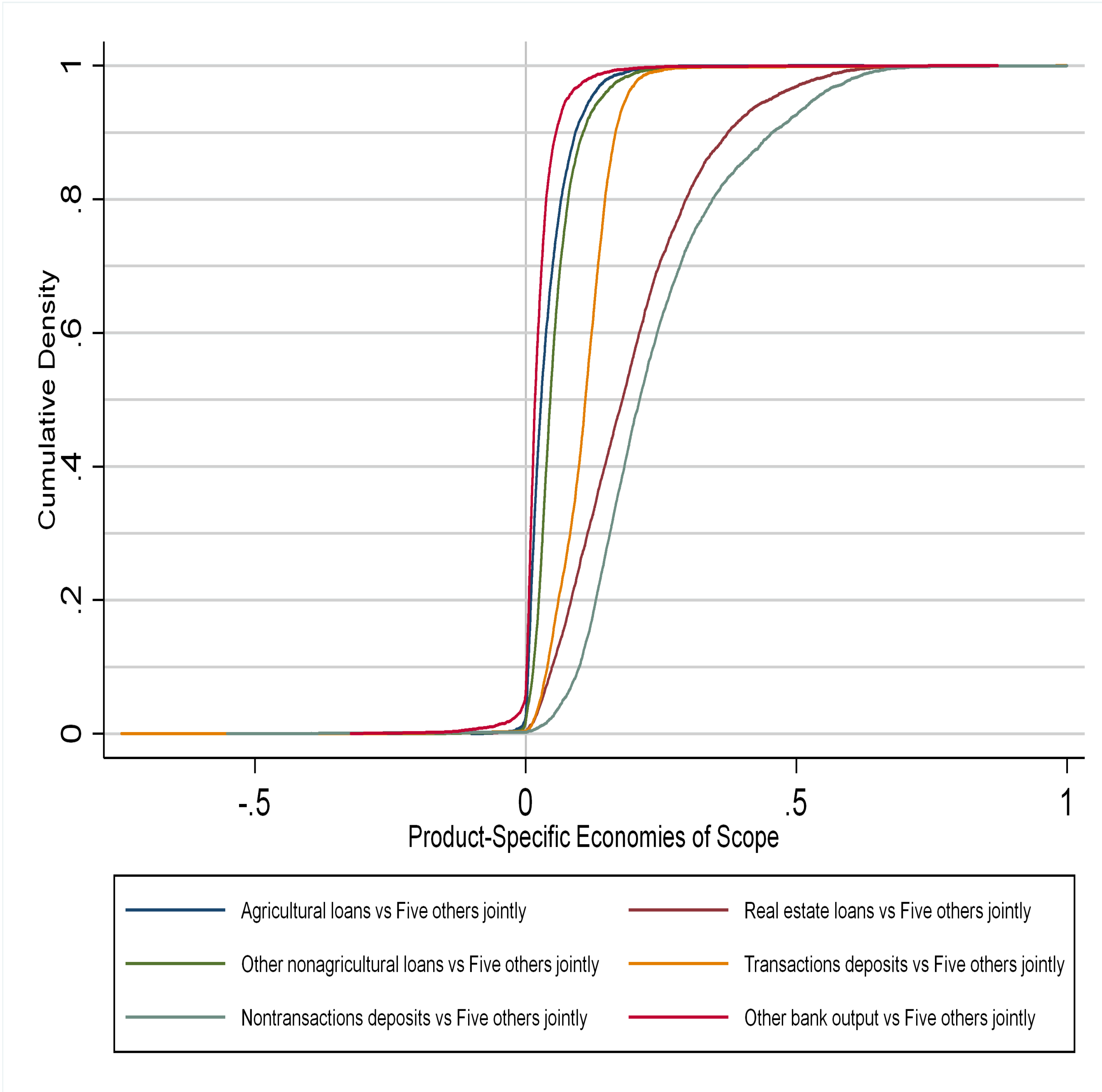

Figure B.17: *Cumulative Density of Product-Specific Economies of Scope, 2012.*

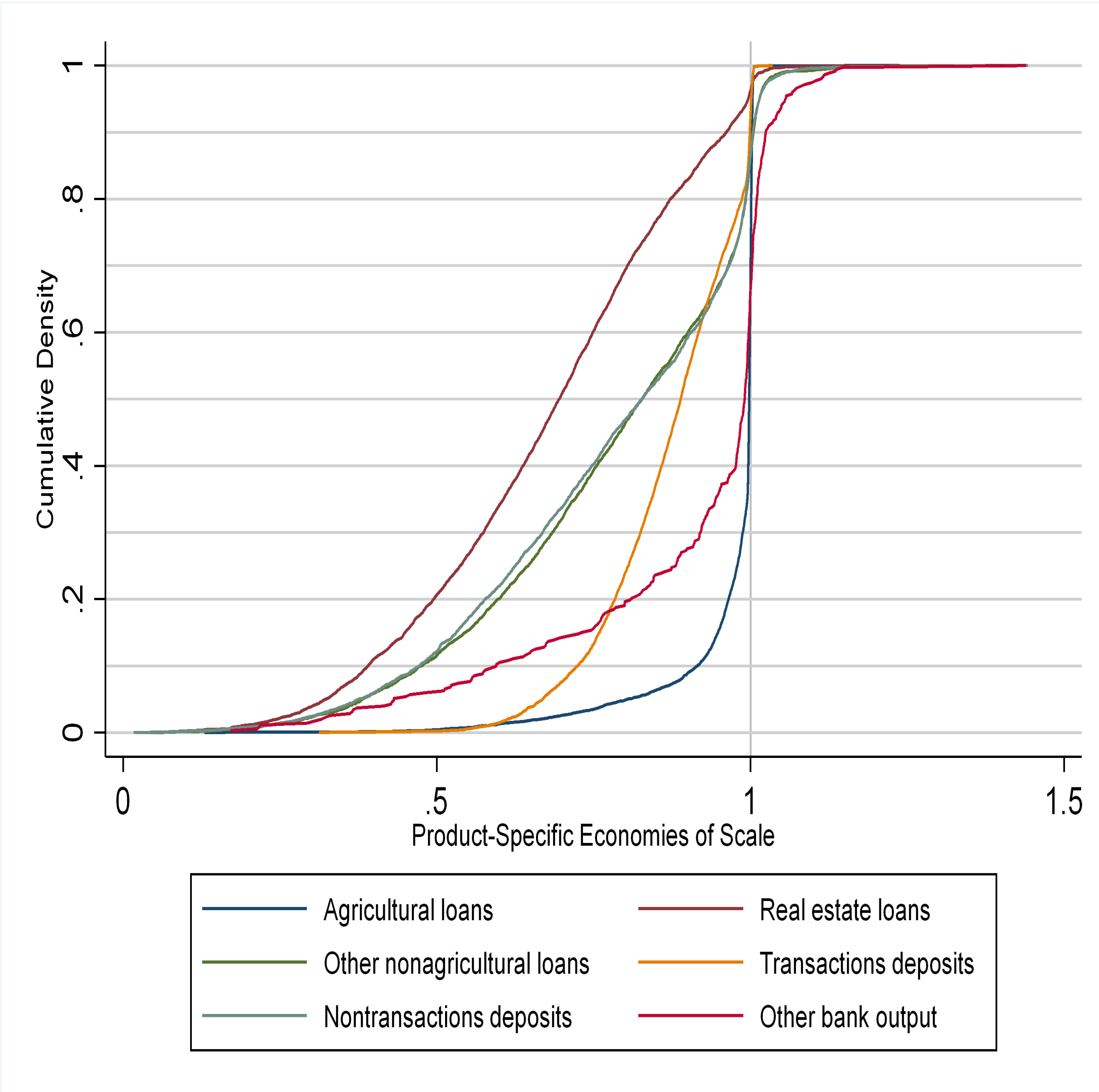

Figure B.18: *Cumulative Density of Product-Specific Economies of Scale, 2013.*

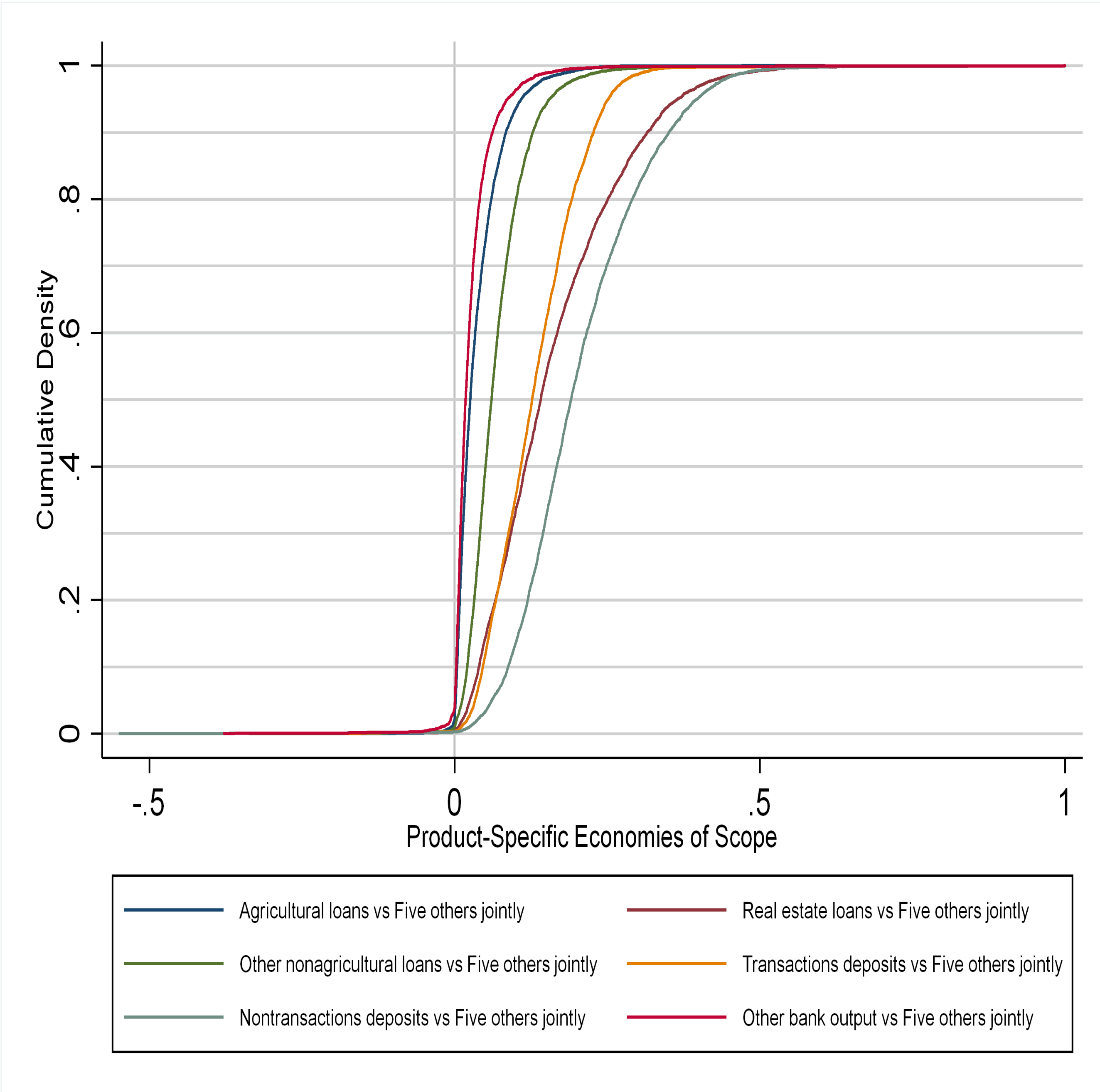

Figure B.19: *Cumulative Density of Product-Specific Economies of Scope, 2013.*

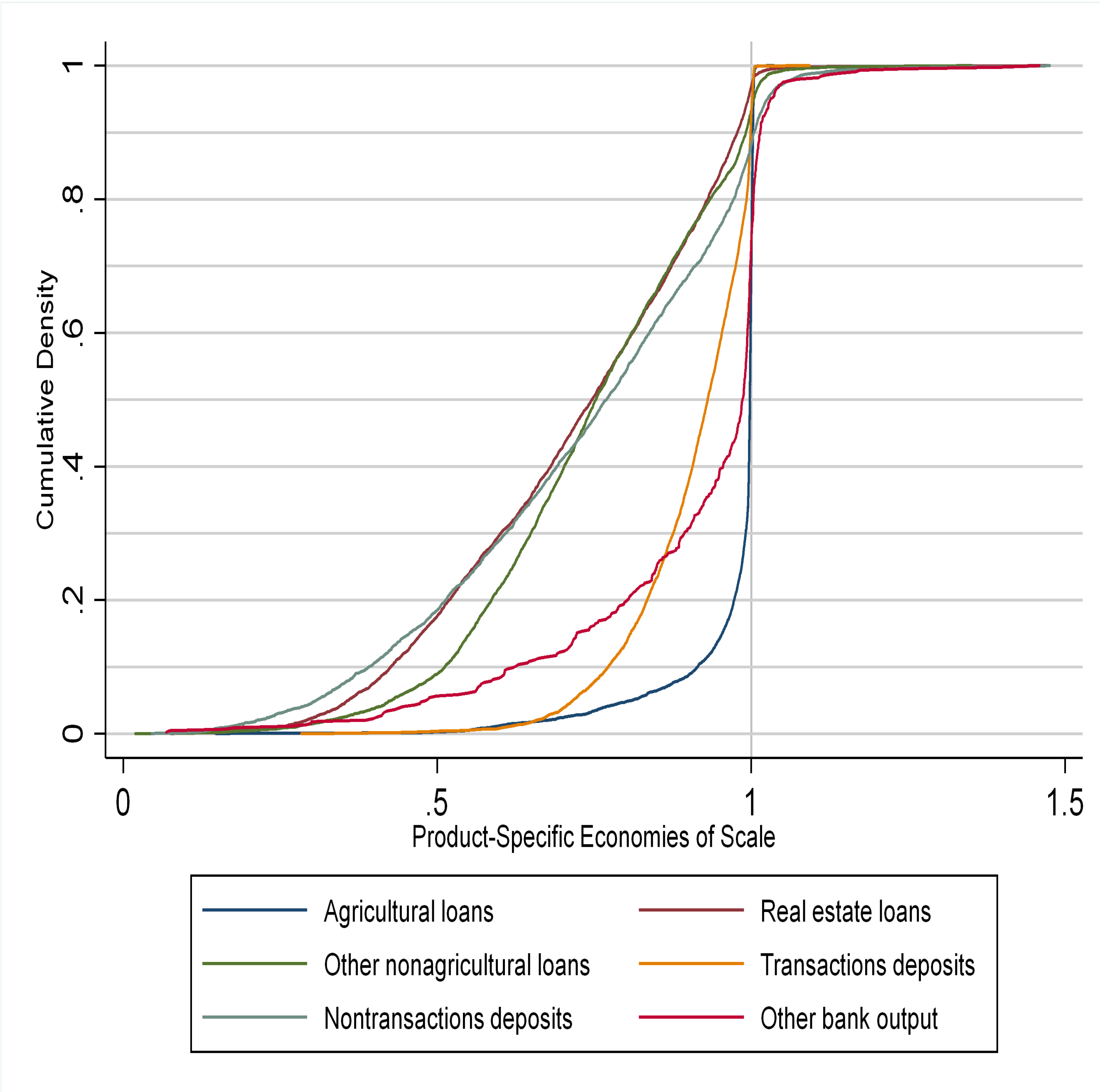

Figure B.20: *Cumulative Density of Product-Specific Economies of Scale, 2014.*

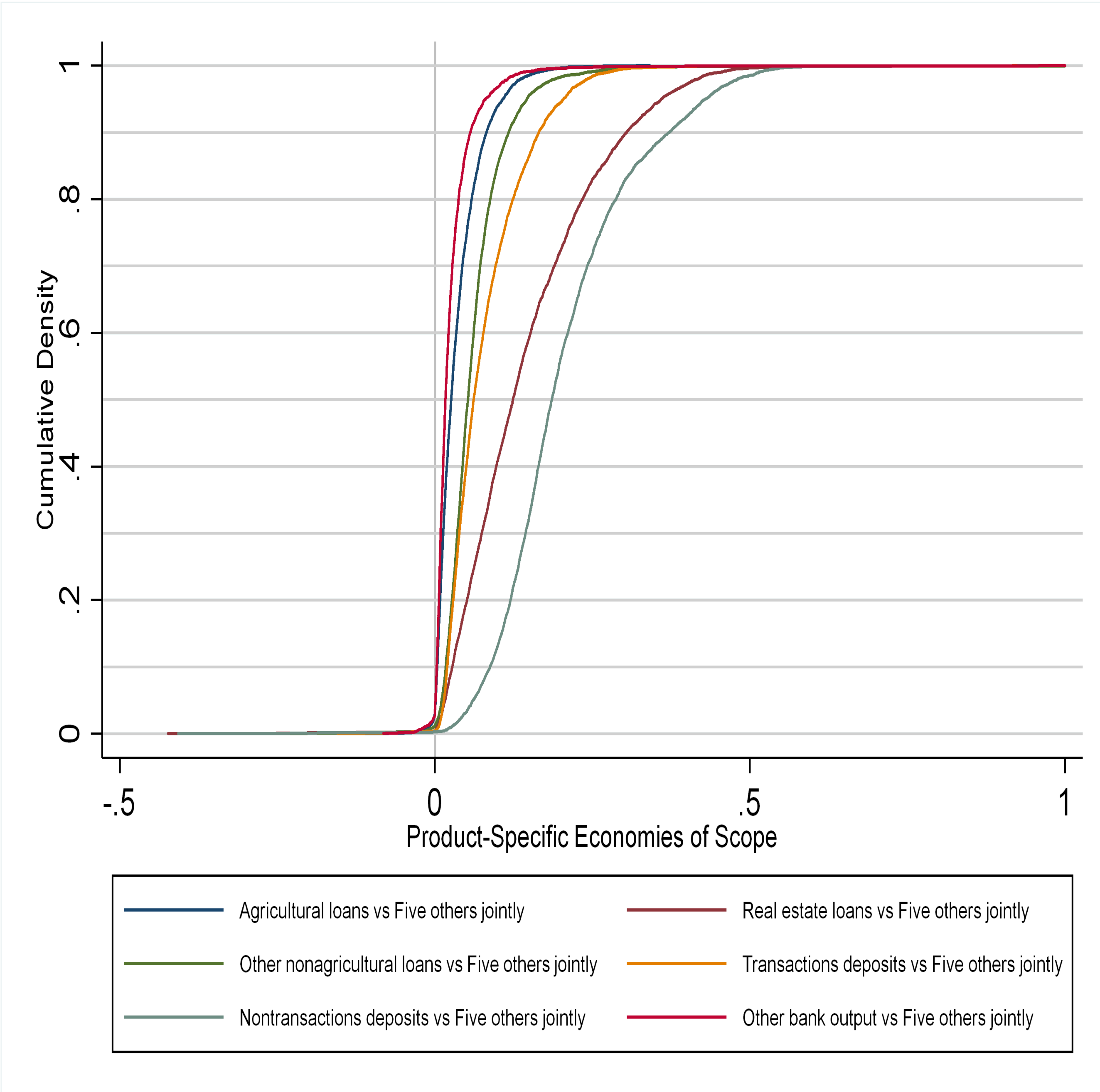

Figure B.21: *Cumulative Density of Product-Specific Economies of Scope, 2014.*

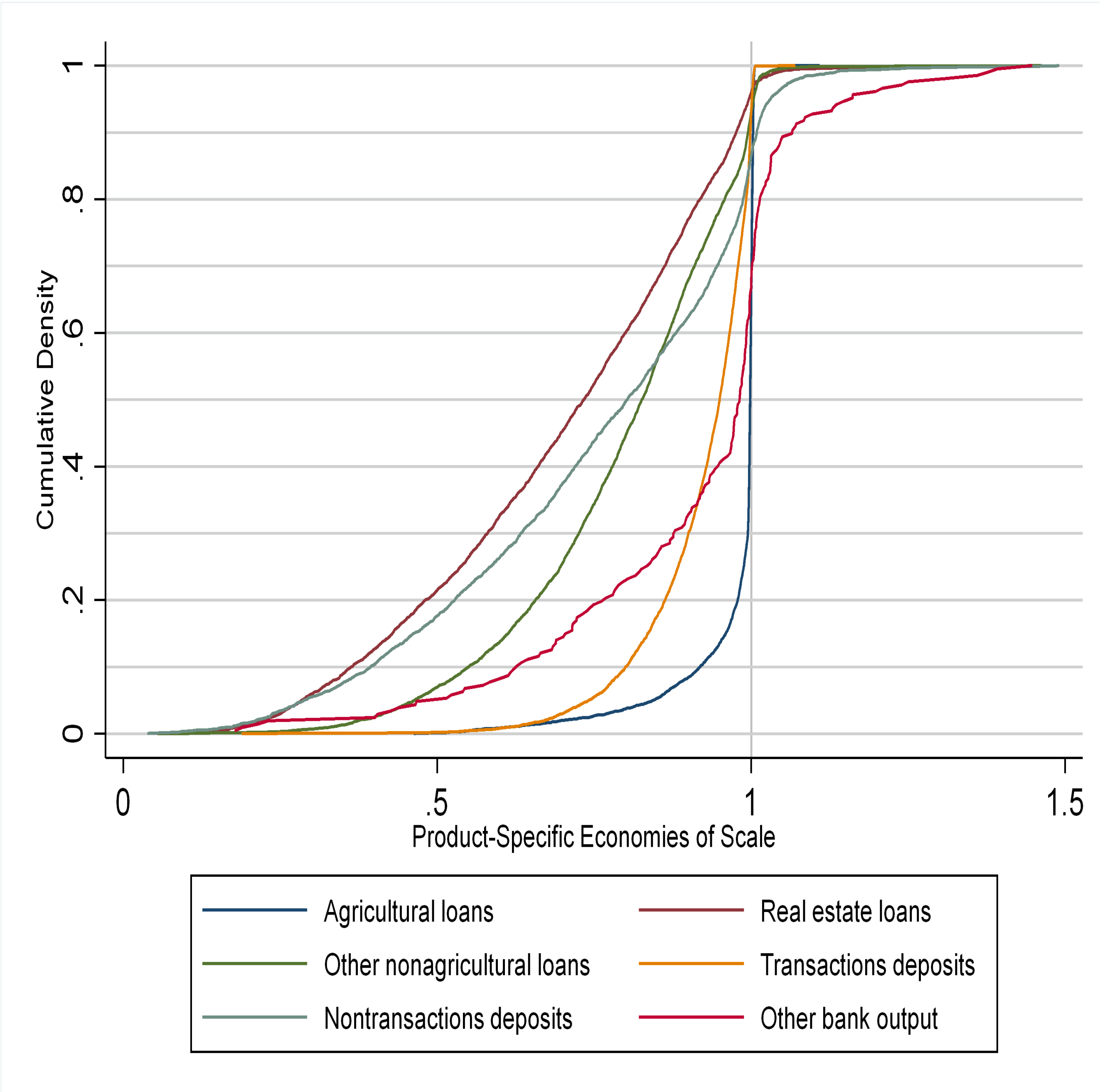

Figure B.22: *Cumulative Density of Product-Specific Economies of Scale, 2015.*

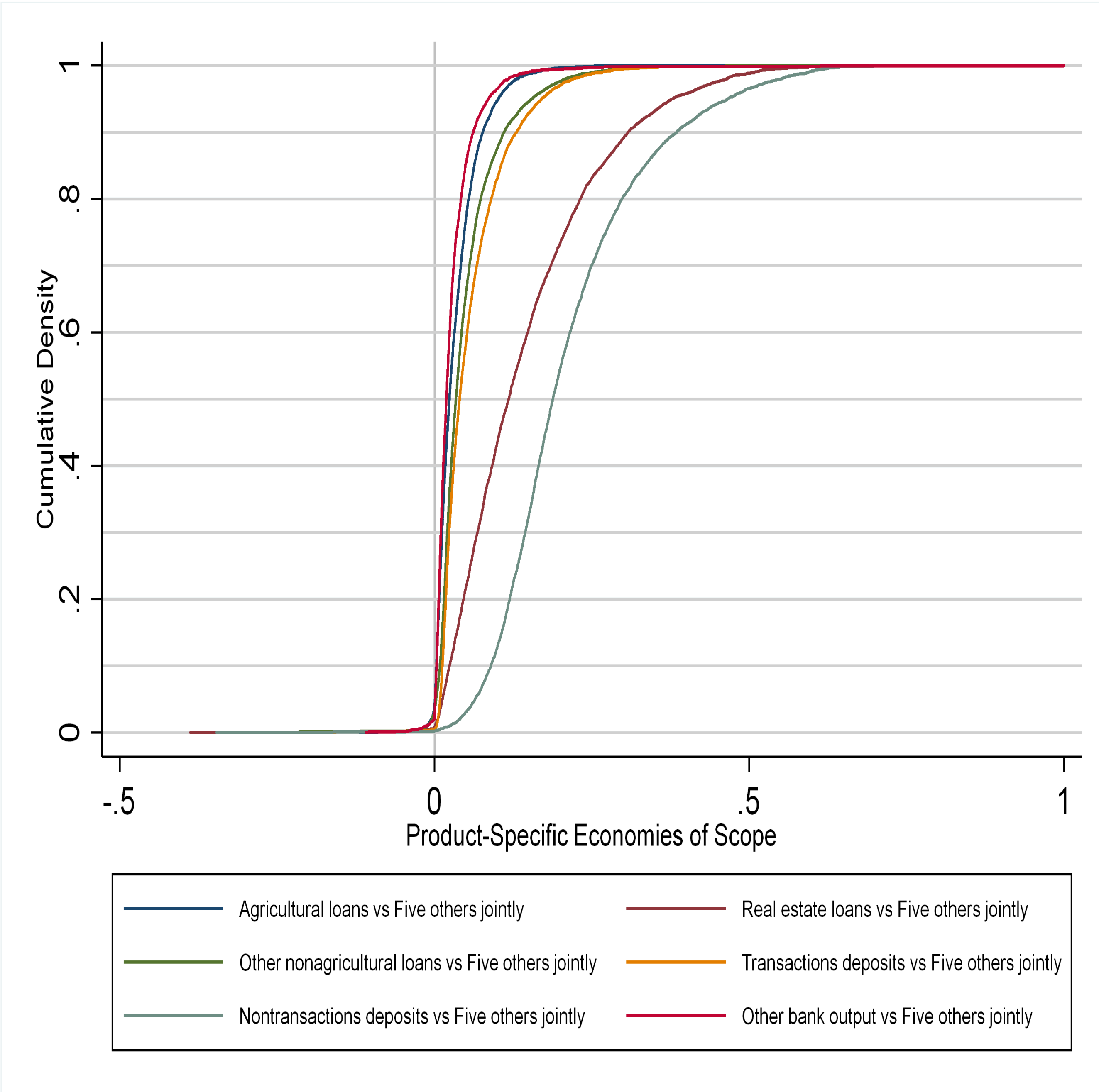

Figure B.23: *Cumulative Density of Product-Specific Economies of Scope, 2015.*

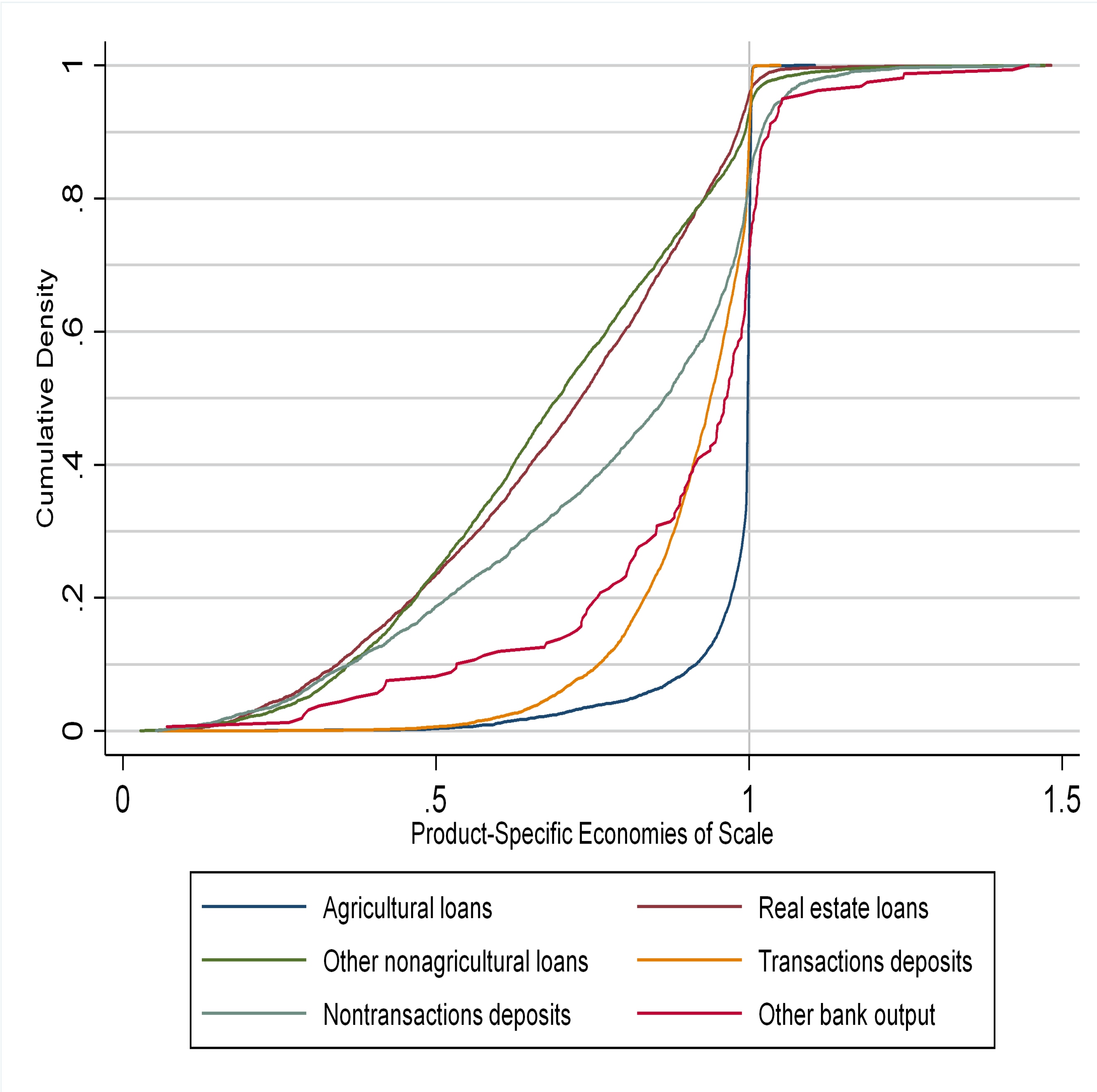

Figure B.24: *Cumulative Density of Product-Specific Economies of Scale, 2016.*

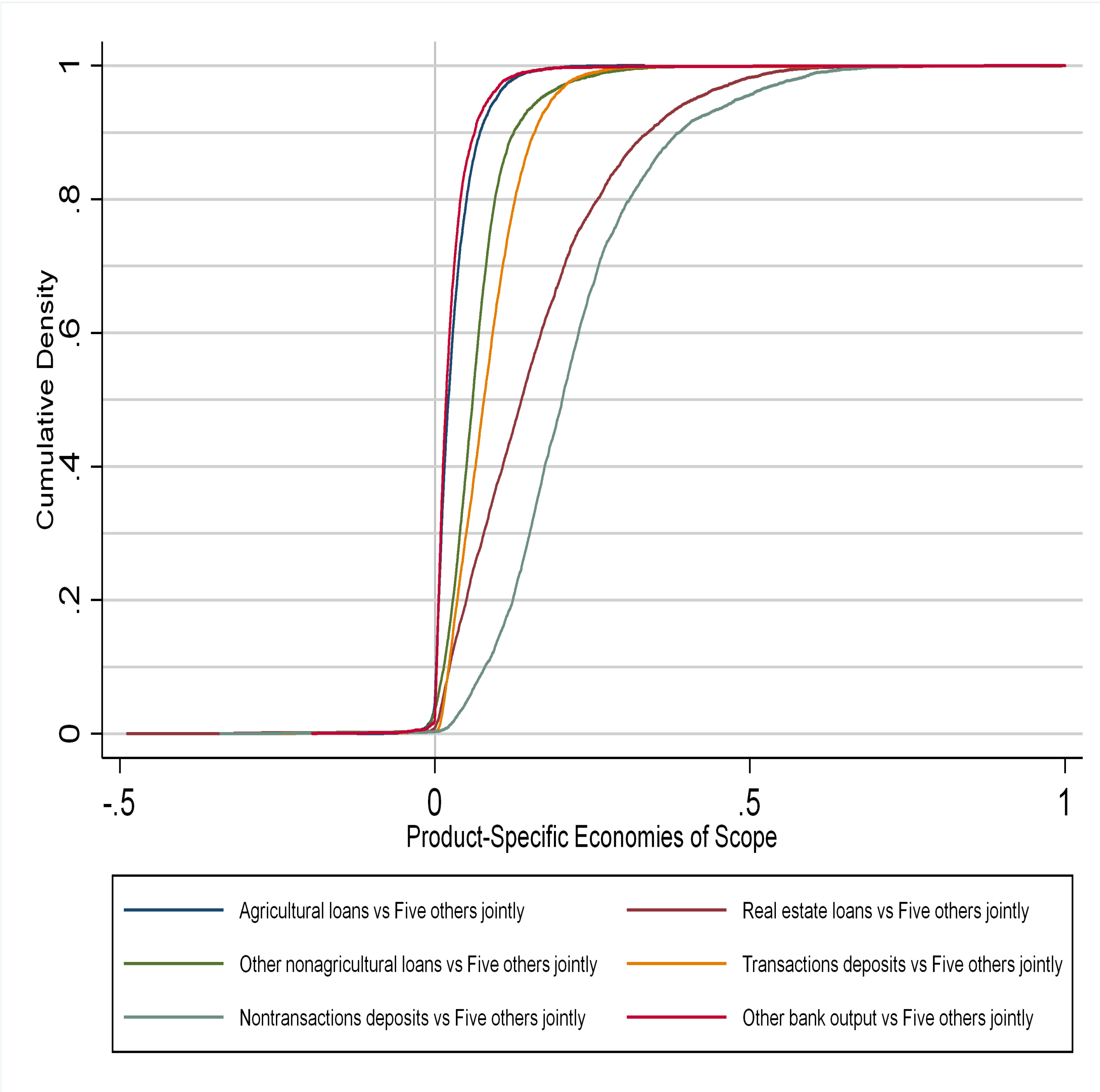

Figure B.25: *Cumulative Density of Product-Specific Economies of Scope, 2016.*

Appendix C

Market Share of Real Estate and Non-Real Estate Farm Debt

Appendix C is for the third essay. Figure C.1 plots the market share of real estate farm debt. Figure C.2 plots the market share of non-real estate farm debt.

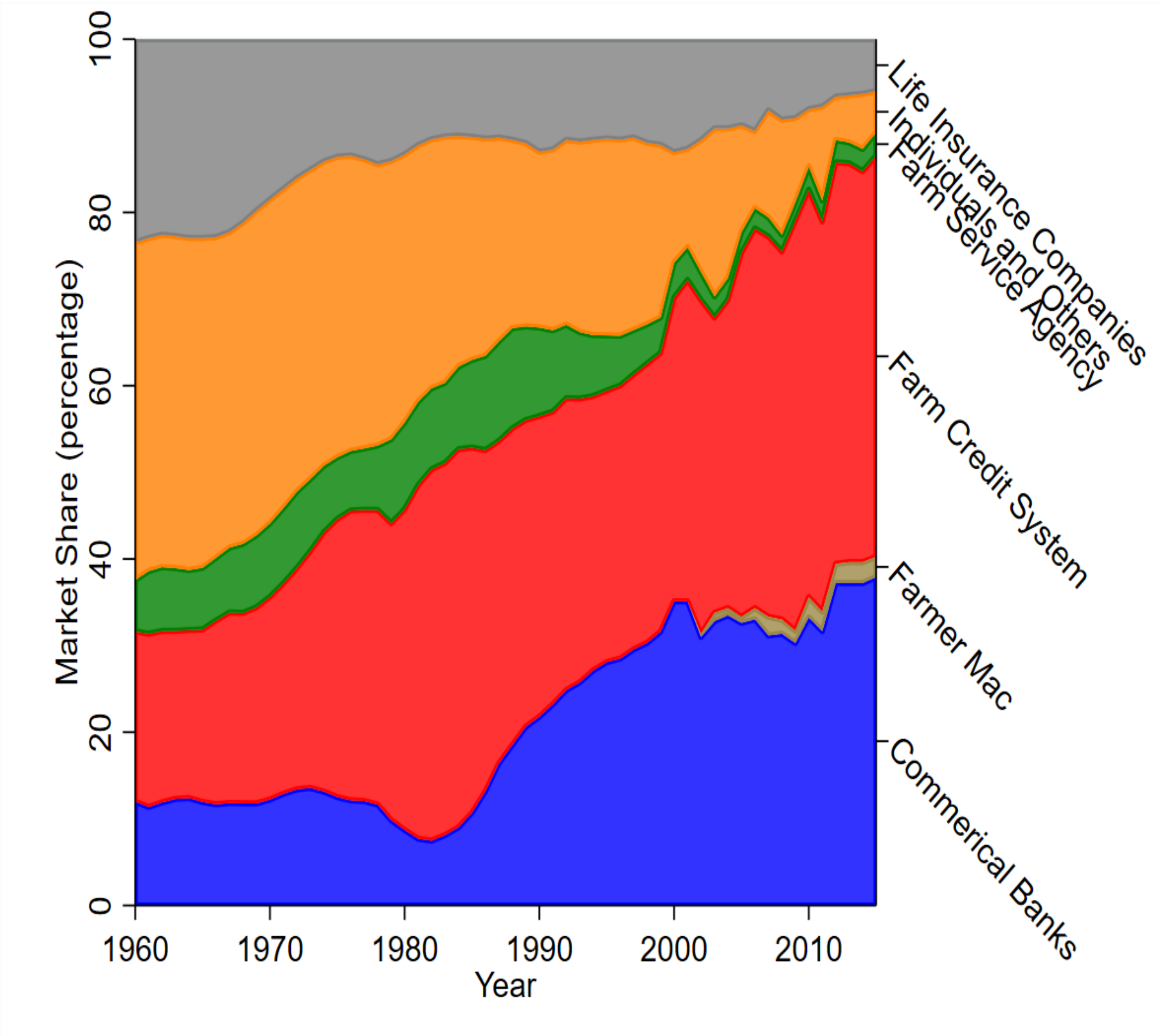

Figure C.1: *Market Shares of Real Estate Farm Debt.*

Note: This figure is developed by author using the USDA ERS data.

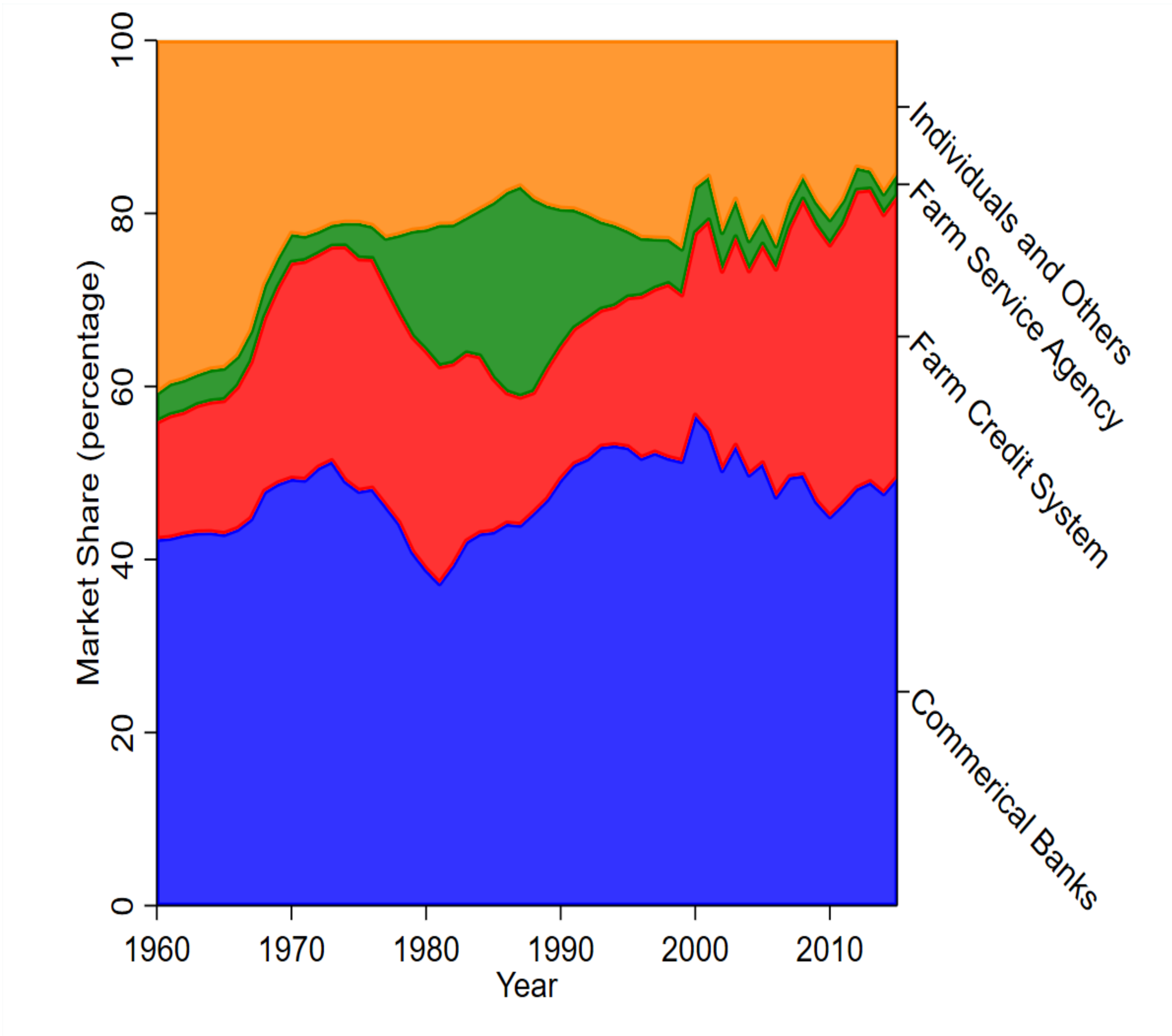

Figure C.2: *Market Shares of Non-Real Estate Farm Debt.*

Note: This figure is developed by author using the USDA ERS data.